2016-17 Annual Environmental Watering Priorities for the South Australian River Murray Water Resource Plan Area

The information contained in this document is prepared for the purpose of complying with South Australia's obligations in respect of annual environmental watering priorities for the South Australian River Murray Water Resource Plan Area, as set out in Chapter 8 of the Murray-Darling Basin Authority Basin Plan (Environmental Watering Plan).

1. Introduction

This document has been prepared to fulfil obligations related to the preparation of annual environmental watering priorities (the priorities) as specified in the Basin Plan Chapter 8 Division 4. Chapter 8 (Environmental Watering Plan) of the Basin Plan requires Basin States to identify the priorities for the following year and submit these to the Murray-Darling Basin Authority (MDBA) by 31 May.

Preparation of the priorities also provides an opportunity to consolidate and rank the suite of watering actions proposed for the South Australian River Murray Water Resource Plan area (WRP area) for the upcoming water year. This work is useful for coordinating watering within the WRP area, informing decisions relating to water delivery and evaluating the environmental outcomes.

The principles and method described in Chapter 8 Part 6 of the Basin Plan have been applied in developing the priorities. Per previous years, the due date for submission of the priorities proved challenging for the completion of the detailed documentation relating to the priorities. Comprehensive documentation will therefore be provided in the 2016-17 Annual Environmental Watering Plan for the South Australian River Murray (the Annual Plan). This document will provide further technical information that underpins the priorities, including additional information as to how the principles and methods were applied. This document will be published later in 2016.

2. Identification of priorities

Approach

The priorities for the WRP Area for 2016-17 have been developed in accordance with the Basin Plan requirements. The priorities for 2016-17 are consistent with the long term environmental watering plan (LTWP) for this WRP area[1], which was completed and published in November 2015 (Department of Environment Water and Natural Resources, 2015). The LTWP includes a list of priority environmental assets and their ecological objectives, targets and environmental water requirements (EWRs), and also demonstrates alignment between these and the expected

[1] The Coorong is considered by the Basin Plan to be part of the SA Murray Region WRP area, however it is addressed in the priorities for the SA River Murray WRP Area (i.e. this document) as the ecological outcomes of in the Coorong are primarily driven by surface water inputs from the River Murray. This is consistent with the approach taken for the LTWP.

environmental outcomes of the Basin Wide Environmental Watering Strategy (BWEWS) (Murray-Darling Basin Authority, 2014a).

A scenario-based approach was used to develop proposed watering actions for 2016-17. Five resource availability scenarios were identified; these scenarios are based on the MDBA annual operating probabilities (AOP) provided in February 2016 (**Figure 1**): 95% (very dry), 90% (dry), 75% (moderate), 50% (near average) and 25% (wet). These percentages refer to the likelihood of occurrence of different water resource availability based on previous records, current volumes in storage and operational considerations for the upcoming year. A volume of held environmental water (HEW) potentially available for delivery to South Australia in 2016-17 under each of the resource availability scenarios was assumed for planning purposes (refer 'Assumptions').

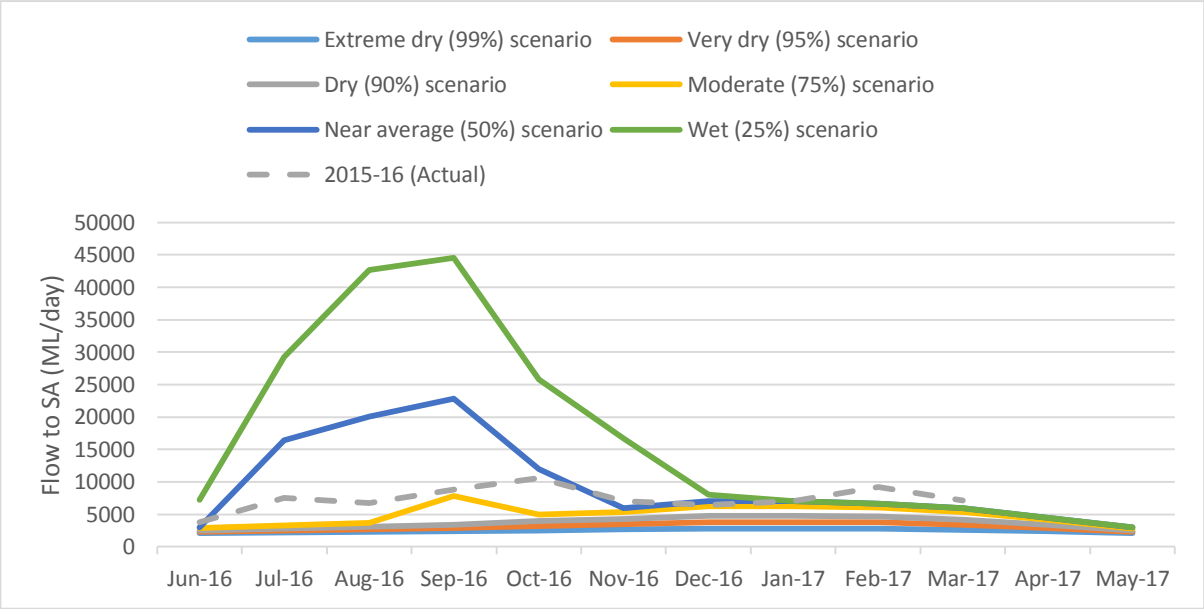

Figure 1. Annual operating probabilities provided by MDBA in February 2016 for the purpose of informing environmental water planning for 2016-17

The resource availability scenarios and assumed HEW availability were used by environmental site or asset managers to develop environmental watering proposals for each site/asset. The watering actions proposed under each resource availability scenario were then prioritised using agreed State criteria (**Table 1**), which are based on criteria used by The Living Murray (Murray-Darling Basin Authority, 2014b) and are consistent with the principles set out in the Basin Plan. The prioritisation process was undertaken in April 2016 in a workshop setting involving site/asset managers.

