2018-19 Annual Environmental Watering Priorities for the South Australian River Murray Water Resource Plan Area

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.

The principles and method described in Chapter 8 Part 6 of the Basin Plan have been applied in developing the South Australian River Murray priorities. These priorities will be incorporated as a chapter of the 2018-19 Annual Environmental Watering Plan for the South Australian River Murray.

2. Identification of priorities

Approach

The priorities for the Water Resource Planning (WRP) Area for 2018-19 have been developed in accordance with the Basin Plan requirements. The priorities for 2018-19 are consistent with the South Australian River Murray Long-Term Environmental Watering Plan (LTWP)[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 demonstrates alignment between these and the expected environmental outcomes of the Basin Wide Environmental Watering Strategy (BWEWS) (Murray-Darling Basin Authority, 2014a).

A scenario-based approach was used to develop proposed priority watering actions for 2018-19. Five resource availability scenarios were utilised as advised by the MDBA and based on the MDBA annual operating probabilities (AOP) provided in February 2018: 90% (dry), 75% (moderate), 50% (near average), 25% (wet) and 10% (very wet) (Figure 1). These percentages refer to the likelihood of exceeding different water resource availability based on the analysis of historical inflows, current storage volumes, and operational considerations for the upcoming year. A volume of held environmental water (HEW) potentially available for delivery to South Australia in 2018-19 under each of the resource availability scenarios was assumed for planning purposes (refer 'Assumptions').

[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.

