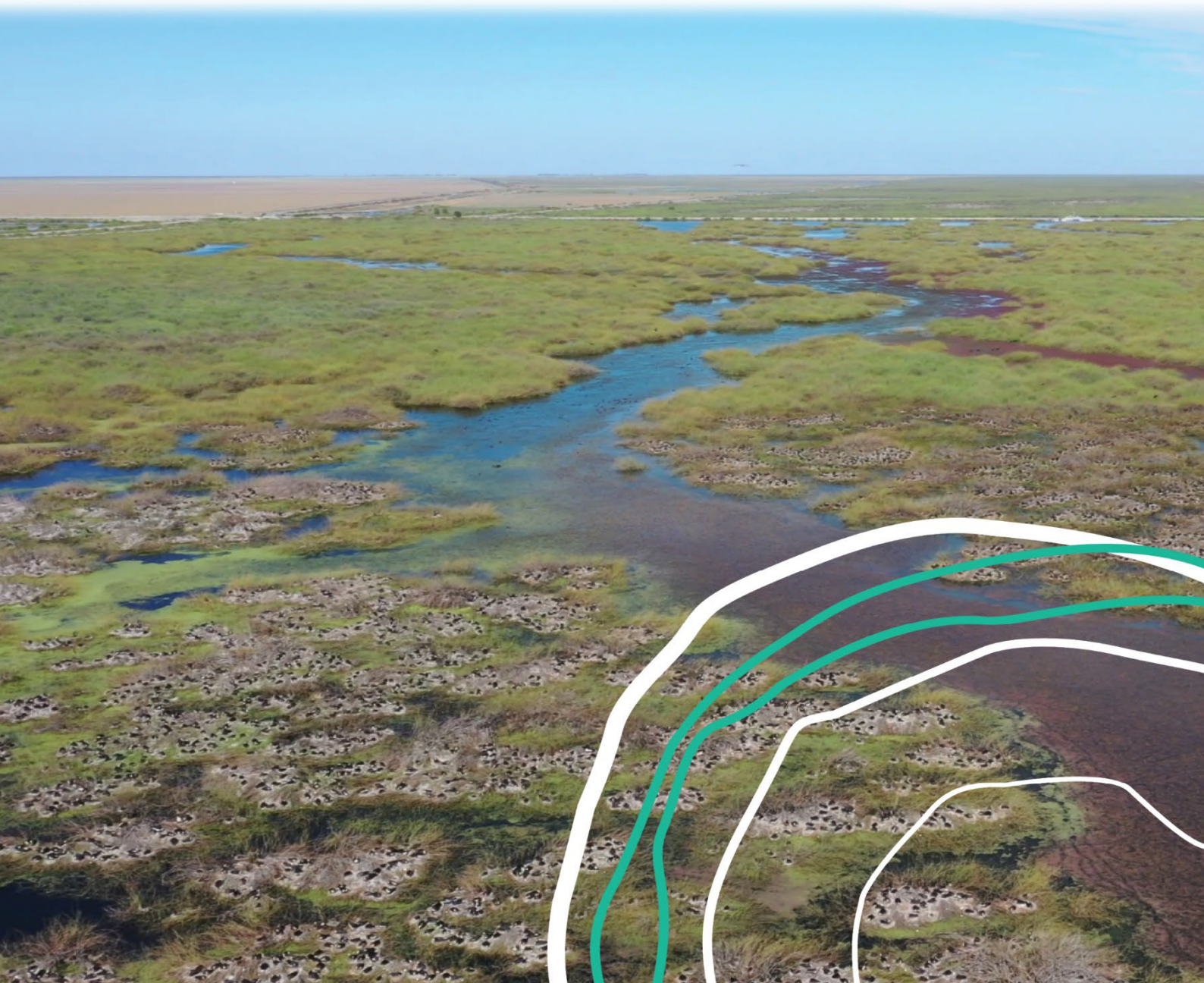
Australian Government
Commonwealth Environmental Water Holder

Water Management Plan 2023-24

Chapter 10 – Murrumbidgee Valley Water Plan



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For more information about Commonwealth environmental water, contact us at:
Commonwealth Environmental Water Holder
Department of Climate Change, Energy, the Environment and Water
GPO Box 858 Canberra ACT 2601
Telephone 1800 218 478
Email ewater@dcceew.gov.au
Web dcceew.gov.au/water/cewo

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Acknowledgement of Country

Our department recognises the First Peoples of this nation and their ongoing connection to culture and country. We acknowledge Aboriginal and Torres Strait Islander People as the Traditional Owners, Custodians and Lore Keepers of the world's oldest living culture and pay respects to their Elders past, and present.

Acknowledgement of First Nations people

The Commonwealth Environmental Water Holder (CEWH) and their staff acknowledge the First Nations communities of the Murray–Darling Basin and pay respect to their Elders past and present.

We acknowledge First Nations people as the Traditional Owners and custodians of the land, water and sky country across the Basin. We recognise the intrinsic connection of First Nations people to Country, and we value their enduring cultural, social, environmental, spiritual, and economic connection to the rivers, wetlands, and floodplains of the Basin.

Over millennia, First Nations people have shaped, managed, and cared for the land and waterways that sustain them. The CEWH values the relationships we currently have with First Nations people and is continuously building relationships to understand how we can empower and support First Nations people to care for Country. The CEWH will continue to work with First Nations people to identify ways to support cultural values alongside environmental outcomes with Commonwealth environmental water.

We value the ongoing contribution that First Nations people make to the planning and delivery of environmental water. We acknowledge this contribution is made largely through frameworks and processes that have not been determined, or endorsed, by First Nations people. More can be done to increase First Nations people's involvement and enable progress towards self-determination within and beyond the environmental watering program. We will continue to support and enable this where we can.

There are more than 40 First Nations in the Basin with many distinct cultures and practices.

The rivers and wetlands of the Murrumbidgee River valley hold significant spiritual and cultural importance for First Nations people. The Wiradjuri Nation extends from the Murray River in the south, along the Great Dividing Range to Coonabarabran in the north, and west to Balranald. At the western end of the catchment are the traditional lands of the Barapa Barapa/Perrepa Perrepa, Muthi Muthi, Nari Nari, Nyeri Nyeri, Wadi Wadi, Wamba Wamba/Wemba Wemba, Weki Weki, and Wolgalu Nations. The mountains at the eastern end of the Murrumbidgee River Valley are Ngunnawal and Ngarigo Country. (MDBA 2021). The CEWH respectfully acknowledges these Nations, their Elders past and present, as the Traditional Custodians of the land on which this chapter is focussed.

