Seasonal Watering Plan 2023-24

Section 5

VICTORIAN ENVIRONMENTAL WATER HOLDER

VICTORIA State Government

Section 5
Northern region

5.1 Northern region overview

The northern region has six river systems, four major floodplain sites and many wetlands that can receive water for the environment. The Broken, Campaspe, Goulburn, Loddon and Ovens river systems are tributaries of the Murray River. The four major floodplain sites along the Murray River corridor are Barmah Forest, Gunbower Forest, Hattah Lakes and Lindsay, Mulcra and Wallpolla islands. The other wetlands are distributed across the Broken, Goulburn, Loddon and Murray floodplains. The Goulburn Broken, Mallee, North Central and North East CMAs manage the rivers and wetlands in the northern region.

Many of the water systems in the northern region are connected through infrastructure (such as Goulburn Weir and the Waranga Western Channel), which allows water to be physically delivered from the Goulburn River to the Loddon and Campaspe systems. Water trading also enables transfers of allocation between systems. Within the limitations of each mechanism, water for the environment can be moved between systems for delivery to environmental sites across northern Victoria, although most water for the environment is used to provide benefits in the systems in which the water is held.

Environmental values, objectives and planned actions for each system in the northern region are presented in the following system sections.

Traditional Owners in the northern region

Traditional Owners and their Nations in the northern region have a deep connection to Country that has endured for tens of thousands of years. This includes inherent rights and cultural obligations to Country and community.

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

Several formal agreements are in place with Traditional Owners in the northern region.

In 2013, Djaara entered into a recognition and settlement agreement under the *Traditional Owner Settlement Act 2010* in Victoria. In 2020, the Victorian Government and the Taungurung Land and Waters Council Aboriginal Corporation entered a recognition and settlement agreement (signed in 2018) under the *Traditional Owner Settlement Act 2010*.

In 2004, the Victorian Government entered into a cooperative management agreement with the Yorta Yorta Nation Aboriginal Corporation to improve collaboration in the management of Yorta Yorta Country, including Barmah State Forest and reserves along the Goulburn River. In 2010, the Traditional Owner Land Management Agreement under the *Conservation, Forests and Lands Act 1987* over Barmah National Park was signed, enabling the Yorta Yorta Traditional Owner Land Management Board to jointly manage Barmah National Park. In 2020, the *Joint Management Plan for Barmah National Park*, prepared by the Yorta Yorta Traditional Owner Land Management Board, was publicly released. The plan guides the strategic management of Barmah National Park to 2030.

The Victorian Government is committed to self-determination for Traditional Owners through Treaty negotiations and policies such as *Water is Life: Traditional Owner Access to Water Roadmap 2022*. The VEWH and partners are working with Traditional Owners to embed the outcomes of government policy into the Victorian environmental watering program. Program partners in the environmental watering program are aware that structural changes to how water is managed (such as legislative, policy and/or governance changes) may be made in the future in recognition of Aboriginal water rights. Program partners have heard that Traditional Owners want empowerment and agency in water management, and in many cases, they want to manage water on Country on their own terms.

Return to start of section

Engagement

The environmental watering program is informed by engagement with Traditional Owners, stakeholders and local communities. Program partners undertake extensive engagement at the local level to understand community priorities for the delivery of water for the environment for the coming year.

Program partners also seek to understand how cultural, social, economic and recreational values, uses and objectives may be supported by delivering environmental flows. Opportunities to support these values, uses and objectives are incorporated into watering decisions where possible, and provided they do not compromise environmental outcomes. Cultural, social, economic and recreational values considered for each system in the northern region are presented in the following system sections.

Engagement through other strategies, plans and processes also informs environmental flows objectives. These include regional catchment strategies, regional waterway strategies and technical studies (such as environmental flows studies and environmental water management plans). Traditional Owner cultural objectives for environmental water may refer to cultural flow studies, Aboriginal Waterway Assessments, Traditional Owner Country Plans, Water Resource Plans and other tools to influence environmental water planning. These strategies, plans and technical reports collectively describe a range of environmental, economic, social and Traditional Owner perspectives and longer-term integrated catchment and waterway management objectives that influence environmental flows and priorities for water for the environment.

Return to start of section

Table 5.1.1 Partners and stakeholders engaged by Goulburn Broken Catchment Management Authority in developing seasonal watering proposals for the Barmah Forest, Goulburn River, Goulburn wetlands and Broken wetlands, Broken River and upper Broken Creek and lower Broken Creek systems and other key foundation documents that have directly informed the proposals (grouped in alphabetical order)

Partner/stakeholder	Barmah Forest	Goulburn system	Goulburn wetlands	Broken wetlands	Broken River and upper Broken Creek	Lower Broken Creek
Community groups and environment groups	• Goulburn Broken Wetland Advisory Group members	• Goulburn Valley Environment Group	• Goulburn Murray Landcare Network • Goulburn Valley Environment Group • Turtles Australia	• Goulburn Murray Landcare Network • Goulburn Valley Environment Group • Turtles Australia	• Goulburn Valley Environment Group	• Goulburn Valley Environment Group • Broken Boosey Conservation Management Network • Broken Creek Field Naturalists Club • Goulburn Murray Landcare Network
Government agencies	• Commonwealth Environmental Water Office • Goulburn-Murray Water • Moira Shire Council • Parks Victoria • Victorian Environmental Water Holder	• Commonwealth Environmental Water Office • Goulburn-Murray Water • Murray-Darling Basin Authority • Parks Victoria • Victorian Environmental Water Holder	• Department of Energy, Environment and Climate Action • Goulburn-Murray Water • Greater Shepparton City Council • Parks Victoria • Victorian Environmental Water Holder	• Department of Energy, Environment and Climate Action • Goulburn-Murray Water • Greater Shepparton City Council • Moira Shire Council • Parks Victoria • Victorian Environmental Water Holder	• Commonwealth Environmental Water Office • Goulburn-Murray Water • Parks Victoria • Victorian Environmental Water Holder	• Commonwealth Environmental Water Office • Goulburn-Murray Water • Moira Shire Council • Parks Victoria • Victorian Environmental Water Holder
Landholders/farmers	• None in Victoria (NSW consults with Bullatale Creek landholders)	• Goulburn Environmental Water Advisory Group	• Landowners who adjoin wetlands that receive water for the environment and/ or use the delivery channel	• Landowners who adjoin wetlands that receive water for the environment and/ or use the delivery channel	• Individual landholders who are on the Broken Environmental Water Advisory Group	• Individual landholders who are on the Broken Environmental Water Advisory Group
Local businesses		• Local ecotourism operator • Trellys Fishing and Hunting	• Trellys Fishing and Hunting	• Trellys Fishing and Hunting		

Partner/stakeholder	Barmah Forest	Goulburn system	Goulburn wetlands	Broken wetlands	Broken River and upper Broken Creek	Lower Broken Creek
Recreational users	• Goulburn Broken Wetland Advisory Group members		• Field & Game Australia • Local fishing clubs	• Field & Game Australia • Individual community members on the Broken Environmental Water Advisory Group • Local fishing clubs	• Individual community members on the Broken Environmental Water Advisory Group	• Individual community members on the Broken Environmental Water Advisory Group • Nathalia Angling Club • Numurkah Fishing Club
Technical experts		• Goulburn to Murray Trade Review Scientific Advisory Panel • Scientific leads from the CEWO Monitoring, Evaluation and Research Program – Goulburn River	• Arthur Rylah Institute • Rakali Consulting • Water's Edge Consulting	• Arthur Rylah Institute • Rakali Consulting • Water's Edge Consulting		
Traditional Owners	• Yorta Yorta Nation Aboriginal Corporation	• Taungurung Land and Waters Council • Yorta Yorta Nation Aboriginal Corporation	• Taungurung Land and Waters Council • Yorta Yorta Nation Aboriginal Corporation	• Yorta Yorta Nation Aboriginal Corporation	• Taungurung Land and Waters Council • Yorta Yorta Nation Aboriginal Corporation	• Taungurung Land and Waters Council • Yorta Yorta Nation Aboriginal Corporation

Return to start of section

Table 5.1.2 Partners and stakeholders engaged by Mallee Catchment Management Authority in developing seasonal watering proposals for the Hattah Lakes, Lower Murray wetlands and Lindsay, Mulcra and Wallpolla islands systems and other key foundation documents that have directly informed the proposals (grouped in alphabetical order)

Partner/stakeholder	Hattah Lakes	Lower Murray wetlands	Lindsay, Mulcra and Wallpolla islands
Community groups and environment groups	• Mallee CMA Land and Water Advisory Committee • OzFish Unlimited • Wider community	• Mallee CMA Land and Water Advisory Committee • Millewa-Carwarp Landcare Group • OzFish Unlimited • Red Cliffs Landcare Group • Wider community • Yelta Landcare Group	• Mallee CMA Land and Water Advisory Committee • Millewa-Carwarp Landcare Group • OzFish Unlimited • Wider community • Yelta Landcare Group
Government agencies	• Commonwealth Environmental Water Office • Department of Energy, Environment and Climate Action • Goulburn-Murray Water • Lower Murray Water • Victorian Murray Floodplain Restoration Project Team • Mildura Rural City Council • Murray-Darling Basin Authority • Parks Victoria • Victorian Environmental Water Holder	• Department of Energy, Environment and Climate Action • Lower Murray Water • Mildura Rural City Council • NSW Department of Planning, Industry and Environment • Parks Victoria • Swan Hill Rural City Council • Victorian Environmental Water Holder • Victorian Murray Floodplain Restoration Project Team	• Commonwealth Environmental Water Office • Department of Energy, Environment and Climate Action • Lower Murray Water – Victorian Murray Floodplain Restoration Project Team • Mildura Rural City Council • Murray-Darling Basin Authority • NSW Department of Planning, Industry and Environment • Parks Victoria • SA Water • Victorian Environmental Water Holder
Landholders/farmers	• Landholders and farmers who live around the Hattah Lakes	• Robertson Wetland property owner	
Local businesses	• Hattah Lakes Store • Mallee Tours • Mildura Visitor Information and Booking Centre • Murray Offroad Adventures • Victorian Apiarists' Association (Sunraysia branch) • Visit Mildura • Wildside Outdoors	• Mallee Tours • Mildura Visitor Information and Booking Centre • Murray Offroad Adventures • Victorian Apiarists' Association (Sunraysia branch) • Visit Mildura • Wildside Outdoors	• Lake Cullulleraine Store • Mallee Tours • Mildura Visitor Information and Booking Centre • Murray Offroad Adventures • Victorian Apiarists' Association (Sunraysia branch) • Visit Mildura • Wildside Outdoors

Partner/stakeholder	Hattah Lakes	Lower Murray wetlands	Lindsay, Mulcra and Wallpolla islands
Recreational users	• BirdLife Mildura • Mildura 4WD Club • Sunraysia Bushwalkers Inc.	• BirdLife Mildura • Cabarita Community Inc. • Friends of Merbein Common • Mid-Murray Field Naturalists • Mildura 4WD club • Sunraysia Bushwalkers Inc.	• BirdLife Mildura • Mildura 4WD Club • Sunraysia Bushwalkers Inc.
Traditional Owners	• See the 'Traditional Owner cultural values and uses' section	• See the 'Traditional Owner cultural values and uses' section	• First People of the Millewa-Mallee Aboriginal Corporation • Local Aboriginal community

Return to start of section

Table 5.1.3 Partners and stakeholders engaged by North Central Catchment Management Authority in developing seasonal watering proposals for the Gunbower Creek and Forest, central Murray wetlands and Boort wetlands, Campaspe River, Coliban River, Loddon River, Birchs Creek and Guttrum Forest systems and other key foundation documents that have directly informed the proposals (grouped in alphabetical order)

Partner/ stakeholder	Gunbower Creek and Forest	Central Murray wetlands	Campaspe system	Coliban River	Loddon system (including Boort wetlands)	Birchs Creek	Guttrum Forest
Community groups and environment groups		• Birdlife Australia • Turtles Australia	• Ashbourne Landcare • Echuca Moama Landcare Group • Landcare groups • Strathallan Family Landcare	• Malmsbury and District Landcare Group	• Birdlife Australia • Turtles Australia	• Tullaroop Catchment Restoration Project	• Birdlife Australia • Turtles Australia
Government agencies	• Campaspe Shire Council • Commonwealth Environmental Water Office • Department of Energy, Environment and Climate Action • Forestry Corporation of NSW • Forestry NSW • Gannawarra Shire Council • Goulburn-Murray Water • Murray-Darling Basin Authority • Parks Victoria • VicForests	• Commonwealth Environmental Water Office • Department of Energy, Environment and Climate Action • Goulburn-Murray Water • Parks Victoria • Victorian Environmental Water Holder	• Commonwealth Environmental Water Office • Department of Energy, Environment and Climate Action • Goulburn-Murray Water • Victorian Environmental Water Holder	• Coliban Water • Commonwealth Environmental Water Office • Department of Energy, Environment and Climate Action • Victorian Environmental Water Holder	• Commonwealth Environmental Water Office • Department of Energy, Environment and Climate Action • Goulburn-Murray Water • Parks Victoria • Victorian Environmental Water Holder	• Department of Energy, Environment and Climate Action • Goulburn-Murray Water • Parks Victoria • Victorian Environmental Water Holder	• Commonwealth Environmental Water Office • Department of Energy, Environment and Climate • Goulburn-Murray Water • Parks Victoria • Victorian Environmental Water Holder

Partner/ stakeholder	Gunbower Creek and Forest	Central Murray wetlands	Campaspe system	Coliban River	Loddon system (including Boort wetlands)	Birchs Creek	Guttrum Forest
Landholders/ farmers	• Dairy farmers, irrigators and local residents including via the Enhancing Northern Waterways Advisory Group	• Individual landholders and community members	• Individual landholders and community members including via the Campaspe Environmental Water Advisory Group	• Coliban Water's Rural Advisory Group • Individual landholders and community members	• Individual landholders and community members including via the Loddon Environmental Water Advisory Group	• Individual landholders and community members	• Individual landholders and community members
Recreational users	• Field & Game Australia	• Field & Game Australia	• Field & Game Australia • Local canoe clubs • VRFish	• VRFish	• Boort Angling Club • Field & Game Australia	• VRFish	• Field & Game Australia
Technical experts	• Environmental chemists • Vegetation, fish and bird ecologists		• Arthur Rylah Institute				
Traditional Owners	• Barapa Barapa Traditional Owners • Yorta Yorta Nation Aboriginal Corporation	• Barapa Barapa Traditional Owners • Wamba Wemba Traditional Owners • Yorta Yorta Nation Aboriginal Corporation	• Dja Dja Wurrung Clans Aboriginal Corporation • Taungurung Land and Waters Council • Yorta Yorta Nation Aboriginal Corporation	• Dja Dja Wurrung Clans Aboriginal Corporation	• Barapa Barapa Traditional Owners • Dja Dja Wurrung Clans Aboriginal Corporation's Kapa Gatjin (water advisory) Group • Wamba Wemba Traditional Owners	• Dja Dja Wurrung Clans Aboriginal Corporation's Kapa Gatjin (water advisory) Group	• Barapa Barapa Traditional Owners • Wamba Wemba Traditional Owners • Yorta Yorta Nation Aboriginal Corporation

Return to start of section

Table 5.1.4 Partners and stakeholders engaged by North East Catchment Management Authority in developing the seasonal watering proposal for the Ovens system and other key foundation documents that have directly informed the proposal (grouped in alphabetical order)

Partner/stakeholder	Ovens system
Community groups and environment groups	• Mullinmur Management Committee • Wangaratta Landcare and Sustainability Incorporated
Government agencies	• Commonwealth Environmental Water Office • Goulburn-Murray Water • Rural City of Wangaratta • Victorian Environmental Water Holder • Victorian Fisheries Authority
Landholders/farmers	• Borinya Community Partnership School • Galen Catholic College • A private landholder on the King River
Technical experts	• Arthur Rylah Institute
Traditional Owners	• Non-RAP groups • Taungurung Land and Waters Council • Yorta Yorta Nation Aboriginal Corporation

Integrated catchment management

Altered water regimes are one of many threats to the health of Victoria's waterways. Environmental flows need to be part of an integrated approach to catchment management to be effective. Many of the environmental objectives of water for the environment in the northern region will not be fully met without simultaneously addressing issues such as barriers to fish movement, high nutrient loads, loss of streambank vegetation, bank erosion and invasive species.

Victorian and Australian government agencies, Traditional Owner groups, community groups and private landholders collectively implement a wide range of programs that aim to protect and improve the environmental condition and function of land, soils and waterways throughout Victoria's catchments.

The following are examples of complementary programs that support environmental flow outcomes in the northern region.

A strategic action plan to protect floodplain marshes in Barmah Forest is being implemented. The plan identifies management actions to address key threats to the delicate floodplain vegetation. Specific actions include removing feral horses and other invasive animals and controlling invasive plants. Parks Victoria and the Yorta Yorta Nations jointly manage Barmah National Park.

Implementation of the native fish recovery plan for the North Central CMA region continues to progress, with the construction of a fishway on Taylors Creek Weir, just north of Ghow (Kow) Swamp. The fishway is another important element of a fish 'superhighway', which will allow native fish to migrate up and down rivers in the region, supporting diverse and healthy populations. This follows on from other recent projects, including the construction of fishways at Koondrook and Cohuna weirs in Gunbower Creek in 2021 and fish screens installed in Gunbower Creek to reduce the number of native fish lost to irrigation channels.

An additional 270 km of native fish habitat and refuge was opened up to native fish in the Ovens River with the construction of the Tea Garden Weir fishway in April 2023.

Multiple approaches, including planting native aquatic plants and reintroducing woody habitat (such as snags) in lower Broken Creek, are helping accelerate the recovery of in-stream vegetation, which provides shelter and foraging habitat for native fish, platypus and other aquatic animals. The creek may also be restocked with native fish following the November 2022 blackwater fish death event.

For more information about integrated catchment management programs in the northern region, see the Goulburn Broken, Mallee, North Central and North East CMAs' regional catchment strategies and regional waterway strategies.

Risk management

During the development of the seasonal watering proposals for the northern region systems, environmental watering program partners assessed risks associated with potential environmental flows for 2023-24 and identified appropriate mitigating strategies. Risks and mitigating actions are continually assessed by program partners throughout the year (see subsection 1.2.7).

Return to start of section

What is the Basin Plan 2012?

Northern Victoria is a part of the Murray-Darling Basin, and deliveries of water for the environment in the northern region are subject to the requirements of the Basin Plan 2012, also known as the Murray-Darling Basin Plan or just the Basin Plan.

The Murray-Darling Basin Authority developed the Basin Plan under the *Commonwealth Water Act 2007*, and it became law in November 2012. The Basin Plan sets legal limits on the amount of water that can be taken from the Murray-Darling Basin's surface and groundwater resources. Chapter 8 of the Basin Plan sets out a high-level environmental watering plan, which defines environmental objectives to protect, restore and build the resilience of water-dependent ecosystems and their associated functions. The VEWH's environmental planning and delivery are consistent with the requirements of the Basin

Plan. The potential environmental flows outlined in sections 4 and 5 of this seasonal watering plan fulfil Victoria's obligations to identify annual priorities for the delivery of water for the environment for Victoria's water resource areas under section

8.26 of the Basin Plan 2012.

What is River Murray Increased Flows (RMIF)?

River Murray Increased Flows (RMIF) is water for the environment that has been recovered as part of the Snowy Water Initiative, established in 2002 to address environmental impacts associated with the operation of the Snowy Mountains Scheme. RMIF is stored in Snowy Hydro Limited's storages and released to maintain and improve environmental values in the Murray River. RMIF becomes available when:

- Snowy Hydro Limited releases more than its nominated annual release volume as part of its power-generation operations and/or
- managers of water for the environment request additional RMIF be made available when volumes in Murray River storages exceed specified limits.

The call for and use of RMIF are coordinated by the Southern Connected Basin Environmental Watering Committee, and they must be authorised by the VEWH and NSW Department of Planning and Environment.

What is River Murray Unregulated Flows (RMUF)?

River Murray Unregulated Flows (RMUF) is the remaining unregulated water in the Murray system once Victoria and New South Wales have exercised their rights to use unregulated flows. Unregulated flow events are formally declared by the Murray-Darling Basin Authority when there is more water in the river than is needed to meet demands or can be captured in storage at the time. The use of RMUF is coordinated by the Southern Connected Basin Environmental Watering Committee for environmental outcomes.

Northern Victoria and the southern Murray-Darling Basin

Rivers, creeks and floodplains in northern Victoria form part of the southern connected Murray-Darling Basin. Water flows directly from the Victorian rivers and floodplains into the Murray River, which means that environmental flows delivered in northern Victorian systems can achieve ecological objectives at multiple sites throughout the Murray-Darling Basin. For example, water for the environment delivered in the Goulburn River flows into the Murray River and can be managed to ensure it flows all the way to the Lower Lakes and Coorong in South Australia, providing environmental outcomes at Gunbower Forest, Hattah Lakes, Lindsay Island and the Chowilla floodplain along the way.

Planning

The Basin Plan 2012 and the *Basin-wide environmental watering strategy* (second edition, 2019) guide the long-term planning of water for the environment in the Murray-Darling Basin. Under the Basin Plan, environmental objectives are met by achieving outcomes for connectivity, native vegetation, waterbirds and native fish.

Objectives and outcomes under the Basin Plan reflect local site- and state-based objectives, though site-based objectives are often broader in scope and cover additional values (such as frogs, turtles, waterbugs and physical processes like sediment movement). Watering actions that support Basin Plan outcomes have significant benefits for many other species that rely on the surrounding landscape (such as squirrel gliders living along the lower Campaspe River or flocks of regent parrots moving into the Hattah Lakes floodplain after watering).

The VEWH coordinates its activities with other environmental water holders in northern Victoria, NSW and South Australia to achieve environmental outcomes at the southern connected Murray-Darling Basin scale. Collaborative planning focuses on how upstream and downstream objectives align and how the broader operation of the Murray River system can help

support environmental outcomes. The Murray Lower Darling River Indigenous Nations *Statement on environmental water* use (available at www.vewh.vic.gov.au) is important for understanding Traditional Owner objectives and desired outcomes.

Annual planning is documented in basin annual environmental watering priorities (by the Murray-Darling Basin Authority under the Basin Plan), in annual portfolio management plans (by the Commonwealth Environmental Water Office) and in the VEWH's annual seasonal watering plan (this document). The Southern Connected Basin Environmental Watering Committee publishes its annual operational scenarios for environmental flow coordination in the Murray River. In Victoria, all water for the environment must be delivered in line with the VEWH's seasonal watering plan, meaning coordination during annual planning is fundamental to successful basin-scale outcomes.

Return to start of section

Delivery coordination and monitoring

Environmental water holders in the Murray-Darling Basin are increasingly emphasising the coordination of water deliveries to achieve landscape-scale environmental outcomes. Examples include:

- delivering a winter fresh in the Goulburn River, which subsequently passed through to the Lower Lakes in South Australia and through the barrages to the Coorong to trigger upstream migration of fish (such as lamprey)
- delivering a spring flow from Hume Dam to support floodplain sites (such as Barmah-Millewa Forest) and the river channel from the mid-Murray to the lower Murray all the way to the Lower Lakes and Coorong in South Australia. This event carries carbon and nutrients from the floodplain to the river and transports them through the system, increasing food availability, helping native fish to move and breed and supporting native aquatic plants in the river channel.

To assess the effectiveness of landscape-scale responses to environmental flows, the Southern Connected Basin Environmental Watering Committee developed the *River Murray Channel Monitoring Plan 2021-22 to 2025-26*. The plan focuses on productivity and fish indicators to inform the management of environmental flows. This monitoring complements site-based monitoring programs across the Murray system.

Water holder partnerships and collaboration

The VEWH holds Victorian environmental entitlements for water recovered under interstate projects and agreements – Living Murray and RMIF entitlements – and these require coordinated decision-making about where they are used. The primary objective of Living Murray entitlements is to support Murray icon sites, which include the Barmah Forest, Gunbower Forest, Hattah Lakes and the Lindsay-Mulcra-Wallpolla islands in Victoria. RMIF also supports environmental objectives along the Murray system in Victoria, NSW and South Australia. The Southern Connected Basin Environmental Watering Committee recommends how the Living Murray allocation, RMIF and RMUF should be coordinated and used.

The VEWH partners with the Commonwealth Environmental Water Office to optimise the benefits of water for the environment held by the Commonwealth Environmental Water Holder (CEWH) and delivered in Victoria. Delivery of the Living Murray's and the Commonwealth's environmental Water Holdings to meet Victorian environmental flow objectives is included in relevant system sections in the following pages of this plan.

Water for the environment delivered through northern Victorian waterways can often be re-used to achieve further environmental benefits downstream. If return flows are not re-used at Victorian environmental sites, VEWH, the Living Murray and CEWH return flows continue to flow across the border to South Australia, where they will be used to provide environmental benefits along the Murray River and in the Coorong, Lower Lakes and Murray Mouth icon sites.

The VEWH may order, or authorise waterway managers to order, Living Murray and Commonwealth water for the environment for environmental outcomes at downstream (non-Victorian) sites. The VEWH may also order water for delivery in the Murray system to non-Victorian sites under river operating rules that help improve environmental outcomes while maintaining the reliability of entitlements for all water users. In previous years, this has included deliveries to the Murray from the lower Darling, orders for delivery from Lake Victoria and orders for delivery to the Murray River.

Murray system-scale planning and Traditional Owners in the southern Murray-Darling Basin

Environmental water holders consider the objectives and cultural values of First Nations in the Murray-Darling Basin, and they seek to support these values where possible. The health of the Murray-Darling Basin benefits from meaningful partnerships with Traditional Owners, and their involvement in water planning, coordination and delivery from the local to the basin scales is a priority for environmental water holders.

In April 2021, a forum on Latji Latji Country in Mildura brought together Traditional Owner representatives from many parts of the southern Murray-Darling Basin to share information about the health of Country and to discuss the preferred outcomes of the management of environmental flows. Participants produced the Murray Lower Darling River Indigenous Nations *Statement on environmental water* (available at www.vewh.vic.gov.au).

Seasonal outlook 2023-24

Rainfall across most of northern Victoria in 2022-23 was very much above the long-term average, and record-breaking rainfall in spring caused severe flooding in the Murray, Goulburn, Campaspe, Loddon and Avoca rivers. All major water storages filled and spilled, and large areas of floodplain, including remnant river red gum and black box forests, were inundated. Flooding in the Mallee region was prolonged by inflows from the Murrumbidgee and lower Darling rivers. While this is the third consecutive year of generally wet conditions in northern Victoria, it's the first of the three with widespread natural floodplain connection.

Return to start of section

Widespread floodplain inundation can be devastating for riverside communities. It is an infrequent, natural event that benefits a broad range of native plants and animals, including river red gum and black box trees, aquatic (wetland) plants, waterbugs, frogs, turtles, native fish and waterbirds. The environment's 'boom' response is essential for long-term environmental health, but unfortunately, pest animals (such as European carp) also benefit from these conditions, which highlights the importance of integrated catchment management to address environmental threats. The large spring floods also triggered low oxygen levels in waterways, including Boosey/lower Broken Creek and the Loddon and Murray rivers, which caused fish deaths. The water quality was less affected in the Ovens, Goulburn and Campaspe rivers, and these systems potentially provided refuges for some fish.

Summer and autumn 2023 were close to or slightly drier than the long-term average for northern Victoria, and river flows, excluding that of the lower Murray, returned to typical in-channel low flow rates. Inter-valley transfers from the Goulburn system were relatively small for the second consecutive year, which meant the summer and autumn flows in the Goulburn and Campaspe rivers were largely in line with environmental flow targets.

Water for the environment was managed in line with a wet planning scenario across northern Victoria in 2022-23. Natural flows met or exceeded the planned watering actions for most systems in winter, spring and early summer, but water for the environment was used in waterways, including the Goulburn River and lower Broken Creek, to provide local refuges of better-quality water during blackwater events. Water for the environment was also used to deliver autumn pulses in the Broken, Campaspe and Loddon rivers to improve water quality and support native fish.

As of late-May 2023, the Bureau of Meteorology predicted drier, warmer-than-average conditions across northern Victoria for winter and spring 2023.

The allocation outlook provided by the Northern Victorian Resource Manager in May 2023 indicated all systems would reach 100 percent high-reliability allocation in 2023-24 under the dry-to-wet planning scenarios. The Campaspe system holds sufficient water to allocate 100 percent at the beginning of July. In average-to-wet conditions, allocations are expected to reach 100 percent by mid-August in the Goulburn/Loddon and Murray systems and by mid-October in the Broken system. In an extremely dry planning scenario, allocations in the larger Goulburn/Loddon and Murray systems are forecast to reach 80 percent or more, while the smaller Broken and Bullarook systems are likely to receive 15 percent and zero allocation, respectively. The risk of spill estimate by the Northern Victorian Resource Manager in May 2023 indicated the spill risk to be greater than 90 percent in the Murray and Goulburn systems and above 60 percent in the Campaspe system. Combined with high and early 2023-24 allocations, carryover into 2023-24 is therefore, less critical to meet winter and early spring forecast demands.

Environmental watering actions across northern Victoria in 2023-24 have been planned to consolidate and, where possible, build on the environmental gains of the natural flooding in 2022. The forecast water availability is expected to be sufficient to support the planned watering actions in all planning scenarios.

All the wetlands that can receive water for the environment filled in spring 2022, and many need either relatively small top-ups to maintain target levels during 2023-24 or will be allowed to draw down naturally to support important dry-phase ecological processes. Some wetlands and floodplain complexes, including Gunbower Forest, will be deliberately inundated again in 2023-24 to ensure there is sufficient habitat and food across the landscape to support the large number of juvenile waterbirds that hatched and fledged after last year's floods.

In rivers the focus will be on delivering a low flow and freshes to support native fish, which had mixed outcomes in 2022-23. The floods increased the available food resources and triggered some likely successful breeding in spring 2022, although these outcomes were partially offset by low oxygen levels in some waterways resulting in fish deaths and a large carp-breeding event. Maintaining water quality and fish habitat and encouraging native fish dispersal and migration are key objectives for 2023-24. Bank and in-channel vegetation will also be a focus, especially where post-flood recovery has been slow (such as the lower section of the riverbank along the lower Goulburn River). Under drier planning scenarios, significant deliveries of operational water from Hume Dam or the Goulburn inter-valley trade account may reduce the use of environmental water, potentially making re-use return flows less able to meet Murray demands and environmental flows to South Australia. Wetter conditions may result in spills from relatively full storages, which may cause more high river flows and floodplain inundation.

Return to start of section

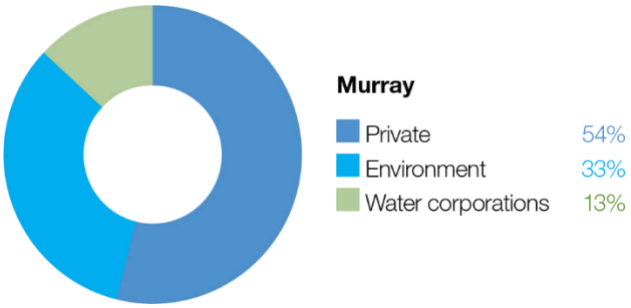
5.2 Victorian Murray system

Waterway manager – Goulburn Broken, Mallee, North Central and North East catchment management authorities

Storage manager – Goulburn-Murray Water, Lower Murray Water, Murray-Darling Basin Authority (River Murray Operations), SA Water and Water NSW

Environmental water holders – Victorian Environmental Water Holder (including the Living Murray program) and Commonwealth Environmental Water Holder

Proportions of water entitlements in the Victorian Murray system held by private users, water corporations and environmental water holders on 30 June 2020



The lands and waters of the Murray River system are central to the culture of the many Traditional Owner groups that have lived along the Murray River for tens of thousands of years. Traditional Owners along the Murray have distinct cultural boundaries, languages and cultural practices. The Murray River has many different names in Aboriginal languages; for example, the Yorta Yorta people know the Murray as *Dhungulla*. The Victorian Murray system referred to in this plan includes waterways, storages, weirs, locks and regulators managed under state and federal legislation. This system overlays many Traditional Owner boundaries.

Within the Victorian Murray system, there are many significant floodplains and wetland systems covering the North East, Goulburn Broken, North Central and Mallee CMA areas. They are sites of significance for Traditional Owners, with tangible and intangible cultural connections dating back thousands of years and continuing to the present day. The Barmah Forest, Kerang wetlands and the Hattah Lakes are internationally recognised Ramsar-listed sites due to the significance of their wetland types and the abundance and range of waterbird species that use them. Many other wetlands in the system are either nationally or regionally significant.

Water for the environment can be supplied to the Victorian Murray system from a range of sources. These include entitlements held by the VEWH, which includes those held on behalf of the Living Murray program and the Commonwealth Environmental Water Holder (CEWH), re-use of return flows, and in some instances, use of operational water en route. The source of the water used for individual watering actions and the ability to deliver all watering actions will depend on water availability, water commitments by other environmental water holders and operational requirements. As a result, the following Victorian Murray system sections do not specify the expected availability of water for the environment.

Victorian Murray system water availability

In 2022-23, allocations against Murray system high-reliability water shares opened at 94 percent and reached 100 percent in August. Low-reliability water shares began receiving allocations in September and reached their full allocations in November. This is the second consecutive water year that Murray seasonal determinations have reached maximum availability since the introduction of the current entitlements in 2007. Spills from Hume Dam resulted in the deduction of all spillable carryover from 2021-22.

Prolonged periods of declared unregulated flow conditions in the Murray River enabled access to unregulated components of environmental entitlements and access to River Murray Unregulated Flows (RMUF). Victorian unregulated entitlements were primarily used to meet Murray floodplain demands at the Gunbower and Hattah icon sites and various central Murray wetlands in winter-spring, while RMUF remained in the Murray River channel (Hume to the Coorong) to meet water actions agreed

by the Southern Connected Basin Environmental Watering Committee (SCBEWC). The strong resource position allowed the Barmah-Millewa Forest Environmental Water Account to be repaid to the environment in mid-August, but it wasn't used because of the large Murray flood through spring.

Return to start of section

The SCBEWC accepted 112,000 ML – 56,000 ML held in Victoria and 56,000 ML held in New South Wales – of River Murray Increased Flows (RMIF) from Snowy Hydro releases in May 2022. A small portion of this volume was used to support native fish and waterbirds in the Murray River through summer 2022-23. Significant volumes were released from the Snowy system to the Murray system in 2022-23, which may result in additional RMIF being available in the Murray system in May 2023. The SCBEWC has the first option on RMIF when it is available.

Total water availability for the environment was high in 2022-23, and there was sufficient supply to meet planned Victorian Murray system demands and carryover needs for 2023-24. The high water availability allowed the VEWH to trade up to 45,000 ML of its allocation in summer-autumn 2023.

This summary covers water availability for all of the waterway systems described in section 5.2.

5.2.1 Upper Murray wetlands

System overview

The upper Murray wetlands are located on the Murray River floodplain between Lake Hume and Lake Mulwala. The wetland system includes the Ryans Lagoon wetland complex, which has two main lagoons: Ryans Lagoon 1 and Ryans Lagoon 2.

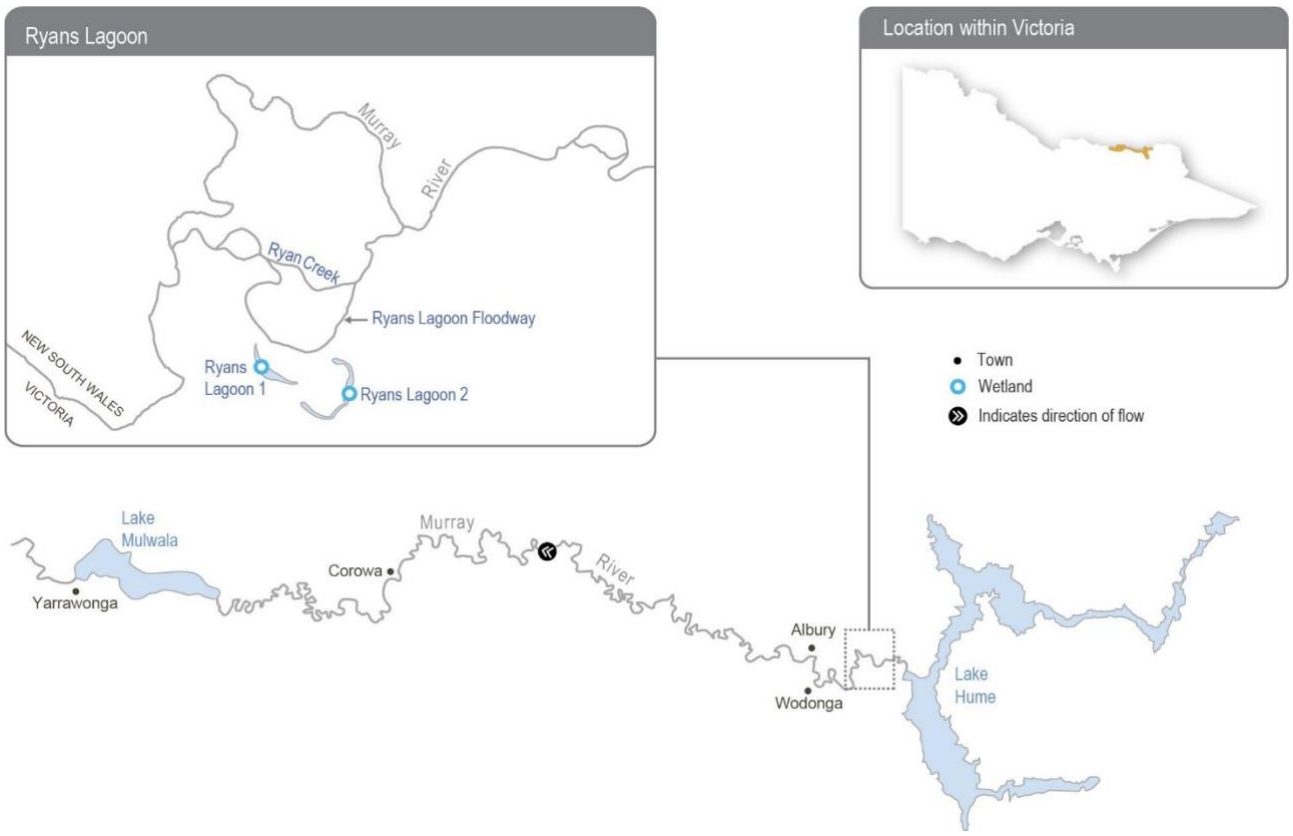
The Ryans Lagoon wetland complex is a network of wetlands positioned downstream of the Lake Hume water storage and upstream of the Kiewa River confluence with the Murray River.

Flows into the complex are mainly influenced by regulated releases from Lake Hume, which travel via Ryans Creek, an anabranch of the Murray River. The complex begins to fill from Ryans Lagoon Floodway when the flow in the Murray River exceeds 23,000 ML per day, but a flow above 26,000 ML per day for extended periods is needed to completely fill both lagoons. High unregulated flows that move across the Kiewa River floodplain during wet conditions can also inundate the site. The regulated flow from Lake Hume has not exceeded 20,000 ML per day since 2014, which has greatly reduced the frequency of watering at Ryans Lagoon.

Temporary pumps are proposed to deliver water for the environment to restore the ecological health of the complex by providing a wetting and drying regime that is closer to the natural flow regime that existed before the Murray River was regulated. Water can be pumped into Ryans Lagoon from the Ryans Lagoon Floodway, which carries water when the flow in the Murray River exceeds 8,000 ML per day. A potential spring pulse of up to 25,000 ML per day (at the Doctors Point gauge) would provide water directly to Ryans Lagoon 1 via the Ryans Lagoon Floodway, but it is likely a pump would still be required to deliver water from Ryans Lagoon 1 to Ryans Lagoon 2 to achieve a full supply level.

The North East CMA is investigating options to improve watering regimes at other wetlands along the upper Murray floodplain.

Figure 5.2.1 The upper Murray wetlands



Return to start of section

Environmental values

The North East CMA's *North East Waterway Strategy* recognises the Ryans Lagoon wetland complex as a high-value wetland system, and it is listed as a nationally significant wetland in the *Directory of Important Wetlands in Australia*. The complex provides habitat for seven bird, three fish and one perennial plant species listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and/or the Victorian *Flora and Fauna Guarantee Act 1988*. Ecological surveys conducted at the site since 1975 have recorded 250 species of waterbugs and 29 species of waterbirds, including the Australian white ibis, great egret and rufous night heron. The complex also supports native wetland vegetation types, the conditions of which are expected to improve once a seasonally aligned, more variable watering regime is reinstated.

Environmental objectives in the upper Murray wetlands
Increase habitat for native fish and increase their populations
Restore carbon and nutrient cycling within the wetlands to increase ecosystem productivity
Increase the extent of fringing and aquatic vegetation
Provide feeding habitat for a range of waterbird species
Increase the abundance and diversity of waterbugs to support aquatic food webs

Traditional Owner cultural values and uses

Traditional Owners have lived on the upper Murray floodplain for tens of thousands of years. Wetlands in the region have immense cultural value to Traditional Owners, including those represented by the Dhudhuroa Nations, the Dalka Warra Mittung Aboriginal Corporation and the Duduroa Dhargal Aboriginal Corporation.

The North East CMA is building relationships with each corporation and aims to support Traditional Owner input to planned environmental flows at the Ryans Lagoon wetland complex in the coming years. In the long term, the North East CMA aims to support the defined objectives of Traditional Owners for the complex and Traditional Owners' obligations to Country more broadly.

Traditional Owners from Duduroa Dhargal Aboriginal Corporation (DDAC) recently received funding to assist in managing Ryans Lagoon Nature Conservation Reserve for three years (2023-26) alongside Parklands Albury Wodonga Ltd. The funding will employ a DDAC Elder as a part-time ranger to undertake management activities, including ecological thinning, weed management and pest control. The ranger will also train First Nations people in cultural burning, cultural harvesting and cultural education activities.