Table 1. Summary of criteria used to prioritise 2016-17 SA River Murray environmental watering proposals

Criteria number	Criteria
1	Scale of environmental benefit
2	Risk of not applying water
3	Environmental risks associated with watering
4	Certainty/likelihood of benefit

Outcomes of planning and prioritisation

A summary all proposed environmental watering actions for 2016-17 is provided in **Appendix 1**. **Appendix 2** is a list of some of the wetlands to which water is proposed to be pumped.

The outcomes of the prioritisation process are presented in **Table 2**. The ranking indicates proposed watering actions under each resource availability scenario from highest priority to lowest priority. It is not intended to exclude watering actions as all are considered important for achieving a range of environmental outcomes throughout the WRP area. However, under some circumstances it may be necessary to prioritise the location or timing of environmental water delivery, for instance, due to low allocations and limited environmental water availability at the start of a water year. The ranked list can be used to inform these types of decisions. The likely ecological outcomes were the primary consideration when undertaking the ranking. The outcomes linked to each watering action are summarised in **Appendix 1** and **Appendix 2**.

In general, watering actions in the Coorong, Lower Lakes and Murray Mouth (CLLMM) asset ranked the highest. The importance of the CLLMM is reflected in the Basin Plan which contains several objectives and targets specific to this asset. Due to relatively dry antecedent conditions, there is an elevated risk of the legislated objectives for the CLLMM not being met, with a subsequent elevated risk of degradation in the condition of the site and decline in ecological character. A significant volume of environmental water is required for the CLLMM in 2016-17 to meet the long-term environmental water requirements (EWRs) of this asset (Department of Environment Water and Natural Resources, 2015), which have been developed with the high-level objective to maintain the ecological character of the CLLMM by restoring a healthy and resilient ecosystem (O'Connor, Steggles, Higham, & Rumbelow, 2015) .

Analysis of the watering history and the long-term EWRs for the channel and the floodplain assets also shows the growing gap between the desired and the actual frequency of inundation. Due to the relatively dry outlook for 2016-17, it is generally not feasible to meet the higher EWRs. Under these conditions, the operation of management levers to deliver water to discrete locations provides a valuable tool for maintaining or improving the condition of areas within these assets.

Wetter conditions (50% and 25% AOPs) would provide the opportunity to raise the Chowilla regulator to a level greater than 19.1 mAHD. Operation at this level has not previously been undertaken; hence, this action is considered as a testing action, which is a very high priority for the MDBA and for the South Australian Government.

It is understood that several non-government organisations will also be undertaking environmental watering actions within the WRP area during the 2016-17 water year. These organisations include Nature Foundation of South Australia (NFSA), Renmark Irrigation Trust (RIT), Ngarrindjeri Regional Authority (NRA), and potentially Banrock Station and Australian Landscape Trust (ALT). The environmental watering actions will be undertaken at selected sites under agreements between each organisation and the Commonwealth Environmental Water Holder (CEWH).

Each of these organisations were invited to participate in the state prioritisation process, however due to time constraints they were not in a position to provide details of their proposed watering actions in time for the prioritisation workshop.

Therefore the ranked watering actions presented in this document are not able to reflect those proposed to be undertaken by the non-government organisations. Department of Environment, Water and Natural Resources (DEWNR) will seek to continue to work with these organisations and staff from the Commonwealth Environmental Water Office (CEWO) throughout 2016-17 with the aim of coordinating environmental watering and river operations within the WRP Area.

Table 2. Environmental watering priorities for the South Australian River Murray in 2016-17

Ranking	Very dry scenario 95 percent	Dry scenario 90 percent	Moderate scenario 75 percent	Near average scenario 50 percent	Wet scenario 25 percent
1	Spring pulse for CLLMM 12 months of barrage releases	Improved spring pulse for CLLMM	Further improved spring pulse for CLLMM	Enhance barrage releases due to unregulated flows Further improved spring pulse for CLLMM	Enhance barrage releases due to unregulated flows Further improved spring pulse for CLLMM Enhance unregulated flows to 35,000 ML/day for 60 days
2	Provision of water to threatened fish refuges	12 months of barrage releases	12 months of barrage releases	12 months of barrage releases	12 months of barrage releases
3	Pump Chowilla wetlands Pump Valley wetlands Pump Gorge wetlands Pump Lower Lakes wetlands	Provision of water to threatened fish refuges	Provision of water to threatened fish refuges	Provision of water to threatened fish refuges	Chowilla maximum floodplain inundation
4	Chowilla anabranch flow pulse	Raise Weir 2 by 75cm Raise Weir 5 by 50cm Pump Chowilla wetlands Pump Valley wetlands Pump Gorge wetlands Pump Lower Lakes wetlands	Winter pulse through barrages	Winter pulse through barrages Create 15,000 ML/d flow pulse for 90 days Chowilla mid-floodplain inundation Raise Weir 2 by 75cm Raise Weir 5 by 50cm	Winter pulse through barrages
5		Create 10,000 ML/d flow pulse for 60 days Chowilla anabranch flow pulse	Raise Weir 2 by 75cm Raise Weir 5 by 50cm Pump Chowilla wetlands Pump Valley wetlands Pump Gorge wetlands Pump Lower Lakes wetlands	Pump Valley wetlands Pump Gorge wetlands Pump Lower Lakes wetlands	Pump Valley wetlands Pump Gorge wetlands Pump Lower Lakes wetlands
6			Create 10,000 ML/d flow pulse for 60 days Chowilla anabranch flow pulse		