We embrace the spirit of reconciliation, working towards equity and equality for First Nations people.

Contents

Tables

1 Murrumbidgee Valley Water Plan

An overview of the Murrumbidgee River valley including the Traditional Owners, key environmental values and sites, environmental objectives and environmental water delivery partners is provided on the CEWH website.

1.1 Recent conditions and seasonal outlook

1.1.1 Recent conditions and environmental water use

The Murrumbidgee valley experienced dry conditions from early 2017 up until early 2020 when wetter conditions prevailed. The Murrumbidgee valley experienced very wet conditions from 2021 to 2023 (DPE 2023). Water allocations against regulated high security, general security and conveyance entitlements in the 2022–23 water year reached 100% in January 2023. With natural high flows meeting many environmental watering requirements throughout the system, approximately 232 gigalitres (GL) of Commonwealth environmental water was delivered in 2022–23.

- Environmental water to the Gayini-Nimmie Caira wetlands in response to large-scale waterbird breeding.
- Dilution flows to mitigate low dissolved oxygen at Maude, Redbank and Balranald.
- High in-channel flows (as guided by Murrumbidgee Long Term Water Plan) to allow for native fish passage between Lowbidgee and River Murray over summer.
- A full watering of the Western Lakes complex.
- An Upper Yanco and Colombo Creeks connection flow on the back of 'very low flows'.
- A small-scale water delivery to an ephemeral creek in Coleambally Irrigation Area.
- Opportunistic water releases from Tombullen, Hay and Maude weirs to support a floodplain connecting fresh.

These actions, combined with unregulated flows and dam airspace releases, resulted in high river flows that connected most riverine wetlands to the river on multiple occasions throughout the year.

Commonwealth and NSW environmental water use in 2022–23 supported the following:

- Water bird breeding
  - An estimated 102,000 nesting pairs of straw-necked ibis at Bala Swamp rookery - the only wetland site in the Basin which has supported the large-scale breeding of waterbirds (greater than 5000 nests) for three consecutive years using environmental water.
  - Over 4000 pairs of nesting adult pelicans at Kieta Lake in Gayini Nimmie-Caira.
  - Threatened Australasian and little bitterns, egrets, spoonbills, herons, cormorants, darters, little grebes, Pacific black, musk and freckled ducks, and Eurasian coots across about 29 smaller sites in the Midbidgee, Yanco Creek system, Lowbidgee and Junction wetlands.
- Frogs
  - Six frog species (barking and spotted marsh frogs, Peron's tree frog, plains froglet, inland banjo frog and the threatened southern bell frog); with successive years of delivering environmental water supporting the return of threatened southern bell frog populations in the Lowbidgee to greater than pre-Millennium Drought numbers, and their continued range expansion.
- Native fish

  - Populations of a range of native fish, including carp gudgeon, Australian smelt, flathead gudgeon, bony-bream, Murray-Darling rainbow fish, Murray cod, golden perch, freshwater catfish and the recently re-introduced southern pygmy perch.
  - Spawning and recruitment of golden perch in the Yanga National Park floodplain for three consecutive years in response to floodplain-river interactions.
  - Movement of native fish between the Murrumbidgee and Murray rivers, and between the Murrumbidgee River and floodplain creeks and lakes in Yanga National Park by expanding on unregulated flows in the mid-Murrumbidgee and the lower Murrumbidgee River - these flows also provided opportunity for critical exchange of carbon and nutrients.
  - The mitigation of low dissolved oxygen conditions in the Lower Murrumbidgee River to protect aquatic animals, including native fish; contributing to the first flooding event in at least a decade where no native fish kills occurred.
- Turtles
  - All three Murrumbidgee turtle species (broad shelled, eastern long-necked and Macquarie River turtles) found in the catchment.

Learn more about previous Commonwealth environmental water use in in the Murrumbidgee River Valley.

1.1.2 Seasonal outlook

The Bureau of Meteorology's seasonal outlook for July to September 2023 indicates that rainfall is likely (60 to 80 per cent chance) to be below average across most of mainland Australia, including the Murrumbidgee River catchment (BOM 2023). Additionally, temperatures are very likely (greater than 80% chance) to be above average across the catchment. The ENSO Outlook remains at El Niño Alert (BOM 2023).

1.1.3 Water availability

The volume of Commonwealth environmental water carried over in Murrumbidgee River valley for use in 2023–24 is approximately 101 gigalitres (GL), representing 30% of general security and conveyance entitlement. In the Murrumbidgee regulated water source, general security and conveyance licences can carry over water up to a maximum of 30% of entitlement. The account limit (allocation plus carryover) is 100% of entitlement.

Allocations against Commonwealth water entitlements in the Murrumbidgee River valley are determined by state governments and will vary depending on inflows. On the 1 July 2023 Water Allocation Statement (DPE 2023), opening allocations to high security entitlements were 95%, and 37% for general security entitlements and conveyance entitlements as per water sharing plan rules.

Based on the available volume of water held by the Commonwealth and other water holders (including carryover and opening allocations), as well as recent and forecast catchment conditions, it is expected that the overall resource availability will be moderate to high in 2023–24.

1.1.4 First Nations environmental watering objectives

Advice on environmental water objectives in the Murrumbidgee catchment has been provided through discussions with First Nations in the Murrumbidgee including those represented by Murray Lower Darling Rivers Indigenous Nations (MLDRIN), and with the Nari Nari Tribal Council. Table MR1 includes just some of the objectives for the Murrumbidgee catchment that were raised. It is important to note these objectives do not represent the detail, depth and complexity of First Nations' localised water-related objectives, nor does it detail the concerns of First Nations people regarding access to water.

The Commonwealth Environmental Water Holder recognises the critical importance of strengthening involvement of First Nations people in environmental watering, and the importance of building transparent, respectful relationships with Traditional Custodians across the Basin. As such, a partnership agreement has been developed between the Nari Nari Tribal Council and the Commonwealth in relation to planning, delivery and monitoring of Commonwealth environmental water on Nari Nari Traditional Lands. The Partnership Agreement was entered into by both parties in March 2023 and aims to maximise environmental outcomes over time by enabling the Nari Nari Tribal Council to facilitate environmental watering on Nari Nari Country, according to their lore and customary obligations. It is hoped this will be the first of many partnerships with First Nations in the Murrumbidgee and across the Basin.

