

The Living Murray Environmental Water Delivery 2012–13



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Postal Address: GPO Box 1801, Canberra ACT 2601
Telephone: (02) 6279 0100 international + 61 2 6279 0100
Facsimile: (02) 6248 8053 international + 61 2 6248 8053
Email: engagement@mdba.gov.au
Internet: <http://www.mdba.gov.au>

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Cover image: Little Rushy Swamp, Barmah Forest following environmental watering. (photo by Keith Ward)

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Acknowledgement of the Traditional Owners of the Murray–Darling Basin

The Murray–Darling Basin Authority acknowledges and pays its respect to the Traditional Owners and their Nations of the Murray–Darling Basin. The contributions of earlier generations, including the Elders, who have fought for their rights in natural resource management are also valued and respected.

The MDBA recognises and acknowledges that the Traditional Owners and their Nations in the Murray–Darling Basin 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. Further research is required to assist in understanding and providing for cultural flows. The MDBA supports the belief of the Northern Murray–Darling Basin Aboriginal Nations and the Murray Lower Darling Rivers Indigenous Nations that cultural flows will provide beneficial outcomes for Traditional Owners.

The approach of Traditional Owners to caring for the natural landscape, including water, can be expressed in the words of Ngarrindjeri elder Tom Trevorrow: ‘our traditional management plan was don’t be greedy, don’t take any more than you need and respect everything around you. That’s the management plan—it’s such a simple management plan, but so hard for people to carry out.’¹ This traditional philosophy is widely held by Traditional Owners and respected and supported by the Murray–Darling Basin Authority.

¹ Tom Trevorrow (2010) Murrundi Ruwe Pangari Ringbalin ‘River Country Spirit Ceremony: Aboriginal Perspectives on River Country’.

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About The Living Murray

The Living Murray (TLM) was established in 2002 in response to evidence of the declining health of the River Murray System. In November 2003 the Murray–Darling Basin Ministerial Council announced The Living Murray First Step Decision. The critical component of this historic decision was targeting the recovery of 500 Gegalitres (GL) of water to be used to protect and restore the environment. An environmental works program was also established to assist with environmental water delivery and optimise the environmental benefits from this water.

The focus of The Living Murray is to improve the environmental health at six 'icon sites' along the River Murray (**Figure 1**) through the use of environmental water. The six icon sites are highly valuable ecological and cultural sites and include:

- Barmah–Millewa Forest
- Gunbower–Koondrook–Perricoota Forest
- Hattah Lakes
- Chowilla Floodplain, and Lindsay–Wallpolla Islands
- Lower Lakes, Coorong and Murray Mouth (LLCMM)
- River Murray channel.



Figure 1: TLM icon sites along the River Murray

Coordination and collaboration

The Murray–Darling Basin Authority (MDBA) coordinates TLM activities on behalf of the TLM partner governments (New South Wales, Victoria, South Australia and Commonwealth). These activities include:-

- planning and delivery of environmental water
- construction and commissioning of environmental watering structures
- monitoring environmental watering outcomes
- water modelling to support planning and decision making, and
- engagement with local and Aboriginal communities.

The success of TLM is underpinned by the strong collaborative approach between the MDBA and the partner governments who deliver TLM on the ground.

Planning and Delivery

One of the key activities within The Living Murray program is the management of a portfolio of environmental water. The portfolio provides a long-term average volume of 479.9 GL. The actual volume available in any given year varies depending on water allocation announcements.

Each year the MDBA coordinates the planning and delivery of this portfolio to optimise its use across the six icon sites. This coordination is undertaken in consultation with TLM partner governments, state coordinators and icon site managers, and with the support of the following TLM program areas:

TLM Environmental Works and Measures oversees the construction and commissioning of environmental works. This includes providing advice on the operating plans and commissioning water requirements for these works, which also informs the TLM annual watering planning.

TLM Monitoring coordinates monitoring that:- provides information about the ecological condition of icon sites; assesses the ecological responses to environmental water delivery and management actions, and monitors the risks associated with the operation of environmental works. The information from this monitoring provides an understanding of the condition of the TLM icon sites and the River Murray system, and informs the planning and adaptive management of future watering actions.

TLM Modelling supports environmental water planning and delivery through the development and refinement of water quantity and quality models. This modelling informs the use of environmental works and the development of watering proposals at icon sites.

