Australian Government

MURRAY–DARLING BASIN AUTHORITY

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The Living Murray Annual Implementation Report 2011–12

and

Audit of The Living Murray Implementation 2011–12

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Cover Image: Cantala Regulator Hattah Lakes icon site, under construction in 2012 (photo by Heather Peachey)

About this document

This document consists of two reports:

- The Living Murray Annual Implementation Report 2011–12
- Audit of The Living Murray Implementation 2011–12.

The first report, *The Living Murray Annual Implementation Report 2011–12*, describes the activities and outcomes of The Living Murray for the 2011–12 financial year, in accordance with clause 199 of The Living Murray Business Plan. The report has been prepared by the Murray–Darling Basin Authority on behalf of The Living Murray partner governments for the Murray–Darling Basin Ministerial Council.

The second report, the *Audit of The Living Murray Implementation 2011–12*, describes the findings of the Independent River Operations Review Group arising from their audit of the implementation of The Living Murray in 2011–12. This report meets the requirements of clauses 200–204 of The Living Murray Business Plan.

Both reports have benefited from the cooperation and assistance of The Living Murray partner governments. Their effort and support in producing these reports is appreciated by both the Murray–Darling Basin Authority and the Independent River Operations Review Group

The information presented in these reports is current as at 30 June 2012.

MURRAY–DARLING BASIN AUTHORITY

The Living Murray
Annual Implementation Report 2011–12

The Hon. Tony Burke
Minister for Sustainability, Environment, Water, Population and Communities
PO Box 6022
House of Representatives
Parliament House
Canberra ACT 2600

Dear Minister

I have great pleasure in submitting to you The Living Murray Annual Implementation Report 2011–12.

The Living Murray was established in 2004 with the long-term goal of achieving a healthy working River Murray system for the benefit of all Australians, in response to evidence showing the declining health of the system.

This report has been produced as a requirement of clause 199 of The Living Murray Business Plan, and reports on the key activities and outcomes of The Living Murray in 2011–12. This report is broadly divided into two parts. Chapters 1 to 5 provide an overview of The Living Murray and describe the efforts of six major program areas that comprise The Living Murray Initiative, while chapters 6 to 12 describe The Living Murray activities and outcomes at each of the icon sites.

The report complements the Audit of The Living Murray Implementation 2011–12, the report of the Independent Audit Group, which has been appended to this report as a companion document.

The Murray–Darling Basin Authority acknowledges the cooperation and assistance received from The Living Murray partner governments in compiling this report.

Yours sincerely

Rhondda Dickson
Chief Executive

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Summary

The Living Murray is a program reaching maturity under remarkable circumstances.

The water recovery effort is almost complete, with managers now able to deploy close to the full complement of environmental water first planned under The Living Murray (TLM) in 2004. During 2011–12, 479.9 gigalitres were registered for annual use under the program, with another 7.1 gigalitres anticipated to be added in future years.

The maturation of the water recovery effort has coincided with two years of record or near-record rainfall and inflows creating unregulated[1] river flows and flooding. This has enormously enhanced the environmental recovery at The Living Murray's's six icon sites, even while creating some new challenges for The Living Murray's managers.

During the long years of the drought, The Living Murray's six icon sites were on life support. Even in 2009–10, at the end of the drought, only 65.7 gigalitres of TLM water could be delivered to the sites. Thoughts were of arresting decline, stabilisation and, eventually, a long slow recovery.

The flooding rains of the past two years have radically changed that perspective, with managers adapting rapidly to changing circumstances.

This past year, with nature leading the way on watering icon sites, managers decided not to deploy The Living Murray's full complement of environmental water, storing over 156.7 gigalitres so the benefits of the wet years can be consolidated, built upon and carried into future years.

The Living Murray managers capitalised on opportunities presented by unregulated river flows and natural flooding during the year. In both the Barmah–Millewa and Gunbower forests, initial natural flooding of the wetlands was maintained for several months using TLM water, thus ensuring the successful completion of significant bird breeding. The Living Murray water was released from the Goulburn and Campaspe systems to reinforce flows reaching down through the South Australian Murray to the Lower Lakes and the Coorong.

The Living Murray managers have used the wet conditions to again trial multi-site watering techniques and strategies, building upon the experience and knowledge gained from an initial trial conducted last year and preparing the way for a third trial in 2012–13.

The trials will generate better knowledge of how the river system works. Just as important, they test the interaction between various jurisdictions and holders of environmental water with the aim of improving co-operation, co-ordination and inter-operability. This will become increasingly important as the Commonwealth Environmental Water Holder and state authorities control more environmental water under the new Basin Plan.

It was expected that the environmental works and measures program would have been completed this year. Instead, widespread flooding delayed infrastructure works at some sites and damaged them at others. Works at; the Koondrook–Perricoota forest; the Chowilla floodplain; Lindsay and Mulcra islands; and Hattah Lakes were all affected, as was work on the fishways, that facilitate fish passage along the main channel of the River Murray, from Sea to Hume. These works are now planned for completion by 2013–14, weather and river conditions permitting.

But whatever the delays and damage caused by flooding, they were overshadowed by the environmental benefits accrued at all icon sites.

The forests, wetlands and floodplains of Barmah–Millewa; Gunbower–Koondrook–Perricoota; Chowilla Floodplain and Mulcra, Lindsay and Wallpolla islands have all experienced extensive watering, both natural and contrived. Creeks, billabongs and lagoons have been reconnected to the main channel of the river. The health of river red gum (*Eucalyptus camaldulensis)* and box forests has rebounded, there has been significant bird breeding and fish movement and the most obvious effects of the long drought are being erased.

The environment of the main channel of the River Murray again benefited from greater river flows, both in-stream and overbank, with connections between the river and surrounding floodplain re-established. At the Lower Lakes, Coorong and the Murray Mouth, fresh water flowed continually across the barrages into the Coorong all year. The ecology of the lakes continues to improve, with salinity levels falling and marine, bird and plant life starting to rebound.

1 Unregulated flows are the component of the flow that is in excess of the immediate needs for downstream water users and the capacity of any downstream storage to re-negotiate the flow to meet a subsequent water user need (MDBA River Murray Operations Reference Manual).

The Living Murray program is now moving into an important new phase. The water recovery program is almost complete, the works and measures program is coming to an end and the six icon sites have all benefited from the increased water of the past two years.

The challenge for The Living Murray is clear: to consolidate and build upon the good fortune of these past two years to ensure that by the time the next drought arrives the icon sites are healthy and resilient and, if the drought continues, the water recovered, the works and measures constructed, and the technical expertise accrued, are all available to protect and nourish the ecosystems of the icon sites.

The Living Murray has reached the stage where the protection and health of the six icon sites has been put on a sustainable basis.

About this report

This report was prepared by the Murray–Darling Basin Authority on behalf of The Living Murray partner governments.

Part 1 of the report provides an overview of programs, progress and outcomes under The Living Murray as a whole. Part 2 reports on activities and outcomes at each icon site.

1 Overview of The Living Murray

The Living Murray is a partnership of the Commonwealth, New South Wales, Victorian, South Australian and ACT governments. To date, The Living Murray partner governments have collectively committed nearly $1 billion towards the initiative.

The Living Murray program targets six icon sites for environmental restoration (see figure 1.1), including the main channel of the River Murray itself. These sites were chosen for their significant ecological, cultural, recreational, heritage and economic values. The icon sites are:

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

Interim ecological objectives were set for each site at the beginning of the program. These objectives have evolved as environmental water management plans have been refined. The current objectives are outlined in the relevant icon site chapters.

Figure 1.1 Location of The Living Murray icon sites

1.1 Water recovery and infrastructure

In 2004, The Living Murray partner governments pledged $700 million to recover an average of 500 gigalitres (GL) of water per year to improve environmental outcomes at the six icon sites.

The investment and water recovery targets for The Living Murray were distributed across the jurisdictions as shown in table 1.1.

Volumes are estimated using long-term Cap equivalents (LTCEs). Long-term Cap equivalents give a more comparable estimate of the amount of water to be returned to the environment than the nominal amount stated on water licences. The water recovery program has now been largely completed with 479.9 GL of the 500 GL target recovered by 30 June 2012. The only listing of recovered water in 2011–12, arose from an additional contribution of water from South Australia. Of the 18 approved water recovery measures, 16 had been finalised with the two outstanding measures expected to deliver an additional 7.1 GL. These measures are shown in table 1.2.

Table 1.1 The Living Murray indicative investment and water recovery targets by jurisdiction

Jurisdiction	Indicative investment target ($ million)	Actual investment at 30 June 2012 ($ million)	Indicative water recovery target (GL LTCE)	Water recovered at 30 June 2012 (GL LTCE)
New South Wales	115.0	113.1	249.0	217.9
Victoria	115.0	114.8	214.0	219.5
South Australia	65.0	67.9	35.0	42.5
ACT	5.0	0.0	2.0	0.0
Australian Government (SEWPaC)[2]	200.0	199.6	-	-
Australian Government (MDBA)	200.0	200.0	-	-
TOTAL	**$700.0**	**$695.4**	**500.0**	**479.9**

2 Water recovered by the Australian Government (SEWPaC and MDBA) is apportioned across state targets according to the source of water recovery on completion of the measure.

Table 1.2 Measures yet to be finally listed

Measure title	Proponent	Measure type	Est. volume of recovery remaining (GL LTCE)	Type of entitlement being recovered
NSW package B *(Application made under Clause 36 of IGA)*	NSW	Infrastructure	7.1	NSW high, general and supplementary security and VIC entitlements
Lake Mokoan water recovery package	VIC	Infrastructure	0.0[3]	VIC unregulated flow entitlements
TOTAL			**7.1 GL**	

3 Water has been recovered but has not been final listed.

Table 1.3 Volumes listed on The Living Murray Central Register

Date	Environmental Water Register (GL LTCE)
30 June 2008	133.0
30 June 2009	342.5
30 June 2010	472.1
30 June 2011	478.9
30 June 2012	479.9
Final projected volume	487.0

The final volume of water that will be recovered once all measures are complete is estimated to be approximately 487 GL (LTCE), or 97% of the original 500 GL (LTCE) target. Several factors have limited the volume recovered including changes in the market price of water, changes to water market rules and changes to project budgets.

In addition to the $700 million earmarked to recover water, $318,410,000 (covering the period 2003–2014) has been allocated for designing and building infrastructure works and measures at icon sites.

These works will enhance the environmental benefits from the use of recovered water at the sites. Flooding and higher-than-average flows during the past two years have delayed the completion of some of these works. Further information is provided in section 4 and in Part 2.

1.2 The Living Murray governance and management

The Living Murray is managed collaboratively by partner governments. The Living Murray Initiative was formalised in 2004 under an agreement[4] signed by The Living Murray partner governments. A supplementary agreement[5] was signed in 2006 providing increased funding of $200 million. A third agreement[6] was signed in June 2009 outlining the arrangements for the control, management and use of water entitlements held under The Living Murray. These agreements provide the governance framework for how jurisdictions invest in and implement The Living Murray program. These intergovernmental agreements are complemented by The Living Murray Business Plan. The Business Plan provides the operational policies that guide the implementation of The Living Murray. The completion of The Living Murray water recovery will trigger the requirement to review the three Intergovernmental agreements and The Living Murray Business Plan.

Several groups have a role in implementing The Living Murray: the Murray–Darling Basin Ministerial Council, Basin Officials Committee, The Living Murray Committee, the Environmental Watering Group and the Operational Advisory Group.

The Murray–Darling Basin Ministerial Council comprises the Commonwealth Water Minister and the minister responsible for water from each participating state and territory government. The Ministerial Council approves intergovernmental agreements, the Business Plan, environment water management plans and makes other key decisions.

The Basin Officials Committee comprises Chief Executives from partner government water agencies. Its responsibilities include exercising high level decision making in relation to river operations. Deviations from historical river practice are referred to the Basin Officials Committee to ensure there are no unacceptable third party impacts.

The Murray–Darling Basin Authority, under the Water Act, is responsible for managing water access rights, water delivery rights, irrigation rights and held water in a way that gives effect to The Living Murray Initiative. This responsibility is delegated to the Executive Director of the Environmental Water Division who takes advice from The Living Murray Committee (TLMC) and Environmental Water Group (EWG). Decisions on advice at The Living Murray Committee and the Environmental Water Group have historically been by consensus.

The Living Murray Committee comprises senior officials from each of the partner governments. It is responsible for advising the Chief Executive of the Murray–Darling Basin Authority in relation to The Living Murray and the Business Plan.

The Environmental Watering Group comprises officers from each of the partner governments. It is responsible for developing environmental water plans and priorities and provides advice to the Executive Director of the Environmental Management Division (as a delegate of the Murray–Darling Basin Authority) on the use of The Living Murray portfolio.

The Operational Advisory Group (OAG) comprises river operators, environmental water holders, site and river managers. The Operational Advisory Group provides technical advice to the Murray–Darling Basin Authority River Murray Operations and other relevant state water authorities on the implementation of environmental water actions within the southern connected basin (i.e. Murray, Lower Darling, Goulburn and Murrumbidgee Valleys), at the relevant geographical scale of a watering event. The aim of an operational advisory group is to improve operational co-ordination for environmental water actions, by providing a forum for the sharing of operational information and environmental observations between all environmental water holders, site managers and river managers. The OAG enables operations to be appropriately adjusted as conditions change and helps ensure successful outcomes of water delivery actions. Water delivery actions will focus on the delivery of The Living Murray environmental water, but may also include the delivery of water from other environmental water holders if requested.

Program management and delivery at the icon sites is undertaken by state and local agencies. Cross-border sites are jointly managed.

The Living Murray program is subject to an annual independent audit. The 2011–12 audit has been conducted by the Independent River Operations Review Group. The audit report has been appended to this report as a companion document.

4 Available online at: www.coag.gov.au/coag_meeting_outcomes/2004-06-25/docs/iga_water_overallocation_murray_darling.pdf
5 Available online at: www.coag.gov.au/coag_meeting_outcomes/2006-07-14/docs/supplementary_agreement_mdbasin.pdf
6 Formally known as the *Further Agreement on Addressing Water Overallocation and Achieving Environmental Objectives in the Murray-Darling Basin – Control and Management of Living Murray Assets*

2 Environmental watering

2.1 The Living Murray planning framework

Environmental water management plans have been agreed by Ministerial Council for Barmah–Millewa Forest, Gunbower Forest, Koondrook–Perricoota Forest, Hattah Lakes, Lindsay–Wallpolla Islands and Chowilla Floodplain. The environmental water management plan for the Lower lakes, Coorong and Murray Mouth has been developed and will be tabled before Ministerial Council in 2012. The River Murray icon site environmental water management plan is still under development.

Icon site environmental water management plans consist of:

1. a long-term strategic plan outlining the icon site's environmental water requirements and how to achieve them with a combination of environmental water and works and measures
2. schedules detailing operational information about the icon site such as operating, condition monitoring, risk management and communication plans.

The Living Murray Annual Environmental Watering Plan applies ranking criteria to environmental water actions under a range of water resource scenarios. Annual priorities are consistent with the ecological objectives for each icon site outlined in the environmental water management plans.

2.2 Water availability

Antecedent conditions

The Murray–Darling Basin was affected by a severe drought between 2000–01 and 2009–10. In 2010–11 there was significant rainfall resulting in good inflows and natural flooding across the Murray–Darling Basin. At the beginning of the 2011–12 water year storage levels were high in the Murray, Goulburn and Murrumbidgee river systems.

Inflows 2011–12

The early part of the 2011–12 water year began with below average rainfall, although wet catchments from the previous season meant inflows remained above average for the winter 2011 period. Rainfall was either average or below average between May and the end of October 2011 in the southern Basin and in the upper Murray catchment, where the majority of inflows are generated. As the below average rainfall persisted into September and October, and catchments dried, inflows were reduced accordingly, see figure 2.1.

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 inflows into the Menindee Lakes from January 2012.

The Bureau of Meteorology considered rainfall across the southern Basin and in the upper Murray catchment from the start of the calendar year to the end of March 2012 as 'very much above average.' March was exceptionally wet, resulting in widespread flooding in many catchments such as the Murrumbidgee River.

River Murray system inflows in the south of the Basin for the year were approximately 11,700 GL which is good follow on from high inflows of 2010–11 of 17,700 and higher than the long-term average of 9,300 GL. River Murray System inflows during March 2012 were approximately 2,200 GL; the highest ever recorded for the month, more than doubling the record set in March 2011 of about 1,000 GL.

