



Australian Government

Commonwealth Environmental Water Office

Integrated planning for the use, carryover and trade of
Commonwealth environmental water

Mid-Murray Region

2015–16



Front cover image credit: Wakool River Junction above confluence with Yallakool Creek, 2015
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Back cover image credit: Trout Cod (endangered under the Environment Protection and Biodiversity Conservation Act 1999), Upper Edward River, 2015
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Acknowledgement of the traditional owners of the Murray-Darling Basin

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

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Table of contents

Commonwealth environmental water portfolio management planning	4
Purpose of the document	4
Purpose of portfolio management planning	4
Scope of integrated portfolio management planning	4
Part I: Portfolio management planning in the Mid-Murray	5
1. Purpose and portfolio management for 2015–16	5
1.1. Overall purpose.....	5
1.2. Water Use	7
1.3. Carryover.....	9
1.4. Trade	9
1.5. A note on transfer	10
1.6. Your input	10
Part II: Commonwealth environmental water portfolio management planning	15
2. Background	15
2.1. Commonwealth environmental water	15
2.2. The Mid-Murray Region.....	15
3. Long-term environmental water demands in the Mid-Murray Region	17
3.1. Basin-wide environmental watering strategy	17
3.2. Long-term watering plans	17
3.3. Expected outcomes in the Mid Murray Region	18
3.4. Flows in scope for Commonwealth environmental watering in the long-term.....	20
3.5. Potential watering actions under different levels of water resource availability.....	22
3.6. Potential watering actions – standard operational considerations	25
4. Long-term water availability	29
4.1. Commonwealth environmental water holdings	29
4.2. Other sources of environmental water	29
4.3. Planned environmental water	29
5. Next steps	30
5.1. From planning to decision making.....	30
5.2. Further information	30
Attachment A – Expected outcomes from the Basin-wide environmental watering strategy	31
Attachment B – Detailed indicative demands for Edward-Wakool system	34
Bibliography	36

Commonwealth environmental water portfolio management planning

Purpose of the document

This document consists of two parts. Part I sets out the Commonwealth Environmental Water Office's (the Office) portfolio management planning for the 2015–16 water year and for the following two years. While focussed on the Mid Murray Region, the identified use, carryover and trading intentions have been considered together with those for other catchments in a Murray-Darling Basin-wide analysis.

Part II of this document establishes the context for how the Office integrates its management of the Commonwealth environmental water portfolio in the Mid Murray Region and across the Murray-Darling Basin more broadly. It sets out the environmental demands that Commonwealth environmental water may contribute to in the Mid Murray Region, as well as the long-term supply profile for Commonwealth environmental water. Part II also explains how these two factors are considered together to inform an overall purpose for portfolio management, as well as the most appropriate mix of portfolio management options to maximise the benefits that can be achieved with the water portfolio across multiple years.

Purpose of portfolio management planning

Efficient and effective management of the Commonwealth environmental water holdings requires the utilisation of all portfolio management options (use, carryover and trade). To support improved outcomes from water use over time, carryover provides the opportunity to optimise water use across water years and to improve water availability early in a water year, while trade provides further capacity to optimise use over the long-term as well as across catchments.

Through multi-year integrated planning, portfolio management tools such as use, carryover and trade can be strategically managed for maximising environmental outcomes. Integrated portfolio management planning will also support the Office in:

- meeting Basin Plan obligations and contributing to the long-term objectives of the environmental watering plan, the expected outcomes in the Basin-wide environmental watering strategy and Basin annual environmental watering priorities
- managing the Commonwealth environmental water portfolio in response to the demands identified by Basin States in long-term environmental watering plans, once available
- applying adaptive management (including the setting of objectives, evaluating outcomes and informing future decision making)
- providing increased transparency in relation to the Commonwealth Environmental Water Holder's portfolio management (use, trade and carryover) behaviour
- coordinating water use with delivery partners, including developing long-term delivery arrangements

Scope of integrated portfolio management planning

The following portfolio management options have been determined to be in scope for integrated planning by the Office:

- use
- carryover
- trade of allocations including:
 - transfer of allocations between connected catchments
 - sale of allocations
 - purchase of allocations

The Office's portfolio management planning seeks to consider long-term demands (i.e. flow regimes) and supply, covering at least the preceding three years and out to three years.

Part I: Portfolio management planning in the Mid-Murray

1. Purpose and portfolio management for 2015–16

1.1. Overall purpose

Demand for environmental water

Since 2010, natural flows events and environmental watering actions have resulted in improvements in the condition of many of the wetlands in the Mid-Murray and promoted recovery following the millennium drought. Drier conditions in 2013–14 and 2014–15 have seen some floodplain wetlands entering into a natural drying phase. Environmental water demands for the Mid-Murray in 2014–15 are represented in Tables 1 and 2(a-b) and summarised below:

River Murray Channel: There is a moderate demand for environmental water to contribute to improved seasonality of flows and to connect the river with low-lying wetlands.

Edward-Wakool System: There is a moderate to high demand for environmental water in the Edward-Wakool system, particularly to maintain and consolidate the benefits of previous environment watering actions.

Barmah-Millewa Forest: Demands for environmental water in the Barmah-Millewa Forest are moderate (on average), however there is a high demand in Barmah-Millewa Forest for flows to support moira grass, which is declining in extent and did not receive significant flows in 2014–15.

Gunbower Creek: There is a moderate demand for environmental water to contribute to variable baseflows and freshes to support the survival of juvenile fish, and stimulate spawning and lateral movement of large-bodied, native fish between Gunbower Creek and Gunbower Forest.

Gunbower-Koondrook-Perricoota Forest: Due to the significant watering action in 2014–15 that supported floodplain fish spawning and bird breeding, there is a low demand for environmental water in Gunbower Forest. In Koondrook-Perricoota Forest there is a moderate to high demand for environmental water to build on the outcomes achieved from the use of The Living Murray and New South Wales environmental water portfolios in the forest during 2014–15.

Central Murray off-channel wetlands and ephemeral creeks - Barham to Euston: In the permanent wetlands, there is a critical demand for environmental water to maintain Murray hardyhead. In the semi-permanent wetlands there is a moderate need to maintain aquatic vegetation and waterbird habitat, and improve the condition of mature River Red Gum trees. There is a low demand for environmental water in the ephemeral wetlands as water has been recently delivered to many of these assets and drying phases are now ensuing.

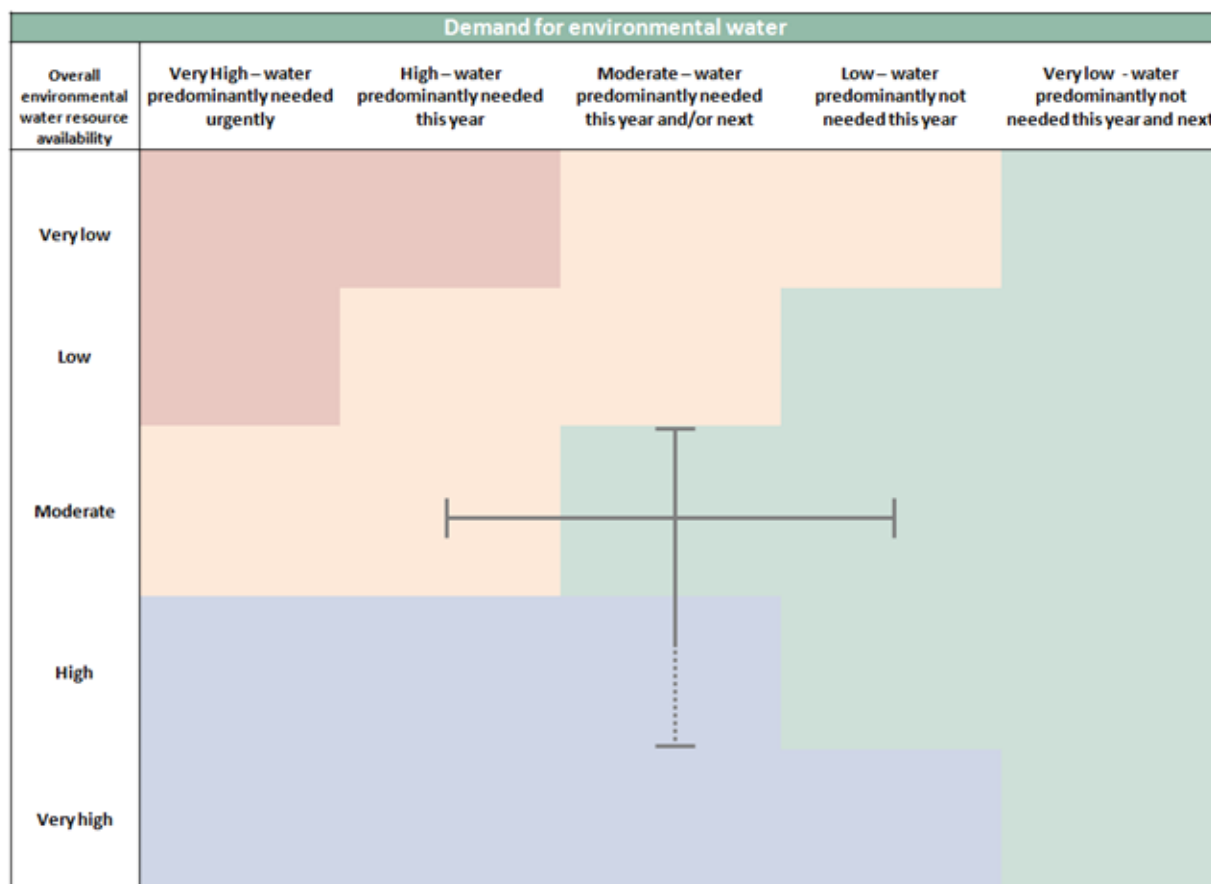
Supply

Water resource availability (supply) in the context of meeting environmental demands is contributed by allocations against entitlements held for the environment by the Commonwealth Environmental Water Holder, New South Wales Office of Environment and Heritage, Victorian Environmental Water Holder and The Living Murray, as well as natural and unregulated flows, and planned environmental water provisions. Further detail is provided in Part II, Section 4.

Considering carryover of Commonwealth environmental allocations from 2014–15 to 2015–16, the range of potential opening allocations for 2015–16, operational considerations, along with the full range of potential streamflows, moderate to high resource availability scenarios are in scope for 2015–16. The condition of the Murray–Darling Basin is likely to be dry for the 2015–16 water year (MDBA 2015). Dry conditions combined with reasonable carryover from 2015–16 and opening allocations presents a **moderate resource availability** scenario overall. High resource availability is only possible if conditions become wet, which is considered unlikely given the seasonal outlook.

Purpose

Figure 1 shows how these two factors are considered together. The overall 'purpose' for managing the Commonwealth's water portfolio in the Mid Murray for 2015–16 is to **protect** the floodplain forest areas where demands are high, while **maintaining** ecological health and resilience of other key sites in the system. If water availability becomes high, there may be scope to **improve** the health and resilience of aquatic ecosystems through the Mid Murray system.



Avoid damage: Avoid damage to environmental assets

Protect: Ensure ecological capacity for recovery

Maintain: Maintain ecological health and resilience

Improve: Improve the health and resilience of aquatic ecosystems / Build future capacity to support ecological health and resilience

Figure 1: Determining a broad purpose for portfolio management in the Mid Murray for 2015–16

Note: grey lines represent potential range in demand and resource availability

1.2. Water Use

Consistent with the demands and purpose described above, the Office is considering supplying environmental water to the following watering actions for 2015–16. Table 1 summarises which of these actions are relevant to which resource availability scenarios in 2015–16, with further detail and rationale established in Table 2, including implications for future years based on assumed use behavior for 2015–16. Table 1 also identifies the 2015–16 Basin annual environmental watering priorities (published by the Murray-Darling Basin Authority) that the various watering actions may contribute to meeting.