Indigenous Partnerships Program (IPP) funds Indigenous icon site facilitators to identify opportunities for Indigenous partnerships in icon site planning and management. This helps to ensure that planning is undertaken in a culturally appropriate manner and cultural elements of environmental water delivery are taken into account. This has been particularly important in meeting cultural heritage approvals associated with the construction of environmental works.

Key elements of the annual TLM water planning and delivery process is presented in Figure 2. This includes the publication of The Living Murray Annual Environmental Watering Plan at the start of each water year (July). This plan, which is developed on behalf of the TLM partner governments, and in consultation with river operators and other environmental water holders, describes annual TLM watering priorities and guides the implementation of watering actions throughout the year.

**Key elements of The Living Murray
environmental watering planning and implementation**



Figure 2: TLM annual environmental watering processes

Basin Plan

The Basin Plan came into effect in November 2012, providing the framework for a coordinated approach to water use across the Murray–Darling Basin. It was developed under the *Water Act 2007* and aims to limit water use to environmentally sustainable levels. This will be achieved by setting limits on the amount of water that can be taken from surface and groundwater resources.

The Environmental Watering Plan is a central part of the Basin Plan and provides a framework to ensure the best possible outcomes for the environment. It does this by setting environmental objectives to protect, restore and build the resilience of water dependent ecosystems and their associated functions.

The Living Murray's planning and implementation activities are consistent with the Basin Plan. In particular, TLM annual environmental watering objectives are consistent with the objectives of the Environmental Watering Plan. TLM implementation activities also seek to maximise environmental outcomes while having regard to water quality and salinity targets of the Basin Plan.

Appendix A of this document provides further details of how TLM activities are consistent with the Basin Plan.

Improvements in Watering Practices in 2012–13

The following activities in 2012–13 contributed to the on-going improvement in TLM environmental water planning and delivery practices.

Operating plans for environmental works

In collaboration with TLM partner governments and icon site management authorities, operating plans were developed for the use of the environmental works at Koondrook–Perricoota Forest, Hattah Lakes and the Lindsay–Wallpolla icon sites. Development of operating plans for the Gunbower Forest and Chowilla Floodplain works also progressed in 2012–13. These operating plans will assist water managers to effectively and efficiently deliver environmental water as well as manage risks related to their operation.

Environmental works operations models

Models have been developed to inform environmental water planning and icon site operating plans. These models simulate the operation of the works to produce information about areas of inundation, water usage, and impacts on downstream flows and water quality. The models will be recalibrated and refined as data becomes available and will provide a robust tool for water managers and river operators.

Operational salinity risk management framework

In coordination with TLM partner governments, a salinity risk management framework was developed that can be applied when delivering TLM environmental water to high salinity risk sites. The framework allows for the identification of salinity risks and mitigation and/or monitoring measures. Selected measures will depend on a range of factors at the time of delivery. Some key measures include hydrograph manipulation, improved coordination of water deliveries and dilution flows.

Blackwater model

A blackwater model of the River Murray and Edward–Wakool rivers was developed in conjunction with the Murray–Darling Freshwater Research Centre. This model can predict downstream dissolved oxygen (DO) levels during watering activities, assisting water managers and river operators manage low DO (blackwater) during environmental water delivery. The model can currently assess the predicted DO levels from the inundation of major floodplains of Barmah, Millewa, Gunbower and Koondrook–Perricoota forests. This model can also be applied at other icon sites.

Review of River Murray channel ecological objectives

This work provides an important link between the identification of flow requirements at all icon sites and the achievement of ecological outcomes along the River Murray channel. Importantly the revised objectives will inform the planning process to optimise environmental outcomes in the River Murray channel through the delivery of environmental water to other icon sites.

Breakdown of models to an icon site scale

Modelling of entire river systems by the MDBA (system scale) cannot usefully inform environmental watering decisions at an icon site scale. Water managers and river operators require detailed accounting of water delivery and return flows in real-time to guide environmental watering actions.

In 2012–13 individual models were developed for each of the icon sites. The models can be used to test different watering scenarios and estimate water-use at the icon site. This allows water managers to develop environmental watering proposals covering a range of potential climatic conditions. The models also guide operational decisions by estimating daily water use. Estimates of water returned to the River Murray can then be considered for downstream use by environmental water managers and river operators.

Synthesis reporting

In 2012–13 icon site managers, with input from their monitoring service providers, used icon site condition monitoring and other monitoring project information to develop synthesis reports for each of the icon sites in Victoria and South Australia. These icon site synthesis reports were used to compile a system synthesis report that provides an overview of 2011–12 River Murray System monitoring findings. The synthesis reporting of monitoring undertaken in 2012–13 will continue.