NSW Local Land Services investigated the use of the Murrumbidgee Cultural Access Licence (CAL) as part of Traditional Owner workshops, identifying sites which have cultural values that could benefit from use of CAL (Alluvium 2022). Sites were identified that have cultural values including for fish, camping, ancestral remains, wetland value and cultural heritage. Many of these sites are known wetland areas and many have opportunities for partnering with CAL to maximise both environmental and cultural outcomes.

Table MR1 includes a short list of cultural objectives within the Murrumbidgee River valley. While they are not extensive, some of these objectives sit outside the scope of environmental water, while for others, the link between environmental water and the site or issues is not well understood. Environmental flows will aim to contribute to identified cultural objectives where possible.

The Commonwealth Environmental Water Holder is committed to continuing to strengthen engagement with all Southern Basin First Nations to support those Nations to articulate objectives for water management.

Table MR1 First Nations environmental water objectives for the Murrumbidgee system

Theme	Learnings
Waterways and Places in Need of watering	Whole of system flows for the Murrumbidgee River, system wide flows into the Murray and beyond, Dry Lake, Yanga Lake, Billabong Creek, wetlands, billabongs, floodplains, creeks, other places – parks, forests, islands, major rivers, tributaries, Ramsar-listed wetlands.
River Flows and Connectivity	System wide flows "snow melt to sea", importance of connections between river and wetlands, flows linking country and nations all along the river, improve water quality, improve timing and seasonality of flows, restore flows in degraded rivers, remove barriers and constraints, improve flows and quantity of water (rivers and general), restore wetland hydrology, improve river and or floodplain connectivity, and improve tributary flows, culturally important "first flush", importance of improving water quality for neighbouring nations, allowing the natural flow of water.
Vegetation	Old man weed, Cumbungi, black box, lignum, river red gum, grasses, water ribbons, phragmites.
Fish	Murray cod, golden perch, catfish, native fish.
Waterbirds	Pelican, ducks, eastern bittern, sea eagle [a], black swan.
Other species	Turtles, frogs, Murray cray, shrimp, mussels, platypus, yabbies, water rat (Rakali), macroinvertebrates, emu [a], kangaroo [a], birds.

a Environmental water targeting other environmental objectives may influence this species or objective.

1.1.5 Environmental demands

Large-scale inundation in recent years has triggered significant increases in abundance and diversity of waterbirds and other water dependent fauna. The environmental water demands for assets in the Murrumbidgee River valley in 2023–24 is moderate to support the environmental gains from the past

three consecutive wet years. Environmental water is required to conserve and manage wetland ecosystems and habitats on which dependent waterbirds and fauna rely for breeding and importantly foraging. For example, the maintenance of foraging habitat in years between large-scale waterbird breeding events is crucial to ensure the survival of juvenile birds.

Watering of key assets within the catchment is also required to improve their ecological resilience leading into a likely drier period. The 2023–24 water year presents an unprecedented situation where water availability is high, however, infrastructure repairs and construction work require many important floodplain sites to be dried. Refer to "*Water delivery in 2023–24*" for further discussion.

Environmental watering demands for 2023–24 are represented in Table MR2.

Table MR2 Environmental demands, watering priorities and outlook for coming year, Murrumbidgee catchment, 2023–24

Environmental assets	Target values	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)	2023–24		Implications for future demands
		Flow/volume	Required frequency (maximum dry interval)		Environmental demand for water (all sources)	Potential Commonwealth environmental water (CEW)contribution	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24
Mid-Murrumbidgee Wetlands[a] (includes pumping to Toogimbie Indigenous Protected Area) (PU 4, 5, 6, 9 and may also contribute flows in PU 7, 8, 10, 11, 12, 13)	Critical refuge habitat, aquatic vegetation, waterbirds, native fish, frogs, turtles, nutrient dispersal.	Infrastructure assisted delivery to individual high priority wetland assets targeting provision of refuge habitat and maintenance of wetland vegetation (minimum of 4 gigalitres (GL) required under a very low inflow scenario to support critical refuge requirements) (PU 6)	8 in every 10 years – annual (2 years)	Demand met or partially met over the last 6 years	Moderate (provide refuge habitat for aquatic animals and maintain established aquatic habitat. However, overbank connection is preferred)	Moderate Potential for CEW use under Very Low to Moderate inflow scenarios as sites already full/partially full following 2022-23 inundation. Up to 15 GL (volume contributed will be dependent on resource availability/antecedent conditions, with a minimum of 4 GL required under a Very Low inflow scenario).	High
		Tombullen storage releases to augment flows over 13 GL/day at Wilbriggie (previously Darlington Point) (PU 6, 7, 8)	*7 to 8 in every 10 years (2 years)*	*Demand partially met over the last 4 years*	*High (condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of inundation)*	*Unlikely for water use due to scheduled SDLAM infrastructure works.*	*High*
		Minimum of 15.5 GL/day at Wilbriggie (previously Darlington Point) for up to 6 days plus a gradual recession targeting low-lying wetland vegetation and aquatic habitat up to 180 GL (multiple PU's)	*7 to 8 in every 10 years (2 years)*	*Demand met 3 out of the last 6 years, last met 2022–23*	*High to Critical (condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of inundation)*	*Unlikely for water use due to scheduled SDLAM infrastructure works.*	*High*
		Augment Airspace and/or Translucent Flow releases to maximise flow peak for inundation of mid-Murrumbidgee wetlands. Up to 40 GL ordered from opposing dam or other storage.	*Opportunistic in response to natural cues and river operations*	*Opportunistic in response to natural cues and river operations*	*High (condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of inundation)*	*Unlikely for water use due to scheduled SDLAM infrastructure works.*	*High*
Murrumbidgee Irrigation (MI) Area Ramsar sites (Fivebough and Tuckerbil wetlands) and includes other important wetlands in MI Area (PU 14)	Ramsar ecological character, waterbirds, aquatic vegetation.	Fivebough 500 megalitres (ML) to inundate 60% of wetland. Implement Fivebough & Tuckerbil Wetlands Advisory Committee recommendations to maintain Ramsar listed ecological character	Fivebough: Shallow water 9 in every 10 years.	Demand met over the last 8 years to maintain ecological character	High Required to maintain ecological character under Ramsar	Moderate Potential for water use. Minimum of 1 GL under a Very Low inflow scenario.	High
		Tuckerbil 500 ML to fill Implement Fivebough & Tuckerbil Wetlands Advisory Committee recommendations to maintain Ramsar listed ecological character	Inundate core wetland habitat every year Fill Tuckerbil 4 of every 10 years	Core wetland demand met over the last 6 years Full fill demand met in 2 of the last 4 years	High (required to maintain ecological character under Ramsar)	Moderate Potential for water use. Up to 1 GL under Low inflow scenario.	High
Coleambally Irrigation Area sites (PU 14)	Critical refuge habitat for frogs and waterbirds.	Up to 2 GL under a Very Low inflow scenario	8 in every 10 years	Demand partially met over the last 5 years	High (provide refuge habitat for aquatic animals and maintain established aquatic habitat)	High Potential for up to 1 GL a under Very Low inflow scenario.	High
	Wetland and black box vegetation communities, frogs and waterbirds.	Up to 20 GL (cumulative volume - includes 2 GL allocated for this asset targeting critical refuge habitat)	3 in every 10 years	Demand partially met over the last 5 years	Moderate (watering following natural cues to maintain condition and build resilience of wetland-floodplain vegetation)	Moderate potential for wetland inundation. Up to 2 GL under **a** Lo**w** inflow scenario, up 5 GL under Moderate scenario and up to 10 GL under High inflow scenario.	Moderate

