Environmental Management Framework Implementation
2017 Basin Plan Evaluation
December 2017
Published by the Murray–Darling Basin Authority

MDBA publication no: 41/17
ISBN (online): 978-1-925599-48-0
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**Acknowledgement of the Traditional Owners of the Murray–Darling Basin**

The Murray–Darling Basin Authority acknowledges and pays respect to the Traditional Owners, and their Nations, of the Murray–Darling Basin, who have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. The MDBA understands the need for recognition of Traditional Owner knowledge and cultural values in natural resource management associated with the Basin.

The approach of Traditional Owners to caring for the natural landscape, including water, can be expressed in the words of the Northern Basin Aboriginal Nations Board:

...As the First Nations peoples (Traditional Owners) we are the knowledge holders, connected to Country and with the cultural authority to share our knowledge. We offer perspectives to balance and challenge other voices and viewpoints. We aspire to owning and managing water to protect our totemic obligations, to carry out our way of life, and to teach our younger generations to maintain our connections and heritage through our law and customs. When Country is happy, our spirits are happy.

The use of terms ‘Aboriginal’ and ‘Indigenous’ reflects usage in different communities within the Murray–Darling Basin.
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Executive Summary

The 2017 Evaluation of the Environmental Management Framework (EMF) represents the first evaluation of the Basin Plan since its implementation in 2012. This evaluation forms part of the monitoring, evaluating and reporting processes required to enable adaptive management. The Evaluation will examine progress towards full implementation of the Plan, as well as early social, economic and environmental outcomes. Evaluation findings will identify how effective the Basin Plan has been, future risks to achieving long-term outcomes, and opportunities for improvement.

The environmental water portfolio represents a significant public asset which demands a serious commitment to effective management, including through adequate resourcing, coordination and monitoring. To enable coordination, the EMF was developed as a key component of the Basin Plan. The EMF includes processes to co-ordinate the planning, prioritisation and use of environmental water, and describes the principles to be applied in environmental watering.

This report examines whether the key components of the EMF have been implemented and how effective they have been. The evaluation also assesses the role of committees in coordinating environmental water; whether the principles to be applied in environmental watering have been implemented; and how well the feedback loop between long-term and short-term planning operates. Based on this information we are able to assess the current strengths and opportunities for improvements in how environmental water is planned and used.

To-date, notable progress has been made in the successful delivery or anticipated delivery of the major components of the EMF. Coordination of environmental watering has improved across the Basin and the Murray–Darling Basin Authority (MDBA) have played an important role in providing collaborative platforms to promote coordinated water delivery. Water holders and managers have incorporated the key components of the EMF into their planning processes, while maintaining the flexibility to respond to prevailing conditions. The framework provides an adaptive mechanism for the planning, prioritisation and use of environmental water, which is continually evolving as new information emerges.

However, there are opportunities for improvement in the planning, reporting and communication of environmental water use. As our knowledge base continues to grow there will be opportunities to further strengthen links between regional-scale objectives, identified in long-term watering plans, and Basin-scale objectives. Although current reporting has, valuably, informed this evaluation, reporting could be further refined to highlight opportunities for improvement in the coordination of environmental water. New knowledge and insights are increasingly being shared at site and Basin scales; however, data could be better integrated to provide broad-scale insights for multiple stakeholders. Finally, while efforts are being made by water managers to communicate the multidisciplinary benefits of environmental water (environmental, social, economic and cultural), negative perceptions of environmental flows persist within small sectors of the community. Further, governments are continuing to work hard to improve communication strategies and correct misinformation.
Outside of the Environmental Management Framework, other measures are being progressed to facilitate the effective coordination of environmental water. The implementation of prerequisite policy measures, the development of mechanisms to protect environmental flows, and the relaxation of operational and physical constraints, will amplify the benefits of environmental water. As these issues are progressed significant progress is likely to be made in achieving greater ecological outcomes using fewer resources.

Environmental water represents a relatively new concept and an entirely different suite of watering objectives (as compared to agricultural needs, for example). This broad water reform program has never been implemented at such a large spatial scale. Although there is ongoing work to do to ensure that environmental water can be effectively coordinated with consumptive water, the progress made and the lessons learnt over the past five years represents a significant achievement.
Introduction

The 2017 interim evaluation of the Basin Plan

The 2017 interim Basin Plan evaluation is the first evaluation of the Plan by the Murray–Darling Basin Authority (MDBA). It examines the social, economic and environmental outcomes associated with the first five years of the Basin Plan implementation (2012-2017), and assesses whether the Plan is on track to deliver a healthy working basin. The 2017 interim evaluation (the evaluation) also identifies opportunities for governments to improve the Basin Plan implementation in the coming years.

The environment is one of 11 themes that the evaluation examines. This theme covers the implementation of the Environmental Management Framework, and assesses outcomes for river flows and connectivity, environmental assets, native vegetation, waterbirds, and native fish.

The report focuses on the implementation, to-date, of the Environment Management Framework.

The Basin Plan and the Environment Management Framework

The river regulation has changed the size, frequency and timing of natural flows in the Murray–Darling Basin. This has contributed to a decline in the health of the Basin’s water-dependent ecosystems – its rivers, floodplains and wetlands.

Flow regulation began in the Murray–Darling Basin in the late 19th century, with intensive development of regulators occurring along the Murray River between 1920 and 1940 (Maheshwari et al. 1995). As more water has been diverted for people, agriculture and other economic activities, the flow through the system to the sea has been reduced by 75%, on average (BWS 2014).

The Basin Plan was legislated in 2012 with the aim of returning the basin to a healthy working system. The focus of the plan is to improve the Basin’s environment, while balancing social and economic needs, in a sustainable way. The plan sets an environmentally sustainable level of water take for consumptive use (sustainable diversion limit) and secures a share of available water for the environment. This ‘environmental water’ allows managers to restore some of the critical elements of the flow regime so that plant and animal species can complete their lifecycles, and to help build population resilience in healthy habitats.

The Environmental Watering Plan (Chapter 8 of the Basin Plan) guides the planning, prioritisation and use of environmental water across the Basin. It includes (amongst other things) environmental objectives, targets to measure progress towards these objectives, and an Environmental Management Framework (Part 4 of Chapter 8).

As outlined in section 8.11 of the Basin Plan, the EMF is intended to:
a) co-ordinate the planning, prioritisation and use of environmental water on both a long-term and an annual basis
b) enable adaptive management to be applied to the planning, prioritisation and use of environmental water
c) facilitate consultation, co-ordination and co-operative arrangements between the Authority, the Commonwealth Environmental Water Holder and Basin States.

The Environmental Management Framework comprises: processes to co-ordinate the planning prioritisation and use of planned environmental water, and held environmental water; the principles to be applied in environmental watering; and a mechanism to enable the Authority to co-ordinate the recovery of additional environmental water.

The Framework enables environmental water to be used efficiently and effectively, and to achieve environmental outcomes at the asset and basin scale. The implementation of the EMF must be reported on (as identified in Schedule 12 of the Basin Plan).

To evaluate the effectiveness of the EMF the MDBA has used the following evaluation questions:

a) Are the key components of the Environmental Management Framework delivered or on track?
b) Are there effective processes to coordinate planning, prioritisation & use of environmental water?
c) Are the Principles to be applied in environmental watering influencing the behaviour of environmental water holders and managers?

The Environmental Management Framework came into effect in 2012, and on the current schedule will be fully implemented in 2019. As a result, this evaluation provides an early assessment of progress to-date.

Lines of Evidence

To inform the 2017 evaluation of the Environmental Management Framework we used the following information sources:

Table 1 Environmental Management Framework information sources

<table>
<thead>
<tr>
<th>Dataset Name</th>
<th>Description</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matter 9.3 reports – A Basin Plan reporting requirement</td>
<td>Each water year environmental water holders report on the purpose, volume and use of environmental water. Data is available for the 2013-14, 2014-15 and 2015-16 water years.</td>
<td>The number of coordinated watering events (i.e. watering events contributed to by more than one water holder) were calculated as a proportion of total watering events (Section B).</td>
</tr>
</tbody>
</table>
### Dataset Name
- Matter 10 reporting – A Basin Plan reporting requirement
- Statements of Assurance
- National Partnership agreement on Implementing water reform milestone assessment report
- Discussions and feedback from environmental water managers and water holders.

<table>
<thead>
<tr>
<th>Dataset Name</th>
<th>Description</th>
<th>Application</th>
</tr>
</thead>
</table>
| Matter 10 reporting – A Basin Plan reporting requirement | Matter 10 reporting monitors how Basin governments are implementing the environmental management framework using the following indicators:  
- Basin-wide environmental watering strategy, long-term watering plans and annual priorities were prepared with the required content and are published, reviewed and updated, (Indicator 10.1)  
- Watering strategies, plans and priorities are prepared in consultation with other parties and having regard to matters as required (Indicator 10.2)  
- How environmental watering principles are applied (Indicator 10.3) | Matter 10 reports identified case studies on how the 'Principles to be applied in environmental watering' had been implemented. |
| Statements of Assurance | Statements of Assurance provide an opportunity for the parties involved in the Basin Plan Implementation Agreement to provide the community with information about their compliance and progress in implementing the Basin Plan. The relevant requirements each water year vary depending on annual deliverables and Party obligations and are detailed in the Basin Plan Implementation Agreement. | Statements were applied to inform the evaluation of progress to date in the implementation of each component of the EMF. |
| National Partnership agreement on Implementing water reform milestone assessment report | This report assesses State progress against key requirements as agreed under the National Partnership Agreement (NPA) on Implementing Water Reform. If non-compliance is identified by DAWR it could have funding implications for Parties. | Reporting was applied to inform the evaluation of progress to date in the implementation of each component of the EMF. |
| Discussions and feedback from environmental water managers and water holders. | Discussions were held with water holders in each jurisdiction and the Commonwealth. In addition feedback provided by environmental water managers through regular meetings and the outputs of workshops was also used to inform this evaluation. | Strengths, weaknesses and opportunities for improvement which were consistently identified have been highlighted in the report. |
### Dataset Name

<table>
<thead>
<tr>
<th>Dataset Name</th>
<th>Description</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDBA reports</td>
<td>A range of reports (including Hydrological cues workshop reports, the Constraints management strategy and Northern Basin review) informed the findings in this document (see references).</td>
<td>A range of reports have already highlighted issues and strengths in the coordination of environmental watering. This evaluation sought to bring these insights together.</td>
</tr>
<tr>
<td>Program Mapping of Environmental Water Management in the Southern Connected Murray–Darling Basin - Synergy, 2017</td>
<td>In 2017 the MDBA commissioned Synergy (an independent consultancy) to review environmental water planning, prioritisation and delivery in the Southern-connected Basin. Synergy mapped these processes and produced a set of recommendations.</td>
<td>Strengths, weaknesses and opportunities for improvement identified by this report were incorporated into this evaluation (and referenced).</td>
</tr>
<tr>
<td>MDBA long-term watering plan reviews</td>
<td>The environmental water planning team in the MDBA reviewed draft Long-term watering plans provided by jurisdictions.</td>
<td>Reviews were applied to inform the evaluation of Long-term watering plans.</td>
</tr>
</tbody>
</table>
Are the key components of the EMF on track?

