Australian Government

MURRAY–DARLING BASIN AUTHORITY

The Living Murray

Annual Environmental Watering Plan 2012–13

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Cover Image: Migratory birds at the Coorong (photo by Pamela Gillen)

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ABBREVIATIONS

AHD	Australian Height Datum
EC	electrical conductivity
EWG	Environmental Watering Group
GL	gigalitre
LTCE	long-term Cap equivalent
MDBA	Murray–Darling Basin Authority
ML	megalitre
OAG	Operations Advisory Group
RMIF	River Murray Increased Flow
RMUF	River Murray Unregulated Flow
TLM	The Living Murray

CONTENTS

SUMMARY

The Living Murray Annual Environmental Watering Plan 2012–2013 outlines the priority watering actions for The Living Murray (TLM) icon sites, the potential water available from the (TLM) water holdings in the 2012–13 water season and presents the decision-making process for determining those priorities. This watering plan was developed by the Murray–Darling Basin Authority, in close consultation with the partner states, represented on the Environmental Watering Group.

The coming water season, 2012–2013 will focus on large multi-site waterings with other environmental water holders, such as Commonwealth Environmental Water Holder, Victorian Environmental Water Holder, New South Wales and South Australia. The Basin Officials Committee has approved principles for a multi-site watering trial for 2012–13 as well as specific operational requirements to allow the efficient use of environmental water whilst seeking to minimise any potential third party impacts.

Conditions as we approach the 2012–13 water season are expected to be good in terms of storage volumes and environmental water availability. It is estimated that over 600 GL may become available to The Living Murray portfolio during 2012–13. The combined allocation of environmental water holders could potentially result in over 1,000 GL of environmental water delivered as part of a multi-site delivery trial in the River Murray system (and tributaries) during 2012–13.

Watering proposals have been presented for a range of River Murray inflow scenarios and will guide watering actions throughout the year. These scenarios provide a guide as to what watering actions may be possible. However it will be the flow conditions that develop during 2012–13 and the availability of allocation that will be influential in determining the actual delivery of environmental water. Early-season predictions by the Bureau of Meteorology suggest that although catchments are currently wet and unregulated flows may persist in the lower reaches of the River Murray early in the season; rainfall is likely to be lower than average, which would be reflected in catchment inflow volumes.

The available environmental water holdings in the southern connected basin provide a good opportunity to meet the majority of priority watering actions for the icon sites, under different seasonal conditions. Whilst water from TLM holdings is focused on the icon sites, its use in conjunction with water from other water holders will be important to maximise environmental outcomes for the icon sites and tributaries of the Murray system.

1. INTRODUCTION

The Living Murray (TLM) Program was first initiated in 2002 in response to evidence of the declining health of the River Murray system[1] . In November 2003 the Murray–Darling Basin Ministerial Council announced its historic Living Murray First Step Decision. The critical component of this Decision was the recovery of an average of 500 gigalitres (GL) per year for the environment.

As at 30 June 2012, 479.9 GL of long-term Cap equivalent (LTCE) had been recovered. The majority of approved water recovery measures under TLM have now been completed. To complement the water recovery process, there is also a structural works program underway to facilitate the efficient delivery of this water.

The focus of The Living Murray's First Step is on achieving a set of agreed ecological objectives at six 'icon sites' along the River Murray through a combination of water delivery and targeted works. The six icon sites are:

- Barmah–Millewa Forest
- Gunbower–Koondrook–Perricoota Forests
- Hattah Lakes
- Chowilla Floodplain, Lindsay–Wallpolla Islands
- Lower Lakes, Coorong and Murray Mouth
- River Murray Channel.

This document, TLM Annual Environmental Watering Plan 2012–13, presents the decision-making framework for prioritising the use of TLM water across significant sites on the River Murray system in 2012–13 and presents priorities for watering in the 2012–13 watering year. The plan has been jointly developed by the Murray–Darling Basin Authority (MDBA) and the Environmental Watering Group (EWG) which consists of the partner governments for The Living Murray initiative.

The annual water planning process is responsive to changes in water resource conditions, opportunities and environmental priorities as the season progresses. Implementation of The Living Murray Annual Environmental Watering Plan 2012–13, including any changes to priorities or other aspects of the plan, is recorded separately and reported at the end of the year in The Living Murray implementation report.

For information about TLM go to http://www.mdba.gov.au/programs/tlm.

[1] River Murray system includes: the main course of the River Murray and all its effluents and anabranches downstream of Hume Dam to the sea including the Edward–Wakool River system, the Mitta Mitta River downstream of Dartmouth Dam and the Darling River and Great Darling Anabranch downstream of Menindee Lakes.

2. ENVIRONMENTAL WATERING ACTIVITIES 2011–12

2.1 INFLOWS 2011–12

Rainfall cross the southern Basin and in the upper Murray catchment between June 2011 and end of March 2012 was considered very much above average (Figure 1). River Murray system inflows in the south of the Basin for this period totalled 9,300 GL. It is significant that March 2012 was a very wet month and River Murray system inflows were around 2,200 GL which is the highest value ever recorded for March, breaking the record set last year of approximately 1,000 GL.

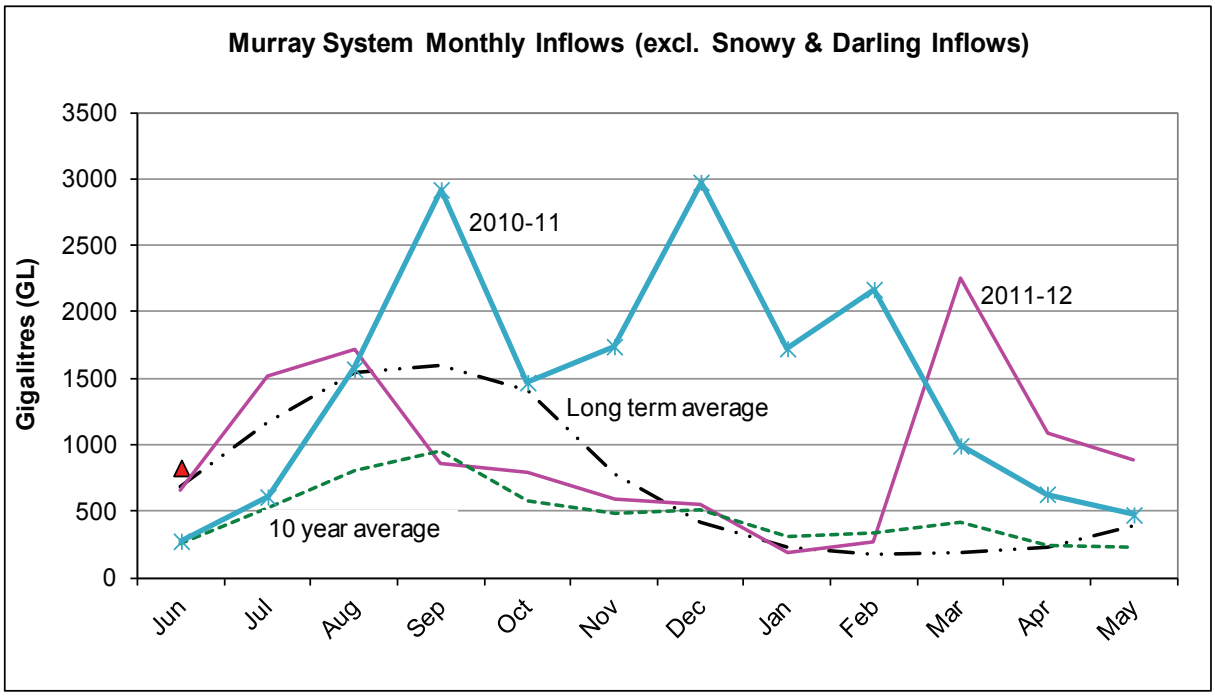

Figure 1 Comparison of inflows to River Murray system (excluding the Darling River and Snowy River) in selected years

In the north of the Basin, significant rainfall events in late November and early December 2011 occurred in some catchments of the upper Darling, including the Namoi, Gwydir and Border Rivers. This resulted in increased flows to the Menindee Lakes from around January 2012. Peak inflows to Menindee Lakes from January to the end of March totalled around 2,600 GL.

In terms of resultant flows, this has meant that the Menindee Lakes, the lower Darling and the Murray downstream of Wentworth have tracked closely to the wet and very wet Scenarios. Peak flows into South Australia from the combined Murray and Darling high flows reached approximately 60,000 ML/day during April 2012. The Bureau of Metereology streamflow forecasts for the May to July 2012 period is favouring near median or high flows for the majority of forecast sites. However the rainfall outlook for the same period is drier for southeast South Australia, western and central Victoria and average in other areas.

2.2 REGULATED WATERING ACTIONS 2011–12

Given the high storage levels at the close of the 2010–11 season, it was anticipated that TLM would have a significant volume of water available in spring 2011 from early season allocations and the carryover of 85 GL in the Goulburn. Opening water allocations were announced in all states and continued to increase until December 2011. By this stage both general and high reliability entitlements in NSW and Victoria had reached 100% and allocation to Spillable Water Accounts in the Goulburn was accessible.

The number of sites that could be considered for watering in 2011–12 was reduced due to the preparation and construction of environmental works being undertaken at Mulcra, Koondrook, Hattah and Chowilla icon sites. The delivery of water to other icon sites was also coordinated to ensure that the construction sites were not inundated where possible. However, high flows that occurred both in spring and in late summer/autumn due to rainfall events meant some of these sites were again over-topped.

High flow periods in the River Murray have also decreased the volume of environmental water required for some icon sites. For example, a pumping program to target significant high value wetlands at Chowilla was planned for early 2012, but most sites were naturally inundated due to the high flows.

Similarly environmental water was held in reserve to provide flows to the Lower Lakes if required. Water was also released from the Goulburn and Campaspe to increase the flows to the Lower Lakes. However, further TLM water was not required due to the periods of high inflows as well as contributions of water from Commonwealth Environmental Water.

One of the key environmental watering actions to occur in 2011–12 was in the Barmah–Millewa Forest. In August-September 2011 a colonial bird breeding event commenced during a period of higher inflows. This watering maintained flow levels for nearly five months to ensure the bird breeding could be successfully completed. It also built on the watering provided in 2010–11 and provided opportunities for fish spawning and benefits to wetland vegetation. The subsequent flows downstream also provided environmental benefits to the Lower Lakes, Coorong, Murray Mouth icon site.

