



Australian Government

Commonwealth Environmental Water Office

# Commonwealth Environmental Water Office Water Management Plan 2021–22

## Chapter 10 Lower Darling/Baaka Water Plan

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### **Acknowledgement of the Traditional Owners of the Murray–Darling Basin**

The Commonwealth Environmental Water Office respectfully acknowledges the Traditional Owners, their Elders past and present, their Nations of the Murray–Darling Basin, and their cultural, social, environmental, spiritual and economic connection to their lands and waters.

# Contents

<b>10 Lower Darling/Baaka Water Plan .....</b>	<b>1</b>
10.1 Region overview.....	1
10.2 Environmental objectives.....	4
10.3 First Nations environmental watering objectives.....	5
10.4 Recent conditions and seasonal outlook.....	5
10.5 Water delivery in 2021–22 .....	10
10.6 Monitoring and lessons learned .....	10
References .....	12

## Tables

Table LDR1 Environmental demands and watering priorities, 2021–22, and outlook for coming year, lower Darling/Baaka catchment .....	8
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## Maps

Map LDR1 Lower Darling/Baaka catchment.....	2
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# 10 Lower Darling/Baaka Water Plan

## 10.1 Region overview

### 10.1.1 River system

Travelling approximately 700 km, the lower Darling/Baaka includes the river channel and adjacent billabongs and wetlands from the Menindee Lakes to the junction of the Murray and the Darling rivers at Wentworth (Map LDR1). The catchment also includes the lakes, floodplains and channel of the Great Darling Anabranch—an ancestral path of the Darling River. The catchment is located on the semi-arid plains of south-western New South Wales.