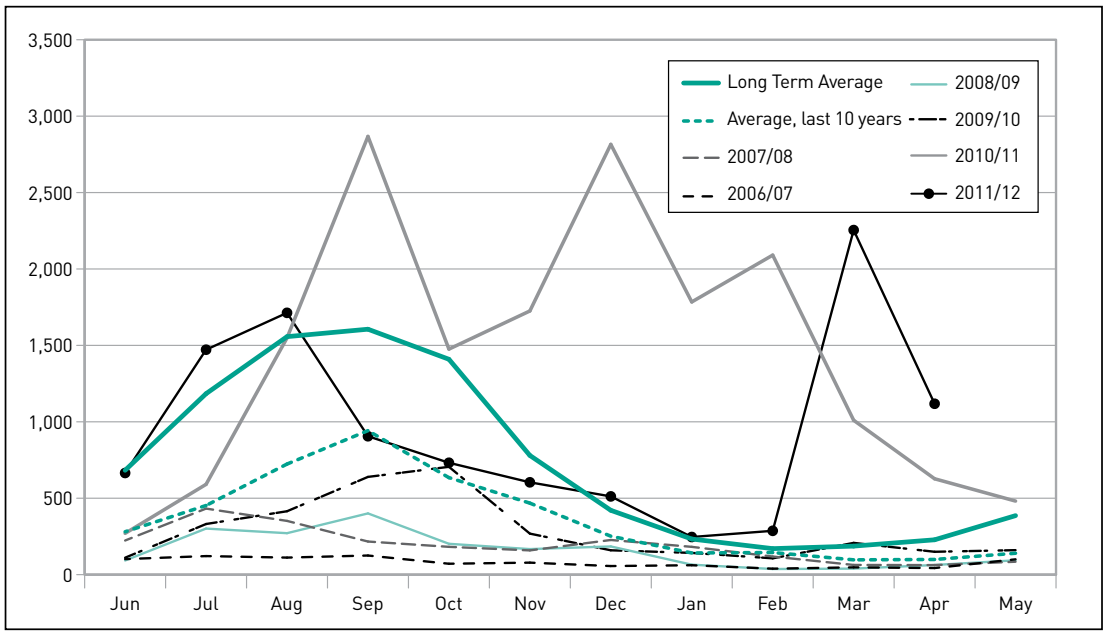

Figure 2.1 River Murray system monthly inflows

The first half of the 2011–12 year tracked closely to the median scenario. High inflows during the second half of 2011–12 year tracked closely to wet and very wet scenarios. Peak flows into South Australia from the combined Murray and Darling floods reached around 60,000 ML a day in April 2012. Figure 2.2 shows the annual River Murray system inflows for 1891 to 2012.

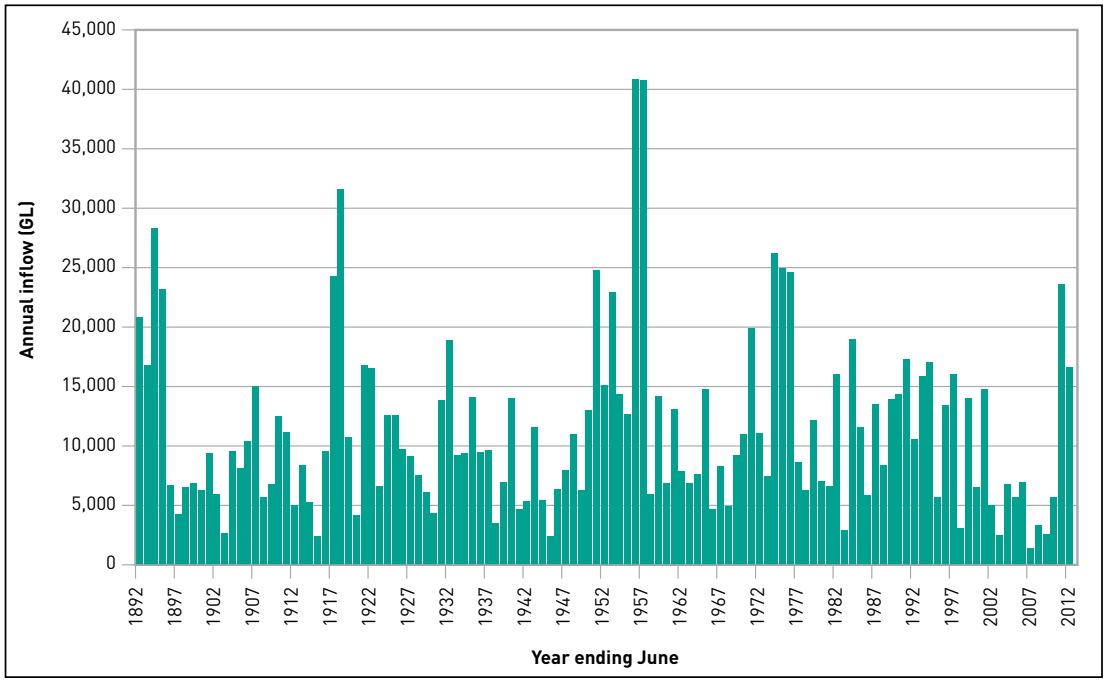

Figure 2.2 River Murray system inflows 1891 to 2012 (includes inflows to Menindee, excludes Snowy releases)

Storages

Storages in the Murray system were generally at relatively high levels throughout the 2011–12 season, resulting in good allocation levels. There were unregulated flows and spills from all storages throughout the year.

Total active storage for the Murray system at the end of June 2012 was 7,945 GL (93% of capacity). Hume Reservoir was at 95% capacity and reservoirs in the Goulburn and Murrumbidgee catchments were also close to full.

2.3 Environmental water accounts

Water available to the River Murray and The Living Murray icon sites for environmental watering under The Living Murray Annual Environmental Watering Plan includes:

- The Living Murray portfolio
- River Murray Unregulated Flows (RMUF)
- River Murray Increased Flows (RMIF).

Environmental water managed under The Living Murray environmental water planning framework is coordinated with the Barmah–Millewa Environmental Water Allocation (EWA) and water held by other environmental water holders; the Commonwealth Environmental Water Holder (CEWH), the Office of Environment and Heritage in NSW (OEH) and the Victorian Environmental Water Holder (VEWH).

The Living Murray and other indicative environmental water holders' that committed water for the River Murray are shown in table 2.1 and table 2.2. While the water reported in these tables show the source that the water is committed from, they do not show the return flows, where applicable, that also provide environmental benefit for the River Murray system.

Environmental water owned and managed by other environmental water holders (CEWH, OEH and VEWH) is outside The Living Murray environmental watering planning framework, and therefore not included in the audit of The Living Murray implementation.

Table 2.1 Environmental water volumes committed on the River Murray 2011–12 by location of environmental account. Information relating to CEWH, OEH and VEWH or other environmental water holders is unaudited and should be considered indicative only.

	TLM regulated water allocation	TLM unregulated water entitlement	EWA	CEWH	NSW OEH[7]	VEWH[8]	RMUF	Other	Total
Victoria Barmah–Millewa			139.8						**139.8**
NSW Barmah–Millewa			139.8						**139.8**
Murray NSW[9]	100.0			224.8[10]	15.0				**339.8**
Murray Victoria and Broken River	26.7	2.0		74.3		10.0			**113**
Goulburn	61.0			113.9					**174.9**
Campaspe	7.2			6.5					**13.7**
Murrumbidgee				88.5					**88.5**
Darling[11]									**0.0**
South Australia	44.9	32.3		69.4		61.6		0.3[8]	**208.5**
Unregulated flows						4.9	3.0		**7.9**
Total	**239.8**	**34.3**	**279.6**	**577.4**	**15.0**	**76.5**	**3.0**	**0.3**[12]	**1225.9**

7 This table does not include all NSW non-TLM water
8 This table does not include all Victorian non-TLM water
9 The Living Murray Environmental Water Register includes 100 GL (17.8 GL/yr LTCE recoverable at the Murray) of NSW Murray Supplementary Water Access entitlement
10 This figure includes water delivered to the Edward–Wakool river system
11 The Living Murray Environmental Water Register includes 250 GL (23.1 GL/yr LTCE recoverable at the Murray) of NSW Lower Darling Supplementary Water Access entitlement. The licence for this entitlement is conditioned to prevent allocation accruing to the licence from being ordered and for the water to remain in the water source during periods when supplementary access is declared. This water therefore contributes to River Murray Unregulated Flow events.
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Table 2.2 Environmental water volumes committed on the River Murray for 2011–12 by delivery site initially targeted. Information relating to CEWH, OEH and VEWH or other environmental water holders is unaudited and should be considered indicative only.

	TLM regulated water allocation	TLM unregulated water entitlement	EWA	CEWH	OEH	VEWH	RMUF	Other	Total
Barmah–Millewa Forest	120.0		279.6		15.0	10.0			**424.6**
Gunbower Forest	0.6								**0.6**
Gunbower Creek	6.1					4.9			**11.0**
Chowilla, Lindsay–Wallpolla	3.0	2.0					3.0		**8.0**
Lower Lakes, Coorong and Murray Mouth	110.1[13]	32.3		195.9		61.6			**399.9**
River Murray Channel				92.1					**92.1**
Edward–Wakool river system				55.4					**55.4**
Broken River				0.05					**0.05**
Campaspe River				6.5					**6.5**
Goulburn River				134.1					**134.1**
Lower Broken Creek				10.4					**10.4**
Lower Murrumbidgee Floodplain				17.8					**17.8**
Murrumbidgee River				65.2					**65.2**
Berri Evaporation Basin								0.3[14]	**0.3**
Total	**239.8**	**34.3**	**279.6**	**577.4**	**15.0**	**76.5**	**3.0**	**0.3**	**1225.9**

13 South Australia received 103.4 GL of this volume
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The Living Murray portfolio

Due to 2010–11 being a very wet year and the near completion of The Living Murray portfolio, a net carryover volume of 85.48 GL was brought forward from 2010–11.

Of the 365.96 GL of allocation received during the year, 274.06 GL of environmental water was used for environmental delivery to icon sites and156.69 GL of The Living Murray portfolio was carried over into 2012–13.

It should be noted that The Living Murray Environmental Water Register includes 250 GL (23.1 GL/Yr LTCE recoverable at the Murray) of Lower Darling Supplementary Water Access entitlement. The licence for this entitlement is conditioned to prevent allocation accruing to the licence from being ordered and for the water to remain in the water source during periods when supplementary access is declared. During these periods, this water contributes to River Murray Unregulated Flow events.

Table 2.3 The Living Murray annual water portfolio 2011–12

	Total allocation (GL)	TLM regulated allocation (GL)	TLM unregulated allocation (GL)
Opening water carried over from 2010–11	88.79	88.79	
Forfeitures on opening carryover[15]	3.31	3.31	
Net carryover water	**85.48**	**85.48**	
Water allocation for 2011–12	365.96	331.66	34.30
Total TLM water available for 2011–12	**451.44**	**417.14**	**34.30**
Seasonal spills and forfeiture	20.69	20.69	
Water usage during 2011–12	274.06	239.76	34.30
Water allocation carried over to 2012–13	**156.69**	**156.69**	

15 A volume of water was forfeited on the opening water carried over (3.31 GL) in accordance with carryover policies in NSW and Victoria

River Murray Unregulated Flows

River Murray Unregulated Flows (RMUF) are unregulated flows on the River Murray available for environmental watering, once upper states have exercised their existing rights. River Murray Unregulated Flows are prioritised and managed according to The Living Murray Annual Environmental Watering Plan through the Environmental Watering Group.

During 2012 natural inundation of icon sites was a result of unregulated flows during 2011–12, making the prioritisation of RMUF mostly redundant. However, 3 GL of RMUF was used during the year (refer section 2.4 Water delivery).

River Murray Increased Flows

River Murray Increased Flows (RMIF) is water recovered under investment in the Snowy Joint Government Enterprise and available as environmental water for the River Murray. This water is managed under The Living Murray environmental watering framework once it is made available to the Murray–Darling Basin Authority.

River Murray Increased Flows were not available during 2011–12 as the rules guiding its use are being negotiated by partner governments. The amount in the RMIF account increased from 160 GL at the beginning of the year to 230 GL at 30 June 2012.

Barmah-Millewa Environmental Water Allocation

The Barmah–Millewa Environmental Water Allocation is a rules based allocation established in 1993. New South Wales and Victoria equally contribute an annual allocation of 100 GL high security and 50 GL of low security allocation. The unused water in the Environmental Water Allocation can be carried over from one year to the next to a maximum of 700 GL. The Barmah–Millewa EWA is not formally managed under The Living Murray Annual Environmental Watering Plan as it is subject to NSW or Victorian direction or default triggers[16]. However, historical usage is discussed at the Environmental Watering Group and is closely coordinated with the water delivered under The Living Murray Annual Environmental Watering Plan.

At 30 June 2012, 279.6 GL of EWA had been used during the year. This was the first time the EWA has been used in consecutive years.

16 *Operating rules for the Barmah–Millewa Forest Environmental Water Allocation.*

2.4 Water delivery

Barmah–Millewa Forest

A proposal for environmental delivery to Barmah–Millewa Forest, and the subsequent return flows from the forest being delivered to the Lower Lakes, was ranked as the highest watering priority by the Environmental Watering Group in 2011–12. This was the second year in a row that flows were delivered to the forest and was important for the recovery of the forest after the drought. Despite two years of high natural flows enhanced by environmental watering, the forest has historically been inundated with much higher flows and for several consecutive years.

The objective of the watering proposal under The Living Murray Annual Environmental Watering Plan 2011–12 at Barmah–Millewa Forest was healthy vegetation in at least 55% of the area of the forest including virtually all giant rush, moira grass, river red gum forest and some river red gum woodland.

In 2011–12, 424.6 GL of environmental water was prioritised for watering Barmah–Millewa Forest. The environmental water was comprised of 120 GL of TLM portfolio allocation, 279.6 GL of Barmah–Millewa EWA allocation, 15 GL of OEH allocation and 10 GL of VEWH allocation.

Throughout the environmental watering event, the Operational Advisory Group advised the River Operators and environmental managers of on-ground information in real time via weekly teleconferences. The flow rates and estimated environmental delivery at Yarrawonga Weir and the environmental observations which informed river management are shown at figure 2.3.

The Barmah–Millewa Forest Environmental Water Management Plan includes an ecological objective relating to waterbirds to promote and/or sustain successful breeding events for thousands of colonial and migratory waterbirds in at least three years in 10, by inundating selected floodplain and wetland areas to provide suitable nesting and feeding habitat. In August–September 2011 a colonial bird breeding event commenced in the forest during a period of natural flooding. Some environmental water was released in mid September to maintain overbank flows.

After a natural peak in early October, river levels were receding, risking the abandonment of the colonial bird breeding event. Environmental water maintained flow levels generally between 11,000–12,000 ML/d for nearly five months. This was slightly above channel capacity of 10,500 ML/d, to sustain, and complete the bird breeding event that is predicted to have occurred naturally. This bird breeding event would not have been successful without environmental water delivery.

The Barmah–Millewa Forest Environmental Water Management Plan includes an ecological objective relating to fish to promote successful recruitment of native fish species by improving flow variability in spring and early summer to replicate natural cues, and inundation of floodplain and wetland areas to provide breeding and nursery habitat. Following advice from the Operational Advisory Group in mid November, a pulse up to 20,000 ML/day at the end of November 2011, was created to trigger fish spawning.

The 424.6 GL of environmental water was not all consumed within the Barmah–Millewa Forest, as return flows from the forest returned to the River Murray and ultimately contributed to flows at the Lower Lakes. The return flows from Barmah–Millewa Forest can only be estimated, and the volume of environmental water which reached the Lower Lakes cannot be exacted. The environmental water released for the event was protected due to three main factors:

- the release of environmental water from Hume Reservoir was in addition to downstream demand and commitments
- NSW Supplementary access in the Murray Irrigation Limited region had been exhausted prior to the release of environmental water
- Lake Victoria was spilling and unregulated periods were announced for parts of the environmental watering and the lake subsequently spilled due to larger flooding later in the season. Figure 2.3 shows that there were unregulated flows at the SA border from the beginning of June until early November 2011 and from late December 2011 to April 2012.

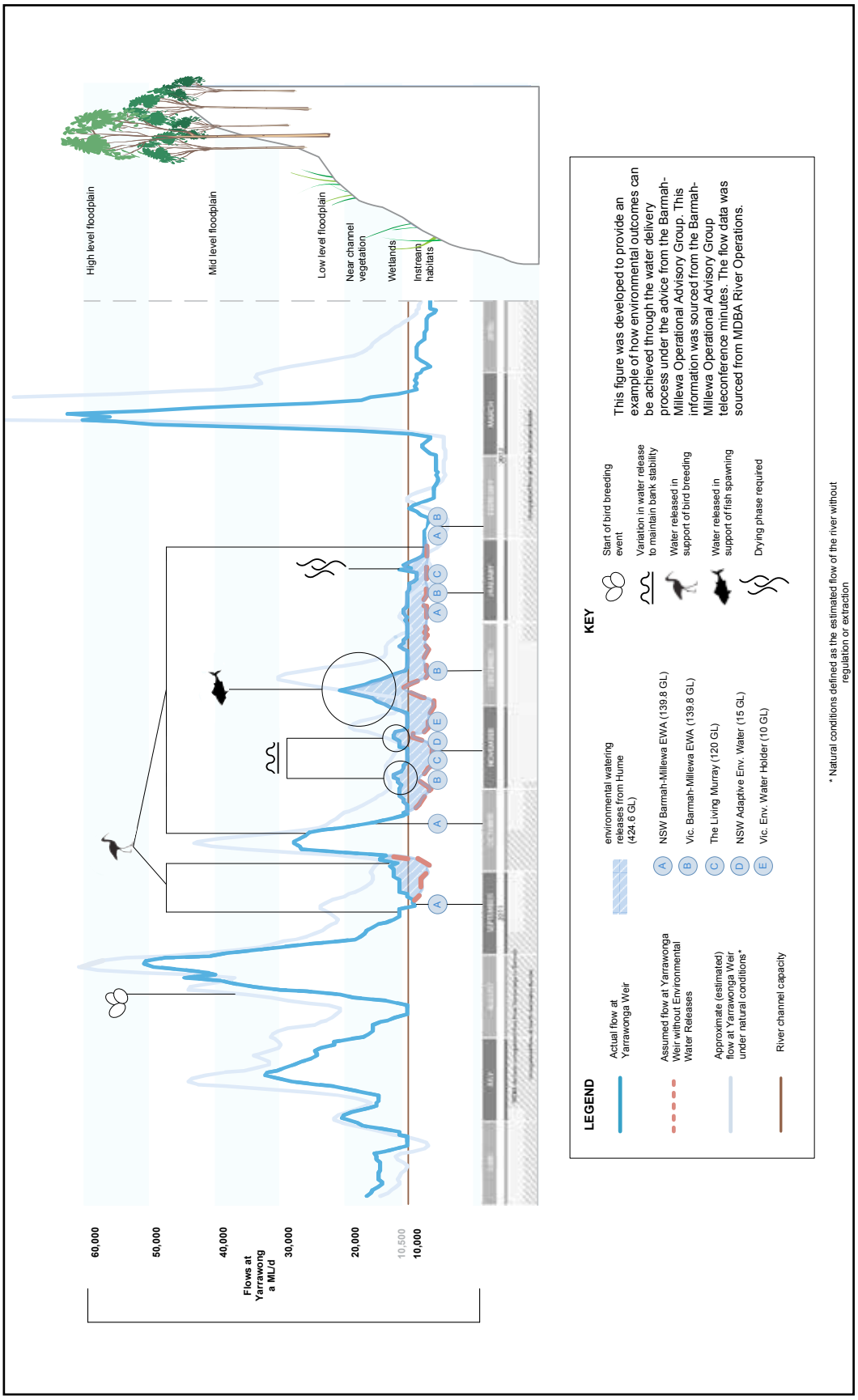

Figure 2.3 Barmah–Millewa Forest environmental watering timeline 2011–12

Gunbower–Koondrook–Perricoota

Environmental watering of Gunbower Creek and Gunbower Forest were ranked as a medium priority by the Environmental Watering Group in 2011–12.

