



Australian Government

Commonwealth Environmental Water Office

Commonwealth Environmental Water Office Water Management Plan 2021–22

Chapter 9 Barwon-Darling River Water Plan

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For more information about Commonwealth environmental water, contact us at:

Commonwealth Environmental Water Office

Department of Agriculture, Water and the Environment

GPO Box 858 Canberra ACT 2601

Telephone 1800 803 772

Email ewater@awe.gov.au

Web environment.gov.au/water/cewo

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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

9	Barwon-Darling River Water Plan	1
9.1	Region overview.....	1
9.2	Environmental objectives.....	3
9.3	First Nations environmental watering objectives.....	4
9.4	Recent conditions and seasonal outlook.....	5
9.5	Water delivery in 2021–22	11
9.6	Monitoring and lessons learned	12
	References	15

Tables

Table BD1	Unregulated Commonwealth environmental water entitlements along the Barwon–Darling River.....	1
Table BD2	First Nations environmental objectives in the Barwon–Darling, 2021–22.....	5
Table BD3	Environmental demands and watering priorities, 2021–22, and outlook for coming year, Barwon-Darling catchment	9
Table BD4	Watering priorities and supporting strategies.....	11
Table BD5	Key lessons learned in the Barwon-Darling River	13

Maps

Map BD1	Barwon–Darling catchment.....	2
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9 Barwon-Darling River Water Plan

9.1 Region overview

9.1.1 River system

The Barwon-Darling River upstream of Menindee Lakes contains a mix of ecosystems including instream habitats, riparian landscapes, and floodplain watercourses. This range of ecosystems help support Commonwealth and NSW-listed threatened ecological communities, threatened, endangered and migratory waterbirds, and threatened native fish species (NSW DPIE 2020a).

The ecology of the Barwon-Darling River is driven by flows that connect the instream benches, cut-off channels, anabranches, floodplains, and wetlands (NSW DPIE 2020a). These flows support nutrient cycling, replenish refuge pools to maintain water quality, and trigger movement and breeding of native fish and waterbirds (NSW DPIE 2020a).

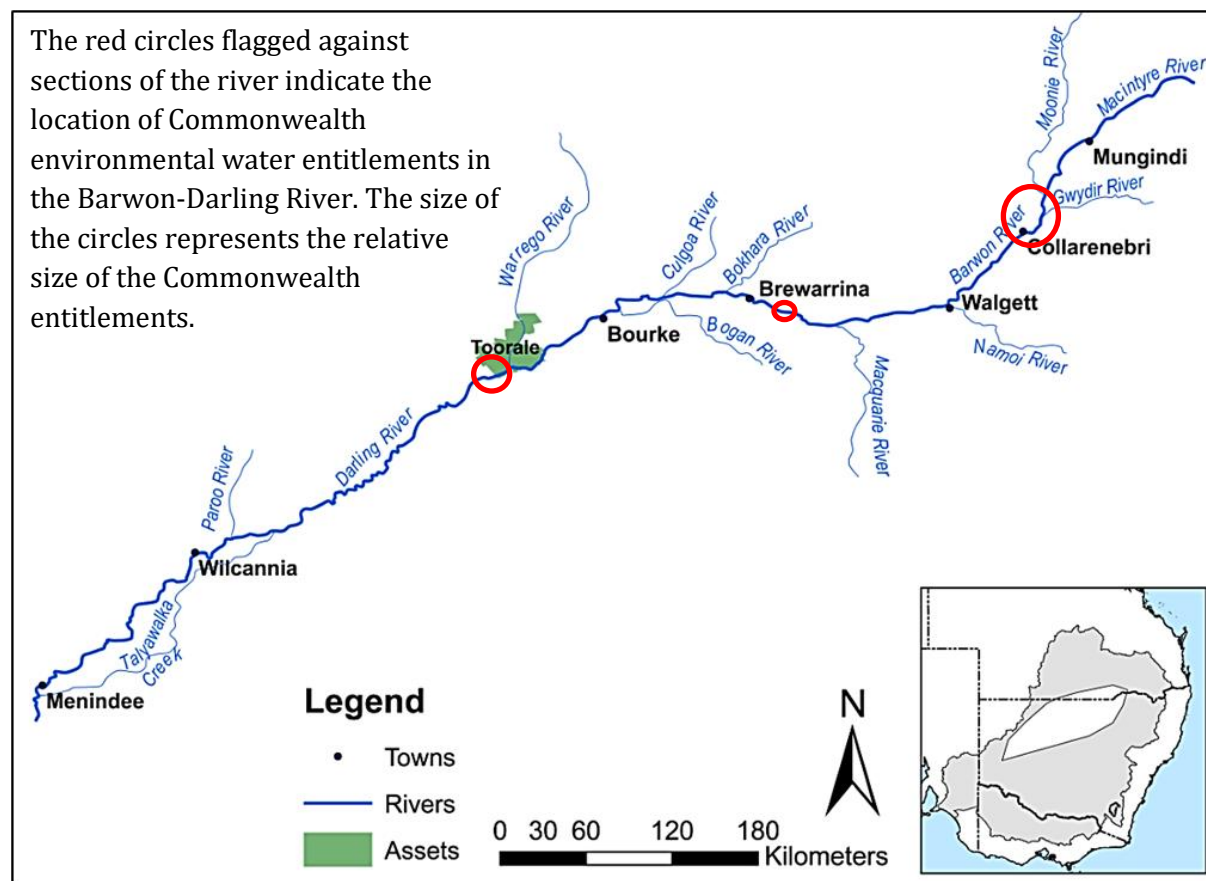
The Barwon-Darling River connects the northern and southern basins. Connection between the two halves of the Basin is critical to maintain and improve the health and condition of native fish (NSW DPIE 2020a). Successful spawning and dispersal of native fish species within and across the Barwon-Darling River enhances the resilience of iconic native fish species such as golden perch (NSW DPIE 2020a).