Environmental assets	Target values	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)	2023–24		Implications for future demands
		Flow/volume	Required frequency (maximum dry interval)		Environmental demand for water (all sources)	Potential Commonwealth environmental water (CEW)contribution	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24
Yanco/Billabong/Forest Creeks System (PU 12, 13)	Low-lying wetland vegetation and aquatic habitat, and native fish spawning and movement	Up to 20 GL in channel, targeting up to 1,400 ML/day at Yanco Creek off-take. Objectives also achieved by a mid-Murrumbidgee wetlands reconnection flow	7 in every 10 years (2 years)	Demand met or partially met in 4 of the last 6 years, however watering required to maintain condition of wetland-floodplain vegetation	Moderate (watering, required to maintain the good condition of wetland-floodplain vegetation)	Moderate Potential for CEW use. Up to 10 GL under Moderate to High inflow scenarios. Supplementary use prioritised if available	High
Yanco Creek System – Wanganella, Rhyola and Old Corree Swamps *(PU 12, 13)*	*Aquatic vegetation, waterbirds*	*Pumping up to 3.7 GL*	*7 to 8 in every 10 years (2 years)*	*Demand met 4 out of the last 6 years*	*High (prevent loss of aquatic vegetation species such as cumbungi rhizomes)*	*Unlikely for water use under all inflow scenarios due to scheduled SDLAM infrastructure works.* *Old Corree has been wet 3 consecutive years. Black box requires drying phase.*	*High*
Yanco Creek System – Wanganella and Rhyola Swamps *(PU 12, 13)*	*Wetland and black box vegetation communities*	*Up to 5 GL*	*3 in every 10 years (3 years)*	*Demand met or partially met in 3 of the last 6 years*	*Moderate (watering following natural cues to maintain condition of wetland-floodplain vegetation)*	*Unlikely for water use due to scheduled SDLAM infrastructure works.*	*Low (subject to natural cues)*
Lowbidgee – Core refuge and permanent aquatic habitat sites (PU7)	Critical refuge habitats	Up to 60 GL targeting critical refuge habitat requirements (minimum of 8 GL is required under a Very Low inflow scenario to meet these needs)	Annual	Demand met over the last 6 years	High to Critical (annual watering required for critical habitat requirements)	Moderate potential for critical/permanent habitats. Volume contributed will depend on resource availability/antecedent conditions, with a minimum of 5 GL required under a Very Low inflow scenario increasing to 50 GL under moderate inflow scenarios. Supplementary use prioritised if available. Note: Sites limited due to planned SDLAM infrastructure works.	High
Lowbidgee – Rookery sites (PU7)	Naturally triggered waterbird breeding	Up to 30 GL	As required in response to naturally triggered bird breeding event	As required	High (support successful completion of waterbird breeding events)	High potential (if waterbird breeding is triggered under Moderate to Very High inflow scenario). Note: Sites limited due to planned SDLAM infrastructure works.	High
Lowbidgee – North Redbank (PU7)	Wetland vegetation and habitat for native fish, frogs, turtles, and waterbirds	Up to 60 GL[b]	River red gum forest and spike rush wetlands 1 to 3 years (3 years)	Met or partially met over the last 7 years	Moderate (watering following natural cues, to maintain the good condition of wetland-floodplain vegetation and waterbird breeding)	High potential for wetland inundation. Up to 35 GL under Moderate to High inflow scenarios. Supplementary use prioritised if available	Moderate (subject to natural cues)
Lowbidgee – Yanga National Park *(PU7)*	*Wetland vegetation and habitat for native fish, frogs, turtles, and waterbirds*	*Up to 20 GL[b]*	*River red gum forest and spike rush wetlands 1 to 3 years (3 years)*	*Met or partially met over the last 7 years*	*High (watering required to maintain deep creek fish refuges and condition of wetland-floodplain vegetation)*	*Unlikely for water use due to scheduled SDLAM infrastructure works.*	*Moderate (subject to natural cues)*
Lowbidgee – Gayini Nimmie-Caira (PU7)	Wetland vegetation and habitat for native fish, frogs, turtles, and waterbirds	Up to 100 GL[b]	Refuge habitat annual. Lignum dominated wetlands 1 to 5 years, with duration of up to 7 months.	Met or partially met over the last 6 years	High (watering following natural cues to maintain the good condition of wetland-floodplain vegetation)	High Potential for wetland inundation. Up to 70 GL under Moderate to High inflow scenarios. Supplementary use prioritised if available. Note: Sites limited due to planned infrastructure flood damage repair works.	Moderate (subject to natural cues)

