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Murray–Darling Basin Authority

Basin-wide environmental watering strategy

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Acknowledgement of the Traditional Owners of the Murray–Darling Basin

We acknowledge the Traditional Owners and Custodians of Country throughout the Murray–Darling Basin and their continuing connection to land, waters and community. We offer our respects to the people, the cultures and the Elders past and present.

Aboriginal people should be aware that this publication may contain images, names or quotations of deceased persons.

Contents

Introduction

In 2012, there was widespread agreement across governments that a plan was needed to manage water carefully and protect the Basin for future generations. The unprecedented impacts of the Millennium Drought had revealed the weaknesses in the current management arrangements, particularly over-allocation of the available water resource.

The Basin Plan was developed to place the Basin on a sustainable footing and manage it as a connected system. At its core, the Basin Plan sets the amount of water that can be taken from the Basin each year, while leaving enough to ensure that the rivers, wetlands and floodplains of the Murray–Darling Basin are restored to a healthy and resilient state, and are therefore able to support strong communities, the interests of First Nations people and productive industries. This intent is captured in the overarching Basin Plan outcome of a *healthy, working Murray–Darling Basin*.

The Basin Plan identifies an Environmentally Sustainable Level of Take (ESLT) for the Basin and sets the Sustainable Diversion Limit (SDL) – this represents the maximum amount of water that can be taken from the Basin while sustaining the environment. It was clear that there was a gap between the amount of water taken from the Basin each year and the SDL, and this gap became the water recovery target of 2750 GL per year. A program was initiated whereby water was recovered from the consumptive pool and transferred to the Commonwealth Environmental Water Holder (CEWH) as entitlements referred to as held environmental water. This held environmental water, combined with the planned environmental water already in place, is collectively referred to as *water for the environment*.

To ensure that the benefits of water for the environment are maximised, the Basin Plan includes guidance on environmental water planning and management through *Chapter 8: Environmental Watering Plan*. The Environmental Watering Plan sets out the arrangements to be followed by the Murray–Darling Basin Authority (MDBA), the Commonwealth Environmental Water Holder (CEWH) and Basin States to meet the Basin Plan's environmental objectives and targets. The overall objectives of the Environmental Watering Plan are to:

- protect and restore water-dependent ecosystems of the Murray–Darling Basin
- protect and restore the ecosystem functions of water-dependent ecosystems
- ensure that water-dependent ecosystems are resilient to climate change and other risks and threats.

A key component of the Environmental Watering Plan is the development of a Basin-wide environmental watering strategy (the Strategy). The aim of the Strategy is to describe the Basin Plan environmental objectives for the Basin and catchments, and to maximise the benefits of environmental water. The Strategy is a key component of the adaptive management of environmental water to achieve Basin Plan outcomes.

The Strategy sets out to:

- explain the context within which the Basin annual environmental watering priorities will be set
- identify particular Basin wide environmental watering priorities over the long term
- identify priority environmental assets and ecosystem functions
- provide guidance on best practice in planning, prioritisation and use of environmental water

- help coordinate the management of environmental water, including guiding the development of consistent long term watering plans.

The Strategy was first published in 2014. Recognising that the strategy should adapt to new knowledge and new ways of thinking, the Basin Plan requires it to be updated every 5 years. This recognises that environmental water management was an emerging discipline, and continuously learnings would need to be incorporated into management. Hence the strategy was reviewed and re-published in 2019, and it is within this legislative context that this third edition of the Basin-wide environmental watering strategy has been prepared.

Basin-wide environmental watering strategy – third edition

The Basin-wide environmental watering strategy has been reviewed with a vision that drives and supports a healthy, connected and resilient Murray–Darling Basin with thriving ecosystems that support First Nations values, communities and economies.

This third edition of the Strategy builds on much of the content from the first and second editions whilst continuing to incorporate knowledge from a further 5 years of Basin Plan implementation, advances in environmental water delivery and accounting, and a significantly improved body of Murray–Darling Basin science and knowledge. The Strategy was developed in consultation with relevant experts, including Basin State and Territory jurisdictions and respected technical experts through thematic advisory groups. This third edition now includes:

- refinements to the evidence base for the Expected Environmental Outcomes, incorporating updates on current Basin conditions and learnings from more than a decade of experience in applying environmental water across the Basin
- commentary on how climate change, constraints and non-flow threats impact on the Basin's water-dependent ecosystems and the achievement of the Expected Environmental Outcomes
- further involvement and inclusion of First Nations people, and how their cultural rights and obligations can be respected and included to improve environmental water management
- further consideration of social and economic outcomes as a water management strategy.

The third edition of the Basin-wide environmental watering strategy is delivered as a suite of 3 products – the Basin-wide environmental watering strategy (this document), a high-level summary product of the Strategy, and a detailed supporting information document. The statutory components (which Basin States and the CEWH must have regard to) are the Basin-wide environmental watering strategy and the detailed supporting information document including identification of assets and functions.

This third edition has been prepared in the lead-up to and in the context of the 2026 Basin Plan Review (the Review). The Review will examine how effectively the Basin Plan is working and if it should be amended to support future water management. Hence this third edition does not foreshadow the findings and outcomes of the Review in areas such as adapting to the impacts of climate change. Any amendments to environmental watering priorities, objectives and outcomes will be considered in future editions of the Strategy.

Basin-wide environmental watering strategy – Intent and use

The MDBA has drafted the Strategy with the intent to guide the planning and delivery of water for the environment at the Basin scale over the long term. In doing so, the Strategy has been reviewed and is published to:

- outline water management principles and strategies to **maximise the outcomes** that can be achieved from active management of flows in the Basin
- outline the **Expected Environmental Outcomes**, as a quantitative metric, to be achieved by environmental water management at the Basin-scale for 4 themes:
    - River flows and connectivity
    - Native vegetation
    - Waterbirds
    - Native fish
- identify **complementary outcomes for First Nations** to be achieved by environmental water management
- describe how the MDBA, the CEWH and the Basin states should **implement** this Strategy
- outline **how the MDBA identifies** Basin annual environmental watering priorities, and identify **future opportunities for improvement and review** of the Strategy.

The Strategy is one planning component of an environmental management framework used to standardise management of the Basin's water resources to achieve the Basin Plan's environmental objectives. There are 3 others planning components of the environmental management framework, set out below:

- **Long-term environmental watering plans**: State-based plans that detail the environmental objectives and targets at a regional scale, as well as watering requirements for a range of environmental assets and functions. Regional objectives described in these plans nest under the expected environmental outcomes set out in this Strategy.
- **Annual environmental watering priorities**: shorter-term guidance on the actions that should be taken to achieve the longer-term objectives as developed by Basin State and Territory jurisdictions (regional, catchment, or asset scale).
- **Basin annual environmental watering priorities**: shorter-term guidance on the actions that should undertaken at the Basin-scale to achieve the longer-term objectives as developed by the MDBA.

Separate to the environmental management framework but equally critical are Water Resource Plans (WRP) — these are state-based plans that determine how water is used at a local or catchment level. From the perspective of managers of environmental water, a vital purpose of the WRP is to define the foundational flow regime (through mechanisms such as the rules around planned environmental water in each catchment) which the CEWH and other entitlement holders supplement through the application of held environmental water.

The intended audience of the Strategy is primarily those who must comply or act consistently with the Strategy — that is, environmental water holders, managers and river operators.

Strategic Guidance for effective environmental water management

The planning, delivery and management of water for the environment across the Basin relies on a series of interconnected components, recognition of the different types of water in a managed river system, and the different players involved in complex river management. This section provides strategic guidance for environmental water holders, managers and river operators regarding the necessary components for effective water management to support the environment of the Murray–Darling Basin. This includes the use of held environmental water and the discretionary component of planned environmental water.

This strategic guidance also acknowledges the key differences between the northern and southern Basin. These include differences in climate and rainfall patterns, the ability to regulate and store water, and the management approach to water flow, these differences are outlined in Table 1. The overall water management strategies are implemented in consideration of these differences.

Table 1: Key differences between northern and southern Basin.

	Northern Basin	Southern Basin
Climate, rainfall and flow characteristics	Summer dominated rainfall. Flows are highly dependent on episodic rainfall. Natural variability includes periods where the rivers cease to flow entirely. Many of the rivers and streams are ephemeral. Flat topography and vast wetland complexes.	Winter and spring rainfall and snowmelt. Relatively higher and more regular rainfall. Major rivers rarely experience cease to flow conditions. Higher elevation headwaters transitioning to floodplain forests and wetlands.
River regulation and water storage	Some rivers are unregulated and the capacity to regulate flow using public storages is limited. Public water storages are generally smaller in volume and only exist in some river systems.	Highly regulated rivers with large headwater storages, providing more options to apply mechanisms such as carryover and water trade. Networks of weirs and channels are used to meet a range of water demands across the seasons.
Ability to manage flow and 'call' water	Water supplied on demand from storages is limited to a smaller number of valleys and/or smaller volumes. Management is driven by rules for when water can be taken and individual event-based protections.	Water is supplied on demand from storages and re-regulated inflows.

Flow management in the southern Basin, where there is greater water storage and river regulation, is actively managed through the releasing of water via the operation of water storages and in-stream structures (i.e. dams, locks, and weirs). In the northern Basin, water supplied on demand from storages is limited to a smaller number of valleys and/or smaller volumes. Management in the northern Basin is considered more 'passive', driven largely by rules for when water can be extracted under various circumstances and individual event-based protections. Management in the southern Basin has more scope to access operational tools such as carryover and trade to achieve outcomes. Both active and passive flow management will contribute to the Expected Environmental Outcomes.

Box 1 below introduces the strategic guidance that the MDBA advises for the planning, delivery and management of water for the environment. These strategies should be considered in all elements of planning and management of water across the Basin including water resource planning, environmental water planning and prioritisation, and river operations planning and management (including the delivery of consumptive, environmental and other water). The strategic guidance provided here reflects environmental watering experience gained over the preceding decades. They align with the Basin Plan's *Principles to be applied in environmental watering*.

Box 1: Necessary components of effective environmental water management

Necessary components of effective environmental water management

Environmental watering is to be undertaken in a way that maximises multiple environmental benefits. This is to be achieved by following the strategic guidance set out below. This guidance represents best practice in planning, prioritisation and use of environmental water, and should be incorporated in planning and water delivery by environmental water holders, managers and river operators:

- Adaptively manage environmental water by using an **iterative process to test management approaches** to see which are most effective at achieving desired outcomes.
- Where possible, **manage water in harmony with natural environmental cues** to maximise biological responses and ecological outcomes.
- Deliver water for the environment in a co-ordinated way to **target multiple assets and ecosystem functions** through collaboration between stakeholders.
- Identify and deliver both **annual and multi-year priorities** necessary to achieve outcomes.
- **Understand the relative ecological benefits** of applying environmental water to achieve an expected environmental outcome over another expected environmental outcome.
- **Consider the cost** of environmental watering relative to the expected environmental outcome.
- Prioritise objectives, outcomes and strategies for delivery of water for the environment **based on antecedent conditions and the Resource Availability Scenario.**
- Manage risks around environmental water by **conducting risk assessments** with input from relevant stakeholders including environmental water holders and managers, river operators, land managers, First Nations, community representatives and scientists.
- Manage and coordinate all water to **realise environmental benefits through collaboration** between ecologists, environmental water managers and river operators.
- **Seek to support achievement of First Nations outcomes**, and incorporate First Nations and community knowledge in decisions.
- **Look for opportunities to support social and economic outcomes**, where environmental outcomes are not compromised.

Further detail on each of these components is provided below. In addition, specific theme-based guidance is provided in the following *Expected Environmental Outcomes* section.

Adaptively manage environmental water

Adaptive management is a structured decision-making process that is widely used in environmental management. Environmental water holders should use an iterative process to test management approaches to see which are most effective at achieving outcomes. Adaptive management therefore allows for continual improvement, as management actions can be changed (or adapted) in response to a monitored system response. Effective adaptive management relies on effective monitoring and evaluation of the achieved outcomes, which are then passed back to the next stage of the planning process.

Core to adaptive management is the ongoing process of learning from experiences. There are several recent learnings that have been applied environmental water management over recent years. One of the most prominent examples is the series of trials in the Northern Basin to coordinate unregulated flows, held water and temporary rules restricting pumping. These trials required collaboration across

the Commonwealth and State governments, and they enabled managers to collectively achieve longitudinal connectivity outcomes. These trials helped to demonstrate the importance of protecting the first flush of water after an extended dry period, with this practice now embedded in management approaches.

Manage water in harmony with natural cues

Many ecological responses have strong associations with physical environmental cues (such as fish spawning in response to water temperatures). Provision of the appropriate cues is a key factor in triggering biological responses to achieve an ecological outcome. Where possible, delivery of water for the environment should occur in a way that is considerate of, creates and/or enhances environmental cues. This should be guided by the latest scientific knowledge, including First Nations science and knowledge, and lessons learnt from ongoing adaptive management at a given site (or from other sites, if monitoring is limited). The Enhanced Environmental Water Delivery project (EEWD) aims to improve the ability of environmental water managers and river operators to release water for the environment in conjunction with other flows to improve environmental outcomes in the southern Basin. In the northern Basin, the protection of first flush events allows environmental water holders and river operators to connect thousand kilometres of river channel.

Collaborate to target multi-site and system-scale outcomes

Ecological outcomes can be enhanced when environmental water deliveries occur in a coordinated way across the landscape and across hydrologically connected assets, which can include creating wetland mosaics or maximising longitudinal and lateral connectivity. Delivering water for the environment in a way that targets multiple assets and ecosystem functions relies on successful collaboration between stakeholders through a range of forums and agreements. State Water Resource Plans have a pivotal role as they must enable environmental watering to occur between connected water resources.

