

2015-16 Annual Environmental Watering Plan for the South Australian River Murray



Department of Environment, Water and
Natural Resources

August 2015



Government of South Australia
Department of Environment,
Water and Natural Resources

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Environmental Water, Trade and River Operations Policy
Water and Climate Change

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Preferred citing for this publication:

2015-16 Annual Environmental Watering Plan for the South Australian River Murray, Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide

Download this document at: www.environment.sa.gov.au

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Government of South Australia
Department of Environment,
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Foreword

Sustainable management of freshwater resources into the future is one of the most critical challenges facing global communities. By international standards, significant progress towards more sustainable management practices has been made in the Murray-Darling Basin with numerous policy and legislative reforms, and roll-out of on-ground river and wetland restoration programs, including infrastructure to aid in environmental water management. Perhaps most significantly within the Basin has been the decision under the Murray-Darling Basin Plan (2012) to commit to returning 2,750GL of water to the system. This is a key step towards restoring some of the balance between meeting the needs of the environment while still providing for productive industries and communities, including water for irrigation and critical human water needs.

Despite the efforts made to date, ongoing and concerted effort will be required to restore a healthy, working Murray-Darling Basin. South Australia, in partnership with other Basin States, the Murray-Darling Basin Authority, the Commonwealth Environmental Water Holder, local communities and non-government organisations, is progressing well in implementing the Basin Plan, including the environmental water management framework set out in Chapter 8 of that document.

To this end, South Australia is pleased to present this 2015-16 annual environmental watering plan for the South Australian River Murray (the Annual Plan). In 2014-15, South Australia successfully negotiated for over 770 gigalitres (GL) of environmental water to be delivered to the state with a focus on testing the Chowilla environmental regulator, raising three weir pools and maintaining connectivity at the Lower Lakes, Coorong and Murray Mouth icon site.

The outlook for the forthcoming year is for drier conditions in the Murray-Darling Basin so this plan accommodates the potentially reduced volume of water available to sustain the channel, wetlands and floodplains. The Annual plan complements and builds on the 2014 release of the Basin-wide Environmental Watering Strategy by the Murray-Darling Basin Authority, as well as work completed in South Australia's previous Annual Plans and many long-running environmental water management projects. Also - and not least - it adds further detail to complement the annual environmental watering priorities and the Long Term Environmental Watering Plan (LTWP) for the South Australian River Murray which has just been released for consultation.

I would like to thank all those who have been involved in the planning, management, delivery and monitoring of environmental water in 2014-15 and look forward to another successful watering year in 2015-16.

Julia Grant, Executive Director, Water and Climate Change
Department of Environment, Water and Natural Resources
August 2015

Acknowledgement of the Traditional Owners

The Department of Environment, Water and Natural Resources acknowledges and pays respect to the Traditional owners, and their Nations, of the Murray-Darling Basin, who have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters.

Other Acknowledgements

In addition to staff within the Department of Environment, Water and Natural Resources (DEWNR), input from representatives and employees of the following organisations has been gratefully received:

- Commonwealth Environmental Water Office (CEWO);
- Coorong, Lower Lakes and Murray Mouth Community Advisory Panel (CAP);
- First Peoples of the River Murray and Mallee Region;
- Local Action Planning Groups (LAP Groups), through Community Action for the Rural Environment;
- Murray-Darling Basin Authority (MDBA);
- Nature Foundation South Australia (NFSA);
- Ngarrindjeri Regional Authority (NRA), including the Mannum Aboriginal Community Association Incorporated;
- River Murray Advisory Committee (RMAC);
- Scientific Advisory Group for the Lower Lakes, Coorong and Murray Mouth (SAG);
- South Australian Murray-Darling Basin Natural Resources Management (SA MDB NRM) Board;
- South Australian Research and Development Institute (SARDI); and
- Other South Australian government departments through interagency reference groups.

The following water holders are acknowledged for the proposed provision of environmental water to South Australia in 2015-16:

- Commonwealth Environmental Water Holder (CEWH);
- The Living Murray (TLM) program;
- Nature Foundation South Australia; and
- South Australian Minister for Water and the River Murray.

Photos: Kate Mason, Adrienne Rumbelow, Jan Whittle, Scotte Wedderburn, Kirsty Wedge

Glossary: Terms and Acronyms

Units of measurement commonly used (SI and non-SI Australian legal)

Name of unit	Symbol
day	d
gigalitre	GL
megalitre	ML

AEP – Annual Exceedance Probability

ASS – Acid Sulfate Soils

AHD – Australian Height Datum

Barrage — any of the five low weirs at the mouth of the River Murray constructed to exclude seawater from the Lower Lakes

Basin — the area drained by a major river and its tributaries

CEW – Commonwealth Environmental Water

CEWH – Commonwealth Environmental Water Holder; the person charged with responsibility for the Commonwealth Government's water that is held for environmental purposes

CEWO – Commonwealth Environmental Water Office; the office that supports the CEWH

CLLMM – Coorong, Lower Lakes and Murray Mouth

DEWNR — Department of Environment, Water and Natural Resources (Government of South Australia)

Diversity — the distribution and abundance of different plant and animal species and communities

EC — electrical conductivity; 1 EC unit = 1 micro-Siemen per centimetre ($\mu\text{S}/\text{cm}$) measured at 25°C; commonly used as a measure of water salinity

Ecosystem — any system in which there is an interdependence and interaction between living organisms and their immediate physical, chemical and biological environment

Endangered species — any species in danger of extinction throughout all or a significant portion of its range

Entitlement Flow — minimum monthly River Murray flow to South Australia agreed in the Murray-Darling Basin Agreement 1992

Environmental water requirements — the water regimes needed to sustain the ecological values of aquatic ecosystems, including their processes and biological diversity, at a low level of risk

Fishway — a generic term describing all mechanisms that allow the passage of fish along a waterway. Specific structures include fish ladders (gentle sloping channels with baffles that reduce the velocity of water and provide resting places for fish as they 'climb' over a weir) and fishlifts (chambers, rather like lift-wells, that are flooded and emptied to enable fish to move across a barrier)

Floodplain — Of a watercourse means: (1) floodplain (if any) of the watercourse identified in a catchment water management plan or a local water management plan; adopted under the Act; or (2) where (1) does not apply — the floodplain (if any) of the watercourse identified in a development plan under the *Development (SA) Act 1993*; or (3) where neither (1) nor (2) applies — the land adjoining the watercourse that is periodically subject to flooding from the watercourse

Flow bands — flows of different frequency, volume and duration

Flow regime — the character of the timing and amount of flow in a stream

Habitat — the natural place in which an animal or plant, or communities of animals and plants, live

Indigenous species — species that occur naturally in a region

Infrastructure — artificial lakes; dams or reservoirs; embankments, walls, channels or other works; buildings or structures; or pipes, machinery or other equipment

KEAs - Key Environmental Assets

LAP – Local Action Planning

LLCMM – Lower Lakes, Coorong and Murray Mouth; one of TLM icon sites

MDBA — Murray-Darling Basin Authority

MERI Framework – Monitoring, Evaluation, Reporting and Improvement Framework

Model — a conceptual or mathematical means of understanding elements of the real world that allows for predictions of outcomes given certain conditions. Examples include estimating storm run-off, assessing the impacts of dams or predicting ecological response to environmental change

Monitoring — (1) The repeated measurement of parameters to assess the current status and changes over time of the parameters measured (2) Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, animals and other living things

NFSA – Nature Foundation of South Australia

NGO – Non-government Organisation

QSA – River flow to South Australia, as measured at the State border

Ramsar Convention — an international treaty on wetlands titled The Convention on Wetlands of International Importance Especially as Waterfowl Habitat

Return flow – environmental water used upstream for an event returns to the river and can be used for another event downstream

SA MDB NRM Board – South Australian Murray-Darling Basin Natural Resources Management Board

Threatened species — any species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range

TLM – The Living Murray (MDBA program)

VEWH – Victorian Environmental Water Holder

Water allocation — (1) In respect of a water licence means the quantity of water that the licensee is entitled to take and use pursuant to the licence. (2) In respect of water taken pursuant to an authorisation under s.11 means the maximum quantity of water that can be taken and used pursuant to the authorisation.

WAP — Water Allocation Plan; a plan prepared by a CWMB or water resources planning committee and adopted by the Minister in accordance with the *Natural Resources Management Act 2004* (SA)

Water dependent ecosystems — those parts of the environment, the species composition and natural ecological processes that are determined by the permanent or temporary presence of flowing or standing water, above or below ground. The in-stream areas of rivers, riparian vegetation, springs, wetlands, floodplains, estuaries and lakes are all water-dependent ecosystems

Water licence — a licence granted under State legislation entitling the holder to take water from a prescribed watercourse, lake or well or to take surface water from a surface water prescribed area. This grants the licensee a right to take an allocation of water specified on the licence, which may also include conditions on the taking and use of that water. A water licence confers a property right on the holder of the licence and this right is separate from land title

Water year - The period between 1 July in any given calendar year and 30 June the following calendar year; also called a licensing year or a water-use year

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Summary

This Annual Plan sets out the State's agreed plan for environmental water delivery along the South Australian River Murray for the 2015-16 year. The intention is to ensure that the best environmental outcomes are achieved for the South Australian stretch of the river and its floodplains, consistent with requirements under the Murray-Darling Basin Authority Basin Plan ('the Basin Plan').

Some specific objectives of the 2015-16 Annual Plan are to:

- Provide a diverse range of habitats;
- Improve food web pathways;
- Improve vegetation condition;
- Provide breeding opportunities for biota;
- Enhance the estuary;
- Provide connectivity;
- Enable testing of works and infrastructure; and
- Recovery and maintenance of threatened species populations.



Lake Merreti by Kate Mason

PART A: OVERVIEW

1. Introduction

1.1 Overview

Each year South Australia prepares the Annual Plan to guide environmental water delivery to the state. The Annual Plan documents the agreed South Australian program for environmental water delivery along the River Murray in South Australia (including the Lower Lakes, Coorong and Murray Mouth) for the 2015-16 water year. It guides where environmental watering should occur within the respective water year.

The purposes of this document are to:

- formalise planned priorities for environmental watering within South Australia within a given water year and support an adaptive management framework;
- make planned environmental watering activities publicly available for stakeholder information;
- meet the requirements of holders of environmental water who provide water to South Australia;
- meet the requirements of the *Basin Plan* as well as the South Australian *Natural Resources Management Act 2004 (SA)*;
- provide input for the annual South Australian River Murray Operations Plan 2015-16.

The Annual Plan is integral to South Australia's environmental water management. It has been developed based on the best available data and science; however, it may be subject to change depending on actual water availability conditions, which will inform real-time and adaptive water use.

The South Australian Murray-Darling Basin environmental water management framework is presented in Figure 1.



Figure 1: South Australian Murray-Darling Basin environmental water policy, planning and management hierarchy

1.2 Review of the 2014-15 water year

The 2014-15 year started with the delivery of Entitlement Flow only. However, from 23 July 2014 South Australia began to receive a River Murray Unregulated Flow. This continued until the middle of September with a flow peak of 16,500 ML/day in mid-August 2014.

Also in August 2014, the CEWH committed to the supply and delivery of 200 GL of environmental water to South Australia. This was later followed by an additional 75 GL commitment. There were many discussions regarding the trade and use of the water held by the CEWH in South Australia between officers of the CEWO and DEWNR. The outcome was agreement that this water should be delivered to South Australia as part of the Entitlement Flow for 2014-15.

In addition, there were considerable volumes of CEWH return flows from environmental watering actions in the Goulburn, Broken Creek, Campaspe and Hattah Lakes. From January to June 2015 the CEWH provided an additional 200 GL for the Coorong. The delivery of water to the Lower Lakes, Coorong and Murray Mouth was assisted by the development of a Short Term Barrage Operating Plan and a watering schedule. The aim was to maintain the Lower Lakes within a healthy operating height envelope whilst maximising flow to meet environmental outcomes in the Coorong. Longitudinal connectivity was maintained with the Goulburn pulse in January. This meant that the flow peak bypassed Lake Victoria.