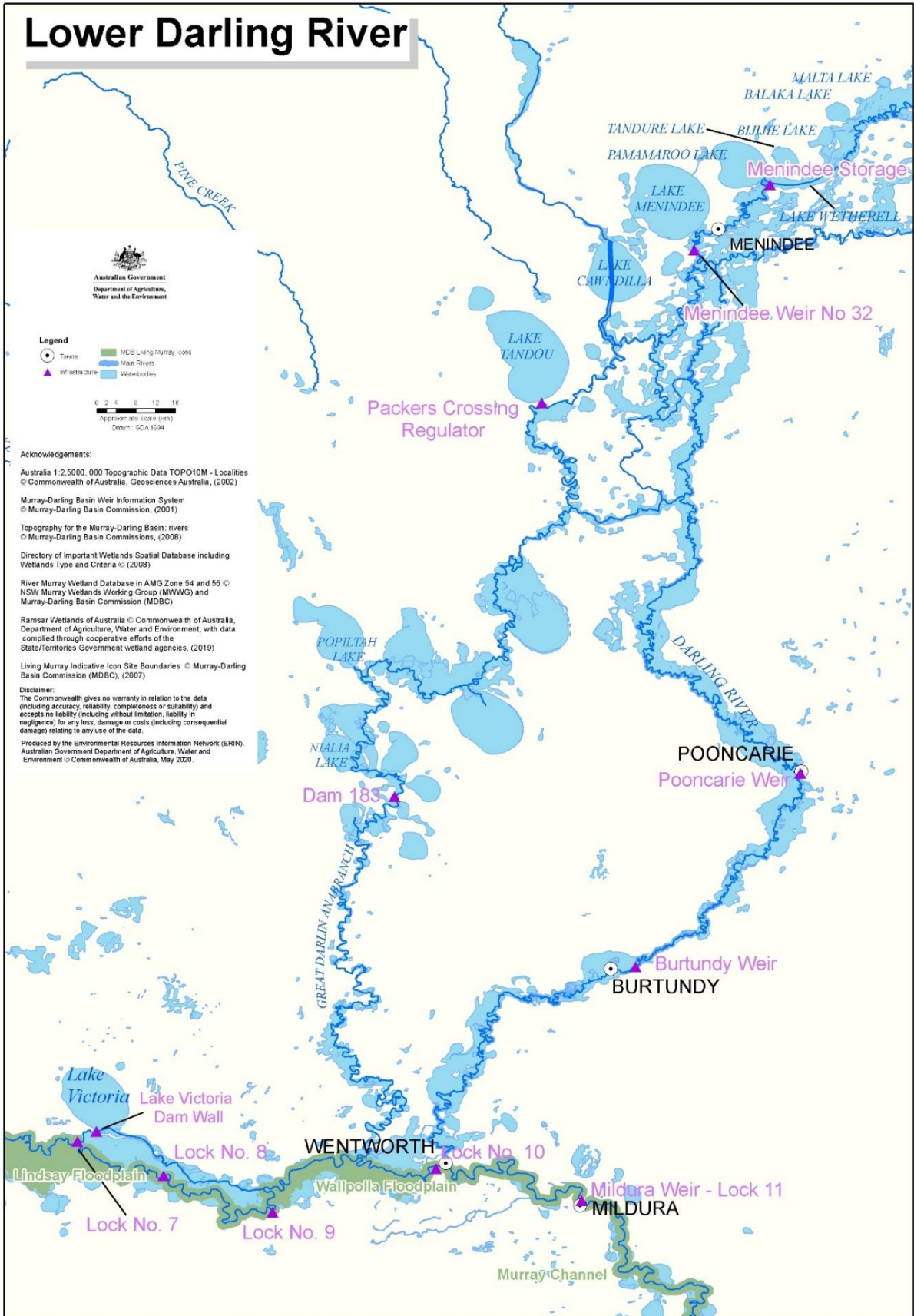
The lower Darling/Baaka valley relies on flows from rivers in southern Queensland and northern New South Wales, including ephemeral systems such as the Warrego, that flow into the Barwon-Darling River. Water is captured in the Menindee Lakes, a series of natural lakes that have been altered to improve water storage. Key storages include lakes Menindee, Pamamaroo Cawndilla and Wetherell (the latter of which incorporates Lakes Tandure, Balaka, Bijiji and Malta, and the floodplains between and adjacent to them). Water is released from lakes Menindee, Wetherell and Pamamaroo to provide flows into the lower Darling/Baaka. Flows to the Great Darling Anabranch can originate from the lower Darling/Baaka (via the Old Anabranch) during elevated flows and floods or delivered from Lake Cawndilla via Tandou and Redbank Creeks. Flows can be provided down the Anabranch from Lakes Menindee, Pamamaroo and Wetherell to supplement flows out of Cawndilla in rare high release rates scenarios.

Land use in the catchment is largely based on pastoral industries, comprising mainly of sheep as well as rangeland goats and beef cattle production. There are also some areas of lakebed cropping and irrigated cropping, horticulture and viticulture. Tourism is vitally important to the local economy, with waterways and national parks supporting widespread recreational activities such as fishing and camping.

### 10.1.2 Traditional Owners

The river and floodplains of the lower Darling/Baaka have long been important for sustenance and spirituality. In 2015, the Barkindji people received Native Title over much of the Darling/Baaka River valley, extending from the South Australian border to Tilpa in the east, Wentworth in the south and north almost to Wanaaring. The lower Darling/Baaka flows through the traditional land of many other Aboriginal nations including the Maraura, Muthi Muthi, Nyeri Nyeri and Ngintait nations. The region contains many significant spiritual and cultural sites, including Menindee Lakes. The Commonwealth Environmental Water Office (CEWO) respectfully acknowledges these Nations, their Elders past and present, as the Traditional Custodians of the lands on which this chapter is focused.

Map LDR1 Lower Darling/Baaka catchment



### 10.1.3 Important sites and values

The Menindee Lakes are listed in the Directory of Important Wetlands in Australia as an exceptional example of the Ephemeral Deflation Basin Lakes (EDBL) wetland type within the bioregion. They provide important waterbird habitat with more than 30 species recorded on the main lakes, including threatened species such as freckled duck and migratory waders. They also provide critical habitat for native fish including golden perch and threatened species such as Murray cod, silver perch and freshwater catfish. The ephemeral large shallow lakes are very productive and provide diverse food sources for fish at a range of life-stages. The Menindee Lakes also provide important refuge for wildlife during drought or adverse conditions.