Commonwealth holdings of water for the environment in the Barwon–Darling are comprised of unregulated entitlements. These entitlements can only be sourced as a share of an unregulated flow event, determined by entitlement conditions and each entitlement’s Individual Daily Extraction Component (IDEC). The list of Commonwealth unregulated entitlements held along the Barwon–Darling River is shown in Table BD1, with their location shown in Map BD1.

Table BD1 Unregulated Commonwealth environmental water entitlements along the Barwon–Darling River

Water Access Licence (WAL)	Water Management Zone	Class	Long-term Average Annual Allocation (ML)	Individual Daily Extraction Component (ML)
37810	Boomi River Confluence to Mogil Mogil Weir Pool	B	3,731	307.4
33619	Downstream of Mogil Mogil to Collarenebri	B	9,252	762.2
33798	Downstream of Mogil Mogil to Collarenebri	C	6,963	1247
37461	Boorooma to Brewarrina	B	323	26.6
33701	Bourke to Louth	A	51	2.7
33704	Bourke to Louth	A	22	1.1
33784	Bourke to Louth	B	1,566	129
35944	Bourke to Louth	B	1,188	97.9
35943	Bourke to Louth	C	5,535	991.3

Map BD1 Barwon–Darling catchment



Source: Department of Agriculture, Water and the Environment (n.d.)

There are no major public water storages along the Barwon–Darling River, although large headwater storages exist in several tributaries. There are also large private off-river storages that store water diverted or pumped from the Barwon-Darling River or harvested from floodplain run-off. There are 15 major weirs along the main stem of the Barwon–Darling River from Mungindi to upstream of Menindee Lakes, which create a series of barriers for fish passage (DPIE 2020a). The Brewarrina and Walgett weirs currently contain effective fishways, with plans also progressing for improved fish passage at Wilcannia Weir as part of the proposed upgrade works at the weir. The NSW fish for the Future: Reconnecting the Northern Basin project has commenced as part of the Northern Basin Toolkit and aims to reinstate fish passage at the other barriers along the system in coming years.

9.1.2 Traditional Owners

The rivers and waterholes of the Barwon–Darling River hold significant spiritual and cultural importance for Aboriginal people from several nations including the Barkandji, Murrwarri, Eahlayi, Ngemba, Ngiyampaa and Wailwan peoples. 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.

9.1.3 Important sites and values

The Barwon–Darling River channel connects the rivers, lakes and wetlands in the northern Murray–Darling Basin as well as providing connectivity with the southern Basin (NSW DPIE

2020a). Connectivity of the Barwon–Darling River has been listed in the Basin environmental watering priorities in recent years. The Barwon–Darling River provides a critical dry period refuge and movement corridor for fish and waterbirds, as well as habitats for other aquatic species including turtles, mussels, river snail and shrimp (NSW DPIE 2020a). Connectivity along the length of the Barwon-Darling River is particularly important for communities of native fish and other aquatic species.

Diverse in-stream habitats including channels, deep pools, riffles, benches, snags, gravel beds and aquatic and riparian vegetation support a significant native fish community (NSW DPIE 2020a). There are more than 1,100 refugial waterholes between Mungindi and Wilcannia (NSW DPI 2015).