To maintain the required flow levels, Barmah–Millewa Forest received a significant volume of environmental water, totalling 428.1 GL; 15 GL of entitlement held by NSW, 10 GL of entitlement held by Victoria, 120 GL from The Living Murray and 283.1 GL from the Barmah–Millewa Environmental Water Account.

The higher inflows in September also initiated a small bird breeding in Gunbower Forest. Environmental water sustained sufficient flows to allow 10 breeding pairs of intermediate egrets to complete their breeding cycle as well as benefiting vegetation in some important permanent wetland complexes. Environmental water was also provided to the Gunbower Creek in conjunction with the Victorian Environmental Water Holder to ensure base flows could be maintained in the creek throughout the year. These flows increased the habitat available for native fish species and provided benefits to fringing vegetation.

In 2011–12 a total of 239.8 GL of regulated TLM allocation was delivered to sites within the River Murray system. A summary of these actions and the allocated water volumes is provided in Table 1.

Table 1 The Living Murray regulated environmental watering activities 2011–12

Site	Locations within site	Volume delivered (GL)	Period of watering	Benefit
Barmah–Millewa Forest		120	September–February	Contribute to bird breeding event for egrets and colonial water birds and to control the encroachment of giant rush, particularly on moira grass and river red gum saplings.
Gunbower–Koondrook-Perricoota Forests	Gunbower Forest	0.6	December–February	Provide sufficient flow to allow 10 breeding pairs of intermediate egrets to complete their breeding cycle.
	Gunbower Creek	6.1	November–December	Contribute to base flow that will improve fish habitat and passage as well as health of fringing river red gums.
Chowilla Floodplain, Lindsay–Wallpolla Islands	Chowilla	3.0	January	To build on previous watering to improve health of river red gum, lignum and black box at Coombool Swamp.
Lower Lakes, Coorong and the Murray Mouth		105.7	September–December	Facilitate the recovery and maintenance of floodplain vegetation, and maintain habitat for birds and frogs, including threatened species such as the southern bell frog.
		4.4	January	Unused volume originally allocated to Chowilla and recommitted to the Lower Lakes later in the season.
	TOTAL	**239.8**		

2.3 RIVER MURRAY UNREGULATED FLOW EVENTS 2011–12

The prioritisation of access to River Murray Unregulated Flow for all environmental sites in the Murray system is being undertaken by TLM as a trial. This trial aims to ensure water is provided to the watering actions that provide the best environmental outcomes.

The Living Murray also has access to a Victorian unregulated entitlement which can be accessed during periods of unregulated flows for the icon sites.

A number of high rainfall events during the 2011–12 season in the upper Murray catchment and the northern sections of the Basin resulted in extended periods of River Murray Unregulated Flows (RMUF) throughout the year. This provided an opportunity to continue the trial prioritisation of environmental watering actions during RMUF events. The unregulated flow periods also meant that TLM was able to access the full volume against its unregulated entitlements.

In spring 2011, 32.3 GL was accessed from TLM's unregulated entitlement and provided to the Lower Lakes. The remaining water available from Victoria's TLM unregulated entitlement (2 GL) was used to deliver water to Lake Wallawalla and consolidate the benefits of the watering

that occurred last year. This was supplemented with an additional 3 GL of RMUF to water black box seedlings along the edge of Lake Wallawalla, thereby increasing their chance of survival.

The trial of RMUF this year highlighted that prioritisation of watering actions was only required for small events. Most sites did not require further environmental water either as a result of high inflows experienced in many parts of the system over the past two years or the need to maintain dry construction sites. By the end of May 2012, approximately 7,100 GL of RMUF flows had reached the South Australian border, thus reducing the need to deliver more regulated allocation to the Lower Lakes and Murray Mouth throughout the year.

Table 2 provides a summary of the environmental watering actions undertaken during the RMUF events this season.

Table 2 The Living Murray unregulated environmental watering activities 2011–12

Icon site	Locations within site	Volume delivered (GL)	Period of watering	Benefit
Chowilla Floodplain, Lindsay-Wallpolla Island	Lake Wallawalla	2.0*	February -March	To provide water to 800ha of Lake Wallawalla to consolidate environmental benefits obtained from watering last year and to water stressed vegetation around the lake.
Lower Lakes, Coorong and Murray Mouth		32.3**	Spring	To contribute to a spring fresh that will provide recruitment cues for a range of fish species, provide wetland connectivity and improve vegetation health. To provide a peak in barrage releases in November
	TOTAL	**34.3**		

* In addition to the 2 GL of allocation to Victoria's TLM unregulated entitlement, 3 GL of RMUF was also delivered to Lake Wallawalla

** Approximately 8.900 GL RMUF reached the South Australian border by end of May 2012. The majority of these flows would then have flowed through to the Lower Lakes and Murray Mouth.

2.4 SYSTEM BENEFITS

The watering actions undertaken in 2011–12 were able to consolidate and build on the environmental benefits obtained during the extensive flooding that occurred during 2010–11. This was extremely beneficial for the environment, particularly in light of the previous extended drought. For example, although the bird breeding event at Barmah–Millewa Forest did not reach the magnitude of 2010-11, thousands of water birds bred successfully and the condition of red gums continued to improve.

The Central Murray Floodplain, including Barmah–Millewa Forest, Gunbower–Koondrook–Perricoota Forests and the Edward–Wakool system benefitted from good rainfall in spring and natural high flows provided an opportunity for the use of environmental water to inundate

many of the permanent and low lying wetlands in Barmah–Millewa Forest and Gunbower Forest. This led to fish spawning, particularly silver and golden perch. At Barmah–Millewa Forest there was also a significant bird breeding event for ibis, spoonbills, darters and cormorants.

In late 2011 floods in the north of the Basin resulted in increased flows to the Menindee Lakes. Menindee Lakes began 'spilling' in December 2011 resulting in good flows in the Darling River anabranch. This has helped to consolidate the environmental benefits gained from last year's flows.

The high flows continued downstream, improving habitat within the River Murray Channel. Locks and weirs were removed during unregulated flow periods which have allowed fish to move freely and helped flush salinity from the system. From 1 June 2011 to the end of May 2012 the total flow over the SA border was approximately 10,250 GL.

Increased flows to SA from both regulated and unregulated sources had a positive impact on water levels at the Lower Lakes, resulting in good flows over the barrages, lowered salinity levels in the Lower Lakes, improved fish passage and contributed to keeping the Murray Mouth open throughout 2011–12.

In May 2012 the level of the Lower Lakes was managed between 0.6 and 0.8 m AHD to help mitigate salinity levels in Lake Albert. The salinity in Lake Albert (measured at Warringee point) was approximately 4,800 EC, compared with 7,000 EC in the previous year. Salinity levels throughout the 2011–12 year were consistently below 500 EC in Lake Alexandrina. Flows through the Lower Lakes and Barrages during May 2012 averaged 55,000 ML/day and there was continuous flow through the Barrages to the Coorong from September 2010.

As the requested volumes of environmental water were successfully delivered to the icon sites in 2011–12, the Environmental Watering Group decided to carryover the remaining volume of allocation in The Living Murray portfolio to spring 2012 to maximise the potential environmental outcomes for the following year.

2.5 THE LIVING MURRAY PORTFOLIO SUMMARY

Table 3 presents the reliability class of entitlements held by TLM in 2011–12 with their associated entitlement, allocation, net use volumes and the volume remaining at June 30 2012. A more detailed listing of the entitlements is provided at Appendix A. A total of 983.9 GL of entitlements is currently held on The Living Murray Environmental Water Register. Of the volume held on The Living Murray portfolio at 30 June 2012, 154.9 GL remained unused, of which 123.2 GL was carried over to spring 2012–13. The remaining portion of unused water was forfeited due to carryover restrictions.

The Living Murray also has access to additional water that is currently not represented in Table 3. River Murray Increased Flows (RMIF) is a volume of water that can be called from Snowy storages, specifically for environmental use in the River Murray. In 2011–12 no RMIF allocation was available. However in 2012–13, there will likely be 230 GL of callable RMIF in the Snowy that will be available to TLM, if requested.

Table 3 The Living Murray Entitlements 2011–12

Entitlement type	Entitlement (GL)	Long-term Cap equivalent (LTCE)[1]	Allocation available to TLM[2] (GL)	Environmental watering use (GL)[3]	Volume remaining at June 30 2012 (GL)[4]
Regulated water entitlements					
NSW High Security	1.9	1.8	5.6[5]	0.00	0.03
NSW General Security	212.7	166.2	214.7	100.0	119.2
VIC High Reliability	63.3[6]	62.5	74.0	72.1	2.9
VIC Low Reliability	263.9	128.9	56.8	22.8	34.1
SA Water Licence	44.9[7]	42.5	44.9	77.2	0.00
Sub total	586.7	401.9	396.0	272.1	156.2
Unregulated/supplementary water entitlements					
NSW Supplementary[8]	350.0	40.9	N/A	0.00	0.00
NSW Unregulated	12.9	9.0	N/A	0.00	0.00
VIC Unregulated	34.3	28.1	34.3	2.00	0.00
Sub total	397.2	78.00	34.3	2.00	0.00
TOTAL	**983.9**	**479.9**	**430.3**	**274.1**	**156.2**

[1]The long term Cap equivalent is the long-term average volume per year.
[2]This volume includes carryover, forfeiture and losses.
[3]This volume is influenced by trade.
[4] The volume remaining is the sum of volume of allocation -(volume used + volume forfeited due to spills)
[5] Includes NSW gifted 3.7 GL
[6] An additional 2.89GL has been included reflecting the anticipated NSW Wetlands recovery, Victorian licence.
[7] Includes SA gifted 1.1 GL
[8] NSW unregulated and supplementary entitlements for TLM do not receive allocation; rather, they increase the size of existing unregulated flow events in the River Murray. To gain an understanding of the volume of water that these entitlements have contributed to the total volume of unregulated flows, modelling will have to be undertaken retrospectively once the unregulated flow event has been completed and as annual accounts are finalised.