The *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) lists the Coolibah Black Box community, Menindee nightshade, silver perch, Murray cod and 37 waterbirds as conservation dependent. Eighteen migratory bird species recorded at Menindee Lakes are listed under international agreements (JAMBA and CAMBA). The *Fisheries Management Act NSW 1994* lists the Menindee Lakes, including lakes Cawndilla and Menindee, lower Darling/Baaka and Great Darling Anabranch as an Endangered Ecological Community.

The Menindee Lakes and lower Darling/Baaka support a diverse native fish community. The natural flow variability of the lower Darling/Baaka River promotes and supports fish breeding, recruitment and dispersal of native fish (particularly by Murray cod and golden perch) which contribute to native fish communities throughout the Northern and Southern Basin (Stuart and Sharpe 2020, Sharpe and Stuart 2018b, Zampatti et al 2018, Price et al 2019). The Menindee Lakes are the only EDBL floodplain lake system in the Murray–Darling Basin in which mass golden perch recruitment events have been demonstrated (Sharpe and Stuart 2018a, Stuart and Sharpe 2020). The Menindee Lakes are considered among the last, functional EDBL golden perch nursery habitat remaining in the Murray–Darling Basin and are listed in Directory of Important Wetlands in Australia (Stuart and Sharpe 2020).

The Great Darling Anabranch is an ancestral path of the Darling/Baaka with its own system of ephemeral lakes. The Anabranch is highly significant in terms of its contribution to terrestrial and biodiversity value through natural wetting and drying cycles and diverse habitats and the Anabranch Lakes are listed in the Directory of Important Wetlands in Australia. Other wetlands, creeks and anabranches in the Lower Darling/Baaka catchment also offer considerable ecological value.

Lake Cawndilla is an important fish nursery habitat. As part of the Menindee Lakes Scheme a channel was cut linking Lake Cawndilla to the Darling Anabranch. Environmental flows have been delivered to the Anabranch from Lake Cawndilla with monitoring indicating a dispersal by native fish, such as golden perch from Lake Cawndilla along the Anabranch to the Murray River.

Flows in the lower Darling/Baaka also transport propagules and nutrients that support food webs and fish communities in the lower Murray. In recent decades, protracted cease-to-flow and low-flow conditions have significantly impacted many of the lower Darling/Baaka values, including fish deaths events in 2004, 2008, 2015–16 and more recently in 2018–19 (NSW DPI Fisheries 2020).

Both the lower Darling/Baaka River and the Great Darling Anabranch are identified in the Basin-wide environmental watering strategy (MDBA 2019) as wetlands of Basin significance for native fish and waterbirds.

### 10.1.4 Stakeholder engagement

In the lower Darling/Baaka, Commonwealth environmental water is managed in partnership with the NSW Department of Planning, Infrastructure and Environment– Environment, Energy and Science (DPIE EES). It is coordinated with other sources of water, including environmental water available through The Living Murray program (TLM), and operational flows managed by WaterNSW and/or the Murray–Darling Basin Authority (depending on who has operational control of Menindee Lakes at the time in accordance with the Murray–Darling Basin Agreement).

In addition to the above agencies, advice is regularly received from the NSW Department of Primary Industries—Fisheries (DPI—Fisheries) regarding watering requirements to support native fish and other aquatic species, as well as the Lower Darling Technical Advisory Group (convened by DPIE EES) and the Lower Darling Regional Operations Stakeholder Consultation Committee (LD ROSCCo), who provide advice to water managers to address stakeholder concerns and share river operation information. Advice and guidance are also sought from representatives of the Barkindji Traditional Owners, Murray Lower Darling Rivers Indigenous Nations (MLDRIN), recreational fishers, landholders and irrigators. Local council and community members with an interest in environmental water management in the lower Darling/Baaka are consulted at key planning and decision points during the year.