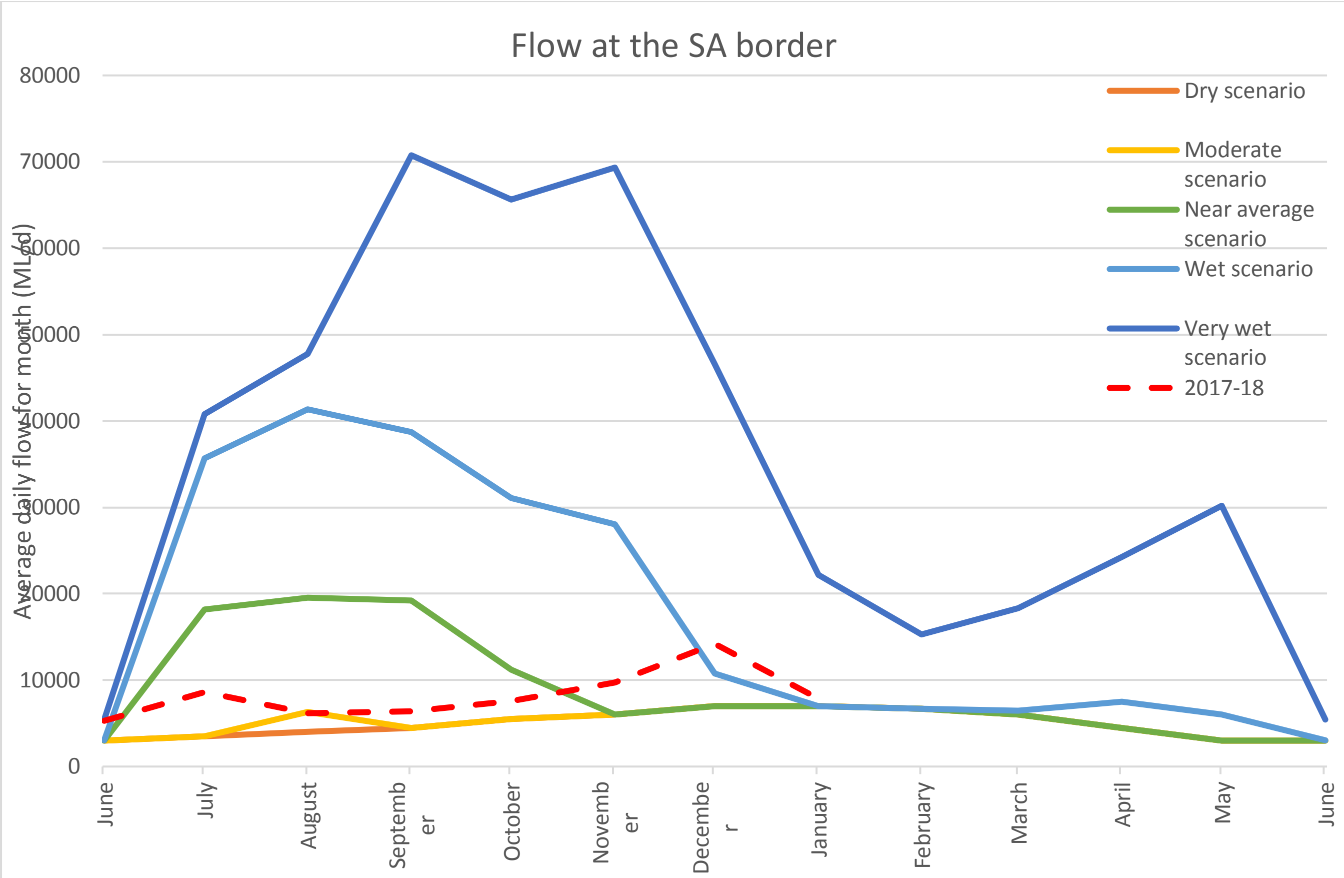

Figure 1. Annual operating probabilities provided by MDBA in February 2018 for the purpose of informing environmental water planning for 2018-19

The resource availability scenarios and assumed Held Environmental Water (HEW) availability were used to develop environmental watering proposals for each site/asset. The preparation of the proposed priorities for the SA River Murray has involved detailed planning and consultation. The priorities have been developed with input from water and land managers, river operators, scientists, community, and indigenous groups.

Annual Priorities

Priority watering actions have been identified for the three Priority Environmental Assets defined in the South Australian River Murray LTWP. These assets are the River Murray floodplain, River Murray channel, and the Lower Lakes, Coorong and Murray Mouth (LLCMM). In addition, priority actions have been identified for a range of infrastructure operations (i.e. Chowilla, weir pool manipulation and wetland management) that significantly contribute to outcomes within the Priority Environmental Assets. A detailed summary of the watering actions proposed under each resource availability scenario is provided in Appendix 1.

Enhanced water delivery in spring and early summer is a priority for assets under all scenarios. Sustained low level delivery throughout the remainder of the year is also a priority for maintaining flows into the Coorong and though the Murray Mouth. Where possible, it is proposed to enhance flows to continue to consolidate the improvements in floodplain and wetlands that resulted from the high flows of 2016, and to sustain high flows into early summer to support outcomes in the

LLCMM. All of the proposed actions are scalable and will be managed to further enhance the benefits of water delivered for system-scale floodplain, channel and LLCMM outcomes.

A range of wetland watering actions are also proposed including drying a number of pool-connected wetlands and pumping priority temporary sites. Wetland watering actions will be undertaken by DEW staff and in conjunction with several non-government organisations (NGOs) including Nature Foundation of South Australia (NFSA), Renmark Irrigation Trust (RIT), Ngarrindjeri Regional Authority (NRA), Banrock Station and Australian Landscape Trust (ALT).

Assumptions

Held Environmental Water Availability

The work required to inform the development of the priorities was undertaken between February and April 2018. For the purposes of planning and prioritisation, an estimate of potential HEW availability under each resource scenario was made based on environmental water delivery in recent years and advice from water holders (Table 1).

Table 1. Estimate of held environmental water available under each resource availability scenario

Scenario	Estimate of HEW available (GL)
Dry (90%)	**1500-1600 GL**
Moderate (75%)	**1730-1850 GL**
Wet (25%)	**1800-2000 GL**

HEW is available from the following sources – the Commonwealth Environmental Water Holder (CEWH), MDBA -The Living Murray (TLM), the Victorian Environmental Water Holder (VEWH), the South Australian Minister for Environment and Water 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 1,984 GL (at 9 April 2018), with varying levels of security and a LTAAY of 1,489 GL. Of this volume, approximately 155 GL registered entitlement (140 GL LTAAY) is held in South Australia and forms part of South Australia's entitlement flow. Some carry-over from 2017-18 may be available, although the CEWH is yet to confirm a volume.

The Living Murray Environmental Water

TLM holdings are 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 Flow. Up to 470 GL of River Murray Increased Flows from the Snowy Agreement may also be available.

Victorian Environmental Water Holder

The Victorian Environmental Water Holder (VEWH) manages environmental water holdings in the Murray, Goulburn and Campaspe rivers. 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 Environment and Water

Apart from TLM holdings, the South Australian Minister for Environment and Water 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 Flow.

Of this total volume, approximately 32.8 GL belongs to the Wetlands Consumptive Pool (Class 9) water access entitlement described in the Water Allocation Plan for the River Murray Prescribed Watercourse (WAP) (SA Murray-Darling Basin Natural Resources Management Board, 2017). This water is for the management of pool-connected wetlands within the WRP Area so there is limited flexibility in the location of use.

Approximately 6.5 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).

Small volumes are held by the South Australian Minister for Environment and Water on interstate licences (less than 2 GL in total).

Decisions on the use of environmental water held by the South Australian Minister for Environment and Water are made within DEW consistent with the annual priorities.

