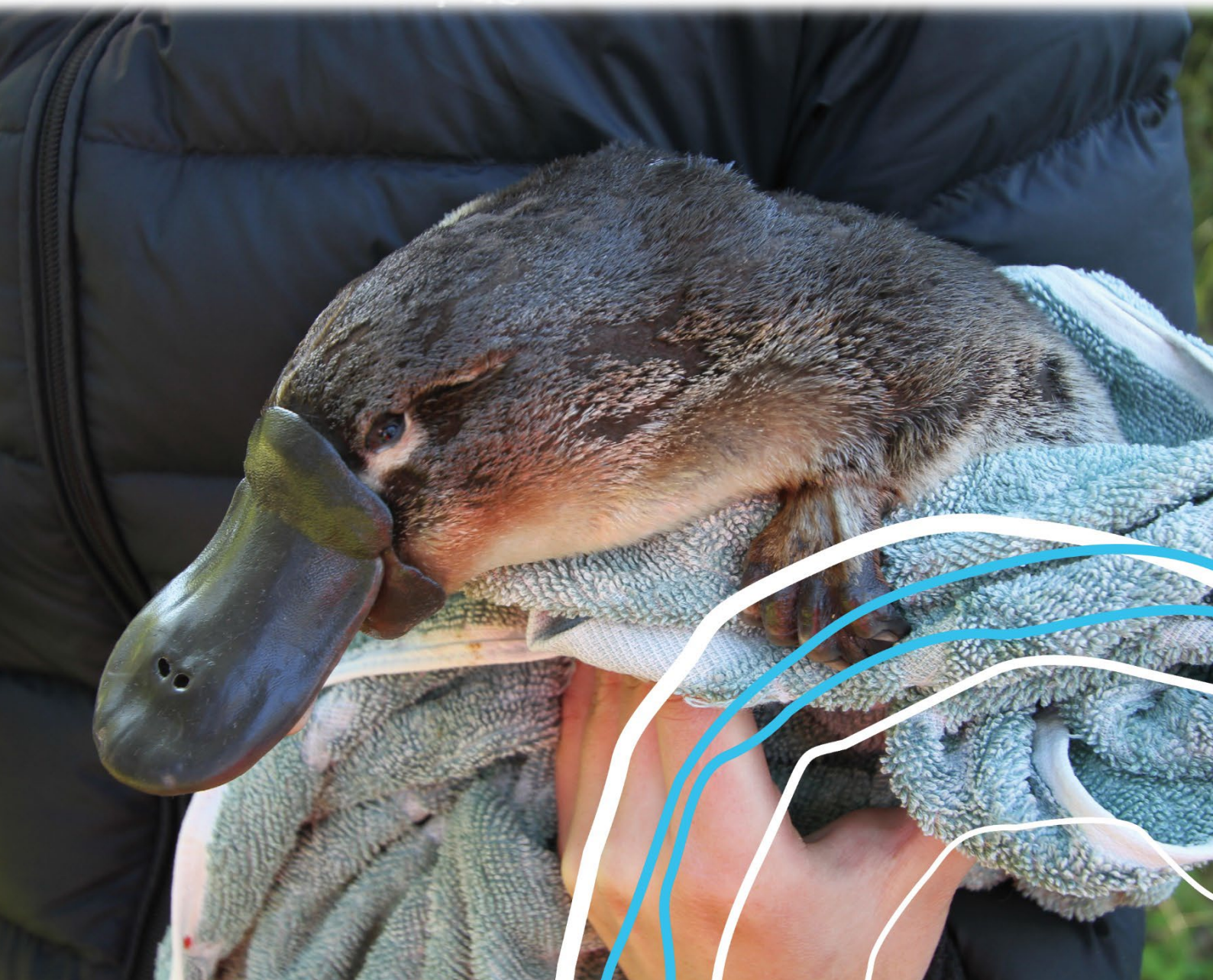
Australian Government
Commonwealth Environmental Water Holder

Water Management Plan 2023-24

Chapter 2 – Border Rivers and Moonie Valleys Water Plan



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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 Peoples 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.

Traditional owners have longstanding and continuing ties to Country and hold the rivers and the many billabongs along the rivers in this catchment in high regard. First Nations of the region include the Bigambul, Euahlayi, Githabul, Kambuwal, Gomeroi/Kamilaroi, Kwiambul, and Ngarabal Nations (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.

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An overview of the Border Rivers and Moonie valleys 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 Border Rivers valley experienced extreme drought conditions between 2017 and 2020, with some areas receiving the lowest rainfall and highest temperatures on record. Widespread rainfall provided much needed flows, with dry conditions easing from early 2021.

Wet conditions continued throughout most of 2021–22, resulting in major flooding in parts of the catchment, with most storages spilling. The large flows and connectivity in unregulated tributaries such as the Mole and Weir rivers triggered widespread native fish recruitment, movement and dispersal. No regulated Commonwealth water or NSW planned environmental water (Pindari stimulus flow) was used during this time. Commonwealth unregulated entitlements in the Queensland part of the catchment contributed 20 gigalitres of flow in 2021–22, to the Dumaresq, Macintyre and Barwon rivers.

Conditions remained very wet throughout the first half of 2022–23, with widespread rainfall and significant river flows. The Border Rivers valley experienced a particularly wet spring, with some areas receiving highest on record rainfalls. Water storages remained full or spilling, over the first half of the water year. In summer 2022–23, conditions rapidly turned hot and dry, with well below average rainfall and lowest on record rainfall in some areas. However, wet conditions returned in autumn with significant rainfall in parts of the Border Rivers valley refilling water storages. As of 1 July 2023, Pindari Dam was at 84% capacity and Glenlyon Dam was at 98% capacity.