The fish community within the Barwon–Darling River includes 15 native species and up to five non-native species (NSW DPIE 2020a). Silver perch is listed as critically endangered and Murray cod as vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The system is likely to contain remnant populations of olive perchlet, purple spotted gudgeon and freshwater catfish, all of which are listed under relevant threatened species legislation within NSW. Other important species found in the Barwon–Darling River that are not widely dispersed across the Basin include Rendahl’s tandan, Hyrtl’s tandan, spangled perch, Darling River hardyhead and desert rainbowfish (NSW DPIE 2020a).

The Barwon–Darling River also supports several species of river mussels, including *Alathyria jacksoni*, which is highly responsive to changes in low and zero flows (NSW DPIE 2020a).

9.1.4 Stakeholder engagement

The CEWO works with the following organisations and groups to collect and collate relevant monitoring information and evaluation results that facilitates adaptive management and changing our practices where needed:

- NSW agencies in particular the Water group and Environment, Energy and Science group in the Department of Planning, Industry and Environment (DPIE) as well as Department of Primary Industries (DPI) - Fisheries
- the Murray–Darling Basin Authority
- regional organisations, local groups and landholders
- research organisations.

This continual review of information and outcomes is helping to build knowledge about the best way to get positive outcomes across the Barwon–Darling River, based on what does and does not work across the system.

The CEWO funds a Monitoring, Evaluation and Research program, that includes a selected area at the junction of the Warrego and Darling rivers. This provides additional information to inform adaptive management.

9.2 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 Barwon–Darling River.

Because of the unregulated nature of the Barwon–Darling River, the objectives that can be achieved in a particular year may vary and are highly dependent on catchment conditions and rainfall events within the systems tributaries. These objectives will continue to be revised as part of the commitment of the CEWO to adaptive management. The objectives are:

- Connectivity – Support longitudinal connectivity, along the Barwon-Darling River, and lateral connectivity within the river network and between the rivers and their floodplains.
- Vegetation – Maintain the condition, growth and survival of riparian, in-channel, floodplain and wetland vegetation.
- Waterbirds – Increase waterbird abundance and maintain species diversity by supporting naturally triggered breeding events, and maintaining suitable refuge, feeding and breeding habitat.
- Native fish – Prevent loss of native fish species and improve population structure and distribution, by supporting opportunities for movement, dispersal, reproduction, and recruitment.
- Other vertebrates and invertebrates – Support opportunities for the reproduction and recruitment of other native aquatic species, including frogs and turtles.
- Processes/water quality/resilience – Support key ecosystem functions and promote productivity, maintain water quality in channels and pools, and maintain drought refuge habitat.

9.3 First Nations environmental watering objectives

The CEWO is committed to working with First Nations groups to better understand their objectives. The CEWO will use environmental flows to contribute to these objectives where possible and where this is consistent with the Commonwealth Environmental Water Holder’s statutory responsibility of protecting and restoring environmental assets in the Basin (see [Chapter 2](#)).

Representatives of the First Nations peoples of the Barwon-Darling have identified environmental objectives for their country for 2021-22 ([Table BD2](#)). These objectives have been developed through a collaborative process under the Barwon-Darling First Nations Environmental Water Objectives and Guidance Pilot Project. The Project was led by NSW Department for Planning, Industry and Environment: Environment, Energy and Science (DPIE EES) with input co-ordinated by Northern Basin Aboriginal Nations (NBAN) staff. Discussion held through the Project involved:

- NBAN Delegates from the Ngemba, Euahlayi, Murrawarri, Ngiyampaa First Nations
- Staff from NSW DPIE EES and the Commonwealth Environmental Water Office.

These discussions identified objectives across a range of sites and values. These discussions have also identified sites of special significance for First Nations across the Barwon-Darling System.

Some of these objectives are potentially outside the scope of Commonwealth water for the environment because the portfolio is only able to contribute during large infrequent flow events.

For other objectives, the link between water for the environment and the site or issues is not well understood and needs further consultation.