Non-Government Organisations

Nature Foundation South Australia (NFSA) holds 0.074 GL of Class 3A Water Access Entitlement on licence. The Murray Darling Association holds 0.018 GL of Class 3A Water Access Entitlement. For 2018-19, Banrock Station holds approximately 1.38 GL of Class 9 (Wetlands) water for the management of the pool-connected areas of Banrock Station Wetland Complex.

Planned Environmental Water Availability

Planned Environmental Water (PEW) has not been defined yet for the River Murray Water Resource Plan Area. This plan is in preparation.

Unallocated Wetlands water

The River Murry WAP establishes 200 GL of Dilution and Loss water as water for pool connected wetlands. Approximately 42 GL of this water is held on a licence and is HEW (see above). The remaining 158 GL is considered to be planned environmental water (PEW). This volume is essentially evaporative loss from the wetlands and is 'used' as it replaces evaporative losses from unmanaged, pool-connected wetlands during normal river operations. This water cannot be 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 use 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 presented in Figure 1, unregulated flow provides the increase in volume of water above South Australia's Entitlement Flow. Unregulated flows are critical for the health of South Australia's environmental assets.

Other water

Other water also contributes to environmental outcomes in the SA River Murray including a portion of the Dilution and Loss component, a small unallocated portion, Additional Dilution Flow and the Lindsay River Allowance.

3. Co-operative Watering Arrangements

Between Water Resource Planning 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 water moves through the Southern Connected Basin. In 2013, the Basin Officials Committee (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 making changes to operational practices.

The Trials have tested a range of actions including new accounting methods, addition of environmental water to unregulated flow, 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 successful outcomes. These actions will be further documented for incorporation into the existing framework for managing Basin river flows.

The SCBEWC and Water Liaison Working Group (WLWG) contribute to the development of the multi-site events each year. Real-time Operational Advisory Groups hold regular teleconferences to ensure coordination and communication during the event and rapid response to any issues that may arise. Membership of these groups includes holders of HEW and managers of PEW, managers of environmental assets and River operators. South Australia has representatives on these cross-jurisdictional committees and is participating in the planning for large scale environmental watering events for 2018-19.

In addition, a cross-jurisdictional River Murray channel watering event is being planned to maximise all channel flows for the benefit of the channel biota and to enhance flow delivery to SA.

Within the River Murray Water Resource Planning area

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

For 2018-19, DEW will develop a multi-site plan for the use of environmental water within the WRP Area. The South Australian multi-site watering plan 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 and testing of the Chowilla regulator and weir raisings, from being re-allocated for consumptive use, so this water will flow down the river and 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.

References

Department of Environment Water and Natural Resources. (2015). *Long term environmental watering plan for the South Australian River Murray water resource plan area.* Adelaide: Department of Environment Water and Natural Resources.

Department of the Environment and Energy. (2018). *Water holdings*. Retrieved from Commonwealth Environmental Water Office: http://www.environment.gov.au/water/cewo/portfolio-mgt/holdings-catchment

Murray-Darling Basin Authority. (2014a). *Basin-wide environmental watering strategy.* Canberra: Commonwealth of Australia.

O'Connor, J., Steggles, T., Higham, J., & Rumbelow, A. (2015). *Ecological objectives, targets, and environmental water requirements for the Coorong, Lower Lakes and Murray Mouth.* Adelaide: Department of Environment Water and Natural Resources.

SA Murray-Darling Basin Natural Resources Management Board. (2017). *Water Allocation Plan for the River Murray Prescribed Watercourse.* Murray Bridge: SA Murray-Darling Basin Natural Resources Management Board.

Appendix 1. Summary of environmental watering priorities proposed for 2018-19.