## 10.2 Environmental objectives

Based on long-term environmental objectives in the Basin Plan, state long-term watering plans, site management plans, and best available knowledge, the following objectives are relevant for environmental watering in the lower Darling/Baaka region.

The objectives that are targeted in a particular year may vary, depending on available water, catchment conditions, operational feasibility and demand for environmental water. These objectives will continue to be revised as part of CEWO’s commitment to adaptive management.

The objectives are:

- Native fish – provide flows to support habitat and food resources and promote increased spawning and movement, recruitment and survival/condition of native fish.
- Vegetation – maintain riparian and in-channel vegetation condition. Increase periods of growth for non-woody vegetation communities that closely fringe or occur within river channels.
- Waterbirds – provide habitat and food sources to support waterbird survival and recruitment and maintain condition and current species diversity.
- Invertebrates – provide habitat to support increased microinvertebrate and macroinvertebrate survival, diversity, abundance and condition.
- Other vertebrates – provide habitat to support survival, maintain condition and provide recruitment opportunities for frogs and turtles.
- Connectivity – maintain longitudinal connectivity along the lower Darling/Baaka and with the Murray River, to support important environmental functions (see next objective). Support intermittent connectivity through the Great Darling Anabranch to the River Murray. Provide lateral connectivity between the channels of the lower Darling/Baaka and Great Darling Anabranch with low-lying wetlands. Where feasible, provide lateral



connectivity with wetlands in Kinchega National Park that connect with the Menindee Lakes.

- Processes/water quality/resilience – increase primary productivity, nutrient and carbon cycling, biotic dispersal and movement; maintain suitable water quality for native plants and animals; and provide refuge from adverse water quality events (for example hypoxic blackwater in the Murray). Maintain drought refuge habitat and maintenance/condition of native biota (for example fish and other aquatic fauna).

### **10.3 First Nations environmental watering objectives**

The CEWO and DPIE EES have been participating in workshops run by the Barkandji Native Title Group Aboriginal Corporation to develop their Healthy Country Plan. Both organisations are committed to working with the Barkandji people to incorporate objectives and values identified in this plan into where and when we may deliver water to the Baaka (where this is consistent with our statutory responsibilities). This could include the possibility of delivering water for the environmental to a small number of wetlands in Kinchega National Park in 2021–22, subject to further discussions, feasibility investigations and approvals. The NSW National Parks and Wildlife Service is working with Traditional Owners via the Kinchega Co-Management Committee to align ecological and cultural objectives for the potential watering of the wetlands.

### **10.4 Recent conditions and seasonal outlook**

#### **10.4.1 Recent conditions and environmental water use**

In the past 20 years, the lower Darling/Baaka River has experienced increased frequency and duration of low flow. The Millennium drought saw record low inflows and river flows that led to some major fish deaths.

A series of wet years from 2009–13 saw a breaking of the Millennium drought and high flows/floods through the Barwon-Darling and lower Darling/Baaka to the Murray, including the Great Darling Anabranch. These events boosted fish communities in the lower Darling/Baaka and provided timely dispersal of a strong cohort of golden perch from the Darling to the southern Basin (Zampatti et al 2018, Price et al 2019), which had heightened importance in the wake of hypoxic blackwater fish kills in the southern Basin (Murray and Murrumbidgee rivers).

From 2013–16, dry conditions saw low inflows to the lower Darling/Baaka before a small flood delivered much needed inflows to Menindee Lakes, which filled the lakes from less than 5% to over 90% capacity (Burrell et al 2018).

These inflows enabled environmental releases in spring of 2016 and again in 2017 that supported Murray cod spawning and recruitment in the lower Darling/Baaka. A population census in winter 2018 found that the resulting cohorts represented 28% of the overall population structure, with around 14% from each cohort (Sharpe and Stuart 2018a). Subsequent water releases from the Menindee Lakes and down the lower Darling/Baaka in 2017 to meet consumptive needs were ‘shaped’ by ecologists and environmental water managers in collaboration with the river operators to promote the spawning and dispersal of other large-bodied native fish species such as golden perch and silver perch.