Since 2018, coordinated delivery events have occurred in the northern Basin, with different combinations of releases from the Border Rivers, Gwydir, Namoi and Macquarie catchments occurring to provide environmental benefits within the source waterways, as well as connections with (and associated benefits for) the Barwon–Darling (Baawan-Baaka) River. In the southern Basin, the Southern Spring Flow events have coordinated River Murray releases from Hume Dam with inflows from the Goulburn, Murrumbidgee and Baaka (Lower Darling) rivers to achieve environmental outcomes along the full length of the River Murray. Coordination forums such as the Southern Connected Basin Environmental Watering Committee (SCBEWC) and the Northern Basin Environmental Watering Group (NBEWG) assist this system-scale, integrated river management.

Environmental water holders and managers should also consider if a delivery of environmental water could have associated harmful effects upstream or downstream of the intended location of benefits.

Identify and deliver multi-year priorities necessary to achieve outcomes

Environmental water holders and managers should plan for and deliver water for the environment to consider both multi-year and annual priorities relevant to each site. Some environmental outcomes are highly responsive to environmental water deliveries over the short-term. Other outcomes rely on several years of appropriate hydrology to progress long-term outcomes while responding to antecedent conditions and climate forecasts. The monitoring and evaluation programs that support the adaptive management loop (i.e. the iterative process) must also support the multi-year approach by providing consistent and long-term datasets that support trend and intervention-response analysis. Multi-year

priorities are easier to manage in the southern basin, compared to the north, where more reliable flow patterns and larger storages make it possible to plan for and deliver multi-year strategies.

Understand the relative ecological benefits of applying environmental water to achieve an expected environmental outcome over another expected environmental outcome

Although planning for multi-site and system-scale outcomes should be the priority, there will be instances where environmental water managers will need to make a call between 2 watering events. In making this decision, it will be critical to understand the relative ecological benefits of these watering events. Environmental water holders and managers will need to weigh the ecological value of competing environmental assets (for example, whether it is listed under an international treaty, if it is a threatened species), the condition of the environmental asset to be watered, the likely response of the asset to be watered, and its long-term resilience. While the science of ecology has a degree of uncertainty, previous experience and the best available science and knowledge will need to be drawn on to make these decisions.

Consider the cost of environmental watering relative to the expected environmental outcome

Environmental water holders and managers should consider the quantity of water and other resources needed to achieve successful environmental watering. An appreciation of the cost of environmental watering, which can include directs costs (delivery fees) and ancillary costs (resources to monitor the event) will help environmental water holders and managers consider the efficiency of the planned event. Environmental water holders and managers should not forgo environmental watering because of expense, nor undertake a monetary evaluation of the expected environmental outcome, but instead should examine if the expected environmental outcome can be achieved more efficiently.

Prioritise objectives, outcomes and strategies for delivery of water for the environment based on antecedent conditions and the Resource Availability Scenario

Watering decisions require prioritisation under different antecedent conditions (i.e. the conditions prevailing prior to the current condition) and resource availability scenarios (i.e. the likely availability of surface water in the coming year). This allows for appropriate management outcomes to be targeted with environmental water consistent with outcomes defined throughout this strategy.

Table 2 provides guidance on prioritisation to support environmental water planning and management. Environmental water planning and prioritisation should also consider:

- the ecological status, condition and trend of the Basin-significant environmental assets and ecosystem functions
- the degree to which the environmental watering requirements of environmental assets and ecosystem functions have been met in recent years
- any emerging risks to the health of water-dependent ecosystems.

In drier years, there will be increased need for water for the environment across the Basin. In these years there is a heightened need to compare potential risks and benefits of alternative watering options. This includes considering trade-offs between using small amounts of water on drought refuges in different parts of the Basin or providing water to maintain connectivity and/or minimise risks of poor water quality.

Through the implementation of the annual strategies identified in Table 2, environmental water holders support the achievement of the identified management outcomes at a local scale. When aggregated these local actions combine to achieve the management outcomes identified, and subsequently help to achieve the Basin-scale management objectives identified for each Resource Availability Scenario.

Manage risks around environmental water

Potential risks can vary over space and time depending on the type of delivery event. Risks associated with environmental watering need to be identified and managed through the annual planning and delivery phases. Risk assessments should involve input from a range of relevant stakeholders including environmental water holders and managers, river operators, land managers, First Nations, community representatives and scientists. Arrangements for addressing risks to environmental watering should clearly identify the responsible organisation(s) and be adaptive. Evaluating risks post-delivery is important for identifying new risks and assessing the accuracy of past risk ratings and mitigating actions.

Environmental water holders are expected to engage positively with risk and apply the precautionary principle while using best-available information to maximise net environmental water benefit. This should include consideration of one event versus all others that could be achieved with the same volume of water.

While the management of risks is fundamental across the whole Basin, there are some important differences between the northern and southern Basin. In the north, flow patterns are more variable, and there is a stronger need to manage risks associated with critical dry periods (e.g. fish deaths), as well as consider mitigation strategies including the carrying-over of water for the environment.

Manage and coordinate all water to realise environmental benefits

Storage releases in regulated rivers occur for multiple reasons using different 'types' of water, including operational water for consumptive uses, conveyance water, and water for the environment. Each release from storage has the potential to provide environmental benefits. Some releases provide these benefits automatically, while others need to be managed in a specific way if their environmental benefit is to be realised.

In unregulated rivers, particularly in the northern Basin, environmental water holders can activate their water entitlements to leave water for the environment in the river. These decisions should be made in harmony with natural events, planned environmental water and other decisions to make best use of existing unregulated flows such as (for example) temporary event-based mechanisms. Managing flows in this way protects a portion of the flow event from extraction, enhancing the environmental benefits that can be achieved from the scarce (and often highly variable) water resources available for all water users during periods of low to moderate flow.

Collaboration between ecologists, environmental water managers and river operators is essential for such opportunities to be explored, tested and where successful, embedded into contemporary river management.

Seek to support achievement of First Nations outcomes, and incorporate First Nations and community knowledge in decisions

Where possible, environmental water holders should seek to support First Nations cultural outcomes where environmental outcomes can still be met. These objectives for the Southern Basin are covered in

more detail in the Strengthening First Nations involvement in environmental water management section. First Nations in the Murray–Darling Basin have an in-depth connection to and understanding of Country and waters, developed over tens of thousands of years. First Nations science provides valuable lessons into how land and waters across the Basin can be sustainably managed. Landholders, land managers and community members also have detailed and valuable knowledge about their local rivers and wetlands, and the relationship between river flow and environmental response. The success of environmental water delivery relies on knowledge from First Nations and local people being considered together with the latest ecological science. Input to environmental watering can occur through a range of mechanisms, such as environmental water advisory groups.

Look for opportunities to support social and economic outcomes, where environmental outcomes are not compromised

There are many opportunities for environmental water managers to consider complementary social and economic outcomes when planning environmental water delivery. For example, water for the environment that coincides with peak recreation periods can drive increases in local tourism. Adapting water for the environment to improve social and economic outcomes should only be considered if environmental outcomes will not be compromised.

Environmental water managers can consider social and economic outcomes through multiple points in environmental watering cycle. During the planning phase, environmental managers may consider if and how complementary social and economic outcomes could be achieved across water availability scenarios. Planning to provide complementary socio-economic outcomes needs to consider implications on other areas, particularly downstream of the delivery action. In operational delivery, river operators may consider responding to additional opportunities arising during consumptive water delivery and environmental watering events. Holders and managers may document additional socio-economic benefits achieved from environmental watering and consider these during the next planning cycle. These outcomes are intended to be supportive, rather than prescriptive.

Table 2: Resource availability scenarios. management objectives and outcomes, and strategies to achieve them.

Objectives, outcomes, and strategies	Scenario: Very Dry	Scenario: Dry	Scenario: Moderate	Scenario: Wet	Very Wet
Management objectives	Avoid irretrievable loss of, or damage to, environmental assets.	Ensure environmental assets maintain their basic functions and resilience.	Maintain or improve ecological health, condition and resilience of water-dependent ecosystems	Improve ecological health, condition and resilience of water-dependent ecosystems	Improve ecological health, condition and resilience of water-dependent ecosystems
Management outcomes	Critical loss of species, communities, and ecosystems is avoided. Irretrievable damage and catastrophic events are avoided. Vital habitat and critical refuges are maintained, including through supporting base flows.	Loss of native species is avoided. The capacity of threatened species and communities to survive and maintain viable populations is protected. Environmental assets and ecosystem functions are maintained, including by allowing drying to occur consistent with natural wetting–drying cycles. Vital habitat and critical refuges are maintained, including through supporting base flows.	Growth, reproduction and small-scale recruitment for a diverse range of plants and animals. Diversity of species, genetics, and geomorphic characteristics are maintained. Longitudinal connectivity is supported and ecosystem functions related to medium-level flows are maintained. Inundation of in-channel benches and river connectivity with low-lying floodplains and wetlands is supported.	Growth, reproduction and recruitment for a diverse range of plants and animals. Diversity of species, genetics, and geomorphic characteristics are maintained. Longitudinal connectivity is improved and ecosystem functions related to higher-level flows are supported. Lateral connectivity between rivers, wetlands and low-lying floodplains, leading to improved condition of environmental assets and ecosystem functions. Risks from environmental watering, such as hypoxic blackwater events, are mitigated.	Growth, reproduction and large-scale recruitment for most water dependent plants and animals. Diversity of species, genetics, and geomorphic characteristics are increased. Longitudinal connectivity is maximised and ecosystem functions related to higher-level flows are improved. Lateral connectivity between rivers, wetlands and higher floodplains, leading to improved condition of environmental assets and ecosystem functions on a broad scale. Risks from environmental watering, such as hypoxic blackwater events, are mitigated.
Annual strategies to achieve outcomes	Protect small inflows during dry conditions. Protect the first flush of water after an extended dry period. Allow drying to occur but relieve severe unnaturally prolonged dry periods. Manage unnaturally low flows and mitigate water quality issues that are likely to cause irretrievable damage. Prioritise watering for critical refuges for vegetation, fish and waterbirds. Maintain minimum barrage flows to provide refuges and keep fishways open.	Protect small inflows during dry conditions. Protect the first flush of water after an extended dry period. Allow drying to occur consistent with natural wetting–drying cycles. Manage low flow levels to maintain base flows, support hydrological connectivity, and mitigate water quality issues. Prioritise watering: • to maintain water-dependent vegetation condition in refuge sites • for waterbird drought refuges • for native fish drought refuges. Maintain water levels in the Coorong and Lower Lakes above 0.0m AHD.	Protect the first flush of water after an extended dry period. Undertake watering events to promote longitudinal and lateral connectivity to: • support successful recruitment and assist in restoring and maintaining vegetation condition and extent near river wetlands and anabranches • support growth, reproduction and recruitment for waterbirds including by providing foraging opportunities • promote in-stream flows and lateral connectivity for native fish breeding, foraging, growth and movement. Manage water in the Coorong and Lower Lakes, including barrage flows to: • maintain condition of the Coorong • maintain Murray Mouth opening • maintain water above 0.4m AHD • maintain condition of geomorphic characteristics • support movement of diadromous fish.	Build on natural flows and inundation events to optimise longitudinal and lateral connectivity to: • increase passage and dispersal of biotic and abiotic components • promote recruitment and improvement in vegetation condition and extent on low-lying floodplains • promote growth, reproduction and large-scale recruitment for waterbirds, including watering for episodic productivity of larger wetlands • promote growth, movement and recruitment of native fish, and increased distribution. Manage water in the Coorong and Lower Lakes, including barrage flows to: • improve condition of the Coorong and Lower Lakes ecosystems • improve Murray Mouth opening • maintain water above 0.4m AHD • improve condition of geomorphic characteristics • support movement of diadromous fish.	Build on natural flows and inundation events to maximise longitudinal and lateral connectivity to: • increase passage and dispersal of biotic and abiotic components between hydrologically connected valleys • support large-scale recruitment events and improvement in vegetation condition and extent on majority of the floodplain • support growth, reproduction and large-scale recruitment for waterbirds, including watering of larger wetlands • support growth, movement and recruitment of native fish, including increased distribution across the Basin. Manage water in the Coorong and Lower Lakes, including barrage flows to: • maximise condition of the Coorong and Lower Lakes ecosystems • significant flushing of Murray Mouth • improve condition of geomorphic characteristics • maximise movement of diadromous fish.

Expected Environmental Outcomes

The strategic guidance provided above is designed to support environmental water holders, managers and river operators to best achieve the desired environmental objectives of the Basin Plan. These objectives are outlined in the Environmental Watering Plan (*Chapter 8 of the Basin Plan*) — 3 broad environmental objectives are provided for water-dependent ecosystems: (a) *to protect and restore water-dependent ecosystems of the Murray-Darling Basin*; (b) *to protect and restore the ecosystem functions of water-dependent ecosystems*; and (c) *to ensure that water-dependent ecosystems are resilient to climate change and other risks and threats*. The Basin Plan (through Schedule 7) then sets measurable targets to assess progress towards the objectives.

To provide greater specificity, this Strategy describes *Expected Environmental Outcomes* to be achieved by environmental watering across the Basin over the long-term in pursuit of these targets and objectives (see Figure 2: Objectives hierarchy for environmental objectives). Expected Environmental Outcomes have been developed for 4 ecological themes of the river system:

- **River flows and connectivity**
- **Native vegetation**
- **Waterbirds, and**
- **Native fish**.

The 4 themes are chosen as reliable metrics of water-dependent ecosystem health and restoration as they are sound, representative and measurable indicators at the Basin-scale (via both improvement or decline of ecosystem health), they are responsive to environmental watering, and they are a widely valued by communities of the Basin. Figure 1 provides a visual representation of the value of each theme across the wider Basin landscape.