Condition monitoring review

Monitoring the environmental condition of the TLM icon sites against targets is one of the main activities for TLM Monitoring. Each icon site has a condition monitoring plan which outlines activities and the rationale for the monitoring. Over time, opportunities to improve monitoring are identified.

In 2012–13 a work program to improve condition monitoring plans began. This was in response to the 2012 independent review findings that some icon site monitoring objectives needed to be better defined and points of reference for condition added. This involved an independent statistician, icon site management agencies and their monitoring service providers identifying improvements to objectives, and if required, developing or adding targets or reference points for condition monitoring. This work is continuing in 2013–14.

Environmental Watering for 2012–13

Planning for water delivery

Water allocations available to The Living Murray portfolio for 2012–13 were strong, owing to high rainfall across large parts of the Basin early in the water year, and relatively full water storages.

The need to keep a number of environmental works construction sites dry (including Gunbower-Koondrook–Perricoota, Chowilla Floodplain and Hattah Lakes) meant that planning focused on environmental water delivery to the lower River Murray channel and the Lower Lakes, Coorong and Murray Mouth (LLCMM) icon sites.

Naturally occurring high flows throughout spring 2012 inundated some icon sites delaying the construction of environmental works. These high flows, originating from the Murray, Goulburn, Murrumbidgee and Darling river systems, continued through to South Australia and over the barrages until the end of October 2012.

Water delivered and outcomes achieved

To build on the ecological health improvements to the River Murray system initiated by the return of high flows in recent years, 2012-13 TLM water delivery focused on a whole of system approach. Over 297 GL (including 292 GL of regulated TLM environmental water and 5.45 GL from TLM's unregulated entitlement) was delivered (Table 1).

On the back of high flows in Spring 2012, TLM environmental water was used to support bird breeding events in Barmah-Millewa Forest; provide flow pulses at Gunbower Creek to build the resilience of native fish populations, and to inundate river red gums and lignum understorey on the Chowilla floodplain. In coordination with other environmental water holders TLM contributed 289 GL to the lower River Murray Channel and Lower Lakes, Coorong and Murray Mouth (LLCMM) icon sites. A key component of this event was the coordination of upstream water releases with tributary inflows along the Murray, providing ecosystem outcomes in the River Murray channel, its tributaries and downstream icon sites.

Table 1: 2012-13 TLM environmental watering actions

Site	Volume (GL)	Objective
Barmah – Millewa Forest	2.9	Flow to maintain water levels to support a bird breeding event (ibis) at Boals Deadwoods
Gunbower	5.45	Provide small freshes and baseflow to build the resilience of native fish population
Chowilla Floodplain	0.1	Watering river red gum recruits and lignum understorey to provide habitat for the southern bell frog
Lower River Murray Channel	50	Provide a variable flow regime, stimulate fish recruitment, and provide lateral connectivity with the Lower Lakes, Coorong and Murray Mouth
Lower Lakes, Coorong and Murray Mouth	239	Maintain connectivity between Lower Lakes and estuary, maintain open Murray Mouth, maintain salinity in Lake Alexandrina at <1,000 EC and provide lateral connectivity with the Murray River Channel

Barmah–Millewa Forest

Objective: If initiated by natural flows, deliver environmental water to allow the completion of waterbird nesting.

A total of 2.9 GL of water was delivered to Boals Deadwood between June and October 2012 to support a waterbird nesting event. These flows maintained shallow flooding until the young birds had fledged. Approximately 500 nests — including white ibis, straw necked ibis and royal spoonbills — were observed.



Figure 3: White Ibis chicks at Barmah Forest. Photographer Keith Ward.

Gunbower Forest

Objective: Deliver flow freshes and bank full flows to maintain habitat for native fish.

Early season natural flow events and environmental water (incl 5.45 GL of TLM unregulated entitlement) provided a series of small freshes and base flows to Gunbower Creek. These freshes consolidated the benefits of the naturally high flows from previous years, maintaining habitat to build the resilience of native fish populations.

Chowilla Floodplain

Objective: Provide water to above-pool wetlands on the Chowilla Floodplain to support waterbirds, vegetation and frog communities.

In spring 0.1 GL of TLM environmental water was pumped into Brandy Bottle Wetland on the Chowilla Floodplain to support the recovery of vegetation and improve habitat for wildlife. Brandy Bottle Wetland was the only site on the Chowilla Floodplain that did not receive water during the environmental watering in 2011–12 or the high flows of early 2012–13. The 2012–13 environmental watering resulted in improved condition of trees and understorey vegetation; as well as a positive response from frog and waterbird communities. Eight species of waterbirds and five species of frogs were recorded during or shortly after the watering event.