In the Great Darling Anabranch, environmental water releases in 2016–17 contributed to positive responses in river red gum and black box vegetation communities fringing the Anabranch, and facilitated the successful dispersal of native fish, particularly golden perch



juveniles, from Lake Cawndilla, down the Anabranh and ultimately to the River Murray (Sharpe and Stuart 2018a).

From mid-2017 to early 2020 inflows in the Barwon-Darling were extremely low, with Menindee Lakes volumes shrinking to 1%. The return of dry and low flow conditions had catastrophic impacts on the local ecology. Mass deaths of millions of fish occurred in the lower Darling/Baaka adjacent to the town of Menindee in December 2018 and January 2019. As the lower Darling/Baaka contracted to disconnected pools through 2019, many thousands more fish perished. Small remnant fish populations were supported through intervention such as relocation to more secure waters and use of mechanical aerators at 10 locations in the lower Darling/Baaka and Menindee Lakes region.

A return of inflows to the top Menindee Lakes (Wetherell and Pamamaroo) in early 2020, supported by temporary water restrictions put in place by the NSW Government using Section 324 of the *NSW Water Management Act 2000*, saw total Menindee Lakes storage increase to almost 30% (Burrell et al 2021). This provided an opportunity to ‘restart’ the lower Darling/Baaka River, with a pulsed flow to reconnect with the River Murray in autumn 2020. During spring 2021–21, environmental flows were released into the lower Darling/Baaka. This was the first opportunity for environmental water to support Murray cod breeding, recruitment and river health since the devastating fish deaths in lower Darling/Baaka 2018 and 2019. Many golden perch that had been spawned in the upper reaches of the Barwon-Darling catchment in response to river flows in early in 2020 were transported downstream to Menindee Lakes with some also able to continue their journey into the lower Darling/Baaka and potentially on to the Murray in managed environmental flows and operational releases.

Through the first half of 2021, additional inflows (with protection of inflows in the northern NSW basin via new ‘first flush’ rules) resulted in the Menindee Lakes filling to over 1,000 gigalitres total storage (around 63%), including inflows to the bottom lakes (Menindee and Cawndilla). Further environmental water releases have been made in winter 2021 to provide additional food resources and habitat for growing young fish. As discussed in Sections 1.4 and 1.5 below, the recent inflows also provide an opportunity to plan for environmental water releases to improve the health of the lower Darling/Baaka system in 2021–22.

Learn more about previous [Commonwealth environmental water use in the Lower Darling/Baaka](#) or about the [latest storage and release details for the lower Darling/Baaka and the Menindee Lakes system](#).

### **10.4.2 Seasonal outlook**

According to the Bureau of Meteorology outlook (BoM 2021) above median rainfall between August and October 2021 is likely in both the lower Darling/Baaka valley, as well as the northern catchments that provide inflows to the lower Darling/Baaka system.

While this forecast indicates that dry conditions have somewhat eased, several months of above average rainfall are needed to see recovery from the drought continue.

### **10.4.3 Water availability**

The Menindee Lakes resource became shared with other States in early May 2021 when the system storage volume reached 640 gigalitres. It will remain administratively connected with the Murray until volumes fall below 480 gigalitres. Inter-valley trade will remain open until this

time, enabling allocations to be transferred between the lower Darling/Baaka and other southern river valleys.

Water resource availability is moderate to high at the start of the 2021–22 water year, given inflows to the Lakes system in autumn 2021. Allocations for both general and high security entitlements have opened at 100%, providing a total of 25.8 gigalitres of Commonwealth environmental water available for use within the valley. Trade-in of additional environmental water may be considered subject to a number of factors.