The key components of the Environmental Management Framework are the Basin-wide environmental watering strategy (BWS), the Long-Term Watering Plans (LTWPs), the Basin annual environmental watering priorities, and the State annual environmental watering priorities. Together these documents aim to provide clear objectives and guidance for the coordination of environmental water across the Basin. The four planning documents have been developed collaboratively by Commonwealth and State governments to form a cohesive framework which covers multiple temporal and spatial scales (Figure 1).

Figure 1 Linkages between EMF planning documents

This collaborative approach has been effective in ensuring that, to-date, each of the key components of the EMF has either been implemented, or is track to be delivered, as agreed by the Basin Plan timeframes (Table 2).
Table 2  Key components of the Environmental management framework

<table>
<thead>
<tr>
<th>Component</th>
<th>Delivery Date</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin-wide environmental watering strategy</td>
<td>November 2014</td>
<td>Delivered</td>
</tr>
<tr>
<td>Long-term watering plans</td>
<td>November 2015 (VIC &amp; SA &amp; QLD)</td>
<td>6 of 6 Delivered</td>
</tr>
<tr>
<td>Long-term watering plans</td>
<td>By June 2019 (NSW, QLD, ACT, SA)</td>
<td>In progress</td>
</tr>
<tr>
<td>State Annual Environmental watering priorities</td>
<td>By 31 May each year</td>
<td>Delivered annually as agreed</td>
</tr>
<tr>
<td>Basin Annual environmental watering priorities</td>
<td>By 30 June each year</td>
<td>Delivered annually</td>
</tr>
</tbody>
</table>

The following sections evaluate how effectively each component has contributed to the coordination of environmental watering.

**Basin-wide environmental watering strategy**

The Basin-wide environmental watering strategy (BWS) describes environmental outcomes expected to be achieved in the longer term under the Basin Plan. It identifies strategies for the management and use of water to maximise environmental outcomes; how various partners will work together to plan and manage environmental water; and the approach to determining the Basin annual environmental watering priorities in order to achieve the long-term outcomes. The strategy was prepared in line with Division 2 Chapter 8 of the Basin Plan. Workshops were held with researchers, Basin States, and the Commonwealth to ensure the strategy could be applied by water holders and managers across the Basin. A draft strategy was also released some months prior to publication to allow stakeholders to provide feedback; most of which supported the approach of quantifying expected outcomes.

**Is implementation on track and what outcomes are we seeing?**

Since its release in November 2014, the strategy has helped guide the planning, management and monitoring of environmental water across the Basin. It has coordinated the use of environmental water by providing an agreed set of expected environmental outcomes and water management strategies. For example, the Commonwealth Environmental Water Holder (CEWH), in performing its functions and exercising its powers in a way that is consistent with the strategy and has identified which of the expected environmental outcomes it can help achieve with its growing portfolio of environmental water. These environmental outcomes are identified generally in the CEWH's
portfolio management planning framework, and specifically in its annual portfolio management plans for the catchments where Commonwealth water is held.

The approach to quantifying the expected environmental outcomes has been largely adopted by the Basin states when preparing long-term watering plans. For example, the long-term watering plans received from South Australia and New South Wales have included specific and measurable environmental objectives to be achieved over the long-term. The strategy has also helped the Authority identify a more consistent and influential set of Basin annual environmental watering priorities; these priorities can be written as ‘annual actions’ that build towards longer-term outcomes. Finally, the expected environmental outcomes for flows and hydrology, native vegetation, waterbirds, and native fish have informed the 2017 Basin Plan evaluation. Without quantified outcomes, the 2017 evaluation would have been a more subjective process.

What have we learnt and what can we improve?

The Basin-wide environmental watering strategy has been an important guide for the development of other environmental watering planning documents, providing a robust guide for the monitoring and watering strategies. Nonetheless feedback from environmental water holders and managers has indicated that there are opportunities for improvement and should be examined closely in future BWS reviews:

1. A portion of the expected environmental outcomes are difficult to implement in some catchments, in part because the BWS objectives are set for the larger, whole of basin scale. For example, it may be difficult to reach some areas of the floodplain within current constraints.
2. Some of the assets identified in the strategy (for instance, the basin-significant waterbird sites) are not always manageable with environmental water.
3. There is a need for integration between the different sets of expected environmental outcomes; for example, integration between flows and vegetation, and between vegetation and waterbirds. This may be related to the absence of ecosystem function objectives from the document, which can help link flow with ecosystem response.
4. Water management strategies for native vegetation and waterbirds are not detailed as comprehensively as those for fish and new research may aid the clarification of watering strategies.
5. Adaptation mechanisms to deal with climate change are not yet detailed.

In 2019 the strategy is due for its first review, and this feedback, coupled with new knowledge, will be used to build on our learnings to refine the overall strategy. Basin States will have also completed their long-term watering plans, which may assist with informing a more integrated strategy and improving alignment of outcomes at multiple scales.

Long-term watering plans

Long-term watering plans (LTWPs) are developed by Basin States and guide the management of held and planned environmental water at regional scales over the longer term. The plans aim to improve
the way water is managed to maximise river and wetland outcomes from all available water within and between catchments. The LTWPs set objectives, targets, and watering requirements for priority environmental assets and ecosystem functions, using methods set out in Part 5 Chapter 8 of the Basin Plan.

LTWPs provide important links to other environmental and operational planning documents. The plans have regard to the Basin-wide environmental watering strategy and will, in turn, inform the identification of annual environmental watering priorities each year. These plans will also identify the long-term risks, environmental watering requirements, and management strategies, which will aid the development of operational rules set out in the Water Resource Plans.

Is implementation on track and what outcomes are we seeing?

Long-term watering plans will be developed for each of the twenty surface water resource plan areas in the Basin. The plans were due for publication in November 2015, or as agreed by the Authority and the relevant Basin State.

To-date LTWPs have been published for the Victorian Murray, Northern Victoria, Wimmera-Mallee, Warrego-Paroo-Nebine, South Australian River Murray, and Eastern Mount Lofty Ranges water resource plan areas. For the remaining 14 plans, timelines are aligned to coincide with the development of State water resource plans in 2019.

The published LTWPs are being used to guide long-term environmental water planning by informing the development of the annual priorities which influence annual watering decisions. The plans are also being applied to refine the development of monitoring and evaluation at a Basin and environmental asset scale. Finally, the LTWPs will be important for informing water resource plan development up to June 2019, to ensure there is consideration of the requirements of key environmental assets when planning the use of water resources at each water resource plan area.

What have we learnt and what can we improve

Overall these plans provide a long-term framework for the management of priority environmental assets and functions at regional scales. As Basin States, the MDBA and water holders continue to adaptively manage environmental watering and develop/review LTWPs, we need to maintain a focus on ensuring:

- there is good consistency between the LTWPs and the Basin Plan and Basin-wide environmental watering strategy
- ecological objectives for priority environmental assets are measurable, specific and achievable, in order to advance our ability to monitor outcomes
- that the plans can stand-alone, without recurrent reference to other external planning documents. Where other documents are referred to these should be made readily accessible to facilitate interpretation
the first jurisdictional review of LTWPs will take place within five years of their publication and provides an opportunity to apply new knowledge to update long-term planning.

**Basin annual environmental watering priorities**

The objective of the Basin annual environmental watering priorities is to guide the management of environmental water for a given water year. The priorities aim to achieve the most effective use of water for the environment, promote better environmental outcomes at a Basin scale; and coordinate watering between environmental water holders and water managers. The Basin priorities are also informed by the States' annual environmental watering priorities. The MDBA will review State priorities to identify if there are any of Basin-significance. In these cases the State-priority may be adopted as a Basin priority, or existing priorities may be amended in consultation with the States.

**Is implementation on track and what outcomes are we seeing?**

Five sets of Basin annual environmental watering priorities have been published by the MDBA since 2013-14. These priorities were prepared consistently with Division 5 Chapter 8 of the Basin Plan and are reviewed by States and the Commonwealth prior to their publication. In 2014-15, the Authority began publishing an environmental watering outlook, and has continued to do so each water year. While not required to do so by legislation, the outlook has been published to provide environmental water holders and managers with an early look at what the coming water year's priorities might be.

The Basin annual environmental watering priorities have influenced the management of environmental water across the Basin, with only a few cases where watering has not taken place in accordance with the priorities (noting that this is helped by the broad nature of the priorities). All environmental water holders, including the CEWH, must have regard to the Basin annual environmental watering priorities. Basin states, water holders (including the Commonwealth Environmental Water Holder) and the MDBA work closely to deliver water in accordance with these priorities.