Lower River Murray and Lower Lakes, Coorong and Murray Mouth icon site²

Natural high flows in the lower River Murray meant that environmental water was not required for these icon sites until late spring. Once these flows ceased a coordinated environmental watering event then delivered 1,090 GL to South Australia between November 2012 and June 2013 (**Figure 4**). This was the largest volume of environmental water delivered to the lower River Murray to date. The watering action included contributions from TLM (289 GL), the Commonwealth Environmental Water Holder (787 GL) and from South Australia (14 GL).

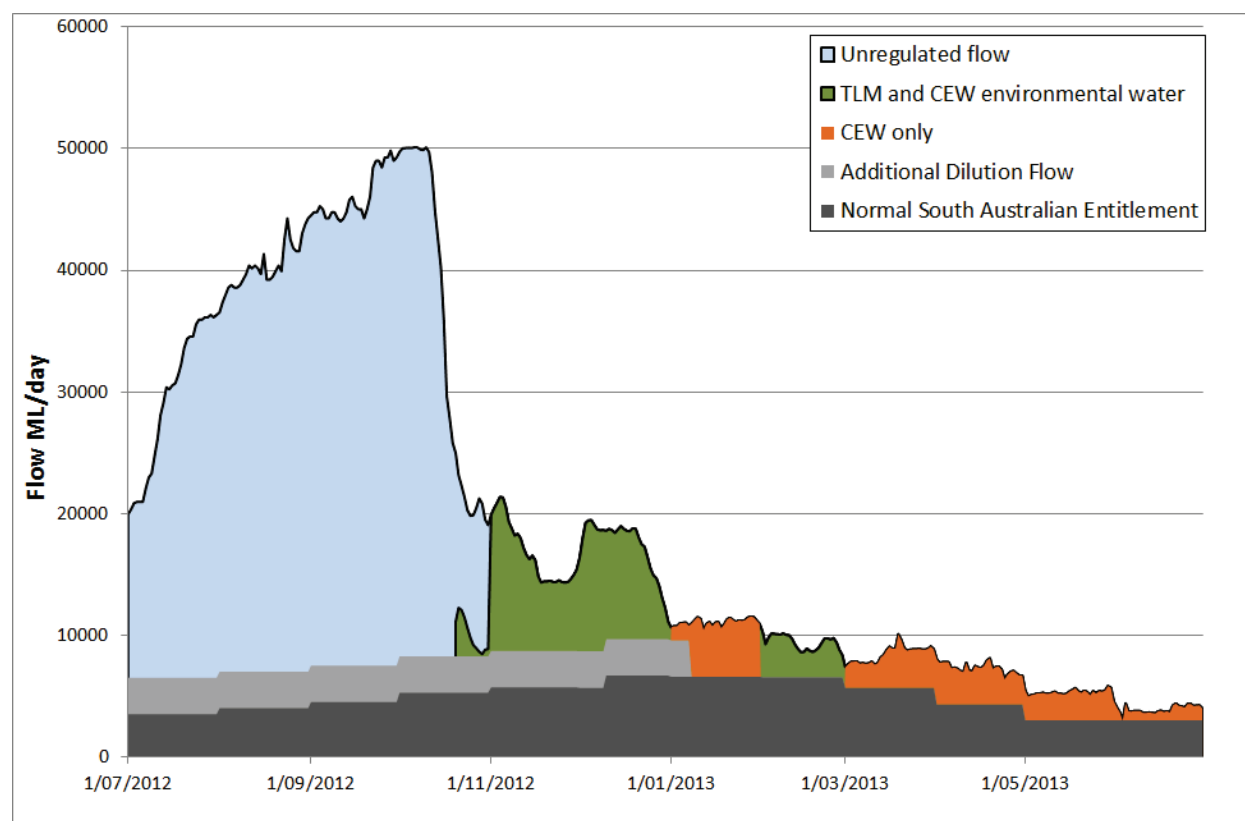


Figure 4: Flows to South Australia in 2012-13

The delivery of environmental water consolidated the benefits of the high natural flows and supported ecological outcomes in the lower River Murray channel and the LLCMM icons sites. These are discussed in detail below.

Lower River Murray channel (South Australia)

Objective: Provide a flow pulse to stimulate fish breeding and recruitment.