Dry (90% AOP) Scenario

Site	Action	Details	o Objectives	Vol GL
LLCMM	Spring inundation of fringing Lower lakes wetlands: raising lake levels in spring to ~0.8m AHD and barrage releases	4 months – Sept - Dec	o Lower Lakes fringing vegetation, threatened fish and frog species o Movement and recruitment of congollis and galaxias o Localised estuary for estuarine fish, macroinvertebrates	548.5
	8 month continuous barrage releases for fish passage	8 months – Jan – Jun and Jul-Aug	o Provide continuous fishway/barrage releases & localised estuarine conditions o Provide continuous connectivity between river & estuary o Maintain lake levels >0.4-0.5m AHD all year	272.5
	Winter flows through barrages/Murray Mouth	July-Aug	o Provide freshwater signal through Goolwa barrages to ocean o Provide for upstream migration of adult lamprey o Minimise accumulation of sediment in Murray Mouth	40
Channel and Floodplain	Target partially delivery EWR-IC2 described in the SA River Murray LTWP (Median discharge QSA 15,000 ML/day) with reduced duration	60-days - mid-Oct to mid-Dec	o Increase availability of moderate-fast (0.18 – 0.25 m/s) velocity habitat o In near-bank areas of upper weir pools, freshen groundwater and maintain/improve adult river red gum tree condition o Support spawning and recruitment of golden perch and silver perch by creating conditions conducive to reproductive activity when temperature thresholds (20 degrees) are exceeded	610
	Target EWR-IC1 described in the SA River Murray LTWP (Median discharge QSA 10,000 ML/day with +/- 2,000 ML/day variability	60-days - Dec-Jan	o Prevent persistent thermal stratification and conditions conducive to harmful algal blooms from occurring o Improved biofilm community composition in upper weir pools (due to variations in water levels in weir pool tailwaters) o Facilitate recruitment of emergent vegetation in upper weir pools (due to variations in water levels in weir pool tailwaters) o Promote annual recruitment by foraging generalist native fish species	174
	Replicate the 2005 QSA hydrograph between 1/10/2005 and 31/12/2005 by maintaining a median QSA of at least 12,000 ML/d (no less than 8,000 ML/d) for at least 70 days with a peak of >15,000 ML/d for at least 20 days	70 days – Oct to Dec	o Improve hydraulic habitat conditions in the River channel o Stimulate fish breeding and recruitment o Improve variation in water levels o Improvements in vegetation health by freshening of near bank groundwater o Inundate small areas of temporary wetlands below Locks o Maximise ecological benefits for the River system through the delivery of water to the Lower Lakes, Coorong and Murray Mouth o Increase flow rates through anabranch systems	418

Weir Pool Manipulation	Lower weir pool 2 by 15-25 cm below normal pool level	40 days – mid July –mid August	o To test procedures and validate models o Increase bank habitat o Improve soil condition o Improve littoral zone cycling and soil condition o Improve riparian habitat o Enhanced flow velocity and matter transport	24.8
	Weir 2 pool raised by up to 50 cm above normal pool level	105 days – Sept-mid Dec	o Growth and expansion of littoral vegetation o Understorey plant community sustained and productive o Diverse and productive biofilm and macroinvertebrate communities o Breeding habitat for small fish and reed dependent waterbirds o Relieve soil salinity stress in littoral zone	6.3
	Weir 2 pool raised by up to 50 cm above normal pool level but reduce duration if QSA >15,000 ML/d from mid Oct	45 days - Sept-mid Oct	o Growth and expansion of littoral vegetation o Understorey plant community sustained and productive o Diverse and productive biofilm and macroinvertebrate communities o Breeding habitat for small fish and reed dependent waterbirds o Relieve soil salinity stress in littoral zone	5.7
	Weir pool 2 raise by up to 50 cm above normal pool level and further raise to 75 cm above normal pool level if QSA 10,000 ML/d in Dec	105 days – Sept-mid Dec	o Growth and expansion of littoral vegetation o Understorey plant community sustained and productive o Diverse and productive biofilm and macroinvertebrate communities o Breeding habitat for small fish and reed dependent waterbirds o Relieve soil salinity stress in littoral zone	10.3
	Lower weir pool 5 by 12-15 cm below normal pool level following lowering in June of 8-12 cm	30 days - July	o To test procedures and validate models o Increase bank habitat o Improve soil condition o Improve littoral zone cycling and soil condition o Improve riparian habitat o Enhanced flow velocity and matter transport	1.8
	Weir 5 pool raised by up to 35 cm above normal pool level	130 days – Aug to early Dec	o Growth and expansion of littoral vegetation o Understorey plant community sustained and productive o Diverse and productive biofilm and macroinvertebrate communities o Breeding habitat for small fish and reed dependent waterbirds o Relieve soil salinity stress in littoral zone	14.4
	Weir 5 pool raised by up to 35 cm above normal pool level but reduce duration if QSA >15,000 ML/d from mid Oct	75 days – Aug to late Oct	o Growth and expansion of littoral vegetation o Understorey plant community sustained and productive o Diverse and productive biofilm and macroinvertebrate communities o Breeding habitat for small fish and reed dependent waterbirds o Relieve soil salinity stress in littoral zone	
	Raise weir pool 6 up to 20 cm above normal pool level	28-42 days – Sept –early Dec	o Growth and expansion of littoral vegetation o Understorey plant community sustained and productive Diverse and productive biofilm and macroinvertebrate communities	2.8