While water availability was high during the first half of 2022–23, 100% of Queensland unregulated entitlements were used. Commonwealth environmental water contributed 12.2 gigalitres (GL) across the Queensland Border Rivers between July and October 2022, including 9.8 GL to the Dumaresq, Macintyre and Barwon rivers, 2.1 LG in the Queensland Severn, and 0.3 GL to the Macintyre Brook.

In the NSW Border Rivers, a small volume (86.2 megalitres (ML)) of supplementary water in the regulated Border Rivers was accounted for in April 2023. No regulated Commonwealth environmental water was delivered in either the NSW or Queensland Border Rivers in 2022–23. This was because of wet conditions in the first half of the year.

Learn more about previous Commonwealth environmental water use in the Border Rivers valley.

The Moonie valley experienced wetter than average and cooler than average conditions in 2021–22 and the first half of 2022–23. The second half of 2022–23 was drier and warmer, with below average to very much below average rainfall and average to above average temperatures.

The Commonwealth's unregulated Queensland licences in the Moonie valley were triggered in winter and spring, with two of the three licences being fully accounted for by the end of spring 2022. 5,487 ML of the available 5,671 ML was left instream to enhance environmental outcomes during 2022–23. Over 183 GL flowed past the most downstream gauge at Gundablouie from July 2022 to June 2023, contributing inflows into the Barwon–Darling River.

1.1.2 Seasonal outlook

The La Niña climate pattern that had been bringing wet weather ended in the Pacific Ocean in mid-March 2023, with climate indicators returning to neutral levels. Climate models in June 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 Border Rivers and Moonie valleys is for well below average rainfall between June and September (BoM 2023b, c).

Maximum temperatures across the Border Rivers and Moonie valleys 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 Border Rivers and Moonie valleys.

1.1.3 Water availability

Commonwealth environmental water is managed in conjunction with other NSW planned environmental water (for example the Pindari stimulus flow). Not all environmental demands can be met by environmental water alone. Generally, the maximum environmental demand environmental water may contribute to in the Border Rivers is a large fresh event (NSW DPE 2022). Other flows such as tributary flows, consumptive water and other water orders may also support environmental demands in the Border Rivers valley.

The volume of Commonwealth regulated environmental water available for use in the Border Rivers valley in 2023–24 is likely to be 18,346 ML (up to 15,540 ML in Queensland and 2,806 ML in NSW).

The Commonwealth may also have access to up to 1,437 ML in NSW supplementary entitlement in the regulated NSW Border Rivers, and up to 19,986 ML in Queensland 'unsupplemented' (unregulated) entitlements in the Queensland Border Rivers. Unregulated entitlements provide opportunistic access to river flows when water levels exceed trigger values at certain locations, as specified in the entitlement conditions. Each triggered Commonwealth environmental water entitlement leaves water in the river which could otherwise be extracted, helping to restore more natural flows. Generally, the Commonwealth accounts for the full allowable volume of unregulated entitlements when they are triggered, apart from a small unregulated entitlement in the Dumaresq, which we do not account use against in winter.

Commonwealth environmental water in the Moonie valley can only be sourced as a share of an unregulated flow event, and water availability depends on the flow events that occur. The Commonwealth generally accounts to the maximum volume possible in the Moonie valley. The Commonwealth has an estimated 5,671 ML of environmental water in the Queensland portion of the Moonie valley. Accounting against each entitlement is triggered when flow rates exceed a specified threshold linked to the entitlement. Commonwealth environmental water is then accounted for using the maximum daily pump rate, until the flow rate drops below the trigger level, or the entitlement's yearly volumetric limit is exceeded. In 2021 the Commonwealth, Queensland and NSW also agreed to new cross-border Commonwealth environmental water accounting arrangements which apply to both the Border Rivers and Moonie valleys.

Based on the expected available volume of water held by the Commonwealth 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. 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's voices, values and knowledge can be considered in environmental water planning decisions (see chapter 1 in the Commonwealth Environmental Water Holder Water Management Plan 2023–24). In the Border Rivers valley, the CEWH and their staff have been building relationships with First Nations people to work towards developing a work program. Over the next year 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 Border Rivers valley in 2023–24 are shown in Table BR1. The environmental water demands for assets in the Moonie valley in 2023–24 are shown in Table BR2. The capacity to contribute to most of these environmental demands is contingent on continued moderate to wet conditions in the catchment.