TLM provided environmental water for the raising of Lock 6 and the testing of the Chowilla Regulator between September and December. Testing the regulator resulted in an additional 2,300 hectares of the Chowilla floodplain being inundated with a significant vegetation and frog response as a result of the extra water. TLM return flows from upstream watering actions at Hattah Lakes and Gunbower Forest also made a major contribution to flow to South Australia.

Other weir raising events were undertaken in spring/summer. The weir pools of Locks 1 and 2 were raised to 50cm above the normal operating range beginning in September. They were raised for three months using unregulated flow and the Minister's environmental reserve. Raising the weir pool level of Locks 1 and 2 enabled an additional 646 hectares of floodplain to be inundated.

Environmental water was also allocated and delivered to approximately 68 priority wetlands and floodplain areas along the River Murray in South Australia. Water was primarily sourced from the CEWH, but was also allocated from the environmental water held against the licences of the SA Minister for Water and the River Murray and a small donation from a private irrigator. Water was delivered to most of these sites via pumping in spring and summer months to achieve a range of vegetation and breeding outcomes.

During the year, a very large volume of sand accumulated inside the Murray Mouth. Therefore it was necessary to commence dredging of the Murray Mouth in January 2015 as barrage outflows alone would not be sufficient to remove this accumulation.

In total, South Australia received over 770 GL of environmental water from the environmental water holders including TLM, the CEWH and the VEWH.

Figure 2 shows the delivery of water to South Australia during 2014-15.

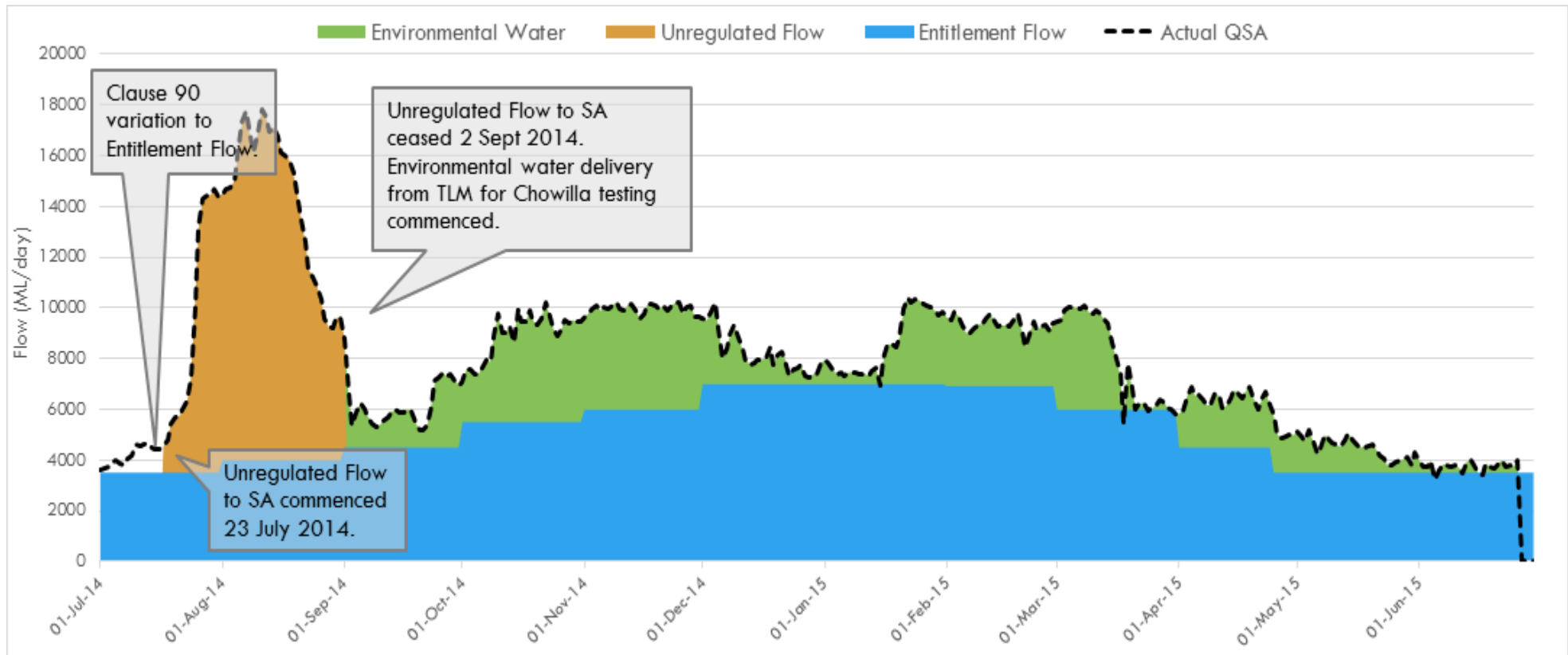


Figure 2: Delivery of water to South Australia 2014-15



2. Environmental Watering

2.1 What is it?

Environmental watering is the delivery or use of water to achieve ecological benefits that contribute to a healthy, working river. Environmental watering ensures that important values of the South Australian River Murray, its wetlands and floodplains, Lakes Alexandrina and Albert and the Coorong are maintained and that environmental objectives are achieved.

Environmental water along the River Murray in South Australia is managed within DEWNR, with input from non-government organisations and other local stakeholders. This portfolio of work includes development of the Annual Environmental Watering Priorities, the Annual Plan, the Annual Report, the broader development of the State's environmental watering policy, the State's contribution to Basin-wide environmental watering policy reform, and management of the environmental water received by South Australia. It also includes development of a Long Term Watering Plan required under the *Basin Plan*.

DEWNR has responsibility for management of TLM Icon Sites within South Australia – the Chowilla Floodplain, the River Murray Channel and the Lower Lakes, Coorong and Murray Mouth – as well as managing environmental watering activities, monitoring, infrastructure and associated projects. Other tasks include management of smaller sites and community liaison.

Environmental water is made available as 'held' or 'planned' environmental water.

- **Held environmental water** is water held on the licence of a water holder who determines that this water will be used for environmental watering activities. Held environmental water may be either a purchased allocation or an allocation granted under the water holder's entitlements.
- **Planned environmental water** is water that is not held on a water licence, but may be committed under State water management law for environmental purposes and managed through river operations.



Congolli by Scotte Wedderburn

The two key Commonwealth sources of environmental water for South Australia are the CEWH and TLM. At the State level, two further sources of environmental water are South Australian Government purchases of water entitlements and allocations for environmental watering purposes; and the South Australian Minister for Water and the River Murray's water licence with Class 9 water entitlement for managed pool connected wetlands. Water may also be held by non-government organisations.

On-ground environmental water delivery and monitoring is managed by various groups in conjunction with DEWNR staff. Eleven Local Action Planning (LAP) Groups operate in the South Australian Murray-Darling Basin, and are associated with the SA MDB NRM Board. They engage with communities to facilitate grass roots environmental activities with local landholders and other community groups.

2.2 Planning process

Development of the Annual Plan commences each February. Figure 3 outlines the overarching process used to decide and consult on the annual State priorities and subsequently to develop the Annual Plan. Within South Australia, the annual planning process is led by DEWNR, with input from water managers, traditional owners and stakeholder groups.



Pelicans at the Barrages by Adrienne Rumbelow

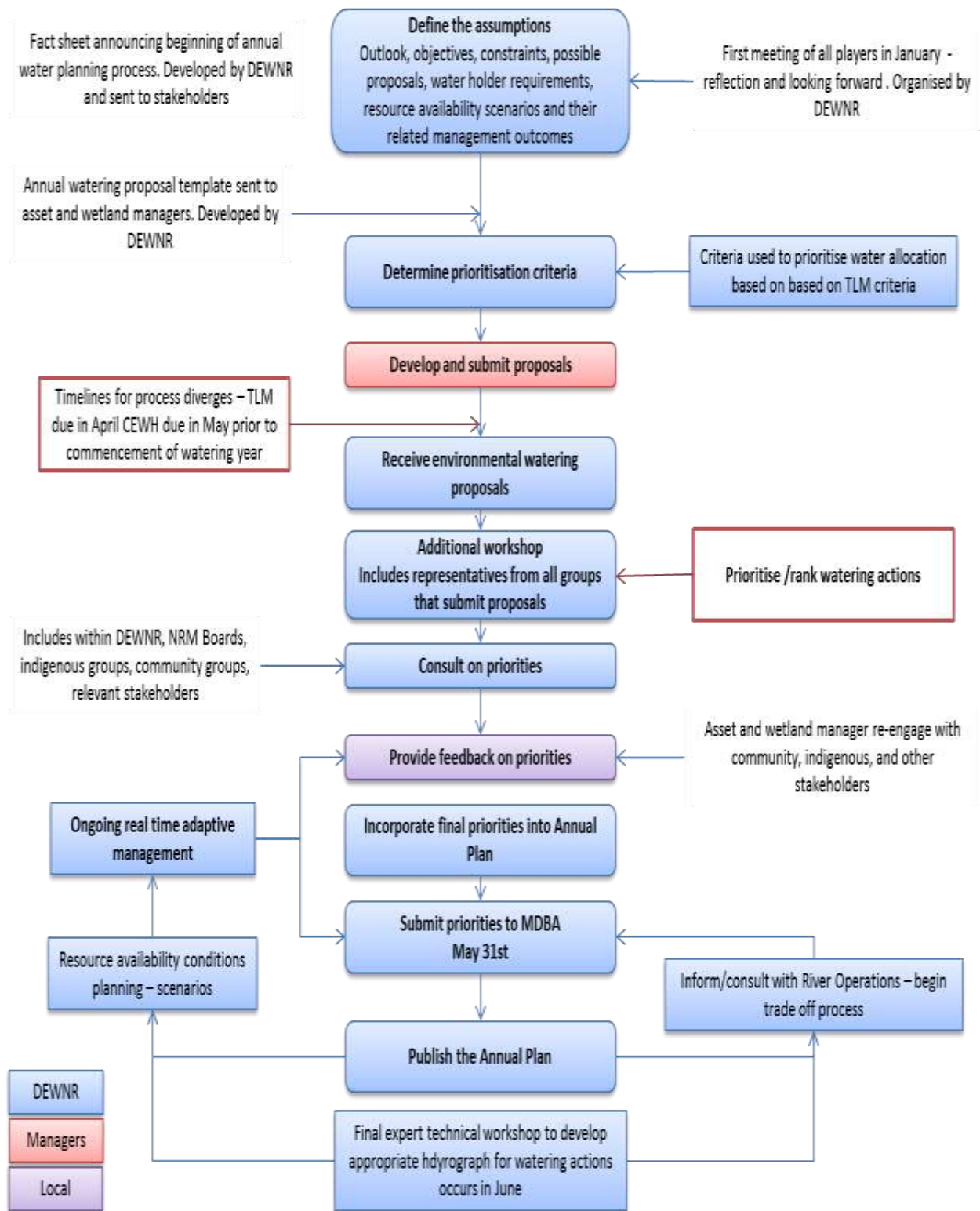


Figure 3: Annual Environmental Watering Planning process

Table 1: Summary of prioritisation criteria

Criteria	Summary
1. Scale of environmental benefit	The contribution the activity would make to meeting key site values and/or management objectives in relation to the whole River Murray system and the length of time for which the benefits will be felt.
2. Risk of not applying water	The risks to species, habitat, previous watering investment and/or resilience if activity does not occur.
3. Environmental risks associated with watering	The risks to water quality, liability and any other factors if activity occurs, with consideration for the timeframe, likelihood and consequence of the risk being realised.
4. Certainty / likelihood of benefit	The likelihood that the desired benefits will be achieved, with consideration of the evidence, models, past experience, and scientific understanding of the results of the activity.
5. Significance of site	The significance of the site in relation to state/national/international agreements and threatened species.

In the prioritisation workshop referred to in Figure 3, proposals were assessed against agreed State criteria (summarised in Table 1, adjacent, and included as Appendix A). These are based on TLM criteria (MDBA 2012a) with some adjustments and are consistent with the principles for annual prioritisation set out in the *Basin Plan*.

Community Engagement

Information sheets were produced and distributed to stakeholder groups. Following the prioritisation workshop, the proposed priorities were refined on the basis of feedback received during the consultation period.