The objectives of The Living Murray environmental watering in 2011–12 at Gunbower were:

- successfully recruit wetland and floodplain vegetation and provide suitable habitat for wetland and floodplain dependant fauna
- successful waterbird breeding events for the suite of waterbirds present
- contribute to population recovery of threatened species
- increase the abundance of native fish species in Gunbower Island
- allow movement of native fish in and out of habitat types.

Koondrook–Perricoota was not targeted for environmental watering in 2011–12 due to the construction of environmental works.

In November and December 2011, 6.1 GL of The Living Murray regulated entitlement was directed to Gunbower Creek, in conjunction with 4.9 GL of VEWH water to assist the recovery and maintenance of native fish populations. These flows increased the habitat available for native fish species and watered fringing vegetation.

Between December 2011 and February 2012, 0.6 GL of The Living Murray regulated entitlement was delivered to top up permanent wetlands in Gunbower Forest. This was to sustain a small, yet significant bird-breeding event which was triggered by natural high flows in early spring. Vegetation in some important permanent wetland complexes also benefited from the sustained watering.

Hattah Lakes

Hattah Lakes was not targeted for any environmental delivery during 2011–12 due to the construction of environmental works.

High river levels in spring 2011 resulted in some flows into Chalka Creek which reconnected the system and consolidated the benefits provided by natural overbank flooding in 2010–11. High river flows early this year were kept out of the site due to the construction of a bank to protect the current construction site there.

Chowilla Floodplain

Environmental watering of the Chowilla Floodplain was ranked as a medium priority by the Environmental Watering Group in 2011–12. The objectives of The Living Murray environmental watering at Chowilla, Lindsay–Wallpolla Islands icon site during 2011–12 were:

- to have high value wetlands maintained, the current area of river red gums maintained and have at least 20% of the original area of black box (*E. largiflorens*) vegetation maintained at Chowilla wetlands
- at Lake Wallawalla to provide a diversity of structural aquatic habitats
- increase diversity and abundance of wetland aquatic vegetation; maintain and improve the populations of threatened flora and fauna that are flow-dependant; restore productivity linkages between river and floodplain habitats; and increase abundance, diversity and extent of distribution of native fish.

Environmental water delivery to Chowilla wetlands was initially planned as a pumping program to supply The Living Murray regulated allocation to significant high value wetlands. However, high flows naturally inundated many sites, reducing the requirement for The Living Murray environmental water. Numerous temporary banks, constructed as part of the environmental watering program, were decommissioned prior to the high flow event to ensure the banks didn't restrict the natural flooding of the sites.

Between December 2011 and March 2012, 3 GL of The Living Murray allocation was delivered to Coombool Swamp to build on the benefits of the natural flooding from 2010–11 and improve the health of river red gums, lignum and black box.

In March and April 2012, 2 GL of The Living Murray unregulated entitlement and 3 GL of RMUF water was pulsed as a fresh to Lake Wallawalla to consolidate environmental benefits obtained from watering the previous year, and to water stressed fringing vegetation.

Lower Lakes, Coorong and Murray Mouth

Environmental watering of Lower Lakes, Coorong and Murray Mouth was ranked as a high priority by the Environmental Watering Group in 2011–12. The objectives of The Living Murray environmental watering at the Lower Lakes, Coorong and the Murray Mouth during 2011–12 were:

- to enhance migratory bird habitat in the Lower Lakes and Coorong
- increase frequency of estuarine fish spawning and recruitment
- to maintain an open Murray Mouth.

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 which contributed to flows across the South Australian border to the Lower Lakes and the Murray Mouth, lowering salinity levels in the Lower Lakes, improving fish passage and contributing to keep the Murray Mouth open throughout 2011–12. The 23.1 GL LTCE of Lower Darling Supplementary Water Access listed on the Environmental Water Register contributed to these unregulated flows to South Australia as the relevant licence is conditioned to ensure that allocation is not ordered and remains in stream during periods of declared supplementary access.

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.

Environmental water was delivered to Lower Lakes, Coorong and the Murray Mouth during 2011–12, from a variety of water accounts and water holders. This included water delivered directly to the Lower Lakes, and return flows from other icon sites. The CEWH and the VEWH also contributed environmental water for delivery to the Lower Lakes. Regulated and unregulated allocation from The Living Murray contributed 110.1 GL and 32.3 GL respectively to the Lower Lakes. Eildon Reservoir on the Goulburn River contributed 58 GL of the 110.1 GL of The Living Murray regulated allocation.

Water delivered from Eildon Reservoir incurred an in-channel conveyance loss in the Goulburn River of 6.6 GL. No conveyance losses were applied in the River Murray.

Environmental watering at the Lower Lakes included return flows from Barmah–Millewa Forest as part of a multi-site watering. The volumes of return flows from Barmah–Millewa Forest are highly variable, depending on antecedent conditions, floodplain inundation and duration and the management of regulators in the forest. Estimations of return flows from Barmah–Millewa Forest range from 70%[17] to 95%[18].

17 Based on the highest observed unaccounted difference of flows between Yarrawonga Weir and the South Australian border.
18 Barmah–Millewa Environment Water Management Plan

3 Environmental monitoring

3.1 Introduction

Effective environmental watering requires well designed and timely environmental monitoring information. Not only does monitoring the environment assist managers to decide where, when and how to provide additional water to icon sites, it provides critical feedback on the success of this watering and whether objectives have been achieved. Hence the lessons from one watering event or one season can inform the planning of future events. As time passes, knowledge of icon site ecology and the effectiveness of environmental watering accrues and the accuracy and sophistication of hydrological models increase. Monitoring the achievement of The Living Murray ecological objectives is therefore an important part of The Living Murray Business Plan.

The types of monitoring as set out in The Living Murray Outcomes Evaluation Framework are:

- River Murray system scale monitoring
- icon site condition monitoring
- intervention monitoring, (which incorporates ecological response, compliance and risk monitoring).

An overview of the Outcomes Evaluation Framework is provided in appendix A. Appendix B provides a further breakdown of monitoring projects in 2011–12. Appendix C lists reports generated under The Living Murray monitoring made publicly available on MDBA's website, through its Basin Plan Knowledge and Information Directory (BP KID).

This chapter details the following for 2011–12:

- ecological outcomes detected through monitoring
- challenges in maintaining monitoring during very wet years
- emerging challenges
- new initiatives to improve adaptive management and demonstrate accountability.

The first phase of The Living Murray monitoring has been a period of significant development. The monitoring activities have been established to determine if the site objectives have been met. They will continue to be refined as part of the adaptive management process. The program is being actively reviewed and adjusted from the lessons learned so that it is well placed to report on long-term benefits of TLM and also on the specific outcomes of environmental watering.

Royal spoonbill chick in Barmah Forest. The bird breeding event this year would not have been successful without environmental water delivery (photo by Keith Ward Goulburn Broken CMA)

3.2 Positive ecological outcomes in 2011–12

The unregulated flows of the last two years have combined with planned environmental watering to enhance ecosystem recovery at The Living Murray icon sites across a range of ecological indicators.

Icon site managers and researchers report on a range of river red gum and understorey vegetation condition. Previous reports found that during the drought period of 2002 to 2010 large areas of river red gum forest across the icon sites had declined from 'in good health' to 'stressed'. Stands that remained in relatively good condition were restricted to areas surrounding the river, creek lines and the limited number of wetlands that received environmental watering. It is expected that the recent flooding will continue to reinvigorate the health of the forests. Stand condition maps for 2012 across icon sites are currently being developed and will provide a very useful update on status and response to the last two years of large flows.

Monitoring understorey vegetation during 2011–12 at Barmah–Millewa indicates that environmental watering provided in 2009–10 has been successfully reinvigorating giant rush in selected areas. The strongest responses occurred where there was a combination of strong initial vigour in the species, following fire and environmental watering. Giant rush provides valuable waterbird habitat and is part of the ecological objectives for the icon site, however, giant rush is also encroaching into moira grass plains and is a management problem in some areas of the icon site. Moira grass has shown a mixed response within the different wetlands of the Barmah–Millewa icon site. Monitoring suggests that the long, severe drought followed by two years of flooding may have reduced the vigour of the species.

While volumes of water from environmental watering were dwarfed by large unregulated flows during the year, information from The Living Murray monitoring program was critical in guiding the maintenance of water levels in key waterbird breeding areas in the Barmah–Millewa Forest. A total of six colonial waterbird species successfully bred in Barmah Forest in 2011–12, leading to approximately 5,400 fledged colonial waterbirds and an additional 24 non-colonial waterbird species suspected or confirmed to have bred in indeterminate numbers (Ward, KA & Chalmers, KD 2012).

Monitoring of waterbirds estimated 197,792 waterbirds comprising 51 species across all Murray icon sites. The overall abundance represented about 21% of the total number of birds estimated by the Eastern Australian Waterbird Survey. The Murray estimate was the third highest in the five years (2007–2011) that the survey has been conducted. Monitoring found Australian white ibis breeding in the Chowilla Lindsay–Wallpolla wetland and breeding colonies of straw-necked ibis, Australian pelicans and pied cormorants concentrated in the Lower Lakes, Coorong and Murray Mouth icon site. The total numbers of waterbirds across the sites increased from the widespread flooding in 2010 where many waterbirds were spread out given the large amount of habitat available.

For a second successive year significant flows connected the Coorong and Lower Lakes, promoting fish movement and breeding. Freshwater releases through the barrage fishways supported the movement of high numbers of fish (over three million fish sampled) including freshwater, estuarine, diadromous and marine species. Lampreys have been sampled at the fishways for the first time since 2006.

3.3 Challenges in very wet years

While large unregulated flood events helped ecological recovery across The Living Murray icon sites, there were some perverse impacts and challenges that resulted from these floods. These include negative ecological impacts, impacts on monitoring operations and communication challenges.

Perverse ecological impacts from large overbank flows include blackwater events and potential increases in carp numbers along the River Murray. Blackwater events can occur naturally in floods. Floods sweep large amounts of organic material, including gum leaves, from the floodplain into river channels. This material decays, removing oxygen from the water which can kill large numbers of fish and other aquatic life. Monitoring blackwater events and mitigating the impacts, by dilution where possible, as well as communicating with stakeholders about blackwater have been priorities in recent years. The Environmental Watering Group considers this an important issue in coming years and has sought to consolidate its efforts in this area.

The numbers of European carp fell during the drought. It is thought the introduced species is not as resilient as drought-adapted native species. Now the drought has broken, and lagoons and billabongs are again reconnected to the main channel, carp numbers have increased significantly.

Monitoring operations were hampered by this

year's floods. Impacts included the destruction or damage of equipment installed on the floodplain. Increased coordination and flexibility were required to complete as much monitoring as possible however, in some instances monitoring was not possible. The resultant gaps in data may delay the demonstration of ecological outcomes or trend lines.

An ongoing challenge for TLM monitoring is distinguishing and communicating which ecological benefits result from environmental watering and which are caused by natural flooding. In some cases, this distinction is not possible. Riverine ecosystems respond to both long-term flow regimes as well as short-term events. While TLM now manages significant volumes of water, these volumes were dwarfed by the very large unregulated flows of the last two years. However, environmental water applied during the drought maintained important refuges for flora and fauna that contributed to the recovery once natural high flows returned. Communicating the relative role of TLM remains a challenge.

3.4 Emerging challenges to demonstrate The Living Murray's achievements

Pressure is increasing on The Living Murray program to demonstrate environmental benefits. The Living Murray now manages significant volumes of water and the development of the Basin Plan has invited greater public scrutiny and debate about environmental watering.

During the drought years (2002–2010), expectations were largely limited to protecting refuge sites. The years of flood have changed perceptions and there is a greater need to demonstrate improvements in ecological conditions resulting from environmental watering.

There is also an ongoing need for The Living Murray to demonstrate effective coordination with related programs. As The Living Murray program has developed, so too have other significant environmental watering programs: at the Federal level (Commonwealth Environmental Water Holder), in New South Wales (Riverbank) and Victoria (Victorian Environmental Water Holder). Through the Environmental Watering Group, The Living Murray is coordinating its delivery with other jurisdictional environmental watering allocations and sharing information on monitoring approaches and results. Coordination of planning, delivery and monitoring of environmental water is required to maximise environmental outcomes.

3.5 Additional initiatives underway

New initiatives are being put in place as The Living Murray monitoring evolves and matures. This is in response to the growing need to demonstrate accountability and to strengthen adaptive management. These initiatives include:

- *Icon site monitoring synthesis:* The Living Murray monitoring works with jurisdictions to complete a large number of monitoring reports and findings about environmental watering and the icon sites. However, to date, these have not been consistently consolidated into a single over-arching report. Starting in 2012–13, icon site managers will report the year's activities and outcomes including monitoring results. These annual icon site reports will form the basis for a system-wide synthesis to be produced in June each year, reporting the outcomes of The Living Murray program.
- *Statistical review of condition monitoring methodology*: condition monitoring is designed to assess the change in condition over time and in the longer-term, to determine if the icon site ecological objectives are being achieved. This review examines the effectiveness of condition monitoring and whether its methodologies are appropriate. The draft report was delivered in June 2012. Once the results of this review are understood, the sampling design and methods will be adjusted and improved where required. A second review stage is envisaged in 2012–13. This will involve the analysis of condition monitoring data for some indicators where up to five years of data have been collected, to determine the sensitivity of the current designs and detect if trend lines are evident at this stage in the program. This will also determine the frequency required for future sampling activities.
- *Gathering monitoring data for future analysis:* data and metadata generated by past TLM monitoring projects is currently being compiled. When this compilation is complete, the MDBA will undertake data cleansing and will need to develop data management standards and protocols to guide future TLM monitoring data management.
- *Increasing scientific capacity through the MDFRC:* negotiations are underway to secure funding for the Murray Darling Freshwater Research Centre (MDFRC) to continue a close alliance with The Living Murray monitoring program and other environmental watering agencies. A program of monitoring and research is being developed to understand system-wide processes, to better inform management decisions and to better manage risks.

4 Environmental works and measures

4.1 Introduction

The Living Murray Environmental Works and Measures Program designs and builds infrastructure to improve the effectiveness of environmental watering at icon sites. These works include regulating structures, water delivery channels and fishways.

The program comprises approximately $318.4 million of investment and was expected to have been largely completed within the past year. However, continuous flooding has hampered progress. The program is now due to be completed in 2013–14.

Once completed, the works will enable water regimes to be improved for wetlands and floodplains using a combination of regulated water and enhanced unregulated water delivery. As such, they break the dependence on natural floods to get water onto the floodplain, although natural floods are still critical and will be used where available to trigger and optimise watering events.

The operation of the proposed works can be adapted to a wide range of climatic conditions and water availability scenarios, enabling highly efficient use of environmental water. This is particularly important in the context of potential climate change, which is likely to reduce the size and frequency of the natural floods that have historically sustained wetland and floodplain ecosystems.

4.2 Overall progress of major infrastructure works in 2011–12

Under the Environmental Works and Measures Program, seven major infrastructure projects are being undertaken across four of the icon sites, including:

- two projects at Gunbower–Koondrook–Perricoota Forest
- one project at Hattah Lakes
- three projects at Chowilla Floodplain, Mulcra Island and Lindsay–Wallpolla Islands
- the Sea to Hume Fishways project along the Murray Channel.

