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Commonwealth Environmental Water Holder

Water Management Plan 2023-24

Chapter 6 – Macquarie Valley Water Plan

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Cover photo credit: wetland vegetation in the Macquarie Marshes, CEWH.

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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 peoples 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 peoples 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 Macquarie Valley hold significant spiritual and cultural importance for First Nations people. The upper and middle Macquarie Valley are within Wiradjuri Country, while on the plains the Bogan River forms the boundary between the Ngemba and Ngiyampaa Nations to the west, and the Wailwan Nation to the east (MDBA 2023). Wailwan Country includes most of the Castlereagh catchment, except the north-east corner, which is the traditional land of the Gamilaroi Nation (MDBA 2023). The CEWH respectfully acknowledges these Nations, their Elders past and present, as the Traditional Custodians of the lands on which this chapter is focused.

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

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An overview of the Macquarie 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 Macquarie Valley experienced its worst drought on record between 2017 and 2020, with well below average rainfall and highest on record temperatures. As conditions improved in early 2020, Commonwealth and NSW supplementary water contributed to much needed flows to the Macquarie River/Wambuul and Macquarie Marshes. Commonwealth and NSW water for the environment was delivered during spring and summer in 2020–21 to support recovery in the system.

Widespread rainfall and significant river flows occurred during 2021–22, increasing water in storage and allocations. Colonial waterbird breeding occurred in response to the wet conditions in the Macquarie Marshes. Large colonies of ibis (Australian white, straw-necked and glossy) and egrets (primarily intermediate and eastern great) were established, along with nankeen night heron and spoonbills. An estimated 150,000 nests were observed breeding during monitoring, across 32 colonies in the Marshes.

A small volume of Commonwealth and NSW environmental water was delivered between winter and spring 2021 to support wetland vegetation, waterbird habitat, and connectivity along the Macquarie River/Wambuul to the Barwon River. Additional small volumes of Commonwealth and NSW supplementary environmental water were delivered in late summer and autumn to help support the successful completion of colonial waterbird breeding and to provide foraging habitat for juvenile birds.

Good rainfall and tributary flows continued in 2022–23, maintaining increased flows in the mid and lower Macquarie River/Wambuul and Macquarie Marshes. Burrendong Dam remained above 100% of capacity (in the Flood Mitigation Zone) between July 2022 and early February 2023, peaking at over 149% capacity in October 2022 (WaterNSW 2023b). Allocations of General Security entitlements reached 100% on 6 September 2022 (NSW DPE – Water 2022).

Large water flows into the Macquarie Marshes resulted in colonial waterbird breeding occurring for the second consecutive year in 2022–23. An estimated 200,000 nests were observed, which exceeded the nesting events recorded in the Marshes in 2021–22 and 2016–17.

Burrendong Dam storage levels dropped below 100% of capacity in February 2023 (WaterNSW 2023b). Commonwealth and NSW environmental water was delivered for approximately 3 weeks in February/March to support later nesting waterbird colonies to completion. This water also helped to provide food and foraging habitat for juvenile and adult birds and maintained the duration of connection between the lower Macquarie/Wambuul and Barwon rivers for native fish movement.

As conditions began to dry out during autumn, additional water for the environment was delivered to the Macquarie/Wambuul River. This water was designed to provide opportunities for native fish to move up from the lower Macquarie and Marshes into more permanent waterholes, where they can grow and survive during drier conditions.

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

1.1.2 Seasonal outlook

The La Niña climate pattern that brought wet weather ended in the Pacific Ocean in mid-March 2023, with climate indicators returning to neutral levels. Climate models in June 2023 suggest that there is a 70% chance that an El Niño event will form later in 2023 (BoM 2023a).

According to the Bureau of Meteorology outlook, the forecast across the Macquarie Valley is for well below average rainfall between June and September 2023 (BoM 2023b, c).

Maximum temperatures across the Macquarie Valley are forecast to be well above average between June and September (BoM 2023d, e).

This forecast indicates that dry conditions may again be returning to the Macquarie Valley.

1.1.3 Water availability

Commonwealth environmental water is managed in conjunction with other held and planned environmental water managed by NSW. Other flows such as tributary flows, consumptive water and other water orders may also support environmental demands in the Macquarie Valley and downstream along the Barwon-Darling.