While each set of Basin priorities has been wholly consistent with the Basin Plan they have evolved over the past five years. Numerous factors have driven this change, namely:

- new knowledge and tools which have helped the identification of Basin-scale priorities;
- publication of the Basin-wide environmental watering strategy, which provided long-term expected environmental outcomes;
- feedback from environmental water holders and managers, which has helped to improve the priorities' representativeness, achievability and timing; and
- shifts in climate, which in 2016 required the Authority to publish an addendum so that there were appropriate priorities for the wetter conditions.
What have we learnt and what can we improve

Given that the priorities are published and reviewed annually, each year provides an opportunity to adaptively improve how they are developed. Feedback from water holders has indicated that, whilst the Basin priorities have beneficially evolved from year-to-year, there remain opportunities for improvement. These improvements include:

- developing more specific priorities. The priorities are generally broad in scope. While this makes it easy to comply with the Basin priorities, it also means that the priorities could add more value in the annual planning process,
- outlining how Basin-wide datasets are applied in the development of priorities, to improve transparency of decision making,
- building in the capacity to adapt if resource conditions change from those predicted, such as by defining priorities for different scenarios. This improvement has already been considered and in past years where the resource availability scenario has changed, a 'priorities addendum' was published later in the water year. The addendum realigned priorities to be consistent with prevailing conditions, however a different option could be considered in future instances,
- a refinement of the publication dates for the Basin annual environmental watering priorities. The publication of State priorities in May, prior to Basin priorities means that it can be difficult for States to incorporate the Basin-scale priorities into their annual planning cycle. Recognising this limitation the MDBA has typically published a Basin-wide annual environmental watering outlook in March each year. The outlook provides an indication of the coming year’s Basin annual environmental watering priorities. Nonetheless the outlook only provides a preliminary list of priorities and a variation in the publication date of the Basin priorities may facilitate State planning,
- balance the focus of Basin priorities to align with the long-term outcomes identified in the Basin-wide annual environmental watering strategy. An analysis of the alignment between the Basin priorities and the Basin-wide environmental watering strategy demonstrated that the priorities tend to focus on short to medium term outcomes. This means that long-term quantified expected outcomes, which can only be achieved through multiple years of environmental watering, are not always represented.

The MDBA have already been considering how to address some of these issues and, in 2017, published Basin annual environmental watering priorities that have multi-year components, with watering actions for each resource availability scenario (i.e. the availability of water). This multi-year perspective should better enable water managers to have regard to the priorities in their annual planning processes, and provide environmental watering in line with the priorities should climate conditions rapidly change. The new approach is also better suited to build towards the long-term environmental outcomes in the Basin-wide environmental watering strategy, as the multi-year framework provides a consistent approach across a longer timeframe.
State annual environmental watering priorities

State annual environmental watering priorities (States' priorities) aim to guide annual environmental water planning, prioritisation, and delivery at the catchment scale. The States' priorities identify environmental assets and ecosystem functions in each water resource plan area using the method included in Part 6, Chapter 8 of the Basin Plan. State priorities also inform Basin-scale priorities and will, in turn, be guided by information included in the State long-term watering plans.

Is implementation on track and what outcomes are we seeing?

Each State has developed five sets of annual environmental watering priorities, as agreed, with the exception of the ACT. Instead the ACT has develop Environmental Flow Guidelines which prescribes releases of planned environmental water. The variable content and format of State annual environmental watering priorities reflect the differing operational rules, licencing, and environmental water availability between the States. This variability ensures that each set of priorities is fit for purpose.

The States develop priorities through consultation with communities and water managers to build a set of priorities which are relevant to each water resource plan area, and the needs of priority assets. Generally the priorities vary each year in response to antecedent conditions and strategic objectives, providing guidance in annual decision-making.

The CEWH has no obligation to prepare annual environmental watering priorities; rather, it prepares annual portfolio management plans for the catchments where the Commonwealth owns the water. These plans detail environmental objectives, environmental flow requirements, and water availability, as well as content unique to the CEWH’s operations, such as water trading. The decision framework embedded in these plans, which looks at environmental demands and the outlook for coming years, has been influential in setting annual environmental priorities, especially in NSW catchments, where it contributes to decisions made by environmental water advisory committees.

What have we learnt and what can we improve?

The annual publication of State priorities provides an opportunity to incorporate new information and knowledge into the prioritisation process each year. In coming years it is anticipated that State priorities will be developed for unregulated catchments. By 2019 water recovery in unregulated catchments will be more advanced; mechanisms for protecting and coordinating environmental flows should have been developed; and Water Resource Plans finalised. These developments will facilitate the management of planned environmental water and provide opportunities to improve the priorities set out for unregulated water resource plan areas.
How the key components inform short-term planning and delivery

Long-term planning documents, which form the foundation of the Environmental Management Framework (Figure 1), inform short-term planning and delivery through their incorporation into annual portfolio management plans and seasonal or annual watering plans (Appendix 1). These annual plans inform, and are informed by, site-based watering proposals. The combined top-down and bottom-up approach to environmental water planning ensures that water is applied to achieve optimal outcomes. The long-term planning documents also provide a framework for committee deliberations, providing the strategic context for coordinated environmental watering events.

An evaluation of how effectively long-term planning documents inform deliveries is possible through reviewing current reporting outputs (Matter 10). These reports demonstrate that the Basin annual environmental watering priorities are met 85% of the time, and that all events have demonstrated consistency with the ‘Principles to be applied in environmental watering’ specified in Chapter 8. Where a Basin priority has not been met State reporting has generally identified constraints as being the primary barrier.

However, although reporting was beneficially applied to inform the 2017 evaluation, it could be improved to allow water planners to reflect on the year’s watering actions, and answer the question ‘how could the environmental management framework further improve environmental water coordination and planning?’.

While the format of the implementation reports and their content has evolved over the years, further modifications to the reporting would enable water planners to analyse practice change. The environmental water plan and its environmental management framework constitutes, in the terminology of program logic, a ‘practice change’ (i.e. it should have made environmental water managers do things differently). A more useful reporting template would endeavour to find out not just what people did but whether they did anything differently as a result of the Basin Plan and, in particular, the environmental management framework. A review of reporting guidelines proposed for 2018 provides an ideal opportunity to address these issues in collaboration with Basin States. Improving the applicability of reporting would build our ability to assess how long-term planning informs delivery in future evaluations.

Summary

This evaluation has demonstrated that the key elements of the EMF have been implemented or are in the process of being implemented. Each component represents a fundamental step towards achieving long-term coordination between water managers, and the timely development of each of these documents, alone, is a notable achievement.

The work underpinning the key components of the EMF has advanced our understanding of freshwater ecosystems to inform strategic water use. There is evidence that the prioritisation process has evolved from year-to-year, which demonstrates that water planners are responsive to
feedback. The collaborative process adopted to develop each component has also built cooperative relationships between the States, the Commonwealth, and the MDBA, facilitating holistic environmental water management across the Basin.

However, there are always opportunities for improvement, even at this early stage of implementation. The published long-term watering plans have made important first steps in setting objectives to secure the long-term health of ecosystem assets. However, as our knowledge improves, LTWPs could further strengthen their linkages with the Basin-wide environmental watering strategy, thereby enabling increased levels of coordinated monitoring and management of assets. In addition, although the current timing for the publication of annual priorities is delineated in the Basin Plan, the release of the Basin annual environmental watering priorities could be varied to enhance opportunities to align priorities across multiple spatial scales.

The review processes built into the EMF provide opportunities to continue to build on the strong planning foundation for environmental water, and to incorporate new knowledge and mechanisms to ensure that planners are able to iteratively improve the Basin's water management framework over time.
Are there effective processes to coordinate planning, prioritisation and use of environmental water?

Operational environmental water management at the Basin-scale is a new, complex and evolving process. The MDBA, water holders, States, river operators, and site managers work collaboratively to coordinate the planning, prioritisation and use of environmental water at a range of temporal and spatial scales. A combination of flexible multi-year and annual planning documents guide strategic water management, whilst operational committees make real-time decisions based on flow and water quality conditions, ecosystem and biota responses, emerging risks, river operations, water availability and managing third party impacts (Figure 2).

To further assess whether the processes in place to coordinate environmental water have been effective, the MDBA has assessed the short-term planning, prioritisation and delivery processes (Figure 2). These processes are coordinated by committees which bring together a range of stakeholders’ expertise. The committees operationalise the key components of the Environmental Management Framework; their roles and achievements are evaluated in the following section. Discussions held within these committees consistently highlight some of the strengths and opportunities for improvement in current environmental watering, which are also set out below.

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**Figure 2** Short-term planning and delivery of environmental water in the Southern-connected Basin

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Coordination Committees

Each water year environmental water delivery must be proactive to address changing hydrological, socio-economic and ecological conditions. Water holders plan for a range of scenarios early in the water year, and vary their approach based on prevailing conditions. A range of committees meet on an ongoing basis during the water year to facilitate responsive decision-making, plan water delivery, and coordinate flows.

At broad spatial scales two committees meet to coordinate environmental watering; the Southern Connected Basin Environmental Watering Committee and the Environmental Water Working Group. At catchment scales Environmental Watering Advisory Groups plan and review deliveries and, at the site scale, Operational Advisory Groups convene as needed to provide specialist real-time advice.

Southern Connected Basin Environmental Watering Committee

The Southern Connected Basin Environmental Watering Committee (SCBEWC) was established by the Ministerial Council in 2014. The committee includes representatives from agencies responsible for managing environmental water across the Commonwealth, New South Wales, Victorian, and South Australian governments, and meetings commenced in Autumn 2015. In order to streamline planning processes and avoid duplication, the SCBEWC incorporates two functions:

- The coordination of environmental water in the southern connected system (collaborative and non-binding); and
- The shared decision-making on the use of jointly held water available under The Living Murray (TLM) portfolio, along with the River Murray Increased Flows (RMIF) and the River Murray Unregulated Flows (RMUF); as well as the governance of other TLM program components, such as site management, monitoring, and the Indigenous Partnership program.

SCBEWC coordination principles aim to ensure that environmental water management and delivery is consistent with the Environmental Watering Plan (Chapter 8 of the BP). An annual report of key achievements and progress is provided to the Basin Officials Committee and Ministerial Council.