Table BD2 First Nations environmental objectives in the Barwon–Darling, 2021–22

Nation	Site	Objective	Values	Indicator Species
Ngemba	Ngemba (Brewarrina) Fish Traps	To always have flows moving through the site.	Cultural heritage site	N/A
	Yanda Creek, Mulga Creek,	To have flows moving through the sites during cooler months.	Connection to the Barwon-Darling River	N/A
	Gundabooka (National Park) (beside Yanda Creek)		Cultural heritage site	
	Byrock (beside Mulga Creek)		Cultural heritage site	Wedge-tail eagle, kangaroo, crayfish, turtle, black duck, shrimp, crayfish, turtle, echidna, sand goanna, bronzed wing pigeons and mulga trees.
Euahlayi	Collymongle	To always have flows moving through the site.	Ceremonial site, sacred women's site, and scarred trees.	Coolabah, red gum, crayfish, yellowbelly, and Murray cod.
	Eurool	N/A	Woman's site	Red gum, coolabah, black box, ducks, kangaroos, ibis, pelican, crayfish, and mussels
	Fish Holes Lagoon	To always maintain some water in the lagoon	Mussel dreaming site	Mussel, pelican, duck, and shrimp
	Merchadool and riparian areas along the Barwon State Conservation area	To see water flow through at the site during winter and spring	Crayfish breeding site	Ducks, crayfish, tea trees, yellowbelly, and cod
	Area surrounding Yambie Lagoon	To see water flow through at the site during August - October	Site of black swan dreaming story	Waterbirds including swans, ducks, ibis, pelicans, cranes
Murrawarri	May's Bend (Darling River) – floodplain channel connecting the two ends of the bend	To enhance flows through the channel	Spiritual connection to red gums	Red gum, coolabah, blackbox, yellowbelly, cod, catfish, mussels
Ngemba/ Ngiyampaa	North Bourke Bridge lagoon	To ensure that when there is rainfall, that the lagoon has water flowing through it	Vegetation used for toolmaking	Black cockatoo, shrimp, yellowbelly, cod, bream, red gum, coolabah, nardoo, bulrush, and pin rush.

9.4 Recent conditions and seasonal outlook

9.4.1 Recent conditions and environmental water use

Like much of the northern Basin, the Barwon–Darling River experienced very hot and dry conditions in the drought between January 2018 and January 2020. The two highest annual average maximum temperatures at Brewarrina for the 83 years of record occurred in 2018 and 2019. Rainfall was well below average. Flows along the River during this period were also

generally low, with long reaches of the Barwon–Darling ceasing to flow for extended periods. The hot and dry conditions resulted in the Darling River downstream of Bourke not flowing for over 430 days between September 2018 and November 2019. Other river reaches such as downstream of Collarenebri and upstream of Wilcannia experienced low or no flow periods of over 170 days and 200 days respectively. These long periods of low or no flow reduced the number and quality of drought refuge pools within the Barwon–Darling River. This is likely to have had a significant impact on the aquatic communities of the system. Exceptions to these dry conditions were:

- Small flow events moving through the system in autumn 2018, winter 2019 (river reaches downstream of the Warrego/Darling River junction to just downstream of Wilcannia), and late spring 2019.
- Environmental flows from the Northern Connectivity Event along both the Barwon-Darling River to the Menindee Lakes during autumn and winter 2018, and Northern Fish Flow moving along the full-length of the Barwon River during autumn and winter 2019.

During late summer and early autumn 2020 widespread rainfall occurred across most of the northern Basin with the upper parts of northern Basin valleys recording more than 300 mm of rainfall during January and February. This rainfall generated significant flows in most Barwon–Darling tributaries and corresponding inflows into the Barwon-Darling River. The contribution each tributary made to flows along the Barwon-Darling River varied, with the Condamine-Balonne contributing the most (205 gigalitres as measured at the end of system gauges on the Culgoa and Bokhara rivers) (WaterNSW 2021a).

Between September and December 2020, flows across the Barwon–Darling River declined, with most river reaches experiencing extended cease to flow periods. In January 2021, Commonwealth and planned NSW water for the environment was provided to the Barwon–Darling River as part of the Northern Waterhole Top-up. The Northern Waterhole Top-Up originally targeted 230 river kilometres of the Barwon River between Mungindi and Walgett, where refuge habitat was declining in quality. Water for the delivery was sourced from the Gwydir and Border Rivers catchments. Summer rain helped extend the Northern Waterhole Top-Up well beyond its original target range, enabling some of this water to reach the Menindee Lakes. In addition to connecting river reaches along the Barwon-Darling River, the flow provided connectivity benefits between both the Gwydir and Macintyre (Border Rivers) systems and the Barwon River.

During the 2020–21 water year NSW implemented active management arrangements in the Barwon–Darling for the first time. These arrangements enabled held environmental water delivered from the Gwydir and Border Rivers systems, as part of the Northern Waterhole Top-up, to be protected from extraction along the Barwon–Darling.

Following widespread rainfall in March 2021, significant unregulated flows entered the Barwon–Darling River. Consistent with active management arrangements, Commonwealth water for the environment remained instream by activating a range of water licences to enhance flows along the Barwon-Darling River. While Commonwealth water for the environment made up only a part of the overall flows, it helped reconnect parts of the Barwon-Darling River and enabled fish to move and breed. Commonwealth water for the environment also helped connect the Barwon–Darling and Lower Darling systems.