Table 1: Potential Commonwealth watering actions and applicable resource availability scenarios for the Mid Murray Region in 2015–16

Watering action	2015–16 Basin annual environmental watering priority(s) ¹	Resource availability scenarios action is likely to be pursued under	
		Moderate	High
River Murray from Hume to Euston	<ul style="list-style-type: none"> • Basin-wide flow variability and longitudinal connectivity • Basin-wide in-stream and riparian vegetation • Moira grass • Basin-wide native fish habitat and movement • Silver perch 	Yes (requires appropriate natural flow cue for delivery to Barmah-Millewa Forest)	Yes (requires appropriate natural flow cue for delivery to Barmah-Millewa Forest)
Edward-Wakool system and Koondrook-Perricoota (including—permanent water ways, ephemeral waterways and wetlands and forests)	<ul style="list-style-type: none"> • Basin-wide flow variability and longitudinal connectivity • Basin-wide in-stream and riparian vegetation • Basin-wide waterbird habitat and future population recovery • Basin-wide native fish habitat and movement • Silver perch 	Yes	Yes (though flows components mabe be met through other sources of water)
Gunbower Creek channel flow	<ul style="list-style-type: none"> • Basin-wide flow variability and longitudinal connectivity • Basin-wide in-stream and riparian vegetation • Basin-wide native fish habitat and movement • Silver perch 	Yes	Yes
Central Murray off-channel wetlands and ephemeral creeks - Barham to Euston	<ul style="list-style-type: none"> • Basin-wide in-stream and riparian vegetation 	Yes	Yes

River Murray system from Hume to Euston

Summary: In response to natural cues, in-channel freshes may be provided to maintain suitable aquatic habitat for native fish, support longitudinal and lateral hydrological connectivity and contribute to the transport and export of salt and nutrients. Subject to appropriate triggers, Commonwealth environmental water may be provided to low elevation floodplain areas, such as to extend the duration of inundation of the Barmah and/or Millewa forests. The inundation of floodplain areas would

¹ For full details on the Basin annual environmental watering priorities refer to the MDBA website at <http://www.mdba.gov.au/what-we-do/environmental-water/environmental-watering-priorities>

be for the purpose of maintaining the condition, diversity and extent of floodplain and wetland native vegetation, and in particular, protecting moira grassland from further decline.

Timing: Year round, in response to seasonal cues

Operational considerations and feasibility:

- As per the standard operational considerations for watering actions 1. Mid River Murray Channel Flows and 2. Barmah Millewa Forest Flows (see Part II, section 3.6).

Edward-Wakool River system

Permanent Waterways

Summary: The purpose would be to maintain in-stream habitat, particularly aquatic vegetation and areas supporting the various life stages of native fish. Environmental water use is most likely to contribute to in-channel base flows and freshes. It may also be used to provide a more gradual recession to periods of high flow (e.g. rain rejection flows) and improve water quality. Environmental water may also be used to assist in the management of natural hypoxic-blackwater events if they occur.

Timing: July 2015 to June 2016 (biased late winter to early summer)

Ephemeral waterways and wetlands

Summary: The purpose would be to maintain ephemeral in-stream and wetland habitat, particularly water quality, aquatic vegetation and areas supporting the various life stages of native frogs, birds and aquatic invertebrates.

Timing: Spring–summer 2015 and/or autumn 2016

Edward-Wakool forests

Summary: The purpose would be to maintain vegetation health and to contribute to hydrological connectivity and nutrient/carbon cycling processes. Commonwealth environmental water may be provided to complement the use other flows in Koondrook-Perricoota and Werai forests.

Timing: Winter/spring

Operational considerations and feasibility (for all Edward-Wakool actions): As per the standard operational considerations for watering action 3a, b and c. Infrastructure Delivery: Water may also be sourced from either Murray Irrigation and/or private landholder irrigation infrastructure (see Part II, section 3.6).

Gunbower Creek channel flow

Summary: Environmental water may be provided in partnership with the North Central Catchment Management Authority and the Victorian Environmental Water Holder. The purpose would be to maintain the diversity and condition of small and large-bodied native fish populations through the provision of habitat and opportunities for breeding and recruitment. Improved water quality and hydrological connectivity between Gunbower Forest and Gunbower Creek is also expected to support native fish, aquatic invertebrates and nutrient and carbon movement through the system.

Timing: Year round

Operational considerations and feasibility:

- As per the standard operational considerations for watering action 4. Infrastructure Delivery: Gunbower Creek Channel Flow (see Part II, section 3.6).

Central Murray off-channel wetlands and ephemeral creeks - Barham to Euston

Summary: Commonwealth environmental water may be provided to a number of Wetlands in 2015–16, in partnership with the North Central Catchment Management Authority and the Victorian Environmental Water Holder. Expected outcomes will vary among wetlands but would typically involve hydrological connectivity to refill low-lying wetlands to support wetland vegetation communities,

provide habitat to maintain condition of waterbirds, fish, other aquatic vertebrates (turtles, frogs) and macroinvertebrates.

Timing: Year round

Operational considerations and feasibility:

- As per the standard operational considerations for watering action 8. Infrastructure Delivery Central Murray Off-Channel Wetlands - Barham to Euston (see Part II, section 3.6).

Stakeholder feedback: Consultation on long term portfolio management planning has occurred with key delivery partners (New South Wales Office of Environment and Heritage, Victorian Environmental Water Holder, Victorian Catchment Management Authorities, New South Wales Local Land Services, New South Wales Fisheries, New South Wales Office of Water, New South Wales National Parks and Wildlife, the Murray Darling Basin Authority, the Murray-Darling Wetlands Working Group, scientists engaged in monitoring the outcomes of Commonwealth environmental water use, the Murray-Lower Darling Environmental Water Advisory Group, the Edward-Wakool Stakeholder Committee and various community groups and individuals. Feedback will be sought on an ongoing basis as planning transitions to implementation phase (see Section 1.6).

1.3. Carryover

A moderate proportion of allocations available in 2014–15 are expected to be carried over to 2015–16 in the southern connected basin (350-360 gigalitres). Given the moderate environmental demands in the Mid Murray for 2015–16, if water resource availability remains moderate, a moderate to high proportion of Commonwealth's available allocations for 2015–16 are expected to be used for the watering actions described above. Based on the potential watering activities described above, a low to moderate proportion of allocations are expected to be carried over to support environmental demands in 2016–17 (see Table 2). The level of available allocations to be carried over to 2017–18 will depend upon resource availability and demand.

Given the connected nature of southern Murray-Darling Basin catchments and the varying carryover, account and use limits, carryover is considered at a broader scale than just the Mid Murray Region. More information on how the Commonwealth makes decisions on carryover is here [\[http://www.environment.gov.au/water/cewo/portfolio-mgt/carryover\]](http://www.environment.gov.au/water/cewo/portfolio-mgt/carryover)

1.4. Trade

At this time there is no plan to buy or sell allocations in the southern connected basin in 2015–16. Currently, there is only limited market opportunity for allocation purchase to be pursued. The moderate demands for environmental water that may extend to 2016–17 mean that the sale of allocations will be considered based on ongoing assessments of environmental demands within the southern connected basin and across the Murray-Darling Basin over the next two years (Table 2). The types of scenarios where the need to adjust the availability of Commonwealth allocations is most likely to arise in coming years include:

- If environmental demands have been met and it is determined that there is sufficient forecast allocation to meet future demands across the southern connected Basin, the market will be assessed to determine if there are opportunities to sell surplus water and secure proceeds to improve the Commonwealth Environmental Water Holder's capacity to meet current or future environmental demands across the Murray-Darling Basin
- If a Basin-scale analysis identifies urgent environmental demands within a particular catchment and allocation purchase provides an opportunity to meet those demands using proceeds from the sale of water in a catchment with less urgent demands
- If conditions were to become wet while environmental demands remain high, market conditions might provide a favourable opportunity to purchase allocations to assist in meeting demands and augmenting natural flows

Refer to the [Commonwealth environmental water Trading Framework](#), which includes operating rules, procedures, and [protocols](#), for further information.

1.5. A note on transfer

Where the need arises to adjust the availability of allocations in the Mid-Murray Region, it should be noted that the transfer of allocations from other southern connected catchments would generally be considered as the preferred and more efficient option to allocation purchase or sale, consistent with the rules identified in state water resource plans that apply to all water users.

1.6. Your input

The management of Commonwealth environmental water relies on considerable advice and assistance from local organisations, state governments and others. Individuals and groups within the Murray-Darling Basin community are encouraged to submit suggestions for the management of Commonwealth environmental water. Please contact the Office via: ewater@environment.gov.au.

Table 2a: Environmental demands, potential watering in 2015–16 and outlook for coming years in the Mid-Murray Region – **MODERATE WATER RESOURCE AVAILABILITY IN 2015–16**

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system)		Watering history (from all sources of water)			2015–16			Implications for future demands		
	Flow/volume	Required frequency (maximum dry interval)	2012–13	2013–14	2014–15	Predominant urgency of environmental demand for water	Purpose under moderate resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2016–17 if watering occurred as planned in 2015-16	2017–18 Range of likely demand	Met in 2016–17
			(wet)	(mod)	(drying)						Not met in 2016–17
River Murray from Hume Dam to Euston ¹	12,000 ML/day @ Yarrawonga Weir for at least 7 days and up to 70 days in winter/spring targeting in-channel outcomes and anabranches	4 in 5 years (4 years)				Moderate	Maintain	High likelihood of being met via a combination of natural flows, consumptive deliveries and environmental water	Moderate	Low	
										Moderate	
	16,000 ML/day @ Yarrawonga Weir for at least 7 days and up to 100-150 days in winter/spring targeting in-channel outcomes and giant rush wetlands	1 in 2-3 years (5-6 years)				Low	Maintain	Likelihood of being met via a combination of natural flows, consumptive deliveries and environmental water (Commonwealth environmental water deliveries limited to flow rates that manage third party impacts)	Low-Moderate	Low	
										Moderate	
Barmah-Millewa Forest ¹	25,000-35,000 ML/day @ Yarrawonga Weir (unregulated flow) for at least 7 days (river red gum forest) and followed by 15,000 ML/day flows for three to five months targeting moira grass plain	2-3 in 5 years (6 years) for river red gums	Met for red gum; mostly met for moira grass				Protect	Requires significant natural flow trigger, with Commonwealth environmental water contribution limited to recession component. Note operational challenges identified in Part II, section 3.6	Moderate	Moderate	
		Annual (2 years) for moira grass								High -Critical	
Edward-Wakool River System ⁵ (further detail on Edward-Wakool indicators is provided at Attachment B)	Permanent waterways	Annual				System is continuing to recover from past drought and black water events	Protect	A high potential for environmental water to contribute to this action to continue system recovery and support native fish communities	Moderate -High	Moderate -High	
										Critical	
	Ephemeral waterways and wetlands	1 in 2 years (3 years) for aquatic vegetation and water quality				Drying down in some sites may be required to maintain ephemeral character of the waterway/wetland concerned	Maintain	Some potential for Commonwealth environmental water to be provided to sites that do not require drying down, with potential to alternate sites watered depending on urgency of environmental outcome being sought	Moderate -High	Moderate -High	
										Moderate -High	
	Forests	2-3 in 5 years (6 years) for river red gums				Water has recently been provided to a number of forest areas (e.g. Werai)	Maintain	More extensive watering could be considered, subject to natural cues and other requirements such as third party impacts and return flows being addressed	Moderate	Low	
								Moderate-High			
Gunbower Creek ²	Winter base flow (up to 400 ML/day @Gunbower weir for 90 days). Net use ~6,000 ML	Annually (1 year)				Base flow of sufficient magnitude and duration urgently required for maintaining Murray cod population	Protect	A high potential to support native fish communities	High	High	
										Critical	
	Spring pulse and stable summer flows for fish breeding: <ul style="list-style-type: none">Base-flow of up to 550 ML/day in SpringSingle fresh up to 700ML/d for 120 days in spring/summer	Fish spawning fresh 2 in 3 years				Significant watering action in 2014-15 inundated various wetlands in Gunbower Forest via Gunbower Creek, however flows within the creek required annually to maintain the diversity and condition of small and large-bodied native fish populations	Maintain	A high potential to support native fish communities	Moderate	Moderate	
								High			
Gunbower-Koondrook-Perricoota Forest ³	Small-moderate action(25,000 ML/day @ Torrumbarry Weir for at least 20 days and up to 150 days in winter/spring) targeting semi-permanent wetlands, or: <ul style="list-style-type: none">~3,000 ha via Gunbower Forest infrastructure~8,000 ha via Koondrook-Perricoota Forest infrastructure	6-9 in 10 years (2 years)			Gunbower	Despite recent natural flows and managed deliveries, the site requires further water for continued recovery from drought	Maintain	Site likely to be watered by other water holders. If sufficient additional Commonwealth environmental water is available and required, a contribution guided by a natural cues approach could be considered.	Low – drying is proposed for Gunbower Forest in 2016-17 (unless a natural event occurs to allow 'piggybacking' of environmental water)	Low	
										Moderate	
					Koondrook-Perricoota	Despite recent natural flows and managed deliveries, the site requires further water for continued recovery from drought		Moderate-High	Moderate		
									High		