3. FRAMEWORK FOR DECISION-MAKING

3.1 ENVIRONMENTAL MANAGEMENT OBJECTIVES

To maximise the environmental outcomes at the icon sites it is necessary to understand how the whole system may operate under different climate conditions. The Living Murray uses scenario planning to preview the potential watering activities which may occur during the year which considers both the water available from environmental water holdings (supply) and the icon site environmental objectives (demand) for 2012–13.

The Living Murray uses a model that outlines management objectives for different climatic conditions (Table 4). The ecological objective and relative management objectives and actions for extreme dry, dry, median and wet scenarios are outlined in the table and provide guidance on how TLM water is likely to be managed under different climatic conditions.

3.2 PROCESS FOR PLANNING AND IMPLEMENTATION FOR REGULATED FLOWS

An important component of the TLM Annual Environmental Watering Plan 2012–13 is the information on how the environmental benefits of the proposed watering program are consistent with the stated objectives for each site. In order to accommodate the potential range in water allocation volumes, inflow scenarios and varying icon site conditions, a flexible framework has been developed to guide the implementation of environmental watering actions during 2012–13.

This framework provides the focus for particular environmental watering actions at icon sites and the timeframes for the review of potential watering actions at all sites. These reviews will help assess TLM available water and consider its potential contribution to provide environmental benefit to all proposed watering sites using the ranking criteria.

During the 2012–13 water year, EWG will review the schedule of potential environmental watering actions using the process outlined in Figure 2. These review periods allow for the assessment of available TLM water against the environmental demand to assess which watering actions should be implemented to maximise environmental benefit. Depending on the conditions at the review time, proposed watering actions may be adjusted in response to water inflow data and the most suitable scenario at that time.

Based on the outcomes at each review period, EWG will provide advice to the MDBA on whether any environmental watering actions should be implemented at that stage. The approval of any watering actions recommended by EWG is delegated to the Executive Director of Environmental Management, Murray–Darling Basin Authority.

Real-time factors that may impact on the delivery of environmental water will also be considered during the review periods. This includes the operation of the river, availability of other sources of environmental water, status of TLM works, status of delivery budget, opportunities for multiple site watering actions, conditions at the sites and forecasted flows. Multiple proposed watering actions will also be subject to an assessment of the implications to River Murray operations, the conditions imposed by the Basin Officials' Committee and a thorough assessment of the likely environmental benefits.

During the year, EWG will seek to maximise the use of available TLM water to meet environmental demands within the River Murray system. However this will need to be balanced with any requirements to carryover allocation to facilitate critical watering actions early in the following year when allocations may be low.

Table 4 Proposed ecological watering objectives under different climatic conditions

	Extreme dry	Dry	Median	Wet
Ecological watering objectives	Avoid irretrievable loss of key environmental assets	Ensure priority river reaches and wetlands have maintained their basic functions	Ecological health of priority river reaches and wetlands have been protected or improved	Improve the health and resilience of aquatic ecosystems
Management objectives	Avoid critical loss of species, communities and ecosystems Maintain key refuges Avoid irretrievable damage or catastrophic events	Maintain river functioning with reduced reproductive capacity Maintain key functions of high priority wetlands Manage within dry -spell tolerances Support connectivity between sites	Enable growth, reproduction and small-scale recruitment for a diverse range of flora and fauna Promote low-lying floodplain-river connectivity Support medium flow river and floodplain functional processes	Enable growth, reproduction and large-scale recruitment for a diverse range of flora and fauna Promote higher floodplain-river connectivity Support high flow river and floodplain functional processes
Management actions	Water refugia and sites supporting species and communities Undertake emergency watering at specific sites of priority assets Use carryover volumes to maintain critical needs →	Water refugia and sites supporting threatened species and communities Provide low flow and freshes in sites and reaches of priority assets Use carryover volumes to maintain critical needs →	Prolong flood/high-flow duration at key sites and reaches of priority assets Contribute to the full-range of in-channel flows Provide carry over to accrue water for large watering events →	Increase flood/high-flow duration and extent across priority assets Contribute to the full range of flows incl. over-bank Use carryover to provide optimal seasonal flow patterns in subsequent years
Overarching objective	Avoid catastrophic loss/maintain capacity for potential recovery	Improved capacity for recovery	Protect ecological health	Improved health and resilience

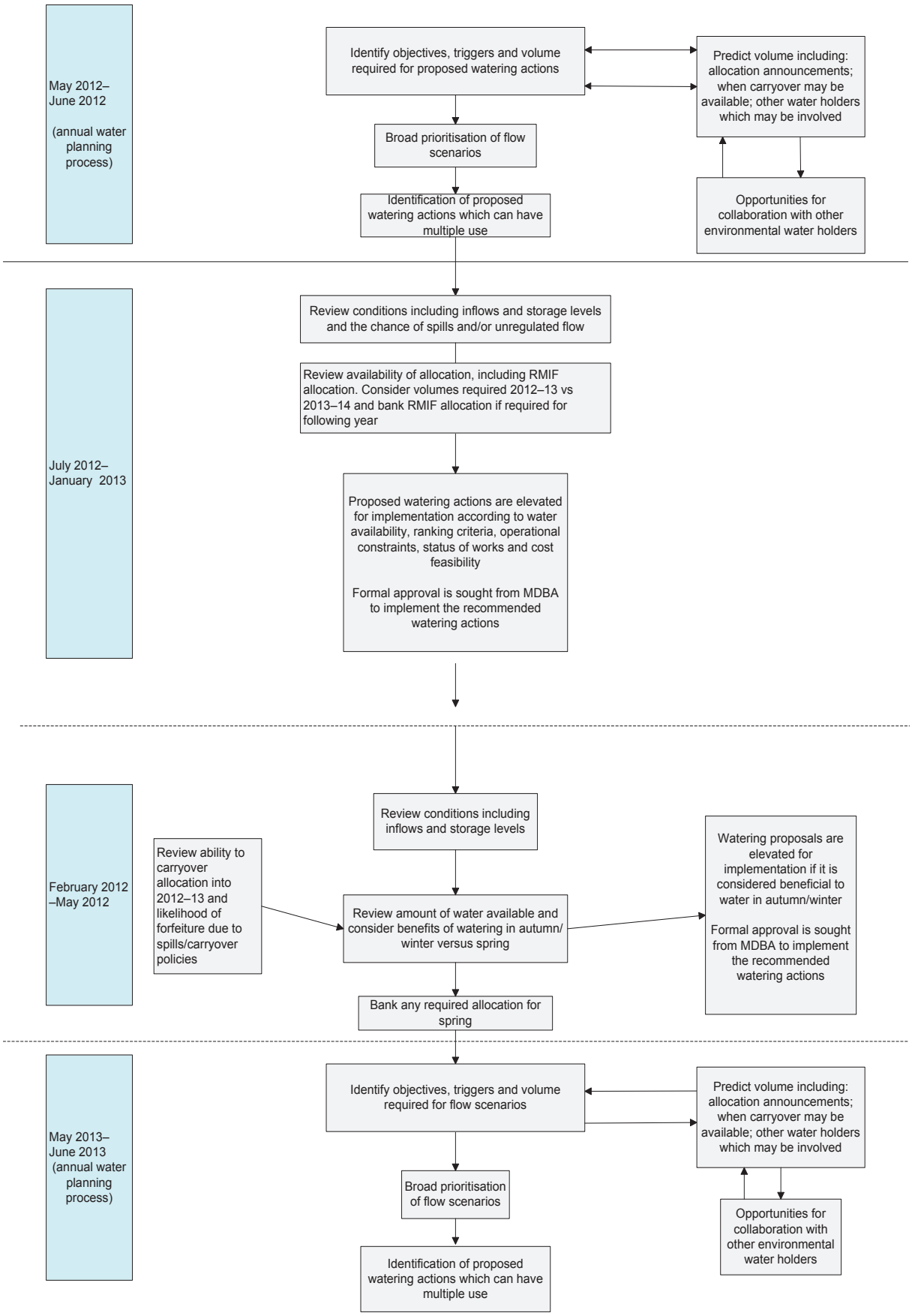

Figure 2 Flow chart of planning and implementation process for regulated flows

3.3 PROCESS FOR PRIORITISATION OF UNREGULATED FLOWS

In 2007, the Ministerial Council agreed to the principle that any unregulated flows that become available are managed according to The Living Murray Environmental Watering Plan through the Environmental Watering Group (EWG). The 2010–11 year provided EWG with its first opportunity to trial the prioritisation of environmental watering actions during a RMUF event. Following this successful trial, the Basin Official's Committee agreed that EWG should continue the trial prioritisation of environmental watering actions during RMUF events to maximize the environmental benefits. The extended RMUF events that occurred in 2011–12 provided a further opportunity to continue this trial prioritisation process.

As each RMUF event varies in location, duration and operational opportunities, it is not possible to provide precise information on watering actions prior to a RMUF event. The full list of potential sites which can receive RMUF are not listed in this plan. However, to be event ready EWG plans to use the developed flow scenarios for the icon sites and apply them to reaches along the River Murray which have sites with access to RMUF. These scenarios will also be subject to an assessment of the implications of River Murray operations, any approvals required from Basin Official's Committee and an assessment of the environmental benefits of all sites which can access unregulated flows.

Proposed watering actions will need to be reviewed as an unregulated event unfolds and supplementary information will be included so that filters such as location, magnitude and feasibility can be evaluated before the prioritisation of the environmental watering actions in real time.

The prioritisation of environmental watering actions during RMUF events in the River Murray system will in principle:

- be based upon a RMUF event declared by River Murray Operations
- be consistent with a one-river approach in that the areas of highest environmental need and benefit are given priority
- recognise existing obligations and rights
- maximise environmental outcomes including integration or substitution with regulated environmental water releases
- be based upon opportunity and relative environmental priority following ranking criteria agreed by the EWG
- be agreed on a case-by-case basis in real-time.

To assist in a real-time event, the ranking criteria adopted for the prioritisation of TLM regulated watering actions are also applied to watering actions sourced from RMUFs.

Figure 3 outlines the process for prioritising watering actions during a RMUF event. The decision to implement a RMUF environmental watering action is the responsibility of the relevant jurisdiction in both physically implementing the agreed priority and in allowing the declared RMUF to be used according to the EWG agreed principles.