Increasing the involvement of Traditional Owners in environmental water management and progressing opportunities for

self-determination in the environmental watering program is a core commitment of the VEWH and its agency partners. This is reinforced by legislation and policy commitments, including the *Water Act 1989*, the *Victorian Aboriginal Affairs Framework*, the 2016 *Water for Victoria*, the *Water is Life: Traditional Owner Access to Water Roadmap 2022*, and in some cases, agreements under the *Traditional Owner Settlement Act 2010*.

Where Traditional Owners are more deeply involved in the planning and/or delivery of environmental flows for a particular site, their contribution is acknowledged in Table 5.2.1 with an icon. The use of this icon is not intended to indicate that these activities are meeting all the needs of Traditional Owners, but is incorporated in the spirit of valuing that contribution.

Watering planned and/or delivered in partnership with Traditional Owners to support cultural values and uses

The North East CMA and DDAC met on Country at Ryans Lagoon in late 2022 and early 2023. These meetings provided an opportunity for DDAC to explain important cultural values at Ryans Lagoon and some of their objectives for managing Country, including water.

As explained above, the recent increase in the DDAC's capacity will enable DDAC to engage in the planning and delivery of environmental water to Ryans Lagoon in 2023-24 and beyond.

Return to start of section

The North East CMA will work with DDAC to develop arrangements for delivering environmental water to Ryans Lagoon, including the timing and methods of delivering water and plans for monitoring in 2023-24. DDAC supports and will assist with pumping water to Ryans Lagoon if required.

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.2.1, the North East CMA considered how environmental flows could support values and uses, including:

- recreation and amenity (such as birdwatching)
- community events (such as visitation by schools, Landcare groups and other community groups)
- socioeconomic benefits (such as incidental visitation to local towns and businesses).

Scope of environmental watering

The term 'environmental watering' refers to the active delivery of held environmental water to support specific environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.2.1 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.2.1 Potential environmental watering actions, expected watering effects and associated environmental objectives for the upper Murray wetlands

Potential environmental watering action	Expected watering effects	Environmental objectives
Ryans Lagoon 1 and Ryans Lagoon 2 (fill in winter/spring) 	• Mobilise carbon and nutrients within the wetlands to support wetland processes • Maintain permanent, deep, open-water habitat that supports food resources for waterbirds and native fish • Inundate wetland margins to provide refuge and feeding habitat for small- and large-bodied native fish • Increase soil moisture to promote the growth of fringing vegetation and the surrounding river red gum community • Inundate beds of aquatic and semi-aquatic vegetation to stimulate growth and increase their extent • Prevent the encroachment of river red gum saplings into deep areas of the wetland • Inundate wetland margins to provide habitat for waterbugs and foraging opportunities for waterbirds	

Scenario planning

Table 5.2.2 outlines potential environmental watering and expected water use in a range of planning scenarios.

2022-23 was the first year the upper Murray wetlands were included in the VEWH's seasonal watering plan, and the first time water for the environment was planned to be delivered to the Ryans Lagoon wetland complex. However, active pumping was not required because natural floods, which peaked at 100,000 ML per day at Doctors Point, naturally filled both lagoons and all other wetlands across the upper Murray floodplain.

Ryans Lagoon 1 and Ryans Lagoon 2 would have naturally filled every year before the river was regulated, and they require frequent watering to maintain permanent water that can support native fish and provide a reliable foraging site for waterbirds. For these reasons, the planned winter/spring watering is a high priority in all planning scenarios in 2023-24. Water for the environment, delivered via temporary pumps, will likely be needed to fill both lagoons under drought, dry and planning scenarios. A high, unregulated flow and natural floods are likely to inundate the wetlands in the wet planning scenario, and water for the environment will only be used in the wet scenario to top up water levels in each lagoon if they do not fill naturally.

Return to start of section

Table 5.2.2 Potential environmental watering for the upper Murray wetlands in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• No unregulated flow below Hume Dam • Regulated flow from Hume Dam is likely to connect the Ryans Lagoon Floodway to allow pumping into Ryans Lagoon 1 and 2	• Unregulated flow unlikely below Hume Dam • Regulated flow from Hume Dam will connect the Ryans Lagoon Floodway to allow pumping into Ryans Lagoon 1 and 2 • Possible spring pulse could deliver water to Ryans Lagoon 1 and partially fill Ryans Lagoon 2	• Unregulated flow is possible below Hume Dam if storages are near capacity and from the Kiewa River • Unregulated flow may achieve partial or complete inundation of Ryans Lagoon 1 and 2 • Regulated flow from Hume Dam and potential flow from the Kiewa catchment will connect the Ryans Lagoon Floodway to allow pumping into Ryans Lagoon 1 and 2 • Possible spring pulse could deliver water to Ryans Lagoon 1 and partially fill Ryans Lagoon 2	• Periods of unregulated flow below Hume Dam and from the Kiewa River are likely and may provide partial or complete inundation to Ryans Lagoon 1 and 2 • Pumping into Ryans Lagoon 1 and 2 if a complete fill is not achieved could be considered, depending on water levels in the lagoons
Potential environmental watering – tier 1 (high priorities)	• Ryans Lagoon 1 and 2 (fill in winter/spring)			
Possible volume of water for the environment required to achieve objectives	• 170 ML (tier 1)		• 0-170 ML (tier 1)	

5.2.2 Barmah Forest subsystem

System overview

The Barmah Forest is located within Yorta Yorta's traditional boundaries. The Barmah-Millewa Forest covers 66,000 ha and spans the New South Wales – Victoria border between Tocumwal, Deniliquin and Echuca (Figure 5.2.1). The Barmah-Millewa Forest is listed under the Convention on Wetlands of International Importance (the Ramsar Convention) as well as the *Directory of Important Wetlands in Australia*, and it is one of six Living Murray icon sites. The forest's Victorian components are the Barmah National Park and part of the River Murray Reserve, covering 29,305 ha of forest and wetlands that support a vast range of significant plant and animal species and culturally significant sites to the Yorta Yorta.

The wetlands throughout the forest provide a constant source of nutritional foods and significant fibres for the Yorta Yorta People. Resources in the landscape were also used to manufacture canoes, shields and carrying devices.

Flooding in the Barmah-Millewa Forest depends on the flow in the Murray River. A natural narrowing of the river (commonly referred to as the Barmah Choke) restricts the flow and causes overbank flooding when the flow below Yarrawonga Weir exceeds the channel's capacity. This restriction influences both the operation of Yarrawonga Weir and the magnitude of environmental flows that can be delivered to the forests. The Yorta Yorta People see this narrow part of *Dhungulla* (Murray River) as a culturally significant creation story, and it provides ecosystem services both from a culturally and environmentally significant viewpoint. The name 'Barmah Choke' is culturally inappropriate for the Yorta Yorta, and it is seen as a negative way to view their traditional lands and waters. Yorta Yorta People refer to this as the 'Pama Narrows', or more simply 'The Narrows'.

Return to start of section

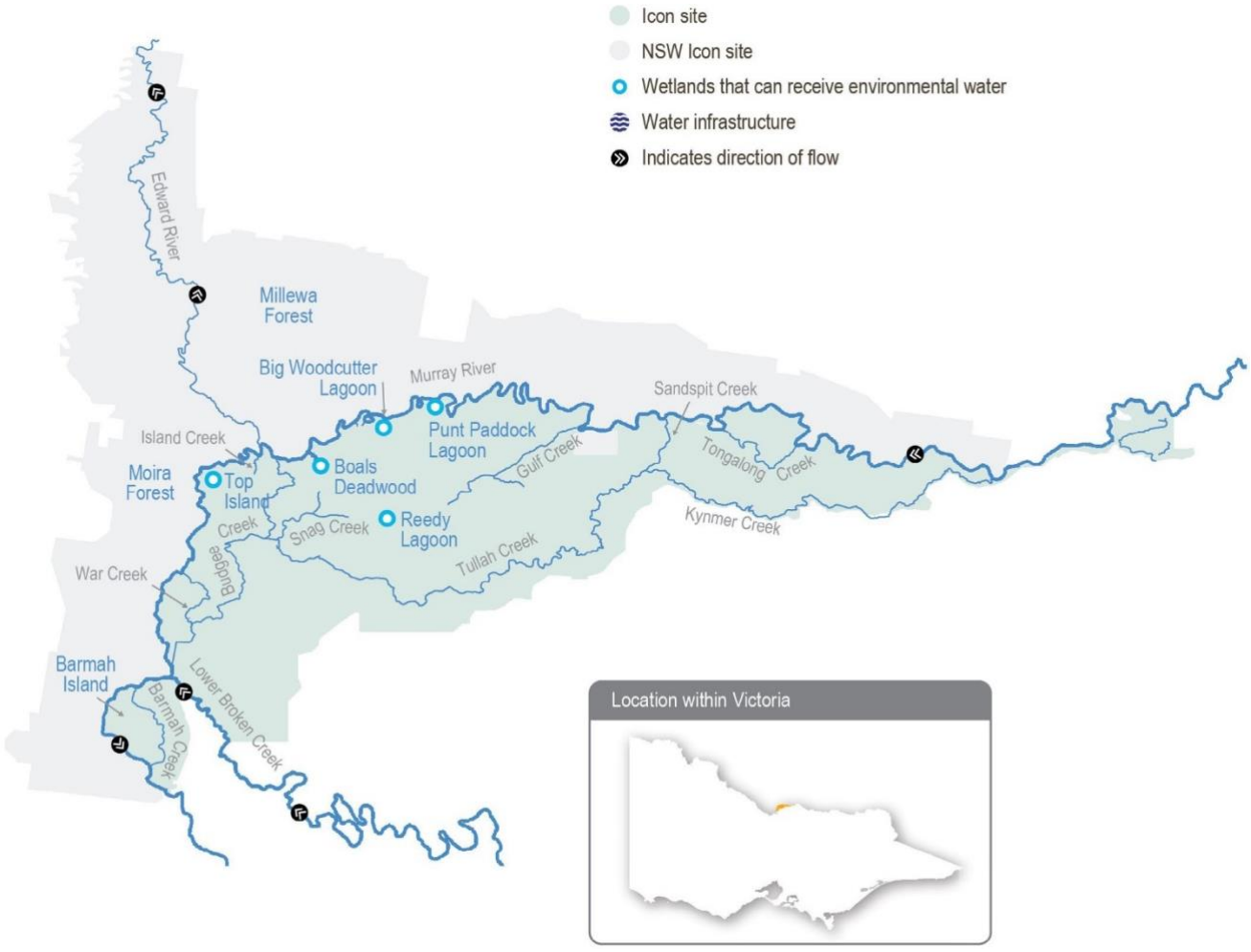
Before the river was regulated, Barmah-Millewa Forest was regularly flooded with high flows from rainfall and snowmelt in winter and spring. These regular floods shaped a rich, productive forest environment. The construction and operation of Hume Dam and Dartmouth Dam have greatly reduced the size and frequency of natural winter/spring floods in Barmah-Millewa Forest.

Operational deliveries that supply water to users downstream of The Narrows can cause unseasonal, low-level floods, which can damage the forest and banks of the river, depending on the timing and volume of the flow. Country for the Yorta Yorta People continues to change, but the changes have been rapid post-settlement due to the installation of infrastructure and river regulation. This has changed Country culturally and environmentally for the Yorta Yorta People.

The delivery of irrigation water during summer/autumn is now managed to minimise the unseasonal flooding of the forest. Regulators along the banks of the Murray River that control flow between the river and the forest remain closed during summer and autumn to restrict flow through low-lying flood runners to simulate natural conditions. The delivery of water to Barmah-Millewa Forest is also limited by a flow constraint below Yarrawonga Weir that aims to minimise impacts to adjacent farming operations in NSW. The current constraint limits the regulated flow to a maximum river level of 3.3 m at the Tocumwal gauge (about 18,000 ML per day downstream of Yarrawonga Weir), subject to various conditions. A regulated flow up to a river level of 3.0 m on the Tocumwal gauge (about 15,000 ML per day downstream of Yarrawonga Weir) can be delivered at any time during the year and is not subject to conditions. To overcome this constraint, most environmental flows are shared between Barmah and Millewa forests to deliver water to low-lying wetlands in each forest at least every second year. It is currently not possible to achieve the desired flood depth and duration for floodplain marsh vegetation in both forests at the same time without larger natural flooding.

Water management at Barmah-Millewa Forest seeks to build on natural flow and the delivery of consumptive and operational water en route to optimise environmental outcomes when possible. As Barmah-Millewa Forest is located towards the upper reaches of the regulated portion of the Murray River, water for the environment that passes through the forest and returns to the river can often be used at sites further downstream as part of multi-site watering events.

Figure 5.2.2 Barmah Forest



Return to start of section

Environmental values

The Barmah-Millewa Forest is the largest river red gum forest in Australia and the most intact freshwater floodplain system along the Murray River. The forest supports important floodplain vegetation communities, including the threatened Moira grass plains, and is a significant feeding and breeding site for waterbirds, including bitterns, ibis, egrets, spoonbills and night herons. Significant populations of native fish, frogs and turtles also live in the forest's waterways. Barmah Forest is known to support 74 plant and animal species protected under state and national legislation.

Environmental objectives in the Barmah Forest
Increase habitat for native fish and increase their populations
Maintain frog populations
Protect forest waterways from increased erosion
Maintain turtle populations, including the broad-shelled turtle
Enable carbon and nutrient cycling between the floodplain and river through connectivity
Enhance the health of river red gum communities and aquatic vegetation in the wetlands and watercourses and on the floodplain Promote the growth of floodplain marsh vegetation communities, with a particular focus on increasing the extent of Moira grass
Provide feeding and nesting habitat for the successful recruitment of colonial nesting waterbirds
Reduce the risk of low-oxygen events in summer

Traditional Owner cultural values and uses

"We are the First People of this place. We were here even before the Murray River flowed through Barmah."
– *Uncle Des Morgan, Yorta Yorta Elder, Joint Management Plan for Barmah National Park*

The Yorta Yorta Nation Aboriginal Corporation manages Barmah National Park with Parks Victoria under a Traditional Owner Land Management Agreement with the State of Victoria. The *Joint Management Plan for Barmah National Park* and the *Yorta Yorta Whole-Of-Country Plan 2021-2030* inform environmental water management in Barmah National Park. Ongoing interaction on land and water management at Barmah also occurs with Yorta Yorta through the Living Murray Indigenous Partnerships Program.

The Goulburn Broken CMA met with the Yorta Yorta Nation Aboriginal Corporation in early 2023 to discuss Barmah Forest and have a general discussion about environmental water planning. Due to capacity constraints, Yorta Yorta did not provide specific feedback on planned watering for Barmah Forest in 2023-24.

The Yorta Yorta Nation Aboriginal Corporation continues to pursue the Yorta Yorta People's inherent rights to water for Country. Rights to water will address their spiritual, cultural, environmental, social and economic needs, in line with the *Yorta Yorta Whole-Of-Country Plan 2021-2030*.

Yorta Yorta values are more than 'stones and bones'. They encompass an inherent and living connection to land (*woka*), water (*wala*) and caring for Country.

Return to start of section

Examples of Yorta Yorta cultural values and uses in Barmah Forest that are supported through deliveries of water for the environment include:

- maintaining refuges that protect turtles, an important totemic species for the Yorta Yorta People
- watering to support floodplain marsh vegetation, which includes important food, fibre and medicinal plants (such as sneezeweed and weaving sedge)
- improving the health of river red gums, which has benefits for important Yorta Yorta sites and significant markings (such as a scarred tree) and furthers connections to Country
- broader restoration to achieving healthy Country.

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.2.3, the Goulburn Broken CMA considered how environmental flows could support values and uses, including:

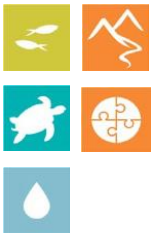
- water-based recreation (such as boating, fishing, kayaking and canoeing)
- riverside recreation and amenity (such as birdwatching, picnicking, photography, camping and the general physical, mental and social benefits of communing with nature)
- community events and tourism (such as boat tours)
- socioeconomic benefits (such as for apiarists and irrigation diverters).

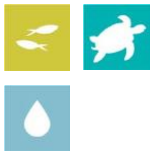
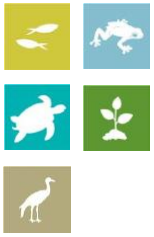
Scope of environmental watering

The term 'environmental watering' refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.2.3 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.2.3 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Barmah Forest

Potential environmental watering action	Expected watering effects	Environmental objectives
Winter/spring forest low flow to various waterways in Barmah Forest (variable flow rates and duration during July to December and June)	• Provide a gradual connection of waterways with the Murray River to minimise erosion within those waterways • Provide flow in forest waterways to ensure adequate refuge pools persist for native fish and turtles • Provide adequate depth and connection between floodplain waterways and the river to facilitate the movement of native fish • Remove accumulated organic matter from waterways to cycle carbon to the river system and minimise the risk of hypoxic blackwater by ensuring throughflow	
Winter/spring/summer low flow (greater than 8,500 ML/day below Yarrawonga Weir during August to December)	• Maintain a sufficient water level in the Murray River main channel to prevent Murray cod from abandoning their nests, increase juvenile survival and improve dispersal opportunities	
Spring/summer fresh(es) in the Murray River channel (one to three freshes that increase flow by at least 500 ML/day and maintain it for two to eight days during November to December)	• Provide variable water levels once water temperatures exceed 22°C to trigger the spawning of native fish species, primarily silver perch	

Potential environmental watering action	Expected watering effects	Environmental objectives
Spring/summer/autumn freshes to Gulf and Boals creeks (100 ML/day for three to five days as required during November to April)	• Maintain critical refuge pools to provide habitat for native fish and turtles • Flush refuge pools to maintain water quality	
Spring/summer/autumn low flow to floodplain waterways, including Sandspit, Gulf, Big Woodcutter, Boals and Island creeks and Punt Paddock Lagoon (200 ML/day for 30 to 60 days during November to April)	• Replenish refuge pools in permanent waterways to maintain water quality, fish and turtle populations • Maintain connectivity between the forest and the river • Remove accumulated organic matter, cycle carbon to the river system and minimise the risk of hypoxic blackwater	
Fill or top-up of Boals Deadwood, Harbours Lake, Reedy Lagoon and Top Island wetlands (200-400 ML/day for four and a half months during September to February)	• Provide a cue to initiate waterbird breeding and maintain a depth of at least 0.5 m beneath reed bed nesting breeding colonies • Maintain wetting duration and depth to grow the wetland vegetation	
Spring wetting of floodplain marshes (variable flow rates of greater than 9,500-18,000[1] ML/day below Yarrawonga Weir for three months during September to December)	• Inundate open plains to a sufficient depth and for a sufficient duration to allow the growth of floodplain marsh vegetation • Inundate forest wetlands and low-lying floodplain areas to create foraging opportunities for waterbirds and increase available habitat for turtles, frogs and small-bodied native fish	
Autumn/winter low flow in the Murray River (4,000-5,000 ML/day downstream of Yarrawonga during May to June)	• Increase water depth in the Murray River channel to provide habitat for large-bodied native fish in the Murray River and unregulated anabranches in Barmah-Millewa Forest	

1 The maximum flow constraint is a level of 3.3 m at the Tocumwal gauge in the Murray River, estimated at 18,000 ML/day downstream of Yarrawonga Weir. The maximum flow rate actually delivered may vary for these actions.

Scenario planning

Table 5.2.4 outlines potential environmental watering and expected water use in a range of planning scenarios.

Widespread flooding in 2022-23 fully inundated Barmah-Millewa Forest, a much greater area than the quarter of the floodplain that can be inundated by environmental flows under current delivery constraints. The potential watering actions in this plan are required in most or all years to support the identified environmental values and objectives. For these reasons, the proposed watering actions under each planning scenario tend to be the same each year, and the proposed actions in this seasonal watering plan are similar to those in previous plans.

The ecological objectives for Barmah-Millewa Forest require a sustained flow in the Murray River through winter and spring. Flow-control structures are used to direct water from the Murray River channel into the forest and to facilitate the later return of most of that water back to the river, transporting carbon and nutrients for use downstream. Current flow constraints mean environmental watering will primarily target Millewa Forest in 2023-24, aiming to meet the depth and duration targets for wetlands. Barmah Forest will still receive a flow, but depth and duration targets for some forest wetlands may not be fully met. These arrangements alternate between Barmah and Millewa forests each year.

Return to start of section

Demands for water for the environment in Barmah Forest vary significantly in response to seasonal conditions. A variable winter/spring forest low flow and spring/summer freshes are required in all planning scenarios. The variable winter/spring forest low flow aims to connect waterways within Barmah Forest to the Murray River to maintain habitat and provide movement opportunities for aquatic animals (such as native fish). This watering action will be achieved by keeping regulating structures open between June and December to allow water to move in and out of the forest in response to variations in the normal flow of the Murray River. The spring/summer freshes specifically aim to trigger silver perch spawning when the water temperature exceeds 22°C and are achieved by varying the flow in the Murray River below Yarrawonga Weir.

Under drought and dry conditions, potential environmental flows primarily aim to maintain water levels and water quality in refuge habitats within the forest to sustain fish and turtle populations. To achieve these objectives, relatively small volumes of water need to be directed into the forest and are unlikely to return much water to the Murray River for downstream use. Given high storage levels and forecast high water availability for 2023-24, these flows may be delivered at greater-than-normal rates. For example, the size of a multi-site environmental watering action supporting whole-of-Murray-River and/or downstream environmental objectives during winter and spring is likely to increase the flow through Barmah Forest, or water for the environment may be used to 'piggyback' operational transfers from Hume Dam. In 2023-24, the forecast high water availability is expected to also allow spring wetting of floodplain marshes and the delivery of an autumn-winter low flow to minimise environmental stress throughout the forest under drought and dry planning scenarios.

The winter/spring/summer low flow in the Murray River channel aims to maintain sufficient water levels for successful Murray cod nesting and recruitment under the dry-to-wet planning scenarios to increase local Murray cod populations and assist the recovery of the species across the broader region. The volume needed to achieve this low flow depends on the contribution of the natural flow and the delivery of operational water downstream through The Narrows. This action will provide an environmental return flow downstream for use at other sites along the Murray River.

In the average or wet planning scenarios, the focus shifts to building resilience in the system by enhancing ecological responses to unregulated floods. Actions in the average and wet planning scenarios may include extending the duration of unregulated floods (within flow constraints) to increase the vigour and resilience of wetland communities (such as Moira grass plains) in floodplain marshes or extending watering in river red gum forests to maintain the health of the trees. These actions may require large volumes of water to be directed into the forest, with water for the environment provided as a directed release from Hume Dam targeting specific flow rates downstream of Yarrawonga Weir and managed using forest regulators. Most of the water used for these actions is eventually returned to the Murray River through the natural shedding action of the floodplain.

A prolonged, low-level spring wetting of floodplain marshes in 2023-24 is desirable to help floodplain vegetation flower, set seed and recruit. Some floodplain inundation will occur when the flow downstream of Yarrawonga exceeds about 9,500 ML per day. A larger flow (of up to 3.3. m at the Tocumwal gauge) will inundate more of the floodplain to a greater depth, which will provide better outcomes for floodplain vegetation, native fish, frogs, turtles and waterbirds.

Regulators may be used to divert water to selected wetlands under various planning scenarios to support any significant waterbird breeding that is triggered by a spring inundation.

Table 5.2.4 Potential environmental watering for the Barmah Forest in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• Unregulated flow periods are unlikely • Flow in the Murray River will remain within the channel all year	• Some small, unregulated flow in late winter/spring • Low chance of overbank flow in late winter/spring	• Likely chance of small-to-medium unregulated flow in winter/spring • Likely chance of overbank flow in winter/spring	• High probability of moderate to large unregulated flow in winter/spring • Expected large overbank flow

Planning scenario	Drought	Dry	Average	Wet
Potential environmental watering – tier 1 (high priorities)[1]	• Winter/spring forest low flow • Spring/summer fresh(es) (one to three freshes) • Spring/summer/ autumn freshes (to Gulf and Boals creeks)	• Winter/spring forest low flow • Winter/spring/ summer low flow • Spring/summer fresh(es) (one to three freshes) • Spring/summer/ autumn low flow • Fill or top up Boals Deadwood, Harbours Lake, Reedy Lagoon and Top Island wetlands	• Winter/spring forest low flow • Winter/spring/ summer low flow • Spring/summer fresh(es) (one to three freshes) • Spring/summer/ autumn low flow • Fill or top up Boals Deadwood, Harbours Lake, Reedy Lagoon and Top Island wetlands • Spring wetting of floodplain marshes • Autumn/winter low flow (in Murray River)	• Winter/spring forest low flow • Winter/spring/ summer low flow • Spring/summer fresh(es) (one to three freshes) • Spring/summer/ autumn low flow • Fill or top up Boals Deadwood, Harbours Lake, Reedy Lagoon and Top Island wetlands • Spring wetting of floodplain marshes • Autumn/winter low flow (in Murray River)
Potential environmental watering – tier 2 (additional priorities)[2]	• Spring wetting of floodplain marshes • Autumn/winter low flow (in Murray River)	• Spring wetting of floodplain marshes • Autumn/winter low flow (in Murray River)	• N/A	• N/A
Possible volume of water for the environment required to achieve objectives[3]	• 8,500 ML (tier 1)	• 550,000 ML (tier 1)	• 200,000 ML (tier 1)	• 130,000 ML (tier 1)

1 Tier 1 potential environmental watering at Barmah Forest is not classified as tier 1a or 1b because the water available for use is shared across various systems, and it is not possible to reliably determine the supply specifically available for Barmah Forest.
2 The volume of water for the environment required to deliver the spring wetting of floodplain marshes and autumn/winter low-flow watering actions in the drought planning scenario will depend on demands for multi-site environmental events or operational transfers and is therefore not estimated in Table 5.2.4.
3 The possible volumes of water for the environment required in Barmah Forest are estimates and highly variable, depending on factors such as seasonal conditions and the contributions of operational and/or unregulated flows. Much of the water for the environment delivered to Barmah Forest is returned to the Murray River – around 80 percent in the dry-to-wet planning scenarios – and can be re-used at downstream sites.

5.2.3 Gunbower Creek and Forest

System overview

Gunbower Forest is a large, flood-dependent forest situated on the Murray River floodplain in northern Victoria between Torrumbarry and Koondrook (Figure 5.2.3).

Gunbower Forest, which covers 19,450 ha, is bounded by the Murray River to the north and Gunbower Creek to the south. It is an internationally significant site under the Ramsar Convention and forms part of the Living Murray Gunbower-Koondrook-Perricoota forests icon site. River regulation and water extraction from the Murray River and Gunbower Creek have reduced the frequency, duration and magnitude of flood events in Gunbower Forest. This has affected the extent and condition of floodplain habitats and the health of plant and animal communities (such as river red gum and black box communities, native fish, birds, platypus, frogs and turtles) that depend on those habitats.

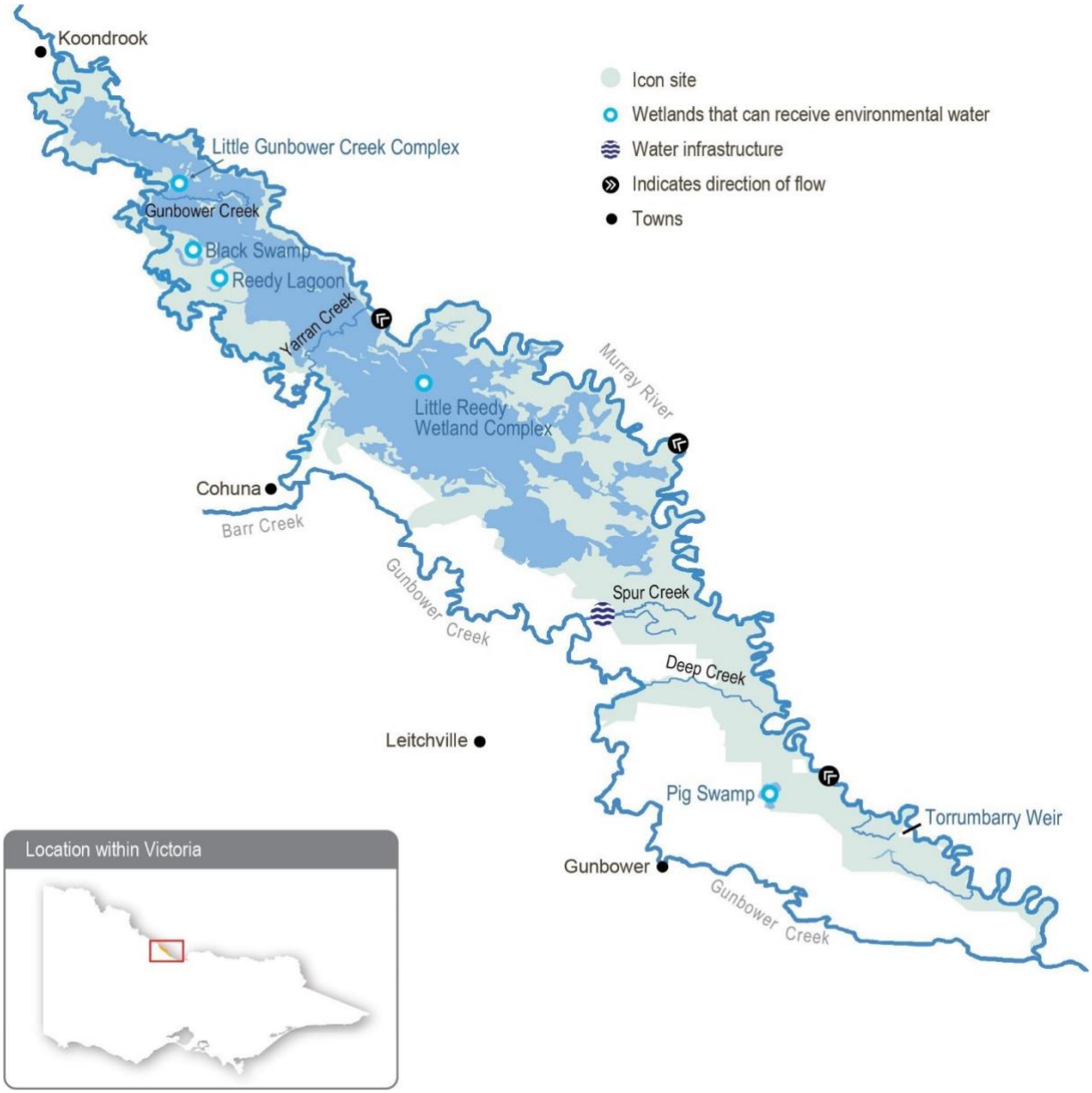
Gunbower Creek is a natural creek that has been modified to supply irrigation water from the Murray River to the Torrumbarry Irrigation Area. There are 12 lagoons, largely located in the upper reaches of the creek system, that are permanently or seasonally connected to Gunbower Creek. Water for the environment is used in Gunbower Creek to improve habitat for native fish, especially Murray cod.

The Living Murray environmental works program in the middle and lower forest was completed in 2013. The works allow up to 4,500 ha of the wetlands and floodplain to be watered with considerably less water than would be required if the watering infrastructure was not in place. The works enable efficient watering through Gunbower Creek and the forest to maintain the

wetland and floodplain condition and provide connectivity between the creek, forest floodplain and the Murray River. Frequent connections between the river and floodplain habitats allow animals to move between habitats and support critical ecosystem functions (such as carbon exchange).

Return to start of section

Figure 5.2.3 Gunbower Creek and Forest



Environmental values

Gunbower Forest contains many important environmental values. It includes rare and diverse wetland habitats and large areas of remnant vegetation communities (such as river red gum forest and woodlands). It is home to vulnerable and endangered plants and animals, including river swamp wallaby grass, wavy marshwort, Murray-Darling rainbowfish and eastern great and intermediate egrets. Gunbower Forest also supports internationally recognised migratory waterbird species.

Return to start of section

Gunbower Creek provides important habitat for native fish (such as Murray cod, golden perch and freshwater catfish). It is a valuable refuge for native fish and provides a source of fish to recolonise surrounding waterways.

Environmental objectives in Gunbower Creek and Forest
Provide feeding, breeding and refuge habitat for small-bodied native fish (such as Murray-Darling rainbow fish) in forest wetlands Improve populations of large-bodied native fish (such as Murray cod) in Gunbower Creek
Increase the diversity and abundance of native frog species within the forest
Maintain the population of freshwater turtles by providing suitable feeding, breeding and refuge habitat
Support carbon and nutrient cycles in the forest and wetlands and periodically deliver carbon and nutrients from the forest to adjacent waterways to support food webs
Improve the health and increase the abundance of native vegetation in permanent and semi-permanent wetlands Improve the health of river red gums and black box communities
Provide feeding, breeding and refuge habitat for waterbirds, including colonial nesting species (such as egrets, cormorants and herons)
Maintain water quality in Gunbower Creek

Traditional Owner cultural values and uses

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.

The North Central CMA seeks engagement and input from both Traditional Owner groups when undertaking annual environmental water planning and throughout the year as part of the Living Murray Indigenous Partnerships Program.

Yorta Yorta custodians and Barapa Barapa custodians have clearly expressed their aspirations for an active role in the management of land and water to fulfil custodianship obligations and contribute to improvements in the health of Country.

Barapa Barapa custodians and North Central CMA staff spent two days in Gunbower Forest in early 2023 to reflect on the condition of the forest and creek, share knowledge and discuss environmental watering plans for 2023-24 and other

opportunities to improve the health of the forest and creek. Barapa Barapa custodians released several Murray cod and golden perch that were salvaged during the low-oxygen blackwater event in 2022 back into Gunbower Creek. Concerns were raised about the potential for future low-oxygen blackwater events.

Increasing the involvement of Traditional Owners in environmental water management and progressing opportunities towards self-determination in the environmental watering program is a core commitment of the VEWH and its agency partners. This is reinforced by a range of legislation and policy commitments, including the *Water Act 1989*, the *Victorian Aboriginal Affairs Framework*, the 2016 *Water for Victoria*, the *Water is Life: Traditional Owner Access to Water Roadmap 2022*, and in some cases, agreements under the *Traditional Owner Settlement Act 2010*.

Where Traditional Owners are more deeply involved in the planning and/or delivery of environmental flows for a particular site, their contribution is acknowledged in Table 5.2.7 with an icon. The use of this icon is not intended to indicate that these activities are meeting all the needs of Traditional Owners, but is incorporated in the spirit of valuing that contribution.

Watering planned and/or delivered in partnership with Traditional Owners to support cultural values and uses

Barapa Barapa custodians have been working in partnership with the North Central CMA to deliver the Water for Country project in Gunbower Forest since 2015. The Water for Country project builds on the work of the previous Barapa Barapa Cultural Heritage Mapping of Lower Gunbower Forest project, delivered in 2013-14, to map a catalogue of cultural heritage assets in the forest. The Water for Country project aims to investigate how Traditional Owners' cultural and spiritual values can be better represented in water management. In 2018, the Water for Country group expanded to also include Wamba Wemba custodians; the group continues to focus on Gunbower Forest.

Return to start of section

Table 5.2.5 identifies opportunities to support cultural values with water for the environment. These have been informed by the Barapa Barapa Watering Objectives Framework (see Table 5.2.6) and North Central CMA engagement with Barapa Barapa custodians in early 2023.

Table 5.2.5 Cultural values and uses at Gunbower Forest as identified by the Barapa Barapa Wamba Wemba Water for Country project

Value/use	How the value/use will be considered by environmental flows in 2023-24
Cultural plants, cultural practices	• Water in wetlands and on the floodplain from deliveries of water for the environment and natural flooding supports culturally important plants throughout Gunbower Forest and allows the continuation of cultural practices, including harvesting of food, medicine and weaving plants. • The watering actions via the Hipwell channel in 2023-24 will support cultural plants that Barapa Barapa custodians value and provide opportunities for cultural practices to continue. • The abundance of cultural resources available is linked to the scale of watering that can be achieved. Floodplain watering via the Hipwell channel provides a greater amount of resources and enables resourceful harvests with less travel and effort. • Barapa Barapa custodians recognise the value of resources that occur on the drawdown after the inundation of the forest floodplain, providing food for animals and cultural plants (such as old man weed). This can be supported by allowing wetlands to draw down naturally prior to the floodplain watering in winter 2023 and through summer and autumn 2024. • Having a diversity of habitat and vegetation responses is a priority for Barapa Barapa custodians. They consider it important to have a range of water depths, which creates a more diverse vegetation response and results in a variety of resources becoming available over a longer period.
Healthy Country	• Providing drought refugia and maintaining areas with healthy habitat is a high priority for Barapa Barapa custodians. • Deliveries of water for the environment will ensure water is present on the floodplain and in high-priority wetlands regardless of whether there is unregulated flooding. This will provide refuge habitat for forest fauna, and the delivery of water across most of the Gunbower Forest wetlands will ensure that high-quality habitat is available.
Cultural heritage	• Barapa Barapa custodians value having water in natural creeks and billabongs off main wetlands, which can contain cultural heritage sites, including earth mounds and a large canoe tree on the edge of a large flood runner. • Delivering water to the floodplain supports this with water flowing through natural creeks and flood runners on the floodplain. Deliveries of water for the environment result in lower levels than natural flooding, which can ensure that earth mounds or other cultural heritage are not overtopped and harmed. • Barapa Barapa custodians have noted that areas of black box and river red gum have cultural heritage values, but the changed watering regime since regulation and climate change is causing the encroachment of black box into areas previously dominated by river red gum. Barapa Barapa custodians expressed the desire to preserve the tree community that was historically present, which is supported by the delivery of water to the floodplain. The lower landscape regulators can target small areas of river red gum, and the Hipwell channel watering planned in 2023-24 will inundate large areas of river red gum and potentially suppress black box encroachment within the flood footprint.
Cultural practices	• Barapa Barapa custodians have aspirations to reintroduce traditional fish traps into natural creeks within Gunbower Forest. The flood runners around the Little Gunbower Creek complex have been identified as potential trial sites, and opportunities may be provided to pursue this in 2023-24. • Traditional Owners have indicated that a smoking ceremony should be a regular activity each year when water is delivered, as it is something that their ancestors would have done when the floodwaters arrived and would represent a restoration of an important cultural practice. The timing of deliveries of water for the environment will be communicated to Traditional Owners so cultural opportunities can be realised.
Cultural resources	• Barapa Barapa custodians have expressed that the ongoing survival of fish populations is important, as the fish are a food resource. In 2023, Barapa Barapa custodians are placing a high priority on protecting native fish populations in Gunbower Creek and avoiding any further fish deaths due to low-oxygen blackwater. • Native wetland fish populations persisting in the Gunbower Forest wetlands following the 2022 floods will be supported by the planned floodplain watering, ensuring a resident fish population persists across multiple years. Watering the wetlands will also provide habitat for freshwater mussels in the wetlands.

Return to start of section

The Barapa Barapa Wamba Wemba Water for Country project has led to the creation of the Barapa Barapa Cultural Watering Objectives Framework, which is a guiding document to ensure cultural priorities and outcomes are considered and incorporated in the planning for and management of water for the environment. The framework considers cultural objectives matched with hydrological considerations, indicators and measures for monitoring success, which Table 5.2.6 shows. These objectives are considered in conjunction with the environmental objectives and expected effects of the potential watering actions shown in Table 5.2.7.

Applying the framework during seasonal watering proposal engagement with the Barapa Barapa Wamba Wemba Water for Country project members ensures that planned environmental flows incorporate Barapa Barapa custodians' cultural aspirations and that water managers are culturally informed when delivering water for the environment.

All the potential environmental watering actions in Table 5.2.7 provide the opportunity to support Barapa Barapa cultural values and objectives. Achieving them will depend on climatic conditions.

Table 5.2.6 Barapa Barapa cultural objectives for environmental flows in Gunbower Forest 2023-24 (from the Barapa Barapa Cultural Watering Objectives Framework)

Cultural objective	Hydrological aim	Indicator	Measure	Watering action
Promote and maintain healthy and abundant native fish communities in Gunbower Creek and Gunbower Forest	• Presence of water in wetlands before spring to support native fish spawning events	• Presence of native fish spawning • Native fish populations show a range of ages	• Fish surveys, larval sampling	• Floodplain watering • Wetland top-ups • Yarran throughflow
	• Presence of water in deep wetlands so that fish can survive for longer	• Presence of native fish following watering event	• Fish surveys	
	• Connectivity between wetlands, Gunbower Creek and the Murray River	• Presence of native fish following watering event	• Fish surveys	
Promote the natural flow of water	• Water flows via natural flow paths to culturally important sites	• Presence of water at culturally significant sites (e.g. fishponds)	• Photo points, site surveys	
	• Presence of healthy-looking and healthy-smelling forest	• Presence of healthy canopies and good ground cover on the forest floodplain	• Plant surveys	
Promote and maintain healthy cultural plants and resources	• Presence of water on the floodplain, in small wetlands and in depressions to provide resources across the forest, particularly in dry years	• Presence of food and fibre resources distributed across the forest	• Cultural harvests, plant surveys, seed collection	
	• Presence of water in wetlands which are healthy	• A diverse range of plants, animals and insects living in harmony	• Results of monitoring activities (e.g. macroinvertebrate surveys, flora and fauna surveys)	
Promote healthy waterbird populations	• Presence of water in wetlands that support waterbird breeding	• Presence of waterbird breeding	• Waterbird surveys, spring/summer surveys for eggs	

Return to start of section

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.2.7, the North Central CMA considered how environmental flows could support values and uses, including:

- water-based recreation (such as boating, canoeing, duck hunting, fishing, stand-up paddle boarding and water skiing)
- riverside recreation and amenity (such as birdwatching, camping, photography and walking)
- community events and tourism (such as park visitation, tour and activity operators)
- socioeconomic benefits (such as consumptive water users, including irrigation and domestic use, timber harvesting and education).

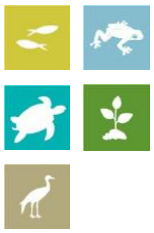
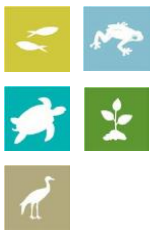
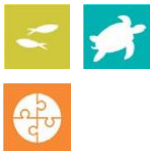
Where possible, releases will be timed to minimise disruption to community uses.