#### **10.4.4 Environmental demands**

For the environmental water demands for assets in the lower Darling/Baaka in 2021–22, see Table LDR1. The extent to which these environmental demands can be contributed to is contingent on several factors described in the table.

**Table LDR1 Environmental demands and watering priorities, 2021–22, and outlook for coming year, lower Darling/Baaka catchment**




Environmental assets	Indicative demand (for all sources of water in the system)			2021–22		Implications for future demands	
	Flow/volume	Required frequency (maximum dry interval)	Watering history (from all sources of water)	Environmental demands for water (all sources)	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2022–23 if watering occurred as planned in 2021–22	
<b>Menindee Lakes</b> <ul style="list-style-type: none"> <li>Native fish: survival, dispersal &amp; recruitment of flow pulse specialists in Lakes and dispersal downstream</li> <li>Vegetation: non-woody wetland, lignum, fringing river red gum, low-lying black box and coolibah</li> <li>Waterbirds: maintain habitat, potential breeding</li> <li>Ecosystems: refuge, productivity</li> </ul>	<b>Lake Menindee:</b> 60 GL (1.5 m, 56 m AHD) <b>Lake Cawndilla:</b> 50 GL (1.5 m, 53.8 m AHD) Timing: anytime of year, filling to be triggered by upstream flows in the Barwon–Darling River system Min duration: 3–5 months Max duration: 3 years	6–8 years in 10 ( <b>Menindee:</b> 2 years) ( <b>Cawndilla:</b> 3 years)	The lakes last refilled in 2016–17 (total storage around 1,730 GL). Inflows in autumn and winter 2021 saw Lake Menindee reach 26% (205 GL) and Lake Cawndilla reach 44% (326 GL).	Low (assuming storage level remains above the identified thresholds for at least 3–5 months)	Lake levels primarily rely on upstream inflows and larger natural events. Commonwealth environmental water deliveries will consider environmental needs in both the Lakes and lower Darling/Baaka system and will look to where the most effective use of available environmental water.	Moderate (if no subsequent re-fill during 2021–22)	
	<b>Lake Menindee:</b> 116 GL (1.8 m, 56.5 m AHD) <b>Lake Cawndilla:</b> 84 GL (2.2 m, 54.5 m AHD) Timing: anytime of year, filling to be triggered by upstream flows in the Barwon–Darling River system Min duration: 3–5 months Max duration: 1–2 years	3–5 years in 10 (4 years)		Low (assuming storage level remains above the identified thresholds for at least 3–5 months)		Moderate (if no subsequent re-fill during 2021–22)	
	<b>Lake Menindee:</b> 57.5 m AHD <b>Lake Cawndilla:</b> 57.5 m AHD Timing: anytime of year, filling to be triggered by upstream flows in the Barwon–Darling River system Min duration: 3–5 months Max duration: 1 year	1.5 year in 10 (8 years)		The lakes last refilled in 2016–17 (total storage around 1,730 GL). This indicator was not met by the autumn/winter 2021 inflows.		Moderate	Moderate
<b>Lower Darling/Baaka River</b> <ul style="list-style-type: none"> <li>Native fish: spawning, nesting and recruitment (riverine specialists, generalists)</li> <li>Ecosystem functions: longitudinal connectivity, refuge habitat, small-scale productivity</li> </ul>	Elevated baseflows above minimum releases through to River Murray for water quality and fish habitat requirements (400 ML/d at Weir 32).	Continuous (if limited water, focus on baseflows during spring and summer).	Very low and cease-to-flow conditions in 2014–15 and 2015–16. Small to moderate spring pulse was achieved in 2016–17 and, to a lesser extent, in 2017–18. Cease-to-flow conditions commenced in 2018–19 and persisted for most of 2019–20. Resumption of flows in March and April 2020. Elevated baseflows in spring 2021, including a short pulse of 1,500 ML/day. Small operational pulse up to 4,000 ML/d in late May 2021, followed by elevated baseflows of 500 ML/d.	Critical	Each of these demands are a high priority for Commonwealth environmental watering 2021–22. Capacity to deliver a large fresh will depend upon availability of allocations held by all Lower Darling environmental water holders and becomes more feasible if an opportunity to ‘piggy-back’ on operational releases arises.	Critical	
	Small to moderate river pulse (up to 800 ML/d at Weir 32 in spring and summer).	1–2 in 5 years (max interval unknown)		High		Moderate	
	Small fresh (up to 2,000 ML/d at Weir 32 for around 60 days in summer) for Murray cod breeding.	2–4 years in 10 (5 years)		High		Moderate	
	Large fresh (up to 7,000 ML/d at Weir 32 for around at least 5 days for dispersal of flow pulse specialists, especially important following mass golden/silver perch recruitment in Menindee Lakes.	3–5 years in 10 (4 years)		High		Low	
<b>Floodrunners and fringing lakes</b> <ul style="list-style-type: none"> <li>Native fish: spawning (flow pulse specialists), dispersal (all species),</li> <li>Waterbirds: foraging habitat, support natural breeding events</li> <li>Ecosystem functions: lateral connectivity, dispersal of biota, channel maintenance,</li> </ul>	10,000 – 12,000 ML/d at Weir 32, ideally August–October or January–April (or anytime) for a minimum of 14 days (to achieve 2–6 months of wetland inundation)	5–8 years in 10 (2 years) Annual event for 2–3 consecutive years for recovery of wetland vegetation	Small overbank flow in 2011 and 2012. Flows since that time have remained within channel.	High	Reliant on large, unregulated flows.	High	