Table BR1 Environmental demands, watering priorities and outlook for coming year, Border Rivers 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 demands for water (all sources)	Potential Commonwealth environmental water contribution	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24
Dumaresq River main channel: • Native fish • Drought refuge habitat • In-stream aquatic ecosystems • Riparian vegetation	Drought refuge habitat. Water quality. Fish maintenance and survival (all groups).	**Very low flow** • Glenarbon: greater than 50 ML/day for a minimum 261 days. • Roseneath: greater than 71 ML/day for a minimum 292 days.	Ideally: minimum 5 years in 10.	Very low flows have been achieved in the Dumaresq River at both Glenarbon and Roseneath in the last two years. Before 2021–22, drier conditions meant that very low flows were not met in the Dumaresq River for 3 to 4 years. The minimum required frequency of very low flows has been achieved at Glenarbon, but not at Roseneath, having been achieved in 4 of the last 10 years. Therefore, the demand for water to provide very low flows has been assessed as moderate (at Glenarbon) to high (at Roseneath).	Moderate to High	High priority for Commonwealth environmental water (CEW) under very low to low scenarios, subject to water availability. Would be met by other water in moderate to very high scenarios.	Moderate to High
	Water quality. Habitat maintenance. Connectivity. Fish maintenance and survival (all groups). Fish recruitment (generalists and in-channel specialists).	**Baseflow (BF)** • Glenarbon: greater than 140 ML/day for minimum 160 days for survival; 102 days for recruitment. • Roseneath: greater than 250 ML/day for minimum 160 days for survival; 102 days for recruitment.	Ideally: 5 years in 10. (max. interval: 95 days). Can occur at any time for native fish maintenance and survival, or Sept to Mar for native fish recruitment.	Baseflows have been met in the Dumaresq River at both Glenarbon and Roseneath in the last two years. Before 2021–22, drier conditions meant that baseflows had not been achieved in the Dumaresq River since at least 2016–17, when conditions were wetter. Baseflows have generally only been met in the Dumaresq River in three of the last 10 years assessed, and the required minimum frequency of these flows has not been achieved. Therefore, the demand for water to support baseflows in 2023–24 has been assessed as high to critical.	High to Critical	High priority for CEW under low to moderate scenarios, subject to water availability. May be met by other water, including operational dam releases.	High
	Longitudinal connectivity. Low level bank and bar wetting. Pool maintenance. Fish movement, productivity and condition. Fish spawning (generalists and in-channel specialists).	**Small fresh (SF)** SF1 (fish dispersal and productivity/condition): • Greater than 500 ML/day at both Glenarbon and Roseneath. SF2 (fish spawning): • 1,000 to 2,400 ML/day at both Glenarbon and Roseneath.	Ideally: Annually for SF1 (max. interval: 1 year). Minimum 2 to 3 in 10 years (ideally 5 to 10 in 10) for SF2 (max. interval 7 to 8 years, ideally 2). SF1: ideally occurs Oct to Apr (but can occur any time) for minimum of 10 days. SF2: Aug to Apr for a minimum of 11 days (ideally 14 or more).	Small freshes to support native fish dispersal, productivity, and condition (SF1) are required annually. These flows have been achieved each year in the Dumaresq River across the last 10 years assessed, excluding at Roseneath in 2015–16. Small freshes to support native fish spawning (in-channel specialists and flow generalists) (SF2) are required at least 2 to 3 in 10 years. These flows have been achieved in the Dumaresq River for the minimum required frequency over the last 10 years assessed. Based on the frequency required for small freshes, these flows have been assessed as having a moderate to high demand for water in 2023–24, with SF1 (required annually) having the highest demand.	Moderate to High	High priority for CEW under moderate to high water resource scenarios, subject to water availability and being delivered in conjunction with other water. May be met by other water under a high or very high scenario.	Moderate to High
	Longitudinal connectivity. Increase ecosystem function. Bench and bank wetting. Access to habitat. Nutrient cycling. Fish dispersal and productivity/condition (all groups). Fish spawning (flow specialists).	**Large fresh (LF)** • Greater than 2,400 ML/day at both Glenarbon and Roseneath.	Ideally: 5 to 10 in 10 years for fish dispersal and condition (max. interval 2 years). 6 years in 10 for fish spawning (max. interval 3 years). Fish dispersal and condition/productivity: ideally occurs July to Sept (but can occur any time) for minimum of 5 days. Flow specialist spawning: Oct to Apr for a minimum of 5 days.	Large freshes have been achieved in the Dumaresq River in each of the last 4 years at both Glenarbon and Roseneath. The minimum required frequency of large freshes for native fish dispersal and condition, and for spawning of flow specialists have been achieved, having been met 6 in the last 10 years. Therefore, the demand for water to provide large freshes in 2023–24 has been assessed as low to moderate.	Low to moderate	Possible use of CEW only under high to very high water resource availability scenarios. Would need to be delivered in conjunction with other flows. Use of unregulated licences may contribute to protecting some flows.	Moderate
Severn (NSW) and Macintyre rivers main channels: • Native fish • Drought refuge habitat • In-stream aquatic ecosystems	Drought refuge habitat. Water quality. Fish maintenance and survival (all groups).	**Very low flow** • Greater than 48 ML/day on the Severn at Ashford for a minimum 258 days. • Greater than 92 ML/day on the Macintyre at Holdfast for a minimum 266 days.	Ideally: minimum 5 years in 10.	Very low flows in both the Severn at Ashford and Macintyre at Holdfast have been achieved in the last two years. However, before this, very low flows were only fully achieved in 2016–17 during wetter conditions. The required minimum frequency of 5 years in 10 has not been achieved in either the Severn or Macintyre rivers, having only been met 3 in the last 10 years assessed. Therefore, the demand for water in 2023–24 to support very low flows has been assessed as high to critical.	High to critical	High priority for CEW under very low to low scenarios, subject to water availability. Would be met by other water in moderate to very high 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 demands for water (all sources)	Potential Commonwealth environmental water contribution	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24