Scope of environmental watering

The term 'environmental watering' refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.2.7 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.2.7 Potential environmental watering actions, expected watering effects and associated environmental objectives for Gunbower Creek and Forest

Potential environmental watering action		Expected watering effects	Environmental objectives
Gunbower Forest			
Gunbower Forest floodplain, floodrunners and wetlands inundation (with variable flow rates during winter/ spring 2023)	Part B: July-November 2023[1]	• Continue floodplain watering commenced in June 2023 to inundate for a second consecutive year river red gums, which are still recovering from the Millennium Drought • Inundate flood-dependent understorey vegetation across the floodplain to support further its establishment and recolonisation to supplement recruitment during the 2022-23 floods • Provide a variety of water depths throughout the forest to provide feeding, foraging and refuge habitat for frogs, turtles and waterbirds, including juveniles from colonial nesting species, and access to breeding habitat for small-bodied native fish	
Extend natural flooding in Gunbower Forest floodplain, flood runners and wetlands (with variable flow rates to maintain an appropriate wetted extent during winter/spring 2023)		• Where possible, extend the duration and/or extent of natural floodplain and wetland inundation over the optimal growing season for aquatic vegetation; the objectives are as per the previous action, with a greater area of floodplain inundated	
Winter/spring fresh in Yarran Creek (variable flow rates and duration based on water levels in Gunbower Forest and flows in the Murray River and Gunbower Creek)		• Connect Gunbower Creek, Gunbower Forest and the Murray River through the Yarran Creek and/or Shillinglaws regulators to increase flowing habitat for the lateral movement of native fish, turtles, carbon and nutrients	

Potential environmental watering action	Expected watering effects	Environmental objectives
Black Swamp, Reedy Lagoon, Little Gunbower Creek complex, Little Reedy wetland complex (top-up, variable flow rates during spring/ summer as required in response to bird breeding)	• Maintain adequate water levels in breeding and feeding habitats to allow breeding waterbirds to successfully fledge their chicks	
Black Swamp, Reedy Lagoon, Little Gunbower Creek complex, Little Reedy wetland complex (top-up, variable flow rates during autumn/ winter 2024 as required)	• Maintain a variety of water depths across the floodplain wetlands to provide feeding, foraging and refuge habitat for frogs, fish, turtles and waterbirds, including juvenile colonial nesting species	
Gunbower Creek (targeting Cohuna Weir)		
Spring/summer/autumn flow (300-400 ML/day during September to March)	• Maintain habitat and food resources for native fish and support breeding and larval survival (such as Murray cod) by minimising large variations in the water level during the irrigation season and achieving about 1.5 m depth in deeper pools and 30 cm depth in the shallow connecting littoral zone to maintain habitat • A greater area of habitat will be inundated at the upper magnitude	
Summer/autumn/winter opportunistic fresh(es) (200-500 ML/day for one to four weeks during July to August 2023 or January to June 2024)	• Increase flowing habitat in Gunbower Creek to provide preferred hydraulic conditions for native fish • Lower the Koondrook Weir pool during this event to create a hydraulic head difference and increase the amount of flowing habitat for native fish in Gunbower Creek	
Autumn/winter low flow (200 ML/day during July to August and March to June)	• Maintain connectivity through the length of Gunbower Creek and between lagoons and fishways during the off-irrigation period and prevent sections from drawing down to isolated pools • Provide access to food resources over the cooler months, and reduce predation pressure on juvenile fish	
Gunbower Creek (targeting Koondrook Weir)		

Year-round opportunistic fresh(es) (300-500 ML/day for one to four weeks, as required)	• Deliver in response to high flow in the Murray River (if conditions allow) to:
	  • promote the exchange of carbon between Gunbower Creek and the Murray River
	  • provide a natural cue to attract native fish (such as Murray cod if delivered in spring and golden perch and silver perch if delivered in autumn) to migrate into or to the upstream reaches of Gunbower Creek, maximising the effects of the fishways at Koondrook and Cohuna weirs	

Trigger-based spring/ summer low flow (50-300 ML/day as required during September to February)	• Dilute carbon-rich water exiting Gunbower Forest at Three Corner Hole to improve water quality (oxygen concentrations) in lower Gunbower Creek if required	

1 This potential watering action is Part B of a watering action that commenced in 2022-23.

Return to start of section

Scenario planning

Table 5.2.8 outlines potential environmental watering and expected water use in a range of planning scenarios.

Gunbower Forest

Wet conditions in winter and spring 2022 triggered the largest flood in Gunbower Forest since 1993. The event re-flooded parts of the floodplain that received water for the environment in 2018 as well as a large portion of the floodplain that cannot be inundated with water for the environment. The conditions of the river red gums and the associated understorey vegetation are still recovering from the Millennium Drought, and vegetation ecologists have recommended using water for the environment to inundate parts of the floodplain again in 2023-24 to consolidate and enhance the vegetation condition and recruitment outcomes of the 2022 flood. Environmental watering is also needed to provide food for juvenile waterbirds that fledged after the 2022 flood to help them reach maturity over the next few years and breed during the next flood. High mortality among juvenile waterbirds over the past 10 to 20 years is considered one of the main reasons why waterbird populations continue to decline across the Murray-Darling Basin, and actions to increase juvenile survival are being implemented across the basin. For these reasons, a floodplain watering event targeting about 23 percent of the forest (or 4,500 ha) is a high priority in all planning scenarios. The watering action will be delivered via the Hipwell Channel. It was due to start in June 2023, as described in the Seasonal Watering Plan 2022-23, and continue until late spring 2023. Deliveries may be modified to extend the duration or extent of any natural floods during the planned watering period.

If river and operational conditions allow (such as with a moderately high flow in the Murray River for at least two weeks when water temperatures are below 16ºC), the Yarran Creek regulator may be opened to transfer carbon, nutrients and propagules between Gunbower Creek, Gunbower Forest and the Murray River (via Yarran Creek) and encourage native fish to move into Gunbower Creek.

Water for the environment may be delivered to selected wetlands in lower Gunbower Forest during late spring and/or summer, if watering of the forest triggers a significant waterbird breeding event, to prevent water levels in the forest from dropping too quickly and risking nest abandonment. The wetlands are likely to draw down over summer, and additional top-ups may be provided in autumn and winter 2024 to provide overwintering habitat for waterbirds and other aquatic animals and prime the wetlands to help optimise the vegetation response ahead of likely top-ups in spring 2024. This is not essential in the drought planning scenario, as deeper pools in some of the wetlands that are expected to be filled in winter/spring 2023 will retain adequate water levels over winter 2024.

Following the 2022 floods, large increases in European carp populations are expected to have occurred throughout the Murray-Darling Basin, and there are carp in residual pools in Gunbower Forest. This has been an important consideration in the planning for environmental flows in 2023-24 and has been carefully balanced alongside the needs of other ecological values (such as waterbird recruitment and water-dependant floodplain vegetation requirements). Environmental flows in 2023-24 are expected to benefit native and non-native fish, and a high priority is minimising carp impacts and population growth as much as possible. Carp management strategies include avoiding increases in flow by maintaining constant flow rates into the forest once water temperatures reach 16ºC (which is the temperature threshold for carp spawning) and consulting fish ecologists to operate the Hipwell Channel fish lock in a manner that supports native fish objectives while minimising the export of carp to Gunbower Creek.

Gunbower Creek

The flow in Gunbower Creek is highly influenced by irrigation demands, which can cause significant fluctuations in the creek's water level during the irrigation season and provide little or no flow from late autumn to the end of winter. Water for the environment is primarily used to smooth out these flow fluctuations to provide suitable habitat, breeding and dispersal opportunities for native fish. A low flow is therefore prioritised in all planning scenarios.

The recommended autumn/winter low flow of 200 ML per day is considered the minimum flow required to maintain fish habitat within the main channel of Gunbower Creek and the connections between the main channel and the upper lagoons, which support freshwater catfish. It is planned to deliver a low flow during the main irrigation season at a rate of 300-400 ML per day to provide stable flow conditions in littoral habitats at the margins of the channel, which are important nursery habitats for Murray cod. The Murray cod breeding season extends from around September to December, depending on the weather and water temperature, and the aim will be to maintain the flow close to 400 ML per day during this period. The flow will be gradually reduced from 300 ML per day from mid-March to provide a smooth transition between the irrigation and non-irrigation seasons. All low-flow targets will be subject to the environment's share of channel capacity and the potential need to prioritise inflows to Gunbower Forest via the Hipwell Channel.

The recommended autumn/winter low flow is smaller than the flow that would naturally occur at that time of year and is smaller than the recommended low flow during the irrigation season for two reasons. First, it is considered sufficient to maintain viable habitat and ecological function and can be met with the available supply of environmental water. Second, providing a lower flow during the non-irrigation season relieves some of the stress imposed on the channel form and its banks by a prolonged near-capacity flow during spring, summer and autumn.

Return to start of section

Other opportunistic or trigger-based watering actions may be delivered in Gunbower Creek during 2023-24. A trigger-based flow of 50-300 ML per day may be delivered to Koondrook Weir in response to low oxygen levels in all planning scenarios. The magnitude of this flow will depend on the flow in the creek at the time a low oxygen level is detected and the rate of dilution required to prevent fish deaths. Freshes targeting Cohuna Weir or Koondrook Weir may also be delivered in the average or wet planning scenarios where opportunities allow. These freshes aim to temporarily increase the amount of flowing habitat, which some fish prefer, and encourage fish to move into the system from the Murray River. These freshes are more likely to be delivered during spring and autumn when fish commonly disperse, but they can only be delivered if the flow in the Murray River is compatible, there is low irrigation demand, Hipwell Channel is not being used and sufficient environmental water is available.

The channel capacity of Gunbower Creek has declined in recent years, and the magnitude of planned environmental flows has dropped accordingly to achieve the target physical and ecological responses without inundating private land. The relationship between the flow over Cohuna Weir and the downstream water level will continue to be monitored and reviewed in 2023-24 and beyond so that environmental flow targets in Gunbower Creek can meet ecological objectives while also adapting to changes in the channel's capacity.

A carryover target of 4,000 ML has been identified in all planning scenarios as guaranteeing sufficient supply to maintain a low flow in Gunbower Creek during the 2024-25 irrigation shutdown season. About 18,000 ML of carryover is required to enable top-ups to the wetlands at Gunbower Forest during winter and spring 2024.

Table 5.2.8 Potential environmental watering for Gunbower Creek and Forest in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• No natural inflow into Gunbower Forest	• No natural inflow into Gunbower Forest	• Minor natural inflow into Gunbower Forest may occur in winter/spring	• Overbank flow is likely in winter/ spring
Gunbower Forest				
Potential environmental watering – tier 1 (high priorities)[1]	• Gunbower Forest partial floodplain, floodrunners and wetlands inundation (Part B) in winter/spring • Winter/spring fresh in Yarran Creek • Black Swamp, Reedy Lagoon, Little Gunbower Creek complex, Little Reedy wetland complex top-up in spring/ summer, if required in response to bird breeding	• Gunbower Forest partial floodplain, floodrunners and wetlands inundation (Part B) in winter/spring 2023 • Winter/spring fresh in Yarran Creek • Black Swamp, Reedy Lagoon, Little Gunbower Creek complex, Little Reedy wetland complex top-up in spring/summer, if required in response to bird breeding • Black Swamp, Reedy Lagoon, Little Gunbower Creek complex, Little Reedy wetland complex top-up during autumn/ winter 2024		• Gunbower Forest partial floodplain, floodrunners and wetlands inundation (Part B) in winter/spring 2023 • Extend natural flooding in Gunbower Forest floodplain, floodrunners and wetlands in winter/ spring 2023 • Winter/spring fresh in Yarran Creek • Black Swamp, Reedy Lagoon, Little Gunbower Creek complex, Little Reedy wetland complex top-up in spring/ summer, if required in response to bird breeding • Black Swamp, Reedy Lagoon, Little Gunbower Creek complex, Little Reedy wetland complex top-up during autumn/winter 2024

Planning scenario	Drought	Dry	Average	Wet
Potential environmental watering – tier 2 (additional priorities)	• Black Swamp, Reedy Lagoon, Little Gunbower Creek complex, Little Reedy wetland complex top-up during autumn/winter 2024	• N/A		
Gunbower Creek (targeting Cohuna Weir)				
Potential environmental watering – tier 1 (high priorities)1	• Spring/summer/autumn low flow • Autumn/winter low flow			
Potential environmental watering – tier 2 (additional priorities)	• N/A		• Summer/autumn/winter opportunistic fresh(es)	
Gunbower Creek (targeting Koondrook Weir)				
Potential environmental watering – tier 1 (high priorities)[1]	• Trigger-based spring/summer low flow		• Trigger-based spring/summer low flow • Year-round opportunistic fresh(es)	
Potential environmental watering – tier 2 (additional priorities)	• N/A			
Possible volume of water for the environment required to achieve objectives	• 94,700 ML (tier 1) • 9,000 ML (tier 2)	• 103,700 ML (tier 1)	• Up to 105,700 ML (tier 1) • 2,000 ML (tier 2)	
Priority carryover requirements for 2024-25	• 22,150 ML			

1 Tier 1 potential environmental watering at Gunbower Creek and Forest is not classified into tier 1a and 1b because the water available for use is shared across various systems, and it is not possible to reliably estimate supply.

5.2.4 Central Murray wetlands

System overview

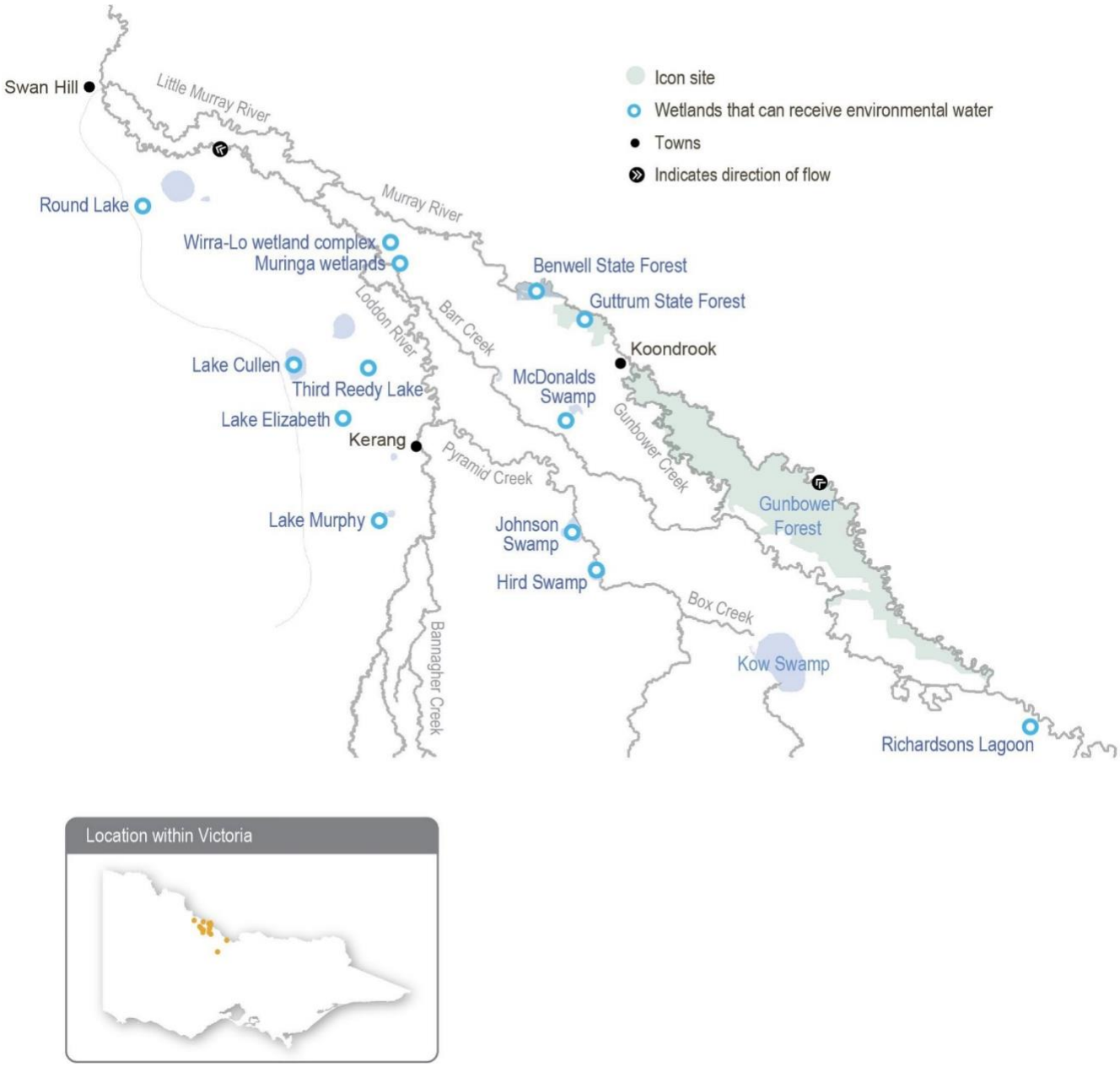
The central Murray wetlands are located on the lower Loddon River and Murray River floodplains (Figure 5.2.4). The wetland system includes Guttrum and Benwell state forests, Hird Swamp, Johnson Swamp, Kunat Kunat (Round Lake), Lake Cullen, Lake Elizabeth, Lake Murphy, McDonalds Swamp, Muringa wetlands, Richardson's Lagoon, Third Reedy Lake and the Wirra-Lo wetlands.

The central Murray wetlands are almost wholly contained within the Torrumbarry Irrigation Area and are all wetlands of regional or international significance. The area has experienced dramatic changes since European settlement with the construction of levees, roads and channels. Most of the wetlands are now cut off from natural flow paths and are rarely filled, except by large natural floods. They rely on water for the environment to maintain their ecological character and health.

Eleven of the central Murray wetlands can receive water for the environment from permanent infrastructure: Hird Swamp, Johnson Swamp, Kunat Kunat, Lake Cullen, Lake Elizabeth, Lake Murphy, McDonalds Swamp, Muringa wetlands, Richardson's Lagoon, Third Reedy Lake and the Wirra-Lo wetlands. Temporary pumps are currently used to deliver water for the environment from the Murray River to some semi-permanent wetlands in the Guttrum and Benwell forests when required. More permanent water delivery infrastructure for Guttrum and Benwell forests is proposed as part of the Victorian Murray Floodplain Restoration Project.

Return to start of section

Figure 5.2.4 The Central Murray wetlands



Environmental values

The central Murray wetlands support numerous listed threatened species ranging from vulnerable to critically endangered, including the Australasian bittern, Murray hardyhead, Australian painted snipe, growling grass frog and the southern purple spotted gudgeon, which was presumed extinct in Victoria until it was found at Third Reedy Lake in spring 2019. When the wetlands receive environmental water, they can attract prolific birdlife and provide feeding and breeding habitat for many threatened and endangered bird species (including the eastern great egret and white-bellied sea eagle) listed under legislation and international agreements. Lake Cullen, Hird Swamp, Third Reedy Lake and Johnson Swamp are internationally recognised under the Ramsar Convention, while the other wetlands in the central Murray system have bioregional significance.

Return to start of section

Environmental objectives in the Central Murray wetlands	
	Maintain populations of small-bodied native fish, including listed threatened (species such as Murray hardyhead)
	Maintain populations of the endangered growling grass frog Maintain populations of common native frogs (such as barking marsh frog, Peron's tree frog and spotted grass frog)
	Maintain populations of native turtles (such as the Murray River turtle and the common long-necked turtle)
	Restore and then maintain the health of streamside trees (such as river red gum and black box) Restore and then maintain mudflat vegetation communities (such as tall marsh, herblands, rushes and sedges) Restore and then maintain native aquatic vegetation species (such as tassel, foxtail stonewort, milfoil and pondweed) Reduce the extent and density of invasive plant species Support a mosaic of wetland plant communities across the region
	Provide resting, feeding and breeding habitat for a variety of waterbird feeding guilds, including threatened species (such as Caspian tern, Australasian bittern, little bittern and brolga)
	Increase the diversity and biomass of waterbugs

Traditional Owner cultural values and uses

The wetlands and surrounding land in the central Murray region hold great significance for the Traditional Owners: the Barapa Barapa, Wamba Wemba and Yorta Yorta peoples. Their traditional knowledge is a living culture evident throughout the landscape in tree markings, significant cultural sites and cultural tools for cultural practices. The rivers and floodplains are a food and fibre source and contain many sites of significance (such as campsites and meeting places).

Environmental watering supports values including native fish, waterbirds and turtles, and it promotes the growth of culturally important plants that provide food, medicine and weaving materials for Traditional Owner groups. The presence of water itself can be a cultural value, as well as the quality of the water: healthy water promotes a healthy Country.

In early 2023, Barapa Barapa and Wamba Wemba Traditional Owners joined North Central CMA staff on Country to reflect on environmental water management in the central Murray wetlands, including plans for 2023-24. This included a day in Guttrum Forest and another day visiting Johnson Swamp, McDonalds Swamp, Third Reedy Lake and Lake Cullen. Topics of discussion included:

- the impacts of the 2022-23 floods on the wetlands, both positive (such as healthy fringing trees and lignum) and negative (such as carp and hypoxic blackwater)
- the proposed schedule for wetland watering and wetland drying in 2023-24; Barapa Barapa and Wamba Wemba Traditional Owners supported the plans for 2023-24 and noted that floods had provided an important ecological reset for many of the wetlands, and the proposed watering schedule will build on this
- Aboriginal Waterways Assessments (AWAs) and the aspiration for Barapa Barapa and Wamba Wemba Traditional Owners to undertake AWAs at several of the central Murray wetlands in the future during wet and dry phases
- the benefits that water for the environment has delivered to the wetlands over the years. Traditional Owners said that water delivery to Johnson Swamp, combined with tall marsh and lignum slashing, has created a more open-water environment that has attracted waterbirds. Similarly, Traditional Owners involved in tree planting at McDonalds Swamp in 2018 were impressed by the growth of the river red gums and the expansion of lignum and cane grass due to environmental watering
- concerns about the impact of duck hunting on waterbird numbers at several central Murray wetlands and concerns about rabbits harming culturally significant locations at Lake Cullen
- Guttrum Forest (particularly Reed Bed Swamp) and the need to dry it out in the coming months to control carp and allow the removal of protective nets that have helped new vegetation establish. The plan is to deliver environmental water to Reed Bed Swamp in 2023-24 to build on the positive outcomes from previous years (such as the growth of aquatic vegetation and tree canopies).

Return to start of section

Increasing the involvement of Traditional Owners in environmental water management and progressing opportunities towards self-determination in the environmental watering program is a core commitment of the VEWH and its agency partners. This is reinforced by a range of legislation and policy commitments, including the *Water Act 1989*, the *Victorian Aboriginal Affairs Framework*, the 2016 *Water for Victoria*, the *Water is Life: Traditional Owner Access to Water Roadmap 2022*, and in some cases, agreements under the *Traditional Owner Settlement Act 2010*.

Where Traditional Owners are more deeply involved in the planning and/or delivery of environmental flows for a particular site, their contribution is acknowledged in Table 5.2.10 with an icon. The use of this icon is not intended to indicate that these activities are meeting all the needs of Traditional Owners, but is incorporated in the spirit of valuing that contribution.

Watering planned and/or delivered in partnership with Traditional Owners to support cultural values and uses

Barapa Barapa and Wamba Wemba input to watering actions for Guttrum Forest in 2023-24

Delivery of water for the environment to Guttrum Forest during 2023-24 has been planned in conjunction with the Barapa Barapa and Wamba Wemba peoples, for whom the wetlands and surrounding forest are places of high cultural significance. Traditional Owners are an important part of Guttrum Forest planning and management and have been directly involved in the delivery of environmental flows to Reed Bed Swamp in 2019-20 and 2021-22. In 2022-23, no environmental water was delivered to Reed Bed Swamp due to large-scale natural flooding.

Barapa Barapa and Wamba Wemba collaborate with waterway managers to ensure that during watering events, their cultural heritage is protected and that the hydrological needs of important cultural values (such as food and medicinal plant species, scar trees and ring trees) are supported through the timing and duration of planned watering actions to the forest.

Table 5.2.9 outlines the values and uses considered in the planning for and management of water for the environment at Guttrum Forest in 2023-24.

Table 5.2.9 Barapa Barapa and Wamba Wemba cultural values and uses at Guttrum Forest

Value/use	Considerations
Food, fibre and medicinal plants	• A winter/spring fill followed by top-ups, as required, will ensure that the duration of wetting will be long enough to support aquatic vegetation during its optimal growth period. Allowing the wetland to draw down before summer will also promote cultural plants on the mudflats in these areas. With annual watering in recent years and natural events like the October 2022 flood, harvesting cultural plants is likely to be possible within a matter of years.
Cultural heritage	• Watering of Reed Bed Swamp supports fringing large old trees, including a couple of ring trees and scar trees. The condition of these trees was seen to improve following previous watering.
Spiritual wellbeing	• The improvement in the condition of the wetland and the presence of water and moisture contribute to a sense of spiritual wellbeing.
Sharing cultural knowledge	• The Traditional Owners provide support and advice about what ecological values to target: that is, they provide information about what the wetland used to look like and what values it previously supported. • Traditional Owners have been present during the set-up of infrastructure and have been able to advise about avoiding impacts on their cultural heritage.
Employment opportunities	• Traditional Owners want to become more involved in the management of their Country through increased employment opportunities (such as ecological and cultural monitoring). This has occurred as part of previous watering of Reed Bed Swamp.
Cultural landscape	• Maintaining the open-water habitat and mudflats underneath will be difficult if the river red gum saplings that germinated in recent floods are not removed. This is important for maintaining the cultural landscape and access to food and medicinal resources.
Cultural practice	• In 2019-20 when water for the environment was first delivered in Guttrum Forest, a smoking ceremony and celebration were held to welcome the water back to the wetland. The Traditional Owners have indicated that this should be a regular activity each year when water is delivered, as it is something that their ancestors would have done when the floodwaters arrived and would represent a restoration of an important cultural practice. • Another priority in 2023-24 is to provide more opportunities for women to return to Country and undertake cultural practices such as weaving, emu egg carving and discussion of the wetlands' health as it relates to women's business.

Return to start of section

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.2.10, the North Central CMA considered how environmental flows could support values and uses, including:

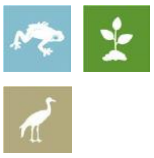
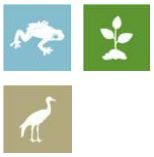
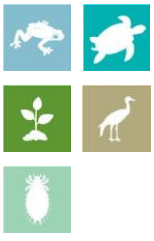
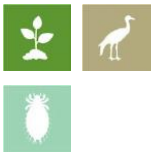
- waterway recreation (such as canoeing, fishing, kayaking, swimming and water sports)
- waterway recreation and amenity (such as birdwatching, duck hunting, camping, cycling, running and walking)
- community events and tourism (such as visitation during the hunting and fishing seasons, Breakfast with the Birds events [hosted annually by the North Central CMA] and supporting Aboriginal cultural heritage and history-based tours)
- socioeconomic benefits (such as ecosystem services like groundwater recharge, flood mitigation, nutrient treatment, carbon storage and stock and domestic uses).

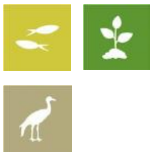
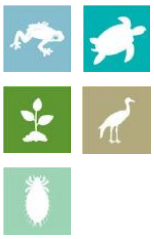
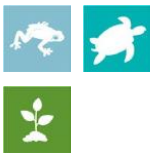
Scope of environmental watering

The term 'environmental watering' refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.2.10 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.2.10 Potential environmental watering actions, expected watering effects and associated environmental objectives for the central Murray wetlands

Potential environmental watering action	Expected watering effects	Environmental objectives
Guttrum Forest (fill in winter/spring, top-ups as required in spring/ summer)	• Wet the fringing adult river red gums to support their growth and drown river red gum saplings within the wetland bed to maintain open-water habitat • Promote the growth and re-establishment of aquatic vegetation and tall marsh vegetation at the fringe of the wetland • Maintain the depth of the wetland to support frogs and waterbird feeding and breeding	
Guttrum Forest (partial fill in autumn/winter 2024)	• Inundate existing adult river red gums to support their growth, and drown river red gum saplings in the open-water habitat • Increase the water depth and extent to trigger wetland plants to germinate in late winter and when follow-up watering is provided in early spring 2024 • Provide feeding and refuge habitat for waterbirds and frogs	
Hird Swamp (partial fill in autumn)	• Drown terrestrial weeds to limit their growth and reduce their extent • Promote the germination and establishment of aquatic vegetation • Inundate the wetland fringe to provide habitat for waterbirds, frogs and turtles and provide conditions suitable for macroinvertebrates that are food for waterbirds	
Kunat Kunat (fill in spring, top-ups as required)	• Maintain salinity within 15,000-80,000 EC and water depth to support suitable habitat and breeding conditions for Murray hardyhead • Restore and maintain submerged aquatic plants • Maintain the water depth to provide permanent feeding, foraging and refuge habitat for waterbirds	
Lake Cullen (top-ups as required)	• Provide feeding, breeding and refuge habitat for waterbirds • Inundate the wetland to provide suitable conditions for submerged plants • Provide suitable conditions for macroinvertebrates to grow and complete their life cycles	

Potential environmental watering action	Expected watering effects	Environmental objectives
Lake Elizabeth (fill in spring, top-ups as required)	• Maintain salinity within 15,000-80,000 EC and water depth to support suitable habitat and breeding conditions for Murray hardyhead • Restore and maintain submerged aquatic plants • Maintain the water depth to provide permanent feeding, foraging and refuge habitat for waterbirds	
McDonalds Swamp (partial fill in autumn)	• Drown terrestrial weeds to limit their growth and reduce their extent • Promote the germination and establishment of aquatic vegetation • Inundate the wetland body and fringe to provide habitat for waterbirds, frogs and turtles and provide conditions suitable for macroinvertebrates that are food for waterbirds, frogs and turtles • Support the growth of planted river red gums and other aquatic and herbland vegetation	
Muringa wetlands (fill in spring or autumn, top-ups as required)	• Support the growth of aquatic and semi-aquatic plants • Increase the area of habitat and grow zooplankton and waterbug communities to provide food resources for frogs and waterbirds	
Wirra-Lo wetlands[1]: Brolga Swamp (fill in winter/spring, top-ups as required)	• Inundate established aquatic vegetation and maintain the large population of growling grass frogs	
Wirra-Lo wetlands: Bunyip Swamp East (fill in winter/spring, top-ups as required)	• Inundate established reed beds to stimulate their growth to create feeding and nesting habitat for Australasian bittern	
Wirra-Lo wetlands: Cattleyard Creek (fill in winter/spring, top-ups as required)	• Inundate river red gum woodland trees to promote their growth and improve their condition • Promote the germination and establishment of aquatic vegetation	
Wirra-Lo wetlands: Duck Creek North (fill in winter/spring, top-ups as required)	• Inundate river red gum woodland trees to promote their growth and improve their condition • Inundate the aquatic and herbland vegetation to promote its growth and increase its extent • Maintain open-water and associated mudflat habitats for waterbirds to feed and breed	
Wirra-Lo wetlands: Emu Creek (fill in winter/ spring, top-ups as required)	• Inundate black box and lignum along the creekline to improve their condition • Promote the germination and growth of aquatic vegetation in the deeper sections of the wetland to support frogs and freshwater turtles	
Wirra-Lo wetlands: Red Gum Swamp (fill in winter/spring, top-ups as required)	• Inundate established river red gum trees to promote their growth and maintain their condition • Inundate habitat to provide feeding and breeding opportunities for frogs, waterbirds and turtles	

1 Watering of the various wetlands within the Wirra-lo complex occurs via Raniformis Creek, which is likely to benefit the small-bodied native fish that live in the creek.

Return to start of section

Scenario planning

Table 5.2.11 outlines potential environmental watering and expected water use in a range of planning scenarios.

The widespread floods in spring 2022 filled most wetlands across the central Murray floodplain, triggering widespread waterbird, frog and fish (including carp) breeding. The floods also improved the condition of established black box, river red gum and lignum communities, but the combination of prolonged deep inundation, the high abundance of carp and poor water quality – water with high turbidity and low oxygen – contributed to poorer-than-expected responses by submerged aquatic vegetation at some sites.

Environmental watering across the central Murray wetlands in 2023-24 will primarily aim to maintain habitat for endangered species, provide foraging habitat for juvenile and subadult waterbirds, reduce the biomass of carp where possible and improve submerged aquatic vegetation communities at sites that had poorer-than-expected responses to the 2022 floods. Providing foraging and resting habitat for waterbirds near recent breeding sites is particularly important because the high mortality of juvenile and subadult waterbirds is the likely reason why large breeding events during other large floods have not significantly grown waterbird populations across the Murray-Darling Basin. Potential watering actions across the central Murray wetlands in 2023-24 aim to create a mosaic of available habitats across the region, with some wetlands drawing down to provide shallow foraging habitat, and then dry-phase ecological processes and others being topped up to maintain deep-water habitat in the landscape. The proposed watering actions are consistent across all potential planning scenarios in 2023-24 to support this strategy, although the volume required to achieve them will be greater in the drier planning scenarios than in the average and wet scenarios.

Watering actions proposed for Kunat Kunat and Lake Elizabeth are needed every year to maintain permanent habitat for the endangered Murray hardyhead. Some wetlands within the Wirra-Lo wetlands complex also require water every year to support endangered species (such as Australasian bittern and growling grass frog) and to maintain red gum and improve aquatic vegetation communities.

Lake Cullen is a large, internationally significant wetland that is known to support very large numbers of waterbirds. Top-ups of water for the environment will be delivered to maintain habitat around the tall marsh at the northern end of the lake to encourage further bird breeding.

Many wetlands across the landscape are expected to dry out over the next 12 to 24 months. These wetlands will provide important foraging habitat for waterbirds during their drawdown phase, and drying for any duration will eliminate carp. However, extended drying for six to 24 months is needed in some wetlands to allow native vegetation (such as lake-bed herbland communities) to germinate and set seed and to support soil health as well as carbon and nutrient cycles. Wetlands that have previously received water for the environment and that will be allowed to partially or fully draw down during 2023-24 include Lake Murphy, Third Reedy Lake, Johnson Swamp and Richardson's Lagoon. Many other highly productive wetlands in the region that filled in spring 2022 and are not within the environmental watering program (such as Bael Bael, Koorangie Marshes and Lake Tutchewop) will also begin to dry.

Muringa wetlands, Hird Swamp and McDonalds Swamp are planned to have a drying phase in 2023, ahead of partial or complete fills. Muringa wetlands need to be watered in spring or autumn to help establish the native vegetation that was planted in recent years, but the wetland will be allowed to draw down first to eliminate carp. Hird Swamp will also be allowed to dry to reduce carp and then partially filled in autumn to improve the condition of aquatic vegetation that suffered during the 2022 floods. A partial fill is also planned for McDonalds Swamp in autumn 2024 under drought to average planning scenarios to provide fresh foraging habitat for waterbirds. Watering McDonalds Swamp is a lower priority in the wet planning scenario because other wetlands in the region, including Bael Bael, Koorangie Marshes and Lake Tutchewop, although highly productive wetlands, are outside the environmental watering program and are likely to retain enough water to provide sufficient waterbird habitat across the region.

In Guttrum Forest, Reed Bed Swamp needs to dry out to reduce carp biomass and allow native mudflat vegetation communities to germinate. The swamp is relatively shallow and dries relatively quickly. If the swamp dries early enough in the year, it will be filled in winter-spring to improve the condition of aquatic vegetation that suffered during the 2022 floods. It will be allowed to dry again over summer 2023-24 and then partially filled in autumn-winter 2024 as part of a longer (six-month) watering action. The Traditional Owners prefer a longer watering action, and it will aim to improve outcomes for large old river red gums by replenishing soil moisture around the wetland fringe and preventing river red gums from becoming established in the open wetland.

Priority carryover for 2024-25 of 7,500 ML is essential to maintain water at sites for endangered fish and frogs and to provide a mosaic of refuge wetlands across the region.

Return to start of section

Table 5.2.11 Potential environmental watering for the Central Murray wetlands in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• Catchment run-off and natural flow into the wetlands are highly unlikely	• Catchment run-off and natural flow into the wetlands are unlikely	• Catchment run-off and natural flow into the wetlands are possible, particularly in winter/spring	• Catchment run-off and natural flow into the wetlands are likely, with potential flooding in some wetlands, particularly in winter/spring
Potential environmental watering – tier 1 (high priorities)	• Guttrum Forest (winter/spring fill and top-ups) • Guttrum Forest (autumn/winter partial fill) • Hird Swamp • Kunat Kunat • Lake Cullen • Lake Elizabeth • McDonalds Swamp • Muringa wetlands • Wirra-lo wetlands	• Guttrum Forest (winter/spring fill and top-ups) • Guttrum Forest (autumn/winter partial fill) • Hird Swamp • Kunat Kunat • Lake Cullen • Lake Elizabeth • McDonalds Swamp • Muringa wetlands • Wirra-lo wetlands	• Guttrum Forest (winter/spring fill and top-ups) • Guttrum Forest (autumn/winter partial fill) • Hird Swamp • Kunat Kunat • Lake Cullen • Lake Elizabeth • McDonalds Swamp • Muringa wetlands • Wirra-lo wetlands	• Guttrum Forest (winter/spring fill and top-ups) • Guttrum Forest (autumn/winter partial fill) • Hird Swamp • Kunat Kunat • Lake Cullen • Lake Elizabeth • Muringa wetlands • Wirra-lo wetlands
Potential environmental watering – tier 2 (additional priorities)	• N/A	• N/A	• N/A	• McDonalds Swamp
Possible volume of water for the environment required to achieve objectives	• 12,370 ML	• 10,510 ML	• 10,210 ML	• 8,410 ML • 400 ML (tier 2)
Priority carryover requirements for 2024-25	• 7,400 ML			

5.2.5 Hattah Lakes

System overview

The Hattah-Kulkyne National Park is situated in north-west Victoria, adjacent to the Murray River (Figure 5.2.4). The national park contains a complex of more than 20 semi-permanent freshwater lakes known collectively as the Hattah Lakes.

The ecology of the Hattah Lakes and the surrounding floodplain is strongly influenced by the flooding regimes of the Murray River. The system fills when there is high flow in the Murray River, and some lakes hold water for several years after floods recede. Regulation of the Murray River has significantly reduced the frequency and duration of small to medium-sized natural floods in the Hattah Lakes system. Over time, this has degraded vegetation communities and reduced the diversity and abundance of animals that use the vegetation and wetlands for habitat and food.

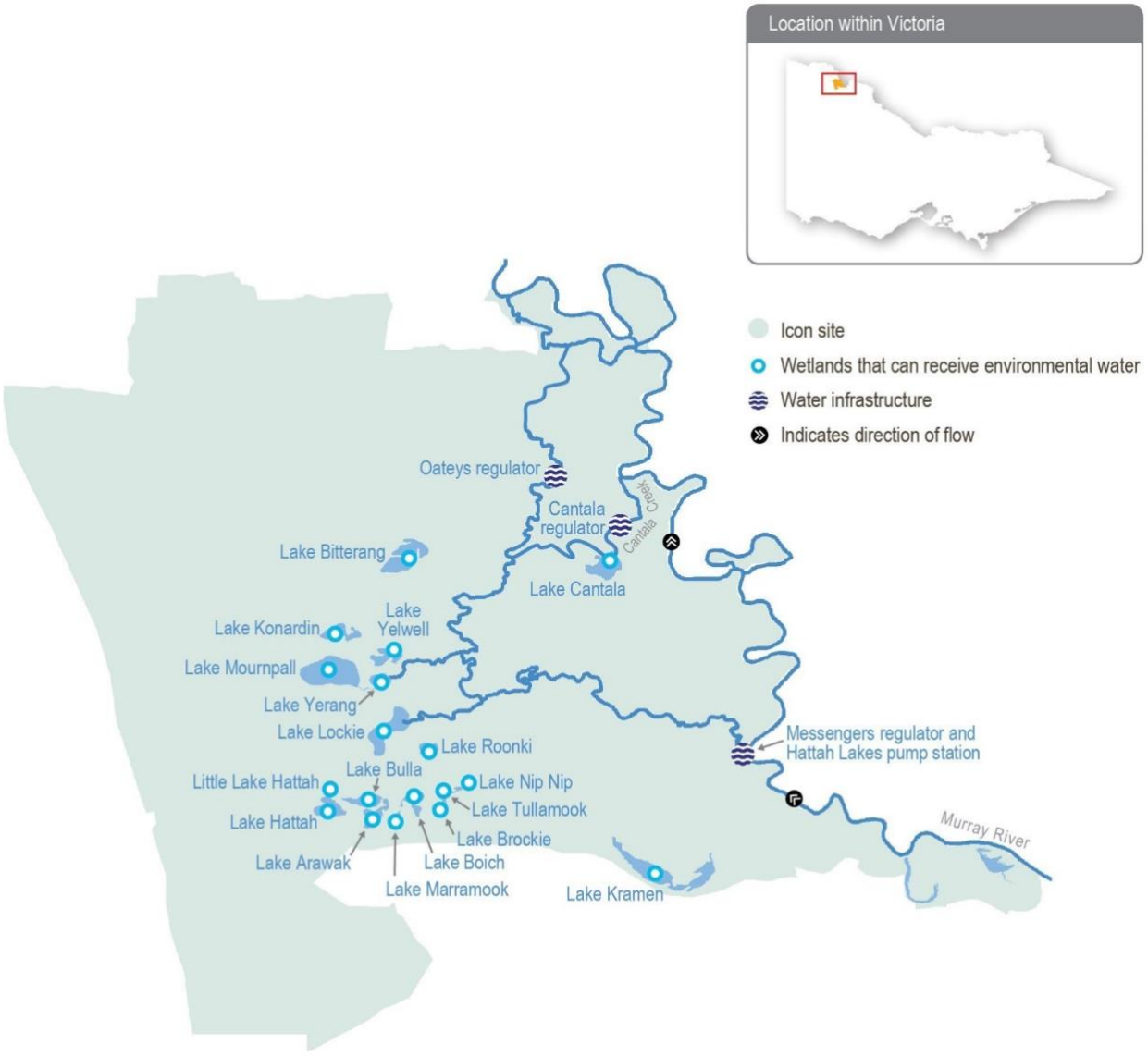
The Hattah Lakes complex can be broadly divided into the southern Hattah Lakes, which contain permanent to semi-permanent wetlands, and the higher-elevation northern Hattah Lakes, which are mostly episodic wetlands.