A fish pulse to initiate golden perch spawning in the lower River Murray channel began in late November 2012 and continued for three weeks. Initial results from monitoring by the South Australian Research and Development Institute (SARDI) indicated a positive response with the presence of golden perch larvae.

² The information presented in this section has relied on the contributions of the University of Adelaide, SARDI and Flinders University. A full list of references is provided at the end of the report. The SARDI monitoring was funded by the CEWO.

Following this pulse, environmental flows continued, helping to support the development of the golden perch larvae. This flow also improved the condition of temporary wetlands, supported bird breeding events and provided lateral connectivity between channel and off-channel habitats.

Lower Lakes, Coorong and Murray Mouth icon site

Objective: Twelve months of continuous barrage releases to:

- 1) Maintain an open Murray Mouth and connection between the Lower Lakes and estuary.
- 2) Achieve optimal salinity levels in the Lower Lakes and Coorong to support native fish and waterbirds:-
 - (a) maintain Lake Alexandrina salinity levels below 1,000 EC,
 - (b) reduce salinity levels in Lake Albert to an average of 2,000 EC by the end of June 2013, and
 - (c) maintain Coorong salinity levels under 100 parts per thousand (ppt).
- 3) Provide flows to the Coorong South Lagoon to facilitate the growth of Ruppia.

Salinity

Increased salinity in waters of lower end of the River Murray continues to be an issue following the recent drought. During the drought, salts derived from upper catchments were not able to be exported to sea due to the low flows. Instead, salts concentrated in the Lower Lakes through evaporation and the reduced freshwater inflows. This resulted in the Lower Lakes becoming more saline and areas of the Coorong becoming hypersaline (salt concentrations higher than sea water).

The large natural flows supported by environmental water in 2012-13 meant that the Murray Mouth remained open. This provided continuous water exchange with the Coorong and allowed the export of salts from the system. Salinity concentrations in Lake Alexandrina and the Coorong were maintained below target levels for the majority of the year, with only small localised spikes observed at Lake Alexandrina when high tides pushed sea water into the lake in late August and September.

While salinity in Lake Albert continued to improve following the drought, salt concentrations remained above the target threshold (2,000 EC) for 2012-13. Lake Albert is a terminal lake with only a narrow connection to Lake Alexandrina. Flow into and out of Lake Albert is controlled by the water level in Lake Alexandrina, which in turn is affected by inflows, waves, wind and evaporation. The hot, dry conditions during the summer of 2012-13 meant that salinity in Lake Albert remained high (3,400 EC) until autumn when local rainfall and wind drove some mixing of water between the two lakes reducing salinity concentrations to around 2,800 EC.

Fish

In the Lower Lakes, all three species of threatened freshwater fish (Murray hardyhead, southern pygmy and Yarra pygmy perch) were observed for the first time since 2008, albeit in low numbers. Two adult pouched lamprey were recorded moving upstream into Lake Alexandrina in late June 2013. Pouched lamprey require high water levels and relatively warm water temperatures (12–14.5° C) to stimulate migration and breeding and were not observed at all during the drought. Passage of the pouched lamprey provides an indication of improving conditions in the Lower Lakes as well as improved connectivity between the Murray estuary, Lake Alexandrina and the River Murray channel.

With environmental water supporting outflows through the barrages in 2012–13, the barrage fishways operated throughout the year. This allowed passage and recruitment opportunities for diadromous fish (fish that migrate between salt and fresh waters) including congolli and common galaxias, which have been found in increasing numbers in the Lower Lakes.

Fish numbers in the Coorong generally increased with the return to higher flows and the associated improvements in water quality, food resources and habitat. In 2012–13 there was increased recruitment success recorded for congolli, yellow-eye mullet and Tamar goby in the estuary and north lagoon. The distribution ranges of some fish species increased spatially into the Coorong south lagoon due to reductions in salinity. Many species increased their distribution range into the south lagoon for the first time since the drought.

Waterbirds

Two years of high natural flows and the delivery of environmental water has seen an increase in the abundance of most waterbird species in the Lower Lakes and Coorong. In January 2013, 286,000 waterbirds were observed across the icon site.

At Lake Alexandrina and Lake Albert the dominant waterbirds recorded were cormorants and ducks; however, some wader bird species like the yellow-billed and royal spoonbills continued to decline because food resources are not yet fully recovered following the drought.

In the Coorong the most abundant birds were ducks, coots, stints and sandpipers. While the recovery of waterbird populations in the Coorong since the drought is tracking positively, recovery is not complete with some shorebirds and coastal species like the pied oystercatcher, fairy tern and common greenshank yet to return to pre-drought abundances.