The CEWH holds 126 GL of general security entitlements in the Macquarie Valley. The volume of Commonwealth environmental water carried over in the Macquarie Valley for use in 2023–24 is 114 GL. The CEWH also holds around 8.3 GL of supplementary water in the Macquarie Valley. However, delivery of supplementary water is dependent on access announcements being made by WaterNSW. As of 1 July 2023, Burrendong Dam is at 96% capacity.

NSW also manage 160 GL of planned environmental water in the Macquarie Valley and holds around 48 GL of general security entitlements, 2.9 GL of unregulated entitlements, and 1.4 GL of supplementary water.

Based on the expected available volume of water held by the CEWH and other water holders, as well as recent and forecast catchment conditions, it is expected that the overall resource availability will be moderate to high in 2023–24. Forecast allocation of regulated (surface water) Commonwealth environmental water in 2023–24 is provided in Table 2 of chapter 1 in the Commonwealth Environmental Water Holder Water Management Plan 2023–24.

1.1.4 First Nations environmental watering objectives

The CEWH is committed to learning from First Nations people to understand how First Nations people voices, values and knowledge can be considered in environmental water planning decisions (see chapter 1 in Commonwealth Environmental Water Holder Water Management Plan 2023–24). Over the next year the CEWH and their staff will work with First Nations people to understand what a work program could look like to ensure that First Nations people and representative groups actively participate in the planning and management of environmental flows in ways that they determine.

1.1.5 Environmental demands

The environmental water demands for assets in the Macquarie Valley in 2023–24 are shown in Table MV1. The capacity to contribute to these environmental demands is contingent on water availability and conditions in the catchment throughout the year.