A wide range of stakeholders and community groups were involved in consultation, which included presentations on the proposed watering priorities. A full list of groups and organisations who contributed during this process are listed under Acknowledgements (page iv).

Indigenous Engagement

Indigenous communities have an important and complex relationship with water that goes beyond simply using it for consumptive purposes. During development of the Annual Plan, consultation was initiated with traditional owner groups along the South Australian River Murray. Meetings were held with the Ngarrindjeri Regional Authority (NRA)

(including the Mannum Aboriginal Community Association Incorporated (MACAI)) to discuss the proposed environmental watering for the River Channel and the LLCMM, as well as the broader annual prioritisation process. Feedback was also sought from a representative body of the First Peoples of the River Murray and Mallee Region on the proposed annual priorities.

The First Peoples of the River Murray and Mallee Region confirmed support for the intent and outcomes of environmental watering in improving ecological health along the River Murray. They welcomed opportunities for further consultation and involvement to incorporate cultural information into watering plans for the wetlands, where appropriate support could be provided for this to occur.

Engagement with the NRA and MACAI was facilitated through the Kungan Ngarrindjeri Yunnan Agreement (KNYA) Taskforce and the TLM Indigenous Partnerships Project. A Statement of Commitment is being developed by DEWNR in partnership with the NRA around Water Planning.

Part B: Annual Priorities

4. Assumptions

4.1 Forecast flow conditions

The annual environmental watering priorities for the South Australian River Murray for 2015-16 have been developed in accordance with the *Basin Plan*. The priorities are summarised in Table 6. The annual priorities were developed based on the MDBA's multi-history analysis plot (Figure 4). The percentages shown in the figure refer to the Annual Exceedence Probability (AEP) – that is, the likelihood that flows will exceed those shown (based on previous records). The optimal timing for flow enhancement actions is spring-summer.

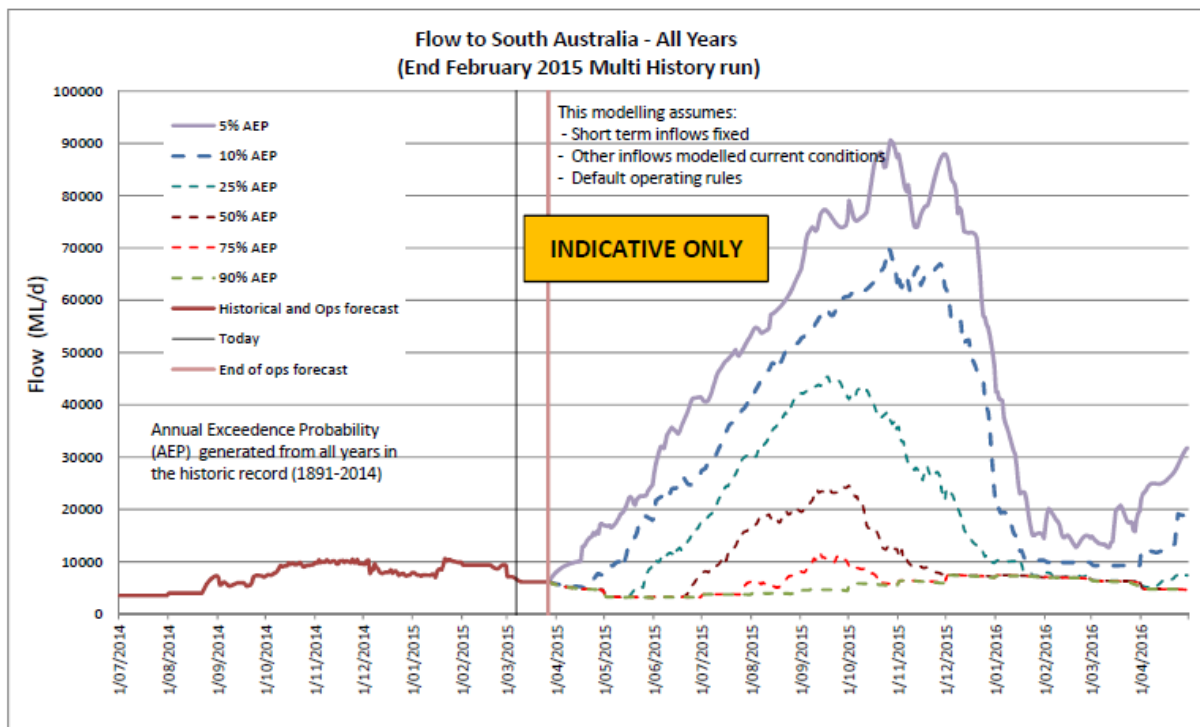


Figure 4: MDBA multi-history water resource outlook

4.2 Environmental water availability

Held Environmental Water

The expected holdings of environmental water are available from four sources – the CEWH, TLM, the South Australian Government and non-government organisations. The VEWH may also contribute return flow from environmental watering events upstream.

Commonwealth Environmental Water

Total CEWH holdings within the Southern Connected Basin are approximately 1,745 GL, with varying levels of security and a long term average annual yield of 1,303 GL. The breakdown of the CEWH water holdings in the Southern Connected Basin is set out in Table 2. The exact allocations available for 2015-16 are not yet known. However, DEWNR staff have been advised that 630-800 GL is likely to be available in the Southern Connected (based on dry to median outlook). The CEWH holds approximately 135 GL of water that is a part of South Australia's Entitlement Flow.

The CEWH provides environmental water held in South Australia to the following organisations: NFSA and the SA MDB NRM Board. It also intends to provide environmental water to the NRA in 2015-16. These organisations are expected to participate in the State prioritisation process each year but site selection is approved directly by the CEWH.

Table 2: CEWH water holdings in the Southern Connected Basin (as at 31 May 2015)

Security	Entitlement (ML)	Long Term Average Annual Yield (ML)
High	715,120	672,480
General / Low	606,048	433,431
Conveyance	22,517	20,903
Supplementary	402,031	176,044
Total	1,745,716	1,302,858

TLM Environmental Water

TLM water holdings are equivalent to approximately 479 GL of water, as set out in Table 3. Use of 20 GL of River Murray Increased Flows from the Snowy Agreement may be trialled in 2015-16 to test procedures. DEWNR staff have been advised that 236-315 GL of TLM water may be available by the MDBA (based on a dry to median outlook). The MDBA TLM holds approximately 45 GL of water that is a part of South Australia's Entitlement Flow.

Table 3: TLM water holdings in the Southern Connected Basin (2015)

Security	Entitlement (ML)	Long-Term Cap Equivalent (ML)
High	114,225	106,829
General / Low	476,554	295,146
Conveyance	350,000	40,900
Supplementary	47,265	37,100
Total	988,044	479,975

South Australian Environmental Water

The volume of water held by South Australia varies from year to year, based on the water that is available and the water that is purchased. The licences holding this water are administered by DEWNR and the held water contributes to addressing the identified Priorities. Six GL of Class 3A Water Access Entitlement are held on the Minister for Water and the River Murray's licence (which is 100 percent allocated for 2015-16) and additional amounts (up to 120 GL over a 10 year rolling period of eligible years) are also required to be provided to the environment by the South Australian Government under an agreement with the Commonwealth.

The Water Allocation Plan (WAP) for the River Murray Prescribed Watercourse establishes 200 GL or 200,000,000 unit shares for use by pool connected wetlands. This volume is the estimated annual evaporative loss from all wetlands that are connected to the South Australian section of the River Murray at normal operating pool level. Of this 200 GL, approximately 34 GL (or 34,781,915 unit shares) have been assigned to a Minister for Water and the River Murray's licence for use in managed pool-connected wetlands. DEWNR staff manage the water allocation for managed wetlands. The water allocation for Class 9 Water Access Entitlements in 2015-16 is 100 percent. The priority for 2015-16 is to implement ecologically-sound hydrological regimes at all managed, pool-connected wetlands.

Non-Government Organisations

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

Planned Environmental Water

Class 9 water

Under the WAP for the SA River Murray Prescribed Watercourse, 200 GL is the estimated annual evaporative loss from all wetlands that are connected to the South Australian River Murray at normal operating pool level. Of this 200 GL, approximately 34 GL is held environmental water (see above for definition). The remaining 166 GL of Class 9 water will be used by non-managed, pool-connected wetlands, including the Lower Lakes and Coorong, via evaporation during normal river operations and is not available for other use.

Other water sources that benefit the environment

River Murray Unregulated Flow (RMUF)

The WAP for the River Murray Prescribed Watercourse allows water to be allocated to high security licences only. Under the Murray-Darling Basin Agreement and the WAP, no provisions exist for the allocation and use of RMUF for non-environmental consumptive purposes in South Australia. RMUF occurs in response to high rainfall events upstream from South Australia. The MDBA Southern Connected Basin Environmental Watering Committee (SCBEWC) has delegated authority from the Basin Officials Committee to assign RMUF for environmental purposes in the River Murray.

Under the different flow scenarios shown in Figure 4, RMUF provides the increase in volume of water above South Australia's Entitlement Flow. This RMUF can only be planned for in a general way, but if it occurs, it can achieve environmental outcomes in South Australia in conjunction with held environmental water. A policy for use of RMUF is being developed within DEWNR.

Unallocated water that is part of Entitlement Flow

120 GL of unallocated water that is part of Entitlement Flow is usually delivered to the Lower Lakes, Coorong and Murray Mouth site to provide water quality and water level benefits. The volume available for this purpose may be reduced by storage of a portion of this water for Critical Human Water Needs.

Water diverted from the South-East to the Coorong

Water is available from the South East for diversion into the Coorong South Lagoon via Salt Creek. Water resource managers from the South-East and River Murray discuss optimal delivery patterns taking into account best available data and scientific input. This volume will vary from year to year. For 2014-15 approximately 21 GL was discharged leading to small localised reductions in salinity near the Salt Creek outfall.

4.3 Delivery considerations

Construction activity in 2015-16

Along the River Murray in South Australia there are numerous construction, maintenance and improvement works planned in 2015-16 for MDBA assets and the Riverine Recovery Program (RRP). Many of these works can only be undertaken when flows are below a specific limit. The works will be considered during real-time management when making decisions to augment flows.

MDBA assets

The following MDBA asset construction works are planned to be undertaken in 2015-16 and may affect River Murray operations:

- Lock 11 (Mildura Weir pool) – Upgrade works (new trestles and mechanised gates) at Lock 11. This work will require a full drawdown of the Mildura Weir pool to around 3.6 metres below full supply level. These works are expected to be completed in late July 2015.
- Mullaroo Weir – Construction of a new concrete weir is expected to be completed by August 2015. At a flow rate below 26 GL/day (at South Australian border) there is no impact on the construction.
- Lock 6 – Stone protection. These works are expected to be undertaken in May 2016. At a flow rate below 7 GL/day (at Lock 6) there is no impact on works.
- Lock 2 – Stone dumping. These works are expected to be undertaken in April 2016. Stop-log bays immediately upstream/downstream of stone dumping will need to be closed. At a flow rate below 10 GL/day (at Lock 2) there is no impact on works.
- Lock 2 – Stone protection - beaching. These works are expected to be undertaken in May 2016. At a flow rate below 7 GL/day (at Lock 2) there is no impact on works.
- Lock 1 – Lock 1 is operating at 0.1 m below normal pool level of 3.2 m AHD to enable engineering investigations to be undertaken. This will be ongoing until the investigations and any required action/works are completed.
- Lock 1 – Stone dumping. These works are expected to be undertaken in April 2016. Stone dumping will require stop-log bays immediately upstream to be closed. At a flow rate below 10 GL/day (at Lock 1) there is no impact on works.
- Goolwa Barrage – Stone dumping at Goolwa Barrage will require stop-log bays immediately upstream to be closed. These works are expected to be undertaken between January and March 2016. At a flow rate below 60 GL/day (at Lock 1) there is no impact on works.
- Construction of barrage fishways at Ewe Island and Mundoo. This work is unlikely to require any restriction to flow rates.

At certain flow rates, programmed work may be impeded by higher current velocity or higher water levels. If South Australia receives RMUF in the months when construction activities are scheduled, SA Water will consider ceasing the activity until the flow reduces.