The Messenger, Oateys and Cantala regulators allow water to flow between the Murray River and the Hattah Lakes. When the flow in the Murray River is about 26,000 ML per day, water begins to flow through Messengers regulator into Chalka Creek and through the Hattah Lakes complex. A permanent pump station can deliver up to 1,000 ML per day to the southern Hattah Lakes through Chalka Creek. The regulators and pump station are used in combination with several small constructed levees to deliver a pattern of flooding to the lakes system that is recommended to improve environmental outcomes. Lake Kramen is in the south-east area of Hattah-Kulkyne National Park and is disconnected from the main Hattah Lakes complex. The Hattah

Lakes pump station can deliver up to 145 ML per day to Lake Kramen. New infrastructure proposed under the Victorian Murray Floodplain Restoration Project will allow water to reach additional wetlands and floodplain areas in the northern Hattah Lakes.

Return to start of section

Figure 5.2.5 Hattah Lakes



Return to start of section

Environmental values

Hattah Lakes is home to a diverse range of flood-dependent vegetation that changes with the topography of the landscape. Vegetation types range from wetland communities in low-lying areas that require almost annual flooding to lignum and black box communities situated higher on the floodplain that only need flooding once every four to five years (on average).

A combination of natural flooding and the delivery of environmental flows since 2010 has improved tree canopy health and recruitment of black box and river red gum communities throughout the Hattah Lakes. Woodland birds, including the endangered regent parrot, have benefitted from improved tree health.

Hattah Lakes provides important waterbird breeding sites in an arid landscape. A total of 34 species of waterbirds are known to breed at the lakes when conditions are suitable. Another six species of waterbirds breed in the surrounding floodplain.

Wetland drought refuge sites are limited in the region, making the Hattah Lakes critically important for water-dependent flora, waterbirds and terrestrial animals during dry periods.

The Hattah Lakes support large-bodied native fish species (such as golden perch) and small-bodied wetland species (such as carp gudgeon). Fish move between the lakes and the Murray River when the flow is suitable. They also persist in wetlands that retain water in the Hattah Lakes during dry years before re-dispersing during floods.

Environmental objectives in the Hattah Lakes
Maintain populations of small-bodied and large-bodied native fish at the Hattah Lakes
By 2030, improve the function of water-dependent ecosystems by improving productivity linkages between the river and floodplain/wetland habitats
By 2030, improve the richness of species and the abundance of native water-dependent floodplain and wetland aquatic vegetation By 2030, maintain the extent and improve the condition of river red gum, black box and lignum, compared to 2006 baseline levels
Maintain the regional waterbird population by providing conditions for breeding and fledging at least three times every 10 years Maintain the regional waterbird population by providing refuge during droughts
Maintain a variety of freshwater ecosystem types within the Hattah Lakes icon site, including semi-permanent lakes, persistent temporary wetlands, floodplain woodlands, shrublands and episodic wetlands

Traditional Owner cultural values and uses

The Hattah Lakes system is part of a highly sensitive region for Aboriginal cultural values and lies on the border of two documented 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.

More than 1,000 Aboriginal archaeological sites at the Hattah Lakes are registered on the Aboriginal Cultural Heritage Register and Information System, with the freshwater lakes and wetlands providing focal points for trade and cultural exchanges among the region's Traditional Owners. Local Aboriginal communities maintain strong connections to the land and its resources, such as native species used for food and medicine.

In early 2023, the Mallee CMA met with representatives of Latji Latji, Nyeri Nyeri, Dadi Dadi Weki Weki, Wadi Wadi Land and Water, Culpra Millee, Munatunga and Murray Valley Aboriginal Corporation to discuss the history of inundations and delivery to the lakes, as well as environmental water planning for 2023-24 and beyond. Groups invited to discussions included Latji Latji Mumthelang, Tati Tati Kaiejin, Tati Tati Land and Water and Gilby.

Return to start of section

Discussions covered the planning of water for the environment and Traditional Owners' interests and aspirations for the Hattah Lakes region, including:

- the history of inundation and deliveries, including the environmental outcomes of previous deliveries and recent natural flooding
- the impacts of recent natural flooding on environmental and cultural values and ways that Traditional Owners can be involved in viewing and assessing these impacts
- areas where environmental flows are planned for 2023-24, the quantity of water to be delivered and the planned environmental outcomes from it
- projects planned or underway, including the northern Hattah Lakes Victorian Murray Floodplain Restoration Project and ecological monitoring being undertaken across Hattah Lakes through the Living Murray program
- the spiritual importance of water in the landscape: water connects people to the landscape and culture.

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.2.12, the Mallee CMA considered how environmental flows could support values and uses, including:

- water-based recreation (such as fishing, kayaking and swimming)
- riverside recreation and amenity (such as birdwatching, camping, photography and walking)
- community events and tourism (educational opportunities, including bushwalking, birdwatching and bug hunting; local school education programs; Melbourne-based schools' educational excursions; and tours involving kayaking, bike riding and camping)
- socioeconomic benefits (such as commercial beekeepers who rest bees away from horticultural orchards in native flowering trees around the lake, multiple ecotourism operators who benefit directly when the lakes contain water, social wellbeing from connecting with nature, and social gatherings).

Scope of environmental watering

The term 'environmental watering' refers to the active delivery of held environmental water to support specific environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.2.12 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.2.12 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Hattah Lakes

Potential environmental watering action[1]	Expected watering effects	Environmental objectives
Southern Hattah Lakes (top-ups of selected wetlands to 42.5 m AHD during autumn)	• Stimulate the growth and improve the condition of river red gums fringing wetlands. • Provide feeding habitat for waterbirds • Stimulate new growth of aquatic vegetation • Inundate dry areas of wetlands to release carbon and nutrients to increase food web productivity • Provide spawning and recruitment habitat for small-bodied native fish and nursery habitat for large-bodied native fish (such as golden perch) • Inundate a variety of wetland types at different elevations across the Hattah Lakes to increase habitat diversity	

1 In consultation with the VEWH, the Mallee CMA and Parks Victoria, the Hattah Lakes pump station may be operated at any time of year by Goulburn-Murray Water for testing, following pump maintenance and repairs. Water held by the Living Murray Program will be used if testing is required.

Return to start of section

Scenario planning

Table 5.2.13 outlines potential environmental watering and expected water use in a range of planning scenarios.

The floods in spring 2022 were the largest in the Mallee since 1956, and they inundated the entire Hattah Lakes and surrounding floodplain. A drawdown period of 12 to 18 months across the Hattah Lakes system will allow native plants within lake-bed herbland communities to grow on exposed soils as water recedes and provide foraging habitat for wading shorebirds.

The northern Hattah Lakes Victorian Murray Floodplain Restoration Project is currently going through an environmental approvals process. If approved, the new infrastructure will likely be commissioned in 2024-25. During commissioning, about 100 GL of environmental water will be pumped from the Hattah pump station over a three-to-four-month period. It is operationally important to retain water in the semipermanent wetlands of southern Hattah Lakes in the lead-up to commissioning, so deliveries in 2024-25 can efficiently pass through the southern system and fill the northern Hattah Lakes. This requirement has influenced planned watering actions at Hattah Lakes for 2023-24.

No deliveries of water for the environment are planned at Hattah Lakes in the first half of 2023-24. About 10,000 ML of water for the environment may be used in autumn 2024 in the dry and average planning scenarios to top up the semi-permanent wetlands within the southern Hattah Lakes system to 42.5 m AHD. These top-ups will be timed to occur at the end of the recommended drawdown period to release carbon and nutrients to stimulate food production for fish and birds and to prime the system ahead of larger deliveries planned for 2024-25.

In the wet planning scenario, large-scale natural floods are expected to inundate large parts of the Hattah Lakes and floodplain. This may happen at any time of year but is most likely during winter or spring.

No active watering is proposed in the drought planning scenario. Water from the 2022 floods is likely to persist in some of the Hattah Lakes throughout 2023-24 without additional top-ups, and will provide regional refuge habitat for waterbirds and for some fish that moved into the Hattah Lakes during the floods. There is little value in trying to deliver extra water in the drought planning scenario to trigger plant and animal growth and reproduction because there may not be sufficient resources within the landscape to sustain new life.

Table 5.2.13 Potential environmental watering for the Hattah Lakes system in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	• Year-round low flow in the Murray River and no natural inflow to the Hattah Lakes; substantial wetland drying will occur	• Rare high-flow events in the Murray River and no natural inflow to the Hattah Lakes	• Short periods of high flow in the Murray River with minor spills from storages, most likely in late winter/ spring, providing minor natural inflow to the Hattah Lakes	• Lengthy periods of high flow in the Murray River with major spills from storages resulting in widespread inundation of the Hattah Lakes and floodplain
Potential environmental watering – tier 1 (high priorities)	• N/A	• Southern Hattah Lakes autumn top-up to 42.5 m AHD targeting semi-permanent wetlands		• All structures will be opened to allow natural flow to fill Hattah Lakes and floodplain
Possible volume of water for the environment required to achieve objectives	• N/A	• 10,000 ML		• 0 ML
Priority carryover requirements for 2024-25	• 100 GL for extensive floodplain watering of southern and northern Hattah Lakes			

Return to start of section

5.2.6 Lower Murray wetlands

System overview

The lower Murray wetlands are dispersed across the Murray River floodplain between Swan Hill and the South Australian border. The system includes a myriad of interconnected creeks, wetlands and floodplains that are ecologically important and reflect the natural character and attributes of the floodplain. While there are hundreds of wetlands across the lower Murray region, only 54 of them have received water for the environment to date.

Regulation and diversion of the Murray River flow have substantially reduced the frequency and duration of the high river flow that would naturally water the lower Murray wetlands. This change to the water regime has been exacerbated by climate change and has reduced the variety and condition of environmental values associated with billabongs and other floodplain habitats.

Water for the environment can be delivered to some wetlands in the region through direct pumping from the Murray River and/ or the use of irrigation supply infrastructure. Most wetlands that receive environmental flows can be managed independently of each other.

Figure 5.2.6 The lower Murray wetlands system

Return to start of section

Environmental values

Environmental objectives in the lower Murray wetlands	
	Increase the populations of Murray hardyhead in permanent wetlands where they are known to persist Maintain populations of other native fish in permanent wetlands
	Maintain populations of native frogs, including the endangered growling grass frog
	Promote carbon and nutrient cycling to enable wetland processes for food webs
	Increase the diversity, extent and abundance of wetland plants Improve the condition of river red gums, black box and lignum communities
	Provide feeding and breeding habitat for a range of waterbird species, including threatened and migratory species and colonial nesting species (such as egrets)

Traditional Owner cultural values and uses

Watering of the lower Murray wetlands supports cultural values such as traditional food sources and medicines and important species, and it provides opportunities for teaching, learning and storytelling.

The Mallee CMA discussed the proposed 2023-24 watering of the lower Murray wetlands with the First People of the Millewa-Mallee Aboriginal Corporation, Latji Latji Mumthelang, Tati Tati Land and Water, Wadi Wadi Land and Water, Murray Valley Aboriginal Corporation, Gilby, Dadi Dadi Weki Weki, Culpra Millee and Munatunga Elders. Tati Tati Kaiejin was invited to discussions.

Discussions covered a range of options for the delivery of environmental flows in 2023-2024 and what the traditional ecological needs are in the current climate. Feedback was positive, with groups in discussions agreeing to the needs and reasoning behind environmental watering. Drawdown and drying were strongly supported in many cases. Understanding the environmental responses to the recent flooding and identifying and protecting cultural heritage were key topics for discussion. A common foundation of all groups was the importance of water in wetlands for their cultural spirituality and connection to Country.

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.2.14, the Mallee CMA considered how environmental flows could support values and uses, including:

- water-based recreation (such as canoeing, fishing and kayaking)
- riverside recreation and amenity (such as bike riding, birdwatching, bushwalking, camping, geocaching, photography and running)
- community events and tourism (such as day trips and sightseeing; education programs for school, TAFE and university students; citizen science projects about birds, frogs and bats; and sporting events)
- socioeconomic benefits (such as economic benefits for businesses in the accommodation, beekeeping, food and beverage, ecotourism, hospitality and retail sectors; creating a focal point for socialising; and providing natural, green spaces for the local community).

Scope of environmental watering

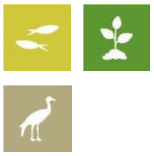
The term ‘environmental watering’ refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, ‘environmental watering’ is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

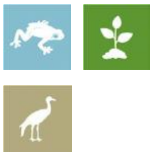
Table 5.2.14 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Return to start of section

Table 5.2.14 Potential environmental watering actions, expected watering effects and associated environmental objectives for the lower Murray wetlands

Potential environmental watering action	Expected watering effects	Environmental objectives
Brickworks Billabong (fill in spring/summer, top-ups as required over summer/autumn)	• Maintain water levels (the target water level is between 30.8 m AHD and 31.6 m AHD) to inundate ruppia beds, provide nursery habitat for Murray hardyhead and provide high levels of aquatic productivity • Maintain water quality suitable for Murray hardyhead • Provide shallow-water habitat and exposed mudflats to support foraging and resting waterbirds, including migratory waterbirds	

Catfish Billabong (fill in winter/spring)	• Fill to 33.5 m AHD to inundate fringing woodland vegetation to improve condition and recruitment
	• Allow water level to draw down over summer and autumn to:
	  • promote the growth of a range of aquatic macrophytes that favour different water depth and inundation patterns
	  • provide suitable foraging conditions for wading shorebirds
	• Maintain water levels above 30.8 m AHD to maintain permanent habitat for large-bodied and small-bodied native fish
		

Koorlong Lake (top-up in spring, then as required)	• Increase and maintain the water level (the target water level is between 36.7 m AHD and 38.0 m AHD) to support the growth of saline aquatic vegetation, including ruppia, to provide nursery habitat for Murray hardyhead and provide high levels of aquatic productivity • Maintain water levels within a 1.3 m range to provide feeding resources for shorebirds and to maintain the Murray hardyhead population	
Lake Hawthorn (top-ups in spring, then as required over summer/ autumn)	• Maintain water level between 33 m AHD and 33.3 m AHD to encourage the germination and growth of saline aquatic vegetation, including ruppia, and provide mudflat and shallow-water feeding habitat for shorebirds	
Robertson Wetland (fill in spring)	• Wet fringing river red gum, black box, lignum and vegetation communities (the target water level is 28.4-28.8 m AHD) to improve their condition • Inundate cane grass beds to improve their condition and resilience • Provide a range of open-water, shallow-water and inundated lignum habitat to provide waterbird feeding opportunities	
Wakool Creek (fill in spring)	• Inundate and wet outer fringing lignum and vegetation communities (the target water level is 55.4 m AHD) to improve their condition • Inundate habitat to provide feeding and breeding opportunities for frogs and waterbirds	

Scenario planning

Table 5.2.15 outlines potential environmental watering and expected water use in a range of planning scenarios.

Brickworks Billabong, Catfish Billabong, Koorlong Lake and Lake Hawthorn are priorities for watering in 2023-24 in all planning scenarios. Koorlong Lake supports an endangered population of Murray hardyhead, and it requires top-ups each year to ensure salinity levels are maintained within an acceptable range to support submerged vegetation that provides habitat for

the fish. Brickworks Billabong is being managed with a view of returning Murray hardyhead to it in the future. A population of Murray hardyhead that was translocated to Lake Hawthorn in 2018 has not persisted, but the site is prioritised to receive water in all planning scenarios because it provides saline habitat and feeding resources for shorebirds. Catfish Billabong is a new site that supports populations of native fish and wading shorebirds. Construction of a new regulator at Catfish Billabong was delayed in 2022-23 due to floods in the Murray River. Watering is prioritised at this site in all planning scenarios to test the capacity of the new infrastructure to achieve the recommended watering regime.

Wakool Creek and Robertson Wetland are included in the lower Murray wetlands program under dry, average and wet planning scenarios. Both sites were naturally filled during floods in 2022, and the condition of vegetation surrounding the wetlands has improved. However, water drains and evaporates quickly from each site, and a second consecutive year of watering is recommended to enhance the regeneration of black box trees so they can sustain future dry periods. Temporary pumps will be used to deliver water and achieve the objectives in the dry and average planning scenarios. If conditions are wet, it is likely that a high flow in the Murray River will naturally fill both sites.

Return to start of section

All other sites in the lower Murray wetlands will be allowed to draw down during 2023-24, unless they are naturally flooded, to support dry-phase ecosystem processes in accordance with recommendations in their management plans.

It is a high priority to carry over 1,900 ML into 2024-25 for Brickworks Billabong and Koorlong Lake. These sites need top-ups each year to sustain threatened fish populations, as does Lake Hawthorn, which requires top-ups each year to maintain suitable conditions for waterbirds and aquatic vegetation.

Table 5.2.15 Potential environmental watering for the lower Murray wetlands in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• Natural flow in the Murray River is too low to connect to wetlands • Very low rainfall year-round and extremely hot and dry conditions in summer/autumn cause substantial wetland drying • Wetlands rely on the delivery of water for the environment	• Short periods of high flow in the Murray River are possible, but overbank flow to wetlands is unlikely; low rainfall and very warm summer/autumn • Wetlands rely on the delivery of water for the environment	• Sustained periods of high flow in the Murray River in late winter and early spring may wet some low-lying wetlands, but most wetlands will rely on water for the environment • Local rainfall may be high and provide run-off to some wetlands	• Lengthy periods of high flow and floods with major spills from storages, resulting in widespread wetting of the floodplain and most wetlands • Some reliance on water for the environment to achieve target water levels • Local rainfall may be high and will provide run-off to most wetlands
Potential environmental watering – tier 1 (high priorities)[1]	• Brickworks Billabong • Catfish Billabong • Koorlong Lake • Lake Hawthorn	• Brickworks Billabong • Catfish Billabong • Koorlong Lake • Lake Hawthorn • Robertson Wetland • Wakool Creek	• Brickworks Billabong • Catfish Billabong • Koorlong Lake • Lake Hawthorn • Robertson Wetland • Wakool Creek	• Brickworks Billabong • Catfish Billabong • Koorlong Lake • Lake Hawthorn • Robertson Wetland • Wakool Creek
Possible volume of water for the environment required to achieve objectives[1]	• 2,800 ML (tier 1)	• 3,700 ML (tier 1)	• 3,700 ML (tier 1)	• 2,800 ML (tier 1)
Priority carryover requirements for 2024-25	• 1,900 ML			

1 Tier 1 potential environmental watering at the lower Murray wetlands is not classified as tier 1a or 1b because the water available for use is shared across various systems, and it is not possible to reliably determine the supply specifically available for the lower Murray wetlands.

Return to start of section

5.2.7 Lindsay, Mulcra and Wallpolla islands

System overview

Lindsay, Mulcra and Wallpolla islands cover over 26,100 ha of Victorian floodplain in the Murray-Sunset National Park (see Figure 5.2.6). They form part of the Chowilla Floodplain and Lindsay-Wallpolla islands icon site that straddles the Victoria–South Australia-New South Wales border in the mid-Murray River system.

The Lindsay, Mulcra and Wallpolla islands floodplain is characterised by a network of permanent waterways, small creeks and wetlands. The Lindsay River, Potterwalkagee Creek and Wallpolla Creek form the southern boundaries of the site and create large floodplain islands with the Murray River to the north.

In their natural state, these waterways and wetlands would regularly flow and fill in response to high water levels in the Murray River. Large floods still occur, but major storages in the upper reaches of the Murray River system and extraction for consumptive use have reduced the frequency of small to moderate-sized floods.

Flows in the mid-Murray River system are regulated through a series of weir pools. The weir pools are colloquially called locks in reference to structures at the weirs that allow vessels to navigate from one weir pool to the next. The weir pools are primarily managed as small water storages to ensure adequate water levels for off-stream diversion via pumps and regulated channels.

Water is diverted from weir pool 9 in the Murray River to Lake Victoria, where it is stored for later use to meet South Australian water demands. The diversion causes water to bypass Murray River weir pools 7 and 8, and at times it can significantly impact flow in those reaches.

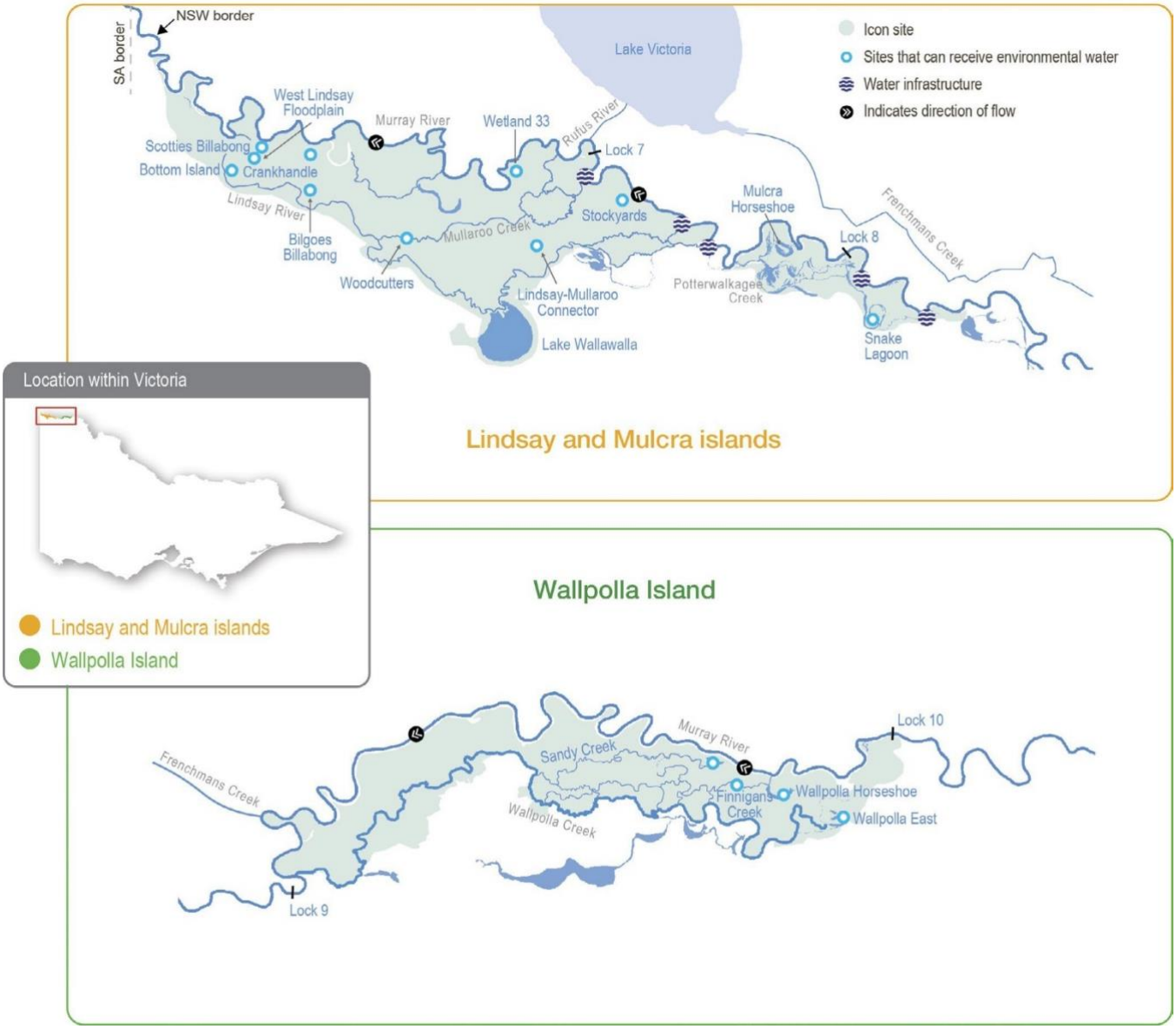
In recent years, water levels in weir pools 7 and 8 have been managed to achieve ecological benefits in the Murray River channel. For example, weir pool levels have been raised during winter and spring and then lowered during summer and autumn to mimic the seasonal river flow. The raising and lowering provide greater environmental benefits than a stable weir pool because it wets and dries off-channel habitats and creates more variable flow patterns in the Murray River and connected floodplain streams. Changes in water levels during appropriate seasons help establish fringing vegetation in shallow margins of the river channel and promote the cycling of nutrients and carbon as conditions fluctuate between wet and dry.

Static weir pool levels and reduced flow in the Murray River have a big effect on the flows in the Lindsay River and Potterwalkagee Creek. When the natural flow increases and/or when water levels in weir pools 7 and 8 are raised above the full supply level, the upper Lindsay River starts flowing (Lock 7) and flow to Potterwalkagee Creek increases (Lock 8). When weir pools are lowered, flow to both the Lindsay River and Potterwalkagee Creek ceases. Mullaroo Creek on Lindsay Island is less affected by weir pool levels, and flow is controlled independently through the Mullaroo Creek regulator, which connects the creek and the Murray River. Moderate lowering of the lock 7 weir pool level has little effect on Mullaroo Creek, but lowering more than 0.5 m below full supply level makes it difficult to deliver the recommended minimum flow of 600 ML per day that is required to maintain fast-flowing habitat for native fish, especially Murray cod.

Fluctuation of weir pool levels is a major consideration for jurisdictions managing flow in the Murray River and the anabranch waterways of Lindsay, Mulcra and Wallpolla islands. Environmental objectives and associated water regimes for the Murray River sometimes conflict with those for the Lindsay, Mulcra and Wallpolla anabranch systems. Responsible agencies in Victoria and NSW and the Murray-Darling Basin Authority collaboratively plan how to effectively manage weir pools and flows to floodplain habitats.

Return to start of section

Figure 5.2.7 The Lindsay, Mulcra and Wallpolla islands



Environmental values

The Lindsay, Mulcra and Wallpolla islands represent three separate anabranch systems that contain various streams, billabongs, large wetlands and swamps. When flooded, waterways and wetlands within these systems provide habitat for native fish, frogs, turtles, waterbirds and water-dependent plants. Terrestrial animals (such as woodland birds) also benefit from improved productivity and food resources when anabranch systems are inundated. Large floodplain wetlands (such as Lake Wallawalla) can retain water for several years after receiving inflows; they provide important refuges for wetland-dependent species and support terrestrial animals (such as small mammals and reptiles).

Mullaroo Creek supports one of the most significant populations of Murray cod in the mid-Murray River system. Mullaroo Creek provides fast-flowing habitat that Murray cod favour, which contrasts with the artificially slow-flowing and still habitats in the nearby Murray River weir pools. Fish in Mullaroo Creek breed and produce juveniles that contribute to populations in adjacent parts of the Murray system (such as in the Darling River in NSW and the lower Murray River in South Australia). Waterways and wetlands throughout the icon site support several other fish species, including freshwater catfish, golden perch, silver perch, Murray-Darling rainbowfish and unspecked hardyhead.

The reduced frequency and duration of floods in the Murray River have degraded the water-dependent vegetation communities throughout the Lindsay, Mulcra and Wallpolla island system, which has, in turn, reduced the diversity and abundance of animals that rely on healthy vegetation for habitat.

Return to start of section

Environmental objectives in Lindsay, Mulcra and Wallpolla islands
By 2030, increase the abundance of small-bodied native fish and the spread of age classes for long-lived native fish, compared to 2006 baseline levels
Maintain populations of frogs
By 2030, improve the function of water-dependent ecosystems by improving productivity linkages between river and floodplain habitats
Improve populations of flow-dependent threatened flora By 2030, maintain the extent and improve the condition of river red gum, black box and lignum compared to 2006 baseline levels By 2030, improve the species richness and abundance of native wetland and floodplain aquatic vegetation functional groups
Maintain communities and the species diversity of colonial nesting waterbirds, waterfowl and waders that feed on fish By 2030, increase populations of colonial nesting waterbirds at Lake Wallawalla and non-colonial waterbirds at Mulcra Horseshoe and Wallpolla Horseshoe

Traditional Owner cultural values and uses

Aboriginal ancestral occupation across the Lindsay-Mulcra-Wallpolla floodplain dates back tens of thousands of years, sustained by the rich productivity of the floodplain woodland and wetland systems. Historically, the islands would have been an abundant source of food and water for these communities. For Aboriginal communities, the floodplain is a vital part of community health and wellbeing.

The First People of the Millewa-Mallee Aboriginal Corporation (FPMMAC) are Latji Latji and Ngintait peoples. The corporation is the recognised Traditional Owner of Country in the north-west of Victoria that runs south of the Murray River to the Mallee Highway and west from the Calder Highway to the South Australian border, including the Murray-Sunset National Park. It is also a Registered Aboriginal Party.

There are many sites of cultural significance across the floodplain, including ceremonial grounds, earth oven remains, scar trees, birthing trees, shell middens, song lines, ancestral resting places and story places.

The FPMMAC has maintained associations with the Murray River for thousands of generations. Indeed, the river and its surrounds are one of the richest sources of Aboriginal archaeological and heritage material in Australia. The floodplain provides vital resources, including food, water, shelter, medicine and tools. The Traditional Owners still use the landscape for these purposes.

The Mallee CMA has a strong working relationship with the FPMMAC, which involves regular two-way communication, including planning, sharing of knowledge and discussions. Water in the landscape is critical to the spirituality of the people of the FPMMAC, strengthening their connection to Country. The Mallee CMA and the FPMMAC have frequent discussions about water, including planning and delivery of environmental water. The Mallee CMA and the FPMMAC discussed plans for the use of environmental water in 2023-24 on the Lindsay-Mulcra-Wallpolla floodplain.

Increasing the involvement of Traditional Owners in environmental water management and progressing opportunities towards self-determination in the environmental watering program is a core commitment of the Victorian Murray Floodplain Restoration Project and its agency partners. This is reinforced by a range of legislation and policy commitments, including the *Water Act 1989*, the *Victorian Aboriginal Affairs Framework*, the 2016 *Water for Victoria*, the *Water is Life: Traditional Owner Access to Water Roadmap 2022*, and in some cases, agreements under the *Traditional Owner Settlement Act 2010*.

Where Traditional Owners are more deeply involved in the planning and/or delivery of environmental flows for a particular site, their contribution is acknowledged in Table 5.2.16 with an icon. The use of this icon is not intended to indicate that these activities are meeting all the needs of Traditional Owners, but is incorporated in the spirit of valuing that contribution.

Watering planned and/or delivered in partnership with Traditional Owners to support cultural values and uses

Return to start of section

The Mallee CMA is partnering with the FPMMAC on planning for the delivery of water to Bottom Island and the West Lindsay Island floodplain. A key reason for watering both sites is to support black box condition and germination after the floods in 2022-23, as explained in Table 5.2.16, which the FPMMAC supports. Another key benefit is to strengthen ground cover vegetation, which increases protection against wind erosion and pest animal activity on the adjacent culturally significant sand dunes. During the 2023-24 watering, the Mallee CMA will partner with the FPMMAC to monitor the delivery of and response to watering.

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.2.16, the Mallee CMA has also considered how environmental flows could support other values and uses, including:

- water-based recreation (such as canoeing, kayaking, fishing and yabbying)
- riverside recreation and amenity (such as bushwalking, camping, bird and wildlife watching, four-wheel driving and photography)
- community events and tourism (such as increased and longstanding repeat visitation, ecotourism and educational programs for school, TAFE and university students)
- socioeconomic benefits (such as for commercial beekeepers who rest bees around the floodplain away from crops and pesticides ready for the next season, local businesses providing accommodation and hospitality to tourists, researchers and local water delivery contractors).

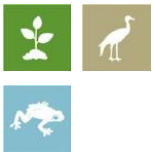
Scope of environmental watering

The term 'environmental watering' refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.2.16 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.2.16 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Lindsay, Mulcra and Wallpolla islands

Potential environmental watering action	Expected watering effects	Environmental objectives
Lindsay Island – Mullaroo Creek		
Year-round low flow (minimum of 600 ML/day)[1]	• Maintain fast-flowing habitat for native fish (such as Murray cod, silver perch and golden perch) • Maintain habitat for aquatic vegetation and soil moisture to maintain the condition of streamside vegetation	
Elevated spring flow (1,200 ML/day for three months during September to November)	• Increase the extent and velocity of fast-flowing habitat to cue the movement and spawning and improve recruitment opportunities for native fish • Increase fish passage between Mullaroo Creek and the Murray River via the Mullaroo Creek regulator fishway	
Lindsay Island – Lindsay River		
Winter/spring/summer low flow via the northern regulator (45 ML/day for three months during August to December)	• Provide temporary flowing water to connect pools and support the dispersal and recruitment of small- and large-bodied native fish and the spawning of small-bodied native fish • Stimulate the release of carbon and nutrients from the sediment to increase the productivity of the floodplain food web • Maintain bank soil moisture to support the growth of streamside vegetation	
Winter/spring/summer low flow via the southern regulator (5 ML/day for three months during August to December)		

Potential environmental watering action	Expected watering effects	Environmental objectives
Lindsay Island wetlands		
Bilgoes Billabong (fill in spring)	• Provide shallow and open-water habitat to create foraging and breeding opportunities for waterbirds and frogs • Stimulate the growth of aquatic vegetation • Increase soil moisture to maintain and improve the condition of streamside and floodplain vegetation, specifically river red gum, black box and lignum • Provide conditions for lake-bed herbaceous plants to grow as the wetland draws down during summer and autumn	
Bottom Island (fill in spring) 	• Provide shallow and open-water habitat to create foraging and breeding opportunities for waterbirds and frogs • Stimulate the growth of aquatic vegetation • Increase soil moisture to maintain and improve the condition of streamside and floodplain vegetation, specifically river red gum, black box and lignum • Increase soil moisture to stimulate germination of black box seed	
Stockyards (fill in spring or autumn)	• Provide shallow and open-water habitat to create foraging and breeding opportunities for waterbirds and frogs • Stimulate the growth of aquatic vegetation • Increase soil moisture to maintain and improve the condition of black box • Increase soil moisture to stimulate germination of black box seed	
West Lindsay Floodplain (fill in spring) 	• Provide shallow and open-water habitat to create foraging and breeding opportunities for waterbirds and frogs • Stimulate the growth of aquatic vegetation • Increase soil moisture to maintain and improve the condition black box • Increase soil moisture to stimulate germination of black box seed • Help protect the highly culturally significant site in the adjacent landscape	
Woodcutters (fill in spring)	• Provide shallow and open-water habitat to create foraging and breeding opportunities for waterbirds and frogs • Increase soil moisture to maintain and improve the condition of river red gums	
Mulcra Island – Potterwalkagee Creek		
Spring low flow via the Stony Crossing regulator (35-115 ML/day for three months during September to December)	• Provide temporary flowing water to connect pools and support the dispersal and recruitment of small- and large-bodied native fish, and the spawning of small-bodied native fish • Stimulate the release of carbon and nutrients from the sediment to increase the productivity of the floodplain food web • Maintain soil moisture to maintain the condition of streamside	
Spring low flow via the upper Potterwalkagee Creek regulator (15 ML/ day for three months during September to December)		
Mulcra Island wetlands		
Mulcra Horseshoe (fill in spring)	• Provide shallow and open-water habitat to create foraging and breeding opportunities for waterbirds • Provide shallow-water refuge habitat, if conditions are dry in the next 2-3 years, and feeding habitat for frogs • Stimulate the growth of emergent, aquatic and streamside vegetation • Provide conditions for lake-bed herbaceous plants to grow as the wetland draws down during summer and autumn	

Potential environmental watering action	Expected watering effects	Environmental objectives
Snake Lagoon extension (fill in spring)	• Provide shallow and open-water habitat to create foraging and breeding opportunities for frogs and waterbirds • Increase soil moisture to maintain and improve the condition of streamside and floodplain vegetation, specifically river red gum, black box and lignum • Provide conditions for lake-bed herbaceous plants to grow as the wetland draws down during summer and autumn	
Wallpolla Island		
• No watering activities are planned for Wallpolla Island in 2023-24		

1 There may be a requirement to reduce the baseflow down to 400 ML per day to assist with construction activities as part of the Victorian Murray Floodplain Restoration Project from early 2024, but this is not expected to affect the quality of habitat provided by the flow.

Scenario planning

Table 5.2.17 outlines potential environmental watering and expected water use in a range of planning scenarios.

The two categories of opportunities to deliver water for the environment at Lindsay and Mulcra islands in 2023-24 are:

- deliveries of water for the environment to anabranch waterways (Mullaroo Creek, Lindsay River and Potterwalkagee Creek) in coordination with weir pool operation
- a program of environmental deliveries via temporary pumps to individual wetlands at Lindsay and Mulcra islands.

Anabranch watering

All of the waterways connected to the weir pools – Mullaroo Creek, Lindsay River and Potterwalkagee Creek – are proposed to receive water for the environment in all planning scenarios.

Deliveries to the Lindsay River, Potterwalkagee Creek and Mulcra Horseshoe may be disrupted during 2023-24 due to maintenance and river operation work. The impact on environmental objectives is expected to be minor because natural flooding across Lindsay and Mulcra islands in 2022-23 and managed floodplain watering at Mulcra Island in 2021-22 have improved the condition of these systems, enabling them to withstand drying in 2023-24.

Permanent flowing water with a modest increase in spring is essential for Mullaroo Creek in all planning scenarios because there is strong evidence this watering regime promotes fish movement and breeding, particularly for Murray cod.

Lindsay River and Potterwalkagee Creek require a short-duration low flow in most years to maintain soil moisture for streamside vegetation. Proposed construction activities associated with the Lindsay Island Victorian Murray Floodplain Restoration Project will limit watering opportunities in 2024-25, so deliveries to Lindsay River in 2023-24 will build ecosystem resilience. In 2023-24, the operation of lock 7 and 8 weir pools is expected to allow low flows to be delivered to the Lindsay River and Potterwalkagee Creek via multiple regulators under dry, average and wet planning scenarios, which will provide good flow and habitat during spring. In the drought planning scenario, the lock 7 and 8 weir pools are likely to be held at a lower level, which will mean deliveries to Lindsay River and Potterwalkagee Creek are restricted to the northern and Stony Crossing regulators, respectively. Flows in all waterways will cease through most of summer, autumn and winter in all planning scenarios unless there is widespread natural flooding.

Floodplain inundation at Mulcra Island cannot be achieved under the proposed operation of weir pool 8 under the drought to average planning scenarios in 2023-24. However, natural flooding in the wet planning scenario could inundate large parts of both Lindsay and Mulcra islands and provide a near-continuous year-round flow through anabranch waterways, but most likely in winter and spring. Natural flooding of Lindsay and Mulcra islands in 2022-23 and managed floodplain watering at Mulcra Island in 2021-22 have improved the condition of floodplain ecosystems. Therefore, active floodplain watering is not required in 2023-24.

Deliveries via temporary pumps

Seven wetlands across Lindsay and Mulcra islands are identified for environmental flows using temporary pumps in spring 2023. By that time, floodwaters in all seven wetlands will have drawn down substantially or completely. Re-wetting for a second consecutive year is considered important to consolidate the growth of new plants that recruited in the 2022 floods and further improve the condition of established vegetation, to increase its resilience if conditions turn drier in the coming years.

Return to start of section

Watering the Snake Lagoon extension and Mulcra Horseshoe on Mulcra Island, Bottom Island and the West Lindsay Floodplain on Lindsay Island are high priorities in all planning scenarios. Snake Lagoon, Bottom Island and West Lindsay Floodplain have only been inundated twice in the last 10 years, and they require another fill in 2023-24 to consolidate the vegetation recruitment that occurred in response to the 2022 floods and further improve the condition of the river red gums, black box and lignum surrounding the wetlands. Mulcra Horseshoe has filled five times in the last 10 years and only twice in the last six years. The vegetation community at Mulcra Horseshoe requires open water nine out of 10 years on average, so another fill is proposed in 2023-24 to help re-establish water-dependent vegetation and improve the condition of the surrounding river red gums.

Bilgoes Billabong and Woodcutters are planned to receive water in the dry, average and wet planning scenarios to build on the positive effects of recent flooding. Both sites were filled by floods in 2016 and 2022 and will benefit from another inundation in spring 2023 to enhance the growth of streamside vegetation and consolidate an aquatic vegetation community. Filling these sites in the drought planning scenario is a lower priority because floods in 2022 improved the condition of the wetland vegetation enough to allow them to tolerate the next dry period.

Stockyards has benefitted from natural inflows in 2016, 2021 and 2022. Watering is planned in the average and wet planning scenarios to promote the abundance and diversity of the understorey vegetation community. The delivery is preferred in spring, but it may need to be deferred until autumn if planned weir-pool-raising operations affect access to the site.

In the wet planning scenario, Mulcra Horseshoe, Stockyards and Woodcutters are expected to fill from natural flooding, but Snake Lagoon extension, Bilgoes Billabong and Bottom Island to only fill if floods are very large. Bilgoes and Bottom Island become inaccessible during floods and cannot be watered via pumping in the wet planning scenario, but it may be possible to transport pumping equipment to Snake Lagoon extension to fill it in the wet planning scenario if required.

Crankhandle, Finnigans Creek, Lake Wallawalla, Lindsay-Mullaroo Connector, Sandy Creek and Lilyponds, Scotties Billabong, Wallpolla Horseshoe, Wallpolla Creek East and Wetland 33 were filled during 2021-22 by natural flows or deliveries of water for the environment, and they were flooded in 2022. Water will not be actively delivered to these sites during 2023-24 to allow them to draw down to support dry-phase ecological processes (such as providing foraging habitat for wading waterbirds and allowing the growth of lake-bed herbland communities). Offsetting wetting and drying phases in different wetlands across Lindsay, Mulcra and Wallpolla islands in non-flood years provides a variety of habitat types and resources for waterbirds, terrestrial birds and other animals.