Environmental assets	Indicative demand (for all sources of water in the system)			2021–22		Implications for future demands
	Flow/volume	Required frequency (maximum dry interval)	Watering history (from all sources of water)	Environmental demands for water (all sources)	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2022–23 if watering occurred as planned in 2021–22
productivity, nutrient/carbon exchange • Frog habitat and breeding						
<b>Great Darling Anabran</b> • Native fish: recruitment and dispersal of flow pulse specialists • Native vegetation: non-woody, fringing river red gum, black box, lignum • Waterbirds: habitat and potential breeding • Ecosystem functions: refuge; productivity	> 800 ML/day (800–2 000 ML/day) from Menindee Lakes for minimum 21 days.	2–3 in 10 years (4 years)	Environmental releases to the Great Darling Anabran last occurred in summer of 2017, allowing for dispersal of large bodied native fish and improved water quality and vegetation condition. No flows have been provided down the Anabran since then.	High	High priority for Commonwealth environmental water use in 2021–22, given recent inflows into Lake Cawndilla	Low




Source: DPIE–Water 2020

**Key**

**Potential watering in 2021–22**

-  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)

## 10.5 Water delivery in 2021–22

Based on the demand for water for the environment, water availability (supply), and catchment conditions, the overall purpose for managing Commonwealth water for the environment in the lower Darling/Baaka in 2021–22 is to support recovery of the system and improve ecological health and resilience.

The highest priority will be to provide elevated baseflows and small to moderate pulses/freshes in the lower Darling/Baaka during spring to support Murray cod and golden and silver perch breeding and recovery of a variety of other aquatic biota (e.g. mussels). A large spring fresh is also a high priority depending on availability of environmental allocations across all water holders and an opportunity to ‘piggy-back’ operational releases in the lower Darling/Baaka.

Golden perch spawning has again been reported upstream in northern basin in response to flow in the Barwon–Darling and its tributaries. Young fish were recorded dispersing with these flows to the Menindee Lakes nursery habitat in 2020, and again with more recent inflows in 2021 (i.e. two juvenile cohorts are now in the lakes). Delivery of environmental water will provide an opportunity for some of these fish to ultimately disperse further into the lower Darling/Baaka and potentially into the River Murray.

Environmental flow to the Great Darling Anabranch is also a high priority for Commonwealth environmental water use, as recent inflow into Lake Cawndilla presents the first opportunity to provide benefits to native fish (including via dispersal from Lake Cawndilla to the Anabranch and ultimately the River Murray), fringing vegetation, waterbirds and frogs for the first time in five years.