• Riparian vegetation	Water quality. Habitat maintenance. Connectivity. Fish maintenance and survival (all groups). Fish recruitment (generalists and in-channel specialists).	**Baseflow (BF)** • Severn at Ashford: greater than 65 ML/day for minimum 224 days for survival; 149 days for recruitment. • Macintyre at Holdfast: greater than 250 ML/day for a minimum 162 days for survival; 111 days for recruitment.	Ideally: 5 years in 10. (max. interval: 66 days at Ashford and 120 days at Holdfast for fish survival; 180 days at Ashford and 192 days at Holdfast for fish recruitment). Can occur at any time for native fish maintenance and survival, or Sept to Mar for native fish recruitment.	Baseflows to support both native fish survival and recruitment have been met in the Severn River at Ashford and Macintyre River at Holdfast in each of the last two years. Before 2021–22, baseflows in the Severn and Macintyre rivers have been variable. Overall, baseflows to support native fish recruitment have been met for the minimum required frequency in both rivers. Baseflows to support native fish survival have also been met for the minimum 5 in 10 years in the Macintyre River. However, they have not been met frequently enough in the Severn River. Therefore, the demand for water to provide baseflows has been assessed as moderate to high, with the highest demand for baseflows for fish survival in the Severn River.	Moderate to High	High priority for CEW under low to moderate scenarios, subject to water availability. May be met by other water, including operational dam releases.	Moderate to High
	Longitudinal connectivity. Low level bank and bar wetting. Pool maintenance. Fish movement, productivity and condition. Fish spawning (generalists and in-channel specialists).	**Small fresh (SF)** SF1 (fish dispersal and productivity/condition): • Greater than 245 ML/day on the Severn at Ashford for a minimum 10 days. • Greater than 1,000 ML/day on the Macintyre at Holdfast for a minimum 8 days. SF2 (fish spawning): • 245–1,520 ML/day on the Severn at Ashford for a minimum 14 days. • 1,000 to 7,400 ML/day on the Macintyre at Holdfast for a minimum 10 days (ideally 14).	Ideally: Annually for SF1 at Ashford and 9 years in 10 at Holdfast (max. interval: 1 year). 7 to 8 in 10 years for SF2 at Ashford and 5 to 10 in 10 years at Holdfast (max. interval: 2 years). SF1: ideally occurs Oct to Apr (but can occur any time). SF2: Sept to Apr.	Small freshes have been generally met in the Severn River at Ashford and the Macintyre River at Holdfast between 2020–21 and 2022–23. Small freshes that support native fish spawning (SF2) have been achieved at the required frequency across the last 10 years assessed, in both the Severn and Macintyre rivers. However, small freshes that support native fish dispersal and condition have not been met annually as required, particularly in the Macintyre River. Therefore, the demand for water in 2023–24 to provide small freshes has been assessed as moderate (SF2) to high (SF1). Providing small freshes in the Macintyre River may be a particular priority.	Moderate to High	High priority for CEW under moderate to high water resource scenarios, subject to water availability and being delivered in conjunction with other water. May be met by other water under a high or very high scenario.	Moderate to High
	Longitudinal connectivity. Increase ecosystem function. Bench and bank wetting. Access to habitat. Nutrient cycling. Fish dispersal and productivity/condition (all groups). Fish spawning (flow specialists).	**Large fresh (LF)** • Greater than 1,520 ML/day on the Severn at Ashford for a minimum 5 days for fish dispersal and condition, and 7 days for spawning. • Greater than 7,400 ML/day on the Macintyre at Holdfast for a minimum 4 days for fish dispersal and condition, and 5 days for spawning.	Ideally: 8 years in 10 for fish dispersal and condition at Ashford and 5 years in 10 at Holdfast (max. interval: 2 years). 4 to 5 years in 10 for fish spawning at Ashford and 3 to 4 in 10 years at Holdfast (max. interval: 4 years). Fish dispersal and condition/productivity: ideally occurs July to Dec (but can occur any time). Flow specialist spawning: Oct to Apr.	Large freshes have been met over the last three years between 2020–21 and 2022–23 in both the Severn River at Ashford and the Macintyre River at Holdfast. Before 2020–21, large freshes have been variable in the Severn and Macintyre rivers. Large freshes to support native fish flow specialist spawning have been achieved as the desired frequency over the 10 years assessed. However, large freshes needed to support native fish dispersal and condition have not been met often enough. These flows are required in most years. Therefore, the demand for large freshes in 2023–24 has been assessed as moderate to high.	Moderate to High	Possible use of CEW only under high to very high water resource availability scenarios. Would need to be delivered in conjunction with other flows.	High
Lower Macintyre – Barwon River (to Mungindi, including Weir River) main channel: • Native fish • Drought refuge habitat • In-stream aquatic ecosystems	Drought refuge habitat. Water quality. Fish maintenance and survival (all groups).	**Very low flow** • Greater than 166 ML/day on the Macintyre at Goondiwindi for a minimum 300 days. • Greater than 40 ML/day on the Macintyre at Terrewah for a minimum 362 days. • Greater than 45 ML/day on the Barwon at Mungindi for a minimum 310 days.	Ideally: minimum 5 years in 10.	Very low flows on the lower Macintyre at Goondiwindi and Terrewah, and on the Barwon River at Mungindi have been generally met in 2021–22 and 2022–23. However, very low flows have not been met at any of the three locations for the minimum of 5 years across the last 10 years. These flows require a long duration and have only been fully met a maximum of 3 in 10 years since 2013–14. Therefore, the demand for water in 2023–24 to support very low flows has been assessed as high to critical.	High to Critical	High priority for CEW under very low to low scenarios, subject to water availability. Would be met by other water in moderate to very high 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 demands for water (all sources)	Potential Commonwealth environmental water contribution	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24