Riverine Recovery Program

The construction works identified in the following table are proposed to be undertaken for the Riverine Recovery Program in 2015-16 and may affect River Murray operations. As the River Murray flow approaches the limits identified in the table, the River Murray Operations Working Group (RMOWG) will need to consider the risks and benefits of enhancing flows above these limits for an environmental watering event. If agreement cannot be reached by the RMOWG, the issue will be forwarded to the Murray-Darling Basin Coordinating Committee (MDBCC) for determination.

Table 4: Riverine Recovery Program of works for 2015-16

Location	Limit (GL/Day)	Duration
Below Lock 1		
North Caurnamont	20	Nov 2015 - Jun 2017
Teal Flat Hut	20	Nov 2015 - Jun 2017
Teal Flat	20	Nov 2015 - Jun 2017
Big Bend	20	Nov 2015 - Jun 2017
Silverlea (Swan Reach Ferry)	20	Nov 2015 - Jun 2017
Sugar Shack (Swan Reach Complex)	20	Nov 2015 - Jun 2017
Lock 1-2		
Irwin Flat	25	Nov 2015 - Jun 2017
Donald Flat	25	Nov 2015 - Jun 2017
Lock 3-4		
Yatco	20	Jul 2015 - Sep 2015
Pyap Horseshoe	20	Nov 2015 - Jun 2017
Lock 4-5		
Goat Island and Paringa Paddock	20	Nov 2015 - Jun 2017

Katfish structures (Bank J)	30	Nov 2015 - Jun 2016
Lock 5-6		
Woolenook Bend	20	Nov 2015 – Jun 2017
Murtho Park	30	Nov 2015 – Jun 2017

The limitation on flow and exact date of commencement could vary from the information in Table 4.

Delivery factors must be considered as part of managing any environmental water delivery. These are identified and taken into account during the planning process. These will be discovered, assessed and addressed on a real-time basis through relevant state and Commonwealth forums (refer to Risk Management, Section 7).

A significant consideration within South Australia relates to augmented flows across the South Australian border that reach above 60,000 ML/day due to potential implications for third parties. South Australia has a system to provide advance notice of high flows and floods to enable preparation to be undertaken. Work is underway to develop a greater understanding of the implications of future increased frequency of mid to high flows in the range of 60,000 - 80,000 ML/day at the South Australian border and to facilitate the management of potential impacts. There are also various delivery considerations upstream of South Australia that can affect delivery of water to the State. These are being progressed through the Constraints Management Strategy which is being delivered in accordance with the *Basin Plan*.



Baby Bream by Scotte Wedderburn

5. Environmental Watering Priorities

The annual environmental watering priorities for the South Australian River Murray for 2015-16 have been developed in accordance with principles listed in the *Basin Plan* (Appendix D). The priorities are summarised in Table 5 below. Proposed watering actions for the assets will not be ranked until we have a greater understanding of the flow scenario for 2015-16. Tables 6, 7 and 8 provide further information with respect to the volumes of water and objectives for each of the priorities under the different resource outlooks. Table 9 provides an indication of which wetlands may be watered in 2015-16.

The Coorong is addressed in this document even though it is within the Murray Region Water Resource Planning Area as its primary source of water is via the River Murray.

The annual priorities have been developed based on three environmental assets: the channel, the Lower Lakes, Coorong and Murray Mouth (LLCMM) and the floodplain; and incorporate ecosystem functions.

Table 5: Environmental watering priorities 2015-16

Asset	90% scenario	75% scenario	50% scenario
LLCMM	<p>Spring delivery for Lower Lakes water levels and fishway releases</p> <p>Base flow of > 1 GL/day for barrage releases</p> <p>Pump to Lower Lakes fringing wetlands</p>	<p>Spring delivery for Lower Lakes water levels and fishway releases</p> <p>Pump to Lower Lakes fringing wetlands</p> <p>Extend duration of small spring unregulated event</p> <p>Provide winter pulse through Murray Mouth</p> <p>Base flow of 2 GL/day for barrage releases</p>	<p>Spring delivery for Lower Lakes water levels and fishway releases</p> <p>Pump to Lower Lakes fringing wetlands</p> <p>Provide winter pulse through Murray Mouth</p> <p>Base flow of 2 GL/day for barrage releases</p> <p>Extend duration of moderate spring unregulated event</p> <p>Extend duration of autumn unregulated event (lake level cycle)</p>
Channel	<p>Median discharge QSA of 10,000 ML/d with +/-2,000 ML/day variability and short 15,000 ML/day peak – for 90 days</p> <p>Median discharge QSA of 10,000 ML/day with +/-2,000 ML/day variability – for 60 days</p> <p>Fill gravity fed wetlands</p> <p>Provide water to threatened fish refuges</p>	<p>Median discharge QSA of 15,000 ML/day including within event variation generating short-term increases to 20,000 ML/day - for 90 days</p> <p>Median discharge QSA 15,000 ML/day including within event variation generating short-term increases to 20,000 ML/day - for 60 days</p> <p>Fill gravity fed wetlands</p>	<p>Median discharge QSA of 20,000 ML/day with +/- 5,000 ML/day variability – for 90 days</p> <p>Median discharge QSA of 20,000 ML/day with +/- 5,000 ML/day variability - for 60 days</p> <p>Fill gravity fed wetlands</p> <p>Provide water to threatened fish refuges</p>

Asset	90% scenario	75% scenario	50% scenario
		Provide water to threatened fish refuges	
Floodplain	<p>Provide flow pulse through Pipeclay and Slaneys weirs</p> <p>Pump to temporary Chowilla wetlands</p> <p>Pump to temporary wetlands – gorge and valley (19 sites)</p> <p>Weir pool raising – L2 and L5 by 50 cm</p> <p>Pump to temporary depressions adjacent to Regent Parrot colonies</p>	<p>Provide flow pulse through Pipeclay and Slaneys weirs</p> <p>Pump to temporary Chowilla wetlands</p> <p>Pump to temporary wetlands – gorge and valley (19 sites)</p> <p>Weir pool raising – L2 and L5 by 50 cm</p> <p>Pump to temporary depressions adjacent to Regent Parrot colonies</p>	<p>Provide flow pulse through Pipeclay and Slaneys weirs</p> <p>Pump to temporary Chowilla wetlands</p> <p>Pump to temporary wetlands – gorge and valley (16 sites)</p> <p>Weir pool raising – L2 and L5 by 50 cm</p> <p>Pump to temporary depressions adjacent to Regent Parrot colonies</p>



Werta Wert at Chowilla by Callie Nicolai

Table 6: 90% AEP scenario

Asset	Action	Additional details	Objectives	Approximate Volume (GL) ¹
LLCMM	Spring delivery for Lower Lakes water levels and fishway releases	September - November 90 days	Spring inundation of fringing Lower Lakes wetlands – Southern bell frog recruitment, small native fish recruitment, fringing and submergent aquatic vegetation health, cryptic waterbird habitat	270-360
	Provide base flow of > 1 GL/day for barrage releases	July - August and December - June 270 days	12 months continuous barrage releases for fish passage – connectivity, movement and recruitment of congollis and galaxias	223
	Pump to Lower Lakes fringing wetlands	Spring - Summer 120 days	Habitat for migratory birds, frog breeding, improve aquatic plant seedbank, improve littoral vegetation communities	0.9
Channel	Median discharge QSA 10,000 ML/day with +/-2,000 ML/day variability and short 15,000 ML/d peak	Mid-September - mid-December 90 days	Create flow pulse in late spring/early summer to support golden perch and silver perch larval dispersal and survival	300-450
	Median discharge QSA 10,000 ML/day with +/-2,000 ML/day variability	September – March 60 days	Generate small variations in water levels to: improve quality of food resources by promoting bacterial biofilms, increase lateral recharge, promote growth and recruitment of understorey vegetation, improve condition of long lived vegetation; Increase hydraulic complexity/diversity of velocity classes	250-300
	Fill gravity fed wetlands	Bookmark Creek (ongoing) + managed wetlands (120 days)	Maintain vegetation communities, provide frog breeding opportunities, provide waterbird	35

¹ Approximate volume is the estimated volume of environmental water required in addition to the base-flows indicated within the AEP hydrographs

Asset	Action	Additional details	Objectives	Approximate Volume (GL) ¹
			habitat, provide flowing habitat in Bookmark Creek	
	Provide water to threatened fish refuges	2 sites (Dishers Creek and Berri Evaporation Basin)	Support Murray hardyhead populations	1.5
Floodplain	Potential further testing of Chowilla regulator ²	Within channel rise	Works and measures testing; Groundwater/vegetation/fauna outcomes	5 GL plus filling volume of 17 GL and 51 GL to boost flows
	Pump to temporary Chowilla wetlands	Spring - Summer	Maintain vegetation and provide frog habitat	2
	Provide flow pulse to Pipeclay and Slaney weirs	Spring - Summer	Vegetation outcomes	0
	Pump to temporary wetlands – gorge and valley (20-30 sites) (see Appendix 2)	September - December 120 days	Regent parrot habitat and breeding, frog breeding, habitat for cryptic birds, maintain and improve vegetation communities, in particular River red gum, black box and lignum	7
	Pump to depressions adjacent to Regent Parrot colonies	Banrock Bends/Overland Corner South – for 30 days, November - December or November - March	Regent parrot breeding	0.05
	Pump to depressions to provide a small flood	Wigley Reach - for 30 days, November - December or November - March	Southern Bell Frog breeding; Swamp daisy	0.13
	Provide water to Banrock Eastern Lagoon	Eastern Lagoon - 120 days August - September or November - March	Create refuge for water birds and Southern Bell Frog	1.43

² A decision to further test has not yet been made. A final decision to proceed with further testing of the Chowilla regulator will be made following consideration of a number of factors, including risks associated with legal proceedings and the availability of the required environmental conditions. The South Australian government is undertaking preparations to satisfy all pre-conditions for testing should a decision to proceed with further testing be made.

Asset	Action	Additional details	Objectives	Approximate Volume (GL) ¹
	Provide water for Banrock Creek	Banrock Creek - 365 days	Create fast flowing fish habitat – for Freshwater Catfish	0
	Raise weir pools	Lock 2 50 cm Lock 5 50 cm; 90 days September - November or August - October	Avoid irretrievable loss of or damage to environmental assets; return some natural variation in water level; improve food web pathways from biofilms; improve vegetation condition Assist the Pike SARFIIP project to identify and address any issues that may restrict future operations of the floodplain infrastructure Increase knowledge of the means of improving environmental river management Communicate and engage with river communities on future weir pool operations	21.3

Table 7: 75% AEP scenario

Site	Action	Additional details	Objectives	Approximate Volume (GL)
LLCMM	Spring delivery for Lower Lakes water levels and fishway releases	September - November 90 days	Spring inundation of fringing Lower Lakes wetlands – Southern bell frog recruitment, small native fish recruitment, fringing and submergent aquatic vegetation health, cryptic waterbird habitat	270-360
	Extend duration of small spring unregulated event	October - December 90 days	Coorong health – salinity, spawning and recruitment in estuarine fish, benthic invertebrates, migratory waders feeding habitat	200
	Provide winter pulse through Murray Mouth	June 30 days	Freshwater signal, lamprey migration, minimise sediment accumulation in Mouth	40-60

Site	Action	Additional details	Objectives	Approximate Volume (GL)
	2 GL/day base flow for barrage releases	July - August and January - June 270 days	12 months continuous barrage releases for fish passage – connectivity, movement and recruitment of congollis and galaxias Enhance estuarine conditions	Up to 446
	Pump to Lower Lakes fringing wetlands (sites to be determined later)	Spring - Summer 120 days	Habitat for migratory birds, frog breeding, improve aquatic plant seedbank, improve littoral vegetation communities	0.9
Channel	Median discharge QSA 15,000 ML/day including within event variation generating short-term increases to 20,000 ML/day	Mid-October - mid-January 90 days	Create flow pulse in late spring/early summer to promote spawning by golden perch and silver perch and facilitate downstream transport of larvae; improve larval survival and promote recruitment by Murray cod	500
	Median discharge QSA 15,000 ML/d including within event variation generating short-term increases to 20,000 ML/day	September - March 60 days	Generate small variations in water levels to: improve quality of food resources by promoting bacterial biofilms, increase lateral recharge, promote growth and recruitment of understorey vegetation, improve condition of long lived vegetation; Increase hydraulic complexity/diversity of velocity classes	200-500
	Fill gravity fed wetlands	Bookmark Creek (ongoing) + managed wetlands (120 days)	Maintain vegetation communities, provide frog breeding opportunities, provide waterbird habitat, provide flowing habitat in Bookmark Creek	7
	Provide water to threatened fish refuges	2 sites (Disher Creek and Berri Evaporation Basin)	Support Murray hardyhead	1.5