Details of [previous Commonwealth environmental water use in the Barwon–Darling](#) are available on the CEWO website.

9.4.2 Seasonal outlook

According to the Bureau of Meteorology outlook in June 2021, above median rainfall is forecast across the Barwon–Darling from July to September 2021 (BoM 2021a). Maximum temperatures are forecast to be below average over the coming months (BoM 2021b, c).

This forecast suggests weather patterns may further improve the condition of the Barwon–Darling system. However, given the variability of the climate of the northern Basin, it is also possible that dry conditions may emerge over coming months, which may hinder ecological recovery.

9.4.3 Water availability

Unregulated held environmental water entitlements

The amount of water for the environment from unregulated entitlements within the Barwon–Darling system depends on the nature of flow events that occur. The *Water Sharing Plan for the Barwon–Darling Unregulated and Alluvial Water Sources 2012* outlines the rules around managing unregulated entitlements. These rules provide opportunistic access to unregulated river flows when triggered. Each entitlement will contribute to restoring in-stream flows reflecting its flow class, daily take rates and location.

The amount of water available in each water year varies, with above average volumes of Commonwealth water for the environment available in wet years and very small or no volumes of water available during dry times.

Environmental water entitlements held in tributary systems

In addition to holdings within the Barwon–Darling River, held water for the environment delivered from within tributary systems of the Barwon–Darling can be delivered to the Barwon–Darling River itself to enhance environmental outcomes. During the 2020–21 water year, active management enabled water for the environment delivered from the Border Rivers and Gwydir systems to be protected from extraction and maximise environmental outcomes.

Regulated and supplementary entitlements of water for the environment in tributary systems of the Barwon–Darling can be delivered to increase flows in the Barwon–Darling River. The Northern Connectivity Event, Northern Fish Flow and Northern Waterhole Top-up were examples of this type of use. Moderate resource availability is forecast in several regulated upstream storages. This may provide an opportunity for regulated releases to be used to maintain the condition of environmental assets in the Barwon–Darling should dry conditions return during the 2021–22 watering year.

Policies to support the use of water for the environment

Recent amendments to the *Water Sharing Plan for the Barwon–Darling River Unregulated River Water Source 2012* included a range of new management arrangements put in place for the 2020–21 water year (NSW DPIE 2020b). These elements are important in protecting further ecologically significant elements of the flow regime such as low flows and protecting Commonwealth water for the environment.

One of the new management arrangements put in place for the 2020–21 water year was active management. Between January and June 2021 active management arrangements were operated to ensure Commonwealth held environmental water was protected from downstream extraction. In addition to protecting held environmental water, these arrangements enabled these volumes to be measured daily as flows moved through the Barwon–Darling.

9.4.4 Environmental demands

Prior to the rainfall and flows that occurred over summer and autumn of 2020-21, the preceding four years had been the driest on record for many Barwon-Darling River tributaries. During these extended dry conditions most environmental demands for the Barwon-Darling River were not met.

Rain in December 2020 to January 2021 saw flows move along the Barwon-Darling River replenishing refuge pools and connecting a range of instream habitats. Significant flows into the Barwon-Darling River during March enabled most environmental demands to be met for 2020-21 and helped the river transition from dry to moderate condition.

The environmental water demands for assets in the Barwon–Darling in 2020–21 are represented in Table BD3. These demands are based on the Barwon-Darling Long-Term Watering Plan, prepared by NSW for the Barwon–Darling River.

Table BD3 Environmental demands and watering priorities, 2021–22, and outlook for coming year, Barwon-Darling catchment