Table 5.2.17 Potential environmental watering for the Lindsay, Mulcra and Wallpolla islands in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• Year-round low flow in the Murray River and no natural floodplain wetting • Weir pools will be maintained at full supply level in spring and drawn down below full supply level during summer, autumn and winter • Substantial wetland drying will occur	• Rare high-flow events in the Murray River and no natural floodplain wetting • Weir pools will be raised in spring and drawn down below full supply level in summer, autumn and winter • Substantial wetland drying will occur	• Short periods of high flow, most likely in spring/ summer, providing minor wetting of the floodplain • Weir pool levels will be maintained at full supply level or raised in winter/ spring and summer and drawn down in summer, autumn and winter	• Long periods of high flow, with major spills from storages resulting in widespread wetting of the floodplain and wetting of most wetlands • Weirs would be removed to allow the passage of natural flow

Planning scenario	Drought	Dry	Average	Wet
Lindsay Island				
Potential environmental watering – tier 1 (high priorities)[1]	• Year-round low flow (Mullaroo Creek) • Spring high-low flow (Mullaroo Creek) • Winter/spring/ summer low flow (Lindsay River via the north regulator) • Bottom Island (fill in spring) • West Lindsay Floodplain (fill in spring)	• Year-round low flow (Mullaroo Creek) • Spring high-low flow (Mullaroo Creek) • Winter/spring/ summer low flow (Lindsay River via the north and south regulator) • Bilgoes Billabong (fill in spring) • Bottom Island Billabong (fill in spring) • West Lindsay Floodplain (fill in spring) • Woodcutters (fill in spring)	• Year-round low flow (Mullaroo Creek) • Spring high-low flow (Mullaroo Creek) • Winter/spring/ summer low flow (Lindsay River via the north and south regulator) • Bilgoes Billabong (fill in spring) • Bottom Island Billabong (fill in spring) • Stockyards (fill in spring or autumn) • West Lindsay Floodplain (fill in spring) • Woodcutters (fill in spring)	• Year-round low flow (Mullaroo Creek) • Spring high-low flow (Mullaroo Creek) • Winter/spring/ summer low flow (Lindsay River via the north and south regulator) • Bilgoes Billabong (fill in spring)[1] • Bottom Island Billabong (fill in spring)[2] • Stockyards (fill in spring or autumn) • West Lindsay Floodplain (fill in spring)[2] • Woodcutters (fill in spring)
Mulcra Island				
Potential environmental watering – tier 1 (high priorities)[2]	• Spring low flow (Potterwalkagee Creek via Stony Crossing regulator) • Mulcra Horseshoe (fill in spring) • Snake Lagoon extension (fill in spring)	• Spring low flow (Potterwalkagee Creek via Stony Crossing and upper Potterwalkagee regulators) • Mulcra Horseshoe (fill in spring) • Snake Lagoon extension (fill in spring)	• Spring low flow (Potterwalkagee Creek via Stony Crossing and upper Potterwalkagee regulators) • Mulcra Horseshoe (fill in spring) • Snake Lagoon extension (fill in spring)	• Spring low flow (Potterwalkagee Creek via Stony Crossing and upper Potterwalkagee regulators) • Mulcra Horseshoe (fill in spring) • Snake Lagoon extension (fill in spring)
Possible volume of water for the environment required to achieve objectives[3]	• 1,690 ML	• 1,860 ML	• 2,660 ML	• 110 ML

1 Bilgoes Billabong, Bottom Island and West Lindsay Floodplain each have a high commence-to-flow rate and may not be naturally inundated in the wet planning scenario. Water cannot be delivered in the wet planning scenario due to site inaccessibility.
2 Tier 1 environmental watering at Lindsay, Mulcra and Wallpolla islands is not classified as tier 1a or tier 1b because the water available to use is shared across various systems and it is not possible to reliably determine supply specifically available for the islands.
3 These estimates include the use of water for the environment at sites across Lindsay, Mulcra and Wallpolla islands and Murray River weir pools. Water for the environment used at these sites may be accounted for in Victoria and New South Wales.

Return to start of section

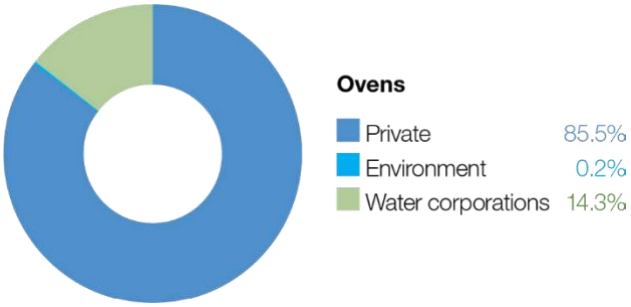
5.3 Ovens system

Waterway manager – North East Catchment Management Authority

Storage manager – Goulburn-Murray Water

Environmental water holder – Commonwealth Environmental Water Holder

Proportions of water entitlements in the Ovens basin held by private users, water corporations and environmental water holders on 30 June 2020



System overview

The Ovens River rises in the steep, forested mountains of the Great Dividing Range near Mount Hotham and flows about 150 km to join the Murray River in the backwaters of Lake Mulwala (Figure 5.3.1). The system has two small water storages: Lake Buffalo on the Buffalo River and Lake William Hovell on the King River. The regulated reaches of the Ovens system include the Buffalo and King rivers below these storages and the Ovens River from its confluence with the Buffalo River to the Murray River.

As its storages are quite small and spill regularly, the Ovens system maintains a large proportion of its natural flow regime, particularly in winter/spring. However, the storages and licensed water extractions throughout the system can restrict flow in drier years, and parts of the system can become flow-stressed during summer and autumn.

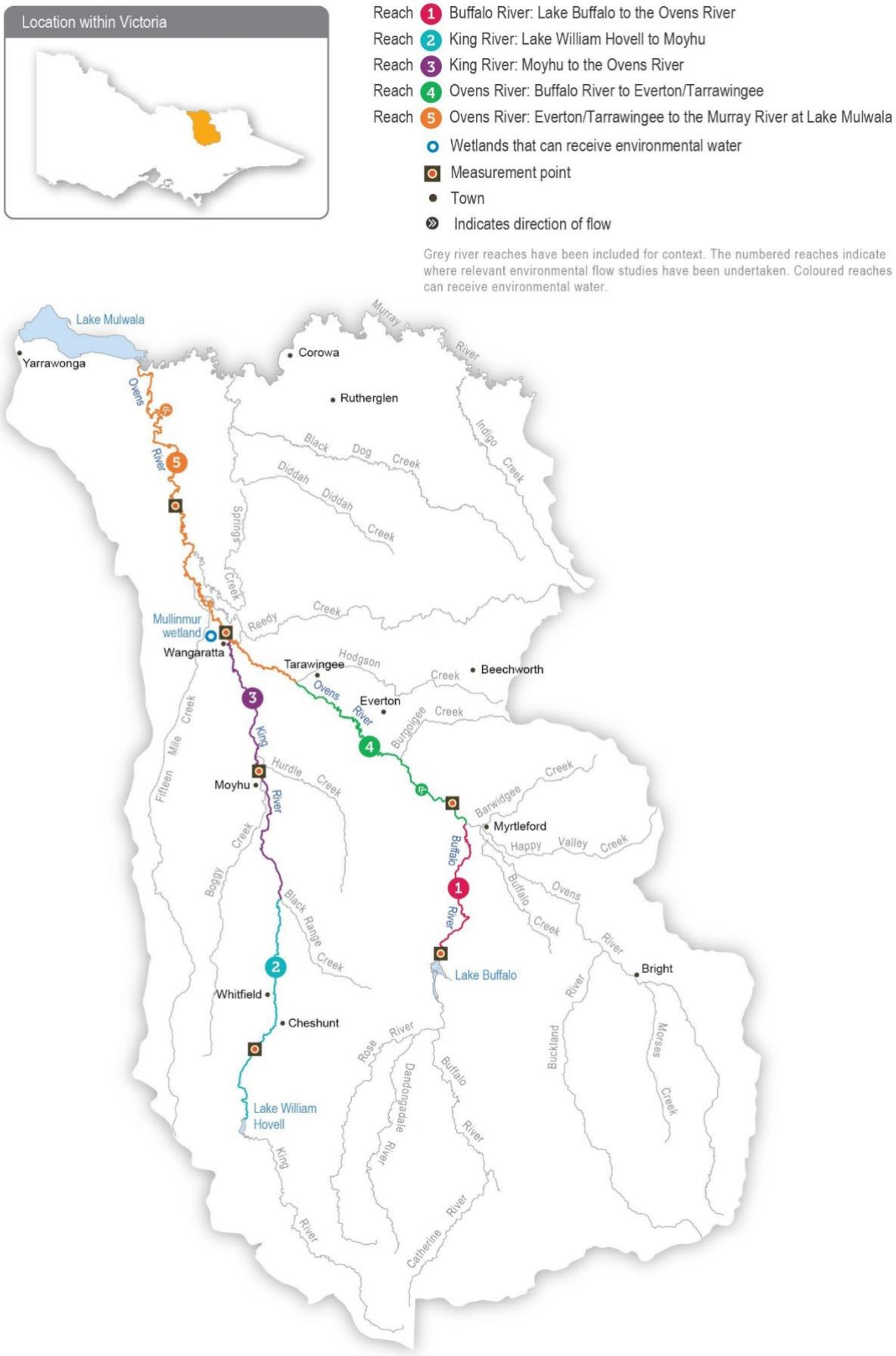
The Ovens River flows into Lake Mulwala on the Murray River; the lake is the largest weir pool on the Murray regulated system. The Ovens River flow contributes to the reliability and variability of the flow in the Murray River and supports many downstream uses, including irrigation, urban supply and watering of iconic floodplain sites (such as Barmah Forest).

Water for the environment is held in Lake Buffalo and Lake William Hovell and can be released when the storages are not spilling. Five reaches in the Ovens system can benefit from releases of water for the environment. While all are important, there is a relatively small volume (123 ML) of water available, and it is insufficient to meet most of the environmental flow objectives. In recent years, private landowners have donated some of their annual water allocations to the VEWH to use in the King River. The Taungurung Land and Waters Council has also transferred some of their annual allocation to the VEWH to be delivered to the King River to heal Country.

The water transfers are used selectively to deliver the greatest possible environmental benefit. Water for the environment is most commonly used in the Ovens system to deliver critical flow events in reaches immediately below the two main storages, or it is used in conjunction with operational water releases to influence the flows of the Buffalo River and the lower Ovens River. It is also used to top up Mullinmur Wetland in Wangaratta.

Return to start of section

Figure 5.3.1 The Ovens system



Return to start of section

Environmental values

The diverse aquatic habitat and abundant food resources associated with the Ovens system support a wide range of native fish species, including Murray cod, trout cod, golden perch and unspecked hardyhead. The Buffalo River provides valuable habitat for large-bodied fish species during part of their breeding cycle, while trout cod have a large range within the system and are found as far up the King River as Whitfield. A project to recover trout cod populations in the Ovens system has been successful, and efforts to reintroduce Macquarie perch are continuing.

Frogs (such as the giant banjo frog and growling grass frog) are abundant in the lower reaches and associated wetlands of the Ovens River and the King River above Cheshunt. The lower Ovens wetland complex contains over 1,800 wetlands, is listed as nationally significant and is home to a variety of waterbirds, including egrets, herons, cormorants and bitterns. The streamside zones of river channels throughout the Ovens system support some of Victoria's healthiest river red gum forests and woodlands, while the wetlands support a variety of aquatic and semi-aquatic vegetation communities.

Water for the environment was delivered to Mullinmur Wetland at Wangaratta for the first time in 2019-20. This site has been the focus of several environmental improvement projects in recent years. Specific management actions include carp removal, a revegetation program and the re-introduction of native fish.

Environmental objectives in the Ovens system	
	Maintain the size and distribution of native fish populations
	Maintain the condition and extent of wetland vegetation communities
	Maintain an adequate abundance and diversity of waterbugs to support river food webs and associated ecosystem processes
	Maintain water quality for all river life

Traditional Owner cultural values and uses

The North East CMA consulted the Taungurung Land and Waters Council and the Yorta Yorta Nation Aboriginal Corporation in planning for potential 2023-24 environmental flows in the Ovens system.

The Taungurung Land and Waters Council water knowledge group Baan Ganalina (Guardians of Water) supports increasing Taungurung influence in water management, building internal capacity and advancing Taungurung water rights.

The Taungurung Country Plan's water chapter *Baan Dhumba-Dji-Ngan Mundak Gunga* (We must speak to protect water) lists several water objectives. These include increasing and strengthening Taungurung voices, increasing water literacy and capacity, and returning water to disconnected wetlands. The future delivery of water for the environment by the Taungurung Land and Waters Council on Taungurung Country would contribute to achieving some of these objectives.

The Yorta Yorta Nation Aboriginal Corporation developed the *Yorta Yorta Whole-Of-Country Plan 2021-2030*. The plan outlines objectives for Yorta Yorta Country, including for the Ovens River, and it identifies the lower Ovens River as a very high priority for management actions. The plan's objectives aim to support more culturally informed planning for water in the lower Ovens River in the future.

The Taungurung Land and Waters Council and the Yorta Yorta Nation Aboriginal Corporation are collaborating with the North East CMA on a 2022-24 project to update environmental flow recommendations for the Ovens system. The project aims to progress Taungurung and Yorta Yorta objectives. In 2023, Yorta Yorta Elders and people will conduct on-Country assessments along reach 5 of the Ovens River as part of this project.

The North East CMA has started conversations with the Bangerang Aboriginal Corporation, which has a representative on the Mullinmur Wetland Management Committee. In 2022, the corporation undertook cultural heritage assessments along the Ovens River at Wangaratta and at Mullinmur Wetland. These assessments identified many culturally significant features, including trees modified for cultural purposes and intact populations of plant species used in traditional practices (such as rope-making and medicine). The corporation has also been involved in management activities at Mullinmur Wetland, including cool weather cultural burning to suppress weed species and promote the growth of native vegetation.

Increasing the involvement of Traditional Owners in environmental water management and progressing opportunities towards self-determination in the environmental watering program is a core commitment of the VEWH and its agency partners. This is reinforced by a range of legislation and policy commitments, including the *Water Act 1989*, the *Victorian Aboriginal Affairs Framework*, the 2016 *Water for Victoria*, the *Water is Life: Traditional Owner Access to Water Roadmap 2022*, and in some cases, agreements under the *Traditional Owner Settlement Act 2010*.

Return to start of section

Where Traditional Owners are more deeply involved in the planning and/or delivery of environmental flows for a particular site, their contribution is acknowledged in Table 5.3.1 with an icon. The use of this icon is not intended to indicate that these activities are meeting all the needs of Traditional Owners, but is incorporated in the spirit of valuing that contribution.

Watering planned and/or delivered in partnership with Traditional Owners to support cultural values and uses

The Taungurung Land and Waters Council may consider using its 39 ML entitlement in the King River system to support environmental objectives as part of its goal of healing and caring for Country. The council's allocation has been released from Lake William Hovell five times as an environmental flow in partnership with the North East CMA, Goulburn-Murray Water and the VEWH to provide additional water to the King River and assist in healing Country.

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.3.1, the North East CMA considered how environmental flows could support values and uses, including:

- water-based recreation (such as boating and fishing)
- riverside recreation and amenity (such as camping, visitation for mental/physical health and wellbeing)
- community events and tourism (such as providing a setting for community gatherings, outdoor school learning, sporting events and citizen science projects)
- socioeconomic benefits (such as businesses used by anglers and stock and domestic uses that rely on water quality, supported by deliveries of water for the environment when the natural flow is at its lowest from November to March).

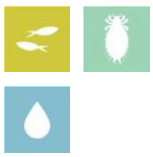
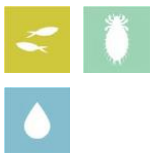
Environmental flows are planned for Mullinmur Wetland in summer to re-establish submerged aquatic vegetation and support native fish at the site. The water is expected to sustain other benefits to the local community (such as recreation and amenity). The Mullinmur Wetland site is managed by the Catholic Education Department, supported by Wangaratta Landcare and Sustainability Incorporated. An education hub provides a space for environmental education for students from Galen Catholic College, young people attending the Borinya Wangaratta Community Partnership and other people from the local community, including a team of Waterwatch citizen scientists. These volunteers have been involved in monitoring changes in conditions for plant and fish species after deliveries of water for the environment.

Scope of environmental watering

The term 'environmental watering' refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.3.1 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.3.1 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Ovens system

Potential environmental watering action	Expected watering effects	Environmental objectives
Buffalo River (targeting reach 1)		
Summer/autumn low flow variability (greater than 70 ML/day for two days during February to April)	• Increase connectivity between pools for fish movement • Maintain waterbug habitat • Maintain adequate oxygen levels in pools	
Autumn low flow fresh (430 ML/day for three days during March to April)	• Provide flow cues to stimulate the movement of native fish • Increase connectivity between pools for fish movement • Mix pools to improve the water quality • Provide small variations in river levels and velocity • Maintain waterbug habitat • Scour biofilm from the river bed	

Potential environmental watering action	Expected watering effects	Environmental objectives
King River (targeting reaches 2 and 3)		
Summer/autumn low flow variability (greater than 60 ML/day for two to four days during February to April) 	• Increase connectivity between pools for fish movement • Maintain waterbug habitat • Maintain adequate oxygen levels in pools	
Mullinmur Wetland		
Mullinmur Wetland (top-up during November to March)	• Maintain the water level within the wetland to support the growth and recruitment of aquatic vegetation • Maintain habitat and water quality for native fish	

Scenario planning

Table 5.3.2 outlines potential environmental watering and expected water use in a range of planning scenarios.

The weather and inflows into storages have a large effect on how water for the environment is likely to be used in the Ovens system. In the drought and dry planning scenarios, the highest priority will be to use available water for the environment to introduce some variability to the summer/autumn low flow to limit the duration of extremely low-flow or cease-to-flow events that can stress native fish and waterbugs. In the average and wet planning scenarios, the objective is to provide a greater flow to support fish movement and breeding and increase the abundance and diversity of waterbugs. There is not enough water for the environment to deliver the recommended autumn fresh in full, so releases would need to coincide with and add to operational water releases. All the potential environmental watering actions for the Ovens River system are expected to be met naturally in the wet planning scenario.

Due to the limited volume of water for the environment available, there is limited opportunity to vary the potential environmental watering actions each year for each planning scenario. However, water allocation donations (such as those by the Taungurung Land and Waters Council and a private donor in the King River) help to increase the effectiveness of some potential watering actions.

All wetlands on the Ovens floodplain, including Mullinmur Wetland, filled naturally during the 2022 floods. Mullinmur Wetland was still holding water at the end of 2022-23, and the main priority in 2023-24 is to top up water levels throughout the warmer months to offset seepage and evaporation and thereby maintain wetland vegetation, habitat and water quality for native fish. These top-ups will need to be actively delivered in the drought and dry planning scenarios, but Mullinmur Wetland is likely to be topped up or flooded naturally in the average and wet planning scenarios.

All available water for the environment is expected to be used in 2023-24. No carryover targets have been set for 2024-25.

Table 5.3.2 Potential environmental watering for the Ovens system in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• Possible winter/ early spring natural fresh • Very low flow through summer and autumn • No bulk water release	• Possible winter/ early spring natural fresh • Very low flow through summer and autumn • Bulk water release is unlikely	• High winter/spring natural freshes • Moderate flow in summer and autumn with occasional natural freshes • Bulk water release is likely	• High natural freshes and low flow throughout most of the year • Bulk water release is likely • All flow objectives are achieved naturally
Expected availability of water for the environment	• 123 ML (73 ML held in Lake Buffalo and 50 ML held in Lake William Hovell)			

Planning scenario	Drought	Dry	Average	Wet
Buffalo River (targeting reach 1)				
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Summer/autumn low flow variability	• Summer/autumn low flow variability	• Summer/autumn low flow variability • Autumn low flow fresh	• Summer/autumn low flow variability • Autumn low flow fresh
King River (targeting reaches 2 and 3)				
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Summer/autumn low flow variability	• Summer/autumn low flow variability	• Summer/autumn low flow variability	• Summer/autumn low flow variability
Mullinmur Wetland				
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Mullinmur Wetland top-up	• Mullinmur Wetland top-up	• Mullinmur Wetland top-up	• Mullinmur Wetland top-up
Possible volume of water for the environment required to achieve objectives	• 123 ML (tier 1a)	• 123 ML (tier 1a)	• 123 ML (tier 1a)	• 0-123 ML (tier 1a)

Return to start of section

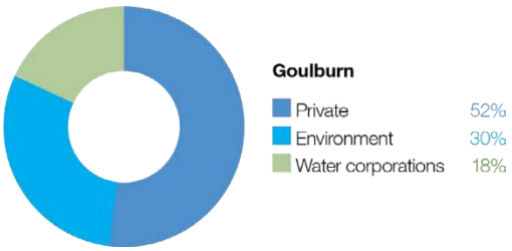
5.4 Goulburn system

Waterway manager – Goulburn Broken Catchment Management Authority

Storage manager – Goulburn-Murray Water

Environmental water holders – Victorian Environmental Water Holder (including the Living Murray program) and Commonwealth Environmental Water Holder

Proportions of water entitlements in the Goulburn basin held by private users, water corporations and environmental water holders on 30 June 2020



The Goulburn system includes the Goulburn River and Goulburn wetlands

5.4.1 Goulburn River

System overview

The Goulburn is Victoria's largest river basin, covering over 1.6 million ha or 7.1 percent of the state (Figure 5.4.1). The Goulburn River flows for 570 km from the Great Dividing Range upstream of Woods Point to the Murray River east of Echuca. It is an ancient, iconic river rich with environmental, cultural and recreational values.

There are several environmental water holders in the Goulburn system. The Commonwealth Environmental Water Holder (CEWH) holds the largest volume, and the use of Commonwealth Water Holdings is essential for achieving outcomes in the Goulburn River and priority environmental sites further downstream. Water for the environment held on behalf of the Living Murray program may assist in meeting objectives in the Goulburn system en route to icon sites in the Murray system (see subsection 4.4.2). Water held by the VEWH in the Goulburn system is primarily used to meet environmental objectives in the Goulburn River and the Goulburn wetlands, but it can also be used to support ecological objectives at downstream sites along the Murray River and in South Australia.

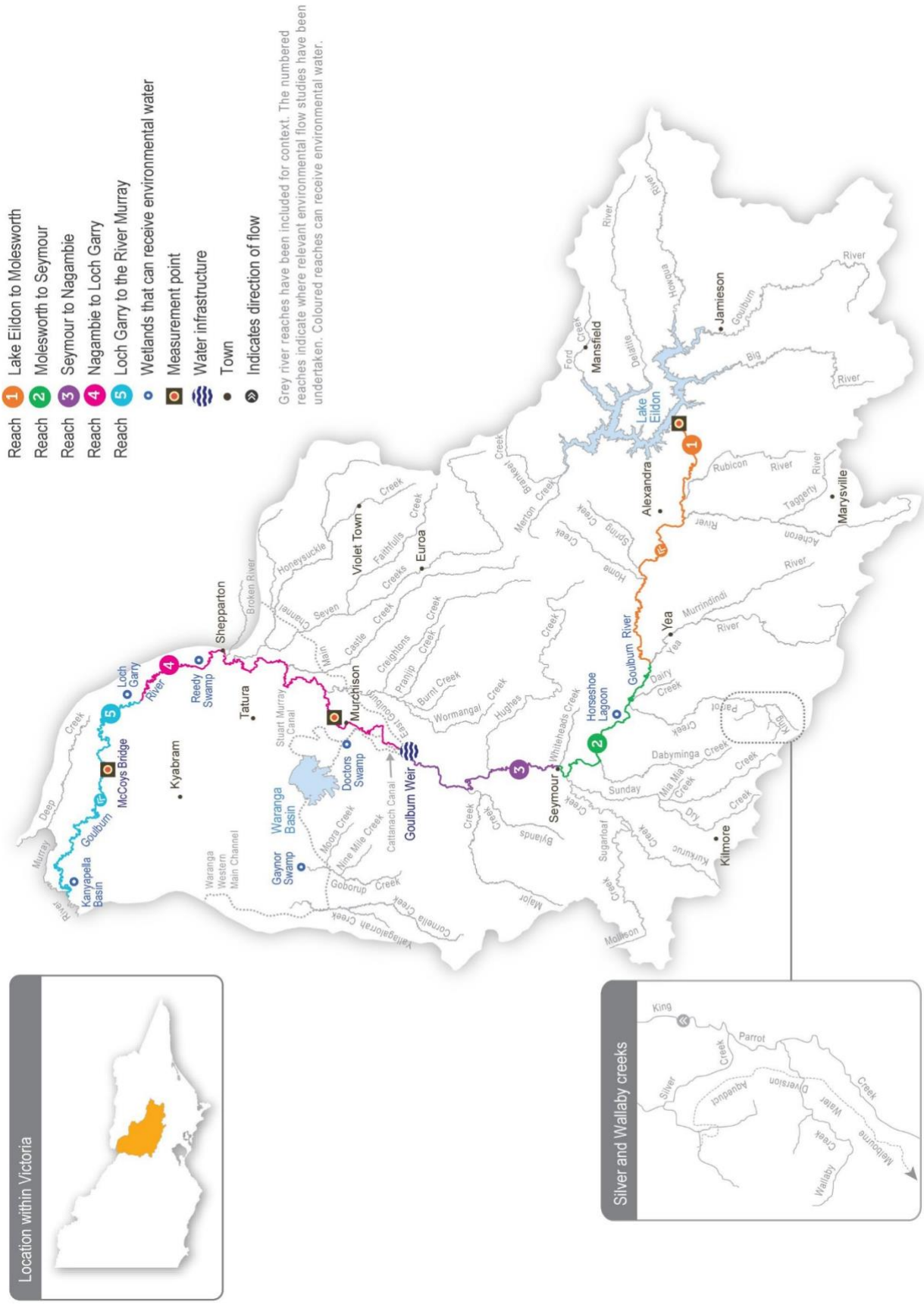
The construction and operation of Lake Eildon and Goulburn Weir have significantly altered the natural flow regime of the Goulburn River. Water harvesting during wet periods, and releases to meet irrigation and other consumptive demands during dry periods, mean that flow below these structures is typically low in winter/spring and high in summer/autumn. This is the reverse of the natural seasonal flow pattern. Land use changes and the construction of small dams and drainage schemes have further modified the Goulburn River's flow regime. Levees and other structures prevent water from inundating the floodplain and filling many of the natural wetlands and billabongs. Several tributaries, including the Acheron, Yea and Broken rivers, join the Goulburn River downstream of Lake Eildon and can add some flow variation on top of the river's regulated flow. Large floods that cause the Goulburn River's storages to fill and spill are also important for the overall flow regime and its associated environmental values.

The priority environmental flow reaches in the Goulburn River are downstream of Goulburn Weir (reaches 4 and 5), which are collectively referred to as the lower Goulburn River. The mid-Goulburn River extends from Lake Eildon to Goulburn Weir (reaches 1 to 3). From early spring to late autumn, large volumes of water are delivered from Lake Eildon to Goulburn Weir to supply the irrigation system. During that period, flow in the mid-Goulburn River is usually well above the recommended environmental flow targets. Deliveries of water for the environment have the most benefit in the mid-Goulburn River (especially in reach 1 immediately downstream of Lake Eildon) outside the irrigation season when the flow is much lower than natural.

Environmental flow targets can sometimes be met by the coordinated delivery of operational water being transferred from Lake Eildon to the Murray River. These inter-valley transfers (IVTs) occur during the irrigation season between spring and autumn and may meet environmental flow objectives without the need to release water for the environment. IVTs in the Goulburn River can significantly exceed the environmental flow recommendations for summer and early autumn and can damage bank vegetation and erode the riverbanks. A new Goulburn to Murray trade rule and operating plan were introduced in 2022-23 to try to prevent further damage to the lower Goulburn River from prolonged high flow over summer and autumn. Wet conditions in 2021-22 and 2022-23 have meant only small volumes of IVTs have been delivered from the Goulburn system. The impacts of the new trade rule and operating plan on environmental assets are yet to be fully assessed.

Return to start of section

Figure 5.4.1 The Goulburn system



Return to start of section

Environmental values

The Goulburn River and its tributaries support a range of native fish (including golden perch, silver perch, Murray cod, trout cod, Macquarie perch, freshwater catfish), turtles, platypus and rakali (water rats). Aquatic vegetation, scour holes and woody debris within the channel provide high-quality habitat for adult and juvenile fish. River red gums are a dominant feature of the streamside zone along the length of the Goulburn River. These trees shade the river and provide habitat for many species, including the squirrel glider. Leaves that fall from the river red gums provide carbon that supports riverine food webs, and dead trees that fall into the river provide a surface for biofilms and waterbugs and habitat for fish. Birds (such as egrets, herons and cormorants) use trees along the river to roost and feed, while frogs benefit from shallow vegetated habitats at the edge of the river channel and in adjacent wetlands.

The Goulburn River system is an important conservation area for threatened species. Several wetlands in the Goulburn catchment are formally recognised for their conservation significance. Tributaries of the mid-Goulburn River between Lake Eildon and Goulburn Weir host some of the last remaining Macquarie perch populations in the Murray-Darling Basin, while freshwater catfish occur in lagoons connected to reach 3 of the Goulburn River. Citizen science monitoring programs indicate the mid-Goulburn River supports a strong population of platypus, which are now classified as vulnerable under Victoria's *Fauna and Flora Guarantee Act 1988*. Monitoring in recent years shows that environmental flows in the lower Goulburn River trigger golden perch and silver perch to spawn. However, the extent to which these spawning events contribute to populations locally and in the wider southern basin is unknown. Self-sustaining populations of Murray cod have been confirmed, and trout cod are extending their range in the lower Goulburn River.

Environmental objectives in the Goulburn River
Protect and increase populations of native fish
Maintain the form of the riverbank and channel and a high diversity of river bed surfaces to support all stream life
Increase populations of platypus
Maintain populations of turtles
Provide sufficient rates of carbon and nutrient production and processing to support native fish and waterbug communities
Increase the abundance of aquatic and flood-tolerant plants in the river channel and on the lower banks to provide shelter and food for animals and stabilise the riverbank
Maintain abundant and diverse waterbug communities to support riverine food webs
Minimise the risk of low-oxygen blackwater

Traditional Owner cultural values and uses

The Goulburn River system flows through Taungurung and Yorta Yorta Country.

Each year, the Goulburn Broken CMA consults with the Taungurung Land and Waters Council and the Yorta Yorta Nation Aboriginal Corporation about plans for environmental watering in the Goulburn River.

In late 2022 and early 2023, the Goulburn Broken CMA met with the Taungurung water knowledge group Baan Ganalina (Guardians of Water) to discuss recently updated environmental flow recommendations for *Waring* (Goulburn River reaches 1 to 3) as well as the 2023-24 Goulburn River watering priorities.

Baan Ganalina indicated the flows would help to reinstate a more-natural water regime that better reflects the size, timing and variability of natural inflows to this part of the river, including off-channel areas. It said:

> *"These flow recommendations will help support Waring (Goulburn River), which is such an important part of Taungurung identity. It's good to see how GBCMA have used peer-reviewed articles to show the effects on important animals like platypus and shared this knowledge. The river is a work in progress, but together with GBCMA, we will continue to seek ways to heal Country despite the harm it has suffered. Baan Ganalina hopes to see the proposed higher winter flows and looks forward to taking an ongoing role in monitoring their effects."*

Return to start of section

The Taungurung Land and Waters Council communicated that the planned reach 1 to 3 baseflows and freshes for 2023-24 would have positive outcomes for *Waring* (Goulburn River reaches 1 to 3) that align with Taungurung objectives and responsibilities to heal and care for Country. These flows will connect wetlands that support valued species at appropriate times. They will help to protect intangible and tangible cultural heritage and values, including traditional food and medicine plants. The flows will also support ongoing efforts by Taungurung and partner organisations to care for the river and its floodplain, including investigations into rehabilitating degraded significant sites.

In early 2023, the Goulburn Broken CMA met with the Yorta Yorta Nation Aboriginal Corporation to discuss 2023-24 environmental watering priorities in the Goulburn River. The Yorta Yorta Nation Aboriginal Corporation indicated there is alignment between planned watering actions for *Kaiela* (Goulburn River reaches 4 and 5) and the cultural and ecological values of the Yorta Yorta people. The planned flows will encourage native fish to spawn, alleviate the slumping of culturally important sites (such as middens and scar trees) and revive streamside vegetation, which is important for food, fibre and medicine.

A Yorta Yorta representative contributed to the 2020 *Kaiela (Lower Goulburn River) Environmental Flows Study*, which has influenced environmental flows in the lower Goulburn River since 2021-22.

Increasing the involvement of Traditional Owners in environmental water management and progressing opportunities towards self-determination in the environmental watering program is a core commitment of the VEWH and its agency partners. This is reinforced by a range of legislation and policy commitments, including the *Water Act 1989*, the *Victorian Aboriginal Affairs Framework*, the 2016 *Water for Victoria*, the *Water is Life: Traditional Owner Access to Water Roadmap 2022*, and in some cases, agreements under the *Traditional Owner Settlement Act 2010*.

Where Traditional Owners are more deeply involved in the planning and/or delivery of environmental flows for a particular site, their contribution is acknowledged in Table 5.4.1 with an icon. The use of this icon is not intended to indicate that these activities are meeting all the needs of Traditional Owners, but is incorporated in the spirit of valuing that contribution.

Watering planned and/or delivered in partnership with Traditional Owners to support cultural values and uses

In 2022, the Taungurung Land and Waters Council joined the Goulburn and Broken Operational Advisory Group, which shares technical and operational information to support environmental water management and decision-making in the Goulburn River and lower Broken Creek.

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.4.1, the Goulburn Broken CMA considered how environmental flows could support values and uses such as:

- water-based recreation (such as boating, canoeing, fishing, gaming, hunting and kayaking)
- riverside recreation and amenity (for landholders and visitors)
- community events and tourism (such as paddling and boating businesses)
- socioeconomic benefits (such as improving water quality for stock and domestic uses, irrigation diverters and water supply for settlements on the Goulburn River).

If the timing or management of planned environmental flows may be modified to align with a community benefit, this is acknowledged in Table 5.4.1 with the following icon.

Watering planned to support angling activities

The Goulburn River provides numerous recreational and economic benefits. Environmental flows support native fish populations by providing fish passage and habitat and by encouraging fish migration and spawning, which in turn provide benefits for recreational anglers. Following community feedback, the timing of a targeted environmental flow in November/ December is planned to reduce impacts on river access around peak fishing periods, benefitting anglers and local businesses.

Scope of environmental watering

The term ‘environmental watering’ refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, ‘environmental watering’ is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

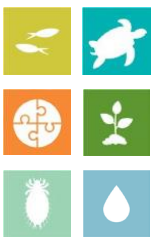
Table 5.4.1 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Return to start of section

Table 5.4.1 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Goulburn River

Potential environmental watering action	Expected watering effects	Environmental objectives
Goulburn River reach 1		

Year-round low flow (400-2,000 ML/day in reach 1) 	• Maintain habitat for small-bodied native fish
	• Maintain adequate foraging habitat for platypus and reduce the risk of predation
	• Provide habitat and food for turtles
	• Wet and maintain riffles to provide habitat for biofilms and waterbugs
	• Additional benefits to reach 1 of the Goulburn River when the flow delivered is above 800 ML/day:
	  • scour fine sediment from the gravel bed and riffle substrate
	  • maintain existing beds of in-channel vegetation
	  • provide connection to off-stream wetland habitats, which increase food resources (waterbugs) available for fish and native animals
		

Winter fresh (one fresh of more than 8,000 ML/day for five to 10 days during July to August in reach 1) 	• Encourage female platypus to select a nesting burrow higher up the bank to reduce the risk of greater flow later in the year flooding the burrow when juveniles are present • Scour fine sediment from the gravel bed and riffle substrate • Maintain existing beds of in-channel vegetation • Connect lower Goulburn River wetlands and anabranches to the river channel	
Winter/spring fresh(es) (one to three freshes of more than 5,000 ML/day for five to 10 days during May to November in reach 1) 	• Scour fine sediment from the gravel bed and riffle substrate • Maintain existing beds of in-channel vegetation • Maximise the period of time off-stream wetland habitats are available for small-bodied native fish and platypus	
Spring fresh (one fresh of more than 8,000 ML/day for five to 10 days during September to November in reach 1) 	• Maintain off-stream habitat for small-bodied native fish and platypus • Scour fine sediment from the gravel bed and riffle substrate • Maintain existing beds of in-channel vegetation • Connect lower Goulburn River wetlands and anabranches to the river channel	
Goulburn River reach 4 and 5		
Year-round low flow (600-1,000 ML/day in reach 4 and 5)	• Provide slow, shallow habitat required for the recruitment of larvae/juvenile fish and habitat for adult small-bodied fish • Provide deep-water habitat for large-bodied fish • Submerge snags and littoral vegetation to provide habitat for fish and waterbugs and a substrate for biofilms to grow • Provide habitat and food for turtles • Maintain habitat for aquatic vegetation and water the root zone of low-bank vegetation • Vary flow within a specified range to encourage plankton production for food, disrupt biofilms and maintain water quality • Low, variable flow to enable vegetation to establish to protect against notching and bank erosion	

Potential environmental watering action	Expected watering effects	Environmental objectives
Winter/autumn fresh (one fresh of more than 7,300 ML/day for four to five days in reaches 4 and 5 during July to August and May to June)	• Wash organic matter and carbon (e.g. leaf litter) into the channel • Provide connectivity to off-channel habitats and through the river for fish dispersal and greater food resources • Scour bed sediments to maintain pools and change in-channel complexity to improve habitat • Provide cues for platypus to nest higher up the bank • Provide sediment and plant propagules from tributary inflows after large rain events to encourage the establishment of new plants • Drown terrestrial vegetation on low banks and trigger the recruitment of native, flood-tolerant streamside vegetation • Improve waterbug habitat and food availability by scouring fine sediments	
Pass a portion of the flow in the mid-Goulburn to reaches 4 and 5 when flow in reach 3 is above 4,000 ML/day (1,000-6,000 ML/day in reaches 4 and 5 during May to October)	• Wash organic matter and carbon (e.g. leaf litter) into the channel • Transport and deposit seed, sediment and plant propagules on the riverbank	
Early spring fresh (one fresh of up to 10,500 ML/day with more than seven days above 7,300 ML/day during September to October in reaches 4 and 5)	• Wash organic matter and carbon (e.g. leaf litter) into the channel • Provide connectivity to off-channel habitats and through the river for fish dispersal and greater food resources • Scour bed sediments to maintain pools and change in-channel complexity for improved habitat • Increase soil moisture in banks to improve the condition of existing native vegetation • Provide sediment and plant propagules from tributary inflows after large rain events to encourage the establishment of new plants • Drown terrestrial vegetation on low banks and trigger the recruitment of native flood-tolerant streamside vegetation • Improve waterbug habitat and food availability by scouring fine sediments and biofilms from hard substrates	
Late spring fresh (one fresh of more than 6,000 ML/day for two days during October to December in reaches 4 and 5) 	• Stimulate spawning of golden and silver perch • Scour bed sediments to maintain pools and change in-channel complexity for improved habitat • Improve waterbug habitat and food availability by scouring fine sediments and biofilms from hard substrates	
Autumn fresh (one fresh of more than 5,700 ML/day for two to five days during March to May in reaches 4 and 5)	• Cue fish to move into and through the system to increase their abundance and dispersal • Scour bed sediments to maintain pools, and change in-channel complexity for improved habitat • Increase soil moisture in banks to maintain existing vegetation • Scour old biofilm from hard substrates to allow new biofilm growth to improve food and habitat for macroinvertebrates	
Slow the recession of unregulated flow or releases from Goulburn Weir (6,000 ML/day in reaches 4 and 5)	• Minimise the risk of bank erosion associated with a rapid reduction in the water level • Transport and deposit seed, plant propagules and sediment on the riverbank • Minimise the risk of low-oxygen blackwater after natural events	

Return to start of section

Scenario planning

Table 5.4.2 outlines potential environmental watering and expected water use in a range of planning scenarios.

The environmental flows study for the Goulburn River recommends a range of watering actions that are needed in most years to achieve the target environmental outcomes. High water availability in the Goulburn system at the end of 2022-23 and a strong resource outlook for 2023-24 mean all the recommended watering actions can potentially be met, even if dry conditions return. Therefore, the proposed actions are the same for all planning scenarios in 2023-24.

Environmental watering actions in the lower Goulburn River in 2023-24 will continue to focus on vegetation recovery after prolonged flooding across the system in spring 2022 and multiple years of artificially high flow during summer and autumn. The spring floods temporarily reduced vegetation cover, but they also deposited sediments and seeds that facilitated the growth

of new vegetation in summer and autumn. Very low demand for IVTs over summer and autumn 2023 allowed for the further recovery of lower-bank vegetation. Ongoing flow management is required to help the vegetation fully recover and reduce the risk of future bank failure.

The most important flows for bank vegetation in the Goulburn River are a year-round low flow and freshes during winter and spring. The target range for the low flow aims to inundate enough of the channel to support in-stream vegetation, while exposing the lower parts of the bank for sustained periods during the warmer growing season to avoid drowning streamside vegetation. Water for the environment will be particularly important for maintaining a minimum flow in reach 1 – immediately downstream of Lake Eildon – during winter, when there are no irrigation releases. Winter and spring freshes are needed to periodically wet higher parts of the bank to enhance the growth and recruitment of native streamside vegetation and deter the growth of terrestrial species. Where possible, these freshes will be delivered by passing tributary inflows from the mid-Goulburn River to the lower Goulburn reaches so that seeds, sediments and nutrients that are carried from natural tributary flows are transported and deposited along banks throughout the whole system.