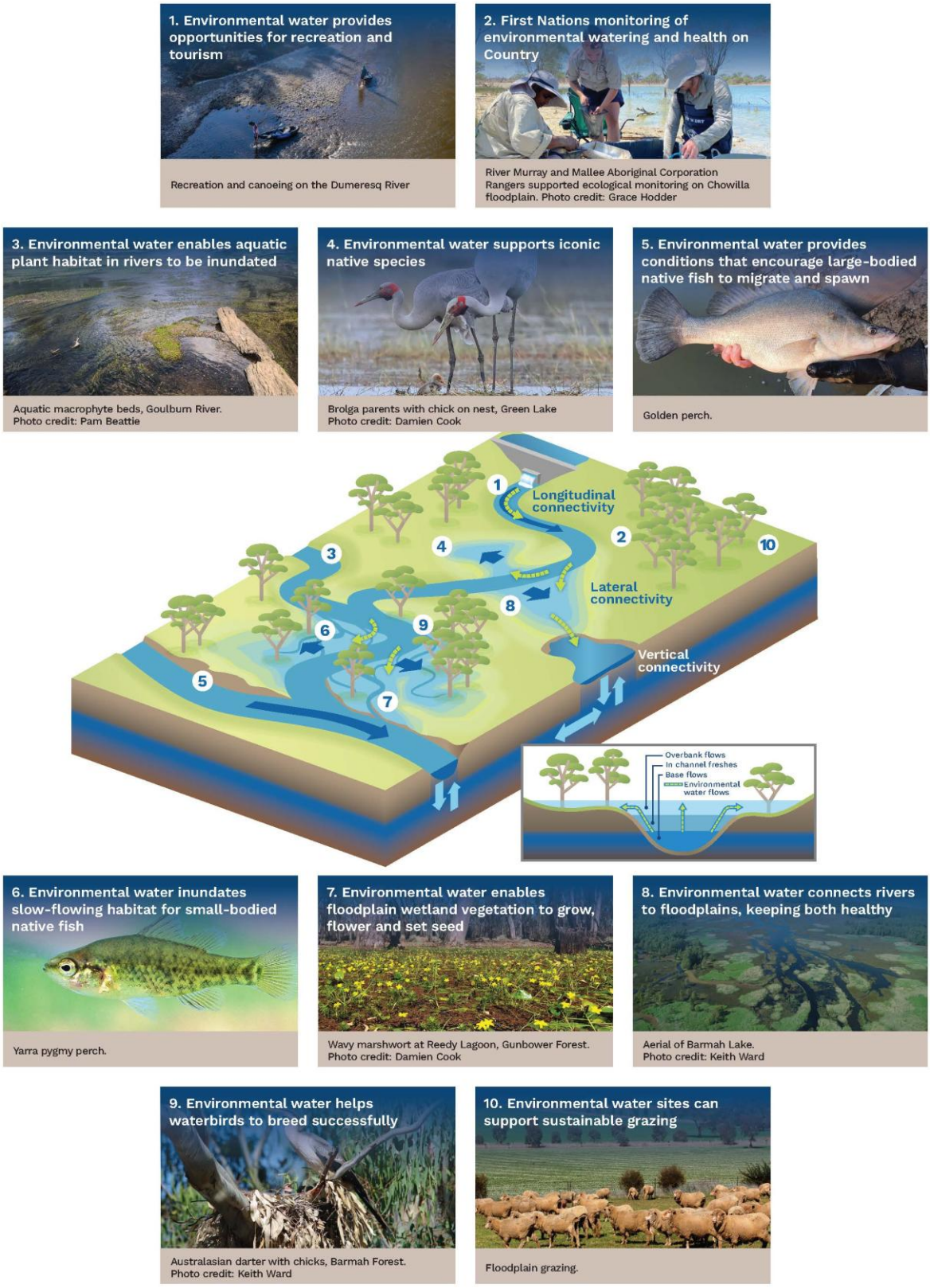

Figure 1: Ecosystem health themes that are responsive to environmental watering.

The Expected Environmental Outcomes described in this Strategy were developed in 2014 based on the best available science and modelling available at that time. They were developed as the best assessment of how the Basin's water-dependent ecosystems were expected to respond to environmental watering and Basin Plan implementation over the proceeding years. They remain a high quality and effective representation of the desired objectives of the Basin Plan.

The Expected Environmental Outcomes were developed to be consistent with SMART principles, that is, they are as Specific, Measurable, Achievable, Relevant, and Time-bound as practicable. Quantified outcomes are a foundation of adaptive management and accountability in the delivery of environmental outcomes under the Basin Plan. They add detail to the qualitative descriptions of key ecological objectives in the Basin Plan and support evaluation of the Basin Plan's effectiveness.

In addition to listing the Expected Environmental Outcomes, this section also provides detailed theme-by-theme guidance to environmental water holders, managers and river operators on how to achieve the outcomes. The specific approaches given here sit under the umbrella of the broader *Strategic Guidance* components provided in the previous section, and are designed to steer the annual environmental water prioritisation process and through this to specific environmental watering event decisions. Environmental water planning and management should be undertaken so that it supports the achievement of the Expected Environmental Outcomes.

To support achievement at the catchment and local scale, environmental water holders are directed to the Appendices of this document which contain significant additional information including the identification of important assets for native vegetation, waterbirds and native fish. The Long-term Watering Plans (or equivalent) for each catchment provide further detailed information on the objectives, targets, functions and assets of importance for environmental water at the catchment scale and also support the achievement of the Expected Environmental Outcomes outlined in this Strategy.

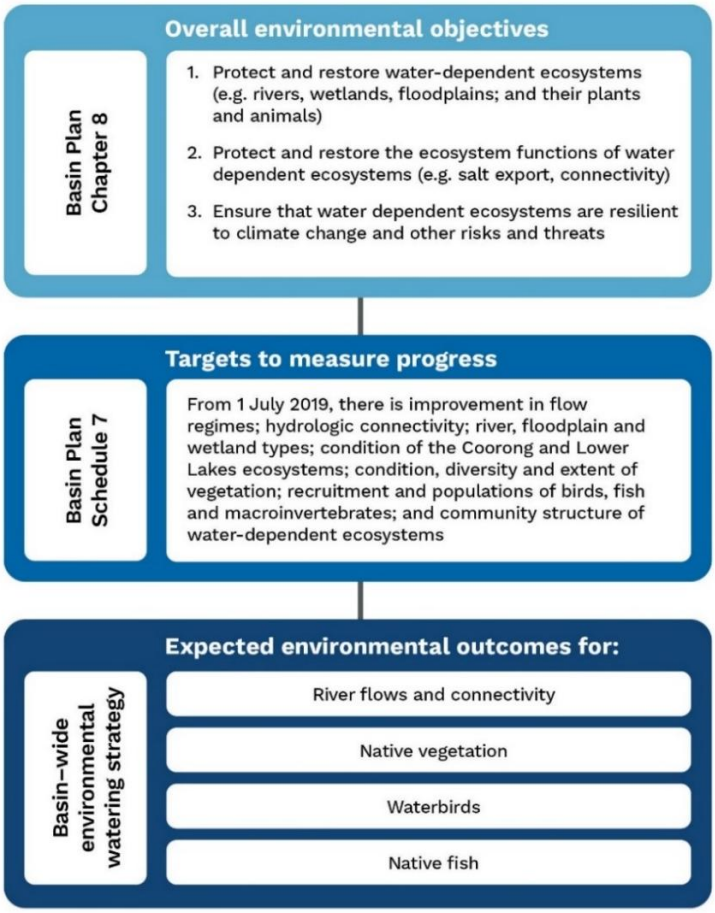

Figure 2: Objectives hierarchy for environmental objectives

Future updates to the Expected Environmental Outcomes

Since the first edition of the Strategy in 2014, there have been major advancements in our understanding across the 4 *Expected Environmental Outcomes* themes, a combined result of the experience gained over the decade through Basin Plan implementation and new insights from the scientific research and data investment over this period. There has been a continuing emphasis on improving our understanding of the northern Basin, particularly the less-regulated systems, and how hydrological processes and ecological processes in the northern Basin differ from the more intensively studied southern and regulated systems of the Basin.

In this time, we have also experienced several extreme events, including historically significant droughts and floods, which have been tied to the emerging impacts of climate change. These experiences have furthered our knowledge and understanding of the hydrological, ecosystem & socio-ecological processes the Basin Plan seeks to maintain and restore.

The MDBA expect that new knowledge will drive a need to revise the Expected Environmental Outcomes and other parts of this Strategy. Rather than initiate this process for this third edition, the Authority have determined that any such revisions should be guided by the broader policy and planning issues under consideration through the 2026 Basin Plan Review and 2027 Water Act Review, which will consider many issues including regulatory refinements (such as *Chapter 8 of the Basin Plan*) and the

longer-term response to climate change. A review of the Expected Environmental Outcomes will take place through the next review of the Basin-wide environmental watering strategy.

Adjusted timing for outcome achievement

In December 2023, the Australian Government introduced the *Water Amendment (Restoring Our Rivers) Act 2023*. The *Restoring Our Rivers* Act made amendments to the Commonwealth *Water Act 2007* and *Basin Plan 2012,* extending Basin Plan timeframes to meet remaining water recovery targets to December 2027.

The Expected Environmental Outcomes described in this Strategy were developed in anticipation of full Basin Plan implementation by December 2024.

Whilst significant progress has been made since the Basin Plan's inception, there are some *time-bound* Expected Environmental Outcomes which will not be met. In line with the *Restoring Our Rivers* amendments, these *time-bound* outcomes have been updated with an extended delivery timeframe of December 2027.

Theme 1 – River flows and connectivity

Changes to the natural patterns of river flows have affected how our rivers connect. Connectivity describes the systematic relationship between flow along and between river channels, across the landscape into wetlands and floodplains, and through the recharge and exchange networks of groundwater systems.

The Expected Environmental Outcomes for the river flows and connectivity theme represent connectivity as an important subset of the ecosystem functions that contribute to healthy water-dependent ecosystems. The use of water for the environment aims to restore ecologically significant components of the flow regime to a more natural pattern, and in turn, generate positive environmental outcomes for native vegetation, waterbirds, native fish and other water-dependent biota.

System-wide connectivity – linking headwaters through the major rivers and into the Lower Lakes, Coorong and Murray Mouth and the Southern Ocean – plays an important role in the Murray–Darling Basin. System-wide connectivity fulfils important environmental functions, such as distributing nutrients, sediments and carbon/energy, allowing organisms to disperse and migrate, expanding the range of feeding and breeding opportunities, supporting genetic diversity and flushing sediment and salt out to sea.

Expected Environmental Outcomes have been established for 3 metrics of river flows and connectivity:

- Longitudinal connectivity
- Lateral connectivity
- End-of-Basin flows

Longitudinal connectivity

Scale	Expected environmental outcomes – Longitudinal connectivity
Basin-wide	**FC1**: To keep base flows at least 60% of the natural level (note: this will be especially important during dry years).
Barwon–Darling tributaries	**FC2**: A 10% overall increase in flows. From increased tributary contributions from the Condamine–Balonne, Border Rivers, Gwydir, Namoi and Macquarie–Castlereagh catchments collectively.
River Murray tributaries	**FC3**: A 30% overall increase in flows. From increased tributary contributions from the Murrumbidgee, Goulburn, Campaspe, Loddon and Lower Darling catchments collectively.
Lower Lakes, Coorong & Murray Mouth	**FC4**: A 30 to 40% increase in flows to the Murray mouth.

Lateral connectivity

Scale	Expected environmental outcomes – Lateral connectivity
Murray, Murrumbidgee, Goulburn–Broken and Condamine–Balonne	**FC5**: A 30 to 60% increase in the frequency of freshes, bank-full and lowland floodplain flows.
Border Rivers, Gwydir, Namoi, Macquarie–Castlereagh, Barwon–Darling, Lachlan, Campaspe, Loddon and Wimmera	**FC6**: A 10 to 20% increase of freshes and bank-full events.
Paroo, Moonie, Nebine, Kiewa, Ovens and Warrego	**FC7**: Current levels of connectivity maintained.

End-of-Basin flows

Scale	Expected environmental outcomes – End-of-Basin flows
Lower Lakes, Coorong & Murray Mouth	**FC8**: The barrage flows are greater than 2,000 GL/yr on a 3-year rolling average basis for 95% of the time, with a two-year minimum of 600 GL at any time.
	FC9: The water levels in the Lower Lakes are maintained above:

Scale	Expected environmental outcomes – End-of-Basin flows
	a) sea level (0m AHD) b) 0.4 metres AHD, for 95% of the time, as far as practicable, to allow for barrage releases
	FC10: Salinity in the Coorong and Lower Lakes remains below critical thresholds for key flora and fauna including: a) salinity in Lake Alexandrina is lower than 1,000 EC 95% of the time and less than 1,500 EC all the time b) salinity in the Coorong's south lagoon is less than 100 grams per litre 95% of the time c) the Murray Mouth is open 90% of the time to an average annual depth of one metre.

Further details on the technical basis, ecological processes and definitions of the river flows and connectivity Expected Environmental Outcomes are provided in the detailed supporting information document.

Water management strategies to achieve outcomes for river flows and connectivity

To achieve the Expected Environmental Outcomes for flow and connectivity, environmental water holders, managers and river operators will need to deliver environmental watering events through a strategic approach to planning and delivery.

Planning and management of environmental water can promote overbank flow, reconnect wetlands and floodplains, reshape the flow hydrograph (such as filling in *troughs*, extending the *tail* of events or increasing flow peaks – where possible), and protect drought refuges to support a range of processes, such as:

- improve and/or reinstate ecosystem functions and provide diverse habitats for feeding, breeding and recruitment
- provide cues for triggering ecological processes
- reduce the frequency and length of artificial dry periods
- minimise the impact of system constraints
- protecting those parts of existing flows that have high ecological significance (e.g. low flows that fill refuge waterholes in ephemeral rivers).

In the southern Basin, environmental water holders, managers and river operators have significant experience supplementing the flow regime of rivers with additional environmental water from dams, generally by reinstating ecologically significant parts of the flow regime.