Environmental assets	Target values	Indicative demand (for all sources of water in the river)			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
Refuge pools along the Barwon-Darling River Refuge habitat Native fish Water quality Aquatic invertebrate species	Critical drought refuge habitat Native fish maintenance and survival Maintenance and survival of key invertebrate fauna	Cease-to-flow Triggers 0 ML/day (Barwon River at Dangar’s Bridge, near Walgett) for a maximum of 45 days during very dry conditions 0 ML/day (Darling River at Bourke) for a maximum of 100 days during very dry conditions 0 ML/day (Darling River at Louth) for a maximum of 110 days during very dry conditions 0 ML/day (Darling River at Wilcannia) for a maximum of 120 days during very dry conditions	Cease to flow period should not exceed periods of 45 to 120 days	The Northern Connectivity Event in April–May 2018 assisted in replenishing refuge pools along the entire Barwon–Darling River. With extremely dry conditions during the 2018–19 water year, the Northern Fish Flow in April to June 2019 assisted in replenishing refuge pools along the Barwon River to just downstream of the Culgoa junction. Reflecting the extremely dry conditions that persisted through most of 2017–18, 2018–19 and 2019–20, cease-to-flow triggers were exceeded at Bourke, Louth and Wilcannia. Rainfall events during late summer to early autumn 2020 helped replenish pools along the River. Between September and December 2020, flows across the Barwon–Darling River decreased, with most river reaches experiencing extended cease to flow periods. Cease-to-flow triggers were exceeded in sections of the Barwon River upstream of Dangar’s Bridge, near Walgett. In January 2021, water for the environment was provided to the Barwon–Darling River as part of the Northern Waterhole Top–up. The combination of tributary inflows and the Northern Waterhole Top–up event helped break cease to flows periods along most reaches of the Barwon-Darling River.	High	A high priority for CEW under dry to very dry conditions. Protection of natural flow events through activation of unregulated environmental water entitlements held along the Barwon-Darling River is a high priority. Using regulated environmental water entitlements to respond to extended periods of no flow may be an option depending on account volumes in key regulated systems.	High
		Very Low flows >95 ML/day for a total of 230 days in a year at Dangar’s Bridge (near Walgett) on the Barwon River >105 ML/day for a total of 180 days in a year at Bourke on the Darling River >70 ML/day for a total of 180 days in a year at Louth on the Darling River >30 ML/day for a total of 175 days in a year at Wilcannia on the Darling River	Every year	These flows help replenish refuge pools along the Barwon–Darling River. Over the last 4 years the requirements for very low flows have been met 2 times. Flow events during late summer and autumn 2021 moved the system to a moderate condition. However, the extremely dry conditions that persisted for most of 2018–19 and 2019–20 mean the requirement for very low flows across the system remains a high priority.	High	A high priority for CEW under dry to very dry conditions. Protection of natural flow events through activation of unregulated environmental water entitlements held along the Barwon-Darling River is a high priority. Using regulated environmental water entitlements to respond to extended periods of no flow may be an option depending on account volumes in key regulated systems.	High
In-stream habitats (pools channels benches, snags, and gravel beds) along the Barwon-Darling River Aquatic habitat Native fish Aquatic invertebrate species Water quality	Enabling native fish to access in-stream habitats Native fish movement Maintaining the condition/quality of in-stream habitat	Baseflows >320 ML/day for a total of 150 days in a year at Dangar Bridge (near Walgett) on the Barwon River >500 ML/day for a total of 135 days in a year at Bourke on the Darling River >450 ML/day for a total of 135 days in a year at Louth on the Darling River >350 ML/day for a total of 145 days in a year at Wilcannia on the Darling River	Every year	These flows provide a flow depth to support movement for small and medium bodied fish as well as assist in managing water quality issues (e.g., destratification of waterholes and blue green algal blooms). During dry years like the 2017–18 water year, held environmental water delivered from tributaries systems (through watering actions like the Northern Connectivity Event) can assist in achieving these environmental water requirements. Over the last 4 years, baseflow requirements across the Barwon–Darling River have generally not been met. The exception to this was the 2020–21 water year when all baseflow requirements were met. Due to the extent of dry periods over the last 4 water years the need for baseflows across the Barwon–Darling River is a high priority.	High	A high priority for CEW under dry to very dry conditions. Protection of natural flow events through activation of unregulated environmental water entitlements held along the Barwon-Darling River is a high priority. Using regulated environmental water entitlements to respond to extended periods of no flow may be an option depending on account volumes in key regulated systems	High

Environmental assets	Target values	Indicative demand (for all sources of water in the river)			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
Native fish habitat and aquatic communities along the Barwon-Darling River Aquatic habitat Aquatic invertebrate species Water quality Breeding opportunities for native fish	Providing native fish with spawning and recruitment opportunities	Small Fresh 1 >700 ML/day for at least 10 days on the Barwon at Dangar’s Bridge near Walgett ideally in Oct to April (but can occur at any time).	Every year	Small fresh 1 flow along the Barwon-Darling River have occurred 2 out of the last 4 years (2019-20 & 2020-21). Small fresh 1 flow seek to provide opportunities for fish movement across each water year and are a moderate to high priority because native fish communities are still in a recovery phase.	Moderate to High	A high priority for CEW under dry to moderate conditions. Protection of natural flow events through activation of unregulated environmental water entitlements held along the Barwon-Darling River is a moderate to high priority.	Moderate to High
		Small Fresh 2 700 to 6,500 ML/day for at least 14 days on the Barwon at Dangar’s Bridge near Walgett in October to April. 1,500 to 15,000 ML/day for at least 14 days on the Darling at Bourke ideally in October to April.	5 to 10 years in 10 (overall, 75% of years)	Small fresh 2 flows seek to support spawning opportunities for native fish - preferred temperature range for fish spawning, >20°C for most native fish and >18°C for Murray cod. Small fresh 2 flows along the Barwon River have occurred 2 out of the last 4 years (2019-20 & 2020-21). Along the Barwon-Darling River the frequency of small fresh 2 events have generally been met within the specified range. However, small fresh 2 flows are moderate priority because native fish communities are still in a recovery phase.			