• Riparian vegetation • Waterbird breeding and foraging habitat • Nationally significant wetlands	Water quality. Habitat maintenance. Connectivity. Fish maintenance and survival (all groups). Fish recruitment (generalists and in-channel specialists).	**Baseflow (BF)** • Macintyre at Goondiwindi: greater than 450 ML/day for a minimum 213 days for survival; 142 days for recruitment. • Macintyre at Terrewah: greater than 50 ML/day for a minimum 345 days for survival; 210 days for recruitment. • Barwon at Mungindi: greater than 160 ML/day for a minimum 220 days for survival; 145 days for recruitment.	Ideally: 5 years in 10. (max. interval: 99 days at Goondiwindi, 62 days at Terrewah and 130 days at Mungindi for fish survival; 188 days at Goondiwindi, 165 days at Terrewah and 205 days at Mungindi for fish recruitment). Can occur at any time for native fish maintenance and survival, or Sept to Mar for native fish recruitment.	Baseflows on the lower Macintyre River at Goondiwindi and Terrewah, and the Barwon River at Mungindi have generally been achieved in both 2021–22 and 2022–23. Before that, baseflows were last achieved during wetter conditions in 2016–17. These flows are ideally required a minimum of 5 in 10 years but have only been met a maximum of 3 years in the 10 years assessed since 2013–14. Therefore, the frequency of baseflows has been insufficient in both rivers to support native fish survival and recruitment. Therefore, the demand for water in 2023–24 for baseflows has been assessed as high to critical.	High to Critical	High priority for CEW under low to moderate scenarios, subject to water availability. May be met by other water sources.	High
	Longitudinal connectivity. Low level bank and bar wetting. Pool maintenance. Fish movement, productivity and condition. Fish spawning (generalists and in-channel specialists).	**Small fresh (SF)** SF1 (fish dispersal and productivity/condition): • Greater than 1,500 ML/day on the Macintyre at Goondiwindi for a minimum 10 days. • Greater than 330 ML/day on the Macintyre at Terrewah for a minimum 13 days. • Greater than 540 ML/day on the Barwon at Mungindi for a minimum 10 days. SF2 (fish spawning): • 1,5000 to 8,000 ML/day on the Macintyre at Goondiwindi for a minimum 14 days. • 330 to 2,200 ML/day on the Macintyre at Terrewah for a minimum 21 days. • 540 to 3,000 ML/day on the Barwon at Mungindi for a minimum 14 days.	Ideally: Annually for SF1 (max. interval: 1 year). 5 to 10 in 10 years (max. interval: 2 years). SF1: ideally occurs Oct to Apr (but can occur any time). SF2: Sept to Apr.	With wetter conditions, small freshes have generally been met on the lower Macintyre at Goondiwindi and Terrewah, and on the Barwon River at Mungindi between 2020–21 and 2022–23. Small freshes to support native fish dispersal and condition (SF1) are required annually. These flows have been met in all the last 10 years assessed on the Macintyre at Terrewah, but in 9 of the last 10 years at Goondiwindi and at Mungindi. The frequency of 5 to 10 in 10 years has been achieved at all three locations across the last 10 years for small freshes to support native fish spawning (SF2). Therefore, the demand for small freshes in the lower Macintyre and Barwon River at Mungindi in 2023–24 has been assessed as moderate (SF2) to high (SF1).	Moderate to High	Possible use of CEW only under high to very high water resource availability scenarios. Would need to be delivered in conjunction with other unregulated flows. Commonwealth unregulated licences may contribute to meeting only if a natural event occurs.	Moderate to High
	Longitudinal and lateral connectivity. Increase ecosystem function. Wetland and riparian vegetation condition. Bench and bank wetting. Refuge habitat. Fish dispersal and productivity/condition (all groups). Fish spawning (flow specialists).	**Large fresh (LF)** • Greater than 8,000 ML/day on the Macintyre at Goondiwindi for a minimum 5 days for fish dispersal/condition and 6 days for spawning. • Greater than 2,200 ML/day on the Macintyre at Terrewah for a minimum 11 days for both fish dispersal/condition and spawning. • Greater than 3,000 ML/day on the Barwon at Mungindi for a minimum 15 days for both fish dispersal/condition and spawning.	Ideally: 5 years in 10 (max. interval: 2 years). 3 to 5 in 10 years (max. interval: 4 years at Goondiwindi and Terrewah, and 2 years at Mungindi). Fish dispersal and condition/productivity: ideally occurs July to Sept (but can occur any time). Flow specialist spawning: Oct to Apr.	Large freshes have been achieved on the lower Macintyre River at Goondiwindi and Terrewah, and on the Barwon River at Mungindi between 2020–21 and 2022–23. Before 2020–21, large freshes have been variable across these sites over the 10 years assessed back to 2013–14. However, the required frequency has been achieved for large freshes to support native fish dispersal and condition, and flow specialist spawning on the lower Macintyre River. The minimum required frequency for large freshes that support native fish dispersal and condition has not been met at Mungindi on the Barwon River and requires water again next year. The maximum interval between large freshes was also exceeded at Mungindi between 2017–18 and 2019–20 for native fish spawning. The demand for large freshes in 2023–24 has been assessed as low on the lower Macintyre River and high on the Barwon River.	Low (lower Macintyre) High (Barwon at Mungindi)	Cannot be met using regulated Commonwealth water. Use of Commonwealth unregulated licences may contribute to protecting a portion of flows if a natural event occurs. Demand may be met by natural flows in high to very high water availability scenarios (unregulated or supplementary events).	Low (lower Macintyre) High (Barwon at Mungindi)