Site	Action	Additional details	Objectives	Approximate Volume (GL)
Floodplain	Potential further testing of Chowilla regulator ³	In channel rise	Works and measures testing; Groundwater/vegetation/fauna outcomes	5 GL plus filling volume of 17 GL
	Provide flow pulse for Pipeclay and Slaney weirs	Spring - Summer	Vegetation outcomes	0
	Pump to temporary wetlands – gorge and valley	20-30 sites	Regent parrot habitat and breeding, frog breeding, habitat for cryptic birds, maintain and improve vegetation communities, in particular River red gum, black box and lignum	7
	Pump to depressions adjacent to Regent Parrot colonies	Banrock Station – for 30 days, November - December or November - March	Regent parrot breeding	0.05
	Pump to depressions to provide a small flood	Wigley Reach - for 30 days, November - December or November - March	Southern Bell Frog breeding	0.13
	Provide water to Banrock Eastern Lagoon	Eastern Lagoon - 120 days August - September or November - March	Create refuge for water birds and Southern Bell Frog	1.43
	Provide water for Banrock Creek	Banrock Creek - 365 d	Create fast flowing fish habitat	0
	Raise weir pools	Lock 2 up 50cm; Lock 5 up 50 cm; 90 days September - November or August - October	Ensure environmental assets maintain their basic functions and resilience; return some natural variation in water level Assist the Pike SARFIIP project to identify and address any issues that may restrict future operations of the floodplain infrastructure	21

³ A decision to further test has not yet been made. A final decision to proceed with further testing of the Chowilla regulator will be made following consideration of a number of factors, including risks associated with legal proceedings and the availability of the required environmental conditions. The South Australian government is undertaking preparations to satisfy all pre-conditions for testing should a decision to proceed with further testing be made.

Site	Action	Additional details	Objectives	Approximate Volume (GL)
			<p>Increase knowledge of the means of improving environmental river management</p> <p>Communicate and engage with river communities on future weir pool operations</p> <p>Improve food web pathways from biofilms; improve vegetation condition</p>	



Table 8: 50% AEP scenario

Site	Action	Additional details	Objectives	Approximate Volume (GL)
LLCMM	Spring delivery for Lower Lakes water levels and fishway releases	September - November 90 days	Spring inundation of fringing Lower Lakes wetlands – Southern bell frog recruitment, small native fish recruitment, fringing and submergent aquatic vegetation health, cryptic waterbird habitat	270-360
	Provide winter pulse through Murray Mouth	June 30 days	Freshwater signal, lamprey migration, minimise sediment accumulation in Mouth	40-60
	2 GL/day base flow for barrage releases	July - August and January - June 270 days	12 months continuous barrage releases for fish passage – connectivity, movement and recruitment of congollis and galaxias Enhance estuarine conditions	Up to 446
	Extend duration of moderate spring unregulated event	Mid October - December 75 days	Salinity benefit to Coorong, <i>Ruppia tuberosa</i> growth and seed set, food supply for waterbirds, open Murray Mouth	300-350
	Extend duration of autumn unregulated event (lake level cycle)	March 30 days	Rapid lake level cycle to reduce salinity in Lake Albert	180-270
	Pump to Lower Lakes fringing wetlands	Spring-Summer 120 days	Habitat for migratory birds, frog breeding, improve aquatic plant seedbank, improve littoral vegetation communities	0.9
Channel	Action E: Median discharge QSA 20,000 ML/day with +/- 5,000 ML/day variability	Mid October - mid January 90 days	Objective 4 (Golden and silver perch) Objective 5 (Murray cod) Objective 6 (Catfish) Objective 13 (Frogs) Objective 14 (Waterbirds)	300-450
	Action F: Median discharge QSA 20,000 ML/day with +/- 5,000 ML/day variability	October - December 60 days	Objective 2 (Velocity) – see below Objective 7 (Productivity)	150-300



Site	Action	Additional details	Objectives	Approximate Volume (GL)
	Action G: Median discharge QSA 20,000 ML/day with +/- 5,000 ML/day variability	September - December 60 days	Objective 9 (Redgum recruitment)	150-300
	Action H: Median discharge QSA 20,000 ML/day with +/- 5,000 ML/day variability	September - February 60 days	Objective 10 (Redgum germination)	150-300
	Action I: Median discharge QSA 20,000 ML/day with +/- 5,000 ML/day variability	September - March 60 days	Objective 8 (Redgum condition) Objective 11 (Macrophytes) Objective 12 (Temporary wetlands)	150-300
	Fill gravity fed wetlands	Bookmark Creek + Class 9 wetlands	As for 75%	35
	Provide water to threatened fish refuges	2 sites (Disher Creek and Berri Evaporation Basin)	Support Murray hardyhead	1.5
Floodplain	Potential further testing of Chowilla regulator ⁴	Low-mid floodplain	Works and measures testing; Groundwater/vegetation/fauna outcomes	39 GL plus filling volume of 15 GL and 1,025 GL to boost flows
	Pump to temporary wetlands	16 sites	Regent parrot habitat and breeding, frog breeding, habitat for cryptic birds, maintain and improve vegetation communities, in particular River red gum, black box and lignum	Up to 6.4
	Provide flow pulse for Pipeclay and Slaney weirs	Spring - Summer	Vegetation outcomes	0

⁴ A decision to further test has not yet been made. A final decision to proceed with further testing of the Chowilla regulator will be made following consideration of a number of factors, including risks associated with legal proceedings and the availability of the required environmental conditions. The South Australian government is undertaking preparations to satisfy all pre-conditions for testing should a decision to proceed with further testing be made.

Site	Action	Additional details	Objectives	Approximate Volume (GL)
	Pump to depressions adjacent to Regent Parrot colonies	Banrock Station – for 30 days, November - December or November - March	Regent parrot breeding	0.05
	Pump to depressions to provide a small flood	Wigley Reach - for 30 days, November - December or November - March	Southern Bell Frog breeding	0.13
	Provide water to Banrock Eastern Lagoon	Eastern Lagoon - 120 days August - September or November - March	Create refuge for water birds and Southern Bell Frog	1.43
	Provide water for Banrock Creek	Banrock Creek - all year	Create fast flowing fish habitat	0
	Raise weir pools	Lock 2 up 50cm; Lock 5 up 50 cm; 90 days September - November or August - October	Maintain ecological health and resistance; return some natural variation in water level; improve food web pathways from biofilms; improve vegetation condition Assist the Pike SARFIIP project to identify and address any issues that may restrict future operations of the floodplain infrastructure Increase knowledge of the means of improving environmental river management Communicate and engage with river communities on future weir pool operations	20

Explanation of objectives

Objective 2 (Velocity): Increase hydraulic complexity (i.e. diversity of velocity classes present)

Objective 4 (Golden and silver perch): Promote spawning by golden perch and silver perch, and facilitate downstream transport of larvae

Objective 5 (Murray cod): Improve larval survival and promote recruitment by Murray cod

Objective 6 (Catfish): Improve larval survival and promote recruitment by freshwater catfish



Objective 7 (Productivity): Improve the availability and quality of in-stream resources due to increased carbon and nutrient loads, increased heterotrophic activity and establishment of early successional state biofilms

Objective 8 (Redgum condition): Maintain and/or improve the condition of adult river red gums (in riparian and low-lying floodplain areas)

Objective 9 (Redgum recruitment): Support establishment of river red gum seedlings and saplings

Objective 10 (Redgum germination): Create favourable soil moisture conditions to coincide with period of peak seed fall by river red gums

Objective 11 (Macrophytes): Support the germination, growth, flowering and seed-set by native macrophytes in littoral and low-lying floodplain/wetland areas

Objective 12 (Temporary wetlands): Maximise the inundated area of low-lying temporary wetlands

Objective 13 (Frogs): Support frog recruitment by maintaining the presence of water for sufficient time for tadpoles to complete metamorphosis

Objective 14 (Waterbirds): Support waterbird breeding by maintaining the presence of water for sufficient time for chicks to fledge



Table 9: Proposed potential wetlands for pumping in 2015-16

Wetland	Approx. Use Volume (ML)
Maize Island	220
Markaranka temporary flow paths	12
Hogwash Bend	362
Molo Flat	700
Morgan East	140
Morgan Conservation Park north lagoons	250
Sweeney's	140
Piggy Creek	364
Carparks Lagoon	212
Gerard basin and floodplain	110
Weila Shedding	255
Bookmark Creek and wetlands	450
Murtho Park	40
Old Loxton Rd	28
Katarapko Creek	33
Martin Bend	230
Yabby Creek/ Katarapko Basins	1500
Pike Black Box	5
Banrock Station	2450
Parcoola West	500
Island Reach	100
Whirlpool Corner	90

In addition to the South Australian priorities listed above, the Nature Foundation South Australia (NFSA) is exploring environmental watering actions for 2015-16. Although these actions have not been finalised, Table 10 summarises the location and purpose of some potential actions.

Table 10: Possible NFSA watering actions for 2015-16

Asset	Site	Purpose	Approx. Use Volume
Floodplain	Clarks Floodplain Rilli Reach Thieles Flat	To maintain juvenile vegetation and sustain regeneration from previous watering events	1,000 ML for floodplain sites
	Loxton Riverfront Reserve Ramco River Terrace South Teringie Calperum Station Pike/Mundic Lyrup Lagoon		2,000 ML for wetland sites

Table 11: Possible NRA watering actions for 2015-16

Asset	Site	Purpose	Approx. Use Volume
Floodplain	Sugar Shack Teringie	To maintain juvenile vegetation and sustain regeneration from previous watering events	500 ML



Coppermine wetland by Jan Whittle

6. Co-operative Watering Arrangements

Holders and managers of environmental water

For the last six years, holders and managers of environmental water have worked together to plan and coordinate annual multi-site environmental watering trials in the Southern Connected Basin. The trials attempt to maximise the use of environmental water by re-using return flows as the water moves through the Basin. The long-term objective of the multi-site environmental watering 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. An additional objective is to implement the pre-requisite policy measures from the *Basin Plan*. These include:

- 1) To allow the release of environmental water on top of other in-stream flows, including unregulated flow events
- 2) Environmental water flows throughout the length of the river, and between rivers; and is protected from extraction, re-regulation or substitution.

Each year, the multi-site environmental watering 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.

The MDBA Southern Connected Basin Environmental Watering Committee and the Water Liaison Working Group contribute to the development of the multi-site environmental watering proposal each year. Real-time operation groups hold regular teleconferences to ensure coordination and communication during the trial and a rapid response to any issues that may arise, such as black water events and salinity spikes. A multi-site environmental watering trial will be undertaken in 2015-16. Environmental water holders are working towards co-ordinated delivery from releases in the Murray, Murrumbidgee and the Goulburn to maximise environmental benefits at multiple sites.

The ecological objectives and the environmental water used will vary depending on the seasonal conditions. For example, concurrent delivery of water from the Goulburn and Murrumbidgee Rivers will increase flow along the River Murray in South Australia and boost flows into the Coorong, Lower Lakes and Murray Mouth. There will be in-stream benefits along the entire River Murray system from the Hume Dam to the Murray Mouth.

South Australia is participating in planning for the multi-site watering trial for 2015-16 and will contribute to the operations groups for the management and delivery of the environmental water available from all water holders.

South Australia has an approved Return Flow Policy and Procedure to ensure that when environmental water is used for a watering event using an environmental regulator or lock along South Australia's River Murray, the use volume will be calculated using modelling, and return flows will be re-used for other environmental watering activities further down the river.