Note: Data and information from NSW Department of Planning, Industry and Environment and WaterNSW real time data website (WaterNSW 2021a, b) has informed the watering history in the above table. The Barwon–Darling Long-Term Water Plan (NSW DPIE 2020a) describes the environmental water requirements (EWRs) needed to achieve the specified ecological objectives. The EWR’s defined within the Barwon-Darling River Long-Term Water Plan have been used to inform indicative environmental demands for key assets located within the Barwon-Darling River.

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)

9.5 Water delivery in 2021–22

Environmental water contained within unregulated flows is important in achieving ecological outcomes in the Barwon–Darling River. These flows that are not delivered from dams are particularly important for fish as they contain the natural cues and nutrients fish require for their lifecycles. Unregulated flows through the Barwon–Darling River can be enhanced using Commonwealth holdings both from tributary systems and along the Barwon-Darling.

The focus for Commonwealth environmental water use during the 2021–22 water year will be the protection of unregulated flows along the Barwon–Darling River to meet a range of watering priorities, including:

- supporting longitudinal connectivity and end of system flows
- promoting growth, reproduction, and small-scale recruitment for native fish
- supporting low level lateral connectivity (mainly connection between anabranches and the main channel).

9.5.1 Managing Commonwealth holdings of water for the environment in the Barwon–Darling River

New active management arrangements in the Barwon–Darling came into effect on 1 December 2020. With these arrangements, water users must wait until WaterNSW announce access before they can take water from the river. Under active management arrangements, water access is announced daily and is based on the amount of (actively managed) environmental water in the river at that time. License holders can choose how much water to take on a daily basis up to the IDEC for each entitlement.

In general, the CEWO will maximise the use of Commonwealth entitlements given the opportunistic nature of flows in the Barwon-Darling Rivers. However, there may be some circumstances particularly during large flows (large fresh range) or persistently wet periods where the Commonwealth entitlements are not activated or only partially activated. Broadly this involves maximising environmental outcomes (priority outcomes and supporting strategies are outlined in Table BD4) in consultation with communities, government agencies, First Nations and other stakeholders. However, given how new these arrangements are principles to guide for the use of Commonwealth environmental water entitlements will evolve over time.

9.5.2 Managing Commonwealth holdings of water for the environment in tributaries

Moderate resource availability is forecast in several regulated upstream storages, this may provide an opportunity for regulated releases to be used to maximise outcomes in the Barwon–Darling (Table BD3) should dry conditions return during the 2021–22 watering year.

Table BD4 Watering priorities and supporting strategies

Conditions	Priority Outcomes	Strategies
Dry/very dry conditions	<ul style="list-style-type: none"> • Avoid critical loss of species, communities, and ecosystems • Maintain refugia • Avoid irretrievable damage or catastrophic events 	<ul style="list-style-type: none"> • Use Commonwealth Barwon-Darling unregulated entitlements to support very low and base flows • Use Commonwealth holdings in tributaries to provide

Conditions	Priority Outcomes	Strategies
	<ul style="list-style-type: none"> Avoid prolonged dry periods between flow events Support targeted longitudinal connectivity along the Barwon Darling River for functional processes and a range of flora and fauna 	<ul style="list-style-type: none"> targeted low flows from tributaries, where possible, to boost water quality and quantity of in-stream refugia. Use Commonwealth Barwon-Darling unregulated entitlements to protect flows following extended cease-to-flow periods
Moderate/wet conditions	<ul style="list-style-type: none"> Enable growth, reproduction, and small-scale recruitment for a diverse range of flora and fauna Support medium flow river and floodplain functional processes Support longitudinal connectivity within and between catchments for functional processes and a range of flora and fauna Support low level lateral connectivity (mainly anabranches and flood runners) and end of system flows 	<ul style="list-style-type: none"> Use Commonwealth Barwon-Darling unregulated entitlements to support a range of flows Use Commonwealth holdings in tributaries to provide targeted flows to enhance connection opportunities.

Source: NSW DPIE 2020a

9.6 Monitoring and lessons learned

9.6.1 Monitoring

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

The Monitoring, Evaluation and Research (MER) Program (previously the Long-Term Intervention Monitoring Project 2014–2019) has the junction of the Darling and Warrego rivers as a focus area. It aims to understand the environmental response from Commonwealth environmental watering with respect to the targeted objectives by carrying out monitoring of site condition over many years.