Note: 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 Border Rivers Long-Term Water Plan (NSW DPE 2022) and the Queensland Border Rivers and Moonie Long-Term Water Plan (DRDMW 2022). All watering history sourced from NSW Department of Planning and Environment, and data from the following gauges (WaterNSW 2023 and DRDMW 2023) – 416040 Dumaresq River at Glenarbon, 416011 Dumaresq River at Roseneath, 416006 Severn River at Ashford, 416012 Macintyre River at Holdfast, 416001 Barwon River at Mungindi, 416201A Macintyre River at Goondiwindi, 416047 Macintyre River at Terrewah.

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)

Table BR2 Environmental demands and outlook for coming year, Moonie River 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)	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24	Likely urgency of demand in 2024–25 if watering occurred as planned in 2023–24
Moonie River (at Gundablouie)	Native fish dispersal and condition Native fish spawning and recruitment Native vegetation Aquatic ecosystem function Processes: productivity and resilience	Very low flow (VLF) (greater than 30 ML/day) Timing in line with natural (anytime). Minimum duration: typically, 60 days/year exceed VLF threshold but not less than 9 days/yr.	At least 96% of years. (max. interval 70 days, but not more than 280 days).	Met in 9 out of the last 10 years including 2022–23 but was not met in 2018–19. Required annually, therefore a high demand for water in 2023–24 under dry to wet scenarios, remaining high in 2024–25 if watering occurs.	High	Dependent on flow triggers being met for CEW licences to be activated. Required annually therefore a high priority for CEW under dry to moderate conditions and a moderate priority under moderate to wet conditions.	High
		Small fresh 1: greater than 300 ML/day any time (ideally Oct to Apr). Minimum duration 10 days.	3 to 8 years in 10 (55%) (max. interval 4.5 years).	Met or almost met in 9 out of the last 10 years including 2022–23 but was not met in 2018–19. Required frequency and maximum dry interval are met, therefore a low environmental demand under dry to wet scenarios in 2023–24, remaining low in 2024–25 if watering occurs.	Low	Dependent on flow triggers being met for CEW licences to be activated. Low priority for CEW if triggered under any flow conditions.	Low
		Small fresh 2: between 300 ML/day and 3,900 ML/day (Sept to Apr) Minimum duration 14 days.	1 to 5 years in 10 (30%) (max. interval 7 years).	Met or almost met in 7 out of the last 10 years, including in 2021–22 and 2022–23. Required frequency and maximum dry interval both met, therefore a low environmental demand under dry to wet scenarios in 2023–24, remaining low in 2024–25 if watering occurs.	Low		Low
		Large fresh 1: greater than 3,900 ML/day (any time) duration 5 days.	2 to 6 years in 10 (45%) (max. interval 6.5 years).	Met or almost met in 5 out of the last 10 years, including 2021–22 and fully met in 2022–23. Required frequency and maximum dry interval met, therefore a low environmental demand under dry to wet scenarios in 2023–24, remaining low in 2024–25 if watering occurs.	Low		Low
		Large fresh 2: greater than 3,900 ML/day (October to Apr) duration 5 days.	2 to 5 years in 10 (35%) (max. interval 6.5 years).	Met or almost met in 5 out of the last 10 years, including 2021–22 and fully met in 2022–23. Required frequency and maximum dry interval met, therefore a low environmental demand under dry to wet scenarios in 2023–24, remaining low in 2024–25 if watering occurs.	Low		Low
		Large fresh 3: 5,100 to 18,800 ML/day (any time) duration 3 days.	2 to 7 years in 10 (45%) (max. interval 5 years).	Met in 4 out of the last 10 years, including in 2021–22 and 2022–23. Required frequency almost met and maximum dry interval met, therefore a low environmental demand under dry to wet scenarios in 2023–24, remaining low in 2024–25 if watering occurs.	Low		Low
		Overbank: greater than 18,800 ML/day (any time) duration 3 days.	0 to 3 years in 10 (10%) (max. interval 20 years).	Met in 1 out of the last 10 years in 2021–22. Moderate environmental demand in 2023–24 under dry to wet scenarios, remaining moderate if watering occurs.	Moderate	Dependent on flow triggers being met for CEW licences to be activated. Moderate priority for CEW if triggered under any flow conditions.	Moderate

Note: Information on environmental demands sourced from the NSW Intersecting Streams Long-Term Water Plan (NSW DPE 2023) and the Queensland Border Rivers and Moonie Long-Term Water Plan (DRDMW 2022). All watering history sourced from NSW Department of Planning and Environment, WaterNSW Water Balance Reports, and data from the following gauge (WaterNSW 2023): 417001 – Moonie River at Gundablouie.

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

Based on the demand for environmental water, water availability (supply), and catchment conditions, the overall purpose for managing Commonwealth environmental water in the Border Rivers valley in 2023–24 is to further support recovery and maintain the health and resilience of native fish and aquatic ecosystems.

If there is a return to dry conditions, the relatively small volume of regulated entitlements may be used to support habitat, drought refugia and native fish condition, particularly in the main channels of the Border Rivers. Under moderate to wet scenarios, the use of environmental water may focus on filling gaps in the hydrograph to increase connectivity (including to the Barwon River), and/or delivering flows to support fish breeding, recruitment and movement. The CEWH may also retain a contingency volume of regulated entitlements to avoid extended cease to flow conditions in future dry conditions.

Flows that increase connectivity and provide opportunities for native fish breeding, recruitment and movement will be important in 2023–24, to sustain improvements of native fish populations following two years of good flows.

Consistent with the demands and purpose identified, and advice from the Northern Basin Environmental Watering Group (NBEWG), the CEWH is considering supplying environmental water to the following actions in 2023–24.