During a RMUF event it is possible that unregulated flows may be substituted for TLM allocation if approved watering actions have not yet been completed. This ensures that watering actions are undertaken in the most effective manner. For example, during the 2011–12 season, a planned watering event at Lake Wallawalla was able to substitute regulated allocation with RMUF water as a RMUF event occurred during the watering event.

The construction of environmental works at some sites, such as Koondrook–Perricoota, will provide an opportunity to divert RMUF flows into the icon site. In 2012–13 it has been agreed that if flows below Torrumbarry are less than ~20,000 megalitres per day and RMUF is available, then a proposal to divert into Koondrook–Perricoota will be referred to EWG for prioritisation. This flow level has been chosen as it is the level at which overbank flows occur naturally at Koondrook–Perricoota.

The estimated volumes and benefits of water prioritised by EWG and delivered during a RMUF event will be collated and reported as part of TLM environmental water reporting. This will enable a more comprehensive understanding of environmental water delivered in the River Murray system.

3.4 RANKING CRITERIA FOR PRIORITISATION

In some years and for some scenarios, there will be a requirement to prioritise between watering actions and sites. A set of ranking criteria that assess the environmental benefit of watering actions has been endorsed by EWG and is outlined in Table 5. More detailed descriptions of the ranking criterion are provided in Appendix B. Other factors such as the need to include provisions for commissioning of structures are considered along with the ranking criteria in the overall prioritisation process.

Table 5 Ranking criterion for The Living Murray watering actions

Ranking criterion		Description
Significance of ecological outcome	An assessment of the predicted ecological outcomes provided by the watering. This should reflect the value and condition of the asset, threatened species and communities and magnitude of benefit, including:	
	Amount of benefit for the volume of water	An assessment of the predicted ecological benefit relative to the volume of water required. This may include the opportunity for return flows.
	Risk of not watering	An assessment of ecological risks of not watering. This includes the previous history, desired watering frequency, resilience period and protection of previous investment.
	Certainty/likelihood of benefit	An assessment of the certainty of getting the predicted outcomes; whether the benefit of watering a site can be maintained in the short and long term and the implications for future management.
Operational matters	Risks associated with watering	An assessment of any risks associated with the delivery of water including acid sulphate soils, salinity spikes, blackwater events, algal blooms, operational constraints and the adequacy of mitigation measures.
	Cost	An estimate of the overall costs of delivering the watering action (per ML) including delivery, pumping and associated infrastructure costs.

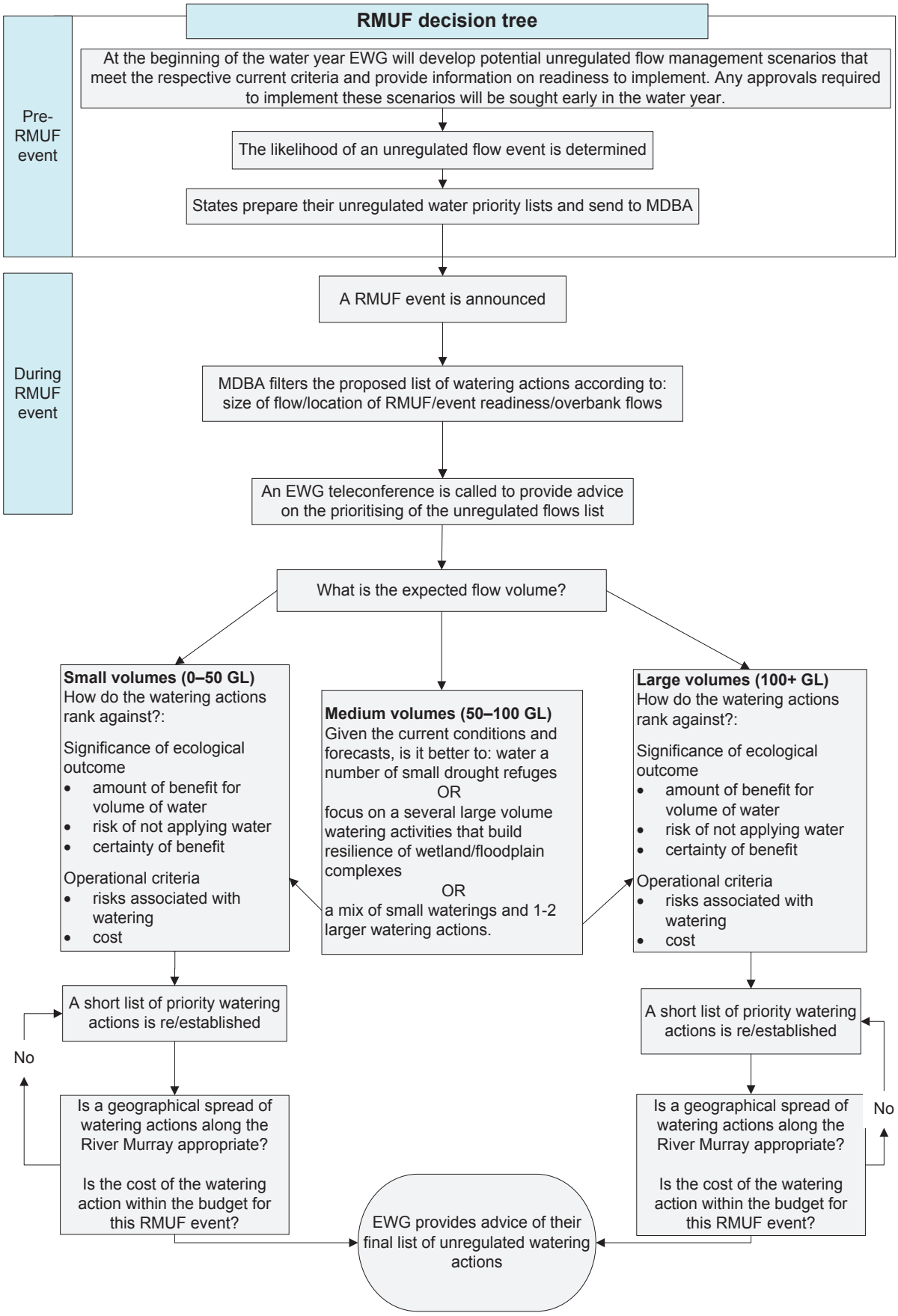

Figure 3 Prioritisation process for unregulated flows

3.5 REAL TIME MANAGEMENT

During a water season, river or climatic conditions may change quickly, requiring responses and decisions within very short timeframes. The MDBA Operations Advisory Group (OAG) is an important component of the real-time management of environmental watering actions. The OAG provides a forum for the sharing of operational and ecological information between all environmental water holders, site managers and river operators and managers during environmental watering actions.

The OAG works within the framework of the multi-site watering strategy, the agreed Basin Official Committee's principles for multi-site watering and agreed priorities and ecological objectives outlined by the environmental water holders in their respective annual watering plans.

Advice is provided by the OAG to River Murray Operations on the appropriate operational adjustments as conditions change and helps ensure successful outcomes of water delivery actions. This is specifically in regard to the implementation of environmental water actions within the southern connected Basin (i.e. Murray, Lower Darling, Goulburn, Campaspe and Murrumbidgee valleys).

The OAG will be convened through teleconferences at regular intervals throughout the delivery phases to provide operational and ecological advice. There will be certain circumstances where OAG will not be able to provide advice to River Murray Operations and matters will be referred back to the relevant environmental water holders. Such situations could include a sudden change in conditions or ecological objectives or the requirement for the allocation of additional water to a watering event.

3.6 IDENTIFICATION AND MANAGEMENT OF RISKS ASSOCIATED WITH ENVIRONMENTAL WATERING

There are some risks associated with undertaking a large, multi-site watering event as proposed for the 2012–13 season. These have been identified and broad mitigation measures have also been determined, with more specific measures to be implemented on a site-by-site basis.

Risks will be continually revised and considered according to emerging conditions and managed appropriately. Based on current and forecast conditions and the proposed operating framework, the risks that are considered of greatest consequence would be:

- flood impacts on people, stock, crops, property or infrastructure through direct flooding or contribution to flooding
- financial implications for river and floodplain construction works should they be flooded
- blackwater events resulting in areas of low dissolved oxygen
- the spread of exotic fish species or increases in exotic fish populations.

The establishment of the OAG to actively manage the proposed environmental watering actions and provide a rapid response to changing river conditions is considered an important tool in managing and mitigating the delivery risks.

4. THE LIVING MURRAY WATER PLANNING 2012–13

4.1 OUTLOOK FOR ENVIRONMENTAL WATER SUPPLY

Depending on storage levels, catchment and climate conditions the water available from TLM holdings in any particular year will change. The magnitude of change will influence the ability to meet the environmental water demands of the icon sites.

4.1.1 Storage levels and potential inflows

Total MDBA active storage on 30 June 2012 was 7,945 GL (93% capacity) which is about 885 GL more than at the end of June 2011 and well above the long-term average for this time of year of approximately 5,537 GL (Figure 4).