Managing infrastructure (such as in-stream weirs and floodplain regulators) to control the extent and duration of floodplain inundation to meet ecological requirements is a crucial element and will support the achievement of environmental outcomes. This active management of environmental water delivery to floodplains should be conducted in partnership with landholders as these partnerships are essential to the achievement of outcomes. Infrastructure operation to maintain fishway function, improve

instream hydraulics, and reduce cold water pollution are similarly supported through strong relationships between environmental water holders, asset owners and river operators.

In the northern Basin, the delivery of held environmental water, state-based rules and individual event management has been fundamental to improving flow connectivity, and ecological condition. Managers have learnt that maintaining connectivity during drought, low flow regimes and resumption of flows are all critical.

Protecting natural flow patterns, particularly in unregulated rivers, through management options such as flow embargoes on re-regulation and extraction, one-off arrangements with third parties, or temporary purchases of water allocations can play a significant role, particularly during periods of dry conditions and help to maintain the integrity of flows throughout the length of the river.

Protecting the first flow following cease-to-flow events (also known as the first flush) has been demonstrated to provide ecological benefits. Maintaining connectivity when water is more readily available under more moderate conditions, and mitigating hypoxic events (and subsequent fish kills) following a flood are also important outcomes from improved connectivity flows.

Theme 2 – Native vegetation

The importance of vegetation extends to all rivers, wetlands and floodplains. Diverse native vegetation in and around waterways provides food and habitat for a variety of aquatic and terrestrial wildlife, provides important refuge and habitat corridors and directly influences nutrient and carbon dynamics of river systems and their food webs.

Native vegetation also holds significant cultural value for First Nations people, contributes to local industry and tourism, and is strongly connected to community health and wellbeing.

The Expected Environmental Outcomes for native vegetation are focused on metrics such as extent, condition, age structure, opportunities for growth, and sustained and adequate populations. To maximise benefits to support native vegetation, environmental water management would be expected to target and provide benefit to diverse plant communities (not just dominant species), and would include in-stream and water level fluctuations and variability to promote permanent, seasonal or intermittent inundation from riverine connections, as well as interactions with groundwater.

Expected Environmental Outcomes have been established for 3 structural groups of native vegetation:

- Forest and woodlands
- Shrublands
- Non-woody vegetation

Forest and woodlands

Scale	Expected environmental outcomes – Forest and woodlands
Basin-wide	**V1**: To maintain the extent of forest and woodland vegetation including approximately: a) 360,000 ha of river red gum b) 409,000 ha of black box c) 310,000 ha of coolabah

Scale	Expected environmental outcomes – Forest and woodlands
	V2: Improved age class structure of river red gum, black box and coolabah communities to support viable population demographics.
	V3: No decline in the condition of river red gum, black box and coolabah across the Basin.
Regional	**V4**: Improved condition of river red gum in the Lachlan, Murrumbidgee, Lower Darling, Murray, Goulburn-Broken and Wimmera-Avoca.

Shrublands

Scale	Expected environmental outcomes – Shrublands
Basin-wide	**V5**: To maintain the extent of the large areas of lignum shrublands within the Basin.
	V6: Improvement in the condition of lignum shrublands.

Non-woody vegetation

Scale	Expected environmental outcomes – non-woody vegetation
Basin-wide	**V7**: To maintain the extent of non-woody vegetation.
	V8: Increased periods of growth for communities that closely fringe or occur within the main river corridors.
Regional	**V9**: Increased periods of growth for communities that form extensive stands within wetlands and floodplains including (but not limited to) Moira grassland in Barmah-Millewa Forest; common reed and cumbungi in the Great Cumbung Swamp and Macquarie Marshes; water couch on the floodplains of the Macquarie and Gwydir rivers; and marsh club-rush sedgelands in the Gwydir.
Lower Lakes, Coorong & Murray Mouth	**V10**: A sustained and adequate population of *Ruppia tuberosa* in the south lagoon of the Coorong, including: a) *Ruppia tuberosa* to occur in at least 80% of sites across at least a 43 km extent b) By 2029, the seed bank to be sufficient for the population to be resilient to major disturbances

Further details on the technical basis, regional breakdown of vegetation communities, ecological processes and definitions of the native vegetation Expected Environmental Outcomes are provided in the detailed supporting information document.

Water management strategies to achieve outcomes for native vegetation

To achieve the Expected Environmental Outcomes for native vegetation, environmental water holders, managers and river operators will need to deliver environmental watering events (within the limitations of available environmental water resources) through a strategic approach to planning and delivery that:

- maintain healthy and diverse species and communities
- support native vegetation over the short to long-term
- support native vegetation to protect iconic and threatened species and communities.

Maintain healthy, diverse, and representative species, communities and landscape mosaics

Planning and management should inundate a mosaic of vegetation types to support a diverse range of plants and plant communities. This should include providing flows that create lateral and longitudinal connections between different plant communities, delivering water at seasonally appropriate times, and ensuring that the flow regime adequately supports life-cycle requirements of targeted vegetation.

While acknowledging the water requirements of particular native vegetation, planning and management should allow for water level and soil moisture variability to promote processes typical of wet-dry systems, including shifts in species composition.

In floodplain forests of the southern Basin, water management and planning should consider the frequency of floodplain inundation required to both maintain forests in a healthy condition and manage the load of organic material present. Regular 'flushing' of floodplain forests ensures a balanced input of organic material into the river system, potentially avoiding large-scale, catastrophic hypoxic blackwater events.

Support native vegetation over the short to long-term

Planning and management should provide water regimes that support native plants through each stage of their life cycles. This should include providing flow regimes that promote viable population demographics in perennial species, to ensure germination and establishment through life history stages. For more ephemeral species, the frequency and timing of flow will need to provide adequate opportunities for reproduction and seed set to maintain healthy seed and propagule banks.

These strategies should factor in the range of timescales over which native vegetation responds to environmental watering and the flow regimes required to rebuild health and resilience from a degraded state. This is particularly important in the northern Basin, where relationships between vegetation response and the sources of water from flow, rainfall, groundwater connectivity and overbank flows are complex and are the focus of continuing research.

Providing flows to maintain and improve aquatic plant communities achieves outcomes for vegetation, waterbirds and native fish. Healthy and diverse aquatic plant communities are essential but are easily drowned-out by artificially prolonged high water levels. Flows to maintain aquatic plant communities should allow adequate light penetration.

Protect iconic and threatened species, communities and habitat

Planning and management should incorporate the best available information on the water needs of threatened, or otherwise iconic, species and communities and prioritise them for management where appropriate.

In heavily modified landscapes, efforts should be made to support and restore the remnant native vegetation, such as that in riparian corridors or wetland complexes, that provide critical habitat for threatened fauna species. Native vegetation known to support threatened species should be prioritised for management, where appropriate, to support and rebuild community health and resilience.

Theme 3 – Waterbirds

Waterbirds are a highly diverse and mobile component of the Basin's aquatic ecosystem, with more than 120 waterbird species regularly living in and using the Murray–Darling Basin. Waterbirds can be found in all aquatic environments in the Basin (including natural to artificial, freshwater to saline, and permanent to ephemeral systems) with species each having specific requirements for diet, foraging, roosting and breeding.

Waterbirds perform a range of important ecological functions across the landscape, with river flows and flooding holding a strong relationship with waterbird outcomes, particularly abundance and opportunities to breed. Waterbirds also hold significant cultural value for First Nations people across the Basin as a source of spiritual meaning, connection to storytelling and through their provision of resources.

This value and importance of the Basin's waterbird community is also reflected in Australia's obligations under state, federal and international agreements to protect and manage various waterbird species. This includes the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) and the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Whilst waterbirds can be grouped into functional groups, Expected Environmental Outcomes have been established to be representative for all waterbirds.

Waterbirds

Scale	Expected environmental outcomes
Basin-wide	**B1**: The number and type of waterbird species present in the Basin will not fall below current observations.
	B2: A significant improvement in waterbird populations in the order of 20-25% over the baseline scenario, with increases in all waterbird functional groups.
	B3: Breeding events (the opportunities to breed rather than the magnitude of breeding per se) of group-nesting waterbirds to increase by up to 50% compared to the baseline scenario.
	B4: Breeding abundance (nests and broods) for all of the other functional groups to increase by 30-40% compared to the baseline scenario, especially locations where the Basin Plan improves over-bank flows.
Lower Lakes, Coorong & Murray Mouth	**B5**: At a minimum, maintain populations of the following 4 key species: curlew sandpiper, greenshank, red-necked stint and sharp-tailed sandpiper, at levels recorded between 2000 and 2014.

Further details on the technical basis, ecological processes and definitions of the waterbirds Expected Environmental Outcomes are provided in the detailed supporting information document.

Water management strategies to achieve outcomes for waterbirds

To achieve the Expected Environmental Outcomes for waterbirds, environmental water holders, managers and river operators will need to deliver environmental watering events (within the limitations of available environmental water resources) through a strategic approach to planning and delivery that will:

- Maintain and improve all waterbird habitat
- Support breeding and life cycle completion, especially for group-nesting waterbirds
- Maintain habitat and water levels for migratory shorebirds in the Coorong and Lower Lakes
- Take a Basin-scale approach

Maintain and improve all waterbird habitat

Planning and management should seek to maximise the extent and diversity of aquatic habitat across the landscape to support as many waterbirds as possible to secure population resilience. This includes providing drought refuges and a mosaic of habitats throughout foraging, roosting and breeding. This mosaic includes mudflats, shallow, and deep open water and inundated vegetation (aquatic plants, emergent species, shrubs and trees), and allowing for appropriate water level variability (including drying in temporary habitats) to increase carbon and nutrient cycling and promote aquatic food production to meet different species needs.

The southern Basin's watercourses and (relatively) reliable availability of habitat, including the Lower Lakes and Coorong, are critical to providing waterbird refuge during dry periods.

Support breeding and life cycle completion, especially for group-nesting waterbirds

Planning and management should ensure the timing and duration of habitat inundation adequately aligns with and supports waterbird life-cycle requirements. This includes consideration of the lag times for production of different food resources post filling and seasonality of waterbird occurrence. Managers should prioritise inundation of foraging habitat as close as possible to active group-nesting waterbird sites (compared to foraging areas further away) and focus deliveries on nesting sites with relatively less foraging habitat available (as this is where food demands from congregated birds are highest). There should also be a focus on supporting obligate wetland feeders first, assuming non-obligate wetland feeders will also benefit from the foraging habitat provision.

To maintain breeding habitat for breeding events, managers should inundate at key breeding sites to build up reliable food resources post filling so birds can build body condition prior to breeding. Promoting adequate vegetation growth for supply of nesting materials and improving the condition of nesting substrate is also an important aim. Environmental water management decisions should support breeding events from nest building to post-fledging care by increasing the extent and prolonging the duration of flooding and maintain stable water levels of flooding to limit nest abandonment and incursion by predatory foxes and pigs. Managers must consider each species frequency of breeding required (i.e. maturity age, average lifespan, mortality rates and recruitment rate), to reduce the risk of population crashes.

Maintain habitat and water levels for migratory shorebirds in the Coorong and Lower Lakes

Planning and management should seek to promote productive mudflat habitat to sustain migratory and non-migratory shorebird foraging in the Coorong and Lower Lakes (including managed wetlands along the Lower Lakes shoreline) during November to March each year. Creating water levels in the Coorong

and Lower Lakes for a variety of shorebird species is crucial, with most shorebirds preferring to forage at or near shorelines where mudflats are covered with only a few centimetres of water.

Take a Basin-scale approach

Management of water for the environment should seek to inundate waterbird habitat in line with natural cues such as large rainfall events, where possible, to encourage waterbird breeding. Large-scale breeding and recruitment of waterbirds relies on widespread inundation of key sites in the northern and southern Basin. These events are driven by high rainfall events and natural flooding. Water management and planning should consider supporting and maximising recruitment outcomes of these events when they occur. This needs to consider opportunities to stagger watering of different wetlands over time to maximise productivity and foraging opportunities, including watering opportunities over autumn, winter and spring where possible (particularly for obligate wetland feeding group-nesting species). Managers should consider the proximity of potential watering sites to other surface water in the landscape and, where beneficial, deliver to sites that complement existing inundation to maximise collective foraging habitat within a particular area.

It is important to examine the type of movement strategies and ranges adopted by various waterbird species, including migratory, seasonal and sedentary movement patterns — overall, there should be consideration of the common movement pathways within the Basin for different species and the need for adequate stop-over habitat. This includes migratory shorebirds and mudflat/shallow open water habitat from February to May, as they move northward from the Coorong and Lower Lakes to breeding locations outside Australia. Managers should consider the need to coordinate environmental watering across the Basin to account for waterbird movements including foraging patterns at different life-history stages, seasonal movements and annual migrations.

Theme 4 – Native Fish

Throughout the Murray–Darling Basin, there are 69 species of native freshwater, estuarine and diadromous fish. Native fishes of the Murray–Darling Basin play important roles within their ecosystems across 3 broad geographical regions; the Northern Basin, Southern Basin and Coorong/Estuarine.

Within each of these regions, native species display a range of life history traits that have adapted specific reproductive strategies, movement capabilities and habitat requirements to the historical environmental conditions and flow regimes prior to river regulation and climate change.

Hydrological connectivity and movement between habitats are important for maintaining healthy, genetically diverse native fish populations in the Basin. Seasonally appropriate flows give fish physical access to a range of aquatic habitats and provide cues for spawning and that stimulate movement—a key ecological process for native fish.

Expected Environmental Outcomes have been established for:

- All native fish
- Short-lived native fish species
- Moderate to long-lived native fish species
- Estuarine species
- Distribution of key native fish species

All native fish

Scale	Expected environmental outcomes
Basin-wide	**F1**. No loss of native fish species currently present within the Basin.
	F2. Improved population structure of key fish species through regular recruitment.
	F3. Increased movement of key fish species.
	F4. Expanded distribution of key fish species and populations in the northern and southern Basin.
	F5. Improved community structure of key native fish species.