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system)		Watering history (from all sources of water)			2015-16			Implications for future demands		
	Flow/volume	Required frequency (maximum dry interval)	2012-13	2013-14	2014-15	Predominant urgency of environmental demand for water	Purpose under <u>moderate</u> resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2016-17 if watering occurred as planned in 2015-16	2017-18 Range of likely demand	Met in 2016-17
			(wet)	(mod)	(drying)						Not met in 2016-17
	Infrastructure delivery to Gunbower and Koondrook-Perricoota Forests targeting river red gum forest equivalent to around 27-35,000 ML/day @ Torrumbarry, or: <ul style="list-style-type: none"> Up to 4,000 ha via Gunbower Forest infrastructure Up to 16,000 ha via Koondrook-Perricoota Forest infrastructure 	1 in 3-4 years (3 years)			Gunbower	As above	Maintain	As per small Gunbower option above.	Low – drying is proposed for Gunbower Forest in 2016-17 (unless a natural event occurs to allow 'piggybacking' of environmental water)	Low	
						As above		As per small Koondrook-Perricoota option above.		Moderate	
					Koondrook-Perricoota	As above			Moderate-High	Moderate	
										High	
Central Murray Off-Channel Wetlands and ephemeral creeks Barham to Euston ⁴	4,500 ML to inundate Permanent wetlands	Annually				Requirement for water to manage salinity to provide suitable habitat for threatened species, such as the Murray hardyhead	Protect	It is anticipated that demands will be met primarily by other water holders in 2015-16. Commonwealth environmental water may be provided if required.	High	High	
										Critical	
	3,700 ML to inundate Semi-Permanent ² wetlands	3-7 in 10 years (5 years)				Requirement for water at some sites to support waterbirds and flora / fauna typical of a deepwater marsh, while other sites are ready for a drying phase.	Maintain	Commonwealth environmental water may be provided if required for sites that are not entering a drying phase.	Low	Low	
										Low-Moderate	
	18,700 ML to inundate Ephemeral wetlands	1 in 5 years				Water delivered to most ephemeral Central Murray Wetlands in previous years and drawdown / drying phases are ensuing	Protect	Environmental water not required	Low	Low	
										Low	

1. Murray and Barmah-Millewa Forest indicators adapted from Department of the Environment (2011a), MDBA (2012d), MDBA (2012g)

2. Sourced from North Central CMA (2013; 2014b; 2015b).

3. Adapted from MDBA (2012c), MDBA 2012 (f), Department of the Environment (2011d)

4. Sourced from North Central CMA (2014a; 2015a).

5. Compiled using a number of sources (Hale & SKM 2011; Watts et al 2013; Watts et al 2014; Webster 2010).

Previous watering actions and their outcomes have also been used for all indicators

Key - events in previous years

means demand was met, by Commonwealth environmental water or any other source
 means demand was partially met, by Commonwealth environmental water or any other source
 means water did not contribute to meeting demands.

Note that not all demands require water every year, drying phases are important for floodplains and temporary wetlands or streams

Key - potential watering in 2015-16

means a high potential for Commonwealth environmental watering (subject to seasonal and operational considerations)
 means a moderate potential for Commonwealth environmental watering, or a partial contribution may be made
 means a low potential for Commonwealth environmental watering

Key - urgency of environmental demands

means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage
 means high demand for water i.e. needed in that particular year
 means moderate demand for water i.e. water needed that particular year and/or next
 means low demand for water i.e. water generally not needed that particular year
 means very low demand for water i.e. water generally not needed that particular year or the following year

Note that demand is considered at a generalised scale; there may be specific requirements that are more or less urgent within the flow regime

Carryover potential	Low to moderate proportion of available allocations expected to be carried into 2016-17	A moderate proportion of available allocations may be carried over to 2017-18, but will depend upon resource availability and demands	Potential carryover will depend upon resource availability and demands
Trade potential	No urgency to augment available allocations, therefore limited potential for allocation purchase. Moderate to high demands means allocation sale unlikely	No expected urgency to augment available allocations, therefore limited potential for allocation purchase. Moderate demands means allocation sale unlikely	Potential to trade will be depend on environmental demands and resource availability

Table 2b: Environmental demands, potential watering in 2015–16 and outlook for coming years in the Mid Murray Region – **HIGH WATER RESOURCE AVAILABILITY IN 2015–16**

Environmental assets	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)			2015-16			Implications for future demands		
						Predominant urgency of environmental demand for water	Purpose under high resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2016–17 if watering occurred as planned in 2015-16	2017–18 Range of likely demand	Met in 2016–17 Not met in 2016–17
	Flow/volume	Required frequency (maximum dry interval)	2012–13 (wet)	2013–14 (mod)	2014–15 (drying)						
River Murray from Hume Dam to Euston¹	12,000 ML/day @ Yarrawonga Weir for at least 7 days and up to 70 days in winter/spring targeting in-channel outcomes and anabranches	4 in 5 years (4 years)				Moderate	Improve	High likelihood of being met via a combination of natural flows, consumptive deliveries and environmental water .	Low-Moderate	Low	
	16,000 ML/day @ Yarrawonga Weir for at least 7 days and up to 100-150 days in winter/spring targeting in-channel outcomes and giant rush wetlands	1 in 2-3 years (5-6 years)				Low	Maintain	High likelihood of being met by natural flows, otherwise Commonwealth environmental water may be provided.	Low-Moderate	Low	
Barmah-Millewa Forest¹	25,000-35,000 ML/day @ Yarrawonga Weir (unregulated flow) for at least 7 days (river red gum forest) and followed by 15,000 ML/day flows for three to five months targeting moira grass plain	2-3 in 5 years (6 years) for river red gums	Met for red gum; mostly met for moira grass			Flows of sufficient magnitude and duration required to maintain the extent of moira grass in both Barmah and Millewa forests.	Improve	High likelihood of natural flow trigger occurring, with Commonwealth environmental water contribution limited to recession component. Note operational challenges identified in Part II, section 3.6	Moderate	Moderate	
		Annual (2 years) for moira grass								High -Critical	
Edward-Wakool River System⁵ (further detail on Edward-Wakool indicators is provided at Attachment B)	Permanent waterways	Annual				System is continuing to recover from past drought and black water events	Improve	A high potential for environmental water to contribute to this action to continue system recovery and support native fish communities.	Moderate -High	Moderate -High	
	Ephemeral waterways and wetlands	1 in 2 years (3 years) for aquatic vegetation and water quality				Drying down in some sites may be required to maintain ephemeral character of the waterway/wetland concerned	Improve	Some potential for Commonwealth environmental water to be provided to sites that do not require drying down, with potential to alternate sites watered depending on urgency of environmental outcome being sought	Moderate -High	Moderate -High	
	Forests	2-3 in 5 years (6 years) for river red gums				Water has recently been provided to a number of forest areas (e.g. Werai)	Improve	More extensive watering could be considered, subject to natural cues and other requirements such as third party impacts and return flows being addressed.	Moderate	Low	
										Moderate-High	
Gunbower Creek²	Winter base flow (up to 400 ML/day @Gunbower weir for 90 days). Net use ~6,000 ML	Annually (1 year)				Base flow of sufficient magnitude and duration urgently required for maintaining Murray cod population	Improve	A high potential to support native fish communities.	High	High	
	Spring pulse and stable summer flows for fish breeding: • Base-flow of up to 550 ML/day in Spring • Single fresh up to 700ML/d for 120 days in spring/summer	Fish spawning fresh 2 in 3 years.				Significant watering action in 2014-15 inundated various wetlands in Gunbower Forest via Gunbower Creek, however flows within the creek required annually to maintain the diversity and condition of small and large-bodied native fish populations	Improve	A high potential to support native fish communities.	Moderate	Moderate	
Gunbower-Koondrook-Perricoota Forest³	Small-moderate action (25,000 ML/day @ Torrumbarry Weir for at least 20 days and up to 150 days in winter/spring) targeting semi-permanent wetlands, or: • ~3,000 ha via Gunbower Forest infrastructure • ~8,000 ha via Koondrook-Perricoota Forest infrastructure	6-9 in 10 years (2 years)			Gunbower	Despite recent natural flows and managed deliveries, the site requires further water for continued recovery from drought	Maintain - Improve	Site likely to be watered by other water holders. If sufficient additional Commonwealth environmental water is available and required, a contribution guided by a natural cues approach could be considered.	Low – drying is proposed for Gunbower Forest in 2016-17 (unless a natural event occurs to allow 'piggybacking' of environmental water)	Low	
										Moderate	
					Koondrook-Perricoota	Despite recent natural flows and managed deliveries, the site requires further water for continued recovery from drought		It is anticipated that demands in Koondrook-Perricoota Forest will be met primarily by other water holders in 2015-16. The Commonwealth may make a contribution following a natural cues approach depending on the risks.	Moderate-High	Moderate	
										High	