Environmental assets	Target values	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)	2023–24		Implications for future demands
		Flow/volume	Required frequency (maximum dry interval)		Environmental demand for water (all sources)	Potential Commonwealth environmental water (CEW)contribution	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24
Lowbidgee – Fiddlers-Uara (PU7)	Wetland vegetation and habitat for native fish, frogs, turtles, and waterbirds	Up to 20 GL	Black box and lignum wetlands every 3 to 7 years	Met or partially 3 out of the last 7 years	Moderate (watering following natural cues to maintain the good condition of wetland-floodplain vegetation)	Moderate potential for wetland inundation. Up to 15 GL under High inflow scenarios. Supplementary use prioritised if available	Low (subject to natural cues)
Lowbidgee – Western Lakes (PU7)	Maintain open water habitats and floodplain vegetation	Up to 30 GL	Wetland habitats and open water, black box, and lignum wetlands every 3 to 7 years	Met or partially met over the last 6 years	Moderate (watering following natural cues to maintain the good condition of wetland-floodplain vegetation)	High potential (up to 20 GL under Moderate to High inflow scenario)	Low (subject to natural cues)
Lowbidgee full system watering *(PU7)*	*Waterbird recovery, improve floodplain habitat condition*	*Up to 180 GL for Basin-wide waterbird habitat and future population recovery*	*Opportunistic based on natural occurring rain and flow events*	*Met or partially met over the last 6 years*	*Moderate (improve the complexity and health of priority waterbird habitat to maintain species richness and aid future population recovery)*	*Unlikely for water use under all inflow scenarios due to scheduled SDLAM infrastructure works.*	*High*
Murrumbidgee River channel, distributaries, and anabranches (PU 6, 7, 8, 9, 10, 11, 12, 13)	Native fish spawning, recruitment, movement, and dispersal.	Contribute up to 10 GL from Tombullen storage to higher river flows (freshes) in spring and summer	7 in every 10 years	Met 3 out of the last 7 years	Moderate (watering following natural cues, required to continue recovery of native fish populations)	High potential. Up to 10 GL if natural flow event triggers an opportunity under Moderate to High inflow scenario.	Low
	Native fish movement and recruitment, productivity, and in-stream vegetation	Moderate in-channel pulse (flows greater than 3,500 ML/day at Balranald) up to 50 GL	7 in every 10 years	Met 4 out of the last 6 years	Moderate (native fish populations in the lower Murrumbidgee River are in poor condition. Water required for improved fish passage and connectivity, aquatic habitat, and riverine productivity)	High potential. Up to 30 GL under Moderate to High inflow scenarios	Moderate
	Native fish, wetland vegetation	Distributary and anabranch freshes to restore flow components most impacted by river regulation up to 10 GL	7 in every 10 years to annual	Demand met 3 out of the last 6 years	Moderate (watering following natural cues to maintain the good condition of wetland-floodplain vegetation)	Moderate Potential subject to natural cues (up to 5 GL)	Moderate (subject to natural cues)
	Native fish nesting support	Contribute up to 70 GL to avoid large decreases in flow in excess of 10% per day during cod nesting season.	5 in every 10 years to annual	Demand met in last three years	High (maintain natural rates of change in flows rates to support trout and Murray cod nesting)	High potential. Up to 40 GL under Moderate to High inflow scenarios	High
	Water quality	Contribute to managing water quality issues within in-stream and wetland environments across the Murrumbidgee Catchment	Contingency in response to poor water quality	As required	Critical (provide refuge habitat for aquatic animals due to poor water quality, including potential hypoxic conditions)	Contingency in response to poor water quality/aquatic habitat availability. This may include up to 15 GL contingency under very low to low inflows, in the absence of IVT (lower Murrumbidgee weir pool stratification, high risk fish kills).	Critical (contingency)

Environmental assets	Target values	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)	2023–24		Implications for future demands
		Flow/volume	Required frequency (maximum dry interval)		Environmental demand for water (all sources)	Potential Commonwealth environmental water (CEW)contribution	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24
						Or may include a very large contingency volume (when allocations allow) under very high inflows and natural flooding to mitigate potential hypoxic water affects.	
Junction Wetlands (PU8)	Wetland vegetation and habitat for native fish, frogs, turtles, and waterbirds	Flows greater than 5 GL/day at downstream Balranald Weir and greater than 10 GL/day on the Murray at Murrumbidgee confluence	5 in every 10 years	Demand met in 3 of the last 6 years	High (condition of the Junction Wetland is generally poor due to a lack of inundation)	Low potential under low inflows. Likely to be achieved by other environmental watering actions and through Lowbidgee Supplementary allocations under Moderate to High inflow scenarios	High
		Flows greater than 7 GL/day at downstream Balranald Weir	5 in every 10 years	Demand met in 2 of the last 6 years	High (condition of the Junction Wetland is generally poor due to a lack of inundation)	*Unlikely for water use due to scheduled SDLAM infrastructure works.*	High
		Pumping up to 4 GL to individual high priority wetland assets	7 to 8 in every 10 years (2 years)	Demand met in 6 of the last 7 years	Moderate *(prevent loss of aquatic vegetation species)*	High potential for water use under Very Low to Moderate inflow scenarios	High

a Difference in filling height (flows required to fill a wetland) vary among the lagoons that make up the mid-Murrumbidgee wetlands, and so their condition and watering requirements vary accordingly. **b** Cumulative volume – includes volume allocated for this asset under Lowbidgee core refuge and permanent aquatic habitat. **PU4** Murrumbidgee River – Tumut River Junction to Berembed Weir. **PU5** Murrumbidgee River – Berembed Weir to Gogeldrie Weir. **PU6** Murrumbidgee River – Gogeldrie Weir to Maude Weir. **PU7** lower Murrumbidgee Floodplain. **PU8** Murrumbidgee River – Balranald to Murray. **PU9** Beavers and Old Man's Creek. **PU10** Upper Yanco Creek. **PU11** Colombo & Billabong Creeks. **PU12** lower Yanco Creek to lower Billabong Creek. **PU13** lower Billabong and Intersecting Streams. **PU14** Murrumbidgee Infrastructure Dependent Floodplain Wetlands
Note: Planning Units (PU) 4 to 14. Identified in the Murrumbidgee Long Term Water Plan Part B (NSW DPIE 2020b).

Key

Potential watering in 2023–24

- High priority for Commonwealth environmental watering (likely to receive water even under low water availability)
- Secondary priority for Commonwealth environmental watering (watering to occur only if natural trigger is met, or under moderate – high water resource availability); or water demand likely to be met via other means
- Low priority for Commonwealth environmental watering (under high – very high water resource availability); or unable to provide water because of constraints or insufficient water

Environmental demands (demand is considered at a generalised scale; there may be specific requirements that are more or less urgent within the flow regime)

- High to critical demand for water (needed in that particular year or urgent in that particular year to manage risk of irretrievable loss or damage)
- Moderate demand for water (water needed in that particular year, the next year, or both)
- Low demand for water (water generally not needed in that particular year)

1.2 Water delivery in 2023–24

In the last three years, climatic conditions have improved, allowing the inundation of a greater number of sites on the floodplain, including sites that require substantial volumes of water to fill.