Assumptions

Held Environmental Water Availability

The work required to inform the development of the priorities was undertaken between February and April 2016 (inclusive), which is prior to water allocation announcements being made. As a result of this timing, environmental water holders were unable to provide advice on HEW availability in 2016-17. For the purposes of planning and prioritisation, an estimate of potential HEW availability under each resource availability was made based on environmental water delivery in recent years (**Table 3**). Potential HEW availability is taken into account during planning so that the proposed actions and associated outcomes consider the feasibility of delivery.

Table 3. Estimate of held environmental water available under each resource availability scenario

Scenario	Estimate of HEW available (GL)
Extreme dry (99%)	**400 to 500 GL**
Very dry (95%)	**500 to 600 GL**
Dry scenario (90%)	**600 to 700 GL**
Moderate (75%)	**700 to 900 GL**
Near average (50%)	**900 to 1,200 GL**
Wet (25%)	**>1,200 GL**

HEW is available from the following sources – the CEWH, MDBA - The Living Murray (TLM), the Victorian Environmental Water Holder (VEWH), the South Australian Minister for Water and the River Murray and non-government organisations. For each water holder, information relating to volumes of registered entitlements and Long-Term Average Annual Yield (LTAAY) is presented below.

Commonwealth Environmental Water

Total Commonwealth environmental water holdings within the Southern Connected Basin are approximately 1,841 GL (at 29 February 2016), with varying levels of security and a LTAAY of 1,384 GL (Department of the Environment, 2016). Of this volume, approximately 147 GL registered entitlement (133 GL LTAAY) is held in South Australia and forms part of South Australia's entitlement. Some carry-over from 2015-16 is also likely to be available, although the CEWH is yet to confirm a volume[2].

The Living Murray Environmental Water

TLM holdings approximately 480 GL Long-Term Cap Equivalent (LTCE), of which approximately 45 GL is held in South Australia and forms part of South Australia's entitlement. At the time of writing, TLM expects to carry-over approximately 127 GL into 2016-17. Increased flows from the Snowy Agreement may also be available but this is yet to be confirmed.

[2] CEWO staff subsequently advised that this is in the order of 270-290GL for the Southern Connected Basin; this information was received after this document had been finalised and approved for publication.

Victorian Environmental Water Holder

The VEWH manages environmental water holdings in the following rivers: Murray, Goulburn and Campaspe. Under some circumstances, the VEWH may trade HEW to South Australia, generally as a result of return flows from upstream environmental watering actions.

South Australian Minister for Water and the River Murray

The South Australian Minister for Water and the River Murray holds approximately 44 GL of water access entitlements in South Australia that are committed to environmental purposes and form part of South Australia's entitlement.

Of this total volume, approximately 38 GL belongs to Class 9 (Wetlands) water access entitlement class described in the Water Allocation Plan for the River Murray Prescribed Watercourse (WAP) (SA Murray-Darling Basin Natural Resources Management Board, 2002). This water is tied to the management of specific pool-connected wetlands within the WRP Area so there is limited flexibility in the location of use.

The remaining volume of approximately 6 GL has been committed for environmental use through the *Implementation Plan for Augmentation of the Adelaide Desalinisation Plant* and the location of its use is flexible (within the South Australian portion of the Murray-Darling Basin). Additional amounts (up to 120 GL over a 10 year rolling period of eligible years) may also be purchased throughout the year.

Small volumes are also held by the South Australian Minister for Water and the River Murray on interstate licenses (less than 2 GL in total).

Decisions on the use of environmental water held by the South Australian Minister for Water and the River Murray are made within DEWNR consistent with the priorities.

Non-Government Organisations

NFSA holds 37 ML of Class 3A Water Access Entitlement on licence that is irrigation water purchased for environmental use.

The Murray Darling Association, through its Murray Darling Foundation, has established 'Water Bank' that receives donations for purchasing and holding water for future environmental activities. It holds 60 ML of Class 3A Water Access Entitlement.

For 2016-17, Banrock Station is seeking approximately 1.67 GL of Class 9 (Wetlands) water for the management of the pool-connected areas of Banrock Station Wetland Complex. At the time of writing the arrangements between Banrock and DEWNR for this water were being progressed.

Planned Environmental Water Availability

Unallocated class 9 water

The WAP establishes 200 GL of Class 9 (Wetlands) water with approximately 40 GL held on a licence (see above). The remaining 160 GL of Class 9 water can be considered planned environmental water. This volume is 'used' as it replaces the evaporative losses from unmanaged, pool-connected wetlands during normal river operations. This water is not actively managed and is not available for other uses.