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system)		Watering history (from all sources of water)			2015-16			Implications for future demands		
	Flow/volume	Required frequency (maximum dry interval)	2012-13	2013-14	2014-15	Predominant urgency of environmental demand for water	Purpose under <u>high</u> resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2016-17 if watering occurred as planned in 2015-16	2017-18 Range of likely demand	Met in 2016-17
			(wet)	(mod)	(drying)						Not met in 2016-17
	Infrastructure delivery to Gunbower and Koondrook-Perricoota Forests targeting river red gum forest equivalent to around 27-35,000 ML/day @ Torrumbarry, or: <ul style="list-style-type: none">Up to 4,000 ha via Gunbower Forest infrastructureUp to 16,000 ha via Koondrook-Perricoota Forest infrastructure	1 in 3-4 years (3 years)			Gunbower	As above	Maintain - Improve	As per small Gunbower option above.	Low – drying is proposed for Gunbower Forest in 2016-17 (unless a natural event occurs to allow 'piggybacking' of environmental water)	Low	
						Moderate					
				Koondrook-Perricoota	As above	As per small Koondrook-Perricoota option above.		Moderate-High	Moderate		
					High						
Central Murray Off-Channel Wetlands and ephemeral creeks Barham to Euston ⁴	4,500 ML to inundate Permanent wetlands	Annually				Requirement for water to manage salinity to provide suitable habitat for threatened species, such as the Murray hardyhead	Improve	It is anticipated that demands will be met primarily by other water holders in 2015-16. Commonwealth environmental water may be provided if required.	High	High	
										Critical	
	3,700 ML to inundate Semi-Permanent ² wetlands	3-7 in 10 years (5 years)				Requirement for water at some sites to support waterbirds and flora / fauna typical of a deepwater marsh, while other sites are ready for a drying phase.	Improve	Commonwealth environmental water may be provided if required for sites that are not entering a drying phase.	Low	Low	
										Low-Moderate	
	18,700 ML to inundate Ephemeral wetlands	1 in 5 years				Water delivered to most ephemeral Central Murray Wetlands in previous years and drawdown / drying phases are ensuing	Maintain	Environmental water not required	Low	Low	
										Low	
See footnotes for Table 2a							Carryover potential	Moderate proportion of available allocations expected to be carried into 2016-17	A moderate proportion of available allocations may be carried over to 2017-18, but will depend upon resource availability and demands	Potential carryover will depend upon resource availability and demands	
Key - events in previous years							Trade potential	No urgency to augment available allocations, therefore limited potential for allocation purchase. Moderate to high demands means allocation sale unlikely	No expected urgency to augment available allocations, therefore limited potential for allocation purchase. Moderate demands means allocation sale unlikely	Potential to trade will be depend on environmental demands and resource availability	
Note that not all demands require water every year, drying phases are important for floodplains and temporary wetlands or streams											

Key - potential watering in 2015-16
 means a high potential for Commonwealth environmental watering (subject to seasonal and operational considerations)
 means a moderate potential for Commonwealth environmental watering, or a partial contribution may be made
 means a low potential for Commonwealth environmental watering

Key - urgency of environmental demands
 means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage
 means high demand for water i.e. needed in that particular year
 means moderate demand for water i.e. water needed that particular year and/or next
 means low demand for water i.e. water generally not needed that particular year
 means very low demand for water i.e. water generally not needed that particular year or the following year
 Note that demand is considered at a generalised scale; there may be specific requirements that are more or less urgent within the flow regime

Part II: Commonwealth environmental water portfolio management planning

2. Background

2.1. Commonwealth environmental water

The Commonwealth Environmental Water Holder is an independent statutory position established by the *Water Act 2007* (the Water Act) to manage the Commonwealth environmental water holdings. The Commonwealth Environmental Water Holder leads and is supported by the Commonwealth Environmental Water Office (the Office), a division of the Australian Government Department of the Environment.

Under the Water Act, Commonwealth environmental water must be managed to protect or restore environmental assets, so as to give effect to relevant international agreements. The Water Act also requires that the Commonwealth Environmental Water Holder perform its functions and exercise its powers consistently with and in a manner that gives effect to the Basin Plan and that Commonwealth environmental water is managed in accordance with the Basin Plan's environmental watering plan.

2.2. The Mid-Murray Region

The Mid-Murray planning area extends from Hume Dam to Euston (Figure 2). The region contains a number of wetlands of national and international importance including the Ramsar listed Barmah-Millewa and Gunbower forests. River Murray flows in this region are strongly influenced by the Goulburn, Ovens, Kiewa, Loddon and Campaspe Rivers.

The delivery of Commonwealth environmental water to the Mid Murray Region differs depending on which part of the region water is being delivered to. Where possible, environmental water will be managed to benefit multiple sites en route, thereby maximising the efficient and effective use of environmental water. The day to day delivery of environmental water along the main stem of the River Murray is managed by the Murray-Darling Basin Authority's River Murray Operations, in close cooperation with state government agencies and state water authorities.

For the New South Wales portion of the Mid-Murray Region, Commonwealth environmental water use is coordinated with other environmental water deliveries by the New South Wales Office of Environment and Heritage. Water delivery is managed by Water New South Wales and/or Murray-Darling Basin Authority River Murray Operations. In some instances Murray Irrigation Limited and landholder infrastructure may also deliver environmental water, subject to separate agreements.

For the Victorian portion of the Mid-Murray Region, Commonwealth environmental water use is coordinated with other environmental water deliveries by the Victorian Environmental Water Holder. Water delivery is managed by the state water authority, Goulburn-Murray Water, and regional waterway managers including the North-Central Catchment Management Authority, Goulburn-Broken Catchment Management Authority, North-East Catchment Management Authority and the Mallee Catchment Management Authority.

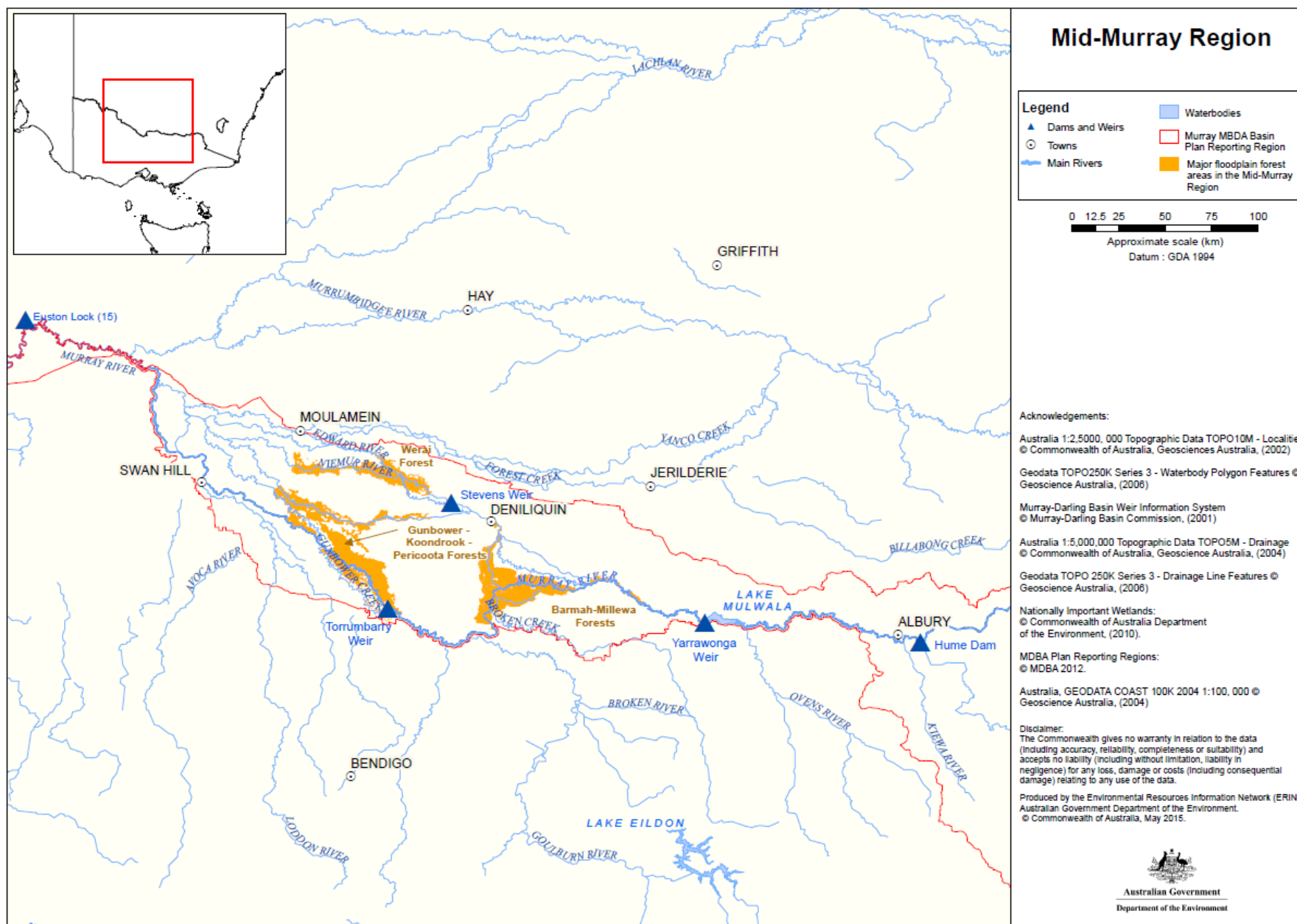


Figure 2: Map of the Mid-Murray Region

3. Long-term environmental water demands in the Mid-Murray Region

3.1. Basin-wide environmental watering strategy

The Murray-Darling Basin Authority has published the first Basin-wide environmental watering strategy (the Strategy, MDBA 2014). Building on Basin Plan's environmental objectives, the Strategy sets out the Authority's best assessment of the expected environmental outcomes over the next decade as a result of implementing the Basin Plan and associated water reforms. The Strategy focusses on four components: river flows and connectivity; vegetation; waterbirds; and native fish. The expected outcomes for each component are summarised below, with more specific quantified outcomes provided in [Attachment A](#).

River flows and connectivity: Improve connections along rivers and between rivers and their floodplains

Vegetation: Maintain extent and improve the condition

Waterbirds: Maintain current species diversity, improve breeding success and numbers

Native Fish: Maintain current species diversity, extend distributions, improve breeding success and numbers

3.2. Long-term watering plans

State governments are developing long-term watering plans for each catchment in the Basin. These plans will identify:

- the priority environmental assets and ecosystem functions in the catchment
- the objectives and targets for these assets and functions
- their watering requirements

In developing these plans, state governments will be consulting with environmental water holders and local communities.

Once developed, these plans will provide the key information on the long-term environmental water demands in the catchment and the Office's planning for the Mid Murray Region catchment will be reviewed so that this information can be incorporated.

Prior to the development of long-term watering plans, the Office will continue to draw on existing documentation on environmental water demands developed by state governments, local natural resource management agencies and the Murray-Darling Basin Authority.

Key documentation includes:

- Seasonal Watering Plan 2015–16, published by the Victorian Environmental Water Holder, (2015)
- Seasonal Watering Proposal documents for Gunbower Forest and Gunbower Creek, and the Central Murray Wetlands Complex, (North Central Catchment Management Authority, 2013–2015).
- Murray and Lower Darling Valleys: Annual Environmental Watering Plan 2015-2016, published by the New South Wales Office of Environment and Heritage.

- Monitoring and Evaluation Plan for the Edward-Wakool Selected Area, developed under the Office's Long-Term Intervention Monitoring Project (Department of the Environment 2014)
- The assessment of environmental water requirements and modelling for the proposed Basin Plan (MDBA 2012 a-c and g)
- The Office's environmental water delivery documents for Yarrawonga to Tocumwal and Barmah-Millewa; Edward-Wakool System; Gunbower Forest; and Koondrook-Perricoota Forest (Department of the Environment 2011 a-d)
- Plans for The Living Murray Icon Sites (MDBA 2012 d-f)
- A range of scientific literature, monitoring outcomes and on-ground knowledge (e.g. Roberts and Marston 2011).

The below section represents the Office's summary of the long-term environmental water demands, based on these documents. The objectives and expected outcomes for water-dependent ecosystems will continue to be revised and refined in response to best available knowledge, including drawing on the results of environmental watering monitoring programmes.

3.3. Expected outcomes in the Mid Murray Region

The expected outcomes from environmental watering in the Mid Murray Region are described below in Table 3 and how these contribute to Basin-wide outcomes. These outcomes will be refined and/or revised once the long-term watering plan for the catchment has been developed.