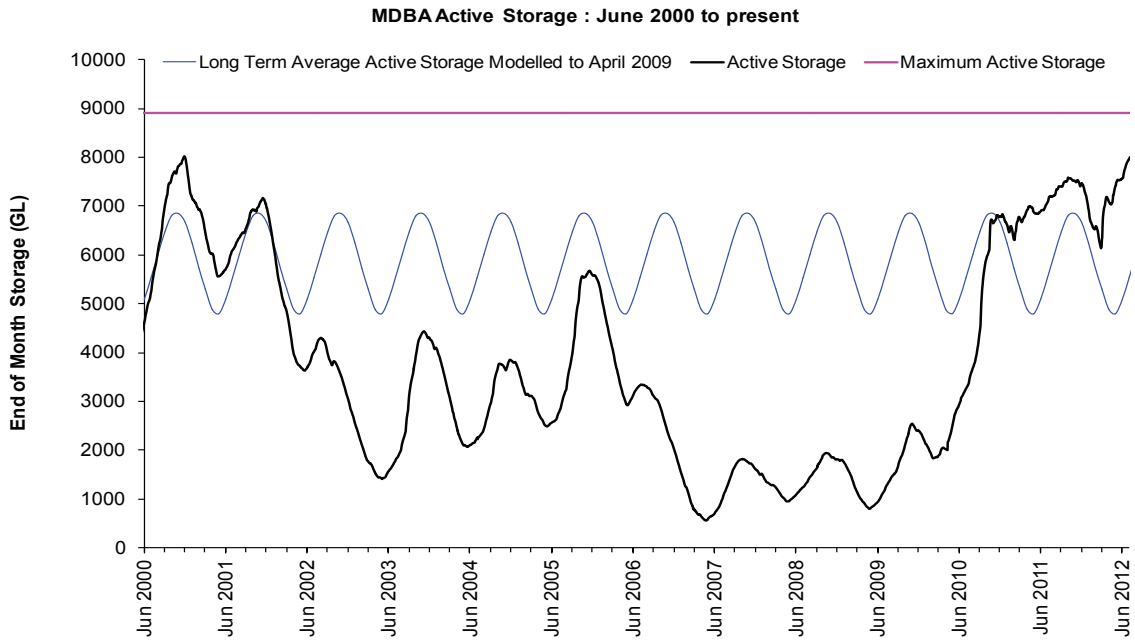

Figure 4 Comparison of active, long-term average and maximum storage levels in the River Murray system June 2000 to June 2012

At the end of June 2012 Hume Reservoir was at 95% capacity. Water storages in the Goulburn and Murrumbidgee catchments were also close to full levels. If average inflow conditions occur through winter and spring of 2012 there are likely to be spills from these storages. Catchments are currently wet and these releases could combine with unregulated flows from the Kiewa, Ovens and Goulburn Rivers, resulting in another significant high flow event along the River Murray in 2012–13.

Figure 5 provides preliminary flow forecasts for different water resource scenarios in 2012–13 provided by River Murray Operations, MDBA.

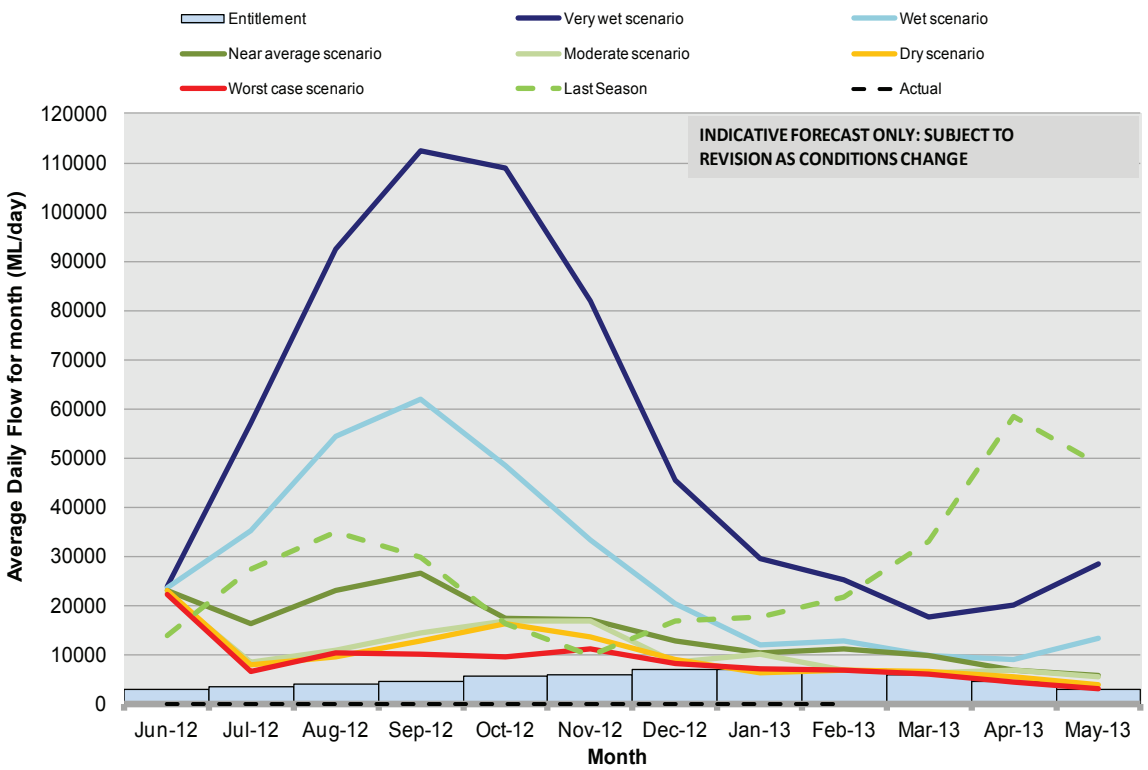

Figure 5 Preliminary flow forecasts for different water resource scenarios 2012–13 as at May 30 2012

Note: in a Worst Case to Moderate scenario, there is no unregulated flow after July. The flow that can be seen above 'normal' entitlement in this graph is a combination of ADF and regulated environmental water delivered to the SA border.
The Near Average scenario has unregulated flows until December 2012, and the wetter cases have unregulated flow throughout the 2012-13 year.

4.1.2 Outlook for environmental entitlements

The MDBA active storage levels are significantly high and it is anticipated that TLM will have a considerable volume of environmental water available in early spring 2012 from carry-over and early season allocations. Table 6 provides estimates of potential allocation to TLM water entitlements, including carryover from 2011–12. Forecasted allocations are expected to be similar under all inflow scenarios; however in drier scenarios it may take a longer time period to achieve the forecasted allocation volumes outlined below.

Table 6. Forecasted available The Living Murray water 2012–13

Season	Forecasted allocation amounts (GL)[1]	Potential carryover available (GL)	Cumulative total (GL)
July 2012	133	156	289
Spring 2012	84	0	373
Summer 2012–13	63	0	436
Unregulated	34		470
RMIF	230		700
Estimated total			700

[1] Less forfeiture

With high storage levels, there is also a high risk of spills. This may delay the availability of water carried over in spillable water accounts. The volume of carryover in these accounts may also be reduced in 2012–13 if spills occur before this carryover is made available.

Given the catchment conditions and storage levels we will have significant volumes under all climate scenarios. The high storage levels also increase the likelihood of natural flooding of icon sites.

4.2 ENVIRONMENTAL WATER DEMANDS

Environmental watering proposals for the 2012–13 year were developed around four main River Murray inflow scenarios; dry, median, median/wet and wet. These inflow scenarios are broadly related to the inflow scenarios utilised by River Murray Operations shown in Figure 5. Each scenario has inbuilt assumptions regarding inflows from the Snowy River Scheme, unregulated flows into Hume Reservoir, inflows into Dartmouth Reservoir, inflows from major tributaries, conveyance and storage losses and usage patterns. These inflow scenarios are related to specific annual inflow volumes to the River Murray that range from 2,900 GL in a dry scenario to 18,100 GL in a wet scenario.

Ecological objectives have been developed that are relevant to the flow conditions that might be encountered under each scenario. The potential watering actions under each flow scenario are outlined in Table 7. The volumes listed in Table 7 specify the estimated demand of environmental water at each site and are not cumulative. It is anticipated that in the wetter scenarios some of the volume required may be met by unregulated flows and return flows from upstream sites. This is true for all sites presented in Table 7, with the exception of South Australia, where environmental water demands are in addition to unregulated flows.

The watering proposals have also taken into consideration antecedent conditions, constraints and risks associated with delivery of environmental water in establishing the ecological objectives for each flow scenario. A detailed summary of the watering proposals is provided at the end of this chapter.

These inflow scenarios outlined above are a planning tool to ensure that TLM is event ready for all possible scenarios. However the implementation of watering proposals during 2012–13 will be undertaken in response to actual flow conditions that may vary during the year and across catchments.

The main focus of the watering proposals for the 2012–13 season has been the delivery of environmental water to multiple sites to the River Murray system, allowing water to be delivered in the most effective and efficient manner. In drier inflow scenarios the aim is to implement a drying phase in the upper Murray catchment after the high inflows experienced in the past two years and allow construction of environmental works at Koondrook to be completed.

In wetter scenarios, if natural inflows inundate Barmah–Millewa Forest the preference is to undertake a short watering event, with some timed pulses to benefit fish breeding and inundate high level floodplain vegetation. In the lower Murray catchments, only sites under construction will need to remain dry. Flow level thresholds that occur in real time will guide the scale of watering actions that will be undertaken in the lower Murray catchment.

In 2012–13, it is proposed to release water from the Goulburn, Campaspe and Murrumbidgee systems to strategically align with releases from Hume Reservoir that will provide benefit to Gunbower–Koondrook–Perricoota as well as the Coorong, Lower Lakes and Murray Mouth icon sites. Releases in the major tributaries will contribute to baseflows and freshes, increasing habitat for fish and providing benefits for riparian and in stream vegetation. Significant volumes, using water from TLM and other environmental water holders will be fundamental to the success of the multi-site watering.