Unregulated flows

Under the WAP, no provisions exist for the allocation and use of unregulated flows for non-environmental consumptive purposes in South Australia. Therefore, when an unregulated flow event occurs, it is protected from being taken for consumptive uses within South Australia. Unregulated flows generally occur in response to high rainfall events upstream from South Australia. The MDBA Southern Connected Basin Environmental Water Committee (SCBEWC) has delegated authority from the Basin Officials Committee (BOC) to authorise use of River Murray Unregulated Flow (RMUF) for environmental purposes in the River Murray.

Under the different scenarios shown in **Figure 1**, unregulated flow provides the increase in height and volume of water above South Australia's Entitlement Flow. Unregulated flows can only be planned for in a general way and therefore are not considered planned environmental water, although they are critical for the health of environmental assets within the WRP area.

3. Co-operative Watering Arrangements

Between WRP areas

For several years, holders and managers of environmental water have worked together to plan and coordinate annual multi-site environmental watering trials (trials). The trials attempt to maximise the use of environmental water by re-using return flows as the water moves through the Southern Connected Basin. In 2013, BOC agreed that the long-term objective of the trials is to work towards incorporating environmental delivery into normal River Murray operations. This is occurring by identifying and analysing issues and potential changes to current operational practices.

The trials have tested a range of actions including new accounting methods, addition of environmental water to unregulated flows, use of loss factors and coordination of environmental releases with natural flow peaks. Each trial builds on lessons learned from the previous year and enhances understanding of the key elements for a successful outcome. In 2016-17 these actions will be further documented for codification into the existing Framework for managing Basin river flows.

SCBEWC and Water Liaison Working Group (WLWG) contribute to the development of the multi-site event strategy each year. Real-time operations groups hold regular teleconferences to ensure coordination and communication during the event and rapid response to any issues that may arise, such as black water events. Membership of these groups includes holders of held environmental water as well as managers of planned environmental water, managers of environmental assets and River operators. South Australia has representatives on these cross-jurisdictional committees and is participating in the planning for the large scale environmental watering event for 2016-17.

Within the WRP area

Existing mechanisms to assist with coordinating environmental watering within the WRP area are described in Section 4.2.1 of the LTWP (Department of Environment Water and Natural Resources, 2015).

For 2016-17, DEWNR will develop a multi-site plan for the use of environmental water within the WRP Area. The South Australian multi-site watering action will seek to align site-specific watering actions that have been identified in this document and maximise the effectiveness of environmental

water delivery and ecological outcomes throughout the system. This multi-site is supported by South Australian policy which prevents return flows from environmental watering actions, such as the operation of the Chowilla regulator and weir raisings, from being re-allocated for consumptive take, and so this water will flow down the river and eventually be delivered to the CLLMM for ecological benefit.

The SA multi-site watering action will be provided to the MDBA, water holders and relevant environmental managers when complete (estimated 30 June 2016), and presented in the SA River Murray annual environmental watering plan (to be published later in 2016).

References

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SA Murray-Darling Basin Natural Resources Management Board. (2002). *Water Allocation Plan for the River Murray Prescribed Watercourse (as amended January 2011).* Murray Bridge: SA Murray-Darling Basin Natural Resources Management Board.

Appendix 1. Summary of environmental watering actions proposed for 2016-17 by environmental asset/site managers

Very dry (95% AOP) Scenario

Site	Action	Details	Objectives	Volume (GL)
LLCMM	(a) Spring delivery	4 months - September to December	○ Barrage outflows for fish migration & localised estuarine conditions ○ Maintain lake levels >0.8 October to December ○ Fringing & submerged aquatic vegetation health ○ Southern Bell frog & small threatened fish recruitment	375.000
	(b) Baseflow	Remainder of year	○ Continuous fishway/barrage releases & localised estuarine conditions ○ Continuous connectivity between river & estuary ○ Maintain lake levels >0.4-0.5m AHD all year	225.000
Channel	N/A			
Weir manipulation	N/A			
Chowilla	Pulse flows	20 weeks - October to February Through Chowilla anabranch via Pipeclay & Stanley Creek weirs	○ Wetland vegetation including River Red Gum & Cooba; fish	TBA
Wetlands	Lower Lakes fringing wetlands - Pumping	4 sites 4 months over Spring - Summer	○ Habitat migratory birds; Snipes, frogs, Southern Bell Frogs, aquatic plant seedbank	Up to 0.900
	Chowilla wetlands - Pumping	Up to 7 sites - priority wetlands July to December	○ Wetland vegetation including River Red Gum, Black Box, Cooba; fish; water birds; amphibians; invertebrates; fauna outcomes	Up to 7.620
	Berri & Disher threatened fish refuges - Inlet operations & pumping	2 sites: ○ Disher - Spring - Summer as needed	○ Murray hardyhead	0.200
		○ Berri - Ongoing	○ Murray hardyhead ○ Waterbird habitat, including threatened & migratory species	Up to 1.327
	Valley wetlands - Pumping	12 sites ~4 months – September to December	○ Various including vegetation (River Red Gum & Black Box) waterbirds, frogs including Southern Bell frogs	Up to 8.000
	Gorge wetlands - Pumping	Up to 9 sites Bookmark Creek ongoing Others ~4 months – September to December	Various including vegetation (River Red Gum & Black Box) waterbirds, frogs including Southern Bell frogs	~3.500