In 2011–12, these projects were scheduled to progress through design and/or construction stages. However, flooding has caused considerable delays, continuing from the end of 2010–11 through to May 2012 (at the time of writing this report). The floods have affected all sites, ranging from loss of access for critical investigations (eg. geo-technical and cultural heritage), through delaying the start of construction, to suspension of construction and damaging incomplete works.

The refurbishment of three regulators located within the Gunbower Forest was expected to have been completed and the regulators commissioned by June 2012. As construction is underway or nearing completion at many sites, there has been an emphasis on developing operational documentation and operational advisory groups.

The Chowilla Floodplain was again affected by continuous floods during 2011–12 and works were not able to restart. Floods prevented or impaired access to Mulcra and Lindsay Island for detailed design and investigative works. The Koondrook–Perricoota works were affected by floods in July-August 2011 and March 2012.

The progress of all Envirionmental Works and Measures Program infrastructure projects during 2011–12 is summarised in table 4.1. Further information on individual projects is provided in the relevant icon site chapters of this report.

Table 4.1 Summary of The Living Murray infrastructure works and progress during 2011–12

Icon site	Description of TLM infrastructure works	Progress in 2011–12
Barmah–Millewa Forest	No major works	n/a
Gunbower–Koondrook–Perricoota Forests	Gunbower Forest: • upgrade of Hipwells Road channel (and associated works) to divert water from Gunbower Creek into the forest via Spur Creek, delivering water to up to 4,750 ha of forest • upgrade of 3 existing regulators to deliver water to up to 2,500 ha, including Black Swamp, Reedy Lagoon and Yarran wetlands in the lower forest	• detailed designs for the Hipwells Road package of works were completed and a construction proposal is expected in July 2012 • construction of the 3 regulators associated with the lower landscape works was practically completed with commissioning of these regulators forecast for August 2012
	Koondrook–Perricoota Forest: • Package of works to deliver water to up to 16,000 ha of forest, including: – 3.8 km channel (Torrumbarry Cutting) and inlet regulator to divert water from the River Murray above Torrumbarry Weir into the forest – 2 regulators at Swan Lagoon – 42 km levee bank and 4 regulators at the lower forest – return channel and regulator at Thule Creek	• construction commenced. The start of construction was delayed due to residual water in the forest from flooding • three major flood events have impacted on construction progress • construction currently scheduled to be completed in February 2013 subject to no further major flood delays
Hattah Lakes	• Package of works to deliver water to up to 6,000 ha within the lakes system, including: – pumping station to supplement natural flows from the River Murray into Hattah Lakes – 4 regulators and 3 levees within the lakes system – refurbishment of an existing regulator – excavation of small sections of Chalka Creek bed.	• all statutory approvals for construction have been sought. • award of tender was given to Comdain Infrastructure in December 2011 • construction commenced in March 2012 • construction is currently scheduled to be completed in two stages. Regulators and levees will be completed in October 2012 and pump station and rock chute fishways completed in February 2013
Chowilla Floodplain and Lindsay–Wallpolla Islands	Chowilla Floodplain: • Package of works to deliver water to manage the watering regime of up to 9,000 ha of the floodplain, including: – regulator on Chowilla Creek to raise water levels in the Chowilla anabranch system – upgrade of weirs on Pipeclay and Slaney creeks and construction of new secondary regulators to manage flows in and out of anabranch system in conjunction with the regulator – fishways to provide fish passage in and out of the anabranch system	• construction of the Chowilla Creek regulator recommenced in May 2012, after ceasing in October 2010 due to the impact of ongoing floods and high river levels • addition of fishways at Slaney and Pipeclay regulators, and construction of the smaller regulators as part of the Chowilla works are expected to occur in 2012–13 • the development of the Operating Plan has progressed to final draft stage
	Mulcra Island: • package of works to deliver water to up to 800 ha of floodplains and wetlands, including: – regulator on Potterwalkagee Creek to inundate Mulcra Island floodplain – smaller secondary regulators to control flows within the anabranch system	• construction was largely completed prior to flooding in 2010–11, however the main regulator was damaged during these floods • repair planning has been completed with work expected to occur during the 2012–13 summer • minor works are also required to complete one of the ancillary regulators
	Lindsay Island: • two small regulators on the upper Lindsay River anabranches to allow greater variability of flows through this system • replacement of an existing weir on Mullaroo Creek with a gated structure and a fishway	• detailed designs for the construction of the Mullaroo Creek regulator are completed • approval documents for works at Mullaroo Creek and the Upper Lindsay have been largely completed
Coorong, Lower Lakes and Murray Mouth	No major works	n/a
River Murray Channel	Sea to Hume Fishways Program: • 12 new fishways on locks/weirs along the River Murray • fishways at Stevens Weir and Edward River off-take in NSW	• fishways at Lock 5 and Edward River completed. • construction of fishways at locks 2, 4,11,15, and Stevens Weir have been progressed. All sites have had some impact from the flooding. Completion of fishways at all these sites should occur during 2012–13 • Steven's Weir grant exhausted. As agreed NSW will fund the remaining works

4.3 Investment in The Living Murray works and measures

During 2011–12, the total budget for The Living Murray Environmental Works and Measures Program (covering the period 2003 to 2014) was increased from $287.8m to $318.4 m. The additional $30.6 m consisted of the following:

- $5.9 million for flooding conditions experienced during the 2010–11 financial year
- $3.2 million in additional funds for the Hattah Lakes project
- $0.4 million from the Victorian Government for the Lindsay Island stage 1 project
- $11.6 million for additional funds for the Koondrook project
- $7.2 million for additional funds for the Chowilla project
- $2.3 million for additional funds for the Mulcra project.

At 30 June 2012, approximately $223 m had been spent by the program. Table 4.2 shows the distribution of this expenditure amongst works at various icon sites, as well as current best estimates of the distribution of the remaining budget.

The Environmental Works and Measures Program may need to seek approval for additional funds for the programs' budget during 2012–13 as a result of potential ongoing impacts from the 2011–12 floods on The Living Murray work sites.

Table 4.2 The Living Murray Environmental works and measures current and projected distribution of budget expenditure

TLM infrastructure project	Total budget expended at 30 June 2012 ($ million)	Estimated total budget still to be expended ($ million)	Estimated total budget expended by end of program* ($ million)
Gunbower–Koondrook–Perricoota Forests			
Koondrook works	61.850	18.445	80.295
Gunbower work	11.336	16.908	28.244
Hattah Lakes			
Hattah works	14.500	18.189	32.688
Chowilla Floodplain and Lindsay–Wallpolla Islands			
Mulcra Island works	9.169	2.781	11.950
Chowilla works	37.573	29.322	66.895
Upper Lindsay River works	1.173	5.827	7.000
River Murray Channel			
Sea to Hume Fishways	35.156	1.715	36.871
Other			
Edward River fishways	1.963	0	1.963
Stevens Weir Fishway	4.326	0	4.326
Minor projects	38.398	0	38.398
Program delivery	7.855	1.925	9.780
TOTAL	**223.298**	**95.111**	**318.410**

* The estimated total budget expended by end of program includes costs incurred prior to the approved prioritisation budget set in 2008–09.

5 Communication, community consultation and Indigenous partnerships

5.1 Communication and community consultation

Communication and consultation are central to the Murray–Darling Basin Authority's roles and responsibilities, and are integral to each core program. Each year, The Living Murray produces a communication and consultation strategy outlining a coordinated, consistent approach to communicating the achievements, progress and future direction of the program to stakeholders and to the wider community.

During 2011–12 this strategy comprised two objectives:

1. Increase awareness of, understanding of and support for The Living Murray by communicating the achievements, progress and future direction of the program through:
   (a) development of media products to proactively communicate the progress and achievements of The Living Murray
   (b) promoting the effectiveness of The Living Murray Water Portfolio in providing environmental benefits
   (c) publicising the progress in constructing water management structures
   (d) raising awareness among the public of the science behind The Living Murray by publishing environmental monitoring reports on the MDBA website and developing associated communication material.
2. Engage communities and stakeholders, providing opportunities for them to contribute through icon site consultation reference groups.

5.2 Communication activities

During 2011–12 The Living Murray Communication and Community Consultation Program was responsible for raising community awareness and support for The Living Murray program by producing communication materials covering areas including:

- the positive impact of environmental watering on icon sites
- the amount of water recovered for environmental watering
- environmental watering activities
- the results of environmental monitoring
- the status of the works and measures program
- future initiatives, including multi-site watering.

Other communication activities aimed at raising awareness of The Living Murray program amongst a broad audience, included publishing The Living Murray environmental watering booklet for 2010–11, updating The Living Murray website, and again providing sponsorship for the Murray Meander, a one week boating charity event which travelled 735 km from Brigenbrong Bridge to Echuca, involving 36 teams and two icon sites. A list of The Living Murray communication products can be found in Table 5.1.

Table 5.1 Communication publications 2011–12

Date	Activities
August 2011	The Living Murray Annual Environmental Watering Plan 2011–12
October 2011	The Living Murray story (teachers notes in development)
November 2011	Media release — Environmental watering to benefit The Living Murray's icon sites
December 2011	Media release — Summer pulse of environmental water to benefit fish
December 2011	Australian River Restoration Centre newsletter — The Living Murray story
Summer 2011–12	Touring Australian Magazine — The Living Murray's icon sites, a natural tourist trail
Summer 2011–12	Murray Guardian — The Living Murray story
January 2012	The Living Murray's story
February 2012	Chowilla brochure, as part of The Living Murray toolkit
February 2012	Wetlands Australia magazine — The Living Murray's icon sites and tourism
May 2012	The Living Murray Environmental Watering in 2010–11
June 2012	International magazine Water Power & Dam Construction — Hume-ward bound — detailing the Sea to Hume Fishway program

A wet Murray Meander 2012 (photo by Jamie Hearn Murray CMA)

5.3 Consultation activities for the icon sites

Just as environmental watering under The Living Murray is icon site specific, consultation activities typically relate to individual sites.

Extensive consultation continued throughout the year at the local level covering environmental watering, environmental monitoring and the works and measures programs. This consultation ensured communities and stakeholders were well informed and had the opportunity to provide input into the planning process and the implementation of watering.

The Murray–Darling Basin Authority appreciates the input of Basin communities and acknowledges that local knowledge is essential to achieving optimum environmental outcomes.

Further information on specific program activities is provided in the icon site chapters of this report.

5.4 Indigenous Partnerships Program

The MDBA recognises and acknowledges that the Traditional Owners and their Nations in the Murray–Darling Basin have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters.

The Living Murray Indigenous Partnerships Project was established in 2006 in consultation with jurisdictions and representatives of Indigenous communities. The project incorporates the Murray Lower Darling Rivers Indigenous Nations (MLDRIN) and The Living Murray Icon Site Indigenous Facilitator Program.

The key objective of The Living Murray Indigenous Partnerships Program is to implement clause 184 of The Living Murray Business Plan:

> *184. Indigenous people will be included in water planning and management at each Icon Site through an agreed approach in conjunction with the Icon Site Managers. This approach will also respect jurisdictions' legislation and other agreements and related processes. The Living Murray Environmental Management Plans for each Icon Site will take into account Indigenous social, spiritual and customary objectives and strategies for achieving these objectives.*

This objective and the implementation of The Living Murray Indigenous Partnership Program reflect commitments made under the Ramsar Convention for the participation of Indigenous people in wetland management.

The Living Murray Indigenous Partenership Program is a vital component of the consultation and communication for The Living Murray initiative, providing benefits to both The Living Murray planners and managers and to Indigenous people living along the river. The most significant achievement of The Living Murray Indigenous Partnerships Program has been in ensuring the support of Indigenous communities for the $318 million works and measures program.

The project employs seven Indigenous Facilitators and many Indigenous Cultural Heritage Monitors who work with Icon Site Managers to fulfil the program's objectives in culturally appropriate ways.

The Murray Lower Darling Rivers Indigenous Nations (MLDRIN) is a self-determining Traditional Owner organisation. Under a Memorandum of Understanding with the MDBA, MLDRIN provides whole-of-river strategic advice to The Living Murray and facilitates cooperation and coordination between Indigenous Nations and the Government.

A summary of the 2011–12 achievements is provided in the icon site chapters of this report.

The 2011–12 MDBA Corporate Plan provided a budget of $1,035,000 for Indigenous facilitators and $552,000 for MLDRIN.

6 Barmah–Millewa Forest

6.1 Icon site description and objectives

The Barmah–Millewa Forest is the largest river red gum forest and wetland system in Australia. It forms the largest and most intact freshwater floodplain system along the River Murray. The icon site covers 66,600 hectares and straddles the Murray and Edward rivers between the towns of Tocumwal, Deniliquin and Echuca.

The site supports a diverse range of native plants and animals, including a number of rare species. The forest wetlands play an important role in the lifecycles of waterbirds, and are listed under the Ramsar Convention.

The forest owes its existence to the Cadell Fault, which blocked the ancient River Murray channel 25,000 years before present, creating the Gulpa Creek and Edward–Wakool river system, and then the Barmah Choke. The Barmah Choke is the section of the River Murray where flows were forced southward to form a narrowing of the main river channel between Picnic Point and the town of Barmah. The Barmah Choke acts as a funnel and river flows in excess of about 10,500 megalitres per day (measured from Yarrawonga Weir) overtop the banks and flow into the floodplain forest. Prior to river regulation, frequent forest flooding occurred naturally during winter and spring, and the forests dried over summer and autumn.

River red gum forests depend on frequent flooding and drying patterns to maintain a high level of resilience and function. However the ecological function of the Barmah–Millewa Forest is under threat from several factors, primarily river regulation, and river water diversion and extraction. Since the construction of the Hume Dam in the mid-1930's there has been a significant change in the timing, frequency, extent and duration of the floods needed to sustain the Barmah–Millewa icon site.

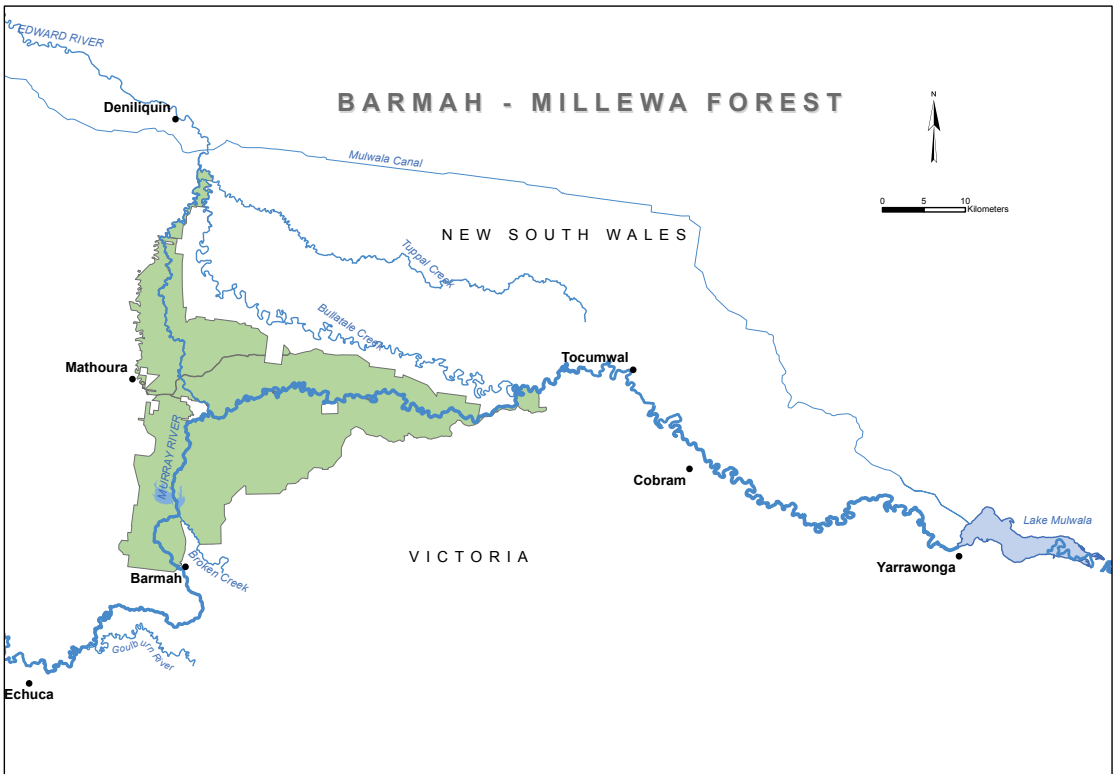

Figure 6.1 Barmah–Millewa Forest icon site

The River Murray flows west from Yarrawonga, then separates the forest, with the River Murray flowing south past Echuca via the Barmah Choke, and also flowing northwards into the Gulpa Creek and Edward-Wakool anabranches.

The site is protected as the Barmah National Park and River Murray Park in Victoria, and forms part of the Murray Valley National and Regional Park estate in New South Wales.

As a cross-border site, implementation of The Living Murray program at Barmah–Millewa is jointly managed by nominated icon site managers in New South Wales (NSW National Parks and Wildlife) and Victoria (Goulburn Broken Catchment Management Authority). The role of lead icon site manager alternates annually between New South Wales and Victoria.

The environment water management plan[19] for the Barmah–Millewa Forest sets out over-arching objectives for the icon site together with more detailed objectives and provides the management framework for achieving those objectives.