Short-lived species

Scale	Expected Environmental Outcomes
Basin-wide	**F6**. Restored distribution and abundance to levels recorded pre-2007 (prior to major losses caused by extreme drought). This will require annual or biennial recruitment events depending on the species.

Moderate to long-lived species

Scale	Expected Environmental Outcomes
Basin-wide	**F7**. Improved **population structure** (i.e. a range of size/age classes for all species and stable sex ratios where relevant) in **key sites**. This will require annual recruitment events in at least 8 out of 10 years at 80% of key sites, with at least 4 of these being 'strong' recruitment events.
	F8. A 10–15% increase of mature fish (of legal take size) for recreational target species (Murray cod and golden perch) in key populations.
	F9. Annual detection of species and life stages representative of the whole **fish community** through key fish passages; with an increase in passage of Murray cod, trout cod, golden perch, silver perch, Hyrtl's tandan, congolli, short-headed lamprey and pouched lamprey through key fish passages to be detected in 2019–2027; compared to passage rates detected in 2014–2019.

Estuarine species

Scale	Expected Environmental Outcomes
Lower Lakes, Coorong & Murray Mouth	**F10**. Detection of all estuarine-dependent fish families throughout 2014–2027.
	F11. Maintenance of annual population abundance (Catch Per Unit Effort – CPUE) of key estuarine prey species (sandy sprat and small-mouthed hardyhead) throughout the Coorong.

Scale	Expected Environmental Outcomes
	F12. Detection of a broad spatial distribution of black bream and greenback flounder; with adult black bream and all life stages of greenback flounder present across >50% of the Coorong in 8 out of 10 years.
	F13. Detection in 9 out of 10 years of bi-directional seasonal movements of diadromous species through the barrages and fishways between the Lower Lakes and Coorong.
	F14. Increased rates of native fish passage in 2019–2027 compared to 2014–2019.
	F15. Improved population structure of mulloway, including spawning aggregations at the Murray Mouth in 6 out of 10 years and recruitment in at least 5 out of 10 years.

Distribution of key fish species

Scale	Expected Environmental Outcomes
Northern Basin	**F16**. A doubling of the current (mostly restricted) distributions of key species in the northern Basin. This may be achieved through the use of re-introductions of species into suitable sites.
Southern Basin	**F17**. Significant increases in the distributions of key species in the southern Basin. This may be achieved through the use of re-introductions of species into suitable sites.

Further details on the technical basis, ecological processes and definitions of the native fish Expected Environmental Outcomes are provided in the detailed supporting information document.

Water management strategies to achieve outcomes for native fish

To achieve the Expected Environmental Outcomes for native fish, environmental water holders, managers and river operators will need to deliver environmental watering events through a strategic approach to planning and delivery that:

- Supports the whole fish community
- Supports native fish species to complete their life cycles
- Improves native fish habitat
- Protects and improves existing population of threatened and endangered species

To achieve the outcomes for native fish, water management should consider the spatial and temporal scales appropriate to the targeted species and populations.

For long-lived species, include planning for fish outcomes on a decadal time scale. Plan for decadal flow regimes that provide suitable inter-annual, annual, biennial, and multi-year flow requirements to enable fish to complete their life-cycles. For short-lived species, recruitment needs to occur on an annual or biennial frequency.

Support the whole fish community

Natural flow events, especially those that coincide with naturally high periods of in stream productivity, should be prioritised and protected as these trigger greater responses from native fish compared to water sourced from large dams and storage. In the northern Basin, planning and management should protect the first post-winter flow event which is one of the most biologically significant events for the fish community. Protecting unregulated systems, particularly in the northern Basin, will be important for native fish biodiversity and resilience.

Planning and management of flows that support connectivity, both longitudinal and lateral, will facilitate fish movement. Connectivity to off-stream habitats, fishway operation, periodic drown-out of low-level barriers (e.g. weirs in the northern Basin), and events that provide secondary connection to off-stream habitats will support a range of species and their life-cycle requirements.

Where possible, following natural hydrographs can prevent fish stranding in off-channel habitats, abandonment of nests, and loss of nursery habitats. In highly regulated systems such as those in the southern Basin, water levels should be managed to fall gradually, and avoid large fluctuations over short time periods (e.g. days).

In the northern Basin and ephemeral systems in the southern Basin, identify and protect priority dry period refuges (e.g. waterholes with high persistence levels) for fish in regulated and unregulated systems. Actions such as scouring flows prior to dry periods, maintenance of longitudinal connectivity between refuges, and protecting small inflows during dry conditions can be important for resilience.

Across the Basin, prioritise flows that prevent fish death events, and when they do occur prioritise flows that support population recovery in the years following.

Support native fish species to complete their life-cycles

Coordination is required in the planning and management of water to complete key life-cycle requirements that occur across site and catchment boundaries. This includes delivering environmental water (and/or protecting flows) in line with the seasonality and timing of fish growth, movement, and reproduction. Providing the required flow cues for migration, aggregation and spawning will support native fish in life cycle completion.

In the regulated systems of the southern Basin,

- Provide spring-summer pulse(s) to stimulate food production for fish, breeding cues, and movement opportunities.
- Reinstate in-channel winter flows in systems where flows are significantly reduced during winter to improve larval and juvenile survival.
- Reinstate in-channel flow variation, particularly in habitats with unnaturally stable water levels.
- Provide flows to create faster-flowing habitats e.g. >0.2m/sec in the lower Murray in spring & early summer to support Golden perch and Murray cod recruitment.
- Provide flows that enable winter migrations through the Coorong barrages and fishways.

In the northern Basin, include consideration of spawning and recruitment requirements for flow-cued spawning species that recruit over large spatial scales and over multiple flow events. Flows need to provide cues for migration and aggregation, as well as for spawning.

Improve native fish habitat

When planning and managing flows, consideration should be given to the suitability of flows in providing fish habitat in addition to the physical habitat requirements native fish need. This includes managing water quality risks to vulnerable populations and species. Cold water temperatures for example can limit reproduction and growth of native fish and should be mitigated where possible. Flows may also be needed to prevent extreme hypoxic blackwater events or to reduce their frequency, intensity and duration.

Faster-flowing habitats with instream habitat structure are particularly important to achieve outcomes for Murray cod, trout cod, Macquarie perch, golden perch and silver perch. In southern Basin systems, planning and management should protect and restore hydrodynamic diversity through innovative delivery of all water. Provide flows to create faster-flowing habitats e.g. >0.2m/sec in the lower Murray in spring and early summer to support Golden perch and Murray cod recruitment.

In the Coorong estuary, maintaining a salinity gradient whilst ensuring the spatial extent of the gradient varies year-to-year will support recruitment of key estuarine species Black bream and Greenback flounder.

Protect and improve existing population of threatened and endangered species

To support known populations of threatened species, establish new populations, and encourage range expansions, managers should provide appropriate flow regimes that:

- Prevent the loss of existing populations of threatened species.
- Maintain reintroduction sites that support establishment of new populations of threatened species.
- Allow range expansions of threatened species from reintroduction sites.
- Be coordinated across site and catchment boundaries so that flows that support recovery of threatened species that complete life cycles over large distances are delivered.

Risks to achieving expected environmental outcomes

Achievement of the Expected Environmental Outcomes will rely upon a range of flow and non-flow related risks and threats being adequately managed.

While there is uncertainty in how, where and when climate change will impact rainfall and runoff, there is consensus that the Basin and its rivers will be challenged by a changing and more variable climate. The future climate of the Murray–Darling Basin will be hotter and is likely to be drier and more variable. The most likely scenario is stronger flood-drought oscillations against a background trend of overall drying and an underlying trend of declining water availability in the long-term.

Extreme and unpredictable weather events are expected to influence river flows, floodplain and wetland inundation and our collective ability to achieve the Expected Environmental Outcomes. New and transformative approaches to Basin water management will be required.

Significant efforts are underway across the Basin to best understand and improve our knowledge on the future impacts of climate change to the river systems and water dependent ecosystems. Basin States have worked with research agencies for many years to understand the potential range of climate change

impacts at the local and catchment level. For the MDBA, the potential climate change impacts and possible responses will be examined and explored through the Basin Plan Review. Further knowledge developed through this review will be reflected in future revisions of this Strategy.

The degree to which the Strategy's expected environmental outcomes can be achieved is also highly dependent upon constraints throughout the system. Constraints are river management practices that govern the volume and timing of regulated water delivery through the river system. These constraints — the result of years of river regulation and regional development — limit the delivery of overbank flow events and water for the environment reaching the floodplain. Yet native flora and fauna rely on floodplain inundation, and ecosystem processes (and more generally a healthy and working river system) depend on the exchange of material between the rivers and low-lying wetlands. Ongoing efforts to relax constraints across the Basin will ensure that the benefits of water for the environment are maximised.

Consideration must also be given to the unintended impacts that result from the delivery of overbank flow. Unintended impacts of system inundation and flooding are poor water quality (e.g. hypoxic blackwater events), erosion and algal blooms. Rapid declines in water quality directly impact aquatic biota (most notably through significant events such as fish deaths) as well as the availability of water for stock and domestic use, irrigation or recreation. The ability to respond to such events is likely to be further impacted by climate change. Changes to rainfall patterns and air temperature, in conjunction with water resource availability, will likely influence water quality throughout the system (upstream and downstream). These risks will require increasingly careful consideration and management throughout the planning and delivery phases to minimise the likelihood of unintended outcomes.

Non-flow related threats may also inhibit achievement of Expected Environmental Outcomes. There are a range of non-flow related threats that impact ecosystem response regardless of environmental watering and hydrological improvements. These non-flow threats include:

- **Interference of pest and invasive species**: Alien fish species (particularly carp with their extensive population, but can include redfin, gambusia and oriental weatherloach) pose a number of risks to native fish. Carp can also be responsible for destroying aquatic plants and increasing turbidity. Other feral species (foxes, cats, pigs, horses, goats) predate on waterbirds and their eggs, or reduce vegetation condition and recruitment through grazing and trampling. Weeds compete with native vegetation impacting on native diversity and condition.
- **Habitat loss and anthropogenic impacts**: Land clearing and cropping on cleared areas impacts remnant vegetation by physically isolating individuals and populations and exposing adjacent vegetation to spray drift. Agricultural expansion can impact water quality and habitat availability, causing impacts on all native biota. Erosion and damage to riverbanks and their vegetation can also occur when transferring water at high volumes to meet downstream demands. Illegal fishing and hunting are also threats to fish and waterbird populations.
- **International impacts**: habitat destruction and pollution including the loss of key stopover sites on international flyaway and routes (e.g. Yellow Sea) pose large risks to migratory shorebirds. Diseases (such as avian influenza) also pose a risk to waterbird populations.

Despite positive intentions, the delivery of environmental water may not always lead to ecosystem-wide outcomes. Threats can impact and reduce the amount and quality of available habitat, promote

increased predation of and competition with native species, lead to water quality issues or ultimately affect the abundance and condition of native flora and fauna at the asset and Basin-scale.

The implementation of non-flow related management options (such as fishways, species recovery through conservation stocking or operational changes) can minimise these impacts and enhance the outcomes achieved from delivering water for the environment. The role of non-flow related management options across the Basin is being further examined and explored through the Basin Plan Review. Further knowledge on their implementation across the Basin developed through this review will be reflected in future revisions of this Strategy.

To ensure the outcomes of environment water are maximised, careful consideration to management approaches is required. Arrangements for addressing threats and risks to environmental watering should be adaptive, collaborative and based on robust analysis of the risk, the causal factors contributing to the risk and the consequence to the environment and water users.

Strengthening First Nations involvement in environmental water management

First Nations people of the Murray–Darling Basin have an intricate and enduring connection to land and water. They are the original custodians of the Basin, where the lands, waters and biodiversity provide resources that sustained life and underpinned trade and commerce. The health and wellbeing of First Nations people is intrinsically linked to the health of Country.

Caring for Country is fundamental to the spirituality and lore of First Nations people, who over thousands of generations have inherent rights, responsibilities and interests to manage land and water. The purpose of this section is to strengthen involvement of First Nations in the planning and management of water for the environment in the Murray–Darling Basin.

This section was informed by work, prepared under commission, by the Murray Lower-Darling Rivers Indigenous Nations (MLDRIN). This collaborative work covers First Nations' voices – truth telling and action; strengthening First Nations' involvement and agency in environmental water planning; First Nations' shared objectives for water for the environment; and implementation, evaluation and monitoring.

The MDBA has prepared this section to talk to some of the aspirations and objectives of First Nations in relation to environmental water, but it is acknowledged that this is based on input from a select number of Basin First Nations. Additional First Nations input is needed from across the Murray–Darling Basin and remains an ongoing endeavour.

The MDBA is committed to strengthening the involvement and agency of First Nations in environmental water planning. The MDBA acknowledges that future updates of the Strategy will require further connection and collaboration with First Nations people and greater inclusion of First Nations input. This includes the need for further consultation with groups that were not involved in the development of this section.

First Nations' voices must be heard

Water is the lifeblood of Country, flowing from snowmelt in the mountains to reach floodplains, forests and ultimately the Southern Ocean. First Nations people have an inherent obligation to care for the rivers and waterways on Country, and for thousands of generations they have nurtured the health of rivers and waterways through sensitive management informed by a sophisticated body of knowledge. This stewardship sustains rivers not just as ecological systems but as ancestral entities, alive with water spirits, a rich diversity of plants and animals, and abundant food resources.

The colonisation of Australia, and the development of the Murray–Darling Basin for towns and industry, have impacted First Nations people and culture. Changes to river flow has impaired the condition of water-dependent ecosystems and this has in turn eroded the wellbeing of First Nations people and their

spiritual connection to the landscape. The abundance of, and access to, traditional foods, fibres and medicines has declined, placing connection to culture and cultural economies at risk.

First Nations have observed this decline in the health of water-dependent ecosystems. First Nations people can provide insights that enhance understanding of complex systems and inform the approach to land and water management across the Basin.