For jointly held portfolio planning, SCBEWC considers the following to inform annual decisions: Basin and State annual environmental watering priorities; priority assets listed in long-term watering plans; watering strategies outlined in the Basin-wide environmental watering strategy; watering proposals from States, hydrological conditions, third party risks, and river operational activities.

A key planning product prepared by SCBEWC in time for the start of each water year (1 July) is the operational scenarios document. The scenarios document provides a mechanism to align annual demands with the MDBA River Operations Annual Operating Plan (AOP) flow forecasts. Its main purpose is to identify opportunities to maximise environmental outcomes through the coordinated delivery of all environmental water (including the allocation of the jointly held portfolio), along with other water in the system.
Throughout the year SCBEWC continues to review and update operational scenarios and provides advice to the Basin Officials Committee in response to changing conditions and priorities (Appendix 1). The SCBEWC must meet at least four times a year. Since the committee’s commencement in 2015, 34 meetings and teleconferences have been held, concentrated at the start of the watering years when the annual delivery plans are coordinated.

Since its establishment the SCEWBC has progressively grown into its role and is now broadly-viewed as a valuable and constructive committee. Key achievements of the SCBEWC to-date include:

a) establishing a high level of trust and information exchange amongst participating agencies, encouraging broader collaboration outside of the committee
b) coordinating system scale environmental water planning and delivery, and the effective management of jointly-held environmental water portfolios for three years
c) forming good working relationships with the Water Liaison Working Group to enable improvements to environmental water delivery and enable more flexible river operations practices
d) sharing the management of environmental water delivery risks and opportunities at the system scale.

Over successive years the SCBEWC’s role has also expanded. The disbandment of the Environmental Watering Group and The Living Murray Committee in 2016 meant that decision-making responsibilities on the joint government funding for icon site management, monitoring and indigenous engagement went to the SCBEWC. A recent self-assessment by the Committee of their role allowed the SCBEWC to focus on progressing matters of strategic purpose including:

- focusing on coordinating system-scale environmental watering actions
- streamlining planning and approvals for jointly held environmental water portfolios
- developing an aligned and effective approach to communicating the role of water for the environment and the outcomes being achieved
- commencing a long-term process to improve the management of environmental water in the Southern-Basin. This process aims to develop more efficient and effective river operations to plan, deliver and learn how to improve the use of environmental water.

Environmental Water Coordination in the Northern Basin

There is currently no equivalent environmental water coordination forum for the Northern Basin. The Northern Basin Review recommended a toolkit measure ‘to improve the management of flows in the Northern Basin’. These improved management of flows would include actions to enhance managers’ ability to coordinate releases from tributary flows to maximise environmental outcomes. Coordination of flows in the Northern Basin would improve habitat for many aquatic organisms during dry times and improve the health of rivers downstream. This measure could be implemented through, for example, the development of an annual Northern-Basin planning forum to facilitate information exchange and collaboration early in the water year. These initiatives will be progressed following approval of the Basin Plan amendments.
Environmental Water Working Group

The Environmental Water Working Group (EWWG) was established as a subcommittee of the Basin Plan Implementation Committee (BPIC), which is provided for under the Murray–Darling Basin Plan 2012 Implementation Agreement (the Agreement).

The purpose of the EWWG is to provide advice on policy and planning issues relating to the Environmental Water Plan, which includes the Basin-wide environmental watering strategy, long-term watering plans, and annual environmental watering priorities (for both the whole Basin and water resource plan areas within it). The EWWG may also provide advice on local engagement, accounting for environmental water use and environmental water delivery.

Commencing in November 2013, the EWWG has been effective in developing policy to support implementation of the environmental water plan. This includes debating and settling the content of the Basin-wide environmental watering strategy, particularly the expected environmental outcomes; as well as determining appropriate timing of a long-term watering plan for the River Murray System as a whole. The EWWG has, through regular reporting, enabled the BPIC to track the implementation of the environmental watering plan, and to increase awareness of issues with the planning, prioritisation and use of environmental water.

Recently the EWWG has identified policy issues with the potential to impact on environmental watering, with such issues being dealt with in forums outside of BPIC, including: Adjustment of Sustainable Diversion Limits, pre-requisite policy measures, and constraints management. These policy issues are the current focus, alongside finalising long-term watering plans.

Catchment-scale Advisory Groups

Advisory groups also operate at catchment scales and meet regularly to discuss proposed or upcoming watering events, potential issues, the outcomes of past watering events, and future opportunities (Appendix 2).

Environmental Watering Advisory Groups (EWAGs) are the key consultative bodies for environmental watering in the New South Wales portion of the Murray–Darling Basin and in some Victorian catchments. EWAGs include water managers, landholders, Aboriginal groups, independent scientists, local government representatives, and a variety of partner agencies. The groups are therefore able to bring together a range of knowledge and experiences to advise on both planned and adaptive environmental water. In South Australia, Queensland, and other parts of Victoria, local knowledge and science informs water use through a range of scientific, Aboriginal, and community-based committees (Appendix 2). This knowledge is drawn together by catchment and site managers to inform water delivery.

Before the start of each water year (July to June), many catchment-scale advisory groups become particularly active, providing advice on developing annual watering plans. These plans consider recent environmental watering history and forecast likely water management actions for the next water year at the valley scale, under different climatic scenarios. Advisory groups aim to anticipate short-term opportunities and identify how to implement various watering actions in order to meet
identified environmental objectives. Each group ensures that the advice and reports they produce are consistent with the relevant operational water sharing plan for their regulated water source.

Although many of these advisory groups were established well before the Basin Plan was implemented, they have adaptively incorporated components of the Environmental management framework into their annual planning cycles. Members have had the opportunity to contribute towards the development of Long-term watering plans, where relevant, and to consider annual priorities when delivering flows. These groups effectively coordinate water within catchments, and have the opportunity to share insights, and coordinate with other catchments through, for example, annual chair forums and workshops.

Operational Advisory Groups
Operational Advisory Groups (OAGs) support operational decisions in the real time management of environmental water delivery at environmental sites in the Southern-Basin. They convene as needed to provide specialist advice aimed at achieving planned objectives and highlighting issues as they arise.

OAGs include representatives from State agencies, State water authorities, river operators, site managers, environmental water managers, and scientists.

Before and during watering events, OAGs meet on a weekly basis to discuss a range of operational matters including flow management, inundation extents, risk management, ecological responses, engineering issues, fishway operations, and water accounting. These groups meet as required, and can have up to 200 meetings per year, depending on prevailing conditions.

OAGs provide effective support for higher level committees and are critical in ensuring each environmental watering event proceeds smoothly and achieves its planned objectives. The groups are already dynamic and active committees, and further improvements have not been identified.

Strengths and opportunities for improvement in environmental water coordination
It is important to consider the current strengths and opportunities for improvement in environmental watering when evaluating the implementation of the Environmental Management Framework (EMF). This section highlights what other factors influence the coordination of environmental watering. By highlighting shared strengths and opportunities for improvement, we are able to promote a coordinated approach to addressing existing limitations, in order to further strengthen the coordination efforts across the Basin.

In February 2017 water holders, river operators, and water planners across the Southern-connected Basin came together to discuss how environmental water delivery could be enhanced. This has informed the section below, along with feedback from water holders, and an independent review of environmental watering in the Southern-connected Basin.
Strengths

Current environmental watering builds on many years of knowledge, testing, trialling and adaptive management. It continues to grow in scope and complexity and coordination mechanisms are adapting to manage larger volumes of environmental water. The design and delivery of specific hydrographs and events to particular assets is well developed and environmental works, measures, and pumps have been effectively used to allow water to reach less-accessible areas. At a system scale the links between science and management are improving, with strengthened feedback loops between monitoring and planning having improved long-term strategic environmental water applications.

Collaboration is ongoing and the trialling of different environmental watering actions has built trust between stakeholders to enable effective coordination. Reporting demonstrates that the number of coordinated environmental watering events has grown from very few events in 2013, to 18% of all events being coordinated across multiple water holders in 2014-15, and to 33% of events being coordinated in 2015-16. These statistics alone, based on Matter 9.3 reporting, demonstrate that collaboration is increasing across the Basin, allowing significant environmental flow events to be delivered.

Knowledge exchange between river operators, water holders, and planners is continuous. Environmental water delivery is viewed as a new positive challenge, promoting beneficial cultural change at multiple river management levels. The section titled ‘Principles to be applied in environmental watering’ below elaborates further on many of the current strengths and successes of environmental watering.

Opportunities for improvement

Operational and Physical Constraints

The Basin governments collectively recognise that the system can be managed better to get the best use of the available water. This recognition led the MDBA to develop a Constraints Management Strategy which ‘identifies and describes the physical, operational and management constraints that are affecting environmental water delivery' primarily in the Southern Basin.

To maximise the benefits from environmental watering, the strategy identified that managers need to be able to work with the natural variability of river systems. At times, managed overbank flows are required to allow for connection between rivers and floodplains, and to support in-stream functions. To achieve this, the strategy identified that managers need to be able to address operational and management constraints that affect the achievement of three environmental outcomes, the ability to:

- Use environmental water in response to natural cues and for restoring natural variability including seasonality
- Use environmental water to target a range of sites and ecosystem functions in, and between, rivers
• Promote the management of all water in the system to contribute environmental benefit.

River management practices, currently set up for consumptive water use, have been focused around extracting water from the river at a defined location. Environmental water holders need to be able to use their entitlements in new ways, such as leaving water in the river to achieve multiple benefits as the water moves downstream.

Currently, as water moves from one jurisdiction to another, environmental water holders must manage different accounting and operational rules. The new objectives associated with environmental flow delivery substantially increases the workload and complexity for river operators.

Operational approvals processes can sometimes be lengthy, making it difficult to rapidly respond to hydrological cues. In addition, approval from high-level committees is required annually to trial deviations from past practice that help improve environmental water delivery. Nonetheless, these interim rules or deviations trials have been valuable in demonstrating the benefits associated with achieving a connected flow through the Murray system. To build on progress so far, there is a need for overarching support from the states to implement several key projects as part of the SDL adjustment mechanism.