Dry (90% AOP) Scenario

Site	Action	Details	Objectives	Volume (GL)
LLCMM	(a) Spring delivery	4 months - September to December	○ Barrage outflows for fish migration & localised estuarine conditions ○ Maintain lake levels >0.8 October to December ○ Fringing & submerged aquatic vegetation health ○ Southern Bell frog & small threatened fish recruitment	375.000
	(b) Baseflow	Remainder of year	○ Continuous fishway/barrage releases & localised estuarine conditions ○ Continuous connectivity between river & estuary ○ Maintain lake levels >0.4-0.5m AHD all year	225.000
	(c) Improved spring barrage releases	September to December	○ Improve: Estuarine conditions; North Lagoon; benthic macroinvertebrate; breeding, spawning estuarine fish (black bream & greenback flounder) ○ Food migratory birds	100.00
Channel	10,000 flow pulse x 60 days	November to December	○ Large positive: Maintain diurnally-mixed water column for diverse phytoplankton; support foraging generalists ○ Moderate positive: Maintain water quality to support aquatic biota; Promote bacterial rather than algal dominance; improve food for consumers.	320.000
Weir Manipulation	Boost QSA to entitlement level	Not consumed by weir pool raising		131.000
	Weir 2 pool raised to 75cm	90 days – September to November Note return flows = 10.500 GL	○ To avoid irretrievable loss or damage to environmental assets	12.000
	Weir 5 pool raised to 50cm	90 days – September to November Note return flows = 9.400 GL	○ To avoid irretrievable loss or damage to environmental assets	14.000
Chowilla	Pulse flows	20 weeks - October to February Through Chowilla anabranch via Pipeclay & Stanley Creek weirs	○ Wetland vegetation including River Red Gum and Cooba; fish	TBA
Wetlands	Lower Lakes fringing wetlands - Pumping	4 sites 4 months over Spring - Summer	○ Habitat migratory birds; Snipes, frogs, Southern Bell Frogs, aquatic plant seedbank	Up to 0.900
	Chowilla wetlands - Pumping	Up to 7 sites - priority wetlands July to December	○ Wetland vegetation including River Red Gum, Black Box, Cooba; fish; water birds; amphibians; invertebrates; fauna outcomes	Up to 7.620
	Berri & Disher -Threatened fish refuges - Inlet operations & pumping	2 sites: Disher - Spring - Summer as needed	○ Murray hardyhead	0.200
		Berri - On-going	○ Murray hardyhead ○ Waterbird habitat, including threatened & migratory species	Up to 1.327
	Valley wetlands - Pumping	12 sites SA Gorge geomorphic region ~4 months – September to December	○ Various including vegetation (River Red Gum & Black Box) waterbirds, frogs including Southern Bell frogs	Up to 8.000
	Gorge wetlands - Pumping	Up to 9 sites Bookmark Creek on-going Others ~4 months – September to December	○ Various including vegetation (River Red Gum & Black Box) waterbirds, frogs including Southern Bell frogs	~3.500

Moderate (75% AOP) Scenario

Site	Action	Details	Objectives	Volume (GL)
LLCMM	(a) Spring delivery	4 months - September to December	○ Barrage outflows for fish migration & localised estuarine conditions ○ Maintain lake levels >0.8 October to December ○ Fringing & submerged aquatic vegetation health ○ Southern Bell frog & small threatened fish recruitment	375.000
	(b) Baseflow	Remainder of year	○ Continuous fishway/barrage releases & localised estuarine conditions ○ Continuous connectivity between river & estuary ○ Maintain lake levels >0.4-0.5m AHD all year	225.000
	(c) Improved spring barrage releases	September to December	○ Improve: Estuarine conditions; North Lagoon; benthic macroinvertebrate; breeding, spawning estuarine fish (Black Bream & Greenback flounder) ○ Food migratory birds	100.000
	(d) Further improved spring barrage releases	3 months - October to December	○ Similar to Action C with further improvements. ○ Improving conditions of mudflats.	140.000
	(e) Winter pulse through barrages	1 month - June	○ Murray Mouth for Lamprey migration ○ Freshwater signal through Goolwa barrage to ocean ○ Minimise accumulation of sediment in Murray Mouth	60.000
Channel	10,000 flow pulse x 60 days	Mid October to Mid December	○ Large positive: Maintain diurnally-mixed water column for diverse phytoplankton; support foraging generalists ○ Moderate positive: Maintain water quality to support aquatic biota; Promote bacterial rather than algal dominance; improve food for consumers.	275.000
Weir Manipulation	Boost QSA to entitlement level	Not consumed by WPR		33.000
	Weir 2 pool raised to 75cm	90 days – September to November Note return flows = 10.500 GL	○ To maintain basic functions and resilience of environmental asset	12.000
	Weir 5 pool raised to 50cm	90 days – September to November Note return flows = 9.000 GL	○ To maintain basic functions and resilience of environmental asset	14.000
Chowilla	Pulse flows	20 weeks - October to February Through Chowilla anabranch via Pipeclay & Stanley Creek weirs	○ Wetland vegetation including River Red Gum and Cooba; fish	TBA
Wetlands	Lower Lakes fringing wetlands - Pumping	4 sites 4 months over Spring - Summer	○ Habitat migratory birds; Snipes, frogs, Southern Bell Frogs, aquatic plant seedbank	Up to 0.900
	Chowilla wetlands - Pumping	Up to 7 sites - priority wetlands July to December	○ Wetland vegetation including River Red Gum, Black Box, Cooba; fish; water birds; amphibians; invertebrates; fauna outcomes	Up to 7.620
	Berri & Disher threatened fish refuges - Inlet operations & pumping	2 sites: Disher - Spring - Summer as needed	○ Threatened fish refuges ○ Murray hardyhead	0.200
		Berri - On-going	○ Murry hardyhead ○ Waterbird habitat, including threatened & migratory species	Up to 1.327
	Valley wetlands - Pumping	12 sites SA Gorge geomorphic region ~4 months – September to December	○ Various including vegetation (River Red Gum & Black Box) waterbirds, frogs including Southern Bell frogs	Up to 8.000
	Gorge wetlands - Pumping	11 sites Bookmark Creek on-going Others ~4 months – September to December	○ Various including vegetation (River Red Gum & Black Box) waterbirds, frogs including Southern Bell frogs	~3.500