In February 2011, the revised Barmah–Millewa environment water management plan was submitted to the MDBA by New South Wales and Victoria. The plan was approved by Ministerial Council in November 2011. The revised objectives for the Barmah–Millewa environment water management plan are contained in table 6.1.

Targets are currently being developed to measure the efficacy of the program and to ascertain whether objectives are being achieved.

6.2 Environmental watering and management

Refer to section 2.4.

6.3 Environmental works and measures

The Environmental Works and Measures Program undertook no works in the Barmah–Millewa Forest in 2011–12. No future works for Barmah–Millewa Forest are included in the current prioritised funding allocated to the program.

19 Available online at: www.mdba.gov.au/programs/tlm/icon_sites/emp.

Table 6.1 Revised ecological objectives for the Barmah–Millewa icon site

Icon site ecological objectives		
Overarching objectives	**Detailed objectives**	**Targets**
To maintain and, where practicable, enhance the ecological character of the Barmah–Millewa floodplain		
Vegetation • Restore the extent, distribution and health of wetland and floodplain vegetation communities.	• Promote healthy and diverse vegetation communities, with an emphasis on restoring natural range and distribution of giant rush, moira grass, river red gum forest and river red gum woodland in at least 55% of the Barmah–Millewa icon site. • Promote healthy and diverse vegetation to provide suitable breeding and foraging habitat for a diverse range of waterbirds and bush birds.	Targets under development
Waterbirds • Provide suitable feeding and breeding habitat for a range of waterbirds, including colonial nesting species.	Promote and sustain breeding events for thousands of colonial and migratory waterbirds in at least three years in 10. This will be achieved by inundating selected floodplain and wetland areas, thereby providing suitable nesting and feeding habitat.	Targets under development
Fish • Support successful breeding and recruitment of native fish species.	Promote successful recruitment of native fish species by improving flow variability in spring and early summer to replicate natural cues, and by inundation of floodplain and wetland areas to provide breeding and nursery habitat.	Targets under development
Other water-dependent species • Provide high quality feeding, breeding and nursery habitat for native frogs, turtles and crayfish.	Facilitate successful breeding and feeding opportunities for native frog species by seasonal inundation of selected floodplain and wetland areas for appropriate season and duration as required for each species. Facilitate successful breeding of native turtle species by inundation of selected floodplains and wetland areas to provide suitable breeding and nursery habitat. Facilitate appropriate management to ensure the sustainability of crayfish populations. Facilitate appropriate management measures to control the abundance and spread of invasive aquatic species. Facilitate appropriate geomorphology management in selected waterways.	Targets under development

6.4 Communication and community consultation

Community support for The Living Murray program at the Barmah–Millewa Forest icon site depends on effective engagement between river managers and local stakeholders. The community is informed of the history, constraints and opportunities for water management in the Barmah–Millewa Forest. In particular, they are consulted about environmental watering plans.

Communication and consultation activities relating to Barmah–Millewa in 2011–12 are summarised in table 6.1.

6.5 Indigenous consultation

Indigenous Australian engagement is a key component of The Living Murray at Barmah–Millewa Forest. Indigenous Australian communities with an interest in the forest have been identified as the Yorta Yorta Nation Aboriginal Corporation (NSW and Victoria) and the (NSW) Cummeragunja Local Aboriginal Land Council (LALC)

An Indigenous facilitator is employed under The Living Murray Indigenous Partnerships Program. The Victorian Department of Sustainability and Environment in collaboration with the Yorta Yorta Nation Aboriginal Corporation (YYNAC) implements the Indigenous Partnership Program at Barmah–Millewa.

The facilitator communicates and engages with local Aboriginal communities, ensuring their views are considered when The Living Murray decisions are made. The Indigenous facilitator attends the Technical Advisory Committee and a member of the Yorta Yorta Nation Aboriginal Corporation and Cummeragunja Local Aboriginal Land Council attends meetings of the Integrated Coordinated Committee. The National Parks and Wildlife Service has also invited the Yorta Yorta Nation Aboriginal Corporation and Cummeragunja Local Aboriginal Land Ccouncil to join the Technical Advisory Committee.

The absence of works and measures programs at this icon site has enabled the Yorta Yorta Nation Aboriginal Corporation to focus on developing research data and tools to identify Aboriginal objectives, together with strategies to achieve those objectives within icon site management plans.

Building upon previous Use and Occupancy Mapping, the Yorta Yorta Nation Aboriginal Corporation is now developing a Geographical Information System to help identify cultural water requirements. Yorta Yorta Nation Aboriginal Corporation workshops and a concept statement on the cultural benefits of environmental watering are also helping local Aboriginal people to have an input into icon site watering plans and management.

Other research projects include a midden fish fauna study that is collecting data on fish species prior to European settlement and a turtle monitoring program.

Use and Occupancy Mapping is a type of map survey that uses a rigorous social-science methodology that has been widely used in Canada. It is a scientifically defendable technique that has helped Indigenous people document the many ways in which they currently use land and water.

Table 6.1 Communication and consultation activities at Barmah–Millewa Forest icon site in 2011–12

Date	Activities
July 2011–June 2012	Continued work on Barmah–Millewa DVD
July 2011–June 2012	Development of a communication strategy for Barmah–Millewa, including consultation with the icon site community reference group
October 2011	Community Reference Group meeting
March 2012	Murray Meander a TLM sponsored charity event goes through Barmah–Millewa Forest
June 2012	Website on TLM Barmah activities on GB CMA website www.gbcma.vic.gov.au/default.asp?ID=the_living_murray

Table 6.2 Indigenous Partnership Program communication and consultation activities at Barmah–Millewa Forest in 2011–12

Date	Activities
July 2011–June 2012	Worked with Barmah–Millewa Indigenous facilitator to develop draft Traditional Owner Communication Strategy
November 2011	Article in the Age newspaper with Lee Joachim, The Living Murray Facilitator re cultural mapping at Barmah–Millewa

7 Gunbower–Koondrook–Perricoota Forest

7.1 Icon site description and objectives

The Gunbower and Koondrook–Perricoota Forests (Figure 7.1) straddle the River Murray, with the Koondrook–Perricoota Forest on the northern side of the river in New South Wales, and the Gunbower Forest on the southern side of the river in Victoria. The Koondrook–Perricoota Forest covers 32,960 hectares and the Gunbower Forest covers 19,931 hectares.

The combined forests form the second largest river red gum forest in Australia after Barmah–Millewa.

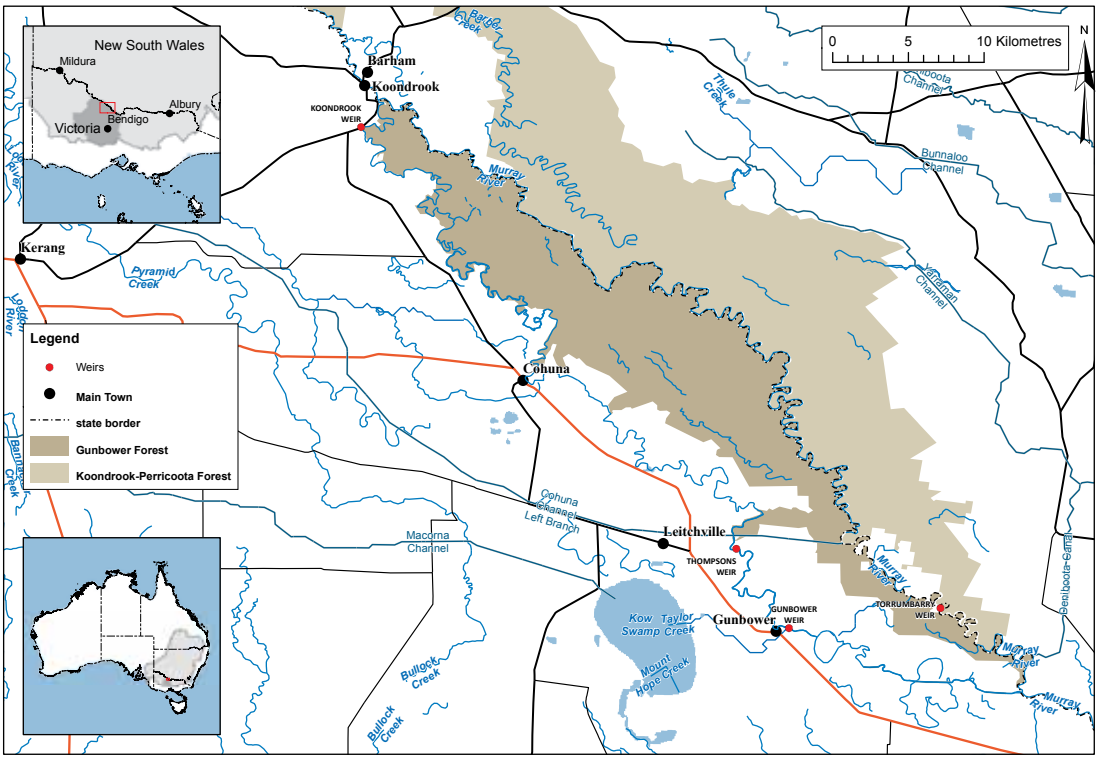

Figure 7.1 Gunbower–Koondrook–Perricoota Forest icon site — the Murray flows north-west, from Echuca towards Barham

Both forest areas are listed under the Ramsar Convention, and host a diverse range of habitats including permanent and semi-permanent wetlands, creeks, forests and open woodlands. The icon site provides breeding

habitat for colonial waterbirds and several rare or threatened animal species such as the carpet python and white-bellied sea eagle. Gunbower–Koondrook–Perricoota represents a substantial proportion of the total river red gum forest in Australia and, when flooded, supports a diverse array of native fish.

Gunbower–Koondrook–Perricoota Forests have historically depended on flooding from the River Murray and its tributaries. River regulation has led to a reduction in flood frequency, duration and extent, resulting in negative ecological impacts such as some permanent wetlands becoming semi-permanent.

Interim ecological objectives were developed based on the icon site's characteristics and ecological requirements. These objectives were approved by the Murray–Darling Basin Ministerial Council in 2003. The objectives were to maintain and restore a mosaic of healthy floodplain communities, including:

- 80% of permanent and semi-permanent wetlands in healthy condition
- 30% of river red gum forest in healthy condition
- successful breeding of thousands of colonial waterbirds at least three years in 10
- healthy populations of resident native fish in wetlands.

Since these objectives were first approved, jurisdictional agencies have continued to review and refine them. These refined ecological objectives reflect eight years of knowledge gained from environmental watering, monitoring, modelling and consultation activities and scientific research. They enable a clearer, more effective evaluation of environmental responses to environmental water delivery.

Implementation of The Living Murray at this icon site is managed by New South Wales (Forests NSW) and Victoria (North Central Catchment Management Authority) in accordance with the site's environment water management plan[20]. Victoria and New South Wales work cooperatively where efficiencies have been identified, for example sharing monitoring resources.

Under the current icon site environment water management plan, The Living Murray's interim ecological objectives for this site have been further refined as follows:

20 Available online at: www.mdba.gov.au/programs/tlm/icon_sites/emp.

Construction of inlet regulator with fishway in the foreground, February 2012 (photo by Jamie Hearn Murray CMA)

Gunbower Forest

Table 7.1 Objectives, outcomes and targets

Vision: To maintain and improve Gunbower Island by enabling native plants and animals to flourish, restoring the floodplain's health for future generations		
Icon site ecological objectives		
Overarching objectives	Specific objectives	Targets
Vegetation • Increase area of healthy permanent and semi permanent wetlands. • Ensure maintenance of healthy river red gum communities. • Maintain black box and grey box communities.	Promote functioning floodplain and wetland ecosystems that are resilient under a range of climatic conditions. Successful recruitment of wetland and floodplain vegetation resulting in a structurally diverse landscape. Provide suitable habitat for wetland and floodplain dependant fauna, e.g. waterbirds, macroinvertebrates, frogs and fish. Facilitate an increase in abundance of threatened flora species	80% of wetlands in healthy condition by 2025 (sustainable intact floristic assemblage). 30% of river red gum forest in healthy condition by 2025 (sustainable intact floristic assemblage and tree canopy cover →60%).
Waterbirds • Provide suitable feeding, breeding and refuge habitat for waterbirds, including colonial nesting species	A range of waterbirds present including waterfowl, colonial waterbirds and other wetland dependant species. Successful waterbird breeding events that are proportionate to the scale of flooding across the forest. A contribution to population recovery of threatened waterbird species by supporting frequent recruitment events. Provide refuge and feeding grounds for waterbirds in drier years.	Successful breeding of thousands of colonial waterbirds at least three years in 10 by 2030
Fish • Maintain healthy populations of native fish in wetlands and increase opportunities for riverine fish to access floodplain resources	Increase in the abundance of native fish species so that each exhibits a robust population structure, with a focus on the recovery of threatened species. Restore presence of locally extinct fish species to Gunbower Island. Allow for movement of native fish in and out of different habitats (creek, river, wetlands and floodplain) for feeding and breeding.	Increase of 10% in the current population of native fish species by 2025 By 2030, presence of two native fish species currently considered locally extinct Range of age/size classes of each species
Frogs • Increase the diversity and abundance of native frog species within the forest	Restore resident populations and breeding events of native frogs, especially threatened species.	By 2030, presence of one native frog species currently considered locally threatened or extinct.

Koondrook–Perricoota Forest

Table 7.2 Objectives and associated water requirements

Vegetation class or behaviour	Target or strategy	Water regime required
Objective 1: protect and enhance a diverse range of healthy wetlands (equivalent First Step Decision objective: 80% of permanent and semipermanent wetlands in healthy condition)		
Deep freshwater marshes	Reinstate 50% of the pre-regulation area of natural deep freshwater marshes. Reinstate habitat quality in deep freshwater marshes so that flora and fauna species typical of these marshes are present.	Frequency: 8–10 years in 10 Duration: 9–12 months Timing: mainly winter/spring/summer, although potentially year round Maximum time between events: 1 year Area inundated: 1% approx.
Shallow freshwater marshes	Restore 50% of shallow freshwater marsh area that has been lost since pre-regulation conditions. Restore habitat quality in shallow freshwater marshes so that flora and fauna species typical of these marshes are present. Increase species diversity in shallow freshwater marshes. Maintain and/or increase the current extent of swamp wallaby grass (*Amphibromus fluitans*).	Frequency: 6–9 years in 10 Duration: 2–8 months Timing: winter/spring/early summer Maximum time between events: 1 year Area inundated: 3% approx.
Objective 2: protect and enhance diverse, healthy vegetation communities (equivalent First Step Decision objective: 30% of river red gum forest in healthy condition)		
River red gum forest (river red gums with flood-dependent understorey)	Restore 50% of the area of river red gum forest that has been lost since river regulation. 80% of the current river red gum forest area in a 'healthy' status (Tree Health Index 4 or above).[b] Less than 20% of current river red gum forest considered 'unhealthy' (Tree Health Index 2 or below)[b]	Frequency: 3–9 years in 10 Duration: 4 months minimum Timing: winter/spring Maximum time between events: 5 years Area inundated: 40% approx.
River red gum woodland (red gums with flood tolerant understorey)	Reduce current extent of river red gum woodland.[c] 30% of the current river red gum woodland area in a 'healthy' status (Tree Health Index 4 or above).[b] 70% of current river red gum woodland area maintained at or improved to better than 'unhealthy' (Tree Health Index 2 or below).[b]	Frequency: 1–4 years in 10 Duration: 1–4 months Timing: winter/spring/summer Maximum time between events: 7 years Area inundated: 50% approx.
Black box	Maintain current extent of black box woodland. 50% of the current black box area in a 'healthy' state (Tree Health Index 4 or above).[b]	Frequency: 1–4 years in 10 Duration: 1–4 months Timing: spring/summer Maximum time between events: 7 years Area inundated: unknown.d
Objective 3: provide for successful waterbird breeding and recruitment events (equivalent First Step Decision objective: successful breeding of thousands of colonial waterbirds in at least three years out of 10)		
Breeding and recruitment	Successful recruitment of waterbirds at a frequency of at least four years in 10. Records of intermediate egret (*Ardea intermedia*) breeding in at least three years in 10.	Frequency: 4–9 years in 10 Duration: 4–10 months Timing: spring/summer Maximum time between events: 6 years Area inundated: variable. Must maintain sufficient depth under nests.

Vegetation class or behaviour	Target or strategy	Water regime required
Objective 4: protect and enhance viable native fish communities (equivalent First Step Decision objective: healthy populations of resident native fish in wetlands)		
Movement	Reduce the barriers to fish passage throughout the floodplain creek system through provision of fishways. Restore populations of cod and perch by providing opportunities for floodplain access.	Frequency: opportunistic, 6–9 years in 10 Duration: 4 months minimum to allow spawning Timing: winter/spring Maximum time between events: 4 years Area inundated: unknown Lagoons and major effluents filled as a minimum.
Breeding and recruitment	Provide for improved recruitment opportunities for small and large bodied native fish.	Frequency: opportunistic, unknown for large bodied fish Duration: 4 months minimum to allow spawning Timing: winter/spring Maximum time between events: unknown. Area inundated: unknown. Lagoons and major effluents filled as a minimum.
	Restore self-sustaining populations of southern pygmy perch (*N. Australis)*, gudgeons and other small native fish.	Frequency: 6–9 years in 10 Duration: 2–4 months Timing: winter/spring/summer Maximum time between events: 4 years Area inundated: unknown. Lagoons and major effluents filled as a minimum.