Table 7 Environmental objectives and associated demands for each icon site under different climate scenarios

Site		Climate scenarios	Dry[1]	Median[2]	Median/Wet[3]	Wet[4]
Barmah–Millewa Forest		Environmental objectives	Site to remain dry after consecutive flooding events.	Inundate red gums and other significant vegetation. Promote fish spawning.	Inundate red gums and other significant vegetation. Promote fish spawning.	Inundate black box higher in the floodplain.
		Priority watering actions	No overbank flows.	Target flow rates of 15,000-20,000 ML/day to provide short peaks to inundate the forest.	Target flow rates of 20,000-25,000 ML/day (current maximum operational level) to provide short peaks to inundate the forest that complement unregulated flows.	Target flow rates of 20,000 - 25,000 ML/day (current maximum operational level) to provide short peaks to inundate the forest that complement unregulated flows.
		Estimated vols.	n/a	90 GL	140-280 GL	154-308 GL
Gunbower–Koondrook–Perricoota Forests	Gunbower	Environmental objectives	Provide water to semi/permanent wetlands.	Facilitate fish movement between the River Murray and the forest and maintain any triggered bird breeding event.	Facilitate fish movement between the River Murray and the forest and maintain any triggered bird breeding event.	Facilitate fish movement, maintain bird breeding and inundate red gums.
		Priority watering actions	Releases through Torrumbarry system into forest.	Releases to meet target flows from the Murray and through Torrumbarry system.	Releases to meet target flows from the Murray and through Torrumbarry system.	Releases to meet target flows from the Murray and through Torrumbarry system.
		Estimated vols.	2 GL	Up to 544 GL	Up to 900 GL	Up to 450 GL
	Koondrook–Perricoota	Environmental objectives	Promote in-stream vegetation.	Promote in-stream vegetation and provide some connection with floodplain (if overbank flows).	Provide connectivity with floodplain and vegetation benefits.	Provide connectivity with floodplain and vegetation benefits.
		Priority watering actions	Diversions in via regulator, return flows out via regulator.	Diversions in via regulator, return flows out via regulator.	Diversions in via regulator, return flows out via regulator.	Diversions in via regulator, return flows out via regulator.
		Estimated vols.	17 GL	17 GL	17 GL	17 GL

Site		Climate scenarios	Dry[1]	Median[2]	Median/Wet[3]	Wet[4]
Hattah Lakes		Environmental objectives	Provide in-stream vegetation and fish benefits.	Provide in-stream vegetation and fish benefits.	Provide in-stream vegetation and fish benefits.	Provide in-stream vegetation and fish benefits, connectivity between lakes.
		Priority watering actions	Pumping into system	Pumping into system	Pumping into system	Overbank flows
		Estimated vols.	44 GL	44 GL	44 GL	44 GL
Chowilla Floodplain, Lindsay–Wallpolla Islands	Lindsay–Wallpolla	Environmental objectives	No watering required.	No watering required.	Top up for Lake Wallawalla to benefit in-stream vegetation and provide fish connectivity.	Top up for Lake Wallawalla to benefit in-stream vegetation and provide fish connectivity.
		Priority watering actions	N/A	N/A	Small pumping	Small pumping/Overbank flows.
		Estimated vols.	0 GL	0 GL	3 GL	3 GL
	Mulcra Island	Environmental objectives	Ecological health of priority river reaches and wetlands.	Ecological health of priority river reaches and wetlands.	Ecological health of priority river reaches and wetlands.	Ecological health of priority river reaches and wetlands.
		Priority watering actions	Flow rates likely to be below 15,000 ML/day. CTF 12,000 ML/day.	Flow rates likely to be up to 25,000 ML/day. CTF 12,000 ML/day.	Flow rates likely to be up to 30,000 ML/day.	Flow rates likely to be up to 65,000 ML/day.
		Estimated vols.	5 GL[5]	5 GL[5]	5 GL[5]	5 GL[5]
Chowilla Floodplain, Lindsay–Wallpolla Islands	Brandy Bottle wetland, Chowilla Floodplain	Environmental objectives	Maintain high value wetland and build on previous watering	Maintain high value wetland and build on previous watering	Maintain high value wetland and build on previous watering	Maintain high value wetland and build on previous watering
		Priority watering actions	Pumping	Pumping	Pumping	No priority watering action required as it is assumed that over bank flows exceed commence-to-flow threshold of 65,000 to 70,000 ML/day.
		Estimated vols.	0.1 GL	0.1 GL	0.1 GL	n/a

Site	Climate scenarios	Dry[1]	Median[2]	Median/Wet[3]	Wet[4]
Lower Lakes, Coorong and the Murray Mouth	Environmental objectives	**LLCMM**- maintain connectivity between lakes and estuary, maintain open Murray Mouth, maintain salinity in Lake Alexandrina <1,000 EC **SA River Murray Channel**[6] – provision of variable flow regimes, stimulate fish recruitment	**LLCMM**- maintain connectivity between lakes and estuary, maintain open Murray Mouth, maintain salinity in Lake Alexandrina <1,000 EC, salinity benefits in Coorong, South Lagoon **SA River Murray Channel** –provision of variable flow regimes, stimulate fish recruitment, maintenance of lower elevation wetlands	**LLCMM**- maintain connectivity between lakes and estuary, maintain open Murray Mouth, maintain salinity in Lake Alexandrina <1,000 EC, salinity benefits in Coorong, South Lagoon **SA River Murray Channel** – maintain/improve majority of lower elevation temporary wetlands; support bird and fish breeding events; microbial decay / export of organic matter; maintain/improve health of lignum shrubland; provide mosaic of floodplain vegetation habitats	**LLCMM**- maintain connectivity between lakes and estuary, maintain open Murray Mouth, maintain salinity in Lake Alexandrina <1,000 EC, salinity benefits in Coorong, South Lagoon **SA River Murray Channel** – provide mosaic of floodplain vegetation habitats; inundation for waterbird breeding; maintain/improve health of existing river red gums & lignum shrubland; stimulate spawning, provide floodplain access to aquatic fauna and provide nutrients and resources; inundate temporary wetlands for large scale bird and fish breeding events

Site	Climate scenarios	Dry[1]	Median[2]	Median/Wet[3]	Wet[4]
Lower Lakes, Coorong and the Murray Mouth	Priority watering actions	Flows Entitlement to 20,000 ML/day	Flows 20,000 to 45,000 ML/day	Flows 45,000 to 60,000 ML/day to enhance, extend or manage the recession of natural high flow events where feasible to increase and/or prolong the inundation of floodplains and wetlands[7]	Flows 60,000 to 80,000 ML/day to enhance, extend or manage the recession of natural high flow events where feasible to increase and/or prolong the inundation of floodplains and wetlands[7]
	Estimated vols.	1,209 GL	1,360 GL	1,129 GL	1,379 GL

1 Approximate annual inflow to the Murray 2,900 GL;
2 Approximate annual inflow to the Murray 4,200 GL;
3 Approximate annual inflow to the Murray 11,200 GL;
4 Approximate annual inflow to the Murray 18,100 GL
5 Mulcra volume is to cover losses; 40 GL is required to operate the structure and is likely to be met by system operating water
6 The needs of the River Murray Channel are likely to be met by flows passing through to the Lower Lakes, Coorong and Murray Mouth
7 These actions would be coordinated in conjunction with construction managers

4.3 ENVIRONMENTAL WORKS PROGRAM

An environmental works program is underway at a number of icon sites and is designed to facilitate the future delivery of environmental water. Flooding and high flows in the River Murray in the past two years have resulted in delays to the finalisation of some infrastructure works. Work is now scheduled for completion during 2012–13 at Mulcra, Koondrook–Perricoota Forest and Hattah Lakes. Construction will continue at Chowilla during 2012–13 and is expected to be completed in 2013–14.

During the construction phase of these projects, environmental watering actions may be constrained by the critical flows required to allow work to progress. If larger unregulated flow periods occur that interrupt work at these construction sites, there may be some opportunities to supplement these flows to provide environmental benefits, depending on the revised works schedule and forecasted future flows.

Once the works are completed, the structures will need to be commissioned in a controlled manner to test the functionality of the new structures and build an understanding of how the structures can deliver the best environmental outcomes to the floodplain. The commissioning of larger structures will be undertaken gradually over several years and will initially only use small volumes of water. The longer term environmental benefits provided by these works will be considered along with the ranking criteria as watering proposals are elevated for implementation in 2012–13.

4.4 PRIORITISATION OF PROPOSED WATERING ACTIONS 2012–13

In order to respond quickly to ensuing conditions and environmental water availability during the year, EWG has prioritised the proposed environmental water demands for each icon site across each of the River Murray inflow scenarios. This prioritisation is based on the ranking criteria outlined in Table 5 but does not yet include the cost criteria. Costs will be assessed throughout the year as proposed watering actions are elevated for implementation. These are only indicative rankings and may be amended during 2012–13 depending on actual flow conditions and other factors such as costs. A summary of the prioritisation results is presented in Table 8, with further detail relating to each individual icon site provided in Appendix C.

To further understand how the initial prioritisation of watering proposals for the 2012–13 year has been applied to the proposed watering actions, a description of each icon site has been compiled below. This description provides the context for the prioritisation by outlining how antecedent conditions, inflow scenarios, key risks and the construction program for environmental works have influenced the demands for environmental water for 2012-13 and the prioritisation of the proposed watering actions.

Table 8 Priorities for icon site watering 2012–13

Icon site		Inflow scenario			
		Dry	Median	Median/ wet	Wet
Barmah–Millewa Forest	Barmah–Millewa Forest	No water requested	Medium	Medium	Medium
	Boals Deadwood Trial (Barmah Forest)	Low	Low	Low	Low
Gunbower–Koondrook–Perricoota Forests	Gunbower Forest	Medium	Medium	Medium	High
	Gunbower Creek	Low	Low	Medium	High
	Koondrook–Perricoota	Medium	Medium	Medium	Medium
Hattah Lakes	Majority of lakes including Lake Bitterang and Lake Kramen	High	High	High	High
Chowilla–Lindsay–Wallpolla	Lake Wallawalla	No water requested	No water requested	Low	Low
	Mulcra Island	Medium	Medium	Medium	Medium
	Brandy Bottle wetland, Chowilla	High	High	High	Naturally inundated
River Murray Channel icon site (SA)		High	High	High	Medium
Lower Lakes and Murray Mouth		High	High	High	High

Barmah–Millewa Forest

After approximately 10 years of drought, high inflows in the River Murray system resulted in extended inundation through the Barmah–Millewa Forest in both 2010–11 and 2011–12. Environmental water delivered to this icon site during this period has sought to maintain minimum water levels between flood peaks to ensure birds could complete their breeding cycle. However, the extended high inflows in the Barmah–Millewa Forest have, in some cases, resulted in unseasonal inundation of some vegetation types. In order to ensure the site maintains a balance of drying and wetting phases, the preferred option in 2012–13 is to exclude water from the site and allow the icon site to complete a drying phase.

Under drier conditions, we would expect to be managing similar to the dry to median planning scenarios, where water is expected to remain within the River Murray channel. This would allow the site to commence drying, hence an allocation is not requested in dry conditions. In wetter conditions, some late winter, early spring floods are expected to occur, resulting in above channel flows and natural inundation of the floodplain. Under these wetter conditions, the objective is to manipulate flood peaks to target vegetation higher in the floodplain, such as red gum and blackbox and to provide pulses for fish breeding. If a large-scale waterbird breeding event does occur as a result of unregulated flows, environmental flows will be

targeted where possible to allow for successful breeding (typically lower-lying wetlands areas), then drying the forest as soon as practical.

Overall priority for watering actions under the median to wetter inflow scenarios is medium due to the likely benefit of watering vegetation communities higher in the floodplain which is not inundated regularly.