One example is the Enhanced Environmental Water Delivery (EEWD) project which seeks to better integrate environmental water and river management. The EEWD project outlines five work components that would help address most of the priority actions identified for progressing operational and management constraints. A significant proportion of the project relates to the development of decision support tools, protocols, procedures and information systems to enable decisions about environmental water delivery to be made much more rapidly and with higher levels of confidence in the outcome. Much of the opportunity associated with the EEWD project is associated with being able to operationally align and use higher regulated flow limits at key locations across the Southern-Basin (relaxed constraints projects, also part of the SDL adjustment mechanism). Although this will involve the same entities that currently operate the river, it is by no means normal business. Investment and implementation of SDL adjustment projects will see a maturation of environmental water delivery processes and integration to become an everyday part of how the Southern-Basin’s rivers and water resources are managed.

Pre-requisite policy measures
The implementation of adequate and appropriate Prerequisite Policy Measures (PPMs) is also an important component of the Basin Plan. The ecological outcomes modelled under the Basin Plan assumed that:

• environmental return flows would be credited for downstream environmental use and;
• environmental water could be called from storage during unregulated events (a practice known as "piggy backing").

Implementation of these rules in some jurisdictions, but not others, make it more difficult for water holders to coordinate flows across multiple jurisdictions and achieve optimal outcomes. However, positive steps are being made to progress these measures. In 2017 the Authority agreed that a set of
‘Prerequisite Policy Measure Implementation Plans’ for each jurisdiction would be implemented by June 2019. Joint governments (NSW, VIC, SA) also agreed on a PPM Implementation plan for the River Murray system, prepared by the MDBA, to be progressed against the same timeline.

Public perceptions of environmental watering
In addition to the above operational constraints, there are sometimes social constraints associated with environmental water delivery. For example, in small sectors there is limited social licence to deliver environmental flows. Feedback from water holders indicates that this could be because the objective of environmental watering is not always communicated effectively with the public, or communities are misinformed, or because land use priorities differ across stakeholders. To mitigate public concerns, State governments have imposed environmental flow thresholds at some sites. For example, at Yarrawonga Weir, maximum releases of 15 000ML per day are permitted without consultation with landholders, whereas prior to the Basin Plan, flows of over 20 000ML were permitted at this weir. The higher flows promoted broader floodplain inundation.

In another example water holders such as the CEWH have implemented a ‘good neighbour policy’ to improve public confidence. This approach to environmental flow management aims to ensure that third-party impacts are neutralised, thus allaying public concerns. Governments are continuing to work hard to improve communication strategies and correct misinformation and these efforts should continue. If the multidisciplinary benefits of environmental water are more broadly understood, water holders could more effectively negotiate with stakeholders to achieve flexible environmental water use.

Data management and reporting
Significant progress has been made in monitoring and evaluation. The States and Commonwealth have reported that their monitoring programs can be usefully applied to assess the impacts of environmental water to allow them to adaptively deliver water informed by previous outcomes. However, datasets are not always collated to provide Basin-scale insights.

In addition, an independent review of environmental watering outcomes in the Southern-connected Basin found that whilst environmental watering committees play an important role in planning and delivery, and contribute valuable local knowledge, the reporting of outcomes is sometimes based on the expertise of particular individuals, rather than by documented outcomes (Synergy, 2017). The development of a coordinated information management system could help to streamline data integration and would facilitate information-sharing.

Under the Basin Plan, the Authority is responsible for developing an environmental assets and ecosystems functions database to fulfil this role. Although a preliminary form of this database exists, the MDBA is working to improve its functionality and scope. Continued coordination across water managers will also be important to develop a knowledge-sharing platform accessible to multiple stakeholders.
Summary

Coordination of environmental water across the Basin is continually evolving. A combination of flexible multi-year and annual planning documents guide strategic water management, whilst operational committees make real-time decisions based on actual conditions. This approach provides a scientifically-robust management framework which maximises the effective use of environmental water.

Committees operate at three different spatial scales to ensure that planning is strategic and responsive. Throughout the water year ongoing consultation facilitates rapid decision making, close coordination and identification of risks. This approach has resulted in an increased number of environmental watering events occurring since 2013, improved relationships between water managers, and a refinement of committee roles.

An existing opportunity for improvement in short-term planning processes is the formal integration of monitoring into Basin-scale future planning. A documented process for collating and integrating monitoring data at broad spatial scales would support the adaptive management of environmental water across the Basin, while providing new insights.

Outside of the EMF, the effectiveness of environmental water use is being actively enhanced by the management of operational and physical constraints and the implementation of prerequisite policy measures. Through the continued progression of these matters, water holders will be better able to maximise environmental outcomes and coordinate environmental watering across multiple States.
Are the Principles to be applied in environmental watering influencing the behaviour of environmental water holders and managers?

There is strong evidence that the 'Principles to be applied in environmental watering' have informed water use across the Basin (Table 3; Appendix 4). While these principles are not always explicitly addressed they are evident through a review of past watering actions. Over time we have become more effective in achieving multiple outcomes through strategic environmental flow delivery. As our knowledge base evolves water, managers are able to more comprehensively implement these Principles to optimise the outcomes of environmental watering.

Over the past few years tangible steps have been made to improve the way environmental water is delivered. Significant progress has been made in applying 'Principle 10: Other management and operational procedures' despite operational constraints, through coordination efforts in multi-jurisdictional forums like the SCBEWC. Other Principles, such as 'Principle 8: Adaptive management', have always been an integral component of environmental watering, but an increased availability of monitoring data has improved our capacity to adaptively manage.

The following table draws together information provided in Matter 10 reporting to assess the progress that has been made in implementing each of the principles over time.

Table 3 Progress in meeting each of the 'Principles to be applied in environmental watering' These Principles were evaluated based on Matter 10 and 9.3 reporting (see ‘Lines of Evidence’ section).

<table>
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<tr>
<th>Principle</th>
<th>Progress</th>
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<tbody>
<tr>
<td>Principle 1: Environmental watering in accordance with Basin annual environmental watering priorities (the priorities)</td>
<td>This principle has been consistently met by water managers where the priority is relevant to their management area. The priorities are generally broad, which means many watering actions can be attributed to a priority. In the few instances where priorities have not been met (e.g. Mid-Murrumbidgee priority), the States have provided justification, and the MDBA has chosen to relist the site where they believe it remains a Basin priority.</td>
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<tr>
<td>Principle 2: Consistency with objectives of part 2 to: (a) to protect and restore water-dependent ecosystems of the Murray–Darling Basin;</td>
<td>This principle has been consistently met by water managers. Matter 9.3 reports submitted to the MDBA by water holders ascribe a primary and secondary purpose to each watering events which took place during the water year. Purposes include: ecosystem function, fish, vegetation, flows, and other ecological components. The reporting, therefore, provides detailed evidence that the objectives of each</td>
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| (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. | watering action align with the overarching objectives of part 2.  
The development of Long-term water planning documents by jurisdictions will further align environmental water use with the overarching objectives of the Basin Plan. |
| Principle 3: Maximising environmental benefits (a-g)                       | This principle has been consistently met by water managers. Compared to annual flow volumes in the Basin, environmental water represents a relatively small volume of water. As a result, use of environmental water always aims to maximise environmental benefits. This is achieved through watering proposals passing through multiple decision-making committees for refinement and decision, incorporating input from researchers, managers and communities (Appendix 1 & 2). Water managers have emphasised that in many cases environmental water is most effective in filling gaps in hydrographs rather than creating new hydrographs (building on the outcomes of natural flows). Principles 8, 10 and 11 provide further evidence that environmental water is applied to maximise benefits.  
Effective planning documents, Basin & State priorities and coordination committees, also support the conclusion that environmental water is applied optimally each water year. As elaborated on in Section B of this report, removing constraints and implementing prerequisite policy measures would further maximise the environmental benefits of environmental water. |
<p>| Principle 4: Risks                                                        | This principle has been consistently met by water managers. Environmental water planning documents (seasonal watering plans, operational scenario documents, etc.) include risk assessment components to ensure environmental watering will have minimal impact on surrounding land uses. In addition, the CEWH has a 'good neighbour policy' to alleviate public concerns that unintended impacts could occur. Watering proposals pass through multiple decision-making committees for refinement and decision, incorporating considerations from researchers, managers and communities (Appendix 1 &amp; 2). Finally, for coordinated watering events in the Southern-connected Basin, the SCBEWC explicitly discusses and mitigates risks prior to, and during, water delivery events. |
| Principle 5: Cost of environmental watering                               | This principle has been consistently met by water managers. Site and catchment managers develop environmental |</p>
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<th>Principle</th>
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<td>Environmental watering is to be undertaken having regard to the quantity of water and other resources required relative to the expected environmental benefits.</td>
<td>Watering proposals; these proposals are then assessed by the water holding agencies or relevant committees, and are progressed if they are deemed cost-effective. The Basin and State annual priorities documents and longer-term plans also ensure environmental water is used effectively.</td>
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<td>Principle 6: Apply the precautionary principle</td>
<td>This principle has been consistently met by water managers as far as practicable. The Basin and State annual priorities are important in identifying which ecosystems are most at risk and prioritising their watering. Environmental water managers are willing to trial watering regimes to benefit particular species and sites; for example, in the Goulburn and Macquarie catchments (Appendix 3) where our knowledge has not been perfect. These trials provide valuable learning opportunities. While the majority of priorities have been met, important sites, such as the Mid-Murrumbidgee wetlands and the Coorong, Lower Lakes and Murray Mouth, have not had their watering requirements met in some time. Removal of constraints and protection of flows is also important to achieve outcomes at these sites.</td>
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<td>Principle 7: Working effectively with local communities</td>
<td>This principle has been consistently met by water managers. In NSW, Environmental Watering Advisory Groups draw on local expertise to inform water use. In Victoria, Catchment Management Authorities consult with communities, and Operational Advisory Groups draw on local knowledge to coordinate watering events. While these are just some examples, many other forums are available so that local communities can become involved with environmental watering. In addition, over the past few years, the States have invested more time and effort into working with Aboriginal Nations to achieve cultural outcomes using environmental flows (Appendix 2). The MDBA have been facilitating this work through the jointly funded Indigenous Partnership program and commencing Commonwealth funded work on Aboriginal waterways assessments. This work is providing a stronger foundation for Traditional Owners to provide advice on culturally important assets and functions.</td>
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<td>Principle 8: Adaptive management</td>
<td>This principle has been consistently met by water managers. Adaptive management has been broadly adopted as a core principle of environmental watering. Monitoring, coordination and environmental watering trials have provided valuable learnings which feed back into water delivery (Appendix 3). Coordination committees have</td>
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<td><strong>Principle</strong></td>
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<td>allowed insights to be shared across water managers. A few examples of successful adaptive management cycle include: the refinement of golden perch spawning hydrographs in the Goulburn, the ability to maintain an environmental pulse from Menindee Lakes to the Murray Mouth, and the improvement of river red gum forests at The Living Murray sites (Appendix 3). Whilst monitoring has been critical in supporting an active adaptive management cycle, water holders and independent environmental watering reviews have highlighted that monitoring could improve to reduce duplication and provide targeted outcomes.</td>
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<td><strong>Principle 9: Relevant International agreements</strong></td>
<td>The principle has been somewhat met by water managers. The Basin includes 16 wetlands listed under the Ramsar convention, and provides habitat for international migratory bird species which use the Basin. Although water has been delivered to all manageable Ramsar sites since the implementation of the Basin Plan, the ecological character of some sites may still be at risk. This may mean Ramsar sites are not being inundated with sufficient frequency, constraints may be limiting the area of the floodplain which can be inundated, or other factors may be impacting the site.</td>
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<td><strong>Principle 10: Other management and operational practices</strong></td>
<td>This principle is being progressively met by water managers. The MDBA and the Basin states continue to review and improve river management and operational practices to improve their capacity to manage the river to meet multiple objectives. Key examples include the ongoing development of river operations environmental guidelines, identification of opportunities during annual operational scenario planning, and the development of rules applicable to annual environmental watering trials (and periodic revisions to the Objectives and Outcomes for River Operations in the River Murray document). These improvements are progressively being trialled and implemented. For example, 2016-17 was the first time water was released from Menindee Lakes and Lake Victoria during unregulated flow periods in the River Murray. The rules for this were approved by the Basin Officials Committee through the 2016-17 Multi-Site Environmental Watering Trial. This action afforded the ability to support recruitment of Murray Cod in the Lower Darling, provide a refuge from hypoxic blackwater for fish around the Lake Victoria outlet, and provide the flows necessary to support Ruppia outcomes in the Coorong.</td>
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In another example, environmental watering trials are taking place to maintain an environmental flow pulse from the Murrumbidgee river, through the length of the Murray River. Environmental water managers have worked with river operators to ensure that these flows were not diverted for consumptive purposes. As flows approached the South Australian border, jointly held environmental water was allowed to continue through to the Coorong, when it would usually have been captured in Lake Victoria.