Commonwealth environmental water use in the Murrumbidgee River Valley in 2023–24 will focus on continuing to improve important wetland habitats and threatened species populations. This will include actions to link the floodplain to the main river channel, where possible – although this may be difficult in 2023–24 due to water delivery constraints and considerations (detailed below). Floodplain inundation will mostly target underwatered areas via minor infrastructure works to access black box areas difficult to water in low allocation years and known waterbird rookery and refuge sites. 2023–24 watering actions will mostly target large in-channel actions to support native fish breeding and movement, and carbon and nutrient exchange between catchments.

Watering constraints and considerations:

The survey work and potential construction of many water savings projects as part of the Sustainable Diversion Limit Adjustment Mechanism (SDLAM) program are scheduled to begin in mid-2023. This requires environmental water managers to keep SDLAM work sites dry for 2023–24, or until completion of construction of required infrastructure. It is highly likely construction at some sites will take up most of 2024–25 water year. These sites include the northern section of Yanga National Park, and Wanganella Swamp and Piccaninny Creek in the Yanco Creek Catchment. Further, flood damage to key Gayini-Nimmie Caira infrastructure, and subsequent repair work may also limit key sites within Gayini Nimmie-Caira from receiving environmental water.

Ideally, a low-level mid-Murrumbidgee wetlands reconnection with the Murrumbidgee River is required annually to continue the recovery of wetlands and their aquatic ecosystems, and to suppress river red gum encroachment into wetlands. However, planned infrastructure works means that this action is unlikely to be achieved at the desired flow rate of 25,000 ML/d at Wagga Wagga due to potential overbanking in the Lowbidgee and Yanco Creek system. Pumping will therefore be prioritised to the few important sites possible in the mid-Murrumbidgee and/or a smaller reconnection flow event of approximately 20,000 ML/d with a longer duration will be considered. The watering action will also contribute to downstream demands, including Yanco Creek, the Lowbidgee floodplain including the Junction Wetlands and potentially the lower Murray (where 'return flows' are available under NSW 'pre-requisite policy measures').

Fortunately, high unregulated flows, coupled with targeted environmental water use during 2022–23 have seen large-scale inundation of all the sites required to be kept dry for infrastructure works. This has provided the resilience for these sites to endure a short drying period. However, discussions will continue between the CEWH and NSW agencies to understand work schedules and proactively provide environmental water to key sites where possible.

On advice from the Murrumbidgee FlowMER team (Charles Sturt University), a very high priority for Commonwealth environmental water will be to target a larger inundation footprint in surrounding landscapes of Gayini-Nimmie Caira, southern section of North Redbank and the Junction Wetlands to provide habitat and foraging opportunities for juvenile waterbirds and other wetland dependent animals and inundate black box habitats. To target a larger footprint of inundation, minor infrastructure works are required.

Floodplain habitats have been found to be critical for native fish spawning, growth, and recruitment (particularly golden perch) and provide high-quality refuges during extreme drought conditions. Therefore, river-floodplain connectivity in the lower Murrumbidgee, specifically to Yanga and Tala Lakes, is highly desirable for 2023–24.

If a decline in water quality of in-stream or wetland environments across the Murrumbidgee catchment occurs (due to low inflows and very hot dry conditions, or flooding conditions), the CEWH will work with NSW agencies to deliver environmental water to protect refuge habitats for native fish and other aquatic animals, subject to available allocations.

Additional environmental demands may also be identified during the water year as new information becomes available. Note, under certain levels of water availability, watering actions may not be pursued for a variety of reasons. For example, this may be due to the environmental demand being met by unregulated flows or the ability to deliver environmental water may be limited by constraints or infrastructure works and/or risks.

1.3 Monitoring and lessons learned

1.3.1 Monitoring

Operational monitoring is undertaken for all Commonwealth environmental watering actions and involves collecting on-ground data regarding environmental water delivery such as volumes delivered, impact on the river systems hydrograph, area of inundation and river levels. It can also include observations of environmental outcomes.

The Monitoring, Evaluation and Research (FlowMER) Program (previously the Long-Term Intervention Monitoring Project 2014 to 2019) has monitoring sites in the mid-Murrumbidgee wetlands, Lowbidgee floodplain and Murrumbidgee River channel as focus areas. FlowMER aims to understand the environmental response from Commonwealth environmental water actions with respect to the targeted objectives by carrying out monitoring and evaluation of ecological conditions at monitoring sites over many years.

Charles Sturt University is the lead agency, contracted by the CEWH to undertake the Murrumbidgee FlowMER program. The CEWH also funds discrete monitoring projects within and across catchments, such as monitoring the success of very large-scale waterbird breeding events across the Basin. Additional monitoring is also undertaken by NSW agencies.

Learn more about monitoring activities funded by the CEWH in the Murrumbidgee River Valley.

1.3.2 Lessons learned

Outcomes from monitoring and lessons learned in previous years are a critical component for the effective and efficient use of Commonwealth environmental water. These learnings are incorporated into the way environmental water is planned and delivered (through decision making processes including advisory groups, water use plans and water use minutes). This includes influencing the targeted areas and species for environmental water, and the timing, magnitude and duration of environmental flows.

Key findings and recommendations from environmental monitoring projects (Baldwin 2019; Wassens et al. 2021; Wassens et al. 2020 a and b; Kopf et al. 2019; Wassens et al. 2019 b and c; Brandis et al. 2023; Wassens et al. 2022; JC NRM Consulting, 2022; Sharpe, 2018) in the Murrumbidgee River Valley is summarised in Table MR3.

Table MR3 Key lessons learned in the Murrumbidgee River Valley

Theme	Lesson learned
Native fish	• Spawning and recruitment of native fish species, such as golden perch, can occur from within the floodplain system. Spawning of golden perch on the floodplain can be triggered using environmental flows, as demonstrated by monitoring in 2018 and 2021.