Figure 5: Waterbirds in Coorong near Tauwitchere Barrages

Vegetation

High natural flows supported by the large deliveries of environmental water over recent years, has seen a positive response from vegetation communities of the Lower Lakes, Coorong and Murray Mouth, particularly in terms of health, abundance and distribution

Water level height and variability in Lake Alexandrina and Lake Albert influence the extent and condition of fringing vegetation as well as submergent and emergent aquatic plants. In 2012–13 the barrages were operated to gradually vary water levels in the Lower Lakes throughout the year. This provided a more seasonal variation in water level with maximum levels occurring in spring, and minimum levels occurring in late summer and autumn. Combined with the reduction in salinity, this presented favourable conditions for vegetation in the lakes.

There were a number of positive vegetation responses to the 2012–13 flows. These included an expansion in the distribution of submergent aquatic vegetation in the sheltered areas (wetlands and protected shore lines) of the Lower Lakes; and a stabilisation in the distribution of emergent vegetation such as reeds, rushes and sedges around the lake edges and wetlands. The continued improvement in the condition of submergent and emergent vegetation communities in the Lower Lakes is important in providing further sediment stability, habitat and food sources for birds, fish, frogs and macroinvertebrate communities.

Ruppia is a native sea grass that is an important part of the Coorong ecosystem. The beds of *Ruppia* have been under pressure over recent years through unfavourable water levels and increased salinity in the Coorong. The natural high flows supported by environmental water delivery generated a flowering response and growth from *Ruppia*, providing important food and habitat for birds, small fish, invertebrates and zooplankton. Operational constraints meant that water levels in the Coorong were unable to be maintained resulting in low seed production and presence of turions (small shoots).

Summary

The return of higher flows in recent years has significantly improved the ecological health of many parts of the River Murray system. The large natural flows in Spring 2012 provided the opportunity for TLM and other environmental water holders to deliver environmental water to continue to support the improvements to the health and resilience of the river.

The main focus of environmental water delivery in 2012-13 was to the lower River Murray Channel and the Lower Lakes, Coorong and Murray Mouth, which is still recovering from the impacts of the millennium drought. In coordination with other environmental water holders, 1,090 GL of environmental water was delivered to the lower end of the system which produced positive water quality and ecological responses, including observations of large numbers of waterbirds, fish movement between the Coorong and the Lower Lakes and improvement in the extent and condition of key vegetation communities.

TLM environmental water will continue to look for opportunities to improve the health of icon sites and the River Murray system, supporting the recovery from drought and building resilience. Given the continued pressures facing water resources of the Murray Darling Basin and climate uncertainties, ecosystem resilience will be important in sustaining a viable functioning river system into the future.

Appendix A – Basin Plan

The Living Murray environmental water planning and delivery functions are consistent with the current requirements of the Basin Plan. In implementing these functions, the planning and delivery of TLM environmental water:

- considers the objectives and outcomes of the Basin Plan to support the health of water dependent ecosystems
- utilises principles and methods consistent with the Basin Plan
- is made in coordination and cooperation with other environmental water holders
- considers associated risks and implements best-available mitigation strategies
- has regard to the salinity and water quality operating targets in the Basin Plan.

The Living Murray icon sites are included as key environmental assets within the Basin Plan. Table 1 below summarises how TLM watering objectives contribute to the environmental objectives of the Basin Plan.

Table 2: The Living Murray watering objectives in alignment with the Basin Plan

Basin Plan reference	TLM annual environmental watering plan practices
Sections 8.04(a) and 8.05 Protect and restore water-dependent ecosystems of the Murray–Darling Basin	Through prioritisation of watering actions, in consideration of icon site ecological objectives, the annual planning and delivery practices specifically target the protection and restoration of water-dependent ecosystems.
Sections 8.04(b) and 8.06 Protect and restore the ecosystem functions of water-dependent ecosystems	The protection and restoration of ecosystem functions are indirectly addressed through the delivery of environmental water to protect and restore water-dependent ecosystems. The physical, chemical and biological processes that support water dependent ecosystems are often not explicitly identified in icon site ecological objectives, but rather underpin the higher level outcomes that are targeted.
Sections 8.04(c) and 8.07 Ensure water-dependent ecosystems are resilient to climate change and other risks and threats	Improvements to the health and diversity of water-dependent ecosystems achieved through environmental water delivery builds resilience within these systems, supporting ecosystem response to risks and threats such as climate change.

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