			Relieve soil salinity stress in littoral zone	
	One or more of weir pool 1, 2, 5 and 6 by 15-30 cm below normal pool level over 60 days	April - Jun	o TBA	TBA
Chowilla	Pump to up to 8 priority wetlands	Sept-Nov	o Fringing vegetation – support seedlings o Habitat for biota o Reduce soil salinity o Improve soil moisture	4
	Pulse flows through Chowilla anabranch via Pipeclay & Slaney Creek weirs in conjunction with raising weir pool 6.	20 weeks – Oct - Feb	o Fast flowing habitat for large bodied fish o Mobilise carbon and nutrients to support aquatic food webs via increased flux of resources through microbial and invertebrate pathways to higher trophic levels (fish water birds) o Provide breeding and feeding habitat for waterbirds, amphibians and invertebrates.	N/A
	Operate Chowilla Regulator to generate in-channel rise. Regulator up to 18.5 mAHD; L6 – 19.45 mAHD	Sept-Dec	o Instate variability in hydraulic conditions (depth, velocity, turbulence) o Reduced salinity of near-bank groundwater due to lateral infiltration of low salinity surface water o Reduced soil salinity and improved soil moisture availability in inundated and adjacent zones o promotion of bacterial-dominated biofilm communities with higher nutritional value (compared to algal biofilms) benefiting higher consumers that use biofilms as a food resource o Improved vegetation growth in riparian zone o Create lateral connection and inundation of early commence to flow wetlands connected *(depending on height of operation*. o Assist in achieving the Ecological Target for trees adjacent to anabranch creeks o 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 o Assist in achieving the Ecological Target for lignum in inundated areas o Provide conditions conducive to achieving ecological targets for flood dependent and aquatic understorey vegetation in inundated and riparian zones	24.7

Moderate (75% AOP) Scenario

Site	Action	Details	Objectives	Vol GL
LLCMM	Spring inundation of fringing Lower lakes wetlands: raising lake levels in spring to ~0.8m AHD and barrage releases	4 months – Sept - Dec	o Provide barrage outflows for fish migration, connectivity & localised estuarine conditions o Maintain lake levels ~0.8 m AHD October to December o Improve fringing & submerged aquatic vegetation health o Provide for Southern Bell frog & small threatened fish recruitment	649
	8 month continuous barrage releases for fish passage	8 months – Jan - June & Jul-Aug	o Provide continuous fishway/barrage releases & localised estuarine conditions o Provide continuous connectivity between river & estuary o Maintain lake levels >0.5m AHD all year	288.5
	Winter flows through barrages/Murray Mouth	July-August	o Provide freshwater signal through Goolwa barrages to ocean o Provide for upstream migration of adult lamprey o Minimise accumulation of sediment in Murray Mouth	40
Channel and Floodplain	Target partially delivery EWR-IC2 described in the SA River Murray LTWP (Median discharge QSA 15,000 ML/day) with reduced duration (note reduced duration may mean a reduced certainty of achieving outcomes)	60-days - mid-Oct to mid-Dec	o Increase availability of moderate-fast (0.18 – 0.25 m/s) velocity habitat o In near-bank areas of upper weir pools, freshen groundwater and maintain/improve adult river red gum tree condition o Support spawning and recruitment of golden perch and silver perch by creating conditions conducive to reproductive activity when temperature thresholds (20 degrees) are exceeded	610
	Target EWR-IC1 described in the SA River Murray LTWP (Median discharge QSA 10,000 ML/day with +/- 2,000 ML/day variability	60-days - Dec-Jan	o Prevent persistent thermal stratification and conditions conducive to harmful algal blooms from occurring o Improved biofilm community composition in upper weir pools (due to variations in water levels in weir pool tailwaters) o Facilitate recruitment of emergent vegetation in upper weir pools (due to variations in water levels in weir pool tailwaters) o Promote annual recruitment by foraging generalist native fish species	174
	Replicate the 2005 QSA hydrograph between 1/10/2005 and 31/12/2005 by maintaining a median QSA of at least 12,000 ML/d (no less than 8,000 ML/d) for at least 70 days with a peak of >15,000 ML/d for at least 20 days	70 days – Oct to Dec	o Improve hydraulic habitat conditions in the River channel o Stimulate fish breeding and recruitment o Improve variation in water levels o Improvements in vegetation health by freshening of near bank groundwater o Inundate small areas of temporary wetlands below Locks o Maximise ecological benefits for the River system through the delivery of water to the Lower Lakes, Coorong and Murray Mouth o Increase flow rates through anabranch systems	418
Weir Pool Manipulation	Lower weir pool 2 by 15-25 cm	22 days – mid July –mid August	o Increase bank habitat o Improve soil condition o Improve littoral zone cycling o Improve riparian habitat	17.8
	Weir 2 pool raised by up to 50 cm above normal pool level	105 days – Sept-mid Dec	o Growth and expansion of littoral vegetation o Understorey plant community sustained and productive	6.3