7. Risk Management

Risks related to the proposed environmental watering actions for 2015-16 have been identified and assessed in accordance with DEWNR's Risk Management Framework for Water Planning and Management, which is consistent with the Australian and New Zealand Standard for Risk Management (AS/NZS ISO 31000: 2009). Site managers undertake their own risk assessment when developing watering proposals. A detailed risk register is provided in Appendix E, including control measures. The applied risk criteria are outlined in Appendix C.

Key identified risks relating to the environmental watering program include:

- disruption to construction works from the planned environmental watering activities, or vice versa;
- impacts on water quality, mostly in terms of salinity;
- legal issues; and
- undesirable impacts of invasive species.

These risks are generally manageable. For instance, the impact from or on infrastructure construction works will be managed on a real-time basis through regular communications with key parties. Site-specific risks will be managed by water managers as required. More general risks relating to river operations and water quality are managed by the DEWNR River Murray Operations team in conjunction with the environmental water policy and programs teams. DEWNR has responsibility for communicating any significant risks to the broader community.



Chowilla Horseshoe wetland Jan Whittle

PART C: IMPLEMENTING THE PLAN

8. Implementation Process Overview

Implementation of the Annual Plan is undertaken throughout the water year by a variety of officers and groups at a local, State and Basin level, as illustrated in Figure 5 below. The implementation process concludes with an environmental watering report and development of the following year's Environmental Watering Plan.

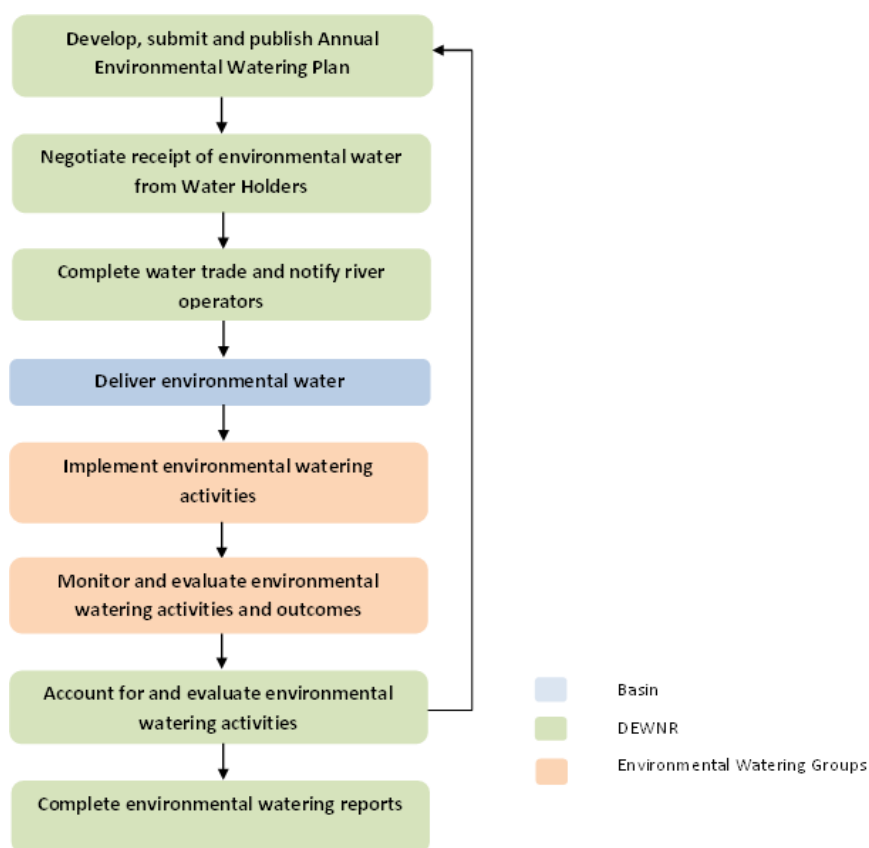


Figure 5: Implementation process for the Annual Environmental Watering Plan

8.1. Securing environmental water

Negotiating receipt of environmental water

The Living Murray program will deliver environmental water to the Chowilla Floodplain, the channel and the Lower Lakes, Coorong and Murray Mouth in line with the multi-site trial for 2015-16. The LLCMM is one of the highest priorities for TLM water in 2015-16. The CEWH has developed a different process regarding the provision of water to the River Murray this year. The CEWH has agreed to provide South Australia with the water held by CEWH in South Australia as part of the monthly Entitlement Flow. The CEWH has also decided to provide 'translucency flows' from Hume Dam in an attempt to get a more natural flow pattern in the River Murray. This will include up to 500 GL of water for the Southern

Connected Basin. There will also be return flows traded to South Australia from upstream watering events in the Goulburn, Broken Creek, and Campaspe.

Completing water trades

A water account has been established for the South Australian Minister for Water and the River Murray to enable DEWNR to manage environmental water trades within and into South Australia from TLM, the CEWH and non-government organisations. All environmental water allocation trades occur through this account to provide transparency and for ease and accuracy of accounting and reporting. Management of the account has been delegated within DEWNR. Site Use Approvals and Works Approvals are also managed by DEWNR. The Minister holds additional accounts for the management of the water purchased to meet obligations with the Commonwealth Government. Online trading is encouraged to streamline the process.

8.2 Delivering environmental water

Delivery of water to South Australia is managed by SA Water in consultation with DEWNR under the direction of River Murray Water (MDBA). The real-time management of water required by South Australia for all purposes (including environmental water) is coordinated by DEWNR in liaison with SA Water and the MDBA on the preferred pattern of delivery to South Australia and related matters including delivery of regulated flow (Entitlement Flow, trade, Additional Dilution Flow and environmental water) and RMUF. Consultation is also carried out across government to identify any potential risks and to optimise the use of water for the best outcomes. Real time environmental management committees operate to adapt flows to changing conditions. These include the Barrage Operations Advisory Group, Environmental Flows Reference Group and CEWO teleconference.

The South Australian River Murray Annual Operating Plan incorporates the annual priorities and watering actions. Therefore, the water delivery required to support these priorities and actions is integrated with broader river operations planning to ensure management on a real-time basis, and appropriate feedback to the MDBA.

8.3 Implementing watering actions

The implementation of environmental watering is managed by water managers in consultation with other interested parties. There are several methods available for implementing environmental watering actions.

Pool-connected wetlands can be managed, if **regulators** have been installed, by opening the regulator to allow inflows to the site. This is environmental watering via gravity and is a relatively cheap mode of environmental water delivery once a regulator has been constructed. A significant amount of regulator construction work has occurred in the South Australian River Murray in recent years and will continue in 2015-16.

Above-pool wetlands can have water delivered via **pumping and irrigation infrastructure**. A variety of permanent and temporary pumps are used, depending on the watering timeframes. Funding is sought from year to year as required.

Environmental regulators such as the one that has been built at Chowilla will potentially water a significant area of the floodplain surrounding their location. This is a new way of managing environmental water and will require ongoing testing and monitoring over the next few years.

The barrages influence water movement into the Coorong and out to sea through the Murray Mouth. They are operated by SA Water and advice is provided by DEWNR and the MDBA utilising the Barrage Operations Working Group.

Channel and floodplain watering actions are implemented through the addition of environmental water to flows that come across the South Australian border.

Some aspects of the river's natural flow regime (including for low-level wetlands and floodplain areas) can be reinstated by using the River Murray locks to manipulate weir pool height and thereby achieve desired water levels. Such manipulations can vary in magnitude, rate of change, duration, timing and frequency: the aim is to manipulate these variables to more closely mimic pre-regulation conditions that native species are adapted to and thereby achieve the greatest ecological benefits for a given volume of water. Weir pool manipulation can be used to enhance the environmental benefits received from small to medium flows. At the same time, a range of operational constraints and risks to other river users need to be overcome or effectively managed.

Weir pool manipulations are in their infancy and, by their nature, are relatively small-scale activities that test the process and increase knowledge for improving environmental river management. This will also aid in generating understanding and community support for weir pool manipulations in the future. For 2015-16, weir pool manipulations are planned for Locks 2, 5 and possibly 6.

8.4 Measuring impacts

Monitoring and evaluation

Monitoring is broadly classified into two categories: condition monitoring and intervention monitoring. Condition monitoring is undertaken at regular intervals to assess the ongoing condition of the sites while intervention monitoring focuses on the assessment of a specific watering action.

The primary responsibility for development and implementation of monitoring programs for environmental watering depends on the wetland location and funding program; however, it generally rests with the following programs:

- South Australia's TLM Icon Site Program: LLCMM and Chowilla Floodplain (DEWNR);
- Regional Wetland and Floodplain Program (SA MDB NRM, DEWNR);
- Murray Futures Coorong, Lower Lakes and Murray Mouth Project (CLLMM Project, DEWNR);
- Weir manipulation (RRP, DEWNR); and
- Long term intervention monitoring program (CEWO, SARDI, DEWNR).

The LLCMM and Chowilla Floodplain Icon Site programs include funding for both condition and intervention monitoring. The methods and parameters monitored under TLM are outlined in the South Australia TLM Icon Site Condition Monitoring Plans approved by the MDBA (see Maunsell 2009 and Wallace 2009). Monitoring within the CLLMM Project is complementary to the LLCMM Icon Site monitoring program.

Additional monitoring at other sites will be undertaken by DEWNR, with support from the South Australian Murray-Darling Basin Natural Resources Management (SA MDB NRM) Board. Monitoring techniques undertaken at other sites managed and monitored by DEWNR generally follow the methods used by TLM.

PART C: IMPLEMENTING THE PLAN

Specific parameters monitored at each site are dependent on the environmental watering objectives, risks, resources and the ecological and physical characteristics of the site.

As environmental watering progresses, it will become increasingly important to undertake strategic and regionally integrated environmental water monitoring. As the volumes of environmental water and number of watering sites grow, it will be more difficult to monitor all sites that receive water. It will be necessary to identify indicator sites and key parameters for monitoring, as well as consider ways to monitor the outcomes of environmental watering at a regional level rather than on an individual site basis.

DEWNR currently relies on information gathered through existing monitoring programs as described above. These programs have been established with specific purposes that generally relate to site-specific management plans and enable adaptive management of these sites. Information on the type of data gathered through each of these programs can be sourced from relevant site managers.

The monitoring data collected during the water year is assessed and evaluated by ecologists to determine whether environmental watering objectives have been achieved. This data is used as input to planning for the following years by helping to determine environmental watering priorities and to manage adaptively to get the best ecological outcomes from the available water.

Accounting and reporting

DEWNR is responsible for maintaining records and reporting on environmental watering data such as allocations, trades, water use volumes, timing and ecological outcomes. Reporting on the benefits and ecological outcomes of environmental watering events occurs through individual site reports. These are consolidated into the Annual Environmental Watering Report and other reports required by the CEWO and TLM. There are also reporting requirements associated with the *Basin Plan* with some reporting being annual and some five yearly.



Murray hardyhead by Scottie Wedderburn

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Legislation / Legislative Instruments

Basin Plan 2012 (Cth)

Murray Darling Basin Authority (2012b) *Guidelines for the method to determine priorities for applying environmental water*

Natural Resources Management Act 2004 (SA)

Water Act 2008 (Cth)

Water Allocation Plan for the River Murray Prescribed Watercourse, South Australian Murray-Darling Basin Natural Resources Management Board, as amended January 2011

APPENDICES

A. Prioritisation Criteria

Ranking criteria 1 – 5 are essentially the same as TLM ‘Methodology for applying ranking criteria’ (provided in MDBA, 2012a) with some minor changes. One additional criteria has been added for the State prioritisation of South Australian River Murray watering proposals to better align with the ‘Principles to determine priorities for applying environmental water’ within the *Basin Plan 2012* (Cth). These are a starting point for further discussion only. As stated against TLM criteria, it is acknowledged that these ranking criteria are a decision support tool and that other factors will contribute to the final decision including water availability and operational feasibility.