Table 3: Summary of long-term expected outcomes from environmental watering in the Mid-Murray Region

BASIN-WIDE OUTCOMES (Outcomes in red link to the Basin-wide environmental watering strategy, MDBA 2014)	EXPECTED OUTCOMES FOR MID MURRAY ASSETS						
	IN-CHANNEL ASSETS			OFF-CHANNEL ASSETS			
	River Murray from Hume Dam to Euston	Edward-Wakool River System	Gunbower Creek	Barmah-Millewa Forest	Gunbower-Koondrook-Perricoota Forest	Edward-Wakool Forests (e.g. Werai, Neimur)	Central Murray off-channel wetlands and ephemeral creeks
VEGETATION	Maintain riparian and in-channel vegetation condition. Increase periods of growth for non-woody vegetation communities that closely fringe or occur within river channels.			Maintain the current extent of water-dependent vegetation near river channels and on low-lying areas of the floodplain. Improve condition of black box, river red gum and lignum shrublands. Improve recruitment of trees within black box and river red gum communities. Increased periods of growth for non-woody vegetation communities that closely fringe or occur within the creek channels, and those that form extensive stands within wetlands and low-lying floodplains including moira grassland in Barmah–Millewa forests.			Maintain and improve condition of wetland vegetation.
WATERBIRDS	Provide habitat and food sources to support waterbird survival and recruitment, and maintain condition and current species diversity.						
				Support naturally triggered colonial bird breeding events.			
FISH	Provide flows to support habitat (including longitudinal connectivity and bench inundation) and food sources and promote increased movement/dispersal, recruitment and survival/condition of native fish.			Provide flows to support habitat and cues for increased movement, recruitment and survival/condition of native fish (particularly for floodplain specialists).			
INVERTEBRATES	Provide habitat to support increased microinvertebrate and macroinvertebrate survival, diversity, abundance and condition.						
OTHER VERTEBRATES	Provide habitat to support survival, maintain condition and provide recruitment opportunities for frogs and turtles.						
CONNECTIVITY	Support lateral connectivity through contributing to an increase in the frequency of freshes, bankfull and lowland floodplain flows.						
	Contribute to the maintenance of baseflows and an overall increase in flows in the River Murray. Support longitudinal connectivity along the River Murray to fulfil important environmental functions, such as nutrient and sediment transport, organism dispersal and water quality.						
PROCESSES	Support primary productivity, nutrient and carbon cycling, biotic dispersal and movement. Support increased transport of organic matter, salt and nutrients downstream.						
WATER QUALITY	Maintain water quality and provide refuge habitat from adverse water quality events (e.g. blackwater).			Support mobilisation and export of salt from the River Murray system.			
RESILIENCE	Provide drought refuge habitat and maintenance/condition of native biota (e.g. fish and other aquatic fauna)						

Information sourced from: MDBA (2014); Department of the Environment (2014); Department of the Environment (2001a-d); MDBA (2012a-f)

3.4. Flows in scope for Commonwealth environmental watering in the long-term

Not all environmental demands can and will be met through the use of held environmental water. Some demands are met by regulated water deliveries for consumptive purposes and inter-valley transfers, while others are met by large unregulated/natural flows events or are beyond what can be delivered within operational constraints. Figure 3 shows the broad environmental demands that are in scope for the Office to focus on contributing to in the Mid Murray Region. Importantly, these are broad, indicative demands and individual watering actions may contribute to particular opportunities, such as using infrastructure to deliver water to individual wetlands that would otherwise not be possible due to constraints. Also, there may be opportunities for Basin State governments to remove or modify constraints, which will improve the efficiency and/or effectiveness of environmental watering.

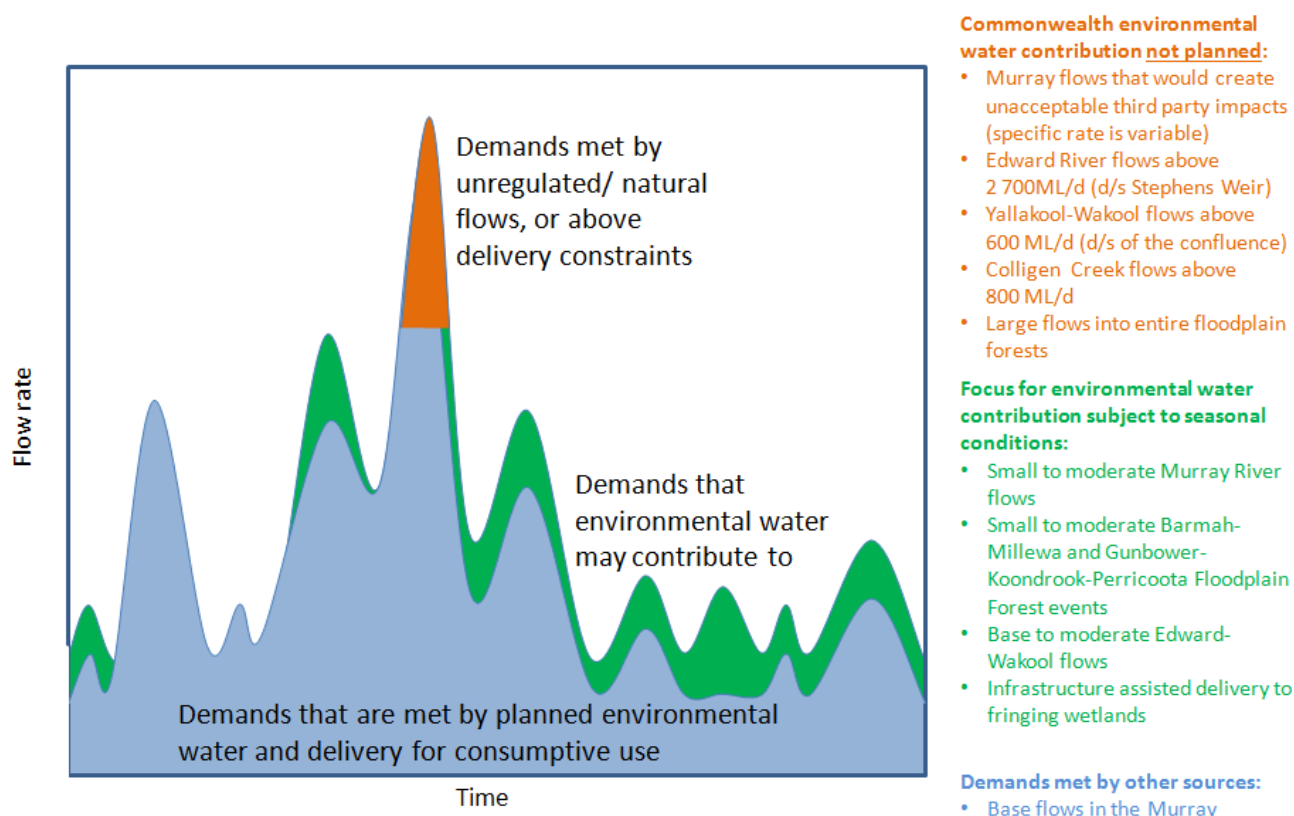


Figure 3: Scope of demands that environmental water may contribute to in the Mid-Murray Region (MDBA 2013, Department of the Environment 2011 (a-d))

The delivery of environmental water in the Mid-Murray is currently constrained by the release capacities from storages, channel capacities and system constraints. Relevant constraints to be considered include:

- To avoid unseasonal inundation of Barmah Millewa Forest during summer, delivery through the Barmah Choke is limited to approximately 10 300 ML/day (downstream of Yarrawonga).
- The delivery of Commonwealth environmental water in the Mid-Murray is affected by constraints in the tributaries of the Mid Murray, particularly the Goulburn River. Releases on major tributaries (to avoid unacceptable third party impacts) may limit the delivery of water to sites in the Mid-Murray Region.
- Channel capacity may limit the delivery of Commonwealth environmental water in certain parts of the Mid Murray Region. On the River Murray main channel there are various flow constraints to avoid the inundation of property and privately owned infrastructure. At Deniliquin flows in the Edward River above 17 100 ML/day result in minor flood events (MDBA 2013).

Further information about constraints in the Mid Murray Region can be found in the *Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2003* (NSW) (pt 10 cl 51) and *Constraints Management Strategy 2013 to 2024* (MDBA 2013).

Operational considerations such as constraints and risks will differ depending on the inflow scenario and are summarised in Table 4. Throughout the year operational and management considerations will be addressed as decisions are taken to make water available for use and as these decisions are implemented. This will include refining the ecological objectives, assessing operational feasibility and potential risks and the ongoing monitoring of the seasonal outlook and river conditions. Constraints as they relate to specific watering actions are described in section 3.5.

Table 4: Constraints on environmental watering for the Mid Murray Region

Inflows	Very low	Low	Moderate	High	Very high
Constraints					
Trade restrictions may limit the delivery of environmental water downstream of the Barmah Choke during periods of high consumptive/irrigation demands					
Flow thresholds to avoid third party impact, such as inundation of river and floodplain work programmes, or crossings restricting access to land.					

Based on the outcomes sought in Section 3.3 and these delivery constraints, Table 5 identifies flows that are in scope for Commonwealth environmental watering. Some specific watering requirements (flow magnitude, duration, timing and frequency) have also been listed, drawn from existing resources. The watering requirements for the Mid Murray Region will be developed in full by the state government as part of their long-term watering plan and will be reflected in future planning documents by the Office.

Table 5: Long-term indicative elements of a flow regime in scope for Commonwealth environmental watering in the Mid-Murray Region

Environmental asset	Indicative demands	Frequency (Maximum dry interval)
River Murray from Hume Dam to Euston	12 000 ML/day @ Yarrawonga Weir for at least 7 days and up to 70 days in winter/spring targeting in-channel outcomes and anabranches	4 in 5 years (4 years)
	16 000 ML/day @ Yarrawonga Weir for at least 7 days and up to 100-150 days in winter/spring targeting in-channel outcomes and giant rush wetlands	1 in 2-3 years (5-6 years)
Barmah-Millewa Forest	25 000–35 000 ML/day @ Yarrawonga Weir (unregulated flow) for at least 7 days (river red gum forest) and followed by 15 000 ML/day flows for 3–5 months targeting moira grass plain	2-3 in 5 years (6 years) for river red gums Annual (2 years) for moira grass
Edward-Wakool River System	Permanent waterways	Annual
	Ephemeral waterways and wetlands	1 in 2 years (3 years)
	Forests	2-3 in 5 years (6 years)
Gunbower Creek	Support mobilisation and export of salt from the River Murray system.	Annually (1 year)

	Spring pulse and stable summer flows for fish breeding: <ul style="list-style-type: none"> • Baseflow of up to 550 ML/day in spring • Single fresh up to 700 ML/day for 120 days in spring/summer 	Fish spawning fresh 2 in 3 years.
Gunbower-Koondrook-Perricoota Forest	Small-moderate action (25 000 ML/day @ Torrumbarry for at least 20 days and up to 150 days in winter/spring) targeting semi-permanent wetlands, or: <ul style="list-style-type: none"> • ~3,000 ha via Gunbower Forest infrastructure • ~8,000 ha via Koondrook-Perricoota Forest infrastructure 	6-9 in 10 years (2 years)
	Infrastructure delivery to Gunbower and Koondrook-Perricoota forests targeting river red gum forest equivalent to around 27-35 000 ML/day @ Torrumbarry Weir, or: <ul style="list-style-type: none"> • Up to 4 000 ha via Gunbower Forest infrastructure • Up to 16 000 ha via Koondrook-Perricoota Forest infrastructure 	1 in 3-4 years (3 years)
Central Murray off-channel wetlands and ephemeral creeks - Barham to Euston	4 500 ML to inundate Permanent wetlands	Annually
	3 700 ML to inundate Semi-Permanent wetlands	3-7 in 10 years (5 years)
	18 700 ML to inundate Ephemeral wetlands	1 in 5 years

References identified at Table 2

3.5. Potential watering actions under different levels of water resource availability

Under certain levels of water resource availability, watering actions may not be pursued for a variety of reasons, including that environmental demand may be met by unregulated flows and that constraints and/or risks may limit the availability to deliver environmental water. Table 6 identifies the range of potential watering actions in Mid Murray Region and the levels of water resource availability that relate to these actions.