Note: since the previous environmental water management plan, the vegetation classes have been reclassified against the targets (data derived from various sources, including MDBC 2007).
a River red gum forest in this context is interpreted to include both forest and woodland forms.
b Tree Health Index ranges from 0 (dead) to 5 (healthy)
c Current extent includes degraded river red gum forest.
d Large floods are needed to attract bird breeding, followed by maintenance of water in freshwater marshes and shallow red gum forest areas to ensure successful recruitment.

7.2 Environmental watering and management

Refer to section 2.4

7.3 Environmental works and measures

Major infrastructure works and measures programs have been planned for both Gunbower Forest and Koondrook–Perricoota Forests, with the construction phase well underway.

Gunbower Forest

Construction of the lower landscape works commenced in spring 2011. These works included refurbishment of three regulators: Yarran Creek, Reedy Lagoon and Black Swamp. Construction is almost complete with some minor electrical works to finalise. Commissioning of these regulators is scheduled for August 2012. Delivery of The Living Murray water into Gunbower Forest using the lower landscape regulators will be possible during late winter–early spring 2012.

Detailed designs for the Hipwell Road package of works progressed through the 2011–12 financial year and are now complete. The construction proposal for these works is currently being developed and is scheduled for submission to the MDBA in July 2012. The project is negotiating with landowners adjacent

to the forest boundary regarding the uptake of flood easements. Statutory approvals for the Hipwell Road package of works have progressed throughout the 2011–12 financial year and are forecast to be completed in October 2012. Construction of the Hipwell Road package of works is forecast to commence in spring 2012 and be completed in spring 2013.

As part of the detailed design process for the Hipwell Road package of works, concept design for a fishway at the National Channel off-take regulator was also refined. The concept design has been completed but will not be progressed any further as part of the Gunbower Environmental Works and Measures Program, due to funding constraints for detailed design and construction.

Koondrook–Perricoota Forest

Construction works have continued during 2011–12. As a result of flooding in winter–spring 2011 and summer 2012 progress has been hindered on some levee sections and concrete structures. Construction of the Swan Lagoon structures was severely impeded by floods. A coffer dam was constructed. However, this has been overtopped during minor flows of 19,000 ML/day (downstream of Torrumbarry). Subject to future flooding, construction should be completed by February 2013.

At the end of June 2012, concrete works on most structures have been completed, including the inlet regulator and fishway, with backfilling and fitout remaining. The levee remains on the critical path and approximately half of the work has been done. Swan Lagoon structures will be completed when river and weather conditions permit access.

A number of minor changes to the project are being investigated or implemented. The levee has been realigned at a number of locations to avoid Indigenous cultural heritage sites, and the height increased in one section in response to community concerns. Minor levee works or flood easements are likely to be undertaken at the upstream end of the forest to mitigate impacts on private property. The project team is also pursuing an amendment to the approved release rates to improve the anticipated ecological outcomes of the works.

As construction nears completion, there has been increased attention on finalising operation documentation and developing advisory groups. The final version of the Operation Environmental Management Plan, as required in the approval process, was submitted to the NSW Department of Planning in July 2012.

A highly effective and innovative consultation with local Aboriginal communities was established during the planning and construction of this environmental infrastructure. Details of this consultation is provided in section 7.4.

Further information is available at www.kpforest.com.au/page/flood_enhancement_works.

7.4 Communication and community consultation

Communication and consultation activities at Gunbower–Koondrook–Perricoota during the year were focused around The Living Murray infrastructure works. Due to the delay in construction activities, further consultation will be required as construction of the works re-commences.

Communication and consultation activities relating to this icon site during 2011–12 are summarised in table 7.3.

The Koondrook–Perricoota information centre and members of the Joint Indigenous Group (photo by Irene Dowdy © MDBA)

Table 7.3 Communication and consultation activities at Gunbower–Koondrook–Perricoota Forest icon site in 2011–12

Date	Activities
July 2011 – June 2012	Staffing Koondrook–Perricoota information centre 2 days a week
July 2011 – June 2012	Fortnightly progress updates about Koondrook–Perricoota into local media
July 2011 – June 2012	Monthly Community Advisory Group and Joint Indigenous Group meetings for Koondrook–Perricoota
November 2011	Monitoring of Gunbower Creek fishways media release
November 2011	Commencement of construction on Lower Landscape regulators media release
December 2011	Article in Koondrook & Barham Bridge re discovery of burial sites during construction of the Koondrook–Perricoota Forest Flood Enhancement Project
February 2012	Community open days Koondrook–Perricoota
February 2012	World Wetlands Day activities publicised on Wetlands Australia website
February 2012	ABC radio interview Koondrook–Perricoota, front page article in the Barham bridge
February 2012	Article in Koondrook & Barham Bridge about the Koondrook–Perricoota works
February 2012	Community meeting at Leitchville
March 2012	Distribution of Flooding for Life books to community
March 2012	Sponsorship of Cohuna Bridge to Bridge canoe race
March 2012 – July 2012	Gunbower Forest Community Reference Group bi-monthly meeting
April 2012	Scoping Torrumbarry Weir display
April 2012	Sponsorship of Cohuna riding team for "Murray to Moyne"
February – June 2012	Gunbower Forest directly affected land holder meetings

Indigenous consultation

Consultation with local Aboriginal communities has proven to be highly effective, especially in connection with planning and construction of environmental infrastructure.

Koondrook–Perricoota

An innovative consultation program was established at Koondrook–Perricoota through the Environmental Works and Measures Program.

A Joint Indigenous Group (JIG), comprising of the Traditional Owners, the Barapa Barapa and Yorta Yorta nations together with the Moama Local Aboriginal Land Council (initially including the Deniliquin Local Aboriginal Land Council) was formed to provide advice and recommendations to the Koondrook–Perricoota forest project on protecting the integrity of Aboriginal culture and heritage and the development of employment opportunities.

The Joint Indigenous Group has provided valuable advice which contributed to the development of a robust and practical Indigenous Partnership Agreement and Cultural Heritage Management Plan. This has enabled the respectful and appropriate management of (at the time of writing) 13 burial sites and approximately 140 cultural sites and material. The principal contractor for construction and the associated government agencies agree the cultural heritage management has been a successful component of the project.

The Aboriginal monitoring team has assisted in discovering and respectfully managing 13 separate burial sites containing the remains of 17 individuals within the project site. The Joint Indigenous Group has acted as a conduit to the local Aboriginal community enabling a transfer of specific ancestral information. Consultation with Traditional Owners and Elders has helped develop a course of action for each of the burial sites, including realignment of designs to removal and repatriation of skeletal remains.

The project provided opportunities for local Indigenous people strategically identified via the Joint Indigenous Group to develop competencies and improve skill sets to be used within this project and future employment. This includes competencies in senior first aid, construction industry white card, TAFE accredited certificate 3 and 4 land and conservation management and articulated dump truck certification. In addition, opportunities to be employed directly by the

contractor have enabled Indigenous people to develop competencies in operating various plant equipment. Skills and competencies developed on this project have made possible three successful applications of employment in the mainstream workplace as well as build meaningful employment experience for the potential employment for many others.

The cultural heritage component of the project has reunited the local Aboriginal groups (as well as the broader local community) and reconnected the local Indigenous people to country. The project has enabled, through the respectful management of the natural resource, the transfer of local cultural heritage knowledge from generation to generation.

In addition, the MDBA is assisting the Joint Indigenous Group at the icon site to develop a schools information kit on the Living Murray program.

Gunbower

Indigenous engagement is a key component of The Living Murray program at Gunbower Forest. Indigenous communities with an interest in the Gunbower Forest have been identified and recognised as the Barapa Barapa and the Yorta Yorta Nations.

The Victorian North Central Catchment Management Authority (North Central CMA) is responsible for implementing the Indigenous Partnerships Program at the Gunbower Forest icon site. The North Central CMA has recently hired a facilitator for the Indigenous program who has begun to establish a network of contacts with Barapa Barapa, Yorta Yorta, state government cultural heritage officers and local Indigenous networks.

A key component in implementing the Indigenous Partnerships Program is the development of the cultural heritage management plans which are a statutory requirement in Victoria for construction of the Hipwell Road Channel package of works and Lower Landscape regulator works.

The North Central CMA Indigenous Facilitator has played a central role in assisting Goulburn-Murray Water (G-MW) with the coordination of Aboriginal groups during the development of the three cultural heritage management plans and assisting the groups to make meaningful and informed decisions.

In August 2011 and May 2012 the Indigenous facilitator assisted with the cultural heritage induction of G-MW work crews and compliance checks for the construction of the Lower Landscape regulator works and flow monitoring sites at the outfall. The North Central CMA, in consultation with these groups, has developed the '*Flooding for Life*' booklet with themes of Aboriginal connection to land. Over 3,000 of these booklets have been distributed to the community.

Table 7.4 Indigenous communication and consultation activities at Gunbower–Koondrook–Perricoota Forest icon site in 2011–12

Date	Activities
July 2011–June 2012	Regular monthly meetings of the Joint Indigenous Group at Koondrook–Perricoota
July 2011–June 2012	Four burial information pamphlets have been produced to communicate the issue to Barapa Barapa and Yorta Yorta people and other interested people in the region
July 2011–June 2012	Several newsletters have been produced to maintain a high level of communication
July 2011–June 2012	Multiple presentations to local schools on local Aboriginal cultural heritage by members of the monitoring team employed as part of the works
October 2011	Cultural heritage induction for Goulburn Murray Water work crews and compliance checks for Lower Landscape regulator works
May 2012	Cultural heritage induction for contractors and compliance check for outfall works
February 2012	Indigenous Family Open Day Koondrook–Perricoota

8 Hattah Lakes

8.1 Icon site description and objectives

The Hattah Lakes are an extensive complex of lakes and floodplain covering approximately 13,000 hectares. They are set within the 48,000 hectare Hattah–Kulkyne National Park and the Murray-Kulkyne Park. The site is in north–west Victoria on the bank of the River Murray, between Robinvale and Mildura.

The Hattah Lakes and the surrounding floodplain were selected as an icon site because of their size, condition, diversity and habitat value, as well as their social and cultural importance.

The system includes more than 20 perennial and intermittent freshwater lakes, ranging in size from less than 10 hectares to about 200 hectares. Twelve of the lakes are listed as internationally important wetland systems under the Ramsar Convention on Wetlands of International Significance, primarily for their value as waterbird habitat and in maintaining regional biodiversity.

Flood flows from the River Murray are essential for the environmental health of the Hattah Lakes.

However, the Hattah Lakes have been severely degraded by regulation of the River Murray and the extraction of water for agriculture, industry and urban use. The reduction in the frequency, magnitude and duration of high flows has adversely affected the wetland system.

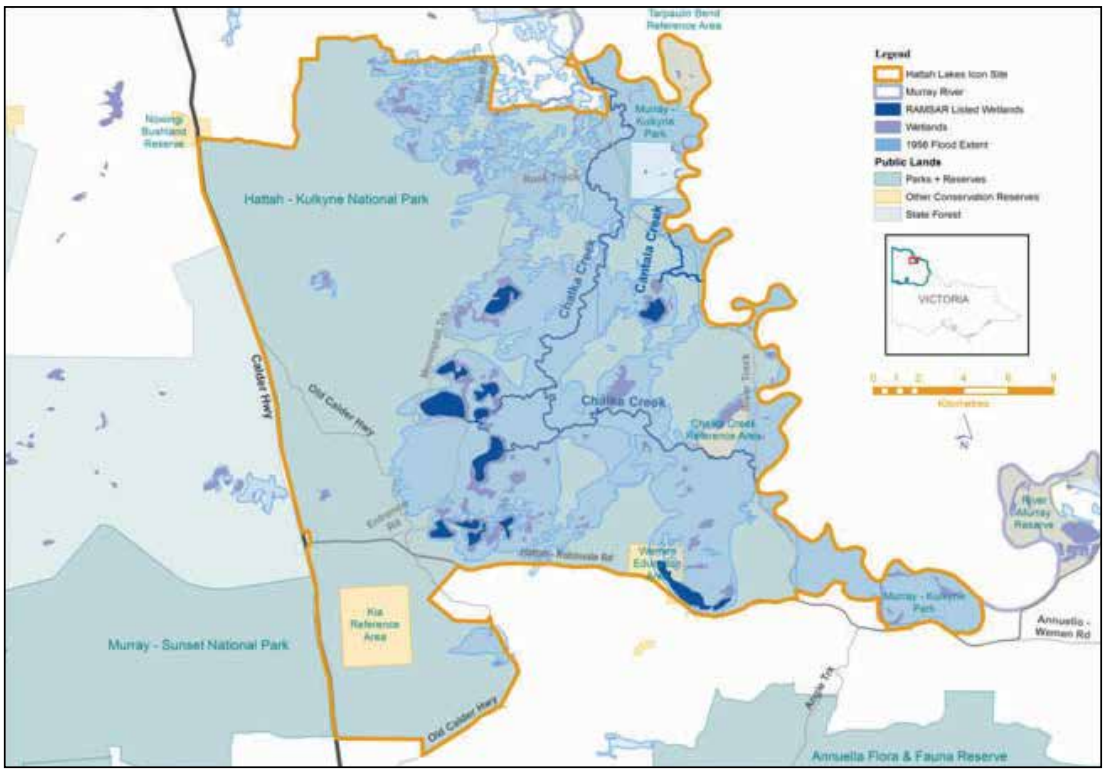

Figure 8.1 Jurisdictional boundaries and 1956 flood extent (1 in 100- year- flood): Hattah Lakes icon site

The health of river red gum and black box communities has suffered, including tree deaths and a demonstrated transition to a more dryland understorey. There has been a reduction in the amount of wetland habitat available for waterbirds, fish, frogs and turtles, and a decline in the diversity and abundance of wetland plants in the lakes.

The Mallee Catchment Management Authority (Mallee CMA) is the icon site manager for Hattah Lakes, and is guided by the icon site environmental water management plan[21]. Under the plan, The Living Murray's interim ecological objectives have been further refined as follows:

21 Available online at: www.mdba.gov.au/programs/tlm/icon_sites/emp.

Table 8.1 The vision and site-specific ecological objectives for the Hattah Lakes icon site

Vision: *Preserve and where possible enhance the biodiversity values of Hattah Lakes; and restore healthy examples of all original wetland and floodplain communities which represents the communities which would be expected under natural flow conditions*		
Icon site objectives		Targets
Overarching objectives	Detailed objectives	
Vegetation • Restore a mosaic of healthy wetland and floodplain communities to maintain the ecological character of the Ramsar site	Restore a variety of flow regimes, which represent pre-development conditions (to maximise biodiversity). Maintain and, where practical, restore the ecological character of the Ramsar site with respect to the Strategic Management Plan (2003). Restore the macrophyte zone around at least 50% of the lakes to increase fish and bird habitat. Improve the quality and extent of deep freshwater meadow and permanent open freshwater wetlands so that species typical of these ecosystems are represented.	Targets under development
Fish • Maintain high quality habitat for native fish in wetlands and support successful breeding events	Increase distribution, number and recruitment of local wetland fish — including hardyhead, Australian smelt and gudgeon by providing appropriately managed habitat. Maximise use of floodplain habitat for recruitment of all indigenous freshwater fish.	Targets under development
Waterbirds • Provide feeding and breeding habitat for a range of waterbird species, including threatened and migratory species • Provide conditions for successful breeding of colonial nesters at least twice every 10 years	Maintain habitat for the freckled duck, grey falcon and white-bellied sea-eagle in accordance with action statements. Increase successful breeding events for colonial waterbirds to at least two years in 10 (including spoonbills, egrets, night herons and bitterns). Provide suitable habitat for a range of migratory bird species (including latham's snipe, red-necked stint and sharp-tailed sandpiper).	Targets under development

8.2 Environmental watering and management

Refer to section 2.4

8.3 Environmental works and measures

The planned infrastructure works at Hattah Lakes aim to increase the frequency of natural inflows to the lakes by lowering the bed of Chalka Creek, which is the main inlet to the lakes.

The works involve:

- lowering of sills in Chalka creek to reduce the inflow threshold for passing flows
- construction of a pumping station near the confluence of the River Murray and Chalka Creek to deliver water into the lakes system
- construction of new regulators and levees, and refurbishment of an existing regulator to contain water within the lakes and surrounding floodplain, and deliver water to different parts of the system.

Once completed, these works will enable Hattah Lakes to experience more natural flooding regimes and enable up to 6,000 hectares to be flooded. This includes flooding 800 hectares at Lake Kramen. This inundation will provide crucial drought refuges and breeding habitats to support threatened wetland-dependent plants and animals.

The construction proposal, including detailed designs, was approved in August 2011. In December 2011 the MDBA authorised Goulburn–Murray Water to engage Comdain Infrastructure. Possession of the site was granted mid-March 2012, and construction began immediately to reduce the threat of delays posed by high flows in the River Murray. It is anticipated construction will be completed by September 2012.

Further information is available at: www.mdba.gov.au/files/publications/MDBA-Hattah-Lakes-13414-WEB-FAB.pdf

8.4 Communication and community consultation

A communication and community engagement plan for the Hattah Lakes has been developed (Regional Development Company 2010). The plan will ensure the community is kept well informed about the Hattah Lakes project and its progress and development.