First Nations have undertaken assessments of waterway condition and cultural health applying on-Country knowledge systems. These assessments have revealed that waterways are in poor condition in many parts of the Basin, with harmful water quality common, stress on river systems high, and the extinction of totemic species likely. Delivery of water to culturally significant waterways and wetlands can increase the abundance of native animals important to First Nations and assist with the recovery of threatened species. The provision of water for the environment can restore connectivity in drying rivers, improving water quality and allowing for the movement of native fish between water holes.

Strengthening First Nations involvement in water for the environment

While water for the environment cannot return rivers to their pre-colonisation state, First Nations people have a significant role to play in improving health of water-dependent ecosystems and addressing some of the harm caused.

A shared understanding can help to strengthen the involvement and agency of First Nations in environmental water planning and delivery – for this purpose, outcomes have been identified to guide and support all Basin governments and water management agencies to deliver best-practice planning and decision-making of environmental water.

The outcomes to be achieved by strengthening involvement and agency of First Nations in environmental water planning are:

- First Nations have their rights and cultural obligations recognised and considered, through increased inclusion, decision making and action for the use of water for the environment on their Country.
- Improved outcomes for Country and First Nations, which may include benefits in environmental, cultural and socio-economic values.
- Improved connection of First Nations to their Country and waters and to progress towards healthier Country and healthier people; through collaborative projects and programs.
- First Nations contribute to the achievement, monitoring and reporting of Expected Environmental Outcomes identified in this Strategy.
- First Nations aspirations are considered as part of long-term adaptive management of environmental water at Ramsar sites.
- Water managers work to increase their understanding of First Nations goals and objectives; and strengthen their relationships with First Nations people.
- The number of formal partnerships and other agreements for shared decision making between environmental water holders and First Nations' organisations is increased over the life of the Strategy.

When water for the environment is planned, delivered and monitored in collaboration with First Nations, and the knowledge and insights of First Nations people are brought into the management of Basin waterways, the water-dependent ecosystems of the Basin can be improved and put on a more sustainable footing for generations to come.

First Nations shared objectives for water for the environment

There are often synergies between what environmental water holders want to achieve and what First Nations people would like to see happening across the landscape as part of caring for and healing Country.

Southern Basin First Nations engaged with for this Strategy update have identified shared objectives for water for the environment that are relevant across the scale of the Basin, including many unique and varied waterways (Table 3). These shared objectives reflect the interconnected nature of Basin waterways, cultural values and biodiversity.

When planning, delivering and evaluating outcomes from water for the environment, environmental water holders and managers should seek to advance these objectives, alongside the detailed, locally specific watering objectives produced by First Nations Communities. The first step will be for Basin states to consult with First Nations when reviewing and updating their long-term watering plans – further details on how environmental water holders and managers should incorporate First Nations can be found later in this document under Delivering the Strategy.

Table 3: Southern Basin First Nations shared objectives for environmental water.

Objective	Links to	Guidance
Ensure Nations can fulfill their responsibilities to downstream and upstream neighbors	All EEOs	Healthy water flowing out of Country to mobs downstream, replenishing Country so everyone can be healthy and thrive. Consider upstream Nations when using water and support outcomes that benefit upstream Nations. Vegetation (grasses, sedges, rushes) filters water as it passes through Country.
Restore proper flows across all waterways		Restore flow components, volumes, timing and duration to a more 'natural' regime that sustains cultural values. Address flow variation from irrigation demand, extraction, and diversion. Proper timing of environmental flows to match seasonal cues, including breeding. Reinstate overbank flows to support total system health. Support adequate base flows. Support end of system flows and salt transport.
Maintain and enhance connectivity across all waterways	Flows and Connectivity EEOs	Connected flows bringing water out to fill creeks, lakes, wetlands, and billabongs. Water flowing out and nourishing dry and neglected parts of Country. Restore flows in degraded rivers and support connected rivers from snowmelt to sea.

Objective	Links to	Guidance
Consider groundwater values and connectivity	Flows and Connectivity EEOs	Consider the cultural significance of groundwater. Maintain, protect, and restore surface water/groundwater connections.
Maintain and enhance important physical features of waterways		Minimise erosion and use water for the environment to help stabilise riverbanks and lake edges. Address sediment and sand build-up that impacts on flows and culturally significant species, sites and uses. Support cultural infrastructure, fish traps and breeding structures, to allow flows to recharge the landscape.
Protect and restore water quality Protecting and restoring flows and habitat for culturally significant fish species.	Flows and Connectivity EEOs/ Native fish EEOs	Prevent hypoxic blackwater, blue-green algae and high salinity events by providing suitable flow regimes (this includes regular 'flushing' of floodplains to move food sources to the river and prevent build-up of organic material). Minimise the impact of hypoxic blackwater, blue-green algae and high salinity events when they occur. Contribute to mitigating the impact of cold water released from dams on native fish and other aquatic life. Protect culturally significant food fish species, small-bodied fish, crayfish, yabbies, shrimp and freshwater mussels.
Protecting and enhancing the extent and condition of culturally significant plant species	Native vegetation EEOs	Including, amongst others: River red gum (especially mature and culturally modified trees), black box and yellow box (especially mature and culturally modified trees). Medicinal plants, fibre and weaving plants and food plants.

Objective	Links to	Guidance
Protecting and restoring habitat and flows for culturally significant bird and animal species, including totemic species	Waterbird EEOs	Birds and waterbirds, aquatic mammals, reptiles and amphibians and significant terrestrial species.
Safeguard culture and cultural heritage	Native vegetation and Flows and Connectivity EEOs	Protect and enhance Cultural heritage features, including amongst others: scar trees, culturally modified/significant trees, middens, burial sites and earth ovens. Protect and enhance significant cultural places and landscapes. Strengthen cultural practices, lore and wellbeing by sustaining the health of Country.

Delivering the Strategy

This Strategy ensures that there is a consistent Basin-wide approach to the planning and delivery of water for the environment, and that the approach evolves as challenges are solved and opportunities are taken. The success of the Strategy depends not just on the work that the MDBA does in preparing and publishing it, but on the adoption by environmental water holders and managers of the guidance and recommendations therein.

Management of water for the environment within the Basin is a shared responsibility between the MDBA, the CEWH, the Basin states, river operators, and environmental water holders and managers. To ensure that adoption is seamless, this section sets out how the MDBA expects the parties involved to implement this Strategy, covering the planning and delivery of water for the environment, and the monitoring, evaluation and reporting of environmental outcomes.

All Basin governments and water management agencies should also ensure First Nations have their rights and cultural obligations recognised and considered in environmental water planning and management.

The instructions below provide further specification to individual roles and responsibilities held by the MDBA, Basins states, CEWH, and environmental water holders.

As this is the third edition of the Strategy, much of the detail below is already in place.

Role of the MDBA

For the MDBA, the Strategy can be used (amongst other things) to identify priority environmental assets, provide guidance about how water should be integrated with broader natural resource management, and make recommendations relating to what constitutes best practice in planning, prioritisation and use of environmental water.

The MDBA must use Basin annual environmental watering priorities to give effect to the Strategy. The MDBA must report on the achievement of environmental outcomes at a Basin-scale.

As the river operator for the River Murray system (on behalf of all Basin governments), the MDBA also has a role in the management and delivery of water for the environment in the southern Basin (see below for further information for all river operators).

Planning of water for the environment

The MDBA uses the Strategy to set the Basin annual environment watering priorities. Priorities are set for each of the 4 themes – flows and connectivity, native vegetation, waterbirds and native fish – and constitute annual steps needed to achieve the expected environmental outcomes.

The MDBA will ensure that the priorities are developed to have First Nations as active participants in the development of the Basin annual environmental watering priorities to incorporate the First Nations watering outcomes identified in *Strengthening First Nations involvement in environmental water management*. Broader First Nations input will substantially strengthen the development of outcomes for the next edition of the Strategy.

The MDBA will support the coordination of environmental water planning and delivery across catchment boundaries, including through the Northern Basin Environmental Watering Group and the Southern Connected Basin Environmental Watering Committee. The MDBA will also work with the CEWH and Basin states to identify where water for the environment can benefit complementary social and economic outcomes at priority environmental assets.

Monitoring, Evaluation and Reporting

MDBA must report on the achievement of environmental outcomes at a Basin-scale, with reference to the targets in Schedule 7 of the Basin Plan. The Strategy builds on some of these targets in the form of expected environmental outcomes, which follow, to the extent possible, the principles of SMART. This means that the expected environmental outcomes are Specific, Measurable, Achievable, Relevant and Timebound. The expected environmental outcomes are thus the most useful measure of the Basin Plan effectiveness in protecting and restoring the water-dependent ecosystems of the Basin. The MDBA uses these expected environmental outcomes to evaluate the achievement of environmental outcomes at the Basin-scale, along with the targets, as necessary. This occurs in the context of any Basin Plan evaluations or in making periodic assessments of Basin condition.

The MDBA will seek to continuously improve how we monitor and evaluate environmental flow planning and delivery in support of the First Nations outcomes and objectives identified in this Strategy.

Role of the Basin states

The Basin-wide environmental watering strategy is an important guidance document for the Basin states. The Basin states must have regard to the Basin-wide environmental watering strategy when preparing long-term watering plans. In cases where particular environmental assets or ecosystem functions are identified by the Strategy, long-term watering plans must be consistent with that particular asset or function.

A Basin state must update its long-term watering plan when the Authority publishes an updated Basin-wide environmental watering strategy that includes updates which materially affect the long-term watering plan.

Planning and delivery of water for the environment

Long-term watering plans are in place for all the catchments of the Murray–Darling Basin and these plans have adopted the approach used in the Strategy.

This update of the Strategy includes content that may materially affect long-term watering plans, including the shifting of the date for expected environmental outcomes to 2027, the inclusion of First Nations outcomes, and the recommendation to further consider complementary social and economic outcomes when delivering water for the environment. With publication of the updated Strategy, the Basin states will need to review and update their long-term watering plan accordingly.

Updates to long-term watering plans are to be submitted to the Authority 3 months after this Strategy has been published or at an alternative time agreed to by the Authority.

Environmental water holders and managers will need to work collaboratively with First Nations to increase opportunities for involvement in environmental water management and use on Country, including in developing annual priorities. Regional, site based, and/or asset scale plans are substantially strengthened by the inclusion of self-determined First Nations input to determine their preferences for identification and inclusion of key assets, key ecosystem functions, objectives and targets, and watering requirements.

This work should focus on the southern Basin, where the principles and actions identified in *Strengthening First Nations involvement in environmental water management* must be given regard to in environmental water planning. This will allow further time for the MDBA to engage with northern Basins and identify shared objectives for environmental water. Where environmental water holders and managers are already working with northern First Nations, the MDBA encourages this work to continue. The actions and outcomes may be informative for working with northern First Nations.

Monitoring, Evaluation and Reporting

As part of their annual reporting obligations, the Basin states may prepare case studies that demonstrate how the Environmental Watering Plan has influenced environmental water outcomes. The MDBA recommends these case studies focus on how the new aspects of the Strategy are being adopted by the Basin states.

Role of the Commonwealth Environmental Water Holder

The CEWH must perform its functions and exercise its powers in a way that is consistent with the Strategy. The MDBA notes that the CEWH's approach to the management of water for the environment has other statutory obligations.

Planning and delivery of water for the environment

The expected environmental outcomes in this strategy are already incorporated into the CEWH's planning and delivery of water for the environment. These expected environmental outcomes should continue to be a focus for the CEWH, alongside the broader objectives and targets of the Basin Plan.

The CEWH are already committed to working with First Nations people in the planning, delivery and monitoring of water for the environment, with initiatives including the appointment of cultural advisors. The First Nations section in this Strategy now provides a common set of outcomes to guide CEWH planning, decision making and delivery of water for the environment.

The CEWH must use its water to achieve environmental objectives, including such things as connecting rivers to their floodplains and helping native animals to feed and breed. However, where opportunities arise, the CEWH should now also consider how complementary social and economic outcomes could benefit from the use of water for the environment.

It is suggested that the CEWH's 'Environmental Water Outcomes Framework' and 'A Framework for Determining Commonwealth Environmental Water Use' be reviewed for consistency with the Strategy and to incorporate any additional steps in decision-making processes.

Monitoring, Evaluation and Research

The CEWH's monitoring, evaluation and research program aligns broadly with the expected environmental outcomes. This program should be strengthened and will need to take into consideration the First Nations outcomes that are listed in this Strategy.

Role of river operators

River operators play a vital role in managing water for the environment, as they make decisions such as how much water should be released, and when to release it so that it gets to the right places on time. They are often in a unique position to assess potential synergies and conflicting demands across the river systems they manage more easily than environmental water holders and managers.

River operators must take care to avoid harmful flow regimes wherever possible as these can undo previous ecological outcomes achieved through the use of water for the environment. For example operational decisions that lead to prolonged high flows may drown out vegetation, or disrupt natural breeding activities for native fish.

Planning and delivery of water for the environment

River operators should continue to participate and assist environmental water holders and managers to plan and deliver flows conducive to expected environmental outcomes. Participation in advisory groups will be essential, and operational guidance documents may need to be updated.

Where system constraints are relaxed in the coming years, there may be a further need to increase the sophistication of delivery, and a step change in management will be required.

Monitoring, Evaluation and Research

As part of ongoing business improvements, river operators are expected to evaluate and review delivery processes and decision making including their role in the delivery of environmental water.

Other environmental water holders and managers

Most water for the environment is managed by the Commonwealth and the Basin states, through water management agencies and independent water holders. However, there are other, smaller holders of water for the environment, such as Environmental Water Trusts, who have made significant contributions to environmental outcomes.

As noted, this Strategy guides and recommends certain approaches to the management of water for the environment across the Basin. The MDBA encourages all environmental water holders and managers more broadly to adopt these approaches when making decisions about water for the environment.