An experiment to investigate the relationship between vegetation types and waterbird breeding is proposed for Boals Deadwood, a wetland within Barmah Forest. This experiment requires a relatively small volume of water and will be possible to undertake under all proposed climate scenarios. This is ranked low due to the experimental nature of the proposed watering and the uncertain nature of the outcome.

Gunbower–Koondrook–Perricoota Forests

Dry climatic conditions prior to the flooding of 2010–11 meant that only small, critical habitat areas within Gunbower Forest had been watered for a significant period. Major overbank flooding during 2010 and 2011 initiated widespread recovery processes in wetland ecosystems and red gum forests. Proposed water actions for 2012–13 will build on these natural flooding activities and target key components of the forest to support recovery processes. Regulator upgrades to increase efficient use of water in the Gunbower Forest Lower Landscape area were completed early in 2012 and the proposed watering actions for 2012–13 will provide the first opportunity to commission and test these upgraded structures.

Under dry conditions, we would expect to be managing similar to the dry scenarios, with small volumes of water being targeted at the permanent and semi-permanent wetlands with the forest, topping up levels from previous flooding. If conditions become wetter the aim will be to open regulators to increase the connectivity throughout the forest, similar to the median to wet scenarios, thereby providing benefits to vegetation and increasing fish habitat. If flows reach the higher floodplains, environmental benefits are likely to be more extensive which is reflected in the ranking of this proposed watering action.

Similarly, conditions within Koondrook–Perricoota Forest were extremely dry for the 10 years prior to the 2010 flooding. Extensive flooding in 2010 and 2011 triggered a recovery process that benefitted the wetlands and significant vegetation communities within the forest. In order to complete the construction of works at Koondrook, it is planned to keep the site dry, if possible, until autumn 2013. The proposed watering action for Koondrook–Perricoota is aimed at further supporting the recovery process for semi-permanent wetlands and red gum communities that commenced with the recent natural flood events and to prime the site for further watering in spring 2013–14.

An integral component of the Koondrook–Perricoota watering for 2012–13 will be the commissioning and testing of the new structures associated with the Flood Enhancement Works. The commissioning process will be staged over several years and will begin with a relatively small watering to test operation of the new structures in all inflow scenarios. This proposed watering action is ranked as medium as it seeks to provide predominantly in channel benefits, plus some watering of vegetation and wetlands. The risk of blackwater will need to be mitigated by planning any event for a cooler period.

Hattah Lakes

The completion of a large-scale structural works program at Hattah Lakes early in the 2012–13 will allow for widespread environmental watering of the site in future years. During the extended drought of 2000–10, individual wetlands sites within the Hattah Lakes were only watered intermittently.

Flooding in spring and summer 2010–11 that resulted in overbank flows provided connectivity between the Murray and the lakes and surrounding floodplain, with the majority of the major wetlands still holding water during 2011–12. The proposed watering action for the 2012–13 year will provide water to many of the lakes, including Lake Bitterang, an important wetland due to its blackbox/red gum vegetation communities that has not been watered for 19 years.

In order to allow for commissioning and testing of the new infrastructure, the proposed watering action remains the same in terms of volume and targeted asset, irrespective of the inflow scenario. This proposed watering action is considered high ranking as it will consolidate on the benefits provided by widespread natural flooding over the past two years to the icon site as well as provide water to Lake Bitterang which has not been watered for a significant period.

Chowilla–Lindsay–Wallpolla

During the drought, environmental water was pumped to a small number of key wetlands on the Chowilla floodplain. Natural flooding in 2011 and 2012 inundated many key wetland sites on the Chowilla floodplain, resulting in widespread environmental benefits. Currently construction of large-scale works at Chowilla is underway and due for completion in 2013–14. In order to keep the site dry during the construction period, there are no proposed large watering actions and the coffer dam has been extended to enable construction to continue at flows of up 45,000 megalitres (ML) per day entering the site. The need to maintain a dry construction site at Chowilla will impact on the flow levels that can be delivered to the River Murray Channel and the Lower Lakes, Coorong and Murray Mouth icon site.

The only proposed watering action for Chowilla in 2012–13 is to pump a small volume of water to Brandy Bottle Wetland, a significant wetland which did not get inundated naturally during the 2012 high flows. This wetland has also been artificially flooded in 2005, 2006 and 2009 and further water is required to consolidate the environmental benefits achieved by previous watering actions. Since this proposed watering action requires pumping, the watering proposal does not vary with the exception of the wet scenario where the site is likely to be naturally inundated. The overall ranking is high as there is a significant risk that tree condition will deteriorate and seedlings may die without further watering in 2012–13.

Lake Wallawalla, a wetland within the Lindsay Island site, was dry from 2001 until the floods of 2010. This wetland was also inundated during the floods in early 2012. Under drier conditions the preference is to allow the site to commence a drying phase to control the large resident carp population that is currently damaging the aquatic vegetation. Under the wetter scenarios, it will not be possible to prevent water entering the wetland and a top up action is recommended to provide water to vegetation surrounding the wetland. If filled, it is intended to trial some attractant flows with the aim of eradicating carp from the wetland. The ranking for this small-scale watering action in the wetter planning scenarios is low as although it will provide benefits to vegetation, there is uncertainty associated with the carp removal trial

Environmental watering at Mulcra Island is proposed to provide benefits to wetlands and riparian areas. Some watering has occurred at Mulcra Island since 2004, with natural inundation occurring in 2010–11 and 2011–12. Important structural works will be undertaken during summer 2012–13 at Mulcra and therefore it is planned to keep the site dry until autumn 2013. In autumn this proposed watering action provides the opportunity to commission and test the new structures as well as wetting up the site in preparation for more extensive flooding in spring 2013. This proposed watering action will provide watering to aquatic and riparian vegetation communities. It is ranked medium as the vegetation benefits will be limited to a relatively small area within the Chowilla Floodplain, Lindsay–Wallpolla icon site.

Murray River Channel icon site

The environmental water demands for the River Murray Channel icon site are currently under review. Specific targets have been identified by South Australia in 2012–13 for the Murray River Channel icon site that aim to provide riparian and wetland benefits, lateral and longitudinal connectivity between the river channel and floodplain as well as deliver flows that will benefit the Lower Murray, Coorong and Murray Mouth. Other environmental demands for the River Murray Channel icon site will be assessed throughout the year, if required.

During the drought period the number of small to medium flow events in the River Murray Channel decreased significantly As a result there was widespread decline in long-lived vegetation and lack of recruitment events. Major overbank flooding during late summer 2010 and unseasonal high flows in autumn 2012 have commenced the recovery process but further inundation is required to build on this recovery process.

Under the drier scenarios, the objective is to provide variable flow regimes that will, stimulate fish recruitment and inundate low elevation wetlands to improve the condition of vegetation. In the wetter scenarios the aim is inundate a mosaic of temporary wetland and floodplain habitats that would facilitate large-scale bird and fish breeding events and improve the condition of river red gum woodlands and forests and lignum shrub land.

This watering proposal is ranked high under the dry to median-wet scenarios as it will provide significant vegetation benefits to lower lying temporary wetlands. However in the wetter scenarios there could be a risk of flooding if higher flow targets were reached that has reduced the ranking to medium. This risk would be carefully managed through communications with any parties affected by the flow levels.

Lower Lakes, Coorong and Murray Mouth

During the drought, environmental water was prioritised for the Lower Lakes, Coorong and Murray Mouth icon site to maintain water levels in Lakes Alexandrina and Albert above acidification thresholds. Small volumes of TLM environmental water were also delivered to key fringing wetland habitats via pumping for the protection of threatened species including Murray hardyhead and southern pygmy perch. However significant inflows in the past two years resulted in the re-opening of the barrages and fishways in September 2010, and since this time there has been continuous flow and connectivity between Lake Alexandrina and the Coorong estuary. These inflows have been sufficient to maintain an open Murray Mouth without the dredging program since December 2010 as well as reduce salinity levels in the lakes.

The 2012–13 proposed watering action for the Lower Lakes, Coorong and Murray Mouth icon site is closely linked to the provision of environmental water for the River Murray channel. This proposal aims to deliver environmental water through the barrages through late spring, summer and early autumn in order to maintain an open Murray Mouth, continue connectivity between the lakes and estuary, and to ensure optimal salinity levels in the Lower Lakes and Coorong. The watering proposal also aims to maintain water levels in the Coorong, South Lagoon between 0.0–0.2 m AHD to facilitate the growth and reproduction of *Ruppia tuberosa*, a keystone species which has failed to recruit over the last few years.

Regardless of water availability scenario, large volumes of environmental water are required (in conjunction with unregulated flow, additional dilution flows and entitlement flow) to deliver the preferred barrage release profile over the year and to achieve the desired environmental outcomes.

This proposed watering action is ranked high as it is likely to provide system-wide environmental benefits including large-scale fish and bird breeding events in the wetter scenarios. It would also reduce environmental risks associated with salinity and acidification, and to continue the process of recovery following drought. However in wetter scenarios, there is a risk that high natural inflows could prevent lake levels dropping significantly enough to allow wading birds to forage for food on the lake edge and similarly in the Coorong.

5. ENVIRONMENTAL MONITORING FOR THE LIVING MURRAY

Monitoring and evaluating the achievement of the ecological objectives is part of The Living Murray Business Plan. A monitoring framework titled the Outcomes Evaluation Framework has guided the development of monitoring arrangements and outlines the types of monitoring necessary to monitor progress toward the ecological objectives of TLM. The types of monitoring undertaken are River Murray system-scale monitoring, condition monitoring, intervention monitoring, compliance monitoring and knowledge generation.

The Living Murray Environmental Monitoring Program also coordinates with other MDBA programs including the Sustainable Rivers Audit, Native Fish Strategy and Natural Resources Information, to provide a coordinated approach to monitoring across the Murray–Darling Basin.

Monitoring is used to inform environmental watering decisions to optimise approaches to achieving positive ecological outcomes at the icon sites and thereby benefit the entire River Murray system.

Reporting this year will occur at a number of levels to provide information for partners and stakeholders. These are:

- targeted individual projects reported as contracts are concluded
- an annual icon site synthesis which pulls all of the information together to continually build a body of knowledge for that site. This will be done in time to inform the Annual Environmental Watering Plan, typically by March 2013
- River Murray program report that integrates monitoring at all levels to develop a picture of River Murray system health. This will be completed by June 2013.