Theme	Lesson learned
	• Floodplain habitats may be critical for golden perch spawning, growth and recruitment, and importantly provide rare refuges of high-quality habitat and productivity during extreme drought conditions. Management decisions to deliver environmental water to inundate and maintain Lowbidgee floodplain habitats during spring and summer are important to maintain viable native fish populations, and to provide food and habitat for resident populations of fish, frogs and a diverse assemblage of waterbirds. • Dispersal of native fish, including golden perch, observed between the Lowbidgee floodplain and Murrumbidgee River during an environmental water flow reconnection. This provides evidence that fish spawned and recruited on floodplain waterways are contributing to the golden perch population in the lower Murrumbidgee. • Poor recruitment to the juvenile stage was found for large-bodied native fish species within the main river channel although young of year golden perch have been detected in floodplain wetlands. • Further locations and water delivery options could be investigated to improve off-channel nursery habitat for golden and silver perch. • Model predictions based on eight years of monitoring indicate that spawning for silver perch is strongly associated with higher water temperatures but not with elevated flows, with little evidence to support predicted increased probability of spawning with increasing river levels. • Native riverine fish spawning was closely linked to temperature, and in the case of silver perch, spawning appears to be associated with specific average daily water temperatures of between 22.3°C and 25.7°C. Whilst spawning of silver and golden perch has been detected over consecutive years, there is minimal evidence of recruitment following these events. As stocking of silver perch does not occur in the Murrumbidgee and golden perch stocking is thought to contribute to around 14% of the golden perch population in the Narrandera zone, it can be assumed that the population is comprised of wild adults that spawned and recruited locally. The drivers of successful recruitment, the key locations which support juveniles and the causes for the recent failures in recruitment remain unknown. Golden perch aged 2 years and over were detected in the Lowbidgee in 2020 to 2021, which confirmed that the system acts as an important nursery habitat for juvenile fish. • Since monitoring commenced in 2014, there has been little evidence to suggest that managing discrete flow peaks within the monitored reaches of the mid-Murrumbidgee influenced native fish spawning. This might be in part due to the already higher water flows occurring in the mid-Murrumbidgee compared to other parts of the river, with irrigation deliveries creating conditions suitable for spawning throughout the breeding season. • Wetland native fish species diversity was highest in wetlands that have an area of permanent water, including Avalon swamp, Telephone Creek and Waugorah Lagoon. • Sampling via electrofishing should be avoided in high flow volumes due to a lowered sampling efficiency when conducting community surveys. • Golden perch have a larval drift period which plays an important role in transporting fish from spawning grounds to productive nursery habitat, explaining why low young-of-year (YOY) are seen in monitoring and high YOY are seen in downstream floodplain wetlands. In the absence of unregulated flow events, watering events targeting spawning of golden perch and silver perch should support latitudinal larval drift and support the connectivity between river, off-channel and wetland habitats. • Large permanent Oxbow wetlands have the potential to act as 'nursery' sites for fish species such as golden perch, southern pygmy perch, as well as other wetland species such as turtles. • Permanent Water – Return/create permanent water within lagoons to support fish and turtle populations throughout an entire year. Reconnect with river rises and/or pumping annually or under a defined regime that allows adequate (depth, width, habitat complexity) permanent water to persist. • Revegetation – Emergent reed-based plants are lacking in many Midbidgee lagoons. Re-establishment of large and small reeds (e.g. Eleocharis, Phragmites, Baumea etc) required. Grazing will have to be managed.
Frogs	• Breeding of many frog species, including the southern bell frog (EPBC Act vulnerable), is triggered by rising water levels in wetlands during October and November. Therefore, watering actions in early spring are important to enhance frog breeding activity and recruitment. • Southern bell frog numbers have now reached pre-Millennium drought levels in the Lowbidgee. The combination of watering actions targeted at maintaining refuge habitat, complemented by larger deliveries during spring and summer should be continued. • The southern bell frog is highly sensitive to environmental water management and has very narrow flow requirements – requiring shallow, well vegetated areas with longer duration.

Theme	Lesson learned
	Southern bell frogs also appear to be sensitive to high fish numbers and pumping of wetlands has been used with considerable success to support southern bell frog populations in the lower Murray (NSW) and lower Murray (SA) and the mid-Murrumbidgee (Mason 2020, Waudby et al. 2021). • Flow peaks that are sufficient to inundate larger areas of wetland habitat and fringing vegetation can trigger breeding of Southern Bell frogs. • Extensive inundation over an elongated period encourages dispersal of frogs, as seen in Southern Bell Frogs over the 2022-23 watering year in the Lowbidgee.
Turtles	• Maintaining the availability of permanent water holes, particularly at Mercedes Swamp, Gooragool, Yarradda, Telephone Creek and Wagourah Lagoon refuge sites is important to support high turtle numbers. • Telephone Creek is an important refuge for broad-shelled turtles in Gayini. • Evidence of turtle recruitment remains limited most likely due to high levels of nest predation. – Ongoing fox control at key wetlands will also be important for maximising nesting success. – Investigate opportunities for head-starting which can involve collecting eggs to hatch in captivity before release of hatchlings. • Breeding of turtles is influenced by food availability in previous year. • To support breeding, target watering actions at 'over bank' flows which inundate the fringing habitat surrounding wetlands and lagoons to create a complex mosaic of water depths and providing extended inundation duration of temporary habitats.
Waterbirds	• Approximately 40,000 ha of floodplain inundation is required to trigger large-scale waterbird breeding events in the Lowbidgee. • Higher waterbird species richness and abundance has been observed at sites that were inundated compared to wetlands that were dry for extended periods. • Where possible, Commonwealth environmental water should be prioritised to provide annual seasonally inundated habitat (spring to summer) for waterbirds in the Lowbidgee floodplain and mid-Murrumbidgee wetlands. – Deliver flows in early spring rather than late summer, and top-up to increase duration into autumn. • Most waterbirds commence breeding in spring, however, the stimulus for breeding is usually a combination of season, rainfall and flooding. • When breeding occurs, water levels in active sites need to be maintained into summer months to ensure the successful fledging of young birds. • In the years following large-scale flooding events, provision of environmental water is likely to be extremely important in creating feeding habitat to support survival of young birds. • When there is limited natural overbank flooding, inundating floodplain habitat to create foraging habitat would benefit waterbird populations in the Murray–Darling Basin by promoting the survival of juvenile and adult waterbirds. • Maintaining refuge and foraging habitat for waterbirds during dry periods, should also consider watering wetland sites earlier in spring to increase productivity the availability of shallow water and mudflats as well as supporting longer duration inundation duration of floodplain inundation. • Keeping the water levels stable at Wanganella Swamp during the months of November, December and January is paramount. The water should be rising in September and rising slightly in October before stabilising in November, December and January, and then slowly drawing down in February and March. – Straw-necked ibis require 60 to 90 cm of water under the reeds or lignum for nesting, which also satisfies requirements for breeding of many other waterbird species. • The draw-down of large floodplain lake systems including Yanga Lake can provide high value foraging habitat for waterbird species. Timing the drawdown of lakes to spring or late summer also coincides with the movement patterns of migratory shorebirds – benefiting populations that extend well beyond the Murrumbidgee catchment. • Extending the delivery of water into late Summer provides foraging habitat for newly fledged juveniles.