Communication and consultation activities relating to Hattah Lakes in 2010–11 are summarised in Table 8.2

Table 8.2 Communication and consultation activities at Hattah Lakes in 2011–12

Date	Activities
May 2012	Article in Mildura Weekly — Hattah Lakes water works on schedule
September 2011 – June 2012	Presentations to a wide variety of community groups relating to works and measures, construction and environmental watering at the Hattah Lakes under the Living Murray Program
November 11 – June 2012	Twitter updates
November 2011	Development of fact sheets and FAQs relating to the project for distribution in hard copy and electronically.
July 2011 – June 2012	MCMA Webpage updates relating to works preparations and works progress
July 2011 – June 2012	Provision of leaflets relating to Hattah Lakes projects to numerous local stores for display and distribution in shopping bags.
Jan 2012 – June 2012	Preparation and erection of signs providing details of works and measures for display at the entrances to the National Park.
July 2011 – June 2012	One on one consultation with interested community members by phone or in person as required.
Feb 2012	Briefing for Parks Victoria Field staff on project details.

Indigenous consultation

Indigenous engagement is a key part of the Hattah Lakes project. It is essential that local Aboriginal communities be consulted at all stages of the Hattah Lakes infrastructure project to ensure cultural beliefs and significant sites are respected.

The Mallee CMA and the Indigenous facilitator implement the Indigenous Partnership Program at Hattah Lakes.

The Living Murray Indigenous facilitator assists the project team in ensuring local Aboriginal communities are fully informed, engaged and consulted. This is critical to the success of the icon site.

An informal steering committee has been established for Indigenous groups involved in cultural heritage management plan work for Hattah Lakes. Groups on the steering committee include Tati Tati, Latji Latji, Weregai and the Munatunga Elders group. Groups consist of Native Title claimants/applicants and Registered Aboriginal Party applicants (as defined under the Victorian Cultural Heritage Act 2006).

Presentations, meetings, discussions and on-site assessments have been conducted to further improve the working relationship between The Living Murray program and the local Indigenous people.

In Robinvale, the community welcomed the concept of Use and Occupancy Mapping with around 50 Tati Tati and Robinvale people taking part in the exercise. This has resulted in over 5,000 places being mapped.

The commencement of the Hattah Lakes infrastructure in March 2012 triggered the implementation of the icon site's Cultural Heritage Management Plan. This includes cultural heritage monitors who ensure the protection of important sites and the salvaging of Aboriginal artefacts.

Table 8.3 Indigenous communication and consultation activities at Hattah Lakes in 2011–12

Date	Activities
July 2011–June 2012	An informal steering committee has been established for Indigenous groups
July 2011–June 2012	Meetings, discussions, presentations and on-site assessments have been undertaken
December 2011 – June 2012	Implementation of the Hattah Lakes cultural heritage management plans during the preworks and construction of the Hattah Lakes works.

9 Chowilla Floodplain and Lindsay–Wallpolla Islands

9.1 Icon site description and objectives

The Chowilla Floodplain and Lindsay–Wallpolla Islands icon site covers a total area of 43,856 hectares. The icon site comprises four main components: Chowilla (including Kulcurna), and the Lindsay, Mulcra and Wallpolla islands.

The Chowilla Floodplain and Lindsay–Wallpolla Islands icon site retains much of the area's natural character and attributes. It has a high diversity of terrestrial and aquatic habitats and supports populations of rare, endangered and nationally threatened species. It also includes several sites of cultural significance that are heritage protected. The icon site is also important for its recreational and economic values.

The Lindsay–Wallpolla Islands are particularly important as they support a number of Murray cod and other native fish nurseries, a diversity of landforms, and a range of fish and bird species.

The health of the Lindsay–Wallpolla system depends on flood flows from the River Murray, but river regulation and water extraction have reduced the frequency and duration of flooding across the islands, threatening the system's health. Reduced flows have degraded flora, fauna and cultural values associated with waterways and wetlands.

The Chowilla Floodplain, covering 17,781 ha, forms the largest floodplain complex in the lower River Murray and is part of the Riverland Ramsar Wetland of International Importance. The floodplain is dependent on the River Murray and a system of more than 100 km of anabranch creeks for flooding.

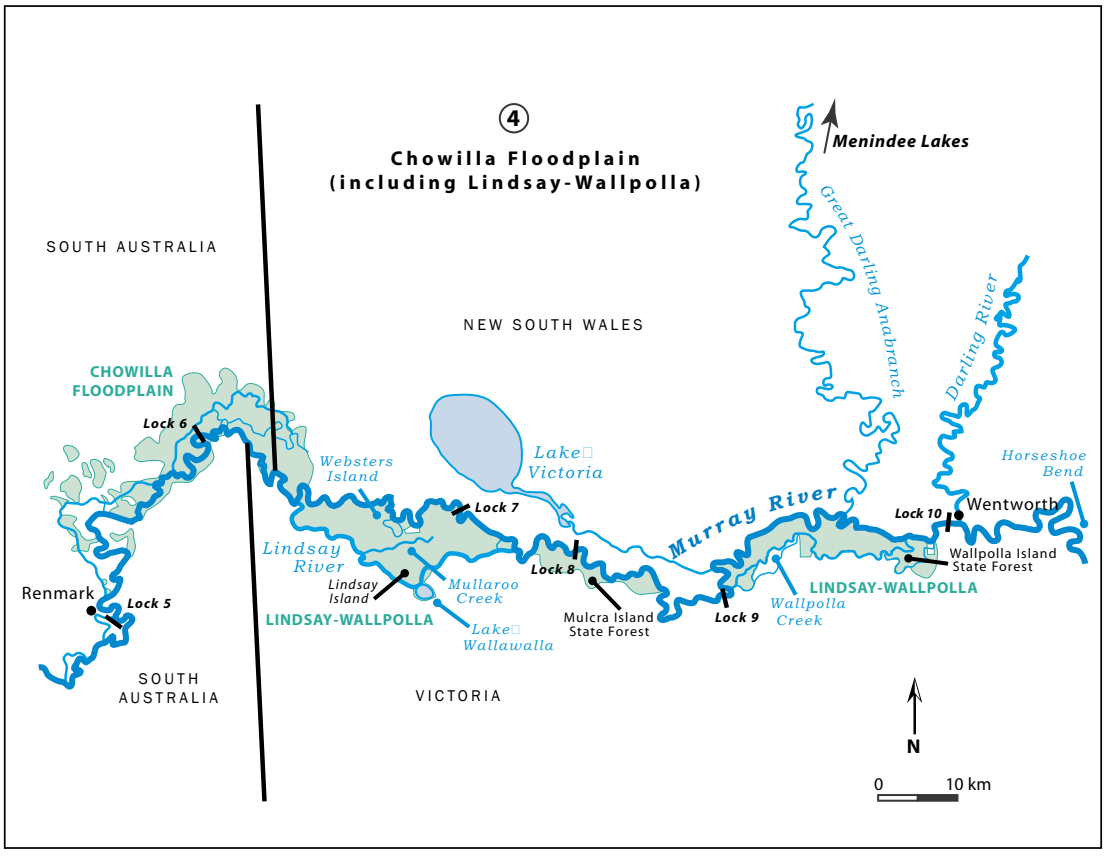

Figure 9.1 Chowilla Floodplain and Lindsay–Wallpolla Islands icon site

The key threats to the Chowilla Floodplain are altered flow regimes, an elevated and altered groundwater regime, obstruction to fish passage, and plant and animal pests. Flow regulation and upstream diversions in particular have reduced flooding frequencies and durations, as well as elevating saline groundwater levels, significantly affecting native fauna and flora. In particular, the health of the icon site's river red gum and black box woodlands have been rapidly declining.

Victoria's Mallee Catchment Management Authority, the South Australian Department of Environment, Water and Natural Resources and the New South Wales Office of Water, jointly implement The Living Murray program at the site.

Under the current icon site environmental water management plan The Living Murray's interim ecological objectives for this site have been defined as follows:

Chowilla Floodplain:

Table 9.1 Site-specific ecological objectives: Chowilla Floodplain (MDFRC 2008)

Refined site-specific ecological objectives by functional groups	
Vegetation	
(1)	Maintain viable river red gum populations within 70% (2,414 ha) of river red gum woodland.
(2)	Maintain viable black box populations within 45% (2,075 ha) of black box woodland.
(3)	Maintain viable river cooba (*Acacia stenophylla*) populations within 50% of river cooba, and mixed red gum and river cooba woodland areas.
(4)	Maintain viable lignum (*Muehlenbeckia florulenta*) populations in 40% of areas.
(5)	Improve the abundance and diversity of grass and herblands.
(6)	Improve the abundance and diversity of flood-dependent understorey vegetation.
(7)	Maintain or improve the area and diversity of grazing sensitive plant species.
(8)	Limit the extent of invasive (increaser) species including weeds.
(9)	Improve the abundance and diversity of submerged and emergent aquatic vegetation.
Fish populations	
(10)	Maintain or increase the diversity, extent and distribution of native fish species.
(11)	Maintain successful recruitment of small and large bodied native fish.
Frog populations	
(12)	Maintain sustainable communities of the eight riparian frog species recorded at Chowilla.
(13)	Improve the distribution and abundance of the nationally-listed southern bell frog at Chowilla.
Bird populations	
(14)	Create conditions conducive to successful breeding of colonial waterbirds in a minimum of three temporary wetland sites at a frequency of not less than one in three years.
(15)	Maintain or improve the diversity and abundance of key bird species.
(16)	Maintain the current abundance and distribution of regent parrots (*Polytelis anthopeplus*)
(17)	Maintain the current abundance and distribution of the bush stone-curlew (*Burhinus grallarius*)

Lindsay, Mulcra and Wallpolla islands:

Table 9.2 Revised ecological objectives for the Lindsay–Wallpolla icon site

Vision: *To maintain and restore a mosaic of healthy floodplain communities across Lindsay, Mulcra and Wallpolla Islands ensuring that indigenous plant and animal species and communities survive and flourish throughout the site*		
Icon site ecological objectives		Targets
Overarching objectives	Specific objectives	
Vegetation • Increase the diversity, extent and abundance of wetland vegetation	Provide a diversity of structural aquatic habitats. Increase diversity and abundance of wetland aquatic vegetation. Maintain and improve the populations of threatened flora and fauna that are flow dependent. Restore productivity linkages between the river and floodplain habitats.	Targets under development
Fish • Increase abundance, diversity and extent of distribution of native fish	Increase abundance, diversity and extent of distribution of native fish.	Targets under development
Waterbirds • Provide habitat for a range of waterbirds, including migratory species and colonial nesters	Provide occasional breeding and roosting habitat for colonial waterbirds. Provide habitat suitable for migratory birds, especially species listed under the JAMBA, CAMBA and RoKAMBA.	Targets under development

9.2 Environmental watering and management

Refer to section 2.4.

9.3 Environmental works and measures

The works at this icon site include three major projects at Chowilla, Mulcra Island and Lindsay Island.

Chowilla Floodplain

The works under construction on the Chowilla Floodplain are the largest of the projects for the Chowilla Floodplain and Lindsay–Wallpolla Islands icon site and will enable inundation of large areas of the floodplain at frequencies similar to natural conditions. The project involves the construction of a major regulator on Chowilla Creek along with complementary minor infrastructure works. Together, depending on prevailing flow conditions, these works will allow up to 30–50% (approximately 5000–9000 ha) of the floodplain to be inundated at relatively lower river flows to restore floodplain health.

Construction works at Chowilla commenced in January 2010 with an initial completion date scheduled for December 2011. As a result of high flows to South Australia, construction work ceased in October 2010 and did not recommence until May 2012. This recommencement has only been made possible by additional work on the coffer dam at the main regulator. This has increased the flow rate at which work can safely occur to 45,000 ML/day.

The complementary minor works involves the upgrade of weirs on Pipeclay and Slaney creeks which will enable enhanced management of inflows to the Chowilla floodplain. Fishways will also be added to these structures.

Without further interruptions, and with periods of lower flows allowing work at Slaney and Pipeclay regulators to be completed, it is expected that a further 15 months of work is required to complete all construction on the floodplain.

The earliest possible operation of the Chowilla Creek environmental regulator is expected to be spring–summer 2013. The upgraded Pipeclay and Slaney creek weirs could be operational as early as autumn 2013, assuming the construction program remains uninterrupted.

Further information is available at: www.mdba.gov.au/files/publications/MDBA-13574-Chowilla-Floodplain-v5.pdf.

Mulcra Island

The proposed works at Mulcra Island are similar to the Chowilla project but on a smaller scale. The works will increase the frequency of flooding to the island's floodplains and wetlands by diverting water from the River Murray above Lock 8 to flood up to 800 ha of floodplains and wetlands. The works include construction of several regulators, erosion control works, and silt removal.

Construction works at Mulcra Island were nearing completion in September 2010 when they were hit by the 2010–11 floods. This damaged the main regulator and embankment. Following a review of the failure mechanisms that contributed to this damage, the design for the repairs was completed in late 2011–12. This will enable repairs to the main structure, and completion of minor works at one of the ancillary structures, to be completed during the 2012–13 summer, provided work can continue uninterrupted.

Lindsay Island

The proposed works at Lindsay Island involve:

- construction of two small regulators on the upper Lindsay River to allow greater variability of flow through that system
- replacement of the existing fixed crest weir in the Mullaroo Creek with a gated structure and fishway.

During early 2011–12 flooding restricted access to the site. This delayed the collection of geotechnical data essential for the detailed design of works at Mullaroo Creek and the preparation of statutory approval documentation. Designs have been completed and final approvals are anticipated in the first half of 2012–13.

Completion of the upper Lindsay structures is likely during 2012–13, while the completion of the Mullaroo Creek regulator is likely to be delayed until the summer of 2013–14. This delay is because construction can only take place between December and June to limit endangering Murray cod populations in Mullaroo Creek.

9.4 Communication and community consultation

Chowilla Floodplain

The South Australian Department of Environment, Water and Natural Resources is responsible for community consultation and communication activities for this icon site.

The Chowilla Floodplain Community Reference Committee was formed during 2005. It has met approximately four times per year since its establishment to provide informed input to the planning and management of the Chowilla project and activities. The Community Reference Committee includes representation from key stakeholder groups, including site lessees, neighbouring landholders, the Aboriginal community, irrigation and tourism industries, conservation and recreation interests and local government. The committee also comprises representatives from the Lower Murray Darling and the Mallee catchment management authorities, and New South Wales and South Australian government agencies.

Lindsay–Wallpolla

The engagement strategies focus on ensuring that the community is informed of the context, history, proposed processes, constraints and opportunities for environmental water management at the Lindsay, Mulcra and Wallpolla islands. This in turn will better enable environmental water managers to consider community values and knowledge in decision making.

Table 9.3 Communication and consultation activities at Chowilla Floodplain and Lindsay–Wallpolla Islands (including Mulcra) icon site in 2011–12

Date	Activities
July 2011–June 2012	Chowilla information signs
August 2011	Presentation at CARE team meeting (network of local planning and other NRM officers)
September 2011	Chowilla Community Reference Group meeting
October 2011	Finalisation of The Living Murray interpretation panels at the Mildura Visitor Information Centre
October 2011	Natural Resources Committee of Parliament tour of Chowilla floodplain
October 2011	Briefing for SA Premier and Minister visit to Chowilla Floodplain
February 2012	Win TV piece regarding Chowilla works
March 2012	Tour of Chowilla for AusAid Indonesian water managers in conjunction with the International Centre of Excellence in Water Management Tour of Chowilla for DENR Regional Assets Services Officers Tour of Chowilla for DFW executives Renmark to Border LAP Community Twilight tour
March 2012	Community Reference Committee meeting
April 2012	Chowilla Coordinating Committee meeting
April 2012	Presentation to NRM Board River Murray Youth Council
April 2012	ABC Riverland interview on water pumped to Coombool Swamp Chowilla
May 2012	Adelaide Advertiser — $35m weir to quench thirst of wetlands
May 2012	Presentation to SA MDB NRM Board's Riverland NRM Local Government Advisory Group re Chowilla projects
June 2012	ABC Riverland interview on the Chowilla works
June 2012	Chowilla Coordinating Committee meeting
June 2012	Presentation to delegation of Senior Water Managers from Iraq

Indigenous consultation

Consultation with local Aboriginal communities is an important component of The Living Murray program, particularly in planning and constructing new infrastructure. The consultation process for Chowilla and Lindsay–Wallpolla Islands is more difficult than at some other icon sites because this site stretches over a much greater distance and because it straddles three states.

Separate Indigenous Facilitators are employed at the New South Wales, Victorian and South Australian sections of the Chowilla icon site.

The positions of Indigenous Facilitator in New South Wales and South Australia have been vacant for some months and have been recently readvertised. Nevertheless, considerable consultation with Traditional Owners continued throughout the year.

The New South Wales Office of Water held several meetings with the Barkindji Maraura Elders Council to inform and consult with them on The Living Murray activities. One of the NSW Office of Water's key achievements this financial year was the completion of the *'Report for Kulcurna Station Conservation Reserve: Cultural Heritage Management Plan.'* Kulcurna Station Conservation Reserve is situated within the eastern NSW area of the Chowilla Floodplains icon site.

The study assessed both Aboriginal and historical heritage values within the reserve to better formulate a heritage management framework. The Barkindji Maraura Elders Council were consulted and provided advice during the development of the report. Barkindji Maraura Elders Council members also participated in a flora and fauna survey to identify their ecological views and values in relation to cultural watering of vegetation communities and environments within the floodplains. The report recommends formalising the considerations of the Barkindji Maraura Elders Council into The Living Murray icon site environment watering plan.