Basin annual environmental watering priorities

The Basin annual environmental watering priorities (the priorities) are the annual expression of this Strategy. The priorities provide guidance to water holders and managers on the priorities for the upcoming year from a whole-of-Basin perspective.

The priorities identify outcomes over multiple years (rolling priorities) at numerous environmental assets. Instead of working from one type of resource availability scenario (for example, dry conditions), the priorities describe watering actions under different resource availability scenarios. This provides flexibility to respond to changes in resource availability and latitude for environmental water holders and managers to determine how best to achieve outcomes using their on-ground expertise and operational experience.

The MDBA applies the method to determine priorities for applying environmental water, as set out in the Environmental Watering Plan (Part 6, Division 2). This is done in the context of the 4 themes of river flows and connectivity, native vegetation, waterbirds and native fish and the Expected Environmental Outcomes that are to be achieved.

This method has 4 steps:

1) determine the resource availability scenario
2) determine the management outcomes that apply to the resource availability scenario
3) determine the provisional priorities for applying water for the environment
4) define the determined priorities based on seasonal, operational and management considerations.

Step 1: Determine the resource availability scenario

Seasonal conditions are a major influence on the objectives sought from water for the environment. The MDBA assesses the likely seasonal conditions for the upcoming water year by determining the Resource Availability Scenario (RAS) in each Basin catchment as either Very Dry, Dry, Moderate, Wet or Very Wet.

The RAS is calculated using the past year's climate conditions (rainfall, runoff and soil moisture) and current surface water availability in public water storages in regulated catchments.

The perspectives of environmental water holders and managers and the Bureau of Meteorology's climate outlook and longer-term forecasts are also considered.

Step 2: Determine the management outcomes

Once the RAS is identified, the MDBA identifies appropriate management outcomes to be targeted with environmental water (consistent with outcomes defined throughout this strategy). The management outcomes are expressed to provide flexibility if seasonal conditions are different to what was expected.

Particular attention is paid to outcomes that need coordination across state borders, as these cannot be addressed by Basin States acting alone.

Step 3: Determine the provisional priorities

Once the RAS is known, a desktop review of environmental information is conducted for each of the environmental themes: flows and connectivity, native vegetation, waterbirds and native fish.

This desktop review collates and assesses:

- the ecological status, condition and trend of each ecological theme, and of the Basin-significant environmental assets and ecosystem functions relevant to the theme, so as to understand progress towards the Expected Environmental Outcomes
- the degree to which the environmental watering requirements of environmental assets and ecosystem functions has been met, especially those of Basin-significance, so that areas of watering deficiency can be identified
- the environmental outcomes that were achieved in the previous watering year or years, so that Murray–Darling Basin Authority can assess whether additional watering is required to consolidate these outcomes, and
- any emerging risks to the health of water-dependent ecosystems, such as poor quality that may lead to fish kills, or evidence of environmental decline at Basin-significant environmental assets, so that these risks can be highlighted and addressed in watering decisions.

This desktop review must apply the 7 principles of Part 6, Division 1 of the Environmental Watering Plan with a focus on environmental condition, environmental watering need and management of emerging risks. The 7 principles to be applied to determine the priorities for applying environmental water are:

1. consistency with the principles of ecologically sustainable development and international agreements
2. consistency with Environmental Watering Plan objectives
3. flexibility and responsiveness
4. condition of environmental assets and ecosystem functions
5. likely effectiveness and related matters
6. risks and related matters, and
7. robust and transparent decisions.

While the desktop assessment largely focuses on information relevant to the Expected Environmental Outcomes, First Nations environmental water planning and delivery outcomes will become a greater focus as this Strategy is implemented.

Further information on the desktop review can be found in the supporting information document.

Step 4: Define Priorities based on seasonal, operational and management considerations

Consultation with environmental water holders and managers is essential for effective prioritisation. The MDBA shares a draft of the Basin annual environmental watering priorities with the Basin states and the CEWH, and uses the feedback received to improve the accuracy and impact of the final report.

Consultation and feedback are used to refine the priorities based on seasonal, operational and management considerations.

Basin States submit annual environmental watering priorities to the MDBA at the end of May. In considering these state annual environmental watering priorities, the MDBA reviews the alignment between state-scale and Basin-scale priorities to ensure consistency and that relevant management outcomes have not been overlooked.

Where Basin states have identified a previously unidentified environmental watering action or outcome of Basin-scale significance, the MDBA will assess and may choose to adopt this as part of the Basin annual environmental watering priorities.

In drier years, there will be increased competition for where water for the environment can be used in the Basin. While all steps outlined above are still appropriate, in these years there will be a heightened need to compare potential risks and benefits of alternative watering options. This includes considering trade-offs between using small amounts of water on drought refuges in different parts of the Basin or providing water to ensure connection to the Coorong and the sea.

The management objectives for delivery of water for the environment in these years range from 'avoiding irretrievable loss of or damage to environmental assets' through to maintaining basic functioning, where possible. Areas of high risk of fish deaths and other risks (e.g. blue-green algae and low water quality) should have early warning systems and emergency response plans in place, including risk assessments in controlling stratification in high-risk weir pools.

The Murray–Darling Basin Authority's priorities provide guidance—the ultimate decision on use rests with the environmental water holders.

Future work

Future review and updating of the Strategy

Based on the legislative timeframes within the Basin Plan, the next review and update of the Strategy must be completed no later than 5 years after this Strategy is published. This means that the scope of the next review and update will be dependent on many of the findings and outcomes of the 2026 Basin Plan Review.

The Basin Plan Review is expected to cover several themes that have the potential to update and adapt water management in the Basin, such as climate change, First Nations science and knowledge, management of the northern Basin, and the regulatory design of the Basin Plan. These will intersect strongly with environmental water management and therefore the next revision of the Strategy.

Future review and changes to the Strategy may include:

- greater inclusion of First Nations objectives and outcomes related to the provision of water for the environment and involvement in environmental water decision making
- inclusion of Northern Basin First Nations outcomes
- further emphasis on the impacts of, and adaptations to, climate change
- improvement and refinement of the Expected Environmental Outcomes and environmental water management strategies, including assessment of their achievability under various climate scenarios
- further exploration of risks, constraints and threats to achievement of outcomes, and the role that non-flow related management options can play in supporting of water for the environment
- assessment on the suitability of current monitoring and evaluation programs to evaluate the outcomes
- greater recognition of the benefits of environmental outcomes to Basin communities and for all Australians.

Knowledge will continue to evolve as lessons are drawn from current implementation of the strategy, further science and research is undertaken across the Basin, and monitoring, evaluation, and reporting helps to further progress our knowledge of the Basin's environment and how it has responded to management interventions. Continual improvement of this Strategy will ensure that it retains its role as the key strategic plan governing environmental watering across the Basin. Future revisions of this Strategy will use this knowledge to improve the Expected Environmental Outcomes and the water management strategies to achieve them.

Appendix A – Expected native vegetation outcomes by region

Table 4: Expected extent and condition outcomes for communities of water-dependent vegetation as a result of the Basin Plan.

BWS region	Outcomes for water-dependent vegetation	Area of river red gum (ha)*	Area of black box (ha)*	Area of coolabah (ha)*	Shrublands	Non–woody water-dependent vegetation	Relevant LTWPs
Paroo	Maintain extent and condition** of water-dependent vegetation near river channels and on the floodplain Where feasible maintain or improve vegetation that contributes to the ecological character of the Paroo River Wetlands[ii] and Currawinya Lakes[ii] Ramsar sites	2,300	38,300	22,800	Lignum in the Paroo River region	Closely fringing or occurring within the Paroo River and associated wetlands	• QLD Warrego, Paroo, Bulloo, Nebine LTWP • NSW intersecting streams LTWP (i.e. Paroo River planning unit)
Warrego	Maintain extent and condition** of water-dependent vegetation near river channels and on the floodplain	7,300	80,400	121,400	Lignum in the Warrego River and Toorale region	Closely fringing or occurring within the Warrego, Langlo, Ward & Nive rivers	• QLD Warrego, Paroo, Bulloo, Nebine LTWP • NSW intersecting streams LTWP (i.e. Warrego River and Toorale planning units)
Nebine	Maintain extent and condition** of water-dependent vegetation near river channels and on the floodplain	200	28,800	15,400		Closely fringing or occurring within the Nebine Creek	• QLD Warrego, Paroo, Bulloo, Nebine LTWP

BWS region	Outcomes for water-dependent vegetation	Area of river red gum (ha)*	Area of black box (ha)*	Area of coolabah (ha)*	Shrublands	Non–woody water-dependent vegetation	Relevant LTWPs
Condamine–Balonne	Maintain extent and condition** of water-dependent vegetation near river channels and on areas of the floodplain Where feasible maintain or improve vegetation that contributes to the ecological character of the Narran Lake Nature Reserve Ramsar site	11,500#	36,100#	62,900#	Lignum in Narran Lakes, the Lower Balonne and Culgoa river regions	Closely fringing or occurring within the Condamine, Balonne, Birrie, Bokhara, Culgoa, Maranoa, Merivale & Narran rivers Forming extensive stands such as lakebed herbfields in Narran Lakes	• QLD Condamine-Balonne LTWP • NSW intersecting streams LTWP (i.e. Culgoa, Narran planning units)
Moonie	Maintain extent and condition** of water-dependent vegetation near river channels and on the floodplain	2,200	2,500	7,900	Lignum in the Moonie river region	Closely fringing or occurring within the Moonie River	• QLD Border Rivers and Moonie LTWP • NSW intersecting streams LTWP (i.e. Moonie River planning unit)
Border Rivers	Maintain extent and condition** of water-dependent vegetation near river channels and on areas of the floodplain	10,700	3,800	35,200	Lignum in the lower Border rivers region, including Macintyre and Boomi Rivers (downstream of the confluence with Dumaresq), Whalan and Croppa Creeks	Closely fringing or occurring within the Barwon, Dumaresq, Macintyre rivers & Macintyre Brook	• QLD Border Rivers and Moonie LTWP • NSW Border Rivers LTWP
Gwydir	Maintain extent and condition** of water-dependent vegetation near river channels and on low-lying areas of the floodplain.	4,500#	600#	6,500#	Lignum in the lower Gwydir	Closely fringing or occurring within the Gwydir River	• NSW Gwydir LTWP

BWS region	Outcomes for water-dependent vegetation	Area of river red gum (ha)*	Area of black box (ha)*	Area of coolabah (ha)*	Shrublands	Non–woody water-dependent vegetation	Relevant LTWPs
	Where feasible maintain or improve vegetation that contributes to the ecological character of the Gwydir Wetlands Ramsar site					Forming extensive stands such as marsh club-rush and water couch in the Gwydir Wetlands	
Namoi	Maintain extent and condition** of water-dependent vegetation near river channels.	6,100	800	4,200	Lignum in the Namoi catchment region	Closely fringing or occurring within the Namoi River	• NSW Namoi LTWP
Macquarie–Castlereagh	Maintain extent and condition** of water-dependent vegetation near river channels and on low-lying areas of the floodplain Where feasible maintain or improve vegetation that contributes to the ecological character of the Macquarie Marshes Ramsar site	58,200	57,100	32,000	Lignum in parts of the Macquarie-Castlereagh region including the Macquarie Marshes	Closely fringing or occurring within the Bogan, Castlereagh, Macquarie and Talbragar rivers Forming extensive stands such as common reed, cumbungi and water couch in the Macquarie Marshes	• NSW Macquarie-Castlereagh LTWP
Barwon–Darling	Maintain extent and condition** of water-dependent vegetation near river channels and on low-lying areas of the floodplain	7,800#	11,700#	14,900#	Lignum in the Barwon-Darling region	Closely fringing or occurring within the Darling River	• NSW Barwon-Darling LTWP
Lachlan	Maintain extent of water-dependent vegetation near river channels and on low-lying areas of the floodplain. Improve condition[i] of black box and river red gum	41,300	58,000		Lignum in the lower Lachlan	Closely fringing or occurring within the Lachlan River and Willandra Creek Forming extensive stands such as common reed and	• NSW Lachlan LTWP

BWS region	Outcomes for water-dependent vegetation	Area of river red gum (ha)*	Area of black box (ha)*	Area of coolabah (ha)*	Shrublands	Non–woody water-dependent vegetation	Relevant LTWPs
						cumbungi in the Great Cumbung Swamp	
Murrumbidgee	Maintain extent of water-dependent vegetation near river channels and on low-lying areas of the floodplain. Improve condition[i] of black box and river red gum Where feasible maintain or improve vegetation that contributes to the ecological character of Ramsar sites in the Murrumbidgee region: Fivebough and Tuckerbil Swamps and Ginini Flats[ii] wetlands	68,300	38,900		Lignum in the lower Murrumbidgee	Closely fringing or occurring within the Murrumbidgee River, Billabong and Yanco creeks Forming extensive stands such as aquatic herbfields in the Lowbidgee	• NSW Murrumbidgee LTWP • ACT LTWP (in prep)
Lower Darling	Maintain extent of water-dependent vegetation near river channels and on low-lying areas of the floodplain. Improve condition[i] of black box and river red gum	10,300	38,600	600	Lignum in the lower Darling region	Closely fringing or occurring within the Darling River, Great Darling Anabranch and Talywalka Anabranch	• NSW Murray-Lower Darling LTWP
Ovens	Maintain extent and condition** of water-dependent vegetation near river channels and on the floodplain	10,200	<100			Closely fringing or occurring within the Ovens River	• Northern Victoria LTWP
Goulburn–Broken	Maintain extent of water-dependent vegetation near river channels and on low-lying areas of the floodplain. Improve condition[i] of black box and river red gum	19,800	500			Closely fringing or occurring within the Broken Creek, Broken and Goulburn rivers	• Northern Victoria LTWP