Table MV1 Environmental demands, watering priorities and outlook for coming year, Macquarie Valley, 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 demand
		Flow/volume	Required frequency (maximum dry interval)		Environmental demand for water (all sources)	Potential Commonwealth environmental water contribution	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24
Mid-Macquarie River / Wambuul (Burrendong – Marebone Weir) • Native fish habitat and spawning including threatened species such as Murray cod, Freshwater catfish • In-stream aquatic ecosystems • Riparian vegetation	Fish refuge Aquatic ecosystems	Baseflows: Small (greater than 200 ML/d), very regular flows through to end of system, wetting waterholes and in-stream storages. Ideally depth greater than 0.3 m above commence to flow level, to allow some movement and prevent pool stratification. Very low flows in the mid-Macquarie River / Wambuul have the same flow rate and requirements as baseflows (greater than 200 ML/day). Cease to flow events should be avoided.	Ideally: continuous flow (max. interval: continuous flow)	Demand expected to be met by essential regulated supplies in all but the most extreme dry years. Minimum baseflows have been achieved in all years, other than in 2019–20 when extreme dry flow conditions meant that the Macquarie River/Wambuul was shut off downstream of Warren Weir in late Aug 2019 until tributary flows improved conditions in Feb 2020. Baseflows are ideally required continuously to maintain in-stream habitat and will be required again in 2023–24. Therefore, the environmental demand has been assessed as high.	High	Expected to be met by essential regulated supply, so a secondary priority for Commonwealth environmental water (CEW). Potential use of CEW under very low water availability scenario, subject to environmental water being available for delivery.	High
	Fish spawning – flow generalists (e.g. Australian smelt, carp gudgeon) and in-channel specialists (e.g. Murray cod, Freshwater catfish)	Small freshes: Small fresh 1(SF1) greater than 500 ML/d anytime (but ideally Oct to Apr) for 10 days. Small fresh 2 (SF2) greater than 500 to 6,000 ML/day for at least 14 days at Baroona in Sept to Apr (Sept to Dec for Murray cod spawning); and conditioning flow in winter (July to mid-Aug).	Ideally: SF1: annually (max. interval: 3 years for large-bodied generalists; 5 years in-channel specialists; 1 year for small-bodied). SF2: 5 to 10 years in 10.	Small freshes were achieved in all years between 2015–16 and 2022–23, excluding in 2019–20 when these flows were only partially met. These flows are ideally provided annually, particularly for small-bodied fish, so are required again in 2023–24. Therefore, the environmental demand has been assessed as high.	High	High priority for CEW under low to high water resource availability scenarios, subject to natural tributary flows and water temperature.	High
	Flow specialists fish movement and breeding	Priming flow: greater than 5,000 ML total flows at Baroona over 3 days with approx. 7-day recession (tributary pulse). Spawning pulse: initial peak greater than or equal to 5,000 ML/day at Baroona for greater than 2 days with event lasting for greater than 7 days (35 to 40 days total event). Dispersal flow: Initial pulse greater than 3,000 ML total flows over 3 days at Baroona. Second pulse minimum 2,000 ML/day peak with recession. Approx. 10-day duration total events (Oct to Mar). Water temperature for all pulses greater than or equal to 19°C.	Ideally: 3 to 5 years in 10 (up to twice per year) (max. interval: 4 years)	Flows for native fish flow specialists were met in 2020–21, 2021–22 and 2022–23, and before that in 2012–13. In 2019–20, tributary flows contributed to priming and dispersal flows. However, spawning flows were not achieved at times that temperatures were suitable, and/or the required flow rates were not achieved along the Macquarie River/Wambuul down to Marebone. Having been met in each of the last three years, the minimum frequency for these flows has been achieved. However, with prolonged drought conditions before this, the maximum interval of 4 years between events was exceeded before 2020–21. These flows may be required again in the next 1–2 years, to increase the frequency this demand is achieved, and to support further recovery of native fish flow specialists in the mid-Macquarie River. Therefore, the environmental demand for water in 2023–24 has been assessed as moderate to high.	Moderate to High	The capacity to target spawning pulses using regulated environmental water is limited in most years. Possible use of CEW (e.g. supplementary) under moderate to high water resource availability scenarios to augment freshes and support movement. Subject to natural tributary flows, water temperature, and significant river rises that will cue movement and possibly spawning of flow specialists.	Moderate to High
	Fish movement In stream and riparian vegetation	Large freshes and bankfull: 10,000 to 20,000 ML/day at Baroona for a minimum of 3 days (to drown out key weirs). (Gin Gin drowns out at 18,000 ML).	Ideally: 2 in 10 years (max. interval: 4 years)	Large freshes were achieved in 2022–23, 2021–22 and in 2016–17. These flows were partially met in 2019–20 and 2020–21. In 2022–23, flows greater than 10,000 ML/day occurred for 25 days in July and for 199 days between early August and December. While the minimum required frequency has been achieved, water may be required again in the next 2–3 years to support further recovery of native fish populations in the mid-Macquarie River. The demand for water in 2023–24 has been assessed as low.	Low	Possible use of CEW (e.g. supplementary) under moderate to high water resource availability under certain conditions.	Moderate
Macquarie Marshes Includes: • areas of Ramsar listed wetlands	Blue and Purple inundation zones (4,000 to 9,000 ha)	30 to 60 GL at Marebone over 3 months between June and Apr to inundate reed beds, lagoons, mixed marsh, and Water couch. Volume required to meet demand may vary depending on antecedent conditions.	Ideally: annually (max. interval: 2 years)	Demand has been met in most parts of the Marshes in most years since 2012–13. This demand was met in the Northern, Southern and Eastern Marshes in 2022–23, based on the flow volume, inundation extent and duration.	High	A high priority for CEW under very low to high water resource availability scenarios.	High