Table 6: Summary of potential watering actions for the Mid-Murray Region

Environmental Asset	Indicative demand	Applicable level(s) of resource availability				
		Very Low	Low	Moderate	High	Very High
River Murray from Hume Dam to Euston	12 000 ML/day @ Yarrawonga Weir for at least 7 days and up to 70 days in winter/spring targeting in-channel outcomes and anabranches 16 000 ML/day @ Yarrawonga Weir for at least 7 days and up to 100-150 days in winter/spring targeting in-channel outcomes, giant rush wetlands		1. <i>Mid River Murray Channel Flow</i> : Contribute to in-stream flows to promote fish movement, condition, spawning and recruitment of flow specialist and floodplain fish species and to re-connect river with low-lying wetlands (including giant rush), subject to appropriate trigger.			
Barmah Millewa Forest	25-35 000 ML/day @ Yarrawonga Weir (unregulated flow) for at least 7 days (river red gum forest) and followed by 15 000 ML/day flows for three to five months targeting moira grass plain		2. <i>Barmah Millewa Forest Flow</i> : Contribute to an overbank flow (15,000-18,000 ML/day following large unregulated peak) to inundate up to 24,000ha of moira grass plain and river red gum; to promote fish movement, condition, spawning and recruitment of some fish species (flow and floodplain specialists); and to support completion of naturally triggered bird breeding events.			
Edward-Wakool River System	Permanent waterways	3a. To maintain in-stream habitat, particularly aquatic vegetation and areas supporting the various life stages of native fish. Environmental water use is most likely to contribute to in-channel base flows and freshes. It may also be used to provide a more gradual recession to periods of high flow (e.g. rain rejection flows) and improve water quality.				
	Ephemeral waterways and wetlands	3b. To maintain ephemeral in-stream and wetland habitat, particularly water quality, aquatic vegetation and areas supporting the various life stages of native fish, frogs, birds and aquatic invertebrates.				
	Forests			3c. To maintain vegetation health and to contribute to hydrological connectivity and nutrient/carbon cycling processes		
Gunbower Creek	Base flow of up to 400 ML/day for 90 days Spring pulse and stable summer flows for fish breeding: <ul style="list-style-type: none">Baseflow of up to 550 ML/day in springSingle fresh up to 700 ML/day for 120 days in spring/summer		4. <i>Gunbower Creek Channel flow</i> : Contribute to in-stream flows to support the survival and condition of juvenile fish and stimulate spawning and lateral movement of large-bodied, native fish between Gunbower Creek and Gunbower Forest.			
Gunbower-Koondrook-Perricoota Forest	Small-moderate action (25 000 ML/day @ Torrumbarry Weir for at least 20 days and up to 150 days in winter/spring) targeting semi-permanent wetlands, or: <ul style="list-style-type: none">~3 000 ha via Gunbower Forest		5. <i>Gunbower-Koondrook-Perricoota Forest Overbank Flow</i> : Contribute to overbank flows to re-connect river with semi-permanent wetlands in Gunbower and Koondrook-Perricoota Forests			

Environmental Asset	Indicative demand	Applicable level(s) of resource availability				
		Very Low	Low	Moderate	High	Very High
	infrastructure <ul style="list-style-type: none">~8 000 ha via Koondrook-Perricoota Forest infrastructure			6. <i>Gunbower Forest Flow</i> : Deliver water to inundate river red gum forest; support survival, condition and spawning of native fish (floodplain specialists) and/or supporting the completion of a bird breeding event.		
	7. <i>Koondrook-Perricoota Forest Flow</i> : Use infrastructure to provide flows to inundate river red gum forest, support bird breeding and/or support survival, condition and spawning of native fish (floodplain specialists).					
Central Murray Off-Channel Wetlands Barham to Euston	Permanent Wetlands	8. Water a range of annual, semi-annual, intermittent central Murray wetlands across all scenarios, subject to seasonal cues.				
	Semi-Permanent Wetlands					
	Ephemeral Wetlands					

Note: Under certain resource availabilities, options may not be pursued for a variety of reasons including that environmental demand may be met by unregulated flows and that constraints and/or risks may limit the ability to deliver environmental water.

3.6. Potential watering actions – standard operational considerations

Table 6 above identifies the range of potential watering actions in the Mid-Murray that give effect to the long-term demands and flow regime identified as potentially being in scope for the Office to contribute environmental water to in any given year. The standard considerations associated with these actions are set out below.

Watering actions 1, 2 and 5: Mid River Murray channel flow; Barmah-Millewa Forest Flow; and Gunbower-Koondrook-Perricoota Forest high flow (within constraints)

Standard operational considerations

- In-stream environmental watering seeks to target improved seasonality of flows to promote spawning of flow specialist and floodplain fish species and to re-connect river with low-lying wetlands. As such, an action will generally be in response to an appropriate flow triggers, such as rainfall events and flows upstream of Hume Dam and in tributaries (e.g. Ovens, Kiewa, Goulburn and Murrumbidgee rivers).
- Larger channel flows will naturally enter creeks and anabranches, low lying wetlands (e.g. Coppingers Lagoon, Duck Lagoon Douglas Swamp, Boals-Deadwoods, St Helena Swamp, Black Swamp, Walthours Swamp, Moira Lake, Barmah Lake and Gulpa Creek Complex). In some cases infrastructure may be used to provide flow conditions for fish outcomes (e.g using Mary Ada regulator to provide flows for native fish in Toupna Creek).
- Barmah Millewa Forest:
 - To create significant flows into Barmah Millewa Forest, significant natural flows are required, with Commonwealth environmental water only provided to extend the duration of flows once the flow rate recedes to a level that does not create unacceptable third party impacts. Regulators may be opened or closed on either side to influence the extent and duration of flows into Barmah and Millewa forests.
 - The action would typically occur during winter or spring, consistent with natural seasonality. From December to May, flows downstream of Yarrawonga Weir are managed below 10 300 ML/day to avoid unseasonal inundation of Barmah Millewa Forest.
 - Flows above 10 300 ML/day enter anabranches and creeks in Millewa Forest that connect with the Edward-Wakool system. Flows are also managed at Yarrawonga Weir to avoid third party impacts in the Edward-Wakool system.
 - With other factors influencing the extent of moira grassland, complementary natural resource management activities will be important if Commonwealth environmental water is to be provided to extend Barmah Millewa Forest flows, such as managing the encroachment by river red gums and grazing by vertebrate pests.
- Gunbower-Koondrook Pericoota Forest:
 - Environmental water may be contributed to channel flows to connect the River Murray with Gunbower and Koondrook-Perricoota forests.
 - A suitable flow trigger is required for environmental water to piggy-back on and resource availability may often be a limiting factor. The action would likely occur as part of a multi-site connected flow action through the Mid-Murray.
 - The use of Commonwealth environmental water in Koondrook-Perricoota Forest will depend on necessary State approvals being in place and an assessment of risks including, but not limited to, water quality issues and potential third party impacts.
- Environmental water delivery may be constrained by other demands on the system, especially during irrigation season, and capacity to release and coordinate releases from multiple storages.

Typical extent:

- Flow rates will be dependent on flow conditions, target outcomes and the operational considerations described above. Releases from Hume Dam will have most impact (in terms of flow variability) on flows in the upper Mid-Murray channel (from Hume to the Barmah Choke). Significantly influencing flow variability in the River Murray downstream of the Barmah Choke requires coordination of water delivery from other tributaries (e.g. the Goulburn and Murrumbidgee rivers).
- In Barmah Millewa Forest, the extent would generally be sufficient in terms of magnitude (initial unregulated trigger of at least 20 000-25 000 ML/day) and duration (at least three months) to water large areas of moira grass plain and allow the grass to complete its flowering. Less frequently, and following a larger unregulated trigger, flows may inundate broader areas of river red gum forest. This action may also contribute to outcomes in the Edward-Wakool system (Action 3).
- For Gunbower Forest, the extent will be limited to low-lying anabranches and semi-permanent wetlands to avoid unacceptable third party impacts. Natural events or actions 6 and 7 below are required to achieve broader inundation.
- For Koondrook-Perricoota Forest the extent will be determined by the watering scenario agreed to by the site manager and water holders.

Approvals: The Murray-Darling Basin Authority's River Murray Operations is responsible for managing flows in the mid River Murray. As this option may have impacts on downstream systems and works, and may be constrained by other demands in the system, the Office will seek advice from river operators on the timing, magnitude and duration of a proposed action. Off-channel flows are implemented with local delivery partners, who will play a key role in engaging with the local community and third parties and implementing the action.

Watering action 3a, b and c: Edward-Wakool River system

Standard operational considerations

- Water NSW is responsible for managing flows in the Edward-Wakool River system, which is highly regulated. Depending on the location and purpose of the action, water may also be sourced from either Murray Irrigation and/or private landholder irrigation infrastructure. Commonwealth environmental water may be delivered in combination with natural, consumptive or other held or planned environment water.
- Forest and ephemeral waterway actions will be timed for winter/spring and late autumn to minimise the risk of hypoxic blackwater impacts.
- Planning for actions will take into consideration the potential impacts of inundating areas that have acid sulphate soils and/or deep pools that may result in the movement of salt.
- During the irrigation off-season (winter) regulating/irrigation systems are shut down and limit the ability to provide environmental flows at that time.

Typical extent: Flows will be delivered within constraints, unless otherwise agreed with potentially impacted landholders and state government agencies.

Approvals: This option would be implemented with local delivery partners, who will play a key role in engaging with the local community and implementing the action.

Watering actions 4 and 6: Gunbower Creek channel flow and Gunbower Forest Flow

Standard operational considerations

- Environmental water can be delivered to Gunbower Creek in combination with consumptive flows to the Torrumbarry Irrigation Area. Water levels in Gunbower Creek are largely driven by irrigation demand. Commonwealth environmental water will be used to account for the losses associated with the delivery of consumptive water en route through Gunbower Creek.
- High flows in the creek can also be used to push water into Gunbower Forest using the Hipwell Road regulator.
- However, when delivering water during the irrigation season, the environment shares the capacity of Gunbower Creek with irrigation flows. As such, there is potential for system capacity constraints to interrupt the supply of environmental water to Gunbower Forest.

Typical extent: In-channel flows through to inundation of up to 4 800 ha of river red gum forest

Approvals: This option would be implemented with local delivery partners, who will play a key role in engaging with the local community and third parties and implementing the action. As this option may be constrained by other demands in the system, the Office will seek advice from river operators on the timing, magnitude and duration of a proposed action.

Watering action 7: Koondrook-Perricoota Forest via infrastructure works

Standard operational considerations:

- Commonwealth environmental water provided to Wakool River-Yallakool Creek (in the Edward-Wakool system) may assist with managing outflows from Koondrook-Perricoota Forest into the Wakool River.
- Water would be delivered to Koondrook-Perricoota Forest via the Torrumbarry Weir pool and inundation managed using a series of regulators. Outfalls to the Wakool River may need to be managed to prevent third party impacts and water quality issues.

Typical extent: To be determined by the watering scenario agreed to by the site manager and water holders. The 2014-15 watering event used 26.3GL to inundated 4 500ha of creeklines, wetlands and low lying forest areas. Up to 16 000ha of the Koondrook-Perricoota can be inundated under a maximum event size. More likely to be in the range of 6 700 – 8 000ha.

Approvals: Any use of Commonwealth environmental water in Koondrook-Perricoota Forest would be subject to an assessment of potential risks and ecological outcomes.