Information on [monitoring activities](#) is available on the CEWO website.

Monitoring information is also provided by state governments and other organisations throughout the Barwon–Darling River.

9.6.2 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.

Key findings from monitoring undertaken across the Barwon–Darling River are summarised in Table BD5.

Table BD5 Key lessons learned in the Barwon-Darling River

Theme	Lessons learned
Native fish and other aquatic species	<ul style="list-style-type: none"> Over the last several years, the University of New England with NSW DPI–Fisheries have been monitoring native fish responses to flow as part of the CEWO's MER/LTIM Warrego-Darling selected area projects. Results from monitoring undertaken in July to August 2020 found reasonable numbers of mature golden perch and bony herring.
Connectivity	<ul style="list-style-type: none"> Connectivity between the Barwon–Darling River and its tributaries can be enhanced using water for the environment. Connectivity is important for supporting native fish habitat and allowing the movement of native fish between rivers for spawning, dispersal and recruitment. The Northern Connectivity, Northern Fish Flow and Northern Waterhole Top-up events delivered from the Gwydir and Border Rivers into the Barwon–Darling River during the 2017–18, 2018–19 and 2020–21 water years were critical actions for survival of native fish. These events reconnected channel habitats and promoted fish movement. Protecting environmental water delivered in these events from extraction was essential for success. In the case of the Northern Waterhole Top-up, protection was provided through active management arrangements. Active management arrangements are complemented by information shown on the Water Insights Portal (WaterNSW Water Insights 2021). The portal provides key information on how water is being managed and shared within the Barwon–Darling River on a daily basis. Both active management arrangements and the portal are invaluable tools for environmental water managers and community members alike. Understanding the amount of water required to refill pools and wet up sections of river channel is a key element to estimating the environmental water requirements of the Barwon-Darling River during dry periods. For the Northern Fish Flow, on a dry riverbed, the volume of water that passed Collarenebri was approximately 15,350 megalitres, of which 2,230 megalitres or about 15% passed Brewarrina. This means about 5,000 megalitres per 100 river kilometres was used to fill pools and wet the dry river channel between Collarenebri and Brewarrina. For the Northern Connectivity Event, where waterholes were full before the flow, the volume of water that passed Collarenebri was about 19,900 megalitres, of which approximately 15,700 megalitres or about 80% passed Brewarrina. This means that approximately three times as much water was used to refill pools and wet up sections of the Barwon River channel between Collarenebri and Brewarrina during the Northern Fish Flow as compared to the Northern Connectivity Event.
Water quality	<ul style="list-style-type: none"> During summer months refuge pools located along the Barwon-Darling River can stratify, reducing habitat quality and putting native fish at risk. The primary risk considered before the Northern Connectivity Event and the Northern Fish Flow was the stratification of waterholes. Waterholes can rapidly de-stratify when flow return, resulting in deoxygenation of the waterholes and fish kills. Consultants were used to gather information about water quality risks (Eco Logical Australia 2020). Samples of dissolved oxygen were collected from refuge pools before, during and after the Northern Fish Flow. If dissolved oxygen falls below 4 mg/L then fish become stressed and may die (Eco Logical Australia 2020). Before the Northern Fish Flow, dissolved oxygen concentrations at the Collarenebri Weir pool were found to be below 4 mg/L in places (Eco Logical Australia 2020). Dissolved oxygen readings show that concentrations increased when the Northern Fish Flow passed (Eco Logical Australia 2020). The Northern Fish Flow was timed for the flows to reach the Barwon River by late May and early June when temperature was significantly reduced, helping to reduce risks to water quality. The Northern Waterhole Top-up (NWT) was the first time a connectivity event was delivered during summer. Timing of the event was based on:

Theme	Lessons learned
	<ul style="list-style-type: none"> – extended dry conditions across the Barwon River during winter-spring 2020 – coordinating with regulated block releases to minimise losses. <p>While dissolved oxygen (DO) levels in the Collarenebri Weir pool were below 4 mg/L following initial inflows, no fish deaths were observed. The NWT most likely assisted in diluting low DO tributary inflows. Regular water quality monitoring would assist in determining the origins and potential mitigation of water quality issues.</p> <ul style="list-style-type: none"> • Commonwealth water for the environment delivered as part of natural flow events can improve water quality, nutrient cycling and provide access to in-channel habitats for other species. Additionally, Commonwealth water delivered as part of small flow events in the Barwon-Darling River may minimise algal productivity and the potential for blooms.

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