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 demand
		Flow/volume	Required frequency (maximum dry interval)		Environmental demand for water (all sources)	Potential Commonwealth environmental water contribution	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24
• Nationally significant wetlands • Waterbird breeding and foraging habitat • Habitat and breeding ground for frogs • Native fish habitat				Widespread rainfall and river flows, along with the delivery of Commonwealth environmental water contributed to good flows into the Marshes in 2022–23. A total of around 1,028 GL of water was recorded at Marebone between July and early January, with the peak of inflows occurring in spring. Overall, the demand for water in 2023–24 has been assessed as high. This assessment reflects the annual watering requirement of vegetation in the core wetlands, and the need to continue supporting recovery and resilience for future dry years. There is also a need to continue maintaining habitat for waterbirds, to support the survival of young birds.			
	Pink inundation zone (19,000 ha)	100 GL at Marebone over 3 months between June and Apr to inundate reeds, water couch, mixed marsh, river red gum forest, river cooba. Volume required to meet demand may vary depending on antecedent conditions.	Ideally: 8 in 10 years (max. interval: Groundcover – 2 years; trees 4 to 7 years)	With high rainfall and flows passed Marebone, this demand was met in 2021–22 in the Northern, Southern and Eastern Marshes. Before this, this demand was met in 2012–13, 2016–17 and again in 2017–18 in all areas of the Marshes, excluding the Eastern Marshes in 2017–18, which was not inundated for the target duration. Demand was either partially or not met in years in between. Ideally these flows are provided 8 in 10 years but have only been met 4 in the last 10 years. Before 2021–22, the maximum interval between these flows had also been exceeded for groundcover. Therefore, the need for water to support groundcover in 2022–23 has been assessed as high. Trees have a longer maximum interval between flows of this size, so the demand for water has been assessed as low. This area requires water in 2022–23 to contribute to the 8 in 10-year frequency, and to build resilience, including in Ramsar sites.	Low (trees) Moderate to High (groundcover)	A high priority for CEW under moderate to high water resource availability scenarios, subject to water availability and conditions.	Low to High
	Red inundation zone (50,000 ha)	250 GL at Marebone over 3 to 5 months between June and Apr to inundate river red gum woodland, river cooba, inner coolibah woodland. Volume required to meet demand may vary depending on antecedent conditions.	Ideally: 1 in 3 years (max. interval: 4 to 7 years)	Demand met in 2022–23, 2021–22, 2016–17 and 2012–13 in all areas of the Marshes. The ideal minimum frequency has been met in the last three years. While the required flow volumes and frequency have been achieved, and the demand for further water for trees is considered low, there is a high demand for water to support groundcover. During 2022–23, there has been a good response from wetland vegetation such as water couch and lignum under the river red gum. This vegetation requires additional water in 2023–24 to allow it to better establish. Additionally, the more time out from a flood, the more difficult it will be to maintain this area. Therefore, the demand for water in 2023–24 has been assessed as low for trees and high for groundcover.	Low (trees) High (groundcover)	Possible use under high or very high water resource availability scenarios. May require other water sources to meet entire demand.	Low to Moderate
	Orange and green inundation zones (81,000 to 145,000 ha)	400 to 700 GL at Marebone over 5 months between June and Apr to inundate outer river red gum (RRG) woodland, coolibah, and black box. Volume required to meet demand may vary depending on antecedent conditions.	Ideally: 1 in 4 years (RRG) or 1 in 8 years (other veg) (max. interval: 7 years (RRG) 20 years (other veg)	This demand was met in 2022–23 and partially met in 2021–22, having not been inundated for sufficient time. This demand has been fully met twice in the last 10 years, in 2016–17 and 2022–23. Some minor inundation occurred in 2011–12 and 2012–13. The demand for water in 2023–24 has been assessed as low.	Low	Low priority for use of CEW in 2023–24 and only able to contribute to this demand when coordinated with major flow event.	Low to Moderate
Lower Macquarie River / Wambuul	In-stream aquatic ecosystems Fish connectivity	In-channel flows: Minimum 20 ML/day at Bells Bridge for 45 days.	Ideally: annually (max. interval: 1 to 2 years)	Small in-channel flows were met in the lower Macquarie in each year since 2016–17, excluding 2019–20, which was extremely dry.	High	Possible use under low to moderate water resource availability scenarios, subject to tributary	High