A year-round low flow and freshes may be fully or partially achieved with natural flows in the wetter planning scenarios, and operational releases (such as IVTs) may help meet environmental flow targets under the drier planning scenarios. Goulburn-Murray Water generally diverts a proportion of the natural high flow from Goulburn Weir into the Waranga Basin. These operational transfers can cause the flow rate in the lower Goulburn River to drop rapidly after a natural high-flow event, and water for the environment may be used as required to slow the recession of natural spills at Goulburn Weir to reduce the risk of bank slumping.

The next-highest priority for environmental watering in 2023-24 will be to support native fish objectives. Wet conditions in 2021-22 and the floods in spring 2022 have significantly increased the number of carp in the Murray River and its tributaries, including the Goulburn River, but recent surveys suggest there was relatively low recruitment of golden and silver perch in

2022-23. Golden and silver perch do not need to spawn every year to maintain good populations, but actions to improve native fish populations will be taken where possible. Late spring freshes are known to trigger spawning in the lower Goulburn River, and water for the environment may be used to deliver freshes in spring 2023 as long as their timing does not compromise the re-establishment of bank vegetation.

The final focus for environmental watering in the Goulburn River in 2023-24 will be to deliver multiple freshes in winter and spring in reach 1 to reinstate some natural flow variation and connect floodplain wetlands between reach 1 and reach 3. This will allow fish and platypus to access off-channel habitats for feeding and breeding. A flow that aimed to connect off-channel habitats in the mid-Goulburn River was trialled successfully in 2022 and will be delivered annually where possible.

Carrying over water to meet minimum low-flow objectives from July 2024 to September 2025 is an important consideration in the drought and dry planning scenarios. It is less important in the average and wet planning scenarios due to likely high early-season allocations.

Table 5.4.2 Potential environmental watering for the Goulburn River in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• Very few or no large natural-flow events • Blackwater could be an issue if there is a large rain event in the warmer months	• One to two short-duration, large, natural-flow events are likely to provide small winter/spring freshes • Blackwater could be an issue if there is a large rain event in the warmer months	• Large natural-flow events will provide low flow for most of the year and will likely provide winter/spring freshes • Blackwater could be an issue if there is a large rain event in the warmer months	• Large natural-flow events will provide low flow and multiple freshes and/or overbank flow events in winter/spring
Expected availability of water for the environment	• 742 GL	• 754 GL	• 754 GL	• 754 GL

Planning scenario	Drought	Dry	Average	Wet
Goulburn River (targeting reach 1)				
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Year-round low flow • Winter fresh • Winter/spring freshes • Spring fresh			
Goulburn River (targeting reaches 4 and 5)				
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Year-round low flow • Winter/autumn fresh • Pass mid-Goulburn tributary flows • Early spring fresh • Autumn fresh • Recession flow management • Late spring fresh			
Possible volume of water for the environment required to achieve objectives	• 576,000 ML (tier 1a)	• 542,000 ML (tier 1a)	• 555,000 ML (tier 1a)	• 555,000 ML (tier 1a)
Priority carryover requirements for 2024-25	• 50,000 ML		• N/A	

5.4.2 Goulburn wetlands

System overview

Within the Goulburn Broken catchment, there are about 2,000 natural wetlands identified, but only six – Doctors Swamp, Gaynor Swamp, Horseshoe Lagoon, Kanyapella Basin, Loch Garry and Reedy Swamp – have received water for the environment through VEWH or CEWH entitlements. Several other small wetlands in the Goulburn catchment have been watered under a separate arrangement through the Murray-Darling Wetlands Working Group.

Doctors Swamp, Gaynor Swamp, Kanyapella Basin, Loch Garry and Reedy Swamp can receive water for the environment through irrigation supply infrastructure. The volume of water that can be delivered to each wetland depends on the physical capacity of the infrastructure and the seasonal allocation. Water for the environment can be delivered from the Goulburn River to Horseshoe Lagoon via a temporary pump.

Environmental values

Many natural wetlands across the Goulburn catchment, including Doctors Swamp, Gaynor Swamp, Kanyapella Basin, Loch Garry and Reedy Swamp, are formally recognised for their conservation significance. The Goulburn wetlands support a variety of plant communities ranging from river red gum swamps to cane grass wetlands.

Doctors Swamp is considered one of the most intact red gum swamps in Victoria, supporting over 80 wetland plant species.

Gaynor Swamp is a cane grass wetland situated on paleosaline soils: soils formed from historic oceans. The wetland supports thousands of waterbirds, including brolga and intermediate egrets, when wet. Gaynor Swamp has a greater salt concentration than other wetlands in the region when water levels are low, and it attracts a different suite of feeding waterbirds as it draws down. One of the most significant species that feed on exposed mudflats at Gaynor Swamp is the red-necked avocet.

Horseshoe Lagoon is a paleochannel of the Goulburn River that has tall marsh, floodway pond herbland and floodplain streamside woodland vegetation communities. The lagoon supports numerous waterbird species and is home to three species of turtle, including the Broad-shelled Turtle.

Kanyapella Basin is a shallow freshwater marsh that provides habitat for numerous plant and animal species, including the threatened intermediate egret. Historically, it has been a popular breeding site for ibis, herons and cormorants.

Return to start of section

Loch Garry is a paleochannel of the Goulburn River that provides deep, open-water habitat. The channel is surrounded by shallow, vegetated wetland depressions, red gum forest and sand ridges. It is an important site for waterbird feeding and roosting, and it is a drought refuge for eastern great egrets, musk ducks, nankeen night herons and royal spoonbills.

Reedy Swamp contains a mosaic of vegetation types, including tall marsh, floodway pond herbland and rushy riverine swamp. It is an important drought refuge, nesting site for colonial waterbirds and stopover feeding site for migratory birds (such as sharp-tailed sandpiper and marsh sandpiper).

Environmental objectives in the Goulburn wetlands	
	Maintain existing frog populations
	Maintain freshwater turtle populations
	Restore carbon and nutrient cycling within the wetlands to increase ecosystem productivity
	Increase the diversity and cover of native wetland plant species consistent with ecological vegetation class benchmarks Reduce the cover and diversity of exotic plants
	Provide breeding habitat for waterbirds Provide feeding and roosting habitat for waterbirds

Traditional Owner cultural values and uses

Of the six Goulburn wetlands currently managed with water for the environment, Doctors Swamp, Kanyapella Basin, Loch Garry and Reedy Swamp are on Yorta Yorta Country. The Yorta Yorta Nation Aboriginal Corporation has been involved in planning for environmental flows at these wetlands for several years, including by participating in the development of environmental water management plans.

Gaynor Swamp and Horseshoe Lagoon are on Taungurung Country. The Taungurung Land and Waters Council has been involved in environmental water planning for both wetlands for several years and in delivering water for the environment at Horseshoe Lagoon since 2021. Taungurung Land and Waters Council has also been working with Parks Victoria to reintroduce aquatic plant species that are either missing or in low numbers at Horseshoe Lagoon to boost their diversity and abundance.

In early 2023, the Goulburn Broken CMA met with the Taungurung Land and Waters Council and the Yorta Yorta Nation Aboriginal Corporation to discuss 2023-24 priorities for water for the environment in the Goulburn wetlands. Both groups indicated they support the priorities for the year ahead.

For Yorta Yorta, water for the environment supports many cultural values. At Doctors Swamp, it supports *nardoo* (a food source), native grasses, old man weed (which has medicinal uses), sedges and rushes (for basket weaving), as well as a wide range of bird and animal species. At Loch Garry, water for the environment supports culturally important food, fibre and medicinal plants. A flow delivered to Loch Garry in April 2020 initiated a resurgence of these plants as well as giant rush, which provided nesting opportunities for important bird species. Loch Garry is rich in cultural values: stone scatters, marked trees and significant sand hills in the higher elevations.

Kanyapella Basin is important for the Yorta Yorta People's cultural and spiritual connections. It supports the health of cultural values in the landscape (such as the Creation Story and traditional food and medicine plants). Before the delivery of environmental flows in winter 2020, Yorta Yorta People conducted a cultural burn at the site, helping to enable direct delivery of the water and help the growth of old man weed.

Return to start of section

The Taungurung Land and Waters Council (TLaWC) has identified that water for the environment supports cultural values by protecting intangible cultural heritage and valued species, traditional food and medicine plants. Participation in environmental water planning by TLaWC and the Taungurung water knowledge group Baan Ganalina (guardians of water) also makes an important contribution to enabling Taungurung Traditional Owners to fulfil their obligations to care for Country. This includes working to restore a more natural watering regime to degraded significant sites and rehabilitating habitat for native species. This in turn contributes to reconnecting the Taungurung community to Country through supporting and securing access for Taungurung contemporary cultural practices and uses, teaching places, camping sites and other places of cultural importance.

The Taungurung people have a special interest in the rehabilitation of floodplain wetlands associated with *Waring* (Goulburn River reaches 1 to 3), which are now largely disconnected from the main river channel due to the impacts of river flow regulation. The council is currently monitoring biocultural values and habitat conditions at six of the disconnected wetlands as part of the ongoing Reading Country program. This process and its findings will inform future seasonal watering proposals and planning for water for the environment. The council is working with partners to enhance habitat conditions for native species in the area, and healthy Country assessments will provide important information about cultural objectives and indicators.

Increasing the involvement of Traditional Owners in environmental water management and progressing opportunities towards self-determination in the environmental watering program is a core commitment of the VEWH and its agency partners. This is reinforced by a range of legislation and policy commitments, including the *Water Act 1989*, the *Victorian Aboriginal Affairs Framework*, the 2016 *Water for Victoria*, the *Water is Life: Traditional Owner Access to Water Roadmap 2022*, and in some cases, agreements under the *Traditional Owner Settlement Act 2010*.

Where Traditional Owners are more deeply involved in the planning and/or delivery of environmental flows for a particular site, their contribution is acknowledged in Table 5.4.3 with an icon. The use of this icon is not intended to indicate that these activities are meeting all the needs of Traditional Owners, but is incorporated in the spirit of valuing that contribution.

Watering planned and/or delivered in partnership with Traditional Owners to support cultural values and uses

Horseshoe Lagoon is of high cultural significance for Taungurung people and, in particular Taungurung women, as it is central to their Creation Story. In 2017, the Taungurung Land and Waters Council undertook an Aboriginal Waterways Assessment at Horseshoe Lagoon. In 2019, the council participated in the development of the environmental water management plan before the first delivery of water for the environment to Horseshoe Lagoon in winter 2019. In 2021 and 2022, council staff and the Taungurung water knowledge group Baan Ganalina (Guardians of Water) coordinated the delivery of environmental flows to Horseshoe Lagoon by managing the pumping and delivery. This is planned again for autumn 2024.

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.4.3, the Goulburn Broken CMA considered how environmental flows could support values and uses, including:

- water-based recreation (such as canoeing)
- riverside recreation and amenity (such as birdwatching, camping, cycling, hiking, photography and walking)
- community events and tourism (such as community birdwatching events, the Nature Scripts Initiative and outdoor classroom learning).

Scope of environmental watering

The term ‘environmental watering’ refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, ‘environmental watering’ is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.4.3 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Return to start of section

Table 5.4.3 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Goulburn wetlands

Potential environmental watering action	Expected watering effects	Environmental objectives
Doctors Swamp (partial fill in autumn if the wetland has been dry for at least six months).	• Inundate 70 percent of the swamp, including deep sections and some shallower margins, to maintain the condition of Red Gum Swamp and Plains Grassy Wetland ecological vegetation classes • Provide habitat and suitable breeding conditions for frogs • Support plant species used for Yorta Yorta traditional medicines and weaving	
Horseshoe Lagoon (fill in autumn if the wetland has been dry for at least six months). 	• Inundate the deeper section and wetland margins to maintain naturally occurring wetland vegetation communities and help recently planted vegetation become established • Suppress the growth of weeds • Provide food and breeding habitat for turtle populations	

Scenario planning

Table 5.4.4 outlines potential environmental watering and expected water use in a range of planning scenarios.

Record flooding in spring 2022 filled all of the Goulburn wetlands. This triggered widespread bird and frog breeding, the growth and recruitment of wetland vegetation communities and carbon, nutrient and sediment exchange between the Goulburn River and its floodplain. It also facilitated the active and passive dispersal of aquatic plants and animals. By autumn 2023, most of the Goulburn wetlands that normally receive water for the environment were still full or partially full. The only exception was Doctors Swamp, which was partially drained in December 2022 to reduce the risk that summer storms would cause the wetland to overflow and inundate adjacent properties. Doctors Swamp completely dried in March 2023.

All the Goulburn wetlands included in the environmental watering program require periodic wetting and drying to support the growth and recruitment of native vegetation communities and carbon and nutrient cycling. When they hold water, this increases productivity and provides food for frogs, turtles and waterbirds.

All the actively managed wetlands in the Goulburn system will be allowed to draw down and, in some cases, dry throughout the rest of 2023 to help meet the drying regime requirements for their vegetation communities and support dry-phase ecological processes (such as carbon and nutrient cycling). As they draw down, the wetlands will also provide foraging habitat for wading waterbirds. The recommended watering actions for each wetland vary depending on the plant and animal communities they support, the maximum and minimum dry phases they require and the wetland size, which determines how long they hold water. For example, Horseshoe Lagoon is smaller than the other Goulburn wetlands. Without further inflows, it is likely to dry by winter or early spring 2023.

If there are no significant natural inflows, Doctors Swamp and Horseshoe Lagoon are likely to reach the end of their recommended dry phase by late summer or early autumn 2024, and environmental watering is proposed at both sites in autumn 2024 in all planning scenarios. The other Goulburn wetlands are not expected to reach the end of their recommended dry phases during 2023-24, so they are unlikely to need deliberate watering. Proposed watering actions at Doctors Swamp and Horseshoe Lagoon will only proceed if each wetland has been dry for at least six months. They not be required in the average and wet planning scenarios.

The proposed watering actions for the Goulburn wetlands in 2023-24 will stagger the timing of wetting and drying phases across the six managed wetlands. This will help provide a mix of food and habitat resources for birds, frogs and turtles until the next large flood. Such diversity is necessary to ensure that some habitat and food resources are always available. It will be particularly important if we enter a prolonged sequence of dry years.

Return to start of section

Table 5.4.4 Potential environmental watering for the Goulburn wetlands in a range of planning scenarios

Planning scenario	Very dry	Dry	Average	Wet
Expected conditions	• Catchment run-off and natural flow into the wetlands are highly unlikely	• Catchment run-off and natural flow into the wetlands are highly unlikely	• Some catchment run-off and natural flow into some of the wetlands are likely, particularly in winter/spring	• Catchment run-off and natural flow into the wetlands are likely to fill or partially fill the wetlands, particularly in winter/spring
Potential environmental watering – tier 1 (high priorities)	• Doctors Swamp • Horseshoe Lagoon	• Doctors Swamp • Horseshoe Lagoon	• Doctors Swamp • Horseshoe Lagoon	• Doctors Swamp • Horseshoe Lagoon
Potential environmental watering – tier 2 (additional priorities)	• N/A			
Possible volume of water for the environment required to achieve objectives	• 720 ML (tier 1)	• 720 ML (tier 1)	• 720 ML (tier 1)	• 360 ML (tier 1)

Return to start of section

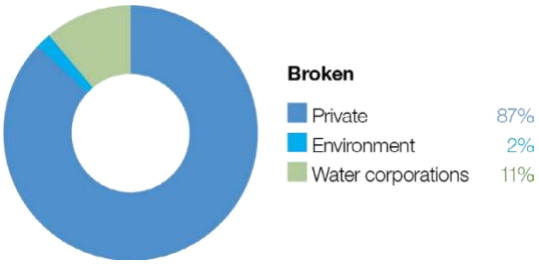
5.5 Broken system

Waterway manager – Goulburn Broken Catchment Management Authority

Storage manager – Goulburn-Murray Water

Environmental water holders – Victorian Environmental Water Holder and Commonwealth Environmental Water Holder

Proportions of water entitlements in the Broken basin held by private users, water corporations and environmental water holders on 30 June 2020



The Broken system includes the Broken River, upper Broken Creek, lower Broken Creek and the Broken wetlands.

5.5.1 Broken River and upper Broken Creek

System overview

The Broken River is a tributary of the Goulburn River, rising in the Wellington-Tolmie highlands and flowing northwest to Benalla and then west for a total distance of 190 km before it joins the Goulburn River near Shepparton (Figure 5.5.1). Lake Nillahcootie is the main storage on the Broken River. It is about 36 km upstream of Benalla and harvests water from the river to support stock and domestic supply and irrigated agriculture. The main tributaries of the Broken River are Hollands Creek, Ryans Creek and Lima East Creek.

Lake Nillahcootie has a storage capacity that is about half the mean annual flow of its upstream catchment, so it fills in most years. The operation of Lake Nillahcootie has modified the river's natural flow pattern: winter/spring flow is less than natural because a large proportion of inflow is harvested, while summer/autumn flow is greater than natural because water is released to meet downstream irrigation demands. These impacts are most pronounced in the reach between Lake Nillahcootie and Hollands Creek. Below Hollands Creek, the river retains a more-natural flow pattern due to flows from unregulated tributaries, although the total annual flow is considerably less than natural. The catchment has been extensively cleared for agriculture, including dryland farming (such as livestock grazing and cereal cropping) and irrigated agriculture (such as dairy, fruit and livestock).

Water is released from Lake Nillahcootie to meet downstream demand and minimum-flow requirements specified under the bulk entitlement for the Broken River system. Releases from storage may be less than 30 ML per day as tributary inflows immediately below the storage (such as from Back Creek) can supply much of the minimum-flow requirements specified in the bulk entitlement.

Upper Broken Creek is defined as the 89-km stretch of creek from the Broken River (at Caseys Weir) to the confluence with Boosey Creek near Katamatite. Upper Broken Creek flows across a flat riverine plain and has naturally low run-off from its local catchment. It receives flood flows from the Broken River, although the frequency of these floods has been reduced by river regulation, earthworks and road construction.

Upper Broken Creek has been regulated for more than a century. Before 2007, water was diverted into upper Broken Creek at Caseys Weir to meet local demand, but recent water savings projects have reduced the demand on the creek. There is now

a low flow throughout the year between Caseys Weir and Waggarandall Weir. The flow below Waggarandall Weir is mainly influenced by rainfall and catchment run-off. These changes have reduced the amount of permanent aquatic habitat.

Delivery of water for the environment to the Broken River is primarily constrained by the small volume of water holdings in the Broken system. Environmental water holders can trade water into the Broken system from other trading zones subject to relevant limits and conditions to meet environmental needs.

The bulk entitlement for the Broken system held by Goulburn-Murray Water stipulates that a minimum environmental flow – also known as passing flow – is to be maintained in the Broken River when there are natural flows into the system. The bulk entitlement also allows Goulburn-Murray Water and the Goulburn Broken CMA to agree to reduce the minimum passing flow and accumulate unused volumes for later releases that will provide a greater environmental benefit. In recent years, the

passing flow has been reduced, accumulated and delivered to maintain a low flow (on days when there is no passing flow due to no natural flow into the system) and freshes in the Broken River. Accumulated passing flow is the first volume lost when the storage spills. Environmental flows in upper Broken Creek are restricted by the volume of available supply, channel capacity and the need to avoid flooding low-lying, adjacent land.

Return to start of section

Figure 5.5.1 The Broken system

Return to start of section

Environmental values

The Broken River retains one of the best examples of healthy in-stream vegetation in a lowland river in the region. A range of native submerged and emergent plant species, including eelgrass, common reed and water ribbons, populate the bed and margins of the river. These plants provide habitat for a range of animals, including small- and large-bodied native fish. Murray cod, Macquarie perch, golden perch, silver perch, river blackfish, mountain galaxias, southern pygmy perch and Murray-Darling rainbowfish all occur in the Broken River. The river also supports a large platypus population.

Upper Broken Creek is dominated by unique box streamside vegetation and remnant plains grassy woodland. The creek and its streamside zone support numerous threatened species, including brolga, Australasian bittern, buloke and ridged water-milfoil. Much of the high-quality native vegetation in the region is set aside as a natural features reserve. Upper Broken Creek supports a variety of native fish species, including carp gudgeon, Murray cod, golden perch and Murray-Darling rainbowfish, as well as platypus and common long-necked turtle.

The Broken River and upper Broken Creek are listed in the *Directory of Important Wetlands in Australia*.

Environmental objectives in the Broken River and upper Broken Creek
Maintain native fish populations
Turn over bed sediments and scour around large wood to maintain in-channel habitat diversity
Maintain platypus populations
Maintain in-stream vegetation
Maintain a wide range and high biomass of waterbugs to break down dead organic matter and support the river's food web
Maintain water quality

Traditional Owner cultural values and uses

The Broken River system flows through Taungurung and Yorta Yorta Country. The Broken Creek is on Yorta Yorta Country.

The Taungurung Land and Waters Council and the Yorta Yorta Nation Aboriginal Corporation are members of the Broken Environmental Water Advisory Group. Water for the environment in the Broken system supports the health of cultural values and landscapes, including intangible cultural heritage, valued species and traditional food and medicine plants.

Each year, the Goulburn Broken CMA meets with the Taungurung Land and Waters Council and the Yorta Yorta Nation Aboriginal Corporation to discuss plans for environmental watering in the Broken River and upper Broken Creek. Meetings were held in early 2023 to discuss 2023-24 environmental watering priorities. Both groups support the proposed watering actions.

The Taungurung Land and Waters Council plans to assess cultural values and objectives for the Broken River through healthy Country assessments like Aboriginal Waterway Assessments. These will help the council develop more-specific cultural objectives for the Broken River system in future as well as culturally informed recommendations for water for the environment.

In 2021, the Yorta Yorta Nation Aboriginal Corporation provided the following statement about the cultural values of the Broken River system, including Broken Creek:

> *"The Broken River (and Broken Creek) holds many cultural values. Common reed contained within the slack water provides important material for tools while also providing refuge for culturally important fish species (large- and small-bodied). The river also has significant stands of old-growth river red gum containing important habitat and exhibiting scars made from carving out canoes and coolamons."*

Return to start of section

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.5.1, the Goulburn Broken CMA considered how environmental flows could support values and uses, including:

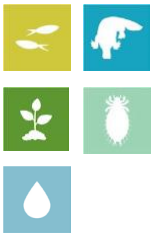
- water-based recreation (such as canoeing, fishing, kayaking and swimming)
- riverside recreation (such as birdwatching, bushwalking, camping, duck hunting and picnicking)
- green and blue spaces important to the community for wellbeing and mental health due to the otherwise dry environment
- community events and tourism (such as markets around Benalla Lake)
- socioeconomic benefits (such as maintaining the volume of water in the lower sections to optimise the efficiency of deliveries of consumptive water, maintain water quality for irrigation, stock and domestic use and support terrestrial birds that help control agricultural pests).

Scope of environmental watering

The term 'environmental watering' refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.5.1 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.5.1 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Broken River and upper Broken Creek

Potential environmental watering action	Expected watering effects	Environmental objectives
Upper Broken Creek[1]		
Winter low flow (5-10 ML/day during June to August)	• Maintain aquatic habitat and connections between weir pools for native fish and platypus • Inundate benthic surfaces and large wood located at the bottom of the channel, which serves as habitat for waterbugs • Maintain water quality and oxygen levels for native fish, platypus and waterbugs	
Spring low flow (5-10 ML/day during September to November)		
Summer low flow (5-10 ML/day during December to February)		
Autumn low flow (5-10 ML/day during March to May)		
Summer/autumn fresh (one fresh of 50-100 ML/day for 10 days during December to May)	• Flush pools to improve their water quality and increase oxygen levels	
Broken River (reaches 1, 2 and 3)[2]		
Winter low flow (15-100 ML/day during June to August)	• Maintain habitat for in-stream and fringing vegetation, and prevent terrestrial vegetation from colonising the stream bed • Maintain riffles, pools and slackwater to provide diverse hydraulic habitat for native fish, aquatic plants, platypus and waterbugs • Maintain water quality and oxygen levels for native fish, platypus and waterbugs	
Spring low flow (15-100 ML/day during September to November)		
Summer low flow (15-100 ML/day during December to May)		
Autumn low flow (15-100 ML/day during March to May)		

Potential environmental watering action	Expected watering effects	Environmental objectives
Summer/autumn fresh (one fresh of 400-500 ML/day for two to five days during December to May)	• Scour sediments around large wood, turn over bed sediments, replenish biofilms and maintain macrophyte habitat • Provide flow cues to stimulate native fish to breed and migrate • Maintain longitudinal connectivity for native fish passage	

1 Potential watering actions in upper Broken Creek will be delivered at a lower magnitude if insufficient water is available to achieve the target magnitude.
2 30-100 ML/day is the recommended flow required to ensure optimal habitat and water quality is achieved in the Broken River. When water availability is low, a flow may need to be delivered at 15 ML per day to provide the minimum habitat and water-quality requirements to sustain populations of fish, platypus and vegetation while conserving enough water to deliver throughout the year.

Scenario planning

Table 5.5.2 outlines potential environmental watering and expected water use in a range of planning scenarios.

The small environmental water entitlement restricts the scope of watering actions that can be delivered in the Broken River system. Therefore, there is little scope to change the proposed watering actions from year to year to enhance outcomes associated with events such as the 2022 floods. The proposed actions presented in Table 5.5.2 are similar to those that have been delivered in previous years.

There are two sets of watering actions: one for upper Broken Creek and another for the Broken River. Delivering flow to upper Broken Creek is a higher priority because upper Broken Creek has no inflows from tributaries and relies more on operational water deliveries and water for the environment. The potential watering actions for upper Broken Creek require less water than those for the Broken River. Any environmental flows delivered to upper Broken Creek will pass through reaches 1 and 2 of the Broken River, where they will provide some environmental benefit.

All potential watering actions in the Broken River and upper Broken Creek are required across all planning scenarios. There is expected to be insufficient water for the environment to meet any of them in the drought planning scenario, or most of them under the dry, average and wet planning scenarios. The VEWH and CEWH may elect to trade water into the system to deliver high-priority actions if a trade opportunity is available.

The main objective of environmental flows in upper Broken Creek is to maintain a low flow throughout the year, to maintain water quality and habitat for native fish, platypus and waterbugs. Maintaining an adequate flow and connectivity is particularly important during spring and summer when native fish, platypus, waterbugs and aquatic vegetation are most active and productive. Water for the environment will likely be prioritised for a spring and summer low flow in the dry, average and wet planning scenarios. This flow will be delivered at the lower end of its recommended ranges under the drier planning scenarios, due to limited supply. It may be delivered at larger magnitudes and longer durations in average and wet conditions to meet more environmental objectives if water allocations allow. Routine summer/autumn freshes are not planned but may be delivered in any planning scenario to help prevent low-oxygen blackwater events. The Goulburn Broken CMA will monitor water-quality conditions in upper Broken Creek and seasonal forecasts, and it may limit the use of water for the environment for low flows during low-risk periods to conserve water for emergency freshes, if needed.

A year-round low flow (in all planning scenarios) and a summer/autumn fresh (under the dry, average and wet planning scenarios) are needed to support Broken River environmental objectives. However, there is little capacity to influence these with environmental water, especially in the drought and dry planning scenarios. Any environmental water allocations in the drought or dry planning scenarios will be prioritised to deliver a flow to upper Broken Creek, and water will need to be traded into the system if a decision is made to supplement low operational deliveries and natural tributary inflows in the Broken River in these planning scenarios. In the average and wet planning scenarios, increased operational deliveries and tributary inflows will help meet the recommended year-round low flow in the Broken River. Water for the environment may be used to supplement any of the recommended low flows in these planning scenarios, but additional water will be required through trade to deliver a summer/autumn fresh.

Carryover requirements have not been identified for the upper Broken Creek and Broken River. The preferred course is to use available water in 2023-24 and seek extra supply through trade in 2024-25, if needed, to meet essential environmental demands.

Return to start of section

Table 5.5.2 Potential environmental watering for Broken River and upper Broken Creek in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• No unregulated flow in Broken River or upper Broken Creek • Low releases of operational water in Broken River • Likely low and cease-to-flow events throughout the year in all reaches	• Low, unregulated flow in Broken River and none in upper Broken Creek • Low releases of operational water in Broken River • Possible low and cease-to-flow events throughout the year in all reaches	• High winter/spring flow in Broken River • Increased releases of operational water in Broken River • Periods of unregulated flow in upper Broken Creek	• High winter/spring flow in Broken River • Increased releases of operational water in Broken River • Periods of unregulated flow in upper Broken Creek with some winter/spring freshes
Expected availability of water for the environment	• 0 ML	• 407 ML	• 647 ML	• 647 ML
Upper Broken Creek				
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Nil	• Spring low flow (partially delivered) • Summer low flow (partially delivered)	• Spring low flow • Summer low flow	
	Tier 1b (supply deficit)			
	• Winter low flow • Spring low flow • Summer low flow • Autumn low flow • Summer/autumn fresh	• Winter low flow • Spring low flow • Summer low flow • Autumn low flow • Summer/autumn fresh	• Winter low flow • Autumn low flow • Summer/autumn fresh	
Broken River (targeting reaches 1, 2 and 3)				
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Nil		• Winter low flow • Spring low flow • Summer low flow • Autumn low flow	
	Tier 1b (supply deficit)			
	• Winter low flow • Spring low flow • Summer low flow • Autumn low flow	• Winter low flow • Spring low flow • Summer low flow • Autumn low flow • Summer/autumn fresh	• Summer/autumn fresh	
Possible volume of water for the environment required to achieve objectives	• 0 ML (tier 1a) • 4,076 ML (tier 1b)	• 407 ML (tier 1a) • 5,579 ML (tier 1b)	• 647 ML (tier 1a) • 3,401 ML (tier 1b)	
Priority carryover requirements for 2024-25	• N/A			

Return to start of section

5.5.2 Lower Broken Creek

System overview

The lower Broken Creek system is within Yorta Yorta Country, and their cultural connection is evident throughout the landscape. The lower Broken Creek system includes the section of Broken Creek that flows from the confluence of Boosey Creek near Katamatite to the Murray River; and Nine Mile Creek, which is an anabranch of lower Broken Creek that flows from the East Goulburn Main Channel to below Numurkah.

Lower Broken and Nine Mile creeks have been regulated for over a century. Before regulation, the creeks would have had most of their flow in winter/spring and contracted to isolated pools or dried out during summer/autumn. The adjacent floodplain would have also flooded regularly. The creeks now have numerous weirs that maintain a relatively constant water level from mid-August until mid-May to support irrigated agriculture and little flow during the non-irrigation season. These modifications have changed the way native species use the creek and favour invasive species (such as arrowhead). Previously, native

fish would have moved into the creek when it was flowing and returned to the Murray River as it dried. Both creeks now provide year-round habitat for native fish, and fish passage structures allow fish to move between weir pools. Water for the environment is used to support these permanent fish habitats by providing flows to trigger fish movement and support fish passage, encourage the growth of native plants, promote in-stream productivity, control water quality and flush the water fern azolla as necessary.

Regulated water is delivered to lower Broken Creek from the Goulburn and Murray systems via the irrigation channel network. Lower Broken Creek is operated separately from upper Broken Creek and Broken River, which are both supplied from Lake Nillahcootie on upper Broken River.

Water for the environment can be provided to lower Broken Creek from the Goulburn system through the East Goulburn Main Channel and from the Murray system through the Yarrawonga Main Channel. Water is released into lower Broken Creek from several irrigation regulators along the length of lower Broken Creek. The main priority for environmental flows in the lower Broken Creek system is to maintain a minimum flow throughout the year to maintain suitable habitat for native fish. Particular attention is given to reaches 1 and 2 during the non-irrigation season when the flow can stop. The next priority is to deliver freshes in winter/spring to trigger fish movement and spawning, maintain water quality and manage azolla accumulations in reaches 3 and 4. Rices Weir is the measurement point for environmental flows in lower Broken Creek.

Some of the environmental flow targets for lower Broken Creek are partly or wholly met by operational water releases: inter-valley transfers (IVTs) from the Goulburn to the Murray or Barmah Choke bypass that are delivered to meet downstream demands. These operational deliveries mainly occur during peak irrigation demand periods between spring and autumn. Water for the environment may be used to supplement these operational releases and to deliver recommended flow components that are not met by operational releases.

Environmental values

Lower Broken Creek and Nine Mile Creek support a diverse and abundant native fish community, including the threatened Murray cod, golden perch, silver perch, unspecked hardyhead and Murray-Darling rainbowfish.

Sections of lower Broken and Nine Mile creeks have been reserved as state park and natural feature reserves. The associated floodplain and wetland habitats support box-dominated grassy woodland communities and numerous species of state and national conservation significance, including river swamp wallaby grass and the Australasian bittern.

Environmental objectives in lower Broken Creek
Protect and increase native fish populations, including the threatened Murray cod, golden perch and silver perch
Protect platypus populations, particularly outside the irrigation season Protect rakali (water rat) populations, particularly outside the irrigation season
Protect turtle populations, particularly outside the irrigation season
Avoid the excessive build-up of azolla Increase the cover and condition of native in-stream and littoral vegetation communities
Increase the diversity and abundance of waterbug populations
Maintain oxygen levels suitable for aquatic animals

Return to start of section

Traditional Owner cultural values and uses

Lower Broken Creek flows on Yorta Yorta Country.

Each year, the Goulburn Broken CMA meets with the Yorta Yorta Nation Aboriginal Corporation to discuss water for the environment in lower Broken Creek. A meeting was held in early 2023 to discuss 2023-24 environmental watering priorities.

The planned environmental flows for 2023-24 in the lower Broken Creek are supported by the Yorta Yorta Nation Aboriginal Corporation. The flows will support in-stream vegetation and native fish, along with other aquatic plants and animals.

The Goulburn Broken CMA will continue to work with Yorta Yorta People to identify how the management of water for the environment can better support cultural values.

In 2021, the Yorta Yorta Nation Aboriginal Corporation provided the following statement about the cultural values of the Broken River system including lower Broken Creek:

> *"The Broken River and Broken Creek hold many cultural values. Common reed contained within the slack water provides important material for tools while also providing refuge for culturally important fish species (large and small-bodied). The creek also has significant stands of old-growth river red gum containing important habitat and exhibiting scars made from carving out canoes and coolamons."*

The Yorta Yorta Nation Aboriginal Corporation has raised concerns about flow regulation in all their waterways, which is affecting their Country and cultural knowledge.

The Yorta Yorta Nation Aboriginal Corporation continues to pursue the Yorta Yorta People's inherent rights to water for Country. Rights to water will improve their spiritual, cultural, environmental, social and economic needs, in line with the *Yorta Yorta Whole-Of-Country Plan 2021-2030*.

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.5.3, the Goulburn Broken CMA considered how environmental flows could support values and uses, including:

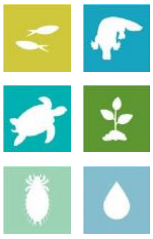
- water-based recreation (such as canoeing, fishing, game hunting and kayaking)
- riverside recreation and amenity (such as aesthetic and amenity values that are particularly important for the community's mental health and wellbeing during dry periods and for passive recreation)
- community events and tourism
- socioeconomic benefits (such as consumptive water users, Goulburn-Murray Water irrigators and diverters and Goulburn Valley Water customers).

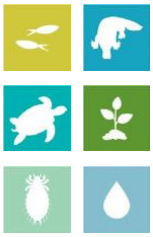
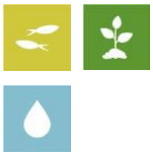
Scope of environmental watering

The term 'environmental watering' refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.5.3 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.5.3 Potential environmental watering actions, expected watering effects and associated environmental objectives for the lower Broken Creek

Potential environmental watering action	Expected watering effects	Environmental objectives
Winter low flow (20-40 ML/day during May to August)1	• Provide native fish with passage through fish ladders • Provide suitable foraging habitat for platypus and rakali (water rats), and support the conditioning of females in preparation for the breeding season • Provide habitat for turtles, including protection from exposure during their winter dormancy • Provide flowing-water habitat and avoid winter drying of weir pools for fish, vegetation, waterbugs, platypus and turtles • Maintain water over submerged aquatic plants so they are protected from drying and frost • Reduce the stagnation of weir pools	

Potential environmental watering action	Expected watering effects	Environmental objectives
Spring/summer/autumn low flow (70-250 ML/ day in reaches 1 and 2 and 200-450 ML/day in reaches 3 and 4 during August to May)	• Provide habitat for native fish, platypus, rakali (water rats), turtles and waterbugs • Support the movement and recruitment of fish • Maintain oxygen levels in summer • Additional benefits when delivered from December to February (at 250-450 ML/day): • mobilise azolla and increase oxygen levels during high-risk periods	
Winter/spring fresh(es) (one to three freshes of 300-450 ML/day for one to two weeks during July to November)	• Flush and mobilise azolla if it has accumulated to maintain water quality • Trigger the movement and spawning of fish • Encourage the germination and growth of littoral and in-stream vegetation • Reduce the stagnation of weir pools	

1 This flow may be difficult to achieve when channel maintenance work is being completed. If maintenance work is required, waterway managers will work with the storage manager to minimise impacts where possible. Possible mitigation actions include closing fishways to maintain water in weir pools and scheduling works to minimise the duration of impacts on flow.

Scenario planning

Table 5.5.4 outlines potential environmental watering and expected water use in a range of planning scenarios.

The high degree of regulation in the lower Broken Creek system means flow patterns in the lower Broken and Nine Mile creeks are the same in all planning scenarios. Water for the environment in the lower Broken Creek system is primarily used to guard against reduced flow during the non-irrigation season.

Potential watering actions in all planning scenarios include maintaining the flow above 40 ML per day outside the irrigation season, ameliorating sudden fluctuations in irrigation demand during the irrigation season and delivering spring freshes to trigger fish movement or flush excessive accumulations of azolla. Delivering spring freshes in 2024-25 in all planning scenarios will be of particular importance to trigger the movement and spawning of native fish in the system after the record flooding and subsequent low-oxygen blackwater event in 2022. These events caused widespread fish deaths in the lower Broken Creek and many parts of the southern connected basin.

The Goulburn Broken CMA will monitor water quality throughout the year, and it may increase the flow to the upper end of the recommended range in Table 5.5.3 if oxygen levels drop below 4.0 mg/L. The total volume of water for the environment that will be needed to achieve planned watering actions in 2023-24 will vary depending on operational deliveries (including IVTs) and the sizes and durations of any unregulated flow events. A carryover target of 5,000 ML applies in all planning scenarios to ensure a minimum low flow and a small fresh can be delivered early in 2024-25.

Return to start of section

Table 5.5.4 Potential environmental watering for lower Broken Creek in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• No unregulated flow	• Some unregulated flow in winter • No unregulated flow throughout the irrigation season (mid-August to May) • No diversion of unregulated Murray River flow is available	• Unregulated flow in winter/spring • Unregulated flow is unlikely from October to May • Diversion of unregulated Murray River flow is available from mid-August to October	• Unregulated flow is likely in winter/ spring • Unregulated flow is possible from November to May • Diversion of unregulated Murray River flow available from mid-August to November
Potential environmental watering – tier 1 (high priorities)[1]	• Winter low flow • Spring/summer/autumn low flow • Winter/spring freshes			
Possible volume of water for the environment required to achieve objectives	• 80,000 ML			
Priority carryover requirements for 2024-25	• 5,000 ML			

1 Tier 1 potential environmental watering for lower Broken Creek is not classified as tier 1a or 1b because the water available for use is shared across various systems and it is not possible to reliably determine the supply specifically available for lower Broken Creek.

Return to start of section

5.5.3 Broken wetlands

System overview

Of some 2,000 natural wetlands in the Goulburn Broken area, only three in the Broken catchment have infrastructure that allows them to receive environmental water: Black Swamp, Kinnairds Wetland and Moodie Swamp.

These wetlands are on the Country of the Yorta Yorta People, whose knowledge and practice are evident throughout the landscape; for example, Black Swamp has evidence of old cooking mounds around its perimeter. Kinnairds Wetland and Black Swamp are red gum swamps near Numurkah. Moodie Swamp is a cane grass wetland adjacent to upper Broken Creek at Waggarandall that provides excellent breeding habitat for brolga.

The water regimes of these wetlands are influenced by their position in the landscape. The development and operation of the Shepparton and Murray Valley irrigation districts have changed the natural flow paths and the timing, frequency, volume and duration of natural flooding to these and other wetlands in the region. The existing irrigation system infrastructure enables water for the environment to be delivered to the three nominated wetlands, but under existing agreements, irrigation deliveries have priority within the channel system. This limits the volume of water that can be delivered to the wetlands. The VEWH, waterway managers and storage managers adjust the timing and rate of environmental deliveries where possible to optimise environmental outcomes within the current system constraints.

Environmental values

Moodie Swamp, Kinnairds Wetland and Black Swamp support a great diversity of vegetation communities ranging from river red gum to cane grass. The wetlands contain state- and nationally-threatened vegetation communities and species, including ridged water-milfoil and river swamp wallaby grass. The wetlands also provide food resources and breeding habitat for bird species of high conservation significance, including eastern great egret, Latham's snipe, white-bellied sea eagle, Australasian bittern, brolga, royal spoonbill, yellow-billed spoonbill, Australasian shoveler and glossy ibis. Many of these species are listed in international agreements and conventions.

Environmental objectives in the Broken wetlands	
	Provide breeding habitat for frogs
	Improve the cover, diversity, recruitment/regeneration and growth of native wetland plant species, consistent with ecological vegetation class benchmarks Reduce the cover and diversity of exotic plant species Maintain populations of ridged water-milfoil
	Provide breeding habitat for waterbirds Provide feeding and roosting habitat for waterbirds

In 2023-24, no active deliveries of water for the environment are planned for the Broken wetlands. The environmental objectives are considered long-term aspirational goals for the system, based on the achievement of multi-year water regimes that involve wetting and drying cycles. Wetland drawdown and drying contribute to important ecosystem processes (such as nutrient cycling and ecosystem productivity). These, in turn, support the achievement of the long-term environmental objectives.