Despite the vacant position in South Australia, the Department has undertaken consultation and engagement with local Aboriginal communities. The Department has organised tours of the Chowilla Floodplain icon site for Riverland Aboriginal women's and men's groups, including site inspections of works and measures. The program has also developed a partnership with the local Working on Country Team. This has resulted in the Working On Country team being trained in the assessment of red gum health, and mapping technology including the implementation of an ongoing scar tree mapping project on the Chowilla floodplain.

In Victoria, the Mallee CMA and the Indigenous facilitator assist the project team in ensuring the local Indigenous community is fully engaged, informed and involved in the project. This is achieved through face-to-face and community meetings, a quarterly newsletter, fact sheets and Mallee CMA website updates.

An informal steering committee has been established for Indigenous groups involved in the Cultural Heritage Management Plan. At Lindsay–Wallpolla groups on the steering committee include Ngintait people, Weregai/Nyeri Nyeri, Latji Latji Native Title Group, Mildura Aboriginal Corporation and Gilby Corporation.

Several presentations, meetings, discussions and on-site assessments have been undertaken in an effort to further improve the working relationship between The Living Murray program and the local Indigenous people.

A DVD showcasing Indigenous engagement at Mulcra Island has been produced and is available from Mallee CMA. *'Steps in the right direction'* focuses on the development of cultural heritage management plans.

Table 9.4 Indigenous communication and consultation activities at Chowilla Floodplain and Lindsay–Wallpolla Islands (including Mulcra) icon site in 2011–12

Date	Activities
July 2011–June 2012	Implementation of Indigenous Partnerships Program
September 2011	Riverland Aboriginal Mens Group tour
September 2011	Riverland Aboriginal Womens Group tour
July 2011-June 2012	Development of CHMPs for the Lindsay River Inlet Regulators and Mullaroo Inlet Regulator and Fishway.

The regulator under construction at Chowilla Floodplain (photo MDBA)

10 The Lower Lakes, Coorong, and Murray Mouth

10.1 Icon site description and objectives

Lakes Alexandrina and Albert (the Lower Lakes), the Coorong and Murray Mouth icon site is located at the end of the River Murray system. The site covers approximately 140,000 hectares, is a Ramsar-listed Wetland of International Importance and is also one of 18 key indicator sites of the Murray-Darling Basin. The site has a unique mosaic of 23 Ramsar wetland types and provides habitat for nationally significant species.

The River Murray flows into Lake Alexandrina near Wellington before flowing into Lake Albert, the Coorong and out through the Murray Mouth. Lake Albert only receives flows directly from Lake Alexandrina via the Narrung Narrows and has no other inlets for exchange of inflows or outflows. The freshwater of Lake Alexandrina is separated from the Coorong by a series of barrages built in the 1930s and 1940s.

The Coorong is a long, shallow lagoon, 140 km in length, separated from the Southern Ocean by a narrow sand dune peninsula. The Coorong comprises two lagoons – North and South – which are divided by a headland (Parnka Point). Water in the Coorong varies from fresh to hyper-saline depending on a series of factors including flow releases over the barrages, the width of the Murray Mouth and the relative positioning of the Murray Mouth to the barrages. The water in the Coorong becomes increasingly saline with distance from the mouth. Salinity can be several times that of sea water salinity in the South Lagoon.

The Murray Mouth joins the Coorong to the Great Southern Ocean and in recent years extensive dredging has been required to keep the Murray Mouth open. The closure of the Murray Mouth was due to the reduction and cessation of River Murray flows as a consequence of increasing diversions and the extended period of drought spanning from 2005-10. Since the break of the drought and return of flows in spring 2010, dredging operations have now ceased.

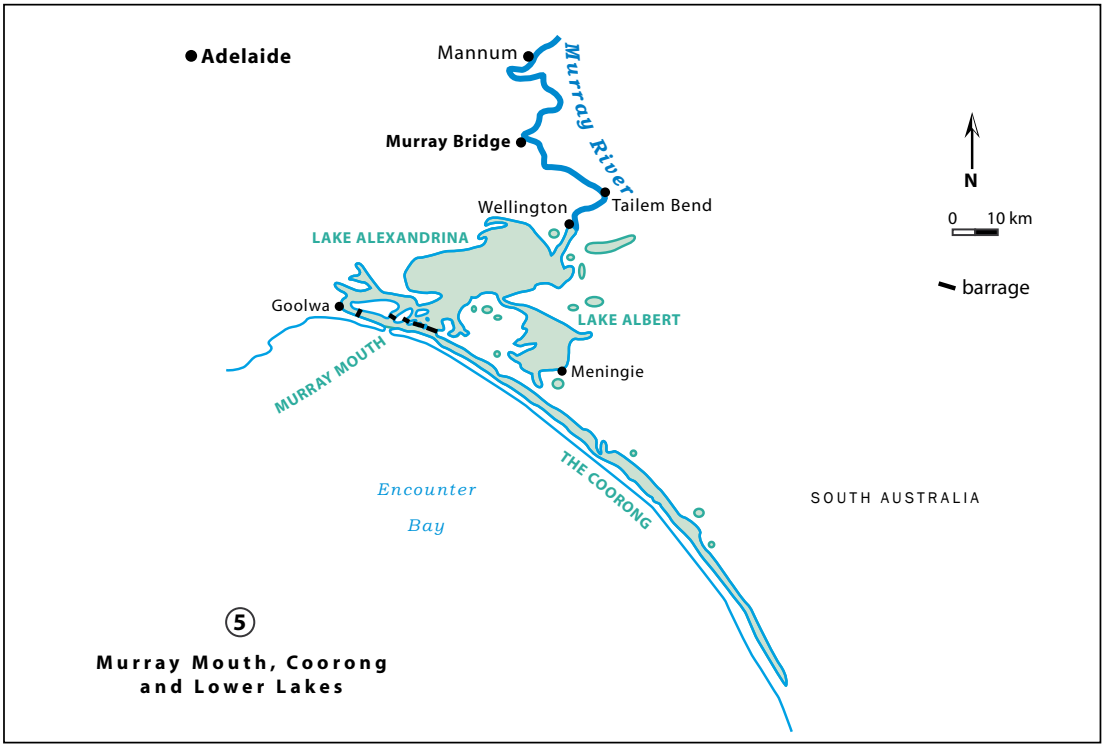

Figure 10.1 The Coorong, Lower Lakes and Murray Mouth icon site

The Lower River Murray environment includes a diverse range of ecosystems covering the spectrum between freshwater and hypersaline environments, and from the ephemeral to the permanent. This area, where the River Murray meets the sea, is one of the most important habitats for large concentrations of migratory birds (particularly waders) in Australia, and is recognised internationally as a breeding ground for many species of waterbirds and native fish. In addition, the site also holds important social, recreational, economic and cultural values for the Ngarrindjeri Traditional Owners and for a range of community groups and stakeholders.

Even before the severe drought, the ecological health of the Lower Lakes, Coorong and Murray Mouth had been in decline for some time. It has been severely degraded by the regulation of the River Murray and the extraction of water for agriculture, industry and human consumption and, to a lesser extent, a reduction of inflows from the south east into the Coorong's South Lagoon.

The flow regime entering and passing through the site is now very different in volume, intensity and frequency compared to natural conditions. Being at the end of the River Murray system, this zone is under the greatest hydrological stress of any icon site in the system.

The overarching vision of The Living Murray Lower Lakes, Coorong and Murray Mouth icon site, is to facilitate *'A healthier Lower Lakes and Coorong estuarine environment'* through achieving its key ecological objectives including:

- an open Murray Mouth
- more frequent estuarine fish spawning and recruitment
- enhanced migratory waterbird habitat in the Lower Lakes and Coorong.

A revised icon site Environment Water Management Plan was developed during 2011-12 which included a series of ecological targets. These are provided in table 10.1. The revised environmental water management plan has yet to be formally approved by Ministerial Council.

10.2 Environmental watering and management

Refer to section 2.4.

10.3 Environmental works and measures

There have been no environmental works and measures undertaken at the Lower Lakes, Coorong and Murray Mouth icon site since 2010–11. No future The Living Murray funded environmental works have been identified at this stage.

Future works to install additional fishways at barrages within the Lower Lakes, Coorong and Murray Mouth are currently being investigated by the Department of Environment, Water, and Natural Resources, Murray Futures Program, funded by the Commonwealth Water for the Future program.

10.4 Communication and community consultation

Communication and consultation activities relating to the Lower Lakes, Coorong and Murray Mouth in 2011–12 are summarised in table 10.2 and table 10.3.

An adult fairy tern in the southern lagoon of the Coorong in 2012. The fairy tern is listed as endangered in South Australia (photo by Pamela Gillen)

Table 10.1 Summary of revised ecological targets and their contribution to icon site objectives

Target ID#	Ecological target	Icon site objective		
		Open mouth	Fish recruitment	Bird habitat
B1	Maintain or improve bird populations in the Lower Lakes, Coorong and Murray Mouth	✓		✓
F1	Maintain or improve recruitment success of diadromous fish in the Lower Lakes and Coorong	✓	✓	
F2	Maintain or improve recruitment success of endangered fish species in the Lower Lakes		✓	
F3	Provide optimum conditions to improve recruitment success of small-mouthed hardyhead in the South Lagoon		✓	
F4	Maintain or improve populations of black bream, greenback flounder and mulloway in the Coorong	✓	✓	
I1	Maintain or improve invertebrate populations in mudflats (both exposed and submerged)	✓	✓	✓
I2	Provide freshwater flows that provide food sources for Goolwa cockles	✓		
M1	Facilitate frequent changes in exposure and submergence of mudflats	✓		✓
M2	Maintain habitable sediment conditions in mudflats			✓
V1	Maintain or improve *Ruppia megacarpa* colonisation and reproduction		✓	✓
V2	Maintain or improve *Ruppia tuberosa* colonisation and reproduction		✓	✓
V3	Maintain or improve aquatic and littoral vegetation in the Lower Lakes		✓	✓
W1	Establish and maintain variable salinity regime with →30% of area below sea water salinity concentrations in estuary and North Lagoon		✓	✓
W2	Maintain a permanent Murray Mouth opening through freshwater outflows with adequate tidal variations to improve water quality and maximise connectivity	✓	✓	✓
W3	Maximise fish passage connectivity between the Lower Lakes and Coorong		✓	
W4	Maximise fish passage connectivity between the Coorong and the sea	✓	✓	

Icon site objectives – Open mouth: an open Murray Mouth; fish recruitment: more frequent estuarine fish recruitment; bird habitat: enhanced migratory wader bird habitat in the Lower Lakes. Target ID – B: bird-related target; F: fish-related targets; I: invertebrate-related targets; M: mudflat-related targets; V: vegetation-related targets; W: water-related targets

Table 10.2 Communication and consultation activities at the Lower Lakes, Coorong and Murray Mouth in 2011–12

Date	Activities
July 2011–June 2012	Consultation for the Lower Lakes, Coorong and Murray Mouth Icon Site Environmental Water Management Plan
July 2011	Lower Lakes, Coorong and Murray Mouth Icon Site Community Reference Committee meeting
August 2011	Coorong, Lower Lakes and Murray Mouth monitoring showcase
September – October 2011	Preparation and interpretation of TLM display for the launch of Native Fish Awareness Week
October 2011	Presentations to the National Water Commission, DFW Murray–Darling Basin Policy and Reform Unit and the Ngarrindjeri Regional Authority on The Living Murray Lower Lakes, Coorong and Murray Mouth icon site
March 2012	Meeting with SAMDBNRM Board staff and local volunteers to discuss Narrung Wetland and introduce the new TLM Lower Lakes, Coorong and Murray Mouth Icon Site Project Officer
March 2012	Tour of Lower Lakes and barrages for Canadian exchange staff
March 2012	Draft article on Threatened Fish Monitoring program
April 2012	First meeting of the newly formed Community Advisory Panel (CAP). The South Australian Minister for Water and the River Murray attended along with departmental Executives and project staff
April – May 2012	Development of TLM Lower Lakes, Coorong and Murray Mouth Icon Site fact sheet
April 2012	Attendance at the South Australian Freshwater Fish Strategic Working Group meeting and contribution to the South Australian MDB Freshwater Fish Strategic Plan 2012 – 2022
May 2012	Development of TLM Lower Lakes, Coorong and Murray Mouth Icon Site banner
May 2012	Second CAP meeting held at Langhorne Creek
May 2012	Draft media release results of LLCMM TLM monitoring program
May 2012	Tour of Coorong for National Parks conference
May 2012	Article for DFW internal newsletter
May 2012	Final meeting of Lower Lakes, Coorong and Murray Mouth Icon Site Community Reference Committee (has been replaced by TLM/Murray Futures Community Advisory Panel)
June 2012	Attendance at the South Australian Freshwater Fish Strategic Working Group meeting and further contribution to the South Australian MDB Freshwater Fish Strategic Plan 2012 – 2022
June 2012	Article to the Lakes HUB newsletter

Indigenous consultation

In South Australia the Department of Environment, Water and Natural Resources, formerly the Department for Water, takes responsibility for The Living Murray Icon Site Indigenous Partnerships Project for the Lower Lakes, Coorong and Murray Mouth icon site.

Representatives from The Living Murray program work in collaboration with the Ngarrindjeri Regional Authority, who represents the Ngarrindjeri Aboriginal communities of the Lower Lakes, Coorong and Murray Mouth region.

The Ngarrindjeri Regional Authority input into the revision of the Lower Lakes, Coorong and Murray Mouth Icon Site Environmental Water Management Plan was coordinated by the – Ngarrindjeri Regional Authority-based Research, Policy and Planning Unit within Flinders University. Ngarrindjeri Regional Authority representatives presented information to The Living Murray staff within the Department of Environment, Water and Natural Resources following presentations to Ngarrindjeri Elders and regular attendance at the Kungun Ngarrindjeri Yunnan Agreement Taskforce Working Group meetings.

The Ngarrindjeri had previously provided input into the initial Lower Lakes, Coorong and Murray Mouth icon site plan, in particular with regard to ecological targets, management options and the provision of cultural knowledge on a range of issues. The final draft plan was endorsed by the Ngarrindjeri Regional Authority.

Ngarrindjeri Yarluwar-Ruwe staff assisted The Living Murray condition monitoring contractors with the collection of field data in the Lower Lakes, Coorong and Murray Mouth region. To date, two Ngarrindjeri Yarluwar-Ruwe staff have spent eight days assisting staff with the Lower Lakes and Coorong fish condition monitoring programs.

The Living Murray staff, on behalf of the Lower Lakes, Coorong and Murray Mouth icon site, have worked cooperatively with Ngarrindjeri Regional Authority key staff to develop a Ngarrindjeri cultural heritage training package for The Living Murray monitoring providers. The training is aimed at service providers who work on Ngarrindjeri country under The Living Murray program, and focuses on heritage issues, the link between the Ngarrindjeri and their connection to Country, future research opportunities and a historical overview of Ngarrindjeri cultural heritage in the Lower Lakes, Coorong and Murray Mouth region. The purpose of the cultural training is for researchers to network with Ngarrindjeri staff and Elders, and to reduce the likelihood of culturally significant sites being disturbed during monitoring activities.

This training package was delivered to The Living Murray staff and service providers at a workshop held at Camp Coorong in May 2012.

Table 10.3 Indigenous communication and consultation activities at the Lower Lakes, Coorong and Murray Mouth in 2011–12

Date	Activities
July 2011–June 2012	Implementation of Indigenous Partnerships program
July 2011–June 2012	Ngarrindjeri Regional Authority input into the Lower Lakes, Coorong and Murray Mouth Icon Site Environmental Water Management Plan
January – June 2012	Regular attendance at Kungun Ngarrindjeri Yunnan Agreement Taskforce monthly meetings to discuss TLM work in the Lower Lakes, Coorong and Murray Mouth region and consult with Ngarrindjeri Regional Authority staff on heritage issues etc
March – June 2012	Regular attendance at Kungun Ngarrindjeri Yunnan Agreement Taskforce Working Group monthly meetings
February – June 2012	Attendance at Ngarrindjeri Regional Authority Coorong Lower Lakes Murray Mouth Murray Futures and TLM Research and Monitoring Working Group meetings to discuss Ngarrindjeri Regional Authority opportunities, Ngarrindjeri cultural heritage training package, and monitoring being undertaken in the Lower Lakes, Coorong and Murray Mouth icon site
March 2012	Icon site coordinator met with Ngarrindjeri Regional Authority representatives and Department of Environment, Water and Natural Resources wetland officers at Narrung Wetland to decide on actions relating to water level management of Narrung Wetland
April 2012	Icon site coordinator and project officer met with Ngarrindjeri Regional Authority and Department of Environment, Water and Natural Resources wetland project officers at Narrung Wetland to further discuss management objectives for Narrung and Waltowa Wetlands including traditional Ngarrindjeri cultural heritage issues
April 2012	TLM monitoring service providers engaged Ngarrindjeri Yarluwar-Ruwe staff in collecting field data and undertaking fish monitoring in the Coorong
May 2012	Icon site coordinator and Ngarrindjeri Regional Authority staff presented to park managers and visiting Indigenous representatives from Australian and New Zealand at a field tour of the