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 demand
		Flow/volume	Required frequency (maximum dry interval)		Environmental demand for water (all sources)	Potential Commonwealth environmental water contribution	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24
(Marshes – Barwon River) • Native fish habitat and dispersal • Provides connectivity between Macquarie and Barwon catchments • In-stream aquatic ecosystems and floodplain vegetation				In 2022–23, flows remained above the minimum of 20 ML/day on all days between July and May. The lower Macquarie has also experienced prolonged cease to flow conditions in many other years. These flows ideally occur annually and are required again in 2023–24. Therefore, the environmental demand has been assessed as high.		flows. Needs may be partially met by other flows (e.g. environmental water delivered to the Marshes).	
	Fish connectivity	System connectivity between the Macquarie and Barwon catchments: e.g. in-channel flow targeting minimum rates of 140 ML/day at Bells Bridge (minimum depth of 50 cm) to connect the lower Macquarie River and the Barwon River for a minimum of 28 days.	5 years in 10 (max. interval: 4 years)	Connection between the lower Macquarie and Barwon rivers was achieved in 2016–17, 2020–21, 2021–22, and again in 2022–23 resulting from a combination of environmental water, rainfall, and natural flows. Based on flows at Bell's Bridge this demand may also have been partially met in 2017–18 and 2018–19. Ideally these connection flows are achieved 5 years out of 10. However, they have only been met 4 in the last 10 years. There are also benefits for system scale productivity and native fish in the Barwon–Darling if these flows are supported for as long as possible. Therefore, water is required again in the next 1–2 years, and the environmental demand has been assessed as moderate to high.	Moderate to High	High priority for CEW under moderate to very high water resource availability scenarios only, subject to suitable conditions and operational feasibility.	Moderate
	Fish. Instream and riparian vegetation. Connectivity	Large freshes: greater than 700 ML/day at Bells Bridge for 5 days. Can occur at any time for large fresh 1 (LF1) (but ideally Jul to Sep), or Oct to Apr for large fresh 2 (LF2).	Ideally: • LF1: 5 to 10 in 10 years (max. interval 2 years) • LF2: 3 to 5 in 10 years (max. interval 4 years).	The demand for large freshes in the lower Macquarie was met in 2022–23 and 2021–22, with dam spill conditions persisting for a substantial time. However, over the last 10 years assessed, this demand has only been met three times (one other in 2016–17). It was partially met in 2012–13. These flows were not met in any other year over that time. Considering these flows are required more frequently, and the maximum interval for both Large Fresh 1 and 2 had been exceeded before 2021–22, the environmental demand has been assessed as high.	High	Possible use under high to very high water resource availability scenarios only, subject to suitable conditions and operational feasibility. Would require coordination with a significant natural flow event or dam spill.	High
Unregulated Distributary creeks **(Marra Creek Lower Crooked Creek)** • Native fish habitat • In-channel and riparian habitat • Connectivity with Barwon–Darling catchment	Fish In-channel and riparian vegetation. Increased frequency and duration of connectivity to Barwon–Darling	Baseflows and freshes to Marra Creek and/or the lower Crooked Creek. Volumes required dependent on which creeks are targeted. Some connectivity may be provided by replenishment flows.	Required frequency unknown (1 in 1 to 3 years based on key vegetation)	Demand was likely met in 2022–23, 2021–22, 2016–17 and 2012–13, with stock and domestic replenishment flows partially contributing to demand in some creeks in years in between. Marra Creek received around 353 GL of flow at Carinda and 591 GL at Billybingbone between July and mid-February. Crooked Creek received lower flows throughout the year, with a total of around 39 GL at the Profile Gauge. The total volumes received in 2022–23 were greater than in either 2021–22 or 2016–17. The peak flows arrived earlier in 2016–17 (Sep to Oct) and later in 2021–22 (Dec), occurring in late October to November. The peak flows in 2022–23 also coincided with temperatures that were largely greater than 20oC, meaning the flows were suitable for vegetation growth and native fish. Considering this demand was met in both 2021–22 and 2022–23, water is not required urgently in 2023–24. Therefore, the environmental demand has been assessed as low.	Low	Possible use of CEW under moderate to very high water resource availability scenarios, subject to water availability and operational feasibility.	Low to Moderate
Prioritised critical refuge habitat – various locations as required in exceptional circumstances	Fish and other aquatic dependent biota refuge. Aquatic ecosystems	Baseflows to replenish significant refuge pools at high risk of drying down in exceptionally dry circumstances. Volumes required are likely to be relatively small, but dependent on which refuge pools are targeted.	As required only during extremely dry conditions	Demand expected to be met by essential regulated supplies in all but the most extreme dry years. While extreme dry conditions persisted for much of 2019–20, conditions have continued to improve since, and regulated supplies, rainfall and tributary flows have maintained critical habitat between 2020–21 and	Low	Expected to be met by essential regulated supplies so a low priority for the use of CEW. Likely only to be used under a very low water availability scenario,	Variable depending on climatic conditions: • If extreme dry conditions persist, demand may be Critical.

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 demand
		Flow/volume	Required frequency (maximum dry interval)		Environmental demand for water (all sources)	Potential Commonwealth environmental water contribution	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24
• Refuge habitat • Native fish (e.g. Olive perchlet), water rat and tortoise survival • Water quality				2022–23. Therefore, the demand for water to support refuge pools in 2023–24 has been assessed as low.		subject to environmental water being available for delivery.	• If conditions become significantly wetter, demand may be to Low or Very Low.