			o Diverse and productive biofilm and macroinvertebrate communities o Breeding habitat for small fish and reed dependent waterbirds o Relieve soil salinity stress in littoral zone	
	Weir 2 pool raised by up to 50 cm but reduce duration if QSA >15,000 ML/d from mid Oct	45 days - Sept-mid Oct	o Growth and expansion of littoral vegetation o Understorey plant community sustained and productive o Diverse and productive biofilm and macroinvertebrate communities o Breeding habitat for small fish and reed dependent waterbirds o Relieve soil salinity stress in littoral zone	5.7
	Weir pool raise by up to 50 cm above normal pool level and further raise to 75 cm above normal pool level if QSA 10,000 ML/d in Dec	105 days – Sept-mid Dec	o Growth and expansion of littoral vegetation o Understorey plant community sustained and productive o Diverse and productive biofilm and macroinvertebrate communities o Breeding habitat for small fish and reed dependent waterbirds o Relieve soil salinity stress in littoral zone	10.3
	Lower weir pool 5 by 12-15 cm following lowering in June of 8-12 cm		o To test procedures and validate models o Increase bank habitat o Improve soil condition o Improve littoral zone cycling and soil condition o Improve riparian habitat o Enhanced flow velocity and matter transport	1.8
	Weir 5 pool raised by up to 35 cm above normal pool level	130 days – Aug to early Dec	o Growth and expansion of littoral vegetation o Understorey plant community sustained and productive o Diverse and productive biofilm and macroinvertebrate communities o Breeding habitat for small fish and reed dependent waterbirds o Relieve soil salinity stress in littoral zone	14.4
	Weir 5 pool raised by up to 35 cm above normal pool level but reduce duration if QSA >15,000 ML/d from mid Oct	75 days – Aug to late Oct	o Growth and expansion of littoral vegetation o Understorey plant community sustained and productive o Diverse and productive biofilm and macroinvertebrate communities o Breeding habitat for small fish and reed dependent waterbirds o Relieve soil salinity stress in littoral zone	12.3
	Raise weir pool 6 up to 20 cm above normal pool level	28-42 days – Sept –early Dec	o Growth and expansion of littoral vegetation o Understorey plant community sustained and productive o Diverse and productive biofilm and macroinvertebrate communities o Breeding habitat for small fish and reed dependent waterbirds o Relieve soil salinity stress in littoral zone	2.8
	One or more of weir pool 1, 2, 5 and 6 by 15-30 cm below normal pool level over 60 days	April - Jun	o TBA	TBA
Chowilla	Pump to up to 8 priority wetlands	Sept-Nov	o Fringing vegetation o Habitat for biota	4

	Pulse flows through Chowilla anabranch via Pipeclay & Slaney Creek weirs in conjunction with raising weir pool 6.	20 weeks – Oct - Feb	o Fast flowing habitat for large bodied fish o Mobilise carbon and nutrients to support aquatic food webs via increased flux of resources through microbial and invertebrate pathways to higher trophic levels (fish water birds) o Provide breeding and feeding habitat for waterbirds, amphibians and invertebrates.	N/A
	Operate Chowilla Regulator to generate in-channel rise. Regulator up to 18.5 mAHD; L6 – 19.45 mAHD	Sept-Dec	o Instate variability in hydraulic conditions (depth, velocity, turbulence) o Reduced salinity of near-bank groundwater due to lateral infiltration of low salinity surface water o Reduced soil salinity and improved soil moisture availability in inundated and adjacent zones o promotion of bacterial-dominated biofilm communities with higher nutritional value (compared to algal biofilms) benefiting higher consumers that use biofilms as a food resource o Improved vegetation growth in riparian zone o Create lateral connection and inundation of early commence to flow wetlands connected *(depending on height of operation*. o Assist in achieving the Ecological Target for trees adjacent to anabranch creeks o 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 o Assist in achieving the Ecological Target for lignum in inundated areas o Provide conditions conducive to achieving ecological targets for flood dependent and aquatic understorey vegetation in inundated and riparian zones	24.7