BWS region	Outcomes for water-dependent vegetation	Area of river red gum (ha)*	Area of black box (ha)*	Area of coolabah (ha)*	Shrublands	Non–woody water-dependent vegetation	Relevant LTWPs
Campaspe	Maintain extent and condition** of water-dependent vegetation near river channels	1,900	<100		Lignum in the Campaspe region	Closely fringing or occurring within the Campaspe River	• Northern Victoria LTWP
Loddon	Maintain extent and condition** of water-dependent vegetation near river channels Where feasible maintain or improve vegetation that contributes to the ecological character of the Kerang Lakes Ramsar site (within the Loddon region)	2,200	700		Lignum in the Loddon region	Closely fringing or occurring within the Loddon River	• Northern Victoria LTWP
Murray	Maintain extent of water-dependent vegetation near river channels and on low-lying areas of the floodplain. Improve condition[i] of black box and river red gum. Where feasible maintain or improve vegetation that contributes to the ecological character of Ramsar sites along the Murray River corridor including Barmah Forest, NSW Central Murray State Forests, Gunbower Forest, Hattah-Kulkyne Lakes, the South Australian Riverland, and the Coorong and Lakes Alexandrina and Albert sites.	90,600	41,700		Lignum along the Murray River from the junction with the Wakool River to downstream of Lock 3, including Chowilla and Hattah Lakes	Closely fringing or occurring within rivers and creeks in the Murray region from Hume Dam to the Murray Mouth *Forming extensive stands such as Ruppia tuberosa* in the Coorong and Moira grasslands in the Barmah–Millewa Forest	• NSW Murray-Lower Darling LTWP • Victorian Murray LTWP • Victorian Wimmera-Mallee LTWP • SA River Murray LTWP • SA Murray Region LTWP
Wimmera–Avoca	Maintain extent of water-dependent vegetation near river channels. Improve condition[i] of black box and river red gum. Where feasible maintain or improve vegetation that contributes to the ecological character of the Kerang Lakes Ramsar site	6,500	3,100		Lignum in wetlands in the Wimmera-Avoca region	Closely fringing or occurring within the Avoca, Avon, Richardson and Wimmera rivers	• VIC Wimmera-Mallee LTWP

BWS region	Outcomes for water-dependent vegetation	Area of river red gum (ha)*	Area of black box (ha)*	Area of coolabah (ha)*	Shrublands	Non–woody water-dependent vegetation	Relevant LTWPs
	(within the Avoca region) and Lake Albacatya[ii] Ramsar site						
Eastern Mt Lofty Ranges	Maintain extent and condition of water-dependent vegetation near river channels	<100	<100			Closely fringing or occurring within river channels Important wetland areas such as the Fleurieu swamps	• SA Eastern Mt Lofty Ranges LTWP

*Area (ha) (+/- 10%) is based on Cunningham SC, White M, Griffioen P, Newell G and Mac Nally R 2013, 'Mapping Floodplain Vegetation Types across the Murray–Darling Basin', Murray–Darling Basin Authority, Canberra.

** Condition parameters are based on Cunningham SC, Read J, Baker PJ and Mac Nally R 2007, 'Quantitative assessment of stand condition and its relationship to physiological stress in stands of *Eucalyptus camaldulensis (Myrtaceae*) in south-eastern Australia', *Australian Journal of Botany*, 55, 692–699. See also Cunningham SC, Griffioen P, White M and Mac Nally R, (2014) A Tool for Mapping Stand Condition across the Floodplain Forests of The Living Murray Icon Sites. Murray–Darling Basin Authority, Canberra.

#the extent and area of forests and woodlands for the lower Condamine–Balonne, Barwon–Darling and Gwydir regions, and the Bogan River, are considered to be an underestimate due to technical limitations in determining the lateral extent achieved through implementation of the Basin Plan.

i Condition, from which improvement is expected, is scored from 0–10, using the Stand Condition Tool (Cunningham et al 2014), and classified within 5 categories for river red gum and 2 categories for black box in the Lachlan, Murrumbidgee, Lower Darling, Goulburn–Broken and Wimmera– Avoca (see also Table 5 and Table 6).

[ii]We acknowledge that some Ramsar wetlands sites in the Basin, such as Currawinya Lakes, Paroo River Wetlands, Lake Albacutya, and Ginini Flats, have very limited capacity to be influenced by Murray–Darling Basin water management.

Table 5: Condition of black box trees in the Lachlan, Murrumbidgee, Lower Darling, Murray, Wimmera–Avoca and Goulburn–Broken.

Basin region	Vegetation with a condition[i] score 0 – 6	Vegetation with a condition[i] score >6 – 10	Percent of vegetation assessed (within the managed floodplain)[ii]
Lachlan	72%	28%	45%
Murrumbidgee	54%	46%	73%
Lower Darling	72%	28%	85%
Murray	33%	65%	28%
Wimmera–Avoca	42%	58%	26%
Goulburn–Broken	28%	72%	77%

Table 6: Condition of river red gum trees in the Lachlan, Murrumbidgee, Lower Darling, Murray, Wimmera–Avoca and Goulburn–Broken.

Basin region	Vegetation with a condition[i] score 0 – 2	Vegetation with a condition[i] score >2 – 4	Vegetation with a condition[i] score >4 – 6	Vegetation with a condition[i] score >6 – 8	Vegetation with a condition[i] score >8 – 10	Percent of vegetation assessed (within the managed floodplain)[ii]
Lachlan	3%	8%	21%	41%	26%	93%
Murrumbidgee	3%	8%	22%	40%	27%	93%
Lower Darling	11%	5%	7%	41%	35%	92%
Murray	2%	1%	10%	51%	35%	51%
Wimmera–Avoca	3%	5%	18%	60%	13%	20%
Goulburn-Broken	1%	2%	7%	34%	55%	89%

Notes:

[i] Condition, using the Stand Condition Tool (Cunningham et al. 2014), is scored from 0–10 and classified within 5 categories for river red gum and 2 categories for black box in the Lachlan, Murrumbidgee, Lower Darling, Goulburn–Broken and Wimmera– Avoca.

[ii] The area of vegetation where condition has been assessed is based on the extent of RapidEye™ imagery purchased for this assessment because Landsat 7 data were corrupted (purchased for the 2014 version of the Strategy).

Appendix B – Important Basin environmental assets for waterbirds

Grey assets can receive water for the environment; ^ Includes Ramsar site(s)

Table 7: Important Basin assets for waterbirds.

Asset		Total abundance and diversity	Shorebird abundance	Group-nesting	Drought refuge
1	Currawinya Lakes (Qld)^	*	*	*	*
2	Narran Lakes (NSW)^	*	*	*	
3	Cuttaburra channels (NSW)	*	*	*	
4	Paroo overflow lakes (NSW)^	*	*	*	
5	Yantabulla Swamp (NSW)	*	*		
6	Tallywalka system (NSW)	*			
7	Gwydir Wetlands (NSW)^	*		*	
8	Macquarie Marshes (NSW)^	*	*	*	
9	Lake Cowal (NSW)	*	*	*	*
10	Lake Brewster (NSW)	*		*	*
11	Booligal Wetlands (NSW)	*		*	
12	Great Cumbung Swamp (NSW)	*		*	*
13	Fivebough & Tuckerbil Swamps (NSW)^	*	*		*
14	Lowbidgee floodplain (NSW)	*	*	*	*
15	River Murray (NSW/Vic/SA)				*
16	Great Darling Anabranch (NSW)	*			
17	Menindee Lakes (NSW)	*	*	*	
18	Barmah-Millewa Forest (NSW/Vic)^	*		*	
19	Gunbower-Koondrook-Perricoota Forest (NSW/Vic)^			*	

Asset		Total abundance and diversity	Shorebird abundance	Group-nesting	Drought refuge
20	Lindsay-Wallpolla-Chowilla (Vic/SA)^	*		*	*
21	Kerang Wetlands (Vic)^	*	*	*	
22	Corop Wetlands (Vic)	*			*
23	Winton Wetlands (Vic)				*
24	Hattah Lakes (Vic)^			*	
25	Lake Albacutya (Vic)^	*			
26	Lake Buloke (Vic)	*			
27	Lake Hindmarsh (Vic)	*			
28	Coorong, Lower Lakes and Murray Mouth (SA)^	*	*	*	*

Appendix C – Important Basin environmental assets for native fish

Notes:

Sites of significance – includes areas that have high natural abundance of native species and/or are recruitment hotspots.

This table has been compiled using expert opinion and information provided for the assessment of key ecological **assets for the development of the Basin Plan.**

Table 8: Important Basin environmental assets for native fish.

Environmental asset	Key movement corridors	High Biodiversity	Site of other Significance	Key site of hydrodynamic diversity	Threatened species	Dry period / drought refuge
Southern Basin						
1. Coorong, Lower Lakes and Murray Mouth	Yes	Yes	Yes		Yes	Yes
2. Swamps on the lower Murray channel, between Wellington and Mannum (swamp geomorphic region)		Yes			Yes	
3. Kerang Lakes					Yes	Yes
4. Katarapko anabranch	Yes			Yes		
5. Pike anabranch	Yes			Yes		
6. Lower River Murray main channel	Yes	Yes	Yes		Yes	Yes

Environmental asset	Key movement corridors	High Biodiversity	Site of other Significance	Key site of hydrodynamic diversity	Threatened species	Dry period / drought refuge
7. Murray main channel (from Hume Dam to Darling junction)	Yes	Yes	Yes	Yes	Yes	Yes
8. Chowilla anabranch	Yes	Yes	Yes	Yes	Yes	Yes
9. Lindsay–Walpolla–Mularoo Creek	Yes	Yes	Yes	Yes	Yes	Yes
10. Lower Darling main channel	Yes	Yes	Yes	Yes	Yes	Yes
11. Darling anabranch			Yes			Yes
12. Hattah Lakes			Yes			Yes
13 Euston Lakes (including Washpen and Taila creeks)					Yes	
14. Lowbidgee Floodplain			Yes			
15. Murrumbidgee main channel (including upland reaches)	Yes		Yes		Yes	
16. Upland Murrumbidgee main channel	Yes		Yes		Yes	
17. Cotter River			Yes		Yes	
18. Koondrook–Perricoota	Yes	Yes	Yes	Yes	Yes	

Environmental asset	Key movement corridors	High Biodiversity	Site of other Significance	Key site of hydrodynamic diversity	Threatened species	Dry period / drought refuge
19. Gunbower	Yes	Yes	Yes	Yes	Yes	
20. Barmah–Millewa	Yes	Yes	Yes	Yes	Yes	Yes
21. Edward–Wakool system	Yes		Yes	Yes		Yes
22. Werai Forest			Yes	Yes		
23. Billabong–Yanco–Columbo creeks		Yes	Yes	Yes	Yes	Yes
24. Lake Mulwala	Yes		Yes	Yes	Yes	Yes
25. Ovens River	Yes	Yes	Yes	Yes	Yes	Yes
26. Lower Goulburn River	Yes	Yes	Yes	Yes	Yes	Yes
27. Upper Mitta River			Yes		Yes	
28. King River		Yes		Yes	Yes	Yes
29. Broken River	Yes	Yes	Yes		Yes	Yes
30. Broken Creek					Yes	Yes
Northern Basin						
31. Warrego (Darling to Ward rivers)	Yes	Yes		Yes	Yes	Yes

Environmental asset	Key movement corridors	High Biodiversity	Site of other Significance	Key site of hydrodynamic diversity	Threatened species	Dry period / drought refuge
32. Anabranches laterally connecting the Paroo and Warrego rivers (including Bow, Gumholes and Cuttaburra creeks)	Yes					
33. Barwon–Darling (Menindee to Mungindi)	Yes	Yes		Yes	Yes	Yes
34. Namoi (Gunnedah to Walgett)	Yes	Yes	Yes	Yes	Yes	Yes
35. Culgoa junction to St George (including lateral connectivity to the floodplain and wetlands)	Yes	Yes			Yes	Yes
36. Macintyre River – floodplain lagoons between Goondiwindi and Boomi	Yes	Yes	Yes		Yes	Yes
37. Macquarie River – below Burrendong Dam to Warren	Yes	Yes			Yes	Yes
38. Macquarie Marshes to Barwon, including lateral connectivity at the marshes	Yes				Yes	Yes
39. Lower Bogan River to junction with the Darling River	Yes				Yes	Yes

Environmental asset	Key movement corridors	High Biodiversity	Site of other Significance	Key site of hydrodynamic diversity	Threatened species	Dry period / drought refuge
40. Talywalka anabranch	Yes			Yes		Yes
41. Lower Moonie River to Barwon River	Yes	Yes		Yes		Yes
42. Condamine River – Surat to Oakey Creek, including lower Oakey Creek	Yes	Yes		Yes	Yes	Yes
43. Floodplain lagoons between Condamine and Surat	Yes	Yes	Yes		Yes	Yes
44. Lachlan River – Condobolin to Booligal	Yes	Yes	Yes	Yes	Yes	Yes
45. Macintyre River – Mungindi to Severn in NSW	Yes	Yes		Yes	Yes	Yes
46. Paroo River	Yes	Yes			Yes	Yes
47. Condamine headwaters and Spring Creek upstream of Killarney				Yes	Yes	Yes
48. Severn River within Sundown National Park		Yes		Yes	Yes	Yes
49. Peel River downstream of Chaffey Dam		Yes		Yes	Yes	Yes

Environmental asset	Key movement corridors	High Biodiversity	Site of other Significance	Key site of hydrodynamic diversity	Threatened species	Dry period / drought refuge
50. Namoi River upstream of Keepit Dam		Yes		Yes	Yes	
51. Charley's Creek and tributaries (upstream from Chinchilla)		Yes	Yes	Yes	Yes	Yes

Office locations – *First Nations Country*
Adelaide – *Kaurna Country*
Canberra – *Ngunnawal Country*
Goondiwindi – *Bigambul Country*
Griffith – *Wiradjuri Country*
Mildura – *Latji Latji Country*
Murray Bridge – *Ngarrindjeri Country*
Wodonga – *Dhudhuroa Country*

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