Note: The Macquarie Marshes Ramsar site includes parts of the northern, southern and eastern areas of the Macquarie Marshes. The Ramsar site contains a range of habitats including core areas of semi-permanent wetlands, such as forests and woodlands, reed beds, marshes, rushlands and open lagoons. These vegetation types have been identified as critical components of the Ramsar site. By maintaining this wetland vegetation, other critical components of the Ramsar site may be supported, including waterbird breeding and foraging habitat. Contributions to meet Barwon–Darling environmental requirements will be considered subject to water availability, antecedent conditions and environmental demands (see chapter 7 of the CEWH Water Management Plan 2023–24). Information on environmental demands has been sourced from the Macquarie–Castlereagh Long-Term Water Plan (NSW DPIE 2020), Barma Water Resources et al. (2011), NSW DECCW (2010), MDBA (2012), Thomas et al. (2015), and Torrible et al. (2011), in conjunction with advice from NSW DPE – EHG and NSW DPI – Fisheries. All watering history sourced from NSW DPE – EHG and NSW DPI – Fisheries, and data from the following gauges (WaterNSW 2023a) – 421090 Macquarie River at d/s Marebone Weir, 421001 Macquarie River at Dubbo, 421147 Macquarie River at Pillicawarrina, 421088 Marebone Break at d/s Regulator, 421107 Marra Creek at Billybingbone Bridge, 421097 Marra Creek at Carinda Road, 421146 Gum Cowal at Bifurcation, 421907 Macquarie River at Brewon, 421127 Macquarie River at Baroona, 421016 Crooked Creek at Profile, 421012 Macquarie River at Carinda (Bells Bridge), 421022 Macquarie River at Oxley Station.

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 to high water resource availability); or water demand likely to be met via other means
- Low priority for Commonwealth environmental watering (under high to 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

The objective for managing Commonwealth environmental water in 2023–24 is to maintain, and where possible improve, the health and resilience of water-dependent ecosystems in the Macquarie River/Wambuul and Marshes, and other important sites in the valley and downstream along the Barwon-Darling as required.

As in previous years, the use of Commonwealth and NSW environmental water in the Macquarie Valley will be adaptively managed together throughout 2023–24, in response to changing water resource availability and environmental conditions and demands.

Water will also be managed to meet demands in future years and support the rolling 3-year objectives, developed with the Environmental Water Advisory Group, to build system resilience, maintain core areas of the Marshes, support native fish populations, connectivity, and waterbird populations. Carryover retained across years as part of the above watering plan will provide a minimum balance sufficient to inundate core Macquarie Marshes areas in the following two years, should that be required.

Water will be delivered to the Macquarie Marshes between August and November, if needed, to target the inundation of up to 50,000 ha (Map 1) of wetland vegetation (river red gum woodland, river cooba, inner coolabah woodland) for around 3 months. Delivery of environmental water to the Macquarie Marshes would:

- Maintain the condition of understorey wetland groundcover and shrub-layer vegetation (including water couch and lignum) in river red gum woodland, which has responded to inundation in 2022–23
- Maintain the condition of inner semi-permanent wetland vegetation, including reeds, water couch and mixed marsh communities
- Provide waterbird habitat, including foraging grounds for juvenile waterbirds, to increase their survival and condition
- Support vegetation condition and structure at key colony sites to improve their ‘event readiness’ for future colonial bird breeding events
- Provide an increase in river productivity and improve the condition of native fish in the mid-Macquarie/Wambuul River, including freshwater catfish
- Support frog recruitment, and provide food and habitat for a range of other water dependent species (e.g. turtles, rakali, mussels)
- Increase connectivity through the lower Macquarie/Wambuul River to the Barwon River, providing opportunities for native fish movement and dispersal.

The CEWH’s delivery teams will also deliver water to the mid-Macquarie/Wambuul River in summer and autumn to support the spawning and recruitment of native fish, particularly freshwater catfish. Delivery of environmental water to the mid-Macquarie/Wambuul River would:

- Support the breeding and recruitment of freshwater catfish
- Support the movement and dispersal of juvenile freshwater catfish