Theme	Lesson learned
Vegetation	• Despite the wide range of hydrological regimes and geomorphologies of wetlands in the Murrumbidgee, there is a clear trend that wetlands which have received environmental water more frequently support higher species richness of water dependent vegetation species and lower numbers of exotic species. • During high water years, management decisions should be made around improving water quality and assisting with the mitigation of water events as the best ways to support native fish. • Inundating Wagourah Lagoon and Telephone Creek in the Lowbidgee during years of high-water availability should be a priority. And future watering actions at Avalon Swamp should aim to achieve complete inundation of the main wetland for approximately 8 weeks, to support the growth and reproduction of key species. • River red gum encroachment remains a concern in the mid-Murrumbidgee wetlands, particularly at McKennas Lagoon. Given the current level of river red gum at this and other wetlands, mechanical removal coupled with repeat inundation over several years may be required for restoration. • Monitoring results show there is a high value in delivering larger flows that achieve overbank conditions within the creeks and channels across Gayini to support the resilience and condition of vegetation. • Supporting persistent off-channel habitat through longer term watering strategies will help maintain populations of small -bodied fish who are in declining abundance. The success of this approach is evident in the high species richness at Yarradda lagoon and mid-Murrumbidgee. • Although environmental water has restored non-woody vegetation in Lowbidgee, Black box communities remain in poor conditions and are overall under-watered (not experiencing minimum watering requirements). • Like rivers, wetlands benefit from occasional high flows which connect the core wetland areas with fringing vegetation and create areas of shallow, temporary habitat and reconnect areas of permanent standing water. In 2021-22, higher volumes of environmental and unregulated flows entered Waugorah and Banim (Avalon) than achieved under previous watering actions. These higher volume flows inundated larger areas of wetland habitat and maintained inundation for longer periods, triggering breeding by Southern bell frogs. They also supported diverse vegetation communities, fringing vegetation in Bayil (Telephone) responded strongly to inundation indicating that these vegetation communities remain in good condition. • Pumping environmental water into wetlands within the mid-Murrumbidgee can limit the biomass of carp entering the wetland, which in turn can improve germination and establishment of water dependent plant species. – During natural reconnections, it is likely that these wetlands will again be recolonised by large carp. Managed drawdowns in autumn or winter may be required to again reduce carp biomass and support vegetation establishment.
Microinvertebrates	• Higher river levels and cooler temperatures in the Narrandera zone may impact the development of a productive and diverse micro-invertebrate community. Environmental flows that inundate dried sediments without creating stable high flows or colder water temperature may be important for maintaining high levels of riverine micro-invertebrate density. • Watering actions that allow key wetlands to drawn down and temporarily dry out will contribute to maintaining micro-invertebrate densities. • Pulse flows can trigger reproductive cues, initiate drift behaviour and create temporary habitat availability by mobilising organic matter and providing opportunities for colonisation or dispersal.
Processes and connectivity	• Since 2014, rates of metabolism have remained relatively stable overall despite considerable variability in flow volume. There seems to be little capacity for Commonwealth environmental water to have a significant influence on the rates of stream metabolism and nutrient availability via manipulation of water levels in the Murrumbidgee River within existing capacity constraints under normal flow conditions. However, previous work has shown that managed return flows do have the capacity to influence riverine nutrient availability at local scales, as was the case of the Redbank return flows undertaken in 2014–15. • Broad-scale wetland reconnections and periods of low flow are necessary to promote resources for river food webs. Future planning of watering actions that allow for wetland reconnections either via managed return flows or by generating peaks in river height may assist with the mobilisation of carbon and nutrients from the floodplain to the river.
Water quality	• Monitoring of weir pool stratification (the establishment of a thermocline, with warmer, oxygenated water above and cooler, low dissolved oxygen below) and hypoxic water management in the lower Murrumbidgee River in 2019 showed that high temperatures and

Theme	Lesson learned
	low flow conditions have the potential to adversely affect water quality. Mixing of the hypoxic bottom water with oxygenated surface water can result in low dissolved oxygen concentrations throughout the water column thereby potentially causing fish kills. Water quality can be improved, and fish kills mitigated against by: – steadily increasing in-channel flows and gradually releasing hypoxic water from weirs – exporting hypoxic water from weirs onto the floodplain using existing regulators. • In the absence of Inter Valley Transfers during Summer, targeted end-of-system flow rates alone (under the Murrumbidgee Water Sharing Plan) are inadequate to maintain acceptable water quality thresholds for aquatic biota under extreme climatic conditions. • Low dissolved oxygen (DO) levels can occur through natural processes that include seasonality, changes in flow velocity and volume, thermal stratification of the water column and diel fluctuations in respiration rates of plants and aerobic organisms. • In some circumstances, environmental water can be delivered to reduce the impacts of hypoxic water events by improving water quality and providing refuge for native fish and other aquatic animals. In summer 2021 to 2022, environmental flows were delivered in the lower Murrumbidgee River; Yanco, Billabong and Bundidgerry Creeks, successfully improving dissolved oxygen levels. • A return flow contains higher concentrations of dissolved organic carbon (DOC) than the river, if a high return flow occurs, this can significantly impact the DO levels in the river. • Physicochemical measurements from monitored wetland sites during the previous 6-year period (2014 to 2020) have been largely consistent and remained within acceptable upper and lower ranges reflecting that wetlands are in good condition. – Delivering water in spring to managed wetlands more closely matches natural inundation and reduces the risk of hypoxic black water events.
Hydrology	• Environmental water is the primary driver of ecological responses for water dependent species in the mid and lower Murrumbidgee floodplains. Maintaining core permanent refuge habitats and providing foraging opportunities for resident species should be a priority in all water years. In years of moderate and high-water availability, inundation of larger, continuous areas of floodplain habitats that support breeding opportunities should continue to be a priority.
Operational	• Very dry conditions occurred through the 2019–20 water year and watering actions were undertaken in-line with very low water availability. Environmental water deliveries were the lowest since monitoring began in 2014. Under these conditions, watering actions maintained critical refuge habitats for water dependent animals in key wetland and floodplain habitats. • Very wet conditions occurred through the 2021-23 water years and watering actions were undertaken in-line with very high water availability and high unregulated flow events. Under these conditions, watering actions maintained water quality in localised areas and mitigated the effect of low dissolved oxygen. • Removal of carp from a wetland prior to pumping, either through physical removal and/or short-term drying of the wetland following natural cues, have shown to have positive benefits for frogs, vegetation and biodiversity as a whole. It is recommended that this management intervention be implemented when carp numbers increase and declines in vegetation and tadpole diversity become apparent.

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