Near Average (50% AOP) Scenario

Site	Action	Details	Objectives	Volume (GL)
LLCMM	(a) Spring delivery	4 months - September to December	○ Barrage outflows for fish migration & localised estuarine conditions ○ Maintain lake levels >0.8 October to December ○ Fringing & submerged aquatic vegetation health ○ Southern Bell frog & small threatened fish recruitment	375.000
	(b) Baseflow	Remainder of year	○ Continuous fishway/barrage releases & localised estuarine conditions ○ Continuous connectivity between river & estuary ○ Maintain lake levels >0.4-0.5m AHD all year	225.000
	(c) Improved spring barrage releases	September to December	○ Improve: Estuarine conditions; North Lagoon; benthic macroinvertebrate; breeding, spawning estuarine fish (black bream & greenback flounder) ○ Food migratory birds	100.000
	(d) Further improved spring barrage releases	3 months - October to December	○ Similar to Action C with further improvements ○ Improving conditions of mudflats	140.000
	(e) Winter pulse through barrages	1 month - June	○ Murray Mouth for lamprey migration ○ Freshwater signal through Goolwa barrage to ocean ○ Minimise accumulation of sediment in Murray Mouth	60.000
	(f) Add water to unregulated flows, higher barrage releases	9 months - Larger flow October to December plus lower flow January to June[3]	○ Salinity benefits North Lagoon ○ *Ruppia tuberosa* in South Lagoon ○ Estuarine fish North & South lagoons ○ Food for waterbirds North Lagoon ○ Open Murray Mouth ○ Enhanced estuary conditions for the Coorong	1051.000 372.000
Channel	15,000 flow pulse x 90 days	October to December	○ Large positive: Maintain diurnally-mixed water column for diverse phytoplankton; Maintain water quality to support aquatic biota; support foraging generalists ○ Moderate positive: Adequate flushing of salt to ocean; Establish and maintain groundwater/soil moisture; Promote bacterial rather than algal dominance; improve food for consumers; Diverse flood-dependant plant community; Support golden perch and silver perch populations	600.000
Weir Manipulation	Weir 2 pool raised to 75cm	90 days – September to November Return flows = 7.000 GL	○ To maintain ecological health and resilience	10.000
	Weir 5 pool raised to 50cm	90 days – September to November Return flows = 8.000 GL	○ To maintain ecological health and resilience	13.000
Chowilla	Operate regulator - mid-floodplain inundation	July to December – 147 days	○ Wetland vegetation including River Red Gum, Black Box, Cooba; fish; water birds; amphibians; invertebrates; fauna outcomes	Up to 278.000
Wetlands	Lower Lakes fringing wetlands - Pumping	4 sites 4 months over Spring - Summer	Habitat migratory birds; Snipes, frogs, Southern Bell Frogs, aquatic plant seedbank	Up to 0.900
	Valley wetlands - Pumping	11 sites ~4 months – September to December	Various including vegetation, waterbirds, frogs	~7.500
	Gorge Wetlands - Pumping	Up to 9 sites ~4 months – September to December	Various including vegetation, waterbirds, frogs	Up to 3.000

[3] NOTE: Environmental water is not requested in July, August and September for barrage fishway outflows if there is sufficient flows as per the AOP scenario. The water is instead requested for October to December.