Near Average (50% AOP) Scenario

Site	Action	Details	Objectives	Vol GL
LLCMM	Spring inundation of fringing Lower lakes wetlands: raising lake levels in spring to ~0.8m AHD and increased barrage releases	Sept-Dec	o Increase estuarine conditions further into North Lagoon o Provide for fish migration, connectivity o Improve benthic macroinvertebrate, migratory birds and attractant flows for migration of fish o Spawning and recruitment of black bream o Feeding habitat for migratory waders	460
	Increase in barrage releases to 1-2 GL/d baseflows for remainder of year for fish passage	Jan - June	o Provide fish passage and localised estuarine conditions o Minimise sand accumulation in Mouth	332
Channel and Floodplain	Target EWR-IC3 (Median discharge QSA 20,000 ML/day)	90-days - Oct to Dec	o Abundant fast flowing habitat (>0.25 m/s) available o Improved soil water availability and reduced soil salinity	656

			o Growth of emergent aquatic plants in temporary wetlands inundated by high flows o Improved river red gum population demographics in inundated areas and areas adjacent due to lateral recharge of groundwater o Improved survival of Murray cod and catfish larvae	
	Target EWR-IC2 described in the SA River Murray LTWP (Median discharge QSA 15,000 ML/day)	90-days - mid-Oct to mid-Dec	o Increase availability of moderate-fast (0.18 – 0.25 m/s) velocity habitat o In near-bank areas of upper weir pools, freshen groundwater and maintain/improve adult river red gum tree condition o Support spawning and recruitment of golden perch and silver perch by creating conditions conducive to reproductive activity when temperature thresholds (20 degrees) are exceeded	712
	Target partially delivery EWR-IC2 described in the SA River Murray LTWP (Median discharge QSA 15,000 ML/day) with reduced duration (note reduced duration may mean a reduced certainty of achieving outcomes)	60-days - mid-Oct to mid-Dec	o Increase availability of moderate-fast (0.18 – 0.25 m/s) velocity habitat o In near-bank areas of upper weir pools, freshen groundwater and maintain/improve adult river red gum tree condition o Support spawning and recruitment of golden perch and silver perch by creating conditions conducive to reproductive activity when temperature thresholds (20 degrees) are exceeded	485
Weir Pool Manipulation	Lower weir pool 2 by 15-25 cm	40 days – mid July –mid August	o Increase hydraulic complexity o Flush salt o Improve water quality	3.8
	Lower weir pool 3 by 8-10 cm	20 days – Jul-Aug	o Increase bank habitat o Improve soil condition o Improve littoral zone cycling o Improve riparian habitat	3.5
	Lower weir pool 5 by 12-15 cm following lowering in June of 8-12 cm	30 days - July	o To test procedures and validate models o Increase bank habitat o Improve soil condition o Improve littoral zone cycling and soil condition o Improve riparian habitat o Enhanced flow velocity and matter transport	1.8
	Weir 5 pool raised 50 cm above normal pool level	45 days – Aug-mid Sept	o Monitor flow velocity and hydraulic complexity during a winter weir pool raising when flows are between 15,000 and 25,000 ML/day to inform future management decisions	14.3
	One or more of weir pool 1, 2, 5 and 6 by 15-30 cm below normal pool level over 60 days	April - Jun	o TBA	TBA
Chowilla	Operate Chowilla Regulator to generate a mid-floodplain inundation. Lock 6 is raised to 19.85 mAHD; Chowilla Regulator is raised up to a maximum of 19.45 mAHD	130 days Aug - Dec	o Improve soil moisture availability to within ranges conducive to active tree growth to reduce potential for loss of tree condition, and support progressive improvement of long-lived vegetation o Generate an increase in the proportion of trees for which condition scores are above the Ecological Target – specifically targeting re-	75.5

			watering mid-level elevation Black Box to consolidate benefits from 2016 managed inundation and unregulated flow event o Instate connectivity to mid-elevation floodplain and all key wetlands o Contribute to ensuring the long-term sustainability of floodplain tree community by 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 o Improve condition of Lignum in inundated areas o Provide breeding habitat for waterbirds, amphibians and invertebrates. o Create conditions conducive to germination and growth of flood dependent and flood responsive vegetation o Mobilise carbon and nutrients to support aquatic food webs via increased flux of resources through microbial and invertebrate pathways to higher trophic levels (fish water birds) o Improve condition of floodplain habitat for dependent species including reptiles, woodland birds and mammals o Establish a flow regime with distinct variability in components of the flood pulse	