These trials and improvements mean that our capacity to manage water in accordance with Principle 10 is constantly evolving. However, the persistence of operational constraints, set out in the Murray–Darling Basin Agreement, limit our ability to expedite progress. Committees, such as the SCBEWC, are critical platforms to achieve coordinated events; however, broader agreement is required to relax operational constraints.

**Principle 11: Management of water for consumptive use**

The principle is being progressively met by water managers. In Victoria, consumptive water is being re-routed through Gunbower forest and losses are charged to environmental water accounts. This represents an efficient use of existing infrastructure and water to achieve environmental outcomes. Other actions include using existing consumptive flows in a river system to deliver environmental flows (sometimes referred to as ‘piggybacking’).

These examples demonstrate that our ability to meet Principle 11 is well developed, although there may be more opportunities to re-route consumptive water at other locations.

### Environmental Management Framework Findings

The three main findings of the Environmental Management Framework (EMF) are presented below:

- The coordination of environmental watering has improved across the Basin, and the MDBA have played an important role in providing collaborative platforms to enable such coordination. The framework provides an adaptive mechanism for the planning, prioritisation, and use of environmental water, which is continually evolving.
• All the major components of the EMF have been delivered, or are on track to be delivered by the agreed timeframes. Each of these components meet Basin Plan requirements and have advanced our ability to manage environmental water and monitor relevant outcomes. Additionally, there are opportunities for improvement which can be addressed in Basin Plan review requirements, as follows:
  • The Basin-wide environmental watering strategy (BWS) is helping to guide environmental watering, and is doing so in a way that targets outcomes for river flows and connectivity, native vegetation, waterbirds and native fish. Nevertheless, this evaluation has highlighted that integration between outcomes, for example, those between river flows and vegetation, will improve the effectiveness of environmental watering in the achievement of the environmental objectives of the Basin Plan.
  • In relation to the continued development of Long-term watering plans, it is important that, as these plans are developed, and/or reviewed, they include objectives that are specific, measurable, achievable, and based on the best available science at the time. The alignment of the plans with Basin Plan requirements, and their capacity to guide the application of environmental water at the catchment scale, are also important attributes of effective LTWPs.
  • There is evidence that the prioritisation process has evolved from year-to-year demonstrating that water planners are responsive to feedback. It is important that, as LTWPs are developed, the priorities continue to incorporate new information and operations.
  • The framework would benefit from improved reporting of environmental water use. Current Matter 10 reporting is useful for understanding how water is used across the Basin, but does not yet identify key opportunities for improvement in how water can be better coordinated.

Conclusion

The Basin’s rivers have been managed for decades to meet consumptive demands. In comparison, environmental water represents a relatively new concept and an entirely different suite of watering objectives. Environmental water holders have invested considerable time and resources into ensuring that environmental water planning under the Basin Plan informs water use.

The Environmental Management Framework has effectively coordinated environmental watering, supporting the optimisation of environmental outcomes across the Basin. The continued implementation of the broader Basin Plan is important to allow environmental water to achieve its full effect. Continued progression of constraints projects will enhance water delivery outcomes. Meanwhile implementation of prerequisite policy measures and the development of new water resource plans will be important in establishing cooperative arrangements, retaining planned environmental water, and protecting delivered flows.
Although there is much work to do to ensure that environmental water can be effectively used in a consumptive system, the progress made, and the lessons learnt, over the past five years represents a significant achievement.
Appendixes

Appendix 1: Southern-connected Basin environmental watering management (Synergy, 2017)
Appendix 2: Catchment-scale advisory groups in the Basin

New South Wales

<table>
<thead>
<tr>
<th>Advisory committee</th>
<th>Membership</th>
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<tbody>
<tr>
<td>Murray and Lower Darling EWAG</td>
<td>OEH, NOW, DPI Fisheries, Forests NSW, Murray CMA, SWC, MDFRC, Murray Irrigation, MLD Customer Service Committee, Indigenous representation – project/region specific, Murray Darling Wetlands Working Group&lt;br&gt;Observers: CEWO and MDBA</td>
</tr>
<tr>
<td>Gwydir EWAG</td>
<td>Border Rivers – Gwydir CMA, Aboriginal Community Representative, UNE, WWF, Landholders – Lower Gwydir, Gingham, NOW, DPI, State Water, Gvia (Gwydir Valley Irrigation Association), DII, NPWS-OEH,&lt;br&gt;Observers: CEWO, as well as extras from Gvia, and 2 Mallowa landholder observers.</td>
</tr>
<tr>
<td>Macquarie EWAG</td>
<td>Macquarie Marshes Environmental Landholders Association, Macquarie River Food and Fibre, Cudgegong Water Users, Effluent Creeks Association, Nature Conservation Council, Local aboriginal community – Wailwan, NOW, DPI-Fish, SWC, OEH, CMA&lt;br&gt;Observers: CEWO</td>
</tr>
<tr>
<td>Lachlan EWAG</td>
<td>LCMA (now Central Tablelands LLS), LCMA (now Central Tablelands LLS), LCMA Aboriginal communities rep (now Central Tablelands LLS), OEH, DPI (Fisheries), NoW, SWC, Community and landholder rep, Community and landholder rep&lt;br&gt;Observers: CEWO officers attend as observers.</td>
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Victoria

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<tr>
<th>Advisory committee</th>
<th>Membership</th>
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<tr>
<td>Campaspe EWAG</td>
<td>Community members from each asset (e.g. local farmers and landholders) and representatives from agency stakeholders (e.g. North Central CMA staff, NRMC and Board members, CEWH, VEWH, DSE, DPI, water corporations, Parks Victoria), and other interest groups (e.g. Field and Game, Birds Australia).</td>
</tr>
<tr>
<td>Loddon EWAG</td>
<td>Community members from each asset (e.g. local farmers and landholders), representatives from agency stakeholders (e.g. North Central CMA staff, NRMC and Board members, CEWH, VEWH, DSE, DPI, water corporations, Parks Victoria), and other interest groups (e.g. Field and Game, Birds Australia).</td>
</tr>
<tr>
<td>Murray Wetlands EWAG</td>
<td>Community members from each asset (e.g. local farmers and landholders), representatives from agency stakeholders (e.g. North Central CMA staff, NRMC and Board members, CEWH, VEWH, DSE, DPI, water corporations, Parks Victoria), and other interest groups (e.g. Field and Game, Birds Australia).</td>
</tr>
<tr>
<td>Gunbower Community Reference group</td>
<td>Community members from each asset (e.g. local farmers and landholders), representatives from agency stakeholders (e.g. North Central CMA staff, NRMC and Board members, CEWH, VEWH, DSE, DPI, water corporations, Parks Victoria), and other interest groups (e.g. Field and Game, Birds Australia).</td>
</tr>
<tr>
<td>Goulburn EWAG</td>
<td>Both Environmental Water Advisory Groups comprise up to six members who come from a range of geographic locations along the Goulburn and Broken Rivers, and Broken Creek or adjacent to wetlands.</td>
</tr>
<tr>
<td>Broken EWAG</td>
<td>Both Environmental Water Advisory Groups comprise up to six members who come from a range of geographic locations along the Goulburn and Broken Rivers, and Broken Creek or adjacent to wetlands.</td>
</tr>
<tr>
<td>Regional Wetland group</td>
<td>This Planning Forum involves all regional stakeholders and meets quarterly to discuss works and strategies for the catchment’s major wetlands (located on both public and private land). It engages with the community-based Waterwatch program for water quality monitoring.</td>
</tr>
<tr>
<td>Barmah-Millewa Forest Icon Site coordinating committee</td>
<td>The Goulburn Broken CMA and NSW Parks and Forest Service alternate the chairing and coordination of this Forum. It is responsible for the development and monitoring of the Barmah-Millewa Environmental Watering Management Plan and Annual Watering Statements. It is supported by a Community Reference Group, Technical Support Committee and Indigenous Reference Group.</td>
</tr>
<tr>
<td>Water Technical Advisory Committee</td>
<td>Technical Advisory Committees exist for each specialist area of operations – water, land, biodiversity – with membership consisting of partner agency representatives (DSE, DPI and Parks Victoria), and experts in relevant fields, such as environmental science, salinity, and ecology.</td>
</tr>
</tbody>
</table>
### Technical Advisory Committees