- Avoid extended cease to flow conditions, provide flowing water habitats, and maintain suitable river depth (particularly in the Severn–Macintyre and Dumaresq). This will help to support native fish and other native aquatic animals such as freshwater mussels and shellfish, shrimp, platypus, turtles, frogs, water dragons, water rats (Rakali).
- Contribute to connected flow events to meet in-valley outcomes and in the downstream Barwon–Darling River system. This may include coordinating flows from storages across tributaries to achieve a connectivity event, potentially in spring, to support native fish.
- Contribute to baseflows and/or small freshes to provide opportunities for native fish movement, breeding and recruitment, particularly in the Dumaresq, Macintyre and Severn rivers. Baseflows and small freshes would also help to maintain habitat, increase connectivity, and help improve water quality.

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

Commonwealth environmental water entitlements in the Moonie are unregulated (or ‘unsupplemented’ in the Queensland portion) and are left instream to contribute to environmental outcomes.

Queensland and NSW have established an accounting method for determining the volume of held environmental water passing the Queensland/NSW border. Queensland Department of Regional Development, Manufacturing and Water (DRDMW) will continue to use the accounting procedure and protocols to account for the volume of Commonwealth environmental water reaching the border.

1.3 Monitoring and lessons learned

1.3.1 Monitoring

In the Border Rivers and Moonie valleys, monitoring is undertaken by NSW and Queensland agencies, including Queensland DAF, Queensland DES, NSW DPE – Water (water quality), Queensland DRDMW and NSW DPI – Fisheries (native fish).

The CEWH has also funded several short-term intervention monitoring projects to evaluate the environmental responses of native fish, and to map aquatic habitat in the Dumaresq and Macintyre Rivers.

Learn more about monitoring activities funded by the CEWH in the Border Rivers valley.

In line with its relatively small entitlement volumes in the Moonie valley, the Commonwealth has taken a targeted approach to monitoring environmental outcomes in the valley. Consistent with this targeted approach the CEWH has co-funded a short-term intervention monitoring project with Queensland DES to better understand native fish resilience following severe drought and reconnection flows in the northern Murray–Darling Basin, including one site in the Moonie. Waterbird movements into the Moonie valley may also be recorded through the Flow-MER Basin-scale Biodiversity Research Project.

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 (Marshall & Lobegeiger 2020; NSW DPI 2021a, b; NSW DPI & DAF 2019; Sharpe 2020; Stuart & Sharpe 2020), aquatic habitat (NSW DPI 2018) and flow monitoring (DAWE 2020; ELA 2020) in the Border Rivers and Moonie valleys is summarised in Table BR3.

Table BR3 Key lessons learned in the Border Rivers and Moonie valleys

Theme	Lessons learned
Native fish and aquatic invertebrates	• Environmental water benefits the healthy and diverse native fish community in the Border Rivers, including nationally, and state listed threatened Murray cod, freshwater catfish and olive perchlet (NSW DPI & DAF 2019) by helping to maintain habitat and productivity, supporting condition and recruitment, and providing opportunities for movement. • There is evidence that the Border Rivers system supports natural spawning and recruitment of golden perch (Rolls et al. 2013; Stuart & Sharpe 2020; NSW DPI 2021a). Small and medium flows to increase connectivity to the Barwon–Darling River are important for the dispersal of juvenile golden perch (Stuart 2020), to contribute to downstream populations as far as Menindee Lakes and the lower Darling River. • There is also the need to protect the integrity of baseflows and small freshes, especially the first post-winter fresh, to enhance system scale recruitment. This can be achieved by building on connecting end-of-system flows and coordinating releases of stored water to provide broad scale connectivity along the Barwon–Darling mainstem and Menindee Lakes (Stuart 2020). • Rapid assessment of priority refuge pools in parts of the Border Rivers through the NSW native fish drought response process in 2019–20 suggests that the Lower Macintyre fish community may be in poor condition. Extensive die-off of freshwater mussels was also observed at some sites. There are also concerns about the extent that Murray cod were