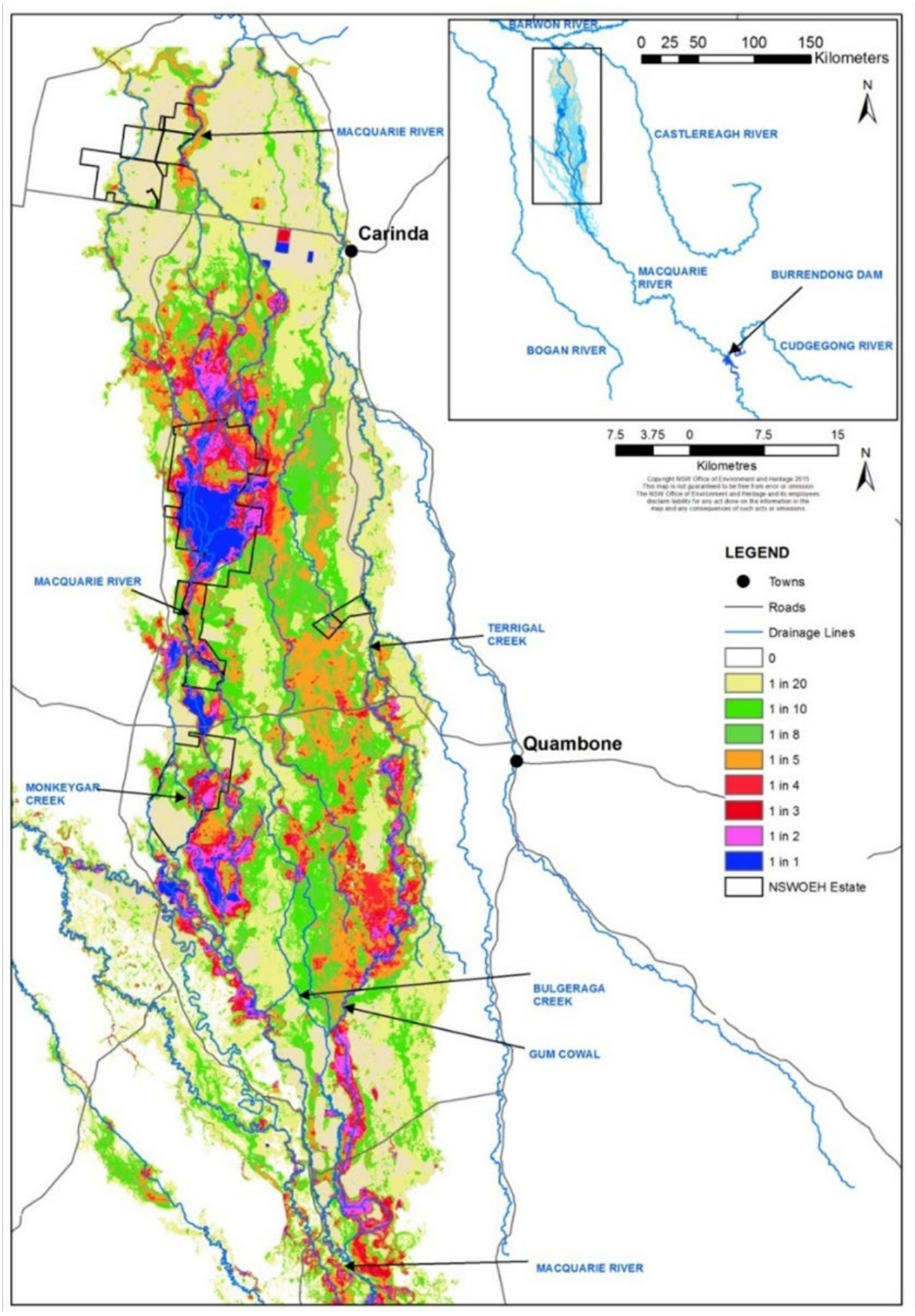
- Provide opportunities for the breeding, recruitment and movement of other generalist and instream specialist native fish species such as Murray cod, Murray–Darling rainbow fish and carp gudgeon.

Depending on water availability and conditions, environmental water may also be delivered to:

- Support further viable colonial waterbird breeding events, should they occur naturally
- Connect the lower Macquarie/Wambuul and Barwon rivers to support the movement and dispersal of native fish (e.g. golden perch) as opportunities arise.

There is a high demand to provide flows to provide large freshes in the lower Macquarie/Wambuul. However, the capacity to support these demands would require significant other flows in the system.

Map 1 Macquarie Marshes inundation frequencies, 1988 to 2008



Source: (Thomas et al. 2015)

1.3 Monitoring and lessons learned

1.3.1 Monitoring

In the Macquarie Valley, monitoring is primarily undertaken by NSW agencies, including NSW DPE – EHG (vegetation, waterbirds and frogs), NSW DPI – Fisheries (native fish), and WaterNSW (hydrology and flow delivery data). The CEWH has also funded several short-term intervention monitoring projects to evaluate the environmental responses of native fish, waterbirds, and freshwater mussels.