Wet (25% AOP) Scenario

Site	Action	Details	Objectives	Volume (GL)
LLCMM	(a) Spring delivery	4 months - September to December	○ Barrage outflows for fish migration & localised estuarine conditions ○ Maintain lake levels >0.8 October to December ○ Fringing & submerged aquatic vegetation health ○ Southern Bell frog & small threatened fish recruitment	375.000
	(b) Baseflow	Remainder of year	○ Continuous fishway/barrage releases & localised estuarine conditions ○ Continuous connectivity between river & estuary ○ Maintain lake levels >0.4-0.5m AHD all year	225.000
	(c) Improved spring barrage releases	September to December	○ Improve: Estuarine conditions; North Lagoon; benthic macroinvertebrate; breeding, spawning estuarine fish (black bream & greenback flounder) ○ Food migratory birds	100.000
	(d) Further improved spring barrage releases	3 months - October to December	○ Similar to Action C with further improvements. ○ Improving conditions of mudflats.	140.000
	(e) Winter pulse through barrages	1 month - June	○ Murray Mouth for lamprey migration ○ Freshwater signal through Goolwa barrage to ocean ○ Minimise accumulation of sediment in Murray Mouth	60.000
	(f) Add water to unregulated flows, higher barrage releases	9 months - Larger flow October to December plus lower flow January to June[4]	○ Salinity benefits North Lagoon ○ *Ruppia tuberosa* in South Lagoon ○ Estuarine fish North & South lagoons ○ Food for waterbirds North Lagoon ○ Open Murray Mouth ○ Enhanced estuary conditions Coorong	1051.000 372.000
	(g) Add water to unregulated flows, higher barrage releases	3 months - October to December	○ Salinity benefits North Lagoon ○ *Ruppia tuberosa* in South Lagoon ○ Estuarine fish North & South lagoons ○ Food for waterbirds North Lagoon ○ Open Murray Mouth ○ Enhanced estuary conditions Coorong	1220.000 200.000
Channel	Build on unregulated flow event e.g. Median discharge QSA 35,000 ML/day	60 days – September to October	Per drier scenarios plus moderate positive contribution to temporary wetland connectivity; RRG recruitment; understorey vegetation; Murray cod recruitment; catfish recruitment	~300.000
Weir Manipulation	No proposal			
Chowilla	Operate regulator – maximise floodplain inundation	July to December – 155 days	○ Wetland vegetation including River Red Gum, Black Box, Cooba; fish; water birds; amphibians; invertebrates; fauna outcomes	98.000
	Operate regulator – maximise floodplain inundation	July to December – 157 days	○ Wetland vegetation including River Red Gum, Black Box, Cooba; fish; water birds; amphibians; invertebrates; fauna outcomes	276.000
Wetlands	Lower Lakes fringing wetlands - Pumping	4 sites 4 months over Spring - Summer	○ Habitat migratory birds; Snipes, frogs, Southern Bell Frogs, aquatic plant seedbank	Up to 0.900
	Valley wetlands - Pumping	3 to 11 sites ~4 months – September to December	○ Various including vegetation, waterbirds, frogs	2 to 7.500
	Gorge wetlands - Pumping	Up to 9 sites ~4 months – September to December	○ Various including vegetation, waterbirds, frogs	Up to 3.000

[4] NOTE: Environmental water is not requested in July, August and September for barrage fishway outflows if there is sufficient flows as per AOP. The water is instead requested for October to December.

Appendix 2. Temporary wetlands for pumping

Watering proposal	Wetland Name	Watering Objectives
Lower Lakes fringing wetlands	Tolderol	• Provide water levels and suitable habitat for Migratory Birds • Provide suitable breeding habitat for frogs; in particular Southern Bell Frogs
	Milang	• Provide suitable water habitat for Snipes during dry years • Improve aquatic plant seedbank
	Jenny's Lagoon	• Provide suitable breeding habitat for frogs; in particular Southern Bell Frogs
	South Teringie*	• Provide water levels and suitable habitat for Migratory Birds
Gorge Wetlands	Overland Corner	• Support a range/mosaic of wetland habitats including Lignum and River Red Gum habitats
	Grieigers @ Sugar shack*	• Support a range/mosaic of wetland habitats including Lignum and River Red Gum habitats
	Greenways*	• Support a range/mosaic of wetland habitats including Lignum and River Red Gum habitats
	Warnochlescheid*	• Support a range/mosaic of wetland habitats including Lignum and River Red Gum habitats
	Riversleigh*	• Support ongoing growth of seedlings and saplings of River Red Gum, Black Box and Cooba that have established in response to flooding and environmental watering recent years
	Waikerie Ferry*	• Support ongoing growth of seedlings and saplings of River Red Gum, Black Box and Cooba that have established in response to flooding and environmental watering recent years
	Rilli – Stanitzkis*	• Support ongoing growth of seedlings and saplings of River Red Gum, Black Box and Cooba that have established in response to flooding and environmental watering recent years
	Calperum Station*	• Support tree health, especially large areas of black box.
	Wigley Reach	• Support a range/mosaic of wetland habitats including Lignum and River Red Gum habitats
	Wigley Reach Central Channel*	• Support a range/mosaic of wetland habitats including Lignum and River Red Gum habitats
	Herons Bend*	• Regent Parrot breeding site
	Banrock's Bend*	• Regent Parrot breeding site
	Eastern Lagoon*	• Support a range/mosaic of wetland habitats including Lignum and River Red Gum habitats
	Akuna	• Support a range/mosaic of wetland habitats including Lignum and River Red Gum habitats
	Parcoola	• Support tree health (River Red Gum) and waterbirds
	Markaranka	• Support a range/mosaic of wetland habitats including Black Box and River Red Gum habitats • Provide frog breeding opportunities, particularly for the Southern Bell Frog • Provide Regent Parrot habitat (including nesting)
	Hogwash Bend	• Support a range/mosaic of wetland habitats including lignum and River Red Gum habitats • Provide frog breeding opportunities, particularly for the Southern Bell Frog • Provide Regent Parrot habitat (including nesting)
	Nilkra	• Support tree health (River Red Gum) for Regent Parrots
	Molo Flat	• Support a range/mosaic of wetland habitats including River Red Gum and open water habitats • Provide frog breeding opportunities, particularly for the Southern Bell Frog