Traditional Owner cultural values and uses

Moodie Swamp, Kinnairds Wetland and Black Swamp support various native plants and animals that provide many cultural values and uses for the Yorta Yorta People. Black Swamp and Kinnairds Wetland support multiple varieties of nardoo (a food source), native grasses (such as old man weed and sneezeweed, which have medicinal uses) and sedges and rushes (used for basket weaving). Basket weaving sedges also grow at Moodie Swamp.

Each year, the Goulburn Broken CMA meets with the Yorta Yorta Nation Aboriginal Corporation about the management of water for the environment in the Broken system, including the Broken wetlands. The Yorta Yorta Nation Aboriginal Corporation is also a member of the Broken Environmental Water Advisory Group, which meets with the CMA two or three times a year.

The Yorta Yorta Nation Aboriginal Corporation supports the planned drying of Moodie Swamp, Kinnairds Wetland and Black Swamp in 2023-24.

Return to start of section

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.5.5, the Goulburn Broken CMA considered how environmental flows could support values and uses, including:

- water-based recreation (such as canoeing)
- riverside recreation and amenity (such as birdwatching, camping, picnicking, photography, walking and hunting)
- community events and tourism (such as community gatherings at Kinnairds Wetland and the Walk and Squawk event)
- socioeconomic benefits (such as tourism, which is a large contributor to the local economy).

Scope of environmental watering

The term 'environmental watering' refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.5.5 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.5.5 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Broken wetlands

Potential environmental watering action	Expected watering effects	Environmental objectives
• No deliveries of water for the environment are planned in 2023-24		

Scenario planning

Table 5.5.6 outlines potential environmental watering and expected water use in a range of planning scenarios.

In September and October 2022, there was widespread flooding in the Broken system, which filled all the floodplain wetlands, including Black Swamp, Kinnairds Wetland and Moodie Swamp. Black Swamp and Kinnairds Wetland reached their optimum fill period of six to eight months during 2022-23. Moodie Swamp received natural inflows from Broken Creek in January, February and October 2022. It was still holding a significant volume during autumn 2023, and aquatic plant diversity may be beginning to decline because of this prolonged inundation.

All three wetlands will be allowed to complete a full natural drawdown during 2023-24 to support dry-phase ecological processes and help eradicate the large number of carp that entered the wetlands during the 2022 floods. Each wetland has a recommended dry phase of at least six months, and staged watering will likely resume at these wetlands from 2024-25.

Table 5.5.6 Potential environmental watering for the Broken wetlands in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• Catchment run-off and natural flow into the wetlands are highly unlikely	• Catchment run-off and natural flow into the wetlands are unlikely	• Some catchment run-off and natural flow into some of the wetlands are likely, particularly in winter/spring	• Catchment run-off and natural flow into the wetlands may significantly contribute to water levels in the wetlands, particularly in winter/spring
Potential environmental watering – tier 1 (high priorities)	• N/A: No deliveries of water for the environment are planned in 2023-24			
Potential environmental watering – tier 2 (additional priorities)	• N/A			

Planning scenario	Drought	Dry	Average	Wet
Possible volume of water for the environment required to achieve objectives	• N/A			
Priority carryover requirements for 2024-25	• N/A			

Return to start of section

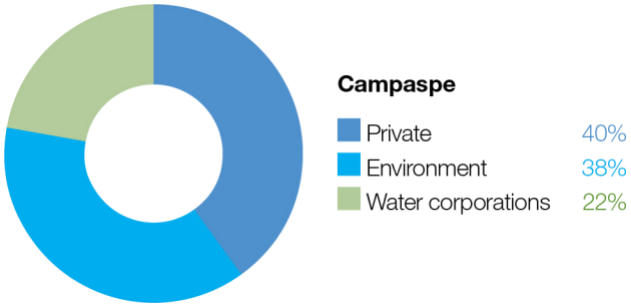
5.6 Campaspe system

Waterway manager – North Central Catchment Management Authority

Storage manager – Goulburn-Murray Water

Environmental water holders – Victorian Environmental Water Holder (including the Living Murray program) and Commonwealth Environmental Water Holder

Proportions of water entitlements in the Campaspe basin held by private users, water corporations and environmental water holders on 30 June 2020



The Campaspe system includes the Campaspe and Coliban rivers.

5.6.1 Campaspe River

System overview

Natural inflows in the upper Campaspe River catchment are harvested into Lake Eppalock, which is located near the townships of Axedale and Heathcote. The main tributaries of the Campaspe River are the Coliban River, McIvor and Wild Duck creeks above Lake Eppalock and Mount Pleasant, Forest and Axe creeks below Lake Eppalock (Figure 5.6.1).

Below Lake Eppalock, the major in-stream structure is the Campaspe Weir, which was built to divert water to the Campaspe Irrigation District. It is no longer used for water diversion but is a barrier to fish migration. Gates on the weir provide some degree of control over the flow, but greater flow spills over the weir. The Campaspe Siphon, just below Rochester, is part of the Waranga Western Channel, which carries water from the Goulburn system to western Victoria. Water can be released from the Waranga Western Channel into the lower reaches of the Campaspe River, but the siphon is another barrier to fish migration when there is low-to-moderate flow.

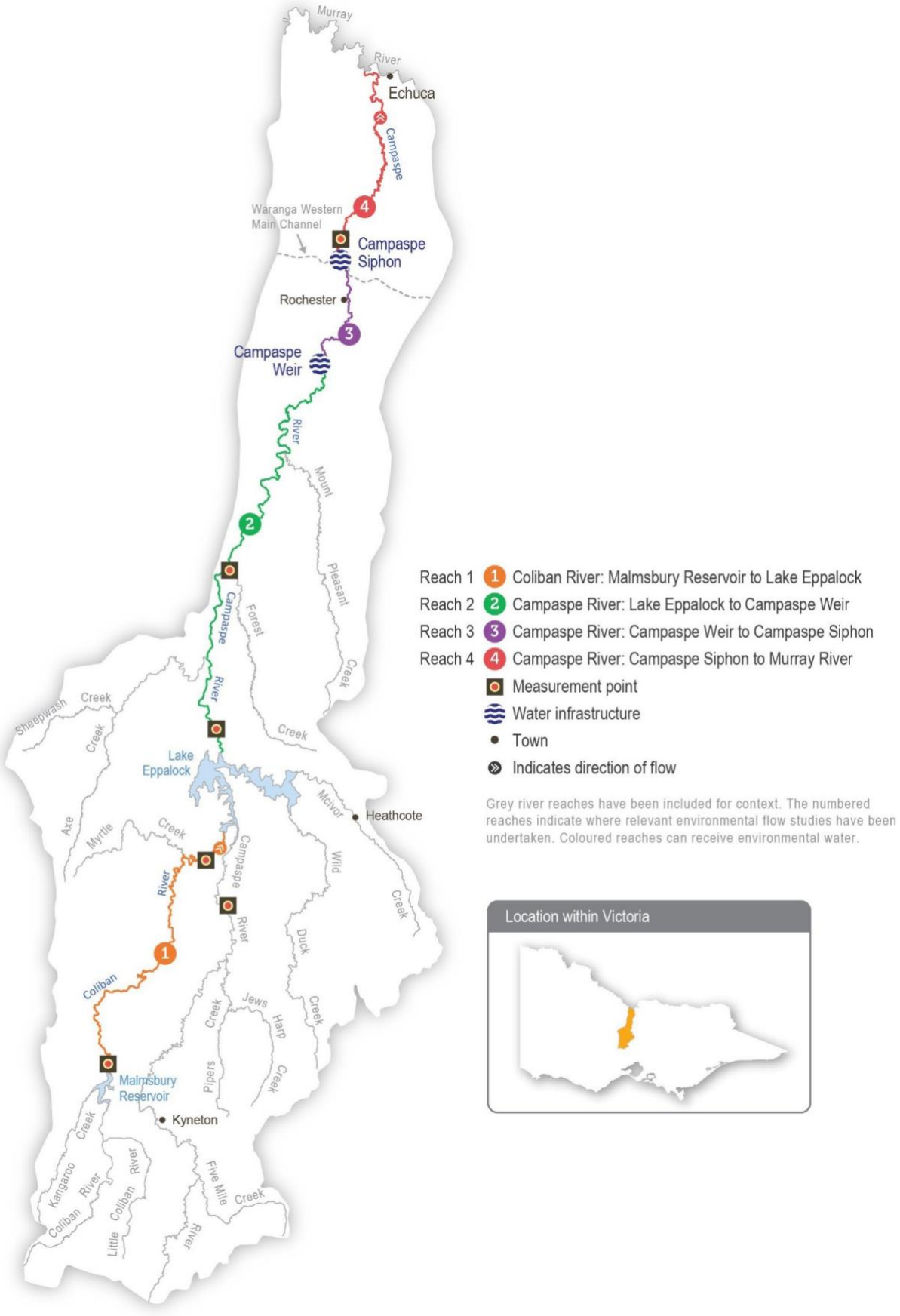
The flow below Lake Eppalock is largely influenced by releases from storage and the operation of the Campaspe Weir and the Campaspe Siphon. The Campaspe's major tributary (the Coliban River) flows through the three Coliban Water storages (the Upper Coliban, Lauriston and Malmsbury reservoirs) before reaching Lake Eppalock. Water for the environment is held and released from Lake Eppalock, with some limited ability to regulate flow further downstream at the Campaspe Weir.

Water for the environment is released from Lake Eppalock to support aquatic plants and animals in and along the Campaspe River. It can be supplemented by water for the environment delivered via the Waranga Western Channel at the Campaspe Siphon, which provides important flexibility to meet environmental demands in reach 4. Water for the environment is primarily used in the Campaspe River to improve the magnitude and variability of flow during winter and spring, but it is also used to deliver critical flow in summer and autumn that is not met or exceeded by operational deliveries. Primary flow measurement points are at Barnadown (reach 2) and below the Campaspe Siphon (reach 4).

Goulburn-Murray Water transfers operational water from Lake Eppalock or through Waranga Western Channel to customers in the Murray River and to downstream storages (such as Lake Victoria). These inter-valley transfers (IVTs) usually occur in summer and autumn and, depending on the rate of delivery, can either support or compromise environmental flow objectives. High IVT flows delivered at a time when the Campaspe River would naturally have low flow may reduce the amount of suitable habitat for juvenile fish, which rely on protected, shallow areas of water near the edge of the river channel. Sustained high IVT flows in summer can also drown recruiting streamside vegetation. Storage managers and the North Central CMA have been working cooperatively to enhance the positive effects and limit the negative effects of IVTs on native plants and animals in the Campaspe River. For example, IVTs are sometimes delivered in a pattern that meets summer low-flow and fresh requirements, thereby reducing demand for the environmental entitlement. IVTs have also been released in a pattern to support native fish migration from the Murray River into reach 4 of the Campaspe River without affecting delivery to downstream users.

Return to start of section

Figure 5.6.1 The Campaspe system



Return to start of section

Environmental values

The Campaspe River below Lake Eppalock provides important habitat for several native fish species, including Murray cod, silver perch, golden perch, Murray-Darling rainbowfish and flat-headed gudgeon. Murray-Darling rainbowfish were presumed lost from the system during the Millennium Drought, but since 2011, they have been recorded at many sites on the Campaspe River and are now abundant below Elmore. Environmental flows help native fish migrate and disperse throughout the Campaspe system.

Platypus, rakali (water rats), turtles and frogs are also present along the length of the Campaspe River. The streamside vegetation zone is narrow and dominated by large, mature river red gum trees that support wildlife (such as the swift parrot and squirrel glider).

Environmental objectives in the Campaspe system	
	Protect and increase populations of native fish Facilitate recolonisation by native fish species (including trout, cod and blackfish) that have been presumed lost
	Enhance the channel form and features, including deep pools and benches Maintain the condition of suitable substrate to maintain ecosystem processes Engage floodrunners, distributary channels, anabranches and backwaters
	Protect the resident platypus population
	Maintain adult river red gums and increase the recruitment of immature trees Maintain the extent and increase the diversity of streamside vegetation Increase the extent of in-stream aquatic plants
	Increase the diversity and biomass of waterbugs
	Maintain water quality in deep pools and prevent stratification in summer Reduce the risk of low-oxygen blackwater events in summer

Traditional Owner cultural values and uses

The Campaspe River flows through Dja Dja Wurrung, Taungurung and Yorta Yorta Country.

In planning for environmental flows in the Campaspe River in 2023-24, the North Central CMA met with Dja Dja Wurrung Clans Aboriginal Corporation (trading as Djaara), the Taungurung Land and Waters Council and the Yorta Yorta Nation Aboriginal Corporation (YYNAC) to discuss how cultural objectives can be supported by water for the environment and the importance of Traditional Owner involvement in the management of water on Country.

The following meetings were held in early 2023:

- the North Central CMA met with Djaara to discuss environmental water management in the Campaspe River in 2023-24. Discussions covered reflections on the previous water year, current conditions in the Campaspe River and how Djaara would like to input to planning in 2023-24 and beyond
- the North Central CMA attended a YYNAC meeting to discuss potential watering in the Campaspe in 2023-24, potential cultural heritage impacts and how YYNAC would like to be involved in environmental water planning and management for the upcoming year
- the North Central CMA attended a Taungurung Land and Waters Council Baan Ganalina meeting to discuss the 2022-23 floods and plans for environmental watering in 2023-24. Baan Ganalina members discussed with North Central CMA the Taungurung Reading Water Country program, including recent monitoring and collection of biocultural knowledge at seven sites on the Campaspe River.

Through the Taungurung Reading Water Country program, Baan Ganalina has developed Taungurung cultural objectives for the Campaspe River. These cultural objectives recognise the interconnectedness of people and Country and the central role of Traditional Owners in speaking for Country.

Regarding water management, Baan Ganalina emphasises the principle of ‘right way water: right time, right place, right amount’. ‘Right way water’ includes flows at varying and seasonally appropriate levels that reconnect backwaters, that maintain water quality and that do not damage cultural sites.

Return to start of section

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.6.1, the North Central CMA considered how environmental flows could support values and uses, including:

- water-based recreation (such as canoeing, kayaking, fishing and water sports)
- riverside recreation and amenity (such as birdwatching, bushwalking, camping, cycling, duck hunting and picnicking)
- community events and tourism (such as visitors travelling to canoe and kayak on the river)
- socioeconomic benefits (such as diversions for irrigation, domestic and stock uses; local and regional economic benefits from increased visitation; ecosystem services [such as carbon storage, groundwater recharge and water-quality regulation]; lower salinity management costs, lower blackwater and blue-green algae risks for landholders; and contributions to community enjoyment, health and recuperation).

If the timing or management of planned environmental flows may be modified to align with a community benefit, this is acknowledged in Table 5.6.1 with the following icon.

Watering planned to support peaks in visitation (e.g. camping or other public activities on long weekends or school holidays)

There are many places along the Campaspe River where visitors like to camp. Aysons Reserve is a popular camping site near Elmore, and it draws hundreds of campers during school holiday periods. Where possible, freshes are delivered outside of peak visitation periods (such as the March and April long weekends) to ensure the flow is not too high for campers and water-related activities.

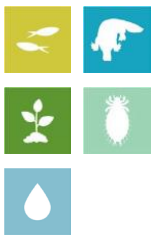
Scope of environmental watering

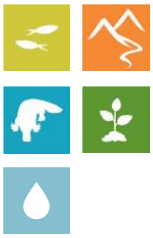
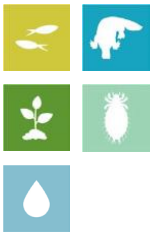
The term 'environmental watering' refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.6.1 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.6.1 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Campaspe River

Potential environmental watering action	Expected watering effects	Environmental objectives
Campaspe River (targeting reach 4)		

Winter/spring low flow (40-200 ML/day during June to November)	• Maintain longitudinal connectivity to allow native fish to disperse within reaches
	• Provide foraging opportunities across a wide range of habitats for female platypus to develop fat reserves before breeding
	• Maintain water quality by preventing pools from stratifying
	• Discourage terrestrial plants from colonising the lower sections of the riverbank and low benches in the channel
	• Maintain soil moisture in the riverbank to water established river red gums and woody shrubs
	• Help establish littoral vegetation[1]
	• Provide a variety and large abundance of habitats for high macroinvertebrate productivity supporting food webs
	• Greater-magnitude flows will facilitate:
	  • long-distance movement by male platypus, especially in the August to October breeding season
	  • greater movement of large-bodied native fish
		

Potential environmental watering action	Expected watering effects	Environmental objectives
Winter/spring fresh(es) (one to two[2] freshes 1,000-1,600 ML/day for two to five days during June to November)	• Flush accumulated leaf litter from the banks and low benches to reduce the risk of blackwater events during high river flow in summer • Maintain soil moisture for established river red gum and woody shrubs (such as bottlebrush and tea tree) • Provide sufficient velocity to scour accumulated sediment from pools and scour biofilms • Maintain connectivity to allow native fish to move and access new habitat • Encourage female platypus to select nesting burrows higher up the bank to reduce the risk of a high flow later in the year flooding burrows when juveniles are present	
Summer/autumn low flow (40-50 ML/day[3] at the Campaspe Siphon during December to May)	• Maintain slackwater habitats for zooplankton and nursery habitats for native fish • Maintain the water depth and prevent stratification in deep pools in summer to maintain habitat for native fish and platypus • Inundate a variety of habitats to facilitate the growth of biofilms and support waterbug productivity • Allow platypus to safely move between pools while foraging, and ensure there is adequate food for lactating females *Reducing flow to 20 ML/day in reaches 2 and 3 in autumn will expose mudflats and encourage the recruitment of some fringing vegetation*	
Summer/autumn freshes (three freshes of 100-200 ML/day for two to three days during December to May) 	• Promote the germination, growth and survival of fringing emergent macrophytes, including phragmites, reeds and sedges, by inundating the lower banks and low benches to wet the soil • Promote the local movement of adult fish to access alternative habitats and trigger migration from the Murray River • Increase longitudinal connectivity to allow native fish to access new habitats • Wet submerged wood and flush fine silt and old biofilms to promote new biofilm growth and increase waterbug productivity for native fish and platypus • Facilitate the downstream dispersal of juvenile platypus in April/May to colonise other habitat areas	
Year-round fresh (trigger-based, 50-200 ML/day as required) *Triggers:* • *oxygen level is below 5 mg/L* • *low or cease-to-flow river conditions* • *high water temperatures*	• Destratify pools and improve water quality (increase oxygen levels) along the river in reach 4, ensuring there is adequate oxygen to support aquatic animals (such as native fish and platypus)	

1 A greater-magnitude flow rate will wet a larger perimeter of the riverbank, supporting increased littoral vegetation.
2 A second winter/spring fresh may be delivered in the average and wet planning scenarios to further enhance the river conditions if required.
3 The reach 4 flow will target 40-50 ML/day. However, a reduction in the flow to 20-30 ML/day at reaches 2 and 3 may be considered in autumn to expose the river's mudflats and promote native vegetation recruitment. To achieve these two flow rate targets, water for the environment from the Goulburn River flow will need to be delivered to reach 4 at the Campaspe Siphon.

Return to start of section

Scenario planning

Table 5.6.2 outlines potential environmental watering and expected water use in a range of planning scenarios.

Following consecutive years of high seasonal determinations, frequent unregulated flows and floods and storages close to capacity, the supply outlook for 2023-24 is expected to be strong in all planning scenarios. It is expected all planned environmental watering actions will be achieved at magnitudes consistent with seasonal tolerances.

Initial post-flood surveys along the Campaspe River in January and February 2023 indicated the 2022 floods provided a net benefit to the river's native vegetation. Although there has been a loss of aquatic (in-stream) vegetation, their root masses remain in place within the bed of the river and are expected to recover quickly. The flood also removed exotic weeds and terrestrial species from the riverbanks. It is important that all potential environmental watering actions are delivered in 2023-24 to consolidate the environmental benefits of the 2022 floods, including maximising the opportunity to increase the extent and diversity of native streamside and in-stream vegetation in the absence of exotic and terrestrial vegetation species.

Planned watering actions for the Campaspe River aim to meet low-flow targets throughout the year and to deliver a mix of small and medium-sized freshes in all planning scenarios. Under drought and dry planning scenarios, freshes and the winter/spring low flow will likely be delivered at the lower end of the target magnitude ranges, in line with climate conditions and limited natural and passing flow. In the average and wet planning scenarios, some watering actions will likely be achieved naturally. This means that water for the environment can be used to deliver freshes and a winter-spring low flow at the

higher end of their recommended magnitude to help increase the size and condition of platypus, native fish and native plant populations. A second winter/spring fresh will only be delivered if it can be timed to not interfere with potential Murray cod breeding. The North Central CMA will monitor water levels and water quality throughout the year and deliver trigger-based freshes in any planning scenario, if needed to mitigate poor water quality.

The flow may be lowered to about 20 ML per day in reaches 2 and 3 in autumn in all planning scenarios to encourage the recruitment of fringing plants on exposed mudflats. This would be a joint initiative between the North Central CMA and vegetation ecologists from the Arthur Rylah Institute, and it will be supported by dedicated monitoring if it proceeds. Lowering the flow in reach 4 may pose a risk to water quality, so the watering trial will only proceed if sufficient water can be delivered from the Western Waranga Channel to supplement the flow downstream of the Campaspe Siphon.

The carryover target for 2023-24 is based on the volume required to deliver a priority summer/autumn low flow during 2024-25 if there is a return to dry or drought conditions. No carryover targets are set for the average/wet planning scenario, as early-season allocations are likely to be sufficient to meet summer/autumn low flow environmental flow demands.

Table 5.6.2 Potential environmental watering for the Campaspe River in a range of planning scenarios

Planning scenario	Drought	Dry	Average to wet
Expected conditions	• Little to no natural flow from tributaries and local run-off • Low passing flow • Operational water deliveries	• Some natural flow from tributaries and local run-off • Increased passing flow • Operational water deliveries	• Moderate-to-high natural flow from tributaries and local run-off • Increased passing flow • An expected spill of Eppalock Reservoir
Expected availability of water for the environment	• 34,500 ML	• 34,500 ML	• 27,500 ML
Campaspe River (targeting reach 4)			
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**		
	• Winter/spring low flow (lower magnitude) • Winter/spring fresh (one of lower magnitude) • Summer/autumn low flow[1] • Summer/autumn freshes (three of lower magnitude) • Year-round fresh (if required)	• Winter/spring low flow (lower magnitude) • Winter/spring fresh (one of lower magnitude) • Summer/autumn low flow[1] • Summer/autumn freshes (three of lower magnitude) • Year-round fresh (if required)	• Winter/spring low flow • Winter/spring fresh(es) (one to two freshes[2]) • Summer/autumn low flow[1] • Summer/autumn freshes (three freshes) • Year-round fresh (if required)
	Tier 1b (supply deficit)		
	• N/A	• N/A	• N/A
Potential environmental watering – tier 2 (additional priorities)	• N/A		

Planning scenario	Drought	Dry	Average to wet
Possible volume of water for the environment required to achieve objectives	• 28,500 ML (tier 1a) • 900 ML[3] (tier 1a Goulburn)	• 28,500 ML (tier 1a) • 900 ML[3] (tier 1a Goulburn)	• 27,500 ML (tier 1a) • 900 ML[3] (tier 1a Goulburn)
Priority carryover requirements for 2024-25	• 6,000 ML	• 6,000 ML	• N/A

1 This potential watering action may have a period of a lower flow rate in reaches 2 and 3 (20 ML/day) while maintaining the 40-50 ML/day flow in reach 4. To achieve this outcome, water for the environment from the Goulburn will need to be delivered to reach 4 at the Campaspe Siphon.
2 A second winter/spring fresh may be delivered in the average and wet planning scenarios to further improve streamside vegetation by wetting riverbanks, support fish movement and clear accumulated leaf litter to reduce the risk of blackwater events during the summer high flow.
3 The possible volume of water required from the Goulburn could increase up to 2,200 ML if it is more effective to source water from Waranga Western Channel to deliver a year-round fresh to reach 4 at the Campaspe Siphon.

5.6.2 Coliban River

System overview

The Coliban River is the major tributary of the Campaspe River and flows into Lake Eppalock. It is highly regulated, with three storages harvesting water primarily for urban use.

Flow in the Coliban River below Malmsbury Reservoir is regulated by the operation of the Malmsbury, Lauriston and Upper Coliban reservoirs. An important distinction between the Coliban River and other regulated Victorian systems is the lack of irrigation demand that may be met by managed releases downstream of system storages. Flow in the river is influenced by the passing flow entitlement, which depends on catchment inflows and major flood events in the catchment.

The VEWH does not have any environmental entitlements in the Coliban system, but the passing flow can be managed – for example, it can be accumulated and released when most needed – to help mitigate some risks associated with a critically low summer/autumn flow, including low oxygen levels in the river between Malmsbury Reservoir and Lake Eppalock. A small volume of Commonwealth water for the environment is held in the system but has a high delivery cost. There is no plan to use the water in 2023-24.

Environmental values

The Coliban River provides important habitat for platypus, rakali (water rats) and small-bodied native fish (such as flat-headed gudgeon and mountain galaxias). The Coliban River also contains a diverse range of waterbugs supported by stands of emergent and submergent aquatic vegetation. It is bordered by remnant patches of streambank shrubland vegetation and woodland containing river red gum, callistemon, woolly tea tree and inland wirilda, which provide habitat for terrestrial animals.

Environmental objectives in the Coliban River	
	Increase the abundance and diversity of small-bodied native fish Facilitate recolonisation by native fish species (including river blackfish) that have been presumed lost
	Maintain the platypus population
	Increase the cover and diversity of aquatic plants Increase the cover and diversity of fringing vegetation while limiting encroachment into the middle of the channel Maintain streamside woody vegetation and facilitate recruitment
	Maintain an adequate diversity and biomass of waterbugs to break down dead organic matter and supply the river's food chain
	Maintain water quality to support aquatic life and ecological processes

Return to start of section

Traditional Owner cultural values and uses

The Coliban River system is on Dja Dja Wurrung Country.

The Djaara (Dja Dja Wurrung people) Nation Statement in the Victorian Government's *Water is Life: Traditional Owner Access to Water Roadmap 2022* and the *Dhelkunya Dja (Healing Country) Country Plan 2014-2034* both describe Djaara's aspirations around the management of water on their Country.

Djaara's Kapa Gatjin (water advisory) Group and the North Central CMA have been working together to identify sites where water for the environment can support Djaara's aspirations for the Coliban River. They have also been identifying opportunities for Djaara to be more involved in managing and administering environmental water, with the aim of Djaara ownership and management of environmental water.

In recent years, Djaara has completed several Aboriginal Waterways Assessments in the upper and lower catchments of the Coliban River.

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.6.3, the North Central CMA considered how environmental flows could support values and uses, including:

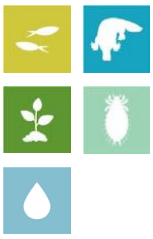
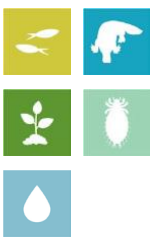
- water-based recreation (such as swimming, canoeing and fishing)
- riverside recreation and amenity (such as socialising, relaxing, birdwatching, bushwalking, camping and cycling)
- socioeconomic benefits, including tourism to Malmsbury, diversions for domestic and stock uses, benefits to the local and regional economies from recreational activities, ecosystem services (such as carbon storage, groundwater recharge and water-quality regulation), lower salinity costs and blackwater and blue-green algae risks for landholders and contributions to community enjoyment, health and recuperation.

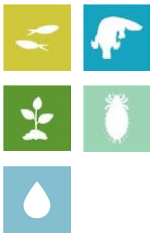
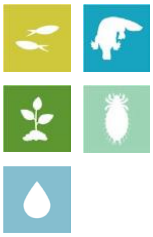
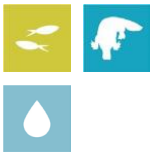
Scope of environmental watering

The term 'environmental watering' refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.6.3 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.6.3 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Coliban River

Potential environmental watering action	Expected watering effects	Environmental objectives
Coliban River (targeting reach 1)		
Winter/spring low flow (2-10 ML/day during June to November)	• Maintain up to 6 cm water depth between pools for native fish movement and maintain river pool depth • Maintain wet areas for native aquatic and streamside plants • Prevent stagnation and a decline in water quality • Maintain aquatic habitat that supports waterbugs, native fish and platypus	
Winter/spring fresh (one fresh of up to 160 ML/day for three to five days during June to September)	• Maintain up to 65 cm water depth between pools so native fish can disperse throughout the river and colonise sites • Encourage female platypus to select a nesting burrow higher up the bank to reduce the risk of a greater flow later in the year flooding the burrow when juveniles are present • Increase the wetted river perimeter for fringing and edge vegetation • Increase the wetted river perimeter to increase habitat for waterbugs • Flush organic matter to reduce the risk of declining water quality in summer	

Potential environmental watering action	Expected watering effects	Environmental objectives
Summer/autumn low flow (2-10 ML/day during December to May)	• Maintain up to 6 cm water depth between pools for native fish movement, and maintain river pool depth • Wet the channel to maintain in-stream aquatic and fringing vegetation • Maintain aquatic habitat that supports waterbugs, native fish and platypus • Maintain water quality, including oxygen levels	
Summer/autumn fresh(es) (one to two freshes of 25-160 ML/day for three to five days during December to May)	• Increase the water depth through riffle-run habitats to 8-20 cm for a 25-50 ML/day event to maintain water quality and habitat for waterbugs • Increase the water depth through riffle-run habitats to 45-60 cm for a 160 ML/day event to: • facilitate the movement of fish and platypus • clean sediment and biofilms from river substrates • wet the benches and low banks to promote the growth and recruitment of fringing vegetation	
Pulsed summer/autumn low flow (5-15 ML/day for up to 14 days during December to May, trigger-based) *Triggers:* • *oxygen level is below 5 mg/L* • *low or cease-to-flow river conditions* • *high water temperatures*	• Improve water quality, including oxygen levels • Maintain refuge habitat for aquatic animals, including fish and platypus	

Scenario planning

Table 5.6.4 outlines potential environmental watering and expected water use in a range of planning scenarios.

The potential environmental flows required for the Coliban River include a low flow and freshes in all planning scenarios, but the magnitude of particular flows and the number and duration of freshes that can be delivered varies between planning scenarios, due to available supply and the expected contribution of natural flows in the system. Where supply is limited, a low flow will be delivered at the lower end of the recommended magnitude to maintain some connecting flow for a longer period. Freshes will be delivered where possible to facilitate the dispersal of platypus and fish and clean biofilms from in-stream surfaces.

In all planning scenarios, the highest-potential watering action in the Coliban River is the summer/autumn low flow to maintain sufficient habitat for native fish, platypus and waterbugs. Natural baseflow and tributary inputs help to maintain some flow through the Coliban River during winter and spring each year, but long sections of the river contract to a series of pools or completely dry during late summer and autumn, especially in dry and drought years. Deliveries of water for the environment in summer and autumn help to maintain water quality, especially when oxygen levels are low. They also maintain the depth of pools in the upper reaches to help sustain populations of native fish and platypus.

In August 2022, Malmsbury Reservoir spilled, resulting in the loss of water held in the Passing Flows Account, including water carried over from 2021-22. The accrual of passing flow resumed in December 2022 when the reservoir ceased spilling, and some of that water was used to deliver a summer/autumn fresh in April 2023. As a result, limited water is expected to be available to carry over into 2023-24. Providing Malmsbury Reservoir does not spill again over winter/spring 2023, any water carried over from 2022-23 will be used to help maintain a continuous low flow in all planning scenarios in 2023-24. If a continuous flow cannot be maintained, shorter, pulsed flows may be delivered to maintain pool habitats for native fish and platypus. These trigger-based pulses will most likely be needed in the dry planning scenario, but may also be needed in the wetter planning scenarios if there is insufficient supply to deliver a continuous low flow in late summer or early autumn. Where possible, summer and autumn freshes will be delivered to facilitate the movement of fish and platypus and support fringing vegetation. These freshes will aim to be delivered in March or April to support the dispersal of juvenile platypus and reduce predation.

Return to start of section

An aspirational carryover target of 720 ML has been set for all planning scenarios to supply high-priority summer and autumn low flows in 2024-25. This target is unlikely to be achieved in most years due to the limited availability of water for the environment in the Coliban system and yearly variations in climatic conditions. The carryover target will be revised throughout the year based on climatic forecasts, the risk of spills and the extent to which priority actions for 2023-24 have been met. For example, if forecasts indicate a high likelihood of dry conditions in 2024-25, setting aside supply for carryover might become a higher priority than delivering a second summer/autumn fresh in 2023-24. Alternatively, if Malmsbury Reservoir is predicted to spill, delivering at least one summer/autumn fresh in 2023-24 will be a higher priority than achieving the full 720 ML carryover target.

Table 5.6.4 Potential environmental watering for the Coliban River in a range of planning scenarios

Planning scenario	Drought	Dry	Average/wet
Expected conditions	• Little to no natural flow	• Some natural flow	• Extended periods of natural flow, including some high-flow events and reservoir spills
Expected availability of water for the environment[1]	• 1,650 ML	• 1,780 ML	• 1,905 ML
Coliban River (targeting reach 1)			
Potential environmental watering – tier 1 (high priorities)	• **Tier 1a (can be achieved with predicted supply)**		
	• Winter/spring low flow (lower magnitude) • Summer/autumn low flow (lower magnitude in the range) • Pulsed summer/autumn low flow (trigger-based)	• Winter/spring low flow • Summer/autumn low flow • Summer/autumn fresh (one fresh of lower magnitude) • Pulsed summer/autumn low flow (trigger-based)	• Winter/spring low flow • Summer/autumn low flow • Summer/autumn fresh(es) (one to two freshes of lower magnitude) • Pulsed summer/autumn low flow (trigger-based)
	• **Tier 1b (supply deficit)**		
	• Summer/autumn low flow (greater magnitude) • Summer/autumn fresh(es) (one to two freshes of lower magnitude)	• Winter/spring fresh (one fresh) • Summer/autumn freshes (tier 1a partially delivered at increased magnitude)	• Winter/spring fresh (one fresh) • Summer/autumn freshes (tier 1a freshes at full magnitude)
Potential environmental watering – tier 2 (additional priorities)	• N/A	• N/A	• N/A
Possible volume of water for the environment required to achieve objectives	• 1,650 ML (tier 1a) • 920 ML (tier 1b)	• 1,780 ML (tier 1a) • 1,640 ML (tier 1b)	• 1,905 ML (tier 1a) • 1,620 ML (tier 1b)
Priority carryover requirements for 2024-25	• 0-720 ML		

1 As there is no formal environmental entitlement in the Coliban River, these are estimated volumes of passing flow that may be accumulated for a managed environmental flow.

Return to start of section

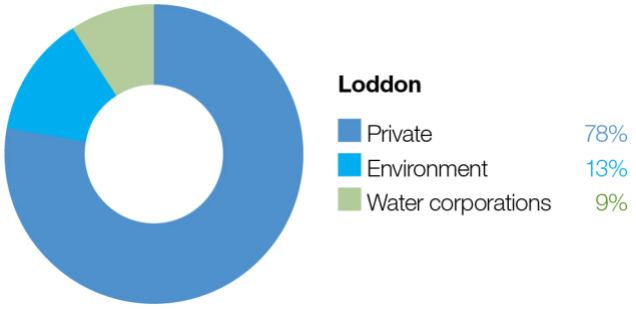
5.7 Loddon system

Waterway manager – North Central Catchment Management Authority

Storage manager – Goulburn-Murray Water

Environmental water holders – Victorian Environmental Water Holder and Commonwealth Environmental Water Holder

Proportions of water entitlements in the Loddon basin held by private users, water corporations and environmental water holders on 30 June 2020



The Loddon system includes the Loddon River system (including Serpentine and Pyramid creeks), the Boort wetlands and Birchs Creek subsystems.

5.7.1 Loddon River system (including Serpentine and Pyramid creeks)

System overview

The Loddon River flows from the Great Dividing Range in the south to the Murray River in the north (Figure 5.7.1). The middle section of the Loddon River is characterised by many distributary streams and anabranches that carry water away from the river onto the floodplain. Pyramid Creek joins the lower Loddon River at Kerang, at which point the Loddon becomes part of the Murray River floodplain.

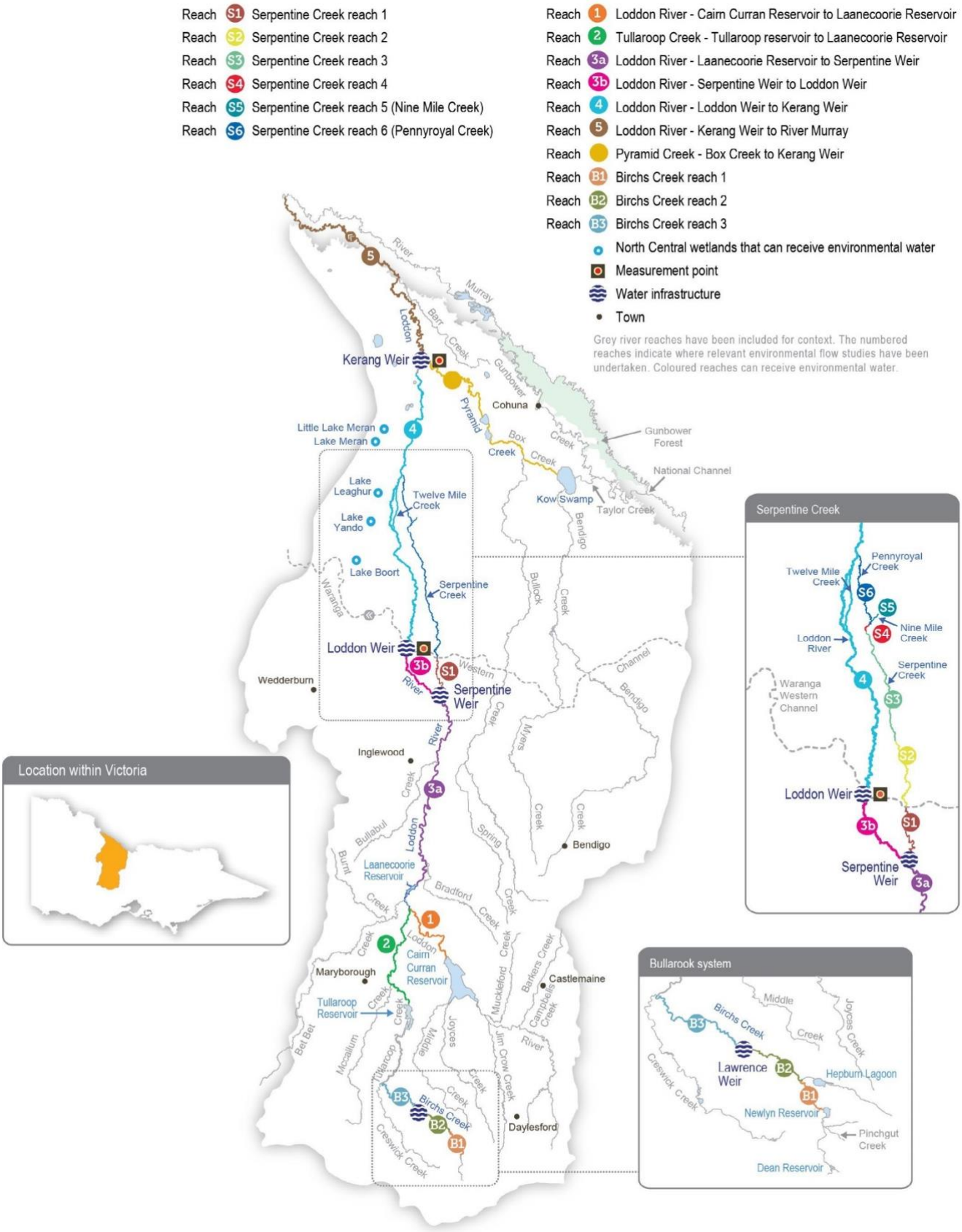
The two main storages on the Loddon River are Cairn Curran Reservoir and Tullaroop Reservoir. Laanecoorie Reservoir is a smaller storage used to regulate water released from the larger upstream storages. Flow in the Loddon River downstream of Laanecoorie Reservoir is regulated by the operation of the Bridgewater, Serpentine, Loddon and Kerang weirs.

Water for the environment can be delivered to the Loddon River from Cairn Curran or Tullaroop reservoirs or from the Goulburn system via the Waranga Western Channel, which intersects with the Loddon River at Loddon Weir. Water is provided to Pyramid Creek through releases from Kow (Ghow) Swamp, which receives water diverted from the Murray River at Torrumbarry Weir. Water is diverted from the Loddon River to the Loddon Valley Irrigation Area to supply agriculture and to Serpentine Creek to support environmental values and supply agriculture.

The highly regulated nature of the Loddon system provides challenges and opportunities for the effective management of water for the environment. The ability to manipulate the timing of releases at multiple locations can help achieve environmental outcomes at discrete locations. However, coordinating environmental and consumptive flows is difficult through the irrigation season, especially when irrigation demand is high or the flow in the river is highly variable. These issues can constrain the timing and delivery of water for the environment or lead to a flow that exceeds the recommended flow rates above Loddon Weir. The structures used for managing irrigation water also form barriers in the waterway that restrict native fish movement throughout the river and make it difficult to meet ecological objectives.

Return to start of section

Figure 5.7.1 The Loddon system



Return to start of section

Environmental values

The Loddon River system supports platypus, rakali (water rats) and several species of native fish (such as Murray cod, golden perch, silver perch, river blackfish and Murray-Darling rainbowfish). Streamside vegetation varies in condition depending on the recent water regime, the extent of clearing and historic and current land management practices. The areas that remain relatively intact support a variety of woodland birds and other native animals. Important plant species across the system include cane grass, tangled lignum, black box and river red gum.

Although fish populations in the Loddon system are affected by the many barriers caused by weirs and reservoirs, a large range of species are still found through the catchment. Native fish are most abundant and diverse in the upper catchment. River blackfish are found in Serpentine Creek, and rare Murray-Darling rainbowfish are found in the middle and lower sections of the Loddon River.