Learn more about monitoring activities funded by the CEWH in the Macquarie 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 from fish, flow, frog and waterbird monitoring in the Macquarie Valley are summarised in Table MV2.

Table MV2 Key lessons learned in Macquarie Valley

Theme	Lessons learned
Native fish [a]	• Spring/early summer delivery has been associated with peaks in breeding of some small-bodied opportunistic fish species (e.g. Australian smelt, un-specked hardyhead, Murray–Darling rainbowfish), particularly on the receding tail of flows, or during sustained periods of increased flow. • Spring/early summer delivery is also likely to support recruitment of native species such as Murray cod and freshwater catfish, by increasing flows and boosting in-stream productivity in the river. • A flow pulse in August/early September would be beneficial to support pre-spawning movement of Murray cod, and to increase productivity and food availability. • Providing stable flows during spring is important for the successful breeding and recruitment of Murray cod. Ideally, this flow would extend from mid-September to late November to early December, at a stable moderate flow of 1,000 ML/d at the Gin Gin gauge. • Real time information from monitoring can be used to inform the management of environmental water during a delivery, for example, delaying the planned release of a flow pulse that could compromise nesting success of native fish.
Frogs [b]	• High frog abundance reflects patterns of wetland inundation, high aquatic plant growth and warm survey temperatures, which make the conditions highly conducive to frog breeding activity and frog detection. • Local weather and inundation extent influence the activity of some species. Increased inundation increases the number of sites with conditions suitable for breeding, and the calling of flow-responsive species. • Flooding events are very important for increasing overall abundance of flow-responsive species, by supporting breeding and enabling frogs to move between wetlands. • Longer duration of inundation is important for frogs to complete metamorphosis. The highest breeding success has occurred in years with longer wetland duration (2016, 2018, 2020 and 2021). Maintaining water levels in the Marshes into late November increases frog recruitment.
Waterbirds [c]	• Delivery in winter to spring (into summer if possible) provides suitable wetland habitat for nationally threatened and internationally recognised migratory species and coincides with warmer temperatures and peak activity for waterbirds and their food supplies.

Theme	Lessons learned
	• A slow steady contraction of inundated area is preferable, particularly for wading species. • Delivery to parts of the Marshes during dry conditions supports a diverse range of waterbirds and provides important feeding and refuge habitat. • Environmental water can play a key role in supporting breeding colonies, by extending the duration of flows, increasing water depth, and maintaining water quality and foraging areas. • Supporting nesting habitat between wet years is crucial for the success of breeding events when they do occur.
Connectivity [d]	• Connectivity between Macquarie / Wambuul and Barwon rivers can be achieved using environmental water and is important for allowing the movement of native fish between rivers for spawning, dispersal and recruitment.
Other aquatic animals [e, f]	• Persistence of healthy populations of freshwater mussels (particularly *Alathyria jacksoni,* which is endemic to the Murray–Darling Basin) is dependent on permanent river reaches and waterholes. The provision and protection of minimum baseflows is vital to their persistence, and for populations to recover from the significant losses experienced during the 2017 to 2020 drought. • Recolonisation of freshwater mussels is dependent on the recovery and movement of native fish populations through the northern Basin. Therefore, the minimum flow requirements of native fish also need to be provided to support recovery of both fish and mussel populations. • Freshwater mussel are extremely vulnerable when rivers dry out during intense drought or periods of low flow. Floodplain mussels could survive for months under drying conditions in certain circumstances when temperatures were cooler. River mussels could only survive for weeks under the same conditions. Survival times decreased to just days for both species as temperatures increase.

a Stocks et al. (2015), Davis, Asmus & Stocks (2017), Stocks (2021). **b** Ocock & Spencer (2017), Ocock & Spencer (2018), Walcott et al. (2019), NSW DPIE – EES (2021), NSW DPE – EHG (2022). **c** Spencer et al. (2016), McGinness et al. (2017), Brandis (2017), NSW OEH (2019), Brandis et al. (2022). **d** Davis, Asmus & Stocks (2017), WaterNSW (2017). **e** Sheldon et al. (2020). **f** Wright et al. (2022).

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