Technical Advisory Committees exist for each specialist area of operations – water, land, biodiversity – with membership consisting of partner agency representatives (DSE, DPI and Parks Victoria) and experts in relevant fields, such as environmental science, salinity, and ecology.

### Land and Water Community advisory group

Technical Advisory Committees exist for each specialist area of operations – water, land, biodiversity – with membership consisting of partner agency representatives (DSE, DPI and Parks Victoria), and experts in relevant fields, such as environmental science, salinity, and ecology.

### Aboriginal reference group

This group helps to foster two-way communications between the Authority and Aboriginal stakeholders across the region, while ensuring projects are delivered in a way that both benefits the environment and respects Indigenous culture.

### Hattah Lakes and Lindsay Wallpolla Island Community Reference Groups

Membership of these groups consists of community members with a specific interest in the Icon Sites and who have skills in irrigation, agriculture, community engagement, business, and natural resource management.

### Other specific consultation

Tailored engagement activities are also routinely undertaken with special interest groups associated with an area planned to receive environmental water. For example, recent water deliveries in the Nyah Vinifera Forest generated meetings with the Wadi Wadi Traditional Owners and the Mid-Murray Field Naturalists.

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### South Australia

#### Advisory committee | Membership
---|---
**Community Advisory Panel for Lower Lakes, Coorong and Murray Mouth** | DEWNR and CLLMM staff, and other advisory members.

**SA Murray–Darling Basin NRM Board** | DEWNR and other advisory members.

**River Murray Advisory Committee** | River Murray Advisory Committee.

**Community Action for the Rural Environment/LAP matters** | DEWNR regional wetlands staff and Local Action Planning (LAP) Committee officers.

**Chowilla Community Reference Group** | DEWNR and other advisory members.
<table>
<thead>
<tr>
<th>Advisory committee</th>
<th>Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLCMM Scientific Advisory Group</td>
<td>DEWNR and other advisory members.</td>
</tr>
<tr>
<td>River Ops Working Group</td>
<td>DEWNR and other advisory members.</td>
</tr>
<tr>
<td>Environmental flows Reg Group</td>
<td>DEWNR and other advisory members.</td>
</tr>
<tr>
<td>Barrage Ops Working Group</td>
<td>DEWNR and other advisory members.</td>
</tr>
</tbody>
</table>

Queensland

<table>
<thead>
<tr>
<th>Advisory committee</th>
<th>Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Border Standing Committee and Intersecting Working Group</td>
<td>NSW and QLD Govt Agencies.</td>
</tr>
<tr>
<td>Border Rivers Food and Fibre</td>
<td>BRFF represents water users from ten different associations in the Macintyre, Dumaresq and Macintyre Brook catchments in both NSW and QLD.</td>
</tr>
<tr>
<td>Border Rivers Water Network</td>
<td>The objective of BREWN is to provide continuing strategic advice to all stakeholders on the policy settings for, and the management of water in, the Border Rivers catchment. Stakeholders include Commonwealth, State and Local government departments and agencies, natural resource management organisations, agricultural and business industry associations, and the general community.</td>
</tr>
<tr>
<td>Lower Balonne Water Network</td>
<td>A Lower Balonne stakeholder group, representing water users, local government, environmental groups, NSW and QLD Governments and local businesses.</td>
</tr>
</tbody>
</table>
Appendix 3: Examples of the application of each Principle to be applied in environmental watering

<table>
<thead>
<tr>
<th>Principle</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Principle 1: E-watering in accordance with BAEWPs</strong></td>
<td>Watering to maintain the condition and range of Moira grass in the Barmah-Millewa Forest was a Basin-wide watering priority in 2015-16. The watering was aimed at maintaining the condition and range of Moira grass in the forest by supplementing a natural flow event and extending the duration of inundation. This action was designed to build on a successful watering of the forest along the River Murray two years earlier. Given the dry outlook at the start of 2015-16, only a small watering action for the Barmah-Millewa Forest was planned to protect critical drought refuges. However, River Murray operational transfers to meet consumptive demands during Spring provided an opportunity to use some environmental water to target flows of between 12,000 ML/day to 15,000 ML/day at Yarrawonga throughout September and October. The delivery was restricted to the current regulated release limit from Yarrawonga Weir of 15,000 ML/d. This limits delivery of larger volumes of water to the Barmah-Millewa Forest required to achieve optimum inundation of moira grass. Further, this constraint, as well as other constraints across the Basin, are being pursued through a Constraints Management Strategy and the constraint projects being developed by States as part of the Sustainable Diversion Limit Adjustment Mechanism. Given this limitation to watering, NSW and Victorian governments ‘take turns’ in inundating their respective sides of the forest. In 2015-16, it was NSW’s “turn” so moira grass on the NSW side of the river was targeted. A significant proportion of the flow was delivered above channel capacity, with the Barmah-Millewa Forest regulators operated to direct flows into Millewa Forest on the NSW side of the river. This watering was delivered as part of a multi-site watering action along the River Murray. The New South Wales Office of Environment and Heritage, the Victorian Environmental Water Holder, The Living Murray, and the Commonwealth Environmental Water Office coordinated the delivery of the environmental water. The delivery included 60 GL from The Living Murray portfolio and 343 GL from the Commonwealth Environmental Water Holder. The coordinated environmental watering inundated around 20% of the Barmah-Millewa Forest, with the majority of the inundation in the Millewa Forest. This water provided the right conditions for moira grass, water ribbons and water milfoil to grow. The moira grass on the eastern side of Moira Lake responded very well with nodule growth, some flowering, and seed set. The watering also provided habitat for frogs, turtles, small bodied fish, and food for waterbirds. There was some moira grass growth in the Barmah Forest on the Victorian side of the river despite the limited water depth.</td>
</tr>
<tr>
<td>Principle</td>
<td>Example</td>
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</tr>
<tr>
<td><strong>Principle 2: Consistency with objectives of part 2</strong></td>
<td>From June to October 2015, the planning and use of environmental water was adjusted to allow us to trial a more responsive approach to natural hydrological cues in the River Murray. A natural cue may be a change in water level, river flow, water temperature, or carbon and nutrient input as a result of local rainfall or inflows. When a natural cue occurs, ecological processes, such as frog breeding, fish spawning and waterbird nesting, are more likely to be triggered and sustained. Put simply, if natural cues are supported there will be a much greater chance that the expected biological response will occur. This novel approach meant that, for the first time, we were able to take advantage of higher flows (triggered by rainfall events and local runoff) to provide a series of freshes to support native fish spawning, including golden perch and, critically, endangered silver perch (listed under the Environmental Protection and Biodiversity Conservation Act 1999). These freshes were the result of operational releases from one of the main storages on the river, the Hume Dam, managed below set limits. The combination of environmental water, water from rainfall events, and local runoff, enabled us to mimic a proportion of what the natural flow downstream would have been, without the dam. This meant that releases followed the pattern but not the magnitude of the modelled natural flow, thereby allowing us to achieve environmental outcomes while avoiding negative impacts on third parties.</td>
</tr>
<tr>
<td><strong>Principle 3: Maximising environmental benefits (a-g)</strong></td>
<td>The delivery of the environmental water during Spring, in response to natural cues, was extended into Summer following observations of waterbirds breeding in the Barmah-Millewa Forest. Basin Governments delivered an additional 27 GL to extend the watering and support the breeding of more than a thousand waterbirds. Monitoring observed the successful breeding of over a thousand pairs of birds, including colonial nesting birds, such as the threatened eastern great egret and the royal spoonbill. A significant proportion of up to 14 percent of the global population of the endangered Australasian bitterns and little bitterns were found to be inhabiting and breeding in the Barmah-Millewa Forest. The environmental water made sure that waterbird chicks were able to survive and successfully fledge. Eighty percent of the water delivered to the Barmah-Millewa Forest was returned to the River Murray for downstream watering actions. This water returned from the wetlands and floodplains rich in carbon, nutrients, zooplankton, fish larvae and macro-invertebrates. The food rich return flows then became part of the river food web, feeding fish, yabbies and other river animals. The return flows from the Barmah-Millewa Forest supported watering actions at downstream sites, particularly the Lower Lakes, Coorong and Murray Mouth, where the water increased the lake levels and provided year-round flows through the barrages for fish passage.</td>
</tr>
<tr>
<td><strong>Principle 4: Risks</strong></td>
<td>While all NSW managed watering events broadly met the annual watering priorities, the mid-Murrumbidgee piggy-back flow was unable to be delivered due to community concerns. A partial solution was found through the delivery to a number of mid-Murrumbidgee wetlands using existing infrastructure.</td>
</tr>
</tbody>
</table>
NSW also managed a series of ‘return flows’ from the North Redbank wetlands system in the Lowbidgee to the Murrumbidgee River channel. This water action was undertaken by NSW on behalf of the Commonwealth Environmental Water Holder.