Theme	Lessons learned
	affected by drought, and about the status of the Darling River hardyhead in the Border Rivers. Further work is needed to identify environmental water requirements to improve abundance and recruitment of Murray cod in the Border Rivers valley, including identifying critical drought refuges for the species. • The Moonie has long and deep waterholes that have been shown to be critical refugia for sustaining native fish populations in the often-long periods between flows in the system. Species including golden perch, bony bream, eel tailed catfish and smelt moved significant distances (up to 70 kilometres) in response to waterhole reconnecting flows, enabling recolonisation of the system and genetic mixing (Marshall et al. 2016). • The Moonie has also been identified as a source population for golden perch recruitment in the Northern Murray–Darling Basin (along with the Condamine–Balonne and Warrego Rivers) with consistent recruitment over the past decade. • Research by Queensland DAF in selected ephemeral northern Murray-Darling Basin rivers suggests that the Moonie supports high abundance of golden perch including large older fish and a range of size classes. Golden perch in the Moonie tend to return to the same habitats and refuge pools, even after moving away on connection flows (Nixon et al. 2022).
Aquatic habitat	• Mapping of aquatic habitat features in parts of the Border Rivers (Dumaresq from Pike Creek to connection with the Macintyre and from the Macintyre–Dumaresq junction to Mungindi) has identified habitat important for native fish and other animals (NSW DPI 2021b). Riparian vegetation condition was also mapped. Key habitat features noted included large woody habitat, refuge pools, and bars and benches. • Many parts of the Border Rivers valley also have a high proportion of riparian vegetation cover (NSW DPI 2021a). • Cold water pollution (CWP) is predicted to occur in river reaches downstream of both Glenlyon and Pindari dams in the Border Rivers (Lugg & Copeland 2014). It is estimated that CWP extends up to 160 km downstream of Glenlyon Dam (approximate to the confluence of Dumaresq and Macintyre rivers) (Lugg & Copeland 2014). There is evidence of some temperature suppression at least 150 km downstream of Pindari Dam, but further monitoring is required (DPI 2021a). • The NSW DPI Fisheries fish passage database identifies 11 in-stream structures for the Dumaresq, including 4 identified as high priority on a state-wide scale: Cunningham Weir, Bonshaw Weir, Glenarbon Weir and Toomelah Weir. Five structures in the Lower Macintyre are considered a high priority for fish passage, including Mungindi, Goondiwindi, Boggabilla and Boomi weirs (NSW DPI 2021a). • The Border Rivers retains a relatively high proportion of waterholes remaining wet even during peak drought compared to some other northern Murray–Darling Basin catchments. Over 22% of the Border Rivers remained wet during the 2018-2020 drought, compared to almost 9% in the Moonie catchment (Marshall et al. 2021). • Fine sedimentation in the Moonie River near Flinton, particularly since the 1950s, is reducing waterhole persistence for the deepest waterholes by up to 30% or 200 days. Sediment appears to remain even after scouring flows. This could reduce resilience of aquatic species that rely on these refuge waterholes for survival during dry periods, particularly in combination with climate change impacts. Sedimentation is likely driven by gully erosion due to high levels of land clearing in the catchment (Tibby et al. 2023). • While barriers to fish passage in the Moonie valley are generally small, these barriers can have significant and wide-reaching impacts on fish movement opportunities. This includes both loss of movement opportunities and increased duration of time between fish movement opportunities. 10 barriers were identified in the Moonie valley, with 3 of these presenting an 'extreme' long-term fish movement risk including Nindigully Weir, and 7 structures presenting a high long-term movement risk (Marshall et al. 2021). Much of the Moonie is identified as being at high drought risk based on long-term movement impacts from barriers and, limited access to drought refuge habitat availability (Marshall et al. 2021).
Connectivity	• Analysis of Macintyre River flows between 1982 and 2017 suggests that cease-to-flow periods and the average dry spell duration have both increased (NSW DPI 2021a). The Northern Connectivity Event in 2017–18, Northern Fish Flow in 2018–19 and Northern Waterhole Top Up in 2020–21 highlighted the importance of coordinated flow delivery and protection of environmental flows from the Border Rivers and Gwydir system into the Barwon–Darling River system during dry conditions. The Northern Waterhole Top-Up in 2020–21 also demonstrated that summer connectivity events can help refill refuge pools and connect tributaries with the upper Barwon–Darling.

Theme	Lessons learned
	• Completion of the cross-border accounting project between NSW and Queensland in combination with active management in the Barwon–Darling by NSW is supporting better tracking and protection of Commonwealth environmental water from upstream tributaries to the Barwon–Darling. Future monitoring by Queensland and NSW partner agencies could also help better understand the role of protecting unregulated tributary flows for waterhole persistence and connectivity, water quality and native fish response. There is also the need for Queensland held environmental water in the Border Rivers and Moonie valleys to be protected once it enters NSW under active management. • There is the need for a better understanding of hydrology and connection between the nationally significant Morella Watercourse /Boobera Lagoon/Pungbougal Lagoon wetland complex and the Macintyre River (NRC 2022). Periodic flooding from the Macintyre River appears important for filling Boobera lagoon, as well as groundwater which is likely to contribute to permanent water in the lagoon between floods (NRC 2022).
Other aquatic animals	• There are platypus colonies in the Border Rivers catchment, including in the Severn River, Tenterfield Creek, the Dumaresq River, and possibly Macintyre Brook. There are historical records of platypus in lowland areas of the Border Rivers as far downstream as Goondiwindi, but these populations are now considered unlikely to be present. Rakali (water rat) are also widespread throughout the Border Rivers, but little is known about their flow requirements. • A 3-year short-term intervention monitoring project funded by CEWH with surveys commencing June–July 2023 will provide further information on platypus populations in the reaches just downstream from Glenlyon, Pindari, Copeton and Chaffey Dams to help better inform environmental water management (along with other water deliveries) that better supports platypus populations. • 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 (Sheldon et al 2020). • Freshwater mussels 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 (Wright et al 2022). • 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 (Wright et al. 2022). • Bankfull and overbank flows are required to maintain the condition of waterholes and adequate depth to support freshwater mussels (Sheldon et al. 2020). • While not recognised as nationally or internationally significant, the Thallon waterholes on the Moonie are important for waterbirds, with representation of 10% abundance for each species between 1983 to 2012 (only 4 other wetlands achieved this including the Cuttaburra channels, Lowbidgee and Lower Coorong) (Bino et al. 2015). • The 2022 Australian aerial waterbird survey identified low waterbird numbers at Thallon waterholes but with reasonable diversity including black duck, glossy ibis, pelicans and cormorants (UNSW 2022).
Use of Commonwealth environmental water	• With limited holdings of environmental water in the Border Rivers system, not all environmental demands can be met. In most years the priorities are for native fish survival and/or recruitment within the catchment, and for connection to the Barwon–Darling (when feasible). • Planning for carryover for future drier years to support native fish survival is important (where possible). • The timing of use of regulated environmental water held in Glenlyon and Pindari Dams is important, with planning for drought needed to help avoid water being quarantined. • Commonwealth environmental water may be used in conjunction with other flows or deliveries where this is beneficial or appropriate (e.g. in conjunction with or sequential to the NSW Pindari Stimulus flow, or to other deliveries from Pindari and/or Glenlyon Dams).

Theme	Lessons learned
	• Considerations for activation and use of Commonwealth unregulated (unsupplemented (Qld) and supplementary (NSW) in unregulated tributary flows include for example: size and timing of events and likely benefits, third party impacts.

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