The highest-priority reach for water for the environment is from Loddon Weir to Kerang Weir. The reach does not carry irrigation water, and it relies heavily on environmental flows to maintain its environmental condition. Environmental flows to this reach aim to maintain water quality, increase the abundance and diversity of native fish and improve the condition of streamside vegetation. Environmental flows are delivered to the upper Loddon River and Serpentine Creek to maintain or increase populations of river blackfish and platypus.

Pyramid Creek and the lower Loddon River support large-bodied fish (such as golden perch, Murray cod and silver perch) and are important corridors for fish migration between the Loddon and Murray systems. Engineering works to provide fish passage at the Chute, Box Creek regulator, Kerang Weir, Fish Point Weir and Little Murray Weir on the Little Murray River in recent years have been important in reopening these migration routes. The Arthur Rylah Institute has monitored fish movement and populations in Pyramid Creek and the lower Loddon River since 2017. The monitoring indicates that the combined flows in the lower Loddon River and Pyramid Creek are stimulating native fish movement through the fishways.

Environmental objectives in the Loddon River system
Increase populations of small and large-bodied native fish Provide habitat for fish to feed and breed and opportunities for movement between habitats
Enhance the channel form and features, including deep pools and benches Maintain the condition of suitable substrate to maintain ecosystem processes Engage flood runners, distributary channels, anabranches and backwaters
Increase the population and recruitment of resident platypus Maintain a stable rakali (water rat) population in the long term
Maintain productive and dynamic food webs Maintain the diversity and abundance of biofilms
Maintain the condition of streamside and floodplain vegetation Maintain and increase the extent of in-stream vegetation
Maintain the diversity and increase the abundance of waterbugs and waterbug functional feeding groups
Maintain water quality to support aquatic animals and minimise the occurrence of blackwater events

Traditional Owner cultural values and uses

The Dja Dja Wurrung Clans Aboriginal Corporation (trading as Djaara) are recognised as the Traditional Owners in the upper part of the Loddon catchment. The Barapa Barapa and Wamba Wemba people are recognised as Traditional Owners in the lower part of the catchment. There are artefacts of cultural practices throughout the Loddon and Pyramid system and its floodplain.

In planning for environmental flows in the Loddon River system, Djaara, Barapa Barapa, Wamba Wemba and North Central CMA have considered how environmental flows in the Loddon system can be managed to support their respective values, priorities and uses.

In the upper part of the catchment, the Djaara Kapa Gatjin (water advisory) Group and the North Central CMA work together to identify opportunities and sites where water for the environment can support Djaara's aspirations for the Loddon River. A key aspiration is for Djaara to be more involved in the management and administering of environmental water, with the aim of future ownership and management of environmental water.

Return to start of section

In August 2022, Dja Dja Wurrung Traditional Owners joined North Central CMA staff for a field visit to three sites along the Loddon River. Key points of discussion included the need to maintain a low river level for cultural burning and to support the growth of weaving plants, the need for restoration projects on creeks that flow into the Loddon, the need to inform Traditional Owners about inter-valley transfer trades and when water is leaving one Country and flowing into another, and the need for more water quality and ecological monitoring (including eDNA sampling and yabby surveys).

Dja Dja Wurrung Traditional Owners plan to undertake more field visits to conduct Cultural Values Assessments in the Loddon catchment. Djaara plans to develop a live and comprehensive report based on the assessments that will inform Loddon water management in the future, including seasonal watering proposals.

In early 2023, Barapa Barapa and Wamba Wemba Traditional Owners joined North Central CMA staff on Country to reflect on environmental water management in the Loddon River system in 2022-23 and to discuss aspirations for 2023-24.

Longstanding concerns were raised about constraints and limitations to delivering environmental water and, in the future, cultural water in the Loddon River system. Related to this, Barapa Barapa and Wamba Wemba Traditional Owners raised that private land tenure often creates impediments to floodplain watering and Traditional Owner restoration efforts on Country.

Building on 2021 discussions about the importance of water for the environment supporting native fish populations in summer, Barapa Barapa and Wamba Wemba Traditional Owners said they would like to be involved in projects and monitoring to investigate fish migration out of the lower Loddon River in response to poor water quality.

The impacts of a carp boom after the 2022 flooding in the Loddon River were also discussed. It was agreed that flow and habitat management (rather than manual control efforts) were more likely to reduce carp numbers in the long term in the Loddon River.

Barapa Barapa and Wamba Wemba Traditional Owners noted that the Loddon west arm at Canary Island contains significant cultural heritage, and they would like to see environmental flows continue to target this reach.

Barapa Barapa custodians have communicated their cultural objectives for the Loddon River and other waterways in the *Barapa Barapa Healthy Country Plan 2018-2021*. Objectives that relate to the Loddon River system include:

- that all wetlands surrounding the Murray River, Gunbower Forest, Loddon River and associated lakes will have good plant life and healthy native fish (cod and yellow belly), mussels and turtle populations by 2033
- by 2033, the Murray, Gunbower and Loddon rivers and associated lakes will have enough water, their water quality is improving, and the water will be clear for most of the year in good years
- Barapa people are actively involved in water management
- there are fewer fish and plant deaths from toxic blackwater events.

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.7.1, the North Central CMA considered how environmental flows could support values and uses, including:

- water-based recreation (such as fishing, powered and non-powered boating, water skiing and water sports)
- riverside recreation and amenity (such as birdwatching, bushwalking, camping and cycling)
- community events and tourism (such as water skiing competitions at Bridgewater and associated visitation)
- socioeconomic benefits (such as diverters for domestic and stock uses, local and regional economic benefits from increased visitation and ecosystem services, including carbon storage, groundwater recharge and nutrient recycling).

If the timing or management of planned environmental flows may be modified to align with a community benefit, this is acknowledged in Table 5.7.1 with the following icon.

Watering planned to support water sports activities (e.g. water skiing)

The North Central CMA will work with Goulburn-Murray Water to manage the delivery of low flow rates and the timing of freshes over summer/autumn to support optimum conditions for annual water skiing competitions at Bridgewater weir pool, where possible.

Scope of environmental watering

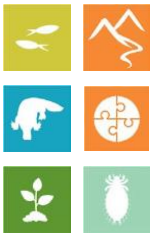
The term ‘environmental watering’ refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, ‘environmental watering’ is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

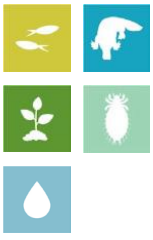
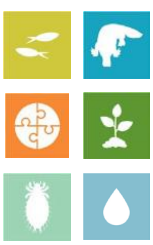
Table 5.7.1 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

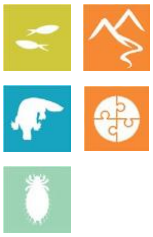
Return to start of section

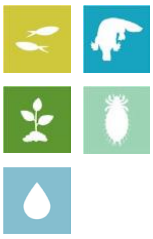
Table 5.7.1 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Loddon River system

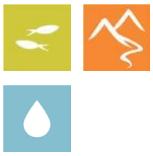
Potential environmental watering action	Expected watering effects	Environmental objectives
Loddon River (targeting reach 4)		

Winter/spring low flow (50-100 ML/day during June to November)[1]	• At 50 ML/day, a low flow will provide a minimum level of continuous flow through the reach and maintain water quality and adequate depth in pools to provide habitat for aquatic plants, waterbugs, fish and rakali (water rats)
	• At 100 ML/day:
	  • increase the water depth for fish, platypus and rakali (water rat) dispersal (especially for male juvenile platypus) to colonise new breeding territory in winter and provide foraging habitat
	  • prevent silt and fine sediment from settling on submerged wood and other hard surfaces
	  • inundate a variety of habitats to increase the growth of biofilms and support waterbug productivity
	  • inundate native fringing bank vegetation to support seed germination and growth and prevent the encroachment of exotic terrestrial plants in the river channel
		

Winter/spring low-flow trial (one to three trials of 100-200 ML/day for one to 30 days during June to November, if triggered by an unregulated flow event)	• Increased longitudinal connectivity by drowning out fish barriers to allow fish to access new habitats • Inform future works to modify or remove fish barriers	
Winter/spring high flow (one high flow of 400-450 ML/day for 10 days during August to November)	• Provide sufficient velocity to scour accumulated sediment from pools and scour biofilms, promoting the growth of new biofilms and increasing waterbug productivity • Flush accumulated organic matter from the bank and benches to increase productivity and reduce the risk of a hypoxic blackwater event in summer • Wet the banks to promote the recruitment and growth of streamside and emergent vegetation • Stimulate native fish movement and breeding	
Summer/autumn low flow (50 ML/day during December to May)[2] 	• Maintain an adequate depth in pools for aquatic plants and to provide habitat for waterbugs, fish and rakali (water rats) • Provide a continuous flow through all reaches • Maintain water quality throughout most of the reach, except the Loddon River west branch, during warm weather • Wet the banks and shallow riffles to support the growth of in-stream and fringing non-woody vegetation	
Summer/autumn low-flow trial (50-100 ML/day for six weeks during December to May)	• Maintain water quality and mitigate against a hypoxic blackwater event in the Loddon River west branch • Prevent the emigration of native fish species due to poor water quality	
Summer/autumn freshes (three freshes of 100 ML/day for three days during December to May) 	• Increase the water level to promote seed germination and the growth of fringing emergent macrophytes • Increase connectivity between deep pools to promote the local movement of fish and prompt the dispersal of juvenile platypus in autumn • Generate sufficient force to flush fine sediment and old biofilms from submerged wood and other hard surfaces, promoting the growth of new biofilms and increasing waterbug productivity • Freshen water quality and reoxygenate pools	

Potential environmental watering action	Expected watering effects	Environmental objectives
Autumn high flow (one high flow of 400 ML/day for six days[3] during March to May)	• Trigger and facilitate the upstream movement of golden perch, silver perch and Murray cod older than one year • Facilitate the dispersal of juvenile platypus • Generate sufficient force to flush fine sediment and old biofilms from submerged wood and other hard surfaces, promoting the growth of new biofilms and increasing waterbug productivity	
Year-round fresh (trigger-based, 100-200 ML/day as required) *Triggers:* • *dissolved oxygen level is below 5 mg/L* • *low or cease-to-flow river conditions* • *high water temperatures*	• Destratify pools and improve water quality (increase oxygen levels) along the river in reach 4, ensuring there is adequate oxygen to support aquatic animals (such as native fish and platypus)	
Pyramid Creek and Loddon River (targeting reach 5)		

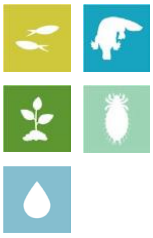
Year-round low flow (90-300 ML/day at Box Creek regulator)	• At 90 ML/day:
	  • the low flow will maintain connectivity between pools, maintain water quality at a level that can support fish and macroinvertebrates and provide habitat for aquatic animals
	• At 200 ML/day:
	  • increase longitudinal connectivity to allow native fish and platypus to access new habitats
	  • improve water quality by reducing salinity levels
	  • increase the wetted area to maintain and promote the growth of fringing emergent (non-woody) vegetation along the lower banks of the channel
	• At 300 ML/day:
	  • facilitate greater movement for large-bodied native fish
	  • increase hydrodynamic diversity and improve the quality of flowing habitats
		

Winter/spring high flow (one high flow of 650 ML/day at Kerang Weir for 10 days during August to November)[4]	• Trigger the migration, spawning and recruitment of native fish species, including Murray cod • Maintain connectivity between habitats and improve water quality • Provide sufficient energy to flush accumulated sediment from pools and substrates	
Autumn high flow (one high flow of 650 ML/day at Kerang Weir for 10 days[3] during March to April)[4]	• Trigger and facilitate the upstream movement of golden perch, silver perch and Murray cod older than one year • Maintain connectivity between habitats and improve water quality • Facilitate platypus dispersal • Provide sufficient energy to flush accumulated sediment from pools and substrates	

Potential environmental watering action	Expected watering effects	Environmental objectives
Serpentine Creek (targeting reach 1)[5]		

Winter/spring low flow (10-30 ML/day[6] during June to November)	• At 10 ML/day:
	  • the low flow will maintain connectivity between pools to allow the dispersal of small to medium-bodied native fish
	  • provide a sufficient flow to maintain water quality by oxygenating pools
	  • maintain foraging habitat for platypus
	  • maintain the wetted area to support in-stream aquatic vegetation (such as water ribbons, eel weed and milfoil)
	• At 20-30 ML/day:
	  • maintain habitat for larger native fish and facilitate movement for aquatic animals
	  • wet exposed roots, woody debris, emergent vegetation and leaf packs to provide habitat for aquatic animals
	  • inundates low benches, banks and some secondary channels, supporting increased macroinvertebrate productivity and native fish breeding, including river blackfish breeding
	  • provide flow variability to maintain the diversity of the fringing vegetation
		

Winter/spring fresh (one fresh of 40-120 ML/day[6] for two days during August to November)	• Provide connectivity for fish and waterbugs to access different habitat areas
	• Transport organic matter that has accumulated in the channel to facilitate its breakdown and incorporation into the foodweb, with a low risk of hypoxic blackwater
	• Wet the banks to promote the recruitment and growth of streamside and emergent vegetation
	• At 120 ML/day:
	  • maintain the channel form and scour pools
	  • encourage female platypus to select nesting burrows higher up the bank to reduce the risk of a greater flow later in the year flooding burrows with juveniles in them
	  • flush accumulated leaf litter from the banks and low benches to reduce the risk of blackwater events during summer
		

Summer/autumn low flow (10-20 ML/day[6] during December to May)	• At 10 ML/day:
	  • the low flow will provide connectivity between pools to allow the dispersal of small to medium-bodied native fish
	  • provide a sufficient flow to maintain water quality by oxygenating pools
	  • maintain foraging habitat for platypus
	  • maintain the wetted area to support in-stream aquatic vegetation (such as water ribbons, eel weed and milfoil)
	• At 20 ML/day:
	  • maintain habitat for larger native fish and facilitate movement of aquatic fauna
	  • wet exposed roots, leaf packs and woody debris to provide habitat for aquatic animals
		

Potential environmental watering action	Expected watering effects	Environmental objectives
Summer/autumn freshes (three freshes of 40 ML/day[6] for two days during December to May)	• Maintain the channel form by inundating benches • Generate sufficient force to flush fine sediment and old biofilms from submerged wood and other hard surfaces, promoting the growth of new biofilms, increasing waterbug productivity and replenishing the food supply for aquatic animals • Increase connectivity between pools to promote the local movement of fish and prompt the dispersal of juvenile platypus in autumn • Provide flow variability to maintain the diversity of fringing vegetation (such as emergent macrophytes) • Freshen the water to improve its quality by diluting salt, reoxygenating the water and flushing poor-quality water in pools, transporting accumulated nutrients and carbon downstream	

1 A winter/spring low flow of 50 ML per day is below the passing flow magnitude and will result in the VEWH banking passing flow savings for use in other potential watering actions.
2 In all planning scenarios except extreme drought, a 100 ML/day summer/autumn low flow rate may be trialled to mitigate low-oxygen blackwater and prevent the emigration of native fish species.
3 The high flow of this event is planned to be delivered for six days, but there is an extended, 14-day ramp-down period.
4 Winter/spring and autumn freshes are planned to occur at the same time in the Loddon River and Pyramid Creek, with the peak timed to meet at Kerang Weir. 650 ML per day is the total combined target at Kerang Weir.
5 The flow in Serpentine Creek may be allowed to either return to the Loddon River or continue down Pennyroyal, Bannacher and/or Nine Mile creeks with the agreement of landholders.
6 The flow delivered from Serpentine Weir may be restricted to manage end-of-system outfalls to avoid third-party impacts until an alternate solution is determined.

Scenario planning

Table 5.7.2 outlines potential environmental watering and expected water use in a range of planning scenarios.

Loddon River

In the Loddon River, the delivery of a continuous, year-round low flow and three summer/autumn freshes are high priorities in all planning scenarios to maintain habitat for native fish, platypus and native vegetation and prevent poor water quality. A minimum flow of 50 ML per day is preferred during summer and autumn to minimise the risk of poor water quality during warm weather. A lower-magnitude flow may be delivered during the cooler months, if needed, to conserve supply in the drier planning scenarios. This lower-magnitude flow should prevent critical harm to aquatic plants and animals, but it is unlikely to grow populations or improve their condition. Low-oxygen incidents in recent years have highlighted the need for a fresh that can be delivered at any time to respond to poor water quality. This watering action may be delivered up to a magnitude of 200 ML per day, based on the flow rate needed to improve water quality in 2017 and 2022, and it is considered a high priority in all planning scenarios.

In the drought-to-wet planning scenarios, the winter/spring low flow will be delivered between 50-100 ML per day to create a variable flow across the seasons, although it will likely be delivered towards the upper range for longer if water availability allows. Delivering the winter/spring low flow at the greater magnitude aims to improve the condition of vegetation higher up the bank, improve water quality and increase the abundance of native fish and platypus populations.

Fish ecologists have recommended trialling different flow rates to improve fish outcomes in the Loddon River if sufficient water is available. The first trial aims to increase the summer/autumn low flow to 100 ML per day during the warmest months – likely in January and February or if hot conditions are forecast at other times – and to reduce the risk of fish emigration. It will also test whether water quality issues in the mid-Loddon River can be mitigated through adaptive flow management. The second trial involves increasing the winter/spring low flow to 200 ML per day after an unregulated event to improve fish passage past low-level barriers. The first trial may occur in any planning scenario if there is sufficient supply. The second trial is proposed in the average-to-wet planning scenarios in response to unregulated flows or spills at Loddon Weir. Each trial will only be implemented if appropriate monitoring is in place to assess their effect and to inform adaptive management.

Return to start of section

Pyramid Creek

Pyramid Creek is regionally significant for native fish. Fish populations within Pyramid Creek have increased since the Millennium Drought, and the removal of fish barriers means it is now an important dispersal corridor for fish moving between the Murray River, Kow (Ghow) Swamp and Gunbower Creek. Maintaining adequate low flow to allow fish to remain in Pyramid Creek all year (including during the non-irrigation season) and delivering high flow to cue and facilitate fish movement at key times of the year are high priorities in all planning scenarios.

Modelling conducted by the Arthur Rylah Institute indicates that maintaining a low flow of at least 200 ML per day throughout the year in Pyramid Creek is optimal for resident fish populations, but a flow of about 90 ML per day should provide minimum habitat requirements. During the irrigation shutdown period, it may not be operationally possible to maintain a flow of at least 200 ML per day. The North Central CMA and the storage manager will aim to maintain the flow within a range of 90-300 ML per day in Pyramid Creek during this period.

The winter/spring high flow in Pyramid Creek has a target flow rate of 650 ML per day at Kerang Weir to cue and facilitate fish movement, which requires coordinated releases in Pyramid Creek and reach 4 of the Loddon River. A similar-sized event in autumn is recommended for the dry-to-wet planning scenarios when large numbers of juvenile fish are likely to migrate from the Murray River into the Loddon system. However, these flows could potentially allow carp to move throughout the Loddon system. Wet conditions in 2021-22 and large floods in spring 2022 greatly increased the abundance and distribution of carp throughout the Loddon catchment and the broader Murray system. The North Central CMA has evaluated the risks and benefits of the planned environmental watering actions for 2023-24 and has determined that the expected benefits to native fish outweigh the cost of allowing already abundant carp to move throughout the system. The planned environmental flows will also allow platypus to disperse, and they will flush accumulated sediment and organic material through the system. The winter/spring high flow is the highest-priority in all planning scenarios to cue native fish to move into the system. It will also flush organic material from the banks of the Loddon River to reduce the likelihood that this material could contribute to a hypoxic blackwater event in summer. The autumn high flow is a lower priority: it is not required every year and was partially achieved in 2022-23. It will be delivered where possible in the dry-to-wet planning scenarios to facilitate the movement of native fish and platypus that may have bred in spring, but it is less likely to be delivered in the drought planning scenario.

Serpentine Creek

In Serpentine Creek, the main priority will be to maintain a low flow throughout the year to provide habitat for native fish, waterbugs, rakali (water rats) and platypus and to deliver freshes to improve water quality, allow fish and platypus movement and improve the condition of streamside vegetation. The flow will likely be delivered at the lower end of the recommended range in most planning scenarios to avoid inundating private property at the end of the system. The planned environmental flows are expected to maintain connectivity between habitats, but they would not provide as much habitat complexity for aquatic plants and animals as would environmental flows delivered at the upper end of the recommended range.

Carryover of 3,000 ML is prioritised into 2024-25 in the drought planning scenario. This water will ensure delivery of the priority winter/spring high flow in the Loddon River if conditions become drier. No carryover targets are set in the dry-to-wet planning scenarios, as early-seasonal allocations are likely to be sufficient to meet winter/spring high-flow environmental flow demands.

Table 5.7.2 Potential environmental watering for the Loddon River system in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• Negligible contributions from unregulated reaches and tributaries of the Loddon River, consumptive water deliveries in the irrigation season (and none in reach 4) • Combined volume in storages above 60 GL	• Small inflows from unregulated reaches and tributaries of the Loddon River contributing to low flow, consumptive water deliveries in the irrigation season (but not in reach 4)	• The natural flow will provide a low flow and multiple freshes, most likely in winter/spring • Consumptive water deliveries in the irrigation season (but not in reach 4) • No spill is likely	• Spills from Loddon system storages will provide an extended-duration high flow, and overbank flow is most likely in late winter/spring
Expected availability of water for the environment[1]	• 22,761 ML	• 23,465 ML	• 23,465 ML	• 23,465 ML

Planning scenario	Drought	Dry	Average	Wet
Loddon River (targeting reach 4)				
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Winter/spring low flow (delivered at 50-77 ML/day) • Winter/spring high flow (one high flow) • Summer/autumn low flow (delivered at 50 ML/day) • Summer/autumn low flow trial • Summer/autumn freshes (three freshes) • Year-round fresh if triggered	• Winter/spring low flow (delivered at 77 ML/day) • Winter/spring high flow (one high flow) • Summer/autumn low flow (delivered at 50 ML/day) • Summer/autumn low flow trial • Summer/autumn freshes (three freshes) • Autumn high flow (one high flow) • Year-round fresh if triggered	• Winter/spring low flow (delivered at 77-100 ML/day) • Winter/spring high flow (one high flow) • Winter/spring low flow trial, if triggered • Summer/autumn low flow (delivered at 50 ML/day) • Summer/autumn low-flow trial • Summer/autumn freshes (three freshes) • Autumn high flow (one high flow) • Year-round fresh if triggered	
	Tier 1b (supply deficit)			
	• Winter/spring low flow (tier 1a delivered at 100 ML/day) • Winter/spring low flow trial, if triggered	• Winter/spring low flow (tier 1a delivered at 100 ML/day) • Winter/spring low flow trial, if triggered	• N/A	
Potential environmental watering – tier 2 (additional priorities)	• Autumn high flow (one high flow)	• N/A		
Possible volume of water for the environment required to achieve objectives	• 17,500 ML (tier 1a) • 3,200 ML (tier 1b) • 3,500 ML (tier 2)	• 20,200 ML (tier 1a) • 3,200 ML (tier 1b)	• 17,900 ML (tier 1a)	• 10,700 ML (tier 1a)
Pyramid Creek and Loddon River (targeting reach 5)				
Potential environmental watering – tier 1 (high priorities)	**Tier 1 (can be achieved with predicted supply)**			
	• Year-round low flow • Winter/spring high flow (one high flow)	• Year-round low flow • Winter/spring high flow (one high flow) • Autumn high flow (one high flow)		
Potential environmental watering – tier 2 (additional priorities)	• Autumn high flow (one high flow)	• N/A		
Possible volume of water for the environment required to achieve objectives[2]	• 4,000 ML (tier 1a) • 2,000 ML (tier 2)	• 6,000 ML (tier 1a)		

Planning scenario	Drought	Dry	Average	Wet
Serpentine Creek (targeting reach 1)[3]				
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Winter/spring low flow (delivered at 10 ML/day) • Winter/spring fresh (one fresh delivered at 40 ML/day) • Summer/autumn low flow (delivered at 10 ML/day) • Summer/autumn freshes (three freshes)	• Winter/spring low flow (delivered at 10 ML/day) • Winter/spring fresh (one fresh) • Summer/autumn low flow (delivered at 10 ML/day) • Summer/autumn freshes (three freshes)	• Winter/spring low flow (delivered at 10 ML/day) • Winter/spring fresh (one fresh) • Summer/autumn low flow • Summer/autumn freshes (three freshes)	
	Tier 1b (supply deficit)			
	• Winter/spring low flow (delivered at 10-20 ML/day) • Winter/spring fresh (tier 1a fresh delivered at 120 ML/day) • Summer/autumn low flow (delivered at 10-20 ML/day)	• Winter/spring low flow (delivered at 10-20 ML/day) • Summer/autumn low flow (delivered at 10-20 ML/day)	• Winter/spring low flow (delivered at 10-30 ML/day)	
Potential environmental watering – tier 2 (additional priorities)	• N/A			
Possible volume of water for the environment required to achieve objectives	• 1,300 ML (tier 1a) • 3,730 ML (tier 1b)	• 1,430 ML (tier 1a) • 2,500 ML (tier 1b)	• 2,500 ML (tier 1a) • 2,000 ML (tier 1b)	• 1,160 ML (tier 1a) • 2,000 ML (tier 1b)
Priority carryover requirements for 2024-25	• 3,000 ML	• N/A		

1 Loddon system entitlements are shared between the Loddon River system and the Boort wetlands. Expected water availability is used to meet demands in both systems.
2 Each environmental watering event in Pyramid Creek has an estimated demand of 2,000 ML for underwriting losses associated with delivering consumptive water en route to downstream locations via Pyramid Creek. The actual demand for each event is expected to be much less.
3 Delivery of a low flow in Serpentine Creek is constrained below recommended flow rates until an approach to deal with end-of-system flow is agreed on.

Return to start of section

5.7.2 Boort wetlands

System overview

The Boort wetlands are on the floodplain west of the Loddon River, below Loddon Weir. They consist of temporary and permanent freshwater lakes and swamps: Lake Boort, Lake Leaghur, Lake Yando, Little Lake Meran and Lake Meran. Together, the Boort wetlands cover over 800 ha. There are numerous other wetlands in the district that are not currently managed with water for the environment.

The natural watering regimes of wetlands throughout the broader Loddon system have been substantially modified by the construction of levees and channels across the floodplain and by the construction and operation of reservoirs and weirs along the Loddon River. Water is delivered to the Boort wetlands through Loddon Valley Irrigation Area infrastructure.

The availability of water for the environment for the Boort wetlands is closely linked to water available for the Loddon River system. The ability to deliver water for the environment to the wetlands is sometimes limited by channel capacity constraints. The VEWH and the North Central CMA work with the storage manager (Goulburn-Murray Water) to best meet environmental objectives within capacity constraints.

Environmental values

The Boort wetlands provide habitat for a range of plant and animal species. At Lake Yando, 12 rare plant species have been recorded, including the jerry-jerry and water nymph. Bird species recorded at Lake Boort, Lake Leaghur and Lake Meran include the white-bellied sea eagle, Latham's snipe and eastern great egret. Little Lake Meran is a swampy woodland with black box trees on the higher wet margins and river red gums fringing the waterline.

Environmental objectives in the Boort wetlands	
	Increase the population of large and small-bodied fish species
	Increase the diversity and population of native frogs, including by enhancing breeding opportunities
	Maintain the population of freshwater turtles and, in particular, of Murray River turtles
	Rehabilitate and increase the extent of emergent and aquatic vegetation (aquatic herblands, tall marsh), intermittent swampy woodland and riverine chenopod woodland Maintain the health and restore the distribution of river red gums and associated understorey species Maintain the extent and restore the health of black box vegetation on the fringes of the wetlands
	Support a high diversity of wetland birds by enhancing feeding and breeding conditions

Traditional Owner cultural values and uses

In planning for environmental flows in the Boort wetlands, the North Central CMA works with Barapa Barapa and Wamba Wemba Traditional Owners and the Dja Dja Wurrung Clans Aboriginal Corporation (trading as Djaara). Lake Boort at Boort is in the Dja Dja Wurrung Registered Aboriginal Party boundary. Boort wetlands to the north of Lake Boort are recognised as Barapa Barapa Country.

In late 2022 and early 2023, Barapa Barapa and Wamba Wemba Traditional Owners met with the North Central CMA to reflect on environmental watering in the Boort wetlands in 2022-23 and to discuss aspirations for 2023-24. At the time, most of the Boort wetlands were full, so the discussion centred on the positive and negative impacts of the flooding. Participants supported the proposal to top up Little Lake Meran in 2023-24 while allowing the other wetlands to draw down. As indicated in previous years, they expressed an interest in doing revegetation work at the Boort wetlands and in undertaking Aboriginal Waterways Assessments at the Boort wetlands in both wet and dry phases.

Increasing the involvement of Traditional Owners in environmental water management and progressing opportunities towards self-determination in the environmental watering program is a core commitment of the VEWH and its agency partners. This is reinforced by a range of legislation and policy commitments, including the *Water Act 1989*, the *Victorian Aboriginal Affairs Framework*, the 2016 *Water for Victoria*, the *Water is Life: Traditional Owner Access to Water Roadmap 2022*, and in some cases, agreements under the *Traditional Owner Settlement Act 2010*.

Return to start of section

Where Traditional Owners are more deeply involved in the planning and/or delivery of environmental flows for a particular site, their contribution is acknowledged in Table 5.7.3 with an icon. The use of this icon is not intended to indicate that these activities are meeting all the needs of Traditional Owners, but is incorporated in the spirit of valuing that contribution.

Watering planned and/or delivered in partnership with Traditional Owners to support cultural values and uses

In 2022, Djaara joined the newly established Lake Boort Operational Advisory Group, which shares technical and operational information to support environmental water management and decision-making at Lake Boort. This is the first example of Traditional Owner membership of a North Central CMA Operational Advisory Group and the first time Djaara has had an operational role in environmental watering.

The North Central CMA will work with Djaara and the Yung Balug clan in 2023-24 regarding the management of water at Lake Boort, including a possible top-up. The natural drawdown of water from Lake Boort after the 2022 floods will be monitored, and throughout the year, there will be a focus on ensuring that current communities of culturally significant plants are maintained and enhanced if possible.

Social, recreational and economic values and uses

In planning the potential environmental flows in Table 5.7.3, the North Central CMA considered how environmental flows could support values and uses, including:

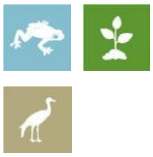
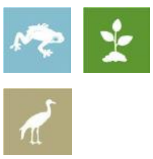
- water-based recreation (such as fishing and water sports)
- waterway recreation and amenity (such as birdwatching, camping and duck hunting)
- community events and tourism (such as attracting locals and visitors for birdwatching and hunting)
- socioeconomic benefits (such as aesthetic benefits for landholders, groundwater recharge and appropriate water levels and quality for flood mitigation, nutrient treatment and carbon storage).

Scope of environmental watering

The term ‘environmental watering’ refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, ‘environmental watering’ is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.7.3 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.7.3 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Boort wetlands

Potential environmental watering action	Expected watering effects	Environmental objectives
Lake Boort (top-up in autumn/winter 2024 as required) 	• Maintain the water depth around the wetland fringe (the target water level is 89.5-90 m AHD) to promote the germination and recruitment of fringing vegetation, including culturally significant species (such as spiny flat sedge) • Support the growth of aquatic and semi-aquatic plants within the wetland • Grow zooplankton and waterbug communities to provide food for waterbirds and frogs	
Little Lake Meran (top-up any time as required)	• Wet the wetland fringe to promote the growth and recruitment of river red gums and maintain existing mature trees • Support the growth of aquatic and semi-aquatic plants • Grow zooplankton and waterbug communities to provide food for waterbirds and frogs • Support waterbird breeding by providing habitat and food resources and maintaining an adequate water depth under nests for juveniles to fledge	

Return to start of section

Scenario planning

Table 5.7.4 outlines potential environmental watering and expected water use in a range of planning scenarios.

Wet conditions in spring 2022 caused widespread flooding across the Loddon system that filled all of the Boort wetland except Little Lake Meran. Little Lake Meran was filled with environmental water in 2022-23 and is expected to hold this level until spring/summer 2023. Each of the Boort wetlands has different recommended watering regimes based on their size and the environmental values they support. Before the floods, the Boort wetlands were in various stages of their wetting and drying cycles, but the floods have effectively re-set those cycles and will influence the schedule of planned watering actions at the wetlands over the next few years.

The only environmental watering planned in the Boort wetlands during 2023-24 is top-ups at Lake Boort and Little Lake Meran. These will maintain water levels for another year to help recently germinated plants become established and to provide adequate water under nesting habitat and food resources for waterbirds. All other managed wetlands in the Boort system will be allowed to draw down naturally to provide a range of foraging habitats for waterbirds and to support the growth of native vegetation communities around the edges and on the banks of the wetlands. The planned approach to environmental watering the Boort wetlands in 2023-24 will ensure wetlands across the region are in various stages of drawdown, which will provide a range of habitat and food types for waterbirds, frogs and turtles. This mix of resources is particularly important to meet the needs of different species that bred in the 2022 floods and will rely on a range of different resources to help juveniles survive and thrive.

No carryover targets into 2024-25 have been set for the Boort wetlands. Many of the wetlands will still be in their drawdown or drying phases, and seasonal allocations are likely to be sufficient to meet expected environmental demands next year.

Table 5.7.4 Potential environmental watering for the Boort wetlands in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• No natural inflow to wetlands • Storages above 60 GL	• Minimal natural inflow to wetlands from local catchment run-off is possible	• Moderate inflow from local catchment run-off, but little if any inflow from nearby creeks or flood runners	• Extended durations of high flow and overbank flow from creeks and flood runners, which fill most wetlands
Expected availability of water for the environment[1]	• 22,761 ML	• 23,465 ML	• 23,465 ML	• 23,465 ML
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Lake Boort (autumn/winter top-ups, as required) • Little Lake Meran (top-ups as required)			
	Tier 1b (supply deficit)			
	• N/A			
Potential environmental watering – tier 2 (additional priorities)	• N/A			
Possible volume of water for the environment required to achieve objectives	• 1,500 ML (tier 1a)			
Priority carryover requirements for 2024-25	• N/A			

1 Loddon system entitlements are shared between the Loddon River system and the Boort wetlands.

Return to start of section

5.7.3 Birchs Creek

System overview

Birchs Creek is a tributary of the Loddon River located in the southernmost part of the catchment. The creek rises in the ranges northeast of Ballarat and flows northwest through Newlyn and Smeaton before joining Tullaroop Creek near Clunes. The lower parts of the catchment are extensively cleared, where the creek meanders through an incised basaltic valley. The creek contains a regionally significant platypus community and a vulnerable river blackfish population.

Birchs Creek is part of the broader Bullarook system, which contains two small storages – Newlyn Reservoir and Hepburn Lagoon – that provide water for irrigation and urban supply. The storages fill and spill during winter or spring in years with average or above-average rainfall. The VEWH holds water for the environment in Newlyn Reservoir, but there is no water held in Hepburn Lagoon.

Birchs Creek receives tributary inflows from Rocky Lead, Langdons, Lawrence and Tourello creeks. Groundwater provides reliable baseflows to the downstream reaches of Birchs Creek in most years.

The VEWH is allocated 100 ML in Newlyn Reservoir on 1 December each year, provided that seasonal determinations in the Bullarook system are at least 20 percent. Any unused allocation from 1 December can be carried over until 30 November of the following water year, but if Newlyn Reservoir spills from 1 July to 30 November, the volume held in carryover is lost. Any water remaining on 30 November is forfeited. When seasonal determinations are below 20 percent, the VEWH does not receive an allocation, and the system's resources are used to protect essential human needs.

Environmental values

Birchs Creek supports threatened aquatic plants, and its deep pools provide habitat for aquatic animals during dry periods. The creek contains native fish, including regionally significant populations of river blackfish and mountain galaxias, as well as flat-headed gudgeon and Australian smelt. Recent monitoring indicates that platypus are present throughout the entire creek.

Environmental objectives in Birchs Creek	
	Maintain the abundance and diversity of small- and medium-bodied native fish, including river blackfish, mountain galaxias, flat-headed gudgeon and Australian smelt
	Maintain the platypus population and improve its resilience to future droughts and floods
	Maintain the diversity and abundance of in-stream aquatic plants Maintain a diverse variety of fringing and streamside native vegetation communities
	Maintain the population of waterbugs and the diversity of functional groups to drive productive and dynamic food webs
	Maintain water quality to support aquatic life and ecological processes

Traditional Owner cultural values and uses

Birchs Creek is recognised as Dja Dja Wurrung Country. The Djaara (Dja Dja Wurrung people) Nation Statement in *Water is Life* and the *Dhelkunya Dja (Healing Country) Country Plan 2014-2034* both describe their objectives around the management of water on their Country.

In planning for environmental flows in Birchs Creek, the Dja Dja Wurrung Clans Aboriginal Corporation (trading as Djaara) and the North Central CMA have identified the creek as a potential site for future projects.

The North Central CMA and Djaara continue to work towards increased engagement in planning and delivering environmental water, including identifying opportunities for Dja Dja Wurrung to play a greater role in its management and administration.

Return to start of section

Social, recreational and economic values and uses

In planning the potential environmental watering actions in Table 5.7.5, the North Central CMA considered how environmental flows could support values and uses, including:

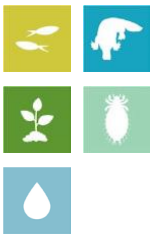
- water-based recreation (such as fishing)
- riverside recreation and amenity (such as cycling and walking [particularly in Newlyn, Smeaton and Clunes] and improved amenity at key community spaces like Andersons Mill)
- improved water quality (such as for domestic and stock use)
- socioeconomic benefits (such as increased tourism and visitation to key community spaces).

Scope of environmental watering

The term 'environmental watering' refers to the active delivery of held environmental water to support particular environmental objectives by altering the flow in a river or the water level in a wetland. While other terms are sometimes used to describe the delivery of environmental water, 'environmental watering' is deliberately used here and in seasonal watering statements to ensure consistency in the legal instruments that authorise the use of water for the environment in Victoria.

Table 5.7.5 describes the potential environmental watering actions in 2023-24, their expected watering effect (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 5.7.5 Potential environmental watering actions, expected watering effects and associated environmental objectives for Birchs Creek

Potential environmental watering action	Expected watering effects	Environmental objectives
Birchs Creek (targeting reach 2)[1]		
Winter/spring fresh (one fresh of 27 ML/day for three days during June to November)	• Maintain and support the growth and germination of streamside vegetation by increasing soil moisture and depositing sediment on the bank and benches • Scour old biofilms and organic matter that has accumulated in the channel, and cycle nutrients throughout the creek • Improve water quality by freshening refuge pools and provide connectivity between pools for fish and platypus movement	
Summer/autumn freshes (three freshes of 10-15 ML/day for three days during December to May)	• Increase the water depth to maintain and support seed germination and the growth of in-stream aquatic vegetation • Top up pools to refresh water quality (particularly oxygen levels) and enhance connectivity between pools for fish and platypus movement	

1 Environmental flows target outcomes in reach 3, but compliance can only be assessed in reach 2.

Scenario planning

Table 5.7.6 outlines potential environmental watering and expected water use in a range of planning scenarios.

Water for the environment in Birchs Creek is primarily used to deliver winter/spring freshes and summer/autumn freshes, where these are not met by the natural flow or consumptive water deliveries. The volume of available water for the environment is not sufficient to deliver any of the other environmental flows recommended for the system.

Regular winter/spring freshes are important to cycle nutrients throughout the system and wet higher channel features to increase connectivity between habitat types for aquatic animals. Summer/autumn freshes are needed to maintain water quality in the warmer months and ensure pools do not dry out. While both watering actions are important, summer/autumn freshes may be prioritised in the drier planning scenarios, if required and where allocation allows, to avoid critical loss of environmental values when the system is likely to be under the greatest stress. Summer/autumn freshes should be delivered at the upper magnitude where possible, either by augmenting natural or consumptive flows or by using water for the environment to deliver greater-magnitude freshes after one fresh has been met naturally. In the drought planning scenario, the environment is unlikely to receive its allocation in December, so carryover from 2022-23 should be used to deliver a winter/spring fresh before the water is forfeited on 30 November. Winter/spring freshes will likely be delivered naturally by reservoir spills in the average and wet planning scenarios.

Return to start of section

Table 5.7.6 Potential environmental watering for Birchs Creek in a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	• Reservoir is unlikely to spill • Extremely low flow in winter/spring • Limited irrigation releases due to low allocations	• Reservoir spill is possible • Low flow in winter/ spring if no spills occur • Moderate irrigation releases	• Reservoir spills are certain in winter/ spring • Some natural flow through summer/ autumn • Groundwater contributes to baseflow throughout the year	• Reservoir spills are certain in winter/ spring • Natural flow through summer/ autumn • Groundwater contributes to baseflow throughout the year
Expected availability of water for the environment	• 100 ML (2022 carryover)	• 100-200 ML (2022 carryover and likely 2023 allocation)	• 100 ML (2023 allocation)[1]	
Birchs Creek (targeting reach 2)				
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Winter/spring fresh (one fresh for three days)	• Winter/spring fresh (one fresh for three days) • Summer/autumn freshes (three freshes)		
	Tier 1b (supply deficit)			
	• Summer/autumn freshes (three freshes)	• N/A		
Potential environmental watering – tier 2 (additional priorities)	• N/A			
Possible volume of water for the environment required to achieve objectives	• 100 ML (tier 1a) • 135 ML (tier 1b)	• 200 ML (tier 1a)	• 100 ML (tier 1a)	• 0 ML (tier 1a)
Priority carryover requirements for 2024-25	• If the 100 ML allocation is received on 1 December 2023 and water for the environment is not required to achieve summer/autumn freshes, carry over 100 ML allocation into 2024-25 for use by 30 November 2024			

1 In the average and wet planning scenarios, it is likely that Newlyn Reservoir will spill before 30 November 2023, losing the 100 ML carryover from December 2022.

Return to start of section