Environmental flows will be designed with native fish ecologists in consultation with the local community, including First Nations people. Consideration will also be given to the benefits of water retention in the Menindee Lakes and its associated environmental values (for waterbirds, vegetation and as nursery habitat for fish), as well as potential benefits to the River Murray via contribution of Darling/Baaka flows to productivity and fish populations in the lower Murray. Consideration will be given to coordinating and aligning River Murray and Lower Darling/Baaka watering actions to maximise the dispersal of carbon, nutrients and larval/juvenile fish to the River Murray.

## 10.6 Monitoring and lessons learned

### 10.6.1 Monitoring

In the lower Darling/Baaka River, monitoring is primarily undertaken by NSW agencies including NSW DPIE-EES (vegetation, waterbirds and frogs), NSW DPI–Fisheries (native fish), and WaterNSW (hydrology and flow delivery data).

Several short-term intervention monitoring projects were conducted by the CEWO to assess the success of environmental flows in 2016–17, 2017–18 and 2020–21. The monitoring projects demonstrated the success of the flows in achieving outcomes (further described below) and informed real-time adaptive management of the flows.

Technical reports from short term monitoring projects in the lower Darling/Baaka can be found on the departmental website (the final report for 2020–21 will be published on the CEWO website early in 2021–22). Some key reports include:

- [Assessment of Murray cod recruitment to the lower Darling River in response to environmental flows throughout 2016–18](#) (Sharpe and Stuart 2018a).
- [Environmental flows in the Darling River to support native fish populations 2016–17](#) (Sharpe and Stuart 2018b).
- [Environmental flows to support Murray cod spawning in the lower Darling River 2017](#) (Sharpe 2019).

Monitoring under the Darling Anabranh Adaptive Management Monitoring Program may be undertaken in conjunction with flows to the Great Darling Anabranh.

In addition, monitoring in the River Murray may detect outcomes from environmental watering in the Lower Darling/Baaka and Great Darling Anabranh that extend to the lower Murray. For example, monitoring in the lower Murray via the CEWO's Flow-MER program, and implementation of the River Murray Channel Monitoring Plan in 2021–22 is expected to include detection of influences of key tributaries (such as the Lower Darling/Baaka and Great Darling Anabranh) on productivity and fish outcomes in the River Murray.

### **10.6.2 Lessons learned**

Outcomes from monitoring and lessons learned in previous years are a critical component for the effective and efficient use of Commonwealth water for the environment. These learnings are incorporated into the way environmental water is managed.

Monitoring in the lower Darling/Baaka River (2016–17 and 2017–18) and the Great Darling Anabranh (2016–17) showed environmental flows were successful in supporting tangible and significant multi-species outcomes for native fish. Where possible, maintaining the function of the Menindee Lakes and lower Darling/Baaka is critical for Murray cod spawning and recruitment, the dispersal and recruitment of golden perch from their nursery grounds in the Menindee Lakes, and spawning of golden perch and the nationally threatened silver perch in the lower Darling/Baaka River channel (Sharpe and Stuart 2018a and b, Stuart and Sharpe 2020).

Monitoring during 2020–21 spring flow detected a spawning response from Murray cod with strong numbers of larvae and juvenile fish recorded despite a depletion in adult stocks through the 2019 dry period i.e. fish kills (Stuart et. al. 2021). A limited spawning response by golden perch was detected during the flow, however subsequent monitoring in autumn confirmed the presence of young-of-year golden perch in the lower Darling/Baaka (Stuart et. al. 2021). This was likely due to substantial depletion of adults in the lower Darling/Baaka during the 2019 cease to flow period, and subsequent barriers to fish passage which limited replenishment in the lower Darling/Baaka. With connectivity from Wentworth to Menindee having now been restored, the likelihood of golden perch spawning events in the lower Darling/Baaka in response to future freshes is increased.



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