Watering proposal	Wetland Name	Watering Objectives
	Morgan East	• Support a range/mosaic of wetland habitats including Lignum and River Red Gum habitats • Provide frog breeding opportunities, particularly for the Southern Bell Frog
	Nikalapko	• Support tree health (River Red Gum) and waterbirds
	Yarra Creek*	• Support a range/mosaic of wetland habitats including Lignum and River Red Gum habitats
	Morgan CP (South Lagoon)	• Support a range/mosaic of wetland habitats including Lignum and River Red Gum habitats • Provide frog breeding opportunities, particularly for the Southern Bell Frog • Provide Regent Parrot habitat (including nesting)
	Sweeney's	• Provide frog breeding opportunities, particularly for the Southern Bell Frog

Sites marked with an asterisk (*) were included as late entries following the finalisation of the priorities. An officer from the CEWO confirmed that these sites will receive CEWH water in 2016-17. The information in Appendix 1 does not reference these sites (e.g. volumes, number of sites, etc.)

Watering proposal	Wetland Name	Watering Objectives
Valley Wetlands	Carparks Lagoon	• Support a range of floodplain vegetation communities including River Red Gum and Black Box seedlings, and fringing River Red Gum • Support aquatic and wetland bed vegetation • Provide frog breeding opportunities, particularly for the Southern Bell Frog • Provide waterbird habitats for foraging and breeding
	Rilli Reserve*	• Support ongoing growth of seedlings and saplings of River Red Gum, Black Box and Cooba that have established in response to flooding and environmental watering recent years
	Westbrooks*	• Support ongoing growth of seedlings and saplings of River Red Gum, Black Box and Cooba that have established in response to flooding and environmental watering recent years
	Thiele's Flat*	• Support ongoing growth of seedlings and saplings of River Red Gum, Black Box and Cooba that have established in response to flooding and environmental watering recent years
	Clark's Floodplain*	• Support ongoing growth of seedlings and saplings of River Red Gum, Black Box and Cooba that have established in response to flooding and environmental watering recent years
	Loxton Riverfront Reserve*	• Support ongoing growth of seedlings and saplings of River Red Gum, Black Box and Cooba that have established in response to flooding and environmental watering recent years
	Gerard basin and floodplain	• Support a range of floodplain vegetation communities including River Red Gum, Black Box, Cooba and Lignum • Provide frog breeding opportunities, particularly for the Southern Bell Frog
	Wiela shedding and temporary wetlands	• Support a range of floodplain vegetation communities including River Red Gum and Black Box seedlings
	Bookmark Creek	• Support a range of floodplain vegetation communities including fringing River Red Gum • Provide frog breeding opportunities, particularly for the Southern Bell Frog • Provide flowing habitat
	Murtho Park	• Support a range of floodplain vegetation communities including River Red Gum, Black Box and Cooba
	Johnson's Waterhole*	• Support a range of floodplain vegetation communities including River Red Gum, Black Box and Cooba • Provide waterbird habitats for foraging and breeding
	Old Loxton Road	• Support a range of floodplain vegetation communities including Lignum • Support aquatic and wetland bed vegetation
	Piggy Creek	• Support tree health (River Red Gum), Lignum, frogs and waterbirds
	Katarapko Creek	• Support a range of floodplain vegetation communities including River Red Gum, Black Box and Cooba • Provide frog breeding opportunities, particularly for the Southern Bell Frog • Provide waterbird habitats for foraging and breeding
	Martin Bend	• Support a range of floodplain vegetation communities including River Red Gum, Black Box, Cooba and Lignum • Provide frog breeding opportunities, particularly for the Southern Bell Frog
	Yabby Creek / Katarapko Basins	• Support a range of floodplain vegetation communities including River Red Gum and Black Box seedlings • Provide waterbird habitats for foraging and breeding

	Lyrup Lagoon*	• Attempt at brine shrimp breeding event for waterbird habitats for foraging and breeding.
	Mundic wetland*	• Support a range of floodplain vegetation communities including River Red Gum and Black Box seedlings
	Duck Hole*	• Support a range of floodplain vegetation communities including River Red Gum and Black Box seedlings
	Inner Mundic Creek*	• Support a range of floodplain vegetation communities including River Red Gum and Black Box seedlings
	Lescheid Pikes*	• Support a range of floodplain vegetation communities including River Red Gum and Black Box seedlings
Chowilla Wetlands	Coppermine Complex Gum Flat Lake Limbra Monoman Creek Depression Monoman Depression Twin Creeks Woolshed Creek	• Reduce soil salinity and improve soil moisture availability in inundated and adjacent areas • Halt observed increase in proportion of trees for which condition scores are below the Ecological Target • Support ongoing growth of seedlings and saplings of River Red Gum, Black Box and Cooba that have established in response to flooding and environmental watering recent years • Improve condition of Lignum in inundated areas • Provide conditions conducive to growth of flood dependent and aquatic vegetation in inundated zones • Provide breeding habitat for waterbirds, amphibians and invertebrates. • Re-establish habitat condition to sustain high value fauna communities

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