Watering action 8: Central Murray off-channel wetlands - Barham to Euston

Standard operational considerations

- The central Murray wetlands are almost wholly contained within the Torrumbarry Irrigation Region. As such, most of the wetlands are now cut-off from natural inundation and are reliant on the managed delivery of environmental water.
- The delivery of environmental water to these wetlands is constrained by a number of factors such as restrictions to delivery outlets and channel capacity.
- Multiple wetlands having similar watering regimes and requiring water at the same time results in competition for resource availability, particularly in drier years. Prioritisation and ultimately trade-off decisions may be required during low resource availability periods.
- As most of the central Murray wetlands are now managed to maintain permanent or semi-permanent saline water habitats, the decision to provide environmental water may not only relate to lake levels, but also active management of salinity concentrations conducive to salt-tolerant species.

Typical extent:

Permanent Wetlands (Annually)

- Round Lake – 600 ML. Maintain as a permanent, saline lake to provide suitable habitat for Murray Hardyhead, saline aquatic vegetation and waterbirds;
- Lake Elizabeth – 2 500 ML. Maintain as a permanent, saline lake to provide suitable habitat for saline aquatic vegetation and reintroduction of Murray hardyhead;
- McDonald's Swamp – 1 400 ML. Maintain as a shallow freshwater marsh, with open water and mudflats, that supports a diverse range of flora and fauna, in particular providing waterbird habitat and a mix of associated grasses and sedges.

Semi-Permanent Wetlands

- Lake Murphy (2 in 5 years) – 3 000 ML. Provide a watering regime that supports a diversity of waterbirds, flora and fauna typical of a deep freshwater marsh.
- Wirra-Lo Complex (Private Wetlands) – To provide vital habitat including the provision of refuge and suitable breeding conditions for Growling Grass Frog, and to provide high quality feeding and breeding habitat for a large diversity of waterbirds by rehabilitating the river red gum woodland and aquatic vegetation communities:
 - Duck Creek North (6-7 in 10 years) – 15 ML. Fill to 71.65 m AHD in late winter/early spring. Maintain depth of 0.5 –1 m for up to 6 months, allow to draw down late summer.
 - Duck Creek South (6-7 in 10 years) – 129 ML. Fill to 71.65 m AHD in late winter/early spring. Maintain water depth on the floodplain of 20–50 cm for 3–6 months. Allow to draw down to 71.6 m AHD (average depth of 20–50 cm) for an additional 2–4 months (8–10 months in total).
 - Red Gum Swamp and Emu Creek (3 in 10 years) –122 ML. Fill to 71.9 m AHD in late winter/early spring. Maintain water depth for 2 months and allow to draw down to dry over 6 months. Fill to 71.6 m AHD an additional four years in ten. Maintain depth for 4-6 months. Top-ups may be required to support bird breeding.
 - Lignum Swamp (4-5 in 10 years) –441 ML. Fill to 71.9 m AHD in late winter/early spring. Maintain depth for three to six months and allow to draw down over summer. Allow at least two occurrences of filling actions occurring in two consecutive years. Ensure one occurrence of two consecutive dry years in 10 years.

Ephemeral Wetlands

- Johnson Swamp (1 in 5 years) – 2 500 – 3 900 ML (so on average 3 200 ML per action). Provide a watering regime that supports an open water habitat for waterbirds, and a mosaic of native plant communities including Lignum / Blackbox;
- Hird Swamp (2 in 10 years) – 2 500 – 3 500 ML (so on average 3,000 ML per action). Provide a watering regime that supports open water habitat and lignum dominated reed habitat, important for waterbird resting, nesting and feeding;
- Richardson's Lagoon (2 in 10 years) – 1 000 – 2 000 ML (so on average 1 500 ML per action). Provide a watering regime that supports open water reed dominated habitat, River Red Gum and Black Box floodplain communities, important for waterbird resting, nesting and feeding;
- Lake Cullen (2 in 10 years) – 8 000 – 14 000 ML (so on average 11 000 ML per action). Provide a watering regime that targets the maintenance of a submerged salt-tolerant aquatic plant assemblage typical of an intermittent saline lake, and support high levels of waterbird use.

Approvals: These options would be implemented with local delivery partners, who will play a key role in engaging with the local community and third parties to implement the action.

4. Long-term water availability

4.1. Commonwealth environmental water holdings

The Commonwealth holds the following entitlements in the Mid Murray Region:

- NSW Murray High Security
- NSW Murray General Security
- NSW Murray Conveyance
- NSW Murray Supplementary
- Victorian Murray High Reliability
- Victorian Murray Low Reliability

In addition the Commonwealth holds entitlements in the Southern Connected Basin that can be used to delivery environmental water to the Mid Murray Region. The full list of Commonwealth environmental water holdings can be found at

www.environment.gov.au/topics/water/commonwealth-environmental-water-office/about-commonwealth-environmental-water/how-much and is updated monthly.

4.2. Other sources of environmental water

Other potential sources of held environmental water that may be used to complement Commonwealth environmental water delivery in the Mid Murray Region include:

- Environmental Entitlement: The Living Murray Program – Murray Darling Basin Authority
- Environmental Entitlement: New South Wales – New South Wales Office of Environment and Heritage
- Bulk Entitlement – Victorian Environmental Water Holder

4.3. Planned environmental water

In addition to water entitlements held by environmental water holders, environmental demands may also be met via natural or unregulated flows and water provided for the environment under rules in state water plans (referred to as 'planned environmental water'). The *Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2003* (NSW) establishes planned environmental water (pt 3, cl 15) relevant to the Mid-Murray Region. This includes:

- Barmah-Millewa Environmental Allowance:
 - Provides an annual allocation of up to 150 GL (100 GL high security and 50 GL low security allocation). This water can be used to deliver flows to meet ecological objectives in the Barmah-Millewa Forest in accordance with specific rules.
 - A maximum of 700 GL of water can be carried over from one water year to the next. Responsibility for the Barmah-Millewa Environmental Water Allowance is shared between NSW and Victoria. More information about this water allowance is available from the *Barmah-Millewa Forest Environmental Water Management Plan* (MDBA 2012e).
- New South Wales Murray Regulated River Water Source Additional Environmental Allowance:
 - the maximum volume held is calculated as 0.15 ML multiplied by the total number of regulated river (high security) unit shares
 - releases of water from the Murray Regulated River Water Source Additional Environmental Allowance can be made for the purpose of contributing to any of the objectives (a) to (i) outlined in the Water Sharing Plan (Section 2, Clause 10).

5. Next steps

5.1. From planning to decision making

It is important to distinguish between planning and operational decision making. As shown in Figure 4, planning allows the Office to manage the environmental water portfolio in a holistic manner and is an exercise in developing a broad approach or intention, based on the key drivers (demand and supply).

Decisions making throughout each year builds on the intention by considering in more detail the specific prevailing factors and additional factors such as costs, risks, and constraints to water delivery and market conditions.

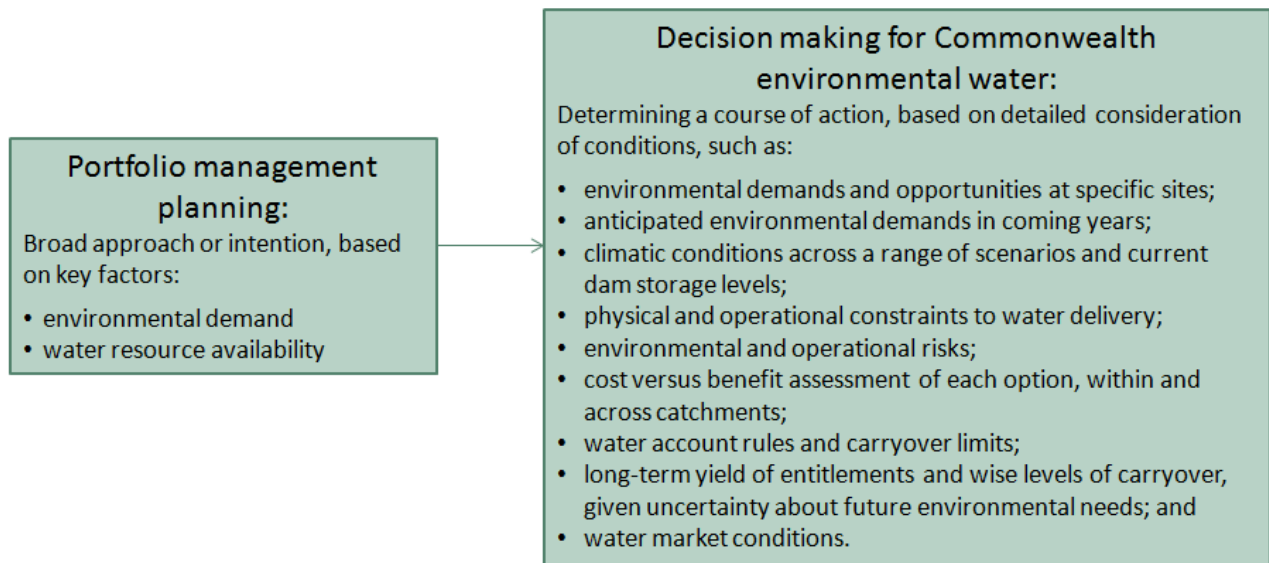


Figure 4: Planning and decision making for Commonwealth environmental water use

5.2. Further information

For further information on how the Office plans for water use, carryover and trade, please visit our web site www.environment.gov.au/topics/water/commonwealth-environmental-water-office

- Water use: www.environment.gov.au/topics/water/commonwealth-environmental-water-office/assessment-framework
- Carryover: <http://www.environment.gov.au/topics/water/commonwealth-environmental-water-office/portfolio-management/carryover>
- Trade: *Discussion Paper – Trade of Commonwealth Environmental Water and Commonwealth Environmental Water Trading Framework*: <http://www.environment.gov.au/water/cewo/trade/trading-framework>

Attachment A – Expected outcomes from the Basin-wide environmental watering strategy

Expected outcomes from the Basin-wide Environmental Watering Strategy (MDBA 2014) that are relevant to the Mid Murray are described below.

RIVER FLOWS AND CONNECTIVITY

Baseflows are at least 60 per cent of the natural level

Contributing to a 30 per cent overall increase in flows in the River Murray

A 30–60 per cent increase in the frequency of freshes, bankfull and lowland floodplain flows

VEGETATION

Maintain the current extent of water-dependent vegetation near river channels and on low-lying areas of the floodplain.

Improve condition of black box, river red gum and lignum shrublands

Improved recruitment of trees within black box and river red gum communities

Increased periods of growth for non-woody vegetation communities that closely fringe or occur within the river and creek channels, and those that form extensive stands within wetlands and low-lying floodplains including Moira grasslands in Barmah–Millewa Forest.