The return flows were considered a priority as they have become less common with the increased demand for water in the Murrumbidgee. Return flows are an important component of floodplain connectivity, transferring nutrients, zooplankton, fish larvae, and invertebrates from the floodplain to the river. Water quality and biological monitoring was funded by the Commonwealth Environmental Water Office, and undertaken by Charles Sturt University, with assistance from environmental water managers. To avoid any adverse impacts on the river, wetland water is assessed prior to, and during, release, and modelling is undertaken to identify release volumes.

By monitoring planned flows, water managers can learn more about the role they play in the health of the river for all water users and reduce the risks associated with the delivery. By understanding the benefits of return flows, water managers can target specific objectives with the timing and duration of future environmental watering events.

Findings to-date indicate that the levels of aquatic micro-invertebrates in the wetlands can be up to 10 times higher than the river. This makes the transfer of water important for feeding young native fish and for generally increasing productivity within the river channel.

### Principle 5: Cost of environmental watering

The 2015-16 watering at Gunbower Forest and Creek was delivered using consumptive water en-route; efficiently using environmental water. This means that consumptive water was diverted through the creek and forest to achieve the desired environmental objectives, whilst on its way to meet consumptive demands downstream in the Murray system. Losses associated with the diversion of this consumptive water were met by environmental water holders (VEWH, TLM and CEWH) to ensure that there was no impact on other water users. The approach allowed desired objectives to be met using much less environmental water.

### Principle 6: Apply the precautionary principle

The Living Murray delivered its first environmental water to icon sites during the longest drought in Australia’s recorded history (2000–2009). The water was used to provide refuges for stressed native plants and animals, and prevented local extinctions.

The $32 million package of works (a permanent pumping station, levee banks, and a three flow regulator) recently built at Hattah lakes will allow the return of a more natural water regime to more than 6,000 ha of River Murray floodplain. The infrastructure will be used to deliver water to fill the lakes every 2 to 3 years, with more extensive watering to reach the floodplain every 8 to 10 years, subject to natural cues and water availability. About half the water used in the more extensive
Principle 7: Working effectively with local communities

The North Central Catchment Management Authority (NCCMA) has engaged the local community, agencies, land managers, ecologists, Traditional Owners, and local government throughout the planning for, and management of, environmental water in the Gunbower system. This engagement occurs through a number of mechanisms, including through the Gunbower Island Community Reference Group (consisting of community members), the NCCMA Natural Resource Management Committee (consisting of local community members from across the North Central CMA region), and through consultation with indigenous groups (Yorta Yorta and Barapa Barapa Traditional Owners), local Government, and community groups (such as Gannawarra Shire Council, local Progress Associations, and Development committees). Engagement also occurs through the Gunbower Operational Advisory Group (comprised of agencies involved in delivering the environmental watering program) and Technical Working Group (comprised of ecological experts).

Input from consultation with the community and stakeholders has been used to refine the timing of flows (for example, to reduce impacts on activities such as firewood collection and commercial timber harvesting), and to ensure information is provided to inform visitors and local communities of the watering program, particularly the timing and extent of the planned inundation. Community consultation has been a vital component in ensuring the success of the infrastructure works and environmental watering at Gunbower Forest.

The Gunbower Operational Advisory Group (GOAG) plays an important role in advising the operational planning and delivery of environmental water. The group is convened by the NCCMA and includes a broad range of agencies, including waterway managers (North Central CMA and NSW State Forests), storage managers and river operators (Goulburn-Murray Water and Murray–Darling Basin Authority (MDBA)), land managers (Parks Victoria and Department of Land, Water and Planning), and water holders (VEWH, CEWH and MDBA). The group coordinates input and advice on river flows and water availability, the feasibility of the desired watering, the identification and mitigation of risks, and the operational management during the watering. In some years, a Technical Working Group also inputs to the GOAG, providing advice on desirable flow regimes and adaptive management to achieve the greatest ecological outcome during the delivery.

The GOAG coordinated throughout the watering event in 2015-16, with input from agencies used to inform how the action was managed as conditions unfolded. The strength of the collaboration between agencies was demonstrated during the final stages of the event, when fish exit strategies continued to be developed, trialled and refined. Environmental water was effectively delivered to the forest and creek to facilitate fish movement between the forest, Gunbower Creek, and the Murray River, enabling native fish to migrate and access an abundance of food resources.
| Principle 8: Adaptive management | The Commonwealth Environmental Water Holder works closely with the Victorian Environmental Water Holder and local delivery partners—the Goulburn Broken Catchment Management Authority and the river operator, Goulburn Murray Water—through an operational advisory group to design and manage environmental watering events in the Goulburn River, and to monitor and evaluate the effectiveness of Commonwealth environmental water use. When planning for environmental water use in 2014–15, all the parties got together and reviewed the lessons of the past three years of Spring flows. This review noted that:  
  - After several unsuccessful attempts in previous years, an environmental flow delivered in Spring of 2013 supported golden perch breeding. The peak of the flow event had been increased when compared to previous years.  
  - There was a need for continuing recovery of riverbank vegetation, which remains in poor condition following prolonged drought and subsequent floods during the last decade.  
  - Community members had raised concerns of riverbank erosion (bank notching and slumping).  
  - Recreational fishers had raised concerns that environmental flows delivered during the opening of the Murray cod fishing season had disrupted local angling events.  

In response, the first spring environmental flow in 2014 was brought forward to October, instead of November, and was delivered as a flow pulse (fresh) with a gradual recession. This watering action was intended to maximise outcomes for riverbank and in-channel vegetation (ensuring it received water before the hot Summer), which in turn provided fish habitat, as well as a reduction in the risk of riverbank erosion.  

A second spring flow pulse was timed for late November, to take advantage of warmer water temperatures to support golden perch spawning. The flow was specifically designed to ensure environmental watering did not coincide with the start of the Murray cod-fishing season on 1 December.  

Monitoring in 2014 identified the largest spawning of golden perch in the region since 2010, which occurred during the November environmental flow. Community members did not raise any concerns regarding riverbank erosion and reported that ‘it was the best fishing in years’. |

| Principle 9: Relevant International agreements | Over the 2014/15 watering year, the NSW Office of Environment and Heritage worked closely with Crown Lands Division (Fivebough and Tuckerbil Wetland Advisory Committee) and the relevant EWAG to deliver 2,474 ML of environmental water to Fivebough and Tuckerbil Swamps in the MIA Wetlands. These areas were targeted for top-up flows during September 2014 in order to maintain suitable waterbird feeding and breeding habitat for JAMBA and CAMBA migratory species. Planning for the event was consistent with the Basin Plan, while the necessary risks and costs were assessed (Form A), and regard was given to the Guidelines for the method to determine priorities for applying environmental water. Proposals to |
Principle | Example
--- | ---
| | Water these wetlands were also included in the 2014/15 Murrumbidgee Annual Environmental Watering Priorities (AEWPs), the Basin AEWPs, and listed as a priority for EW under the Ramsar Convention.

The delivered water maintained and improved wetland-dependent vegetation within these areas (including river red gums), and provided suitable habitat and feeding conditions for waterbirds. These conditions ultimately resulted in the convergence of thousands of waterbirds on Fivebough and Tuckerbil Swamps for feeding, foraging and, in some cases, breeding. This was one of the largest flocks of waterbirds in 20 years. Species observed at these sites, as a result of this watering, included Australasian and Little Bitterns, Egrets, Gull-billed Terns, Broglas, Swamp Harriers, and Sea Eagles.

**Principle 10: Other management and operational practices**

Lake Mulwala (the lake formed by Ythe arrawonga Weir on the Murray) was drawn down below its normal operating level in Winter 2015 (outside the irrigation season so not interrupting consumptive use) to allow vital maintenance. This also aided ongoing efforts to manage the aquatic waterweed Egeria densa¹ (‘Brazilian Waterweed, commonly found in household aquariums). The waterweed spread across much of the lake in the mid-1990s, compromising biodiversity and, at times, restricting recreational activities, including fishing, boating, and water skiing.

Since 2008 there have been four “drawdowns” (or lowering of the lake below its normal water level) in Winter that exposed the weed to air and frost, drying it out. A monitoring survey technique was developed to track the effectiveness of each drawdown in managing the weed Egeria in the lake. The observed information and lessons about Egeria and the four drawdowns were synthesised in 2014-15, alongside stakeholder perspectives.

MDBA and Goulburn-Murray Water will be drawing on the report to develop guidelines for managing submersed aquatic vegetation (including Egeria) in the lake. The guidelines will be implemented as part of normal operations and adapted over time as knowledge and information improves.

**Principle 11: Management of water for consumptive use**

Variable releases of consumptive water (or bulk water transfers from Dartmouth to Hume Dams) were made in accordance with environmental guidelines for flow variability in the Mitta Mitta River. Essentially, these guidelines set out ‘tried and tested’ ways (based on knowledge gained from previous monitored trials) that variable river flow patterns and levels, implemented within the context of achieving a ‘healthy working river’, can be utilised to contribute to the protection and, where possible, restoration of environmental assets and ecosystem functions.

For the highly regulated Mitta Mitta River, pulsing releases of consumptive water is currently the only opportunity to improve the environmental outcomes of river operations in this reach. Past monitoring (to develop the guidelines) shows that flow

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¹ Egeria densa is an aquatic waterweed that reached problematic levels of abundance and distribution in Lake Mulwala around 2008.
<table>
<thead>
<tr>
<th><strong>Principle</strong></th>
<th><strong>Example</strong></th>
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<tr>
<td></td>
<td>pulsing in the Mitta Mitta River, irrespective of the ecological impacts of cold water releases from Dartmouth Dam, does improve the quality of “biofilm” in the river, thereby indicating a positive shift in river health.</td>
</tr>
</tbody>
</table>