Wet (25% AOP) Scenario

Site	Action	Details	Objectives	Vol GL
Channel and Floodplain	Target EWR-FP1 described in the SA River Murray LTWP (Median discharge OSA 50,000 ML/d)	30 days - Sep	All SA River Murray Channel targets are relevant but in addition: o Inundation of the SA River Murray Floodplain PEA commences o Large Murray cod recruitment event o Support large-scale breeding by eight riparian frog species	383
	Target EWR-IC7 described in the SA River Murray LTWP (Median discharge QSA 40,000 ML/day	90 days - Sep-Nov	o Inundation of the entire SA River Murray Channel priority environmental asset (PEA) o Heterotrophic productivity becomes dominant o Significant areas of temporary wetland connected to the River o Growth, condition and recruitment of native vegetation from emergent, amphibious and flood-dependent functional groups is supported across the entire elevation gradient of the SA River Murray Channel PEA	591
Weir Pool Manipulation	Raise weir pool 2 up to 75 cm above normal pool level	120 days – Aug-Nov	Ecological objectives are to promote: o Wetland inundation, connectivity and production o The health, growth and reproduction of floodplain vegetation o Access for aquatic fauna to floodplain and wetland habitats, particularly during key breeding and foraging periods	10

			o The transfer of particulate organic matter from the floodplain to the river channel	
	Lower weir pool 3 by 8-10 cm	20 days – Jul-Aug	o Increase bank habitat o Improve soil condition o Improve littoral zone cycling o Improve riparian habitat	3.5
	Raise weir pool 5 up to 50 cm above normal pool level	120 days – Aug-Nov	Ecological objectives are to promote: o Wetland inundation, connectivity and production o The health, growth and reproduction of floodplain vegetation o Access for aquatic fauna to floodplain and wetland habitats, particularly during key breeding and foraging periods o The transfer of particulate organic matter from the floodplain to the river channel	13.5
	One or more of weir pool 1, 2, 5 and 6 by 15-30 cm below normal pool level over 60 days	April - Jun	TBA	TBA
Chowilla	Operate Chowilla regulator around natural high flows to generate a max- floodplain inundation. Lock 6 is raised up to 19.85 m AHD; CR is raised up to a maximum of 19.75 mAHD)	157 days – July-Dec	o *As for Near Average action above. and* o Potentially test regulator and ancillary structures to higher operating levels	92.5
LLCMM	Add to back of unregulated flow, increase barrage releases into summer	Oct-Nov	o Improve salinity levels in Coorong o Influence water levels in South Lagoon for *Ruppia tuberosa* recruitment o Estuarine fish growth and recruitment o Food for waterbirds o Open Murray Mouth and salt export and minimise sand accumulation	213
	Add to height of unregulated flow; maintain elevated barrage releases to maintain Coorong South Lagoon water levels	Dec-Jan	o Barrage flows o Large estuary o Influence water levels in South Lagoon for *Ruppia tuberosa*	487
	(g) Increase barrage releases to 2 GL/d for remainder of year for fish passage	Feb-May	o Provide fish passage o Maintain estuary	178

Very Wet Scenario (10% AOP)

Site	Action	Details	Objectives	Vol GL
LLCMM	(h) Action f plus add to back of unregulated flow, increase barrage releases into summer	Jan-Feb	o Improve salinity levels in Coorong o Influence water levels in South Lagoon for *Ruppia tuberosa* o Estuarine fish growth and recruitment o Food for waterbirds	411

			o Open Murray Mouth and salt export and minimise sand accumulation	
Channel and Floodplain	Target EWR –FP5 target described in the SA River Murray LTWP (Median discharge QSA 80,000 ML/day for 60-days)	60 days – Sep - Oct	o Inundation of the entire SA River Murray Floodplain PEA o Maintain/improve condition of adult river red gum and black box trees across the entire elevation gradient of the SA River Murray Floodplain PEA o Maintain/improve condition of lignum shrublands across the entire elevation gradient of the SA River Murray Floodplain PEA o Maintain inundation of habitat for breeding by a range of waterbird species o Improved river red gum and black box population demographics by supporting recruitment due to extended inundation of the entire elevation gradient of the SA River Murray Floodplain PEA	589
	Target EWR-FP4 target described in the SA River Murray LTWP (Median discharge QSA 80,000 ML/day for 30-days)	30 days - Sep	o Inundation of the entire SA River Murray Floodplain PEA o Maintain/improve condition of adult river red gum and black box trees across the entire elevation gradient of the SA River Murray Floodplain PEA o Maintain/improve condition of lignum shrublands across the entire elevation gradient of the SA River Murray Floodplain PEA o Maintain inundation of habitat for breeding by a range of waterbird species	227
Weir pool manipulation	*No additional actions*			
Chowilla	Operate Chowilla regulator around natural high flows to generate a max- floodplain inundation. Lock 6 is raised up to 19.85 m AHD; CR is raised up to a maximum of 19.85 mAHD) *either before or following a flow peak (or both).* Operation of the Chowilla Regulator on rising or falling limb of natural high flow to extend period of inundation	157 days – July-Aug	*As for near average action above, and* o Potentially test regulator and ancillary structures to higher operating levels	78.4