Vegetation extent

Region	Area of river red gum (ha)	Area of black box (ha)	Area of coolibah (ha)	Shrublands	Non-woody water dependent vegetation
Murray (assessment is for entire Murray catchment)	90,600*	41,700*	-	Lignum along the Murray River from the junction with the Wakool River to downstream of Lock 3, including Chowilla and Hattah Lakes	Closely fringing or occurring within the Murray, Edward, Kiewa, Mitta Mitta, Niemur and Wakool rivers and Tuppall Creek; Moira grasslands in the Barmah–Millewa Forest

Black box condition

Region	Vegetation condition score		Percent of vegetation assessed (within the managed floodplain)
	0 – 6	>6 – 10	
Murray (assessment is for entire Murray catchment)	33 per cent	65 per cent	28 per cent

River red gum condition

Region	Vegetation condition score					Percent of vegetation assessed (within the managed floodplain)
	0 – 2	>2 – 4	>4 – 6	>6 – 8	>8 – 10	
Murray (assessment is for entire Murray catchment)	2 per cent	1 per cent	10 per cent	51 per cent	35 per cent	51 per cent

WATERBIRDS

Maintain current species diversity

Increase Basin-wide abundance of waterbirds by 20–25 per cent by 2024

A 30–40 per cent increase in nests and broods (Basin-wide) for other waterbirds

Up to 50 per cent more breeding events (Basin-wide) for colonial nesting waterbird species

Important Basin environmental assets for waterbirds in the Mid-Murray

Environmental asset	Total abundance and diversity	Drought refuge	Colonial waterbird breeding	Shorebird abundance	In scope for C'th watering
Gunbower–Koondrook–Perricoota			*		Yes
Kerang wetlands	*				Yes
Barmah–Millewa	*		*		Yes

FISH

No loss of native species

Improved population structure of key species through regular recruitment, including

- Short-lived species with distribution and abundance at pre-2007 levels and breeding success every 1–2 years
- Moderate to long-lived with a spread of age classes and annual recruitment in at least 80 per cent of years

Increased movements of key species

Expanded distribution of key species and populations

Key species for the Mid-Murray

Species	Specific outcomes	In-scope for C'th water in the Mid Murray?
Flathead galaxias (<i>Galaxias rostratus</i>)	Expand the core range in the wetlands of the River Murray.	Yes
Freshwater catfish (<i>Tandanus tandanus</i>)	Expand the core range in Columbo-Billabong Creek and Wakool system	Yes
Golden Perch (<i>Macquaria ambigua</i>)	A 10–15 per cent increase of mature fish (of legal take size) in key populations	Yes
Murray cod (<i>Maccullochella peelii peelii</i>)	A 10–15 per cent increase of mature fish (of legal take size) in key populations	Yes
Murray hardyhead (<i>Craterocephalus fluviatilis</i>)	Expand the range of at least two current populations. Establish 3–4 additional populations, with at least one in the mid-Murray conservation unit.	Yes
Olive perchlet (<i>Ambassis agassizii</i>)	Olive perchlet are considered extinct in the southern Basin. Reintroduction using northern populations is the main option for recovery. Candidate sites may result from improved flow	Restoration of flow to River Murray could support the future

Species	Specific outcomes	In-scope for C'th water in the Mid Murray?
	that reinstates suitable habitat in the River Murray.	reintroduction of the species.
River blackfish (<i>Gadopsis marmoratus</i>)	Expand the range of current populations from the Mulwala canal	Yes
Silver perch (<i>Bidyanus bidyanus</i>)	Expand the core range within the River Murray (Yarrowonga–Euston)	Yes
Southern purple-spotted gudgeon (<i>Mogurnda adspersa</i>)	-	Yes
Southern pygmy perch (<i>Nannoperca australis</i>)	Expand the range of current populations at Barmah-Millewa and other mid-Murray wetlands	Yes
Trout cod (<i>Maccullochella macquariensis</i>)	Expand the range of trout cod up the Murray upstream of Lake Mulwala and into the Kiewa River. For the connected population of the Murrumbidgee–Murray–Edwards: continue downstream expansion.	Yes
Two-spined blackfish (<i>Gadopsis bispinosus</i>)	Establish additional populations (no specific locations identified)	Yes

Important Basin environmental assets for native fish in the Mid-Murray

Environmental asset	Key movement corridors	High Biodiversity	Site of other Significance	Key site of hydrodynamic diversity	Threatened species	Dry period / drought refuge	In-scope for C'th water
Koondrook–Perricoota	*	*	*	*	*		Yes
Gunbower	*	*	*	*	*		Yes
Barmah–Millewa	*	*	*	*	*	*	Yes
Edward–Wakool system	*		*	*		*	Yes
Werai Forest			*	*			Yes
Billabong–Yanco–Columbo Creeks		*	*	*	*	*	Yes
Lake Mulwala	*		*	*	*	*	Yes

Attachment B – Detailed indicative demands for Edward-Wakool system

Environmental demands and potential watering in 2015–16 for the Edward-Wakool system – **MODERATE WATER RESOURCE AVAILABILITY IN 2015–16**

Environmental assets	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)						2015-16		
	Flow/volume	Required frequency (maximum dry interval)	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	Predominant urgency of environmental demand for water	Purpose under <u>moderate</u> resource availability	Potential Commonwealth environmental water contribution?
			(drought)	(very wet)	(wet)	(wet)	(moderate)	(drying)			
Yallakool -Wakool	Small events ² of ~30-60 GL (~600ML/d) for 60-120 days in late winter to early summer ^{1,2}	2 in 3 (4 years)							Water is required to continue ecosystem recovery and capitalise on previous years watering. Watering may involve delivery to both systems.	Maintain	Commonwealth environmental water required to continue ecosystem recovery
	Pulse/Fresh of (~600ML/d peak for 2 days) for 7 days in winter-spring	As Required							To provide for a pulse to fill low commence to flow backwaters, flood runners and wetlands for nutrient cycling and later return to the system.	Maintain	Commonwealth environmental water may be used if these are no Murray regional flows or natural events
Colligen/ Niemur	Small events ² of ~36-72 GL (~600ML/d) for 60-120 days in late winter to early summer ^{1,2}	2 in 3 (4 years)							To maintain recession flows on rain-rejection or natural events and see to extend inundation within constraints if possible	Maintain	Commonwealth environmental water may be used to provide habitat flows such as those received in the Yallakool in previous years.
	Pulse/Fresh of (~600ML/d peak for 2 days) for 7 days in winter-spring	As Required							To provide for a pulse to fill low commence to flow backwaters, flood runners and wetlands for nutrient cycling and later return to the system.	Maintain	Commonwealth environmental water may be used if these are no Murray regional flows or natural events
Edward River	Winter Low flows for Murray Crayfish flow 30 GL (maintaining 650-850 ML/d over mid May to October).	1 in 1							To provide improved water quality and aquatic habitat in the Edward River while maintaining annual cycle of lower winter flows that enable bank drying & stabilisation.	Maintain	Commonwealth environmental water may be used to supplement low flows, particularly during winter
Ephemeral Streams (e.g. Tuppai, Jimaringal, Cochran's and Gwynnes creeks)	Small events ¹ ~6 GL a year in stream Winter/Spring/ Autumn events	1 in 2 (4 years)							Some watering may be important to supplement flows to maintain water quality and ecosystem health.	Maintain	Commonwealth environmental water may be used in these systems, depending on the individual need. Sites may be more likely to be water by NSW Office of Environment and Heritage
Fringing Wetlands (e.g. Private wetlands on Colligen Creek)	Small site specific actions <10 GL	Site specific	N/A	System wide flows	System wide flows	May have received flows	N/A	N/A	Site Specific	Maintain	Commonwealth environmental water may be used in these systems, depending on the individual need. Sites may be more likely to be water by NSW Office of Environment and Heritage
Weraí Forest	Small events of ~5 GL to provide drought relief and to flush accumulated organic matter from late Autumn to early Spring ³	As Required		System wide flows	System wide flows				High late autumn-early spring flows in the Edwards may trigger the use of these flows.	Maintain	Commonwealth environmental water may be used in this area, depending on the need. Sites may be more likely to be water by NSW Office of Environment and Heritage

Compiled using a number of sources (Hale & SKM 2011¹; Watts et al 2013²; Watts et al 2014²; Webster 2010³). Previous watering actions and their outcomes have also been used for all indicators .

Key - events in previous years

	means demand was met, by Commonwealth environmental water or any other source
	means demand was partially met, by Commonwealth environmental water or any other source
	means water did not contribute to meeting demands.

Note that not all demands require water every year, drying phases are important for floodplains and temporary wetlands or streams

Key - potential watering in 2015-16

	means a high potential for Commonwealth environmental watering (subject to seasonal and operational considerations)
	means a moderate potential for Commonwealth environmental watering, or a partial contribution may be made
	means a low potential for Commonwealth environmental watering

Key - urgency of environmental demands

	means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage
	means high demand for water i.e. needed in that particular year
	means moderate demand for water i.e. water needed that particular year and/or next
	means low demand for water i.e. water generally not needed that particular year
	means very low demand for water i.e. water generally not needed that particular year or the following year

Note that demand is considered at a generalised scale; there may be specific requirements that are more or less urgent within the flow regime

Environmental demands and potential watering in 2015–16 for the Edward-Wakool system – **HIGH WATER RESOURCE AVAILABILITY IN 2015–16**

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system)		Watering history (from all sources of water)						2015-16		
	Flow/volume	Required frequency (maximum dry interval)	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	Predominant urgency of environmental demand for water	Purpose under a <u>high-very high resource availability</u>	Potential Commonwealth environmental water contribution?
			(drought)	(very wet)	(wet)	(wet)	(moderate)	(drying)			
Yallakool-Wakool	Small events ² of ~30-60 GL (~600ML/d) for 60-120 days in late winter to early summer ^{1,2}	2 in 3 (4 years)							Water is required to continue ecosystem recovery and capitalise on previous years watering. Watering may involve delivery to both systems	Maintain	Commonwealth environmental water required to continue ecosystem recovery.
Colligen-Niemur	Small events ² of ~36-72 GL (~600ML/d) for 60-120 days in late winter to early summer ^{1,2}	2 in 3 (4 years)							To maintain recession flows on rain-rejection or natural events and see to extend inundation within constraints if possible	Maintain	Commonwealth environmental water may be used to provide habitat flows such as those received in the Yallakool in previous years.
Edward River d/s Stephens	Winter Low flows for Murray Crayfish flow 30 GL (maintaining 650-850 ML/d over mid May to October).	1 in 1							To provide improved water quality and aquatic habitat at a time when Edwards River downstream of Stephens Weir is subject to annual low flows	Maintain	Commonwealth environmental water may be used to supplement low flows, particularly during winter.
Ephemeral Streams (e.g. Tuppal, Jimaringal, Cochran's and Gwynnes creeks)	Small events ¹ ~6 GL a year in stream Winter/Spring/Autumn events	1 in 2 (4 years)							Some watering may be important to supplement flows to maintain water quality and ecosystem health	Maintain	Commonwealth environmental water may be used in these systems, depending on the individual need. Sites may be more likely to be water by NSW Office of Environment and Heritage
Fringing Wetlands (e.g. Private wetlands on Colligen Creek)	Small site specific actions <10 GL	Site specific	N/A	System wide flows	System wide flows	May have received flows	N/A	N/A	Site Specific	Maintain	Commonwealth environmental water may be used in these systems, depending on the individual need. Sites may be more likely to be water by NSW Office of Environment and Heritage
Weraí Forest	Small events of ~5 GL to provide drought relief and to flush accumulated organic matter from late Autumn to early Spring ³	As Required		System wide flows	System wide flows				High late autumn-early spring flows in the Edwards may trigger the use of these flows	Maintain	Commonwealth environmental water may be used in this area, depending on the need. Sites may be more likely to be water by NSW Office of Environment and Heritage

Compiled using a number of sources (Hale & SKM 2011¹; Watts et al 2013²; Watts et al 2014²; Webster 2010³). Previous watering actions and their outcomes have also been used for all indicators.

Key - events in previous years

	means demand was met, by Commonwealth environmental water or any other source
	means demand was partially met, by Commonwealth environmental water or any other source
	means water did not contribute to meeting demands.

Note that not all demands require water every year, drying phases are important for floodplains and temporary wetlands or streams

Key - potential watering in 2015-16

	means a high potential for Commonwealth environmental watering (subject to seasonal and operational considerations)
	means a moderate potential for Commonwealth environmental watering, or a partial contribution may be made
	means a low potential for Commonwealth environmental watering

Key - urgency of environmental demands

	means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage
	means high demand for water i.e. needed in that particular year
	means moderate demand for water i.e. water needed that particular year and/or next
	means low demand for water i.e. water generally not needed that particular year
	means very low demand for water i.e. water generally not needed that particular year or the following year

Note that demand is considered at a generalised scale; there may be specific requirements that are more or less urgent within the flow regime

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