A brief description of the types of monitoring undertaken are provided below.

5.1 RIVER MURRAY SYSTEM-SCALE MONITORING

Monitoring at the River Murray system-scale is designed to determine if the health of the River Murray system improves following implementation of the First Step Decision and its focus on the six icon sites. The current River Murray system-scale projects are:

- The Annual Aerial Waterbird Survey of The Living Murray icon sites will be conducted in October – November 2012. The survey will be linked to the Eastern Australia Aerial Waterbird Survey so that geographical context is incorporated. The survey will also be conducted in cooperation with the onground waterbird surveys conducted as part of icon site condition monitoring to ensure cryptic species, not easily identified by the aerial survey, are also assessed.
- A red gum and black box stand condition assessment has been implemented using remote sensing approaches to allow reporting annually on stand condition.

5.2 ICON SITE CONDITION MONITORING

Icon site condition monitoring will determine change in the environmental condition of individual icon sites resulting from water application and implementation of works programs under The Living Murray. Icon site condition monitoring will be used to determine if the objectives for each icon site (as articulated in the site condition monitoring plan) are being met.

Monitoring and evaluation at the icon site–scale is surveillance in type and typically undertaken annually fish, bird and vegetation communities. A core set of consistent approaches to monitoring condition has been developed and applied across the icon sites. These approaches include linkages to the system assessments identified in the system monitoring section. For example, the river red gum and black box on-ground condition assessment will provide key support to the red gum and black box stand condition remote sensing assessments.

5.3 INTERVENTION MONITORING

Intervention monitoring assesses the ecological response to types of interventions or environmental management actions implemented under The Living Murray. In doing so, it provides the major link to understanding how the ecological responses to specific environmental management actions result in changes at icon sites. It also provides the foundation information for adopting an adaptive-management approach to implementing The Living Murray.

During 2012–13, intervention monitoring will be focused around three broad areas.

- .onitoring the impacts of fishways and re-snagging on fish populations throughout the River Murray
- monitoring the direct impacts of watering events at icon sites in relation to the event watering objectives and the management of risks
- addressing key information gaps on the response of vegetation, birds, habitat and fish recruitment to watering and works interventions

Event monitoring has become important in managing the implementation of environmental watering activities to inform real-time decision making in relation to achieving ecological outcomes and, quantifying and minimising risks. This monitoring is focused on the specific objectives and risks of an environmental watering event and is targeted in both temporal and spatial scales.

Compliance monitoring includes the measurement of the volume of water used at icon sites and the timing, volume and quality of any return flows and is needed to account and report for the use and management of environmental water at the icon sites.

The Living Murray Environmental Watering Group (EWG) considers proposals from Icon Site Managers and makes judgments about monitoring activities to be funded prior to the start of each financial year. Considerations include:

- The Living Murray works and measures coming on-line that year and the associated specific information needs for adaptive management, such as water measurement, risks and ecological response
- monitoring around specific planned watering events to inform knowledge gaps and document outcomes from watering
- knowledge generated from previous monitoring projects that may be extrapolated to future waterings
- long-term agreed priorities (for example fishways monitoring)

6. REPORTING ON THE LIVING MURRAY ENVIRONMENTAL WATERING

The Living Murray Business Plan requires a consistent and structured approach to identifying, measuring, recording and reporting information to assist report users to make and evaluate decisions about the availability, use and allocation of recovered water in a transparent and accountable manner.

The Living Murray environmental management is reported to the Murray–Darling Basin Ministerial Council annually, consistent with The Living Murray Business Plan. Information reported includes the timing and use of water, volume of water committed from The Living Murray portfolio for watering actions and management actions relating to environmental management and use.

The reporting on TLM management of environmental watering will be outlined in The Living Murray annual implementation report, which is subject to an annual independent audit. Synthesised information on TLM management will also be provided in The Living Murray annual environmental report and the Murray–Darling Basin Authority annual report. The timeframes for these reports vary, but will be completed within six months of the new water year.

At the end of the season, the multi-site watering trial will be reviewed by the Independent River Operations Review Group. The outcomes of the review will be reported to MDBA and environmental water holders by December 2013 and will then be used to inform future large-scale watering events.

All watering actions undertaken during the 2012–13 year will be reported in the annual watering report.

7. COMMUNICATION AND CONSULTATION

The Living Murray communication and consultation strategy provides staff with a framework for implementing a coordinated, consistent approach to communicating the achievements, progress and future direction of The Living Murray across all jurisdictions.

During 2012–13 The Living Murray communication and consultation program will continue to promote the use of The Living Murray water portfolio, and the results of environmental monitoring, through media and communication products. Key messages and communication strategies will take into account the construction of environmental works, as well as the Basin Plan.

The program will also continue to engage with stakeholders through the icon site reference groups. These groups provide opportunities to seek input from community members as well as to inform them about the use of The Living Murray water and the results of monitoring.

APPENDIX A LOCATION OF THE LIVING MURRAY ENTITLEMENT PORTFOLIO

Location	Entitlement volume (GL)
Regulated water entitlements	
NSW Murray Valley High Security	1.4
NSW Murray Valley General Security	83.0
NSW Murrumbidgee Valley General Security	81.9
NSW Lower Darling High Security	0.5
NSW Lower Darling General Security	47.8
Victoria Murray Valley High Reliability	18.0
Victoria Murray Valley Low Reliability	101.8
Victoria Goulburn Valley High Reliability	45.2
Victoria Goulburn Valley Low Reliability	157.0
Victoria Campaspe High Reliability	0.1
Victoria Campaspe Low Reliability	5.0
South Australia Murray Valley	44.9
SUB-TOTAL	**586.6**
Unregulated/Supplementary water entitlements	
NSW Murray Supplementary	100.0
NSW Lower Darling Supplementary	250.0
NSW Unregulated (Poon Boon)	13.0
Victoria Unregulated	34.3
SUB-TOTAL	**397.3**
TOTAL	**983.9**

APPENDIX B METHODOLOGY FOR APPLYING RANKING CRITERIA

The ranking of watering proposals by EWG provides a basis and starting point for discussions on the prioritisation of watering proposals by EWG members and does not constitute the final decision on which proposals will be recommended for implementation. 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. Amount of environmental benefit for the volume of water

high	• contribution to key site values and/or TLM 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	• able to contribute partially (approximately half) to key site values and/or to TLM 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	• minor contribution to key site values and/or TLM site management objectives • outcomes at localised scale • will require follow up watering within short term (eg. 3-6 months) in order to sustain outcomes

2. Risk of not applying water

high	• 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	• 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	• 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 discernable 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. Cost

low	• Total delivery costs* 0–$30/ML
medium	• Total delivery costs $30–$60/ML
high	• Total delivery costs >$60/ML

*this includes all delivery costs such as pumping charges, infrastructure costs (eg levee banks) and irrigation channel fees

APPENDIX C PRIORITISATION OF WATERING PROPOSALS

		Dry inflow scenario					Median inflow scenario					Median/Wet inflow scenario					Wet inflow scenario				
		Amount of benefit for volume of water	Risk of not applying water	Certainty/likelihood of benefit	Risks associated with watering	Overall ranking	Amount of benefit for volume of water	Risk of not applying water	Certainty/likelihood of benefit	Risks associated with watering	Overall ranking	Amount of benefit for volume of water	Risk of not applying water	Certainty/likelihood of benefit	Risks associated with watering	Overall ranking	Amount of benefit for volume of water	Risk of not applying water	Certainty/likelihood of benefit	Risks associated with watering	Overall ranking
Barmah–Millewa Forest	Barmah Forest	Dry phase recommended									MED					MED					MED
	Boals Deadwood Trial (Barmah)					LOW					LOW					LOW					LOW
Gunbower–Koondrook–Perricoota Forests	Gunbower Forest					MED					MED					MED					HIGH
	Gunbower Creek					LOW					LOW					MED					HIGH
	Koondrook–Perricoota					MED					MED					MED					MED
Hattah Lakes	Lake Bitterang Lake Kramen					HIGH					HIGH					HIGH					HIGH

		Dry inflow scenario					Median inflow scenario					Median/Wet inflow scenario					Wet inflow scenario				
		Amount of benefit for volume of water	Risk of not applying water	Certainty/likelihood of benefit	Risks associated with watering	Overall ranking	Amount of benefit for volume of water	Risk of not applying water	Certainty/likelihood of benefit	Risks associated with watering	Overall ranking	Amount of benefit for volume of water	Risk of not applying water	Certainty/likelihood of benefit	Risks associated with watering	Overall ranking	Amount of benefit for volume of water	Risk of not applying water	Certainty/likelihood of benefit	Risks associated with watering	Overall ranking
Chowilla–Lindsay–Wallpolla	Lindsay Island – Lake Wallawalla	Dry phase recommended					Dry phase recommended					[red]	[red]	[yellow]	[yellow]	LOW	[red]	[red]	[yellow]	[yellow]	LOW
	Mulcra Island	[yellow]	[red]	[yellow]	[green]	MED	[yellow]	[red]	[yellow]	[green]	MED	[yellow]	[red]	[yellow]	[green]	MED	[yellow]	[red]	[yellow]	[green]	MED
	Chowilla – Brandy Bottle wetland	[red]	[yellow]	[green]	[green]	HIGH	[red]	[yellow]	[green]	[green]	HIGH	[red]	[yellow]	[green]	[green]	HIGH	Site expected to be naturally inundated				
River Murray Channel icon site (SA)		[yellow]	[yellow]	[pale yellow]	[green]	HIGH	[yellow]	[yellow]	[yellow]	[green]	HIGH	[green]	[yellow]	[yellow]	[yellow]	HIGH	[green]	[yellow]	[yellow]	[red]	MED
Lower Lakes, Coorong and Murray Mouth		[green]	[yellow]	[green]	[yellow]	HIGH	[green]	[yellow]	[green]	[yellow]	HIGH	[green]	[yellow]	[green]	[yellow]	HIGH	[green]	[yellow]	[green]	[yellow]	HIGH

KEY:
- [green] high priority
- [yellow] medium priority
- [red] low priority