1. Scale of environmental benefit

high	<ul style="list-style-type: none"> contribution to key site values and/or key environmental asset (KEA) site management objectives is high (for example breeding event) total area of target community or site watered major outcomes at River Murray system-scale outcomes of the watering (for example maintenance of habitat) can be sustained for a lengthy period of time (e.g. greater than 12 months)
medium	<ul style="list-style-type: none"> able to contribute partially (approximately half) to key site values and/or to KEA site management objectives important outcomes at icon site scale at least half of target community or site watered outcomes of the watering is sustainable for a reasonable length of time (e.g. 6-12 months)
low	<ul style="list-style-type: none"> minor contribution to key site values and/or KEA site management objectives outcomes at localised scale will require follow up watering within short term (e.g. 3-6 months) in order to sustain outcomes

2. Risk of not applying water

high	<ul style="list-style-type: none"> not watering would result in a catastrophic risk to a species or key habitat component or site value that would have a long recovery time high loss of previous watering investment (ecological, volume or \$) site is reaching end of resilience period
medium	<ul style="list-style-type: none"> high risk of loss of a local population of a species, but limited scope for recovery (i.e. poor recolonisers) or long recovery time loss of key habitat components that have a short recovery time moderate loss associated with previous watering investment may not be able to fully deliver minimum regime
low	<ul style="list-style-type: none"> risk of loss of a local population (of a common species) but scope for recovery within short term minor loss associated with previous watering investment may not be able to fully deliver optimum watering regime

3. Environmental risks associated with watering

low	No discernible risks (for example liability, flooding, salinity spikes, blackwater events and other water quality risks) associated with watering. Mitigation strategies ensure no short- or long-term impacts
medium	High localised risks associated with watering. Mitigation strategies may ensure no long-term impacts but may have negative short-term impacts
high	Major widespread risks associated with watering. Mitigation strategies may not be able to prevent long-term negative impacts on ecosystem health

4. Certainty/likelihood of benefit

high	_ Considerable evidence, sound conceptual model with rigorous scientific underpinning, done successfully before at this site
medium	_ Anecdotal support, sound conceptual model supported by good understanding of the processes that would lead to the outcome
low	_ Limited understanding, unsure of outcome, lack of consensus on likely outcome

5. Significance of Site

high	Ramsar Supports state/national listed threatened species
medium	Supports species listed under international agreements (Japan-Australia Migratory Bird Agreement, China-Australia Migratory Bird Agreement, Republic of Korea-Australia Migratory Bird Agreement) Significant previous investment in environmental management
low	New site

B. Risk Criteria

Likelihood



Description	Likelihood of Occurrence
Almost certain (AC)	The event is expected to occur in most circumstances
Likely (L)	The event will probably occur in most circumstances
Possible (P)	The event could occur at some time
Unlikely (U)	The likelihood of the event occurring is low
Rare (R)	The event may occur only in exceptional circumstances

Consequence

	Environmental	People and property	Operational
Critical (C)	Irreversible damage to the environmental values of an aquatic ecosystem and/or connected waters/other parts of the environment; localised species extinction	Death or multiple life threatening injuries or severe trauma; major economic/social impact to multiple communities/ multiple industries	Predicted transmission loss will prevent the achievement of planned outcomes of the watering event (e.g. large majority proportion of water will be lost prior to destination).
Major (Ma)	Long-term damage to environmental values and/or connected waters/other parts of the environment; significant impacts on listed species; significant impacts on water supplies	Life threatening injury/ severe trauma or multiple serious injuries causing hospitalisation; sustained and significant public complaints; severe economic and/or social impact to communities	Predicted transmission loss will significantly detract from the planned outcomes of the watering event (e.g. majority proportion of water will be lost prior to preferred destination).
Moderate (Mo)	Short-term damage to environmental values and/or connected waters/other parts of the environment; short-term impacts on species	Minor injury/trauma or First Aid Treatment Case; sustained public complaints; isolated but significant economic and/or social impact	Predicted transmission loss will moderately detract from the planned outcomes of the watering event (e.g. large minority proportion of water lost prior to preferred destination).
Minor (Mi)	Localised short-term damage to environmental values and/or connected waters/other parts of the environment; temporary loss of water supplies	Short-term but significant public complaints; minor economic and/or social impact contained to small number of individuals	A small amount of water will be lost in transit and this will have a small impact on the environmental outcomes (e.g. small minority proportion of water lost prior to preferred destination).
Insignificant (I)	Negligible impact on environmental values etc.	Minor or isolated public complaints; no economic and social impact	Transmission loss minimal and will not affect the planned outcomes of the watering event (e.g. minimal amount of water lost prior to preferred destination).

The level of risk is determined by the *likelihood* of the hazard occurring, and the level of impact (*consequence*).

Overall risk level rating

		CONSEQUENCE				
		Insignificant	Minor	Moderate	Major	Critical
LIKELIHOOD	Almost certain	low	medium	high	severe	severe
	Likely	low	medium	medium	high	severe
	Possible	low	low	medium	high	severe
	Unlikely	low	low	low	medium	high
	Rare	low	low	low	medium	high

C. Risk Register

Chowilla

Identification of Risk and associated mitigation measures	Controls in place or suggested for managing risk (e.g. <i>landowners will be notified before event to ensure stock are removed from low-lying areas</i>)	Likelihood *	Consequence *	Degree of risk *
		(After controls in place)		
Injury, property / infrastructure damage, stock/crop damage, road access	If further testing of the constructed infrastructure by SA Water proceeds, it will be undertaken under strict OHS&W guidelines. Lessee and neighbouring landholders will be consulted and provided early notification and frequent updates regarding testing to enable alternative stocking and access arrangements to be implemented. If testing proceeds it will be undertaken in close consultation with National Parks (Game Reserve manager) regarding management of access; campsites; visitor communications.	U	Mi	Low
Negative public response	Comprehensive communications and engagement to be undertaken incorporating advice and involvement from Community Reference Committee; key stakeholder engagement and wider community engagement via the media.	U	Mi	Low
Water quality <i>Black water, salinity, acid sulfate soils, algal blooms, transmission of pesticides, cold water pollution, other</i>	Based on current understanding, testing within the "Critical Operational Limits" that have been defined in the event management plan are considered to provide appropriate risk mitigation approaches for (i) maintaining the flow mosaic that is characteristic of the Chowilla Anabranh system, and (ii) management of several water quality issues that are of direct significance to the Basin Plan. Monitoring is in place with real-time access to data and alarm systems established for key parameters. The Chowilla Operations Group will receive real time data regarding key water quality parameters and will actively direct necessary testing responses. Monitoring needs to be undertaken over the full range of tests to confirm these boundaries and the capacity to achieve them.	U	H	Low
Invasive species <i>Spread of weeds, exotic fish etc</i>	Based on the risk assessment, it is anticipated that introduced fish species including common carp will respond to floodplain inundation. Aligning management actions with river hydrology and maintenance of flow velocities to protect habitat in order to ensure native fish are provided with favourable conditions is the primary mitigation tool.	P	Mo	Med
Water loss <i>Unauthorised take, major transmission losses</i>	Agreed methods will be used to determine how water used (evaporation, seepage and water retained) will be accounted for.	P	L	Low
Delivery constraints <i>Failure of delivery infrastructure</i>	SA Water are experienced river operators. If testing proceeds, operations will be undertaken in accordance with an agreed Commissioning Plan which details necessary surveillance, monitoring and constraints on first tests.	U	Mi	Low
Third party impacts <i>Property damage (e.g. crops, livestock, residences), flooding of roads, injury to people</i>	Raising of Lock 6 in conjunction with any potential testing will lead to inundation of land on the southern side of the River Murray. Landholders are being consulted and measures implemented to minimise impacts. If testing proceeds, close and ongoing communications will continue prior to and during testing to ensure any potential third party impacts are considered and mitigated (alternative access arranged; stock relocated).	P	Mi	Low
Failed breeding event <i>Disrupted life cycles, eg Triggering bird breeding event which cannot be completed</i>	The Operations Plan and Event Plan provide guidance for timing and duration of events. Comprehensive monitoring will need to be undertaken to enable adaptive management. Water may be retained at some sites using wetland infrastructure to enable breeding cycles to complete.	L	Mo	Med

Identification of Risk and associated mitigation measures	Controls in place or suggested for managing risk (e.g. landowners will be notified before event to ensure stock are removed from low-lying areas)	Likelihood*	Consequence*	Degree of risk*
		(After controls in place)		
Geomorphic impacts <i>e.g. erosion</i>	The Operations Plan and Event Plan provide clear guidance for rates of rise and fall and management of flows for potential testing to avoid geomorphic impacts such as scour and bank failure. If testing proceeds, careful monitoring will be undertaken and testing modified to manage erosion risks around and downstream of structures as they are tested for the first time.	L	Mo	Low
Lower Lakes, Coorong and Murray Mouth				
Injury, property / infrastructure damage, stock/crop damage, road access	Barrage operations by SA Water are undertaken under strict OHS&W guidelines. The proposed lake operating levels will not impact road access or other infrastructure.	U	Mi	Low
Negative public response	There is a general understanding by the public in regards to the need to continue barrage releases to restore the health of the Coorong and to manage lake levels for ecological benefits. Media releases outlining the benefits of these management strategies will be developed over 2014/15.	U	Mi	Low
Water quality <i>Black water, salinity, acid sulfate soils, algal blooms, transmission of pesticides, cold water pollution, other</i>	Large releases from the LLCMM will help alleviate water quality issues in the MDB. ASS hot-spots on the margins of the Lower Lakes will remain inundated under this management regime, but will continue to be monitored by the EPA through the CLLMM Murray Futures DEWNR Program.	R	Mo	Low
Invasive species <i>Spread of weeds, exotic fish etc.</i>	Oriental Weatherloach (<i>Misgurnus anguillicaudatus</i>) are now in South Australia. All fish monitoring programs in the LLCMM will be asked to document the presence of this species.	L	Mo	Med
Species impacted by inappropriate flooding regimes - <i>promote Carp breeding etc.</i>	Lake levels will be operated so that the seasonal 'rise' will be timed to <u>late</u> spring, to reduce the chance of a carp breeding event in fringing wetlands.	U	Mi	Low
Water loss <i>Unauthorised take, major transmission losses</i>	Transmission losses are likely between the South Australian border and the barrages and will be accounted for.	R	I	Low
Delivery constraints <i>Failure of delivery infrastructure</i>	SA Water are experienced river operators, and undertake barrage maintenance as part of their usual operations.	U	Mi	Low
Third party impacts <i>Property damage (e.g. crops, livestock, residences), flooding of roads, injury to people</i>	Flooding is unlikely due to careful control of water levels and releases managed by the Barrage Operations Teleconference Committee. Large unregulated flow events in late autumn may lead to difficulties in releasing water into a saturated Coorong. This may result in higher than preferred lake levels. This will be avoided by the majority of environmental water being used in spring and summer.	U	Mo	Low
Failed breeding event <i>Disrupted life cycles e.g. triggering bird breeding event which cannot be completed</i>	<i>Ruppia tuberosa</i> recruitment in the Coorong South Lagoon is a major objective. Water releases will be managed where possible to prevent a consecutive breeding event. Continued releases through December, January and February are required to maintain water levels.	L	Mo	Med

Identification of Risk and associated mitigation measures	Controls in place or suggested for managing risk (e.g. landowners will be notified before event to ensure stock are removed from low-lying areas)	Likelihood *	Consequence *	Degree of risk *
		(After controls in place)		
Geomorphic impacts e.g. erosion	Lake-shore erosion will be minimised by only holding lake levels at upper levels for short periods of time. The morphology of the Murray Mouth will continue to be monitored by SA Water. If sand deposition is evident, barrage operations will be changed so that flows are prioritised through Goolwa to keep the mouth open.	U	Mo	Low

Channel

Risk	Description of risk situation (action, scenario, timing, etc)	Controls in place or plan for managing risk	Likelihood *	Consequence *	Degree of risk *
Third party impacts e.g. injury, property/ infrastructure damage, stock/crop damage, road access	<p>At river flows less than 40,000 ML/day QSA, flow remains in-channel and presents a negligible risk to third parties.</p> <p>Between 40,000 – 60,000 ML/day QSA, minor inconvenience may be caused on a localised scale as floodrunners, creeks and anabranches begin to flow. Impacts can include inundation of, or restricted access to, some boat moorings and ramps, pumping infrastructure, access tracks, recreational reserves and camp grounds. 'High flow' advice is issued for the River Murray.</p> <p>When flows reach 60,000 ML/day QSA, there is a greater number of potential third party impacts including the potential for inundation of private properties close to the edge of the River Murray. A 'minor flood warning' is issued for the shack areas only downstream of Cadell (and a high flow warning elsewhere for the River Murray).</p>	<p>Generally, there is four to six weeks notice of expected flows to the SA border. Therefore, early, widespread communication and information to affected stakeholders and the community provide sufficient warning to facilitate flood preparedness. This is the key risk treatment to manage third party impacts of flows in this range and ensure safe use of the River.</p> <p>Based on the AEP curves from the MDBA, flow to SA would exceed 60,000ML/day under the wet scenario only. Detailed work is being undertaken to increase understanding of the likely third party impacts of flows at and above 60,000 ML/day QSA along the River Murray.</p> <p>The outcome of this work will determine whether additional controls are required to manage risks of flows being augmented beyond 60,000 ML/day.</p>	U	Mo	Low
Impact on construction works	Works on the Pike floodplain will be impacted by flows of 30,000ML/day.	<p>Provide flow outlook information to DEWNR staff involved in construction works. Discuss potential mitigation measures (e.g. increasing coffer dam heights) with a minimum of four weeks lead time.</p> <p>Discussions are underway with Project Managers within DEWNR to target one agreed flow constraint for all construction activity on the River Murray floodplain in SA. Ongoing liaison with Project Managers will be undertaken throughout 2013/14 during real-time management of environmental water.</p>	U	Mi	Low
Water quality issues	Blackwater events in the River Murray generally originate in the upper catchment areas (i.e. central Murray	Watering actions proposed under the dry, dry/median and median scenarios are within channel and will result in limited	U	I	Low

Risk	Description of risk situation (action, scenario, timing, etc)	Controls in place or plan for managing risk	Likelihood *	Consequence *	Degree of risk *
<p><i>e.g. black water, salinity, acid drainage from LMRIA, algal blooms, transmission of pesticides, cold water pollution, other</i></p>	<p>floodplain forests) and can impact on dissolved oxygen levels in the Lower Murray catchment. Key factors influencing such events are water temperature and carbon loading, which are in turn influenced by flood timing and whether or not the accumulated plant material litter has been flooded before (Wallace et al 2014b).</p> <p>In South Australia, the regional groundwater table is situated above the surface of the River Murray. This creates a naturally occurring gradient resulting in saline groundwater discharging to the lower elevation River Murray, either directly or via the floodplain. Increased salt mobilisation can occur due to:</p> <ul style="list-style-type: none"> • Rapid changes in river level resulting in increased gradients between the river and the regional groundwater • Groundwater recharge through inundation of the floodplain. 	<p>additional vegetation being inundated. Flows peaked at ~25,000 ML/day in 2013/14 and ~50,000 ML/day in 2012/13. Therefore, plant material accumulated in these areas has been inundated relatively recently. These flow rates are within the range likely to be experienced under a dry, dry/median or median scenario in 2014/15.</p> <p>The timing of environmental water delivery will be in response to natural flow peaks. The addition of environmental water to extend the duration of a flow peak or manage the rate of recession will also provide a dilution flow and likely play a role in mitigating potential water quality impacts.</p> <p>A rapid rate of recession of the flow peak could result in increased discharge of saline groundwater. Environmental water is being added to natural flow peaks and, where the natural recession is predicted to be rapid, environmental water may be used to reduce the rate of recession.</p>			
<p>Negative public response</p>	<p>Public perception that e-water is being inefficiently used.</p>	<p>Communications and community engagement will highlight the potential positive outcomes from watering actions, including evidence from previous actions.</p>	U	I	Low
<p>Invasive species <i>e.g. spread of weeds, exotic fish, etc</i></p>	<p>Increased spawning and recruitment by exotic species particularly carp.</p>	<p>Although management options for preventing carp recruitment are limited, given the already sizable carp population within the region, it should not be a reason for preventing implementation of a flow pulse. Rather, watering actions should be designed to produce the best possible outcomes for native fish to offset any response by carp. An in-channel flow pulse will be undertaken in late spring/early summer, when water temperatures are higher and a positive response by large-bodied native fish is more likely.</p> <p>Adult carp can be excluded from some permanent wetlands through the operation of carp screens, and wetland managers will be advised of any upcoming environmental water delivery to allow them to operate carp screens accordingly.</p> <p>For other proposed actions, the addition of environmental water is unlikely to cause a significant increase in carp recruitment above what would occur as a result of natural flow peaks.</p>	U	I	Low
<p>Geomorphic impacts</p>	<p>Prolonged saturation of bank sediments and steep recession of river levels may result in bank slumping and bank</p>	<p>Bank slumping may be prevented by maintaining a rate of recession that is equivalent to a change in water level of</p>	U	Mo	Low

Risk	Description of risk situation (action, scenario, timing, etc)	Controls in place or plan for managing risk	Likelihood *	Consequence *	Degree of risk *
<i>e.g. erosion, bank slumping</i>	<p>erosion leading to increased sediment mobilisation and water quality problems associated with turbidity.</p> <p>Banks are particularly susceptible to slumping during rapid recession of high flows.</p>	<p><5cm per day. DEWNR staff will aim to work with River operators and MDBA staff to manage the rate of recession during real-time management of environmental water.</p>			
<p>Water loss <i>e.g. unauthorised take, major transmission losses</i></p>	<p>Environmental water may be lost through evaporation losses, re-regulated or diverted for consumptive use.</p>	<p>Transmission losses are expected to be minimal for flow pulse actions (as they remain within channel) and for actions that increase the duration but not magnitude of a flow peak (as the floodplain will already be wet, minimising loss through infiltration).</p> <p>Losses associated with boosting the height of a flow peak are a result of increasing the area of inundation, which is the intent of the watering action and necessary for a positive response by the additional vegetation watered. These 'losses' have been factored into the volume calculated to be returned at the end of the system for subsequent delivery to the LLCMM.</p>	U	I	Low
<p>Failed breeding event <i>e.g. disrupted life cycles (triggering bird breeding event which cannot be completed)</i></p>	<p>Flows are provided at wrong time or insufficient duration to support successful breeding events.</p>	<p>Watering actions have been proposed with durations that are based on the best available conceptual understanding of eco-hydrological responses. This information has been used to developed environmental water requirements based on expert opinion or results from monitoring and observations of positive ecological outcomes.</p>	P	Mo	Med

* See Appendix B for explanation of abbreviations related to the risk rankings in these tables

D. Principles to guide environmental watering priorities

(*Basin Plan* – Chapter 8, Part 6, Division 12, 8.53 – 8.59)

1. Consistency with principles of ecologically sustainable development and international agreements
2. Consistency with objectives in Chapter 8, Part 2 of the Plan (as identified in Table 2, page 13)
3. Flexibility and responsiveness
4. Condition of environmental assets and ecosystem functions
5. Likely effectiveness and related matters
6. Risks and related matters
7. Robust and transparent decisions

E. Guidelines for having regard to ‘Targets for Managing Water Flows’ (Basin Plan, Chapter 9: Water Quality and Salinity Management Plan)

Introduction

Chapter 9 of the *Basin Plan* establishes the Water Quality and Salinity Management Plan (WQSMP) for the water resources of the Murray-Darling Basin. The chapter establishes the key causes of water quality degradation and sets water quality objectives and targets for Basin Water resources.

As part of the implementation of the WQSMP, all river operators and holders of environmental water are required to have regard to ‘Targets for managing water flows’ (9.14) when making flow management decisions.

As part of annual Basin Plan reporting requirements, South Australia will be required to report on how it has had regard to the targets in Chapter 9 when making flow management decisions (*Item 14, Schedule 12, Water Act 2007 - Basin Plan 2012*).

The guidelines presented here are intended to assist South Australian river operators, environmental water managers and holders of environmental water to have regard to the targets when planning and making flow management decisions. They will assist in demonstrating that the South Australian Government has had regard for the targets when making flow management decisions.

It is proposed that these guidelines be reviewed when the MDBA has prepared water quality and salinity guidelines or by June 2015.

What are the targets?

The targets to have regard to when making flow management decisions are outlined in Chapter 9, of the *Basin Plan* and include:

1. To maintain dissolved oxygen at a target value of at least 50% saturation.
2. The targets for recreational water quality (values for cyanobacteria cell counts or biovolume meet the guidelines values set out in Chapter 6 of the Guidelines for Managing Risks in Recreational Water).
3. The levels of salinity at the following reporting sites should not exceed the values set out below 95% of the time (where time is defined as the current water accounting period and the previous 4 water accounting periods, i.e. a rolling five year average):
 - 1) River Murray at Murray Bridge - 830 EC
 - 2) River Murray at Morgan - 800 EC
 - 3) River Murray at Lock 6 - 580 EC
 - 4) Darling River downstream of Menindee Lakes at Burtundy - 830 EC
 - 5) Lower Lakes at Milang - 1,000 EC

Who must have regard to targets for managing flows?

The Murray-Darling Basin Authority, Basin Officials Committee, agencies of Basin States, the Commonwealth Environmental Water Holder, holders of held environmental water and managers of planned environmental water must have regard to the targets when performing functions relating to the management of water flows or making decisions about the use of environmental water.

How to have regard to water quality targets

The following principles should be considered in developing plans or making operational decisions about the management of flow and the use of environmental water in the River Murray.

High level principles

When planning and managing water flows or making decisions regarding the use of environmental water the following principles will be considered:

1. Long term and annual planning for environmental watering and management of water flows will include arrangements and consider measures to achieve the targets and mitigate any adverse impacts on water quality.
2. Management of water flows and operation of structures for environmental benefit require a coordinated approach to planning and decision making in order to identify and address cumulative impacts.
3. Where water flow changes are proposed that could result in a breach of the water quality targets for managing water flow (9.14), actions to avoid the breach must be considered.

Planning principles

1. In developing long term and annual plans and policies for management of held and planned environmental water, environmental watering and management of water flows, the potential for planned actions to impact on the water quality targets for managing water flows should be assessed.
2. Where there is potential for impact, the long term and annual plans and policies should:
 - o consider the operating principles outlined below;
 - o identify arrangements to support consideration of the targets in decision making;
 - o consider arrangements to support a coordinated approach that takes account of interactions with other relevant flow management and environmental water management planning and decision making;
 - o include arrangements for documenting decision making processes and how the targets were considered;
 - o identify relevant monitoring, evaluation and reporting arrangements; and
 - o include notification arrangements where necessary.

Operating principles

When undertaking flow management or environmental watering actions the following must be considered:

3. That the flow decision is consistent with relevant operational and environmental watering plans and policies including:
 - o the South Australian Annual Environmental Watering Plan/Priorities;
 - o South Australia's River Murray Annual Operating Plan;
 - o the MDBS's River Murray System Annual Operating Plan; and
 - o the MDBA's Objectives and Outcomes for River operation in the River Murray System.
4. If there is a high possibility that the flow decision may result in either salinity, dissolved oxygen or cyanobacteria exceeding target values, a risk assessment should be undertaken which considers:
 - a) potential impacts from the water flow decision*;
 - b) current in-stream conditions (including upstream of the South Australian border);
 - c) forecast flow conditions; and
 - d) available mitigation strategies.

** If the likelihood of impact is high further detailed assessment may be required.*

5. The need to undertake **monitoring and evaluation** of the implementation of the flow management decision to assess actual changes to relevant water quality parameters (before and after using existing monitoring or event based) and to determine long term trends.
6. Completing relevant **notification** requirements. This will include:
 - o a River Murray Action Request form to the Department of Environment, Water and Natural Resources River Murray Operations; and
 - o may include community notification through appropriate channels when required.
7. Putting in place appropriate **reporting** arrangements, including:
 - o documentation of decision making process and how targets for managing water flows (9.14) were considered; and
 - o processes to allow provision of monitoring information and documentation on how targets were considered to the Departmental Basin Plan monitoring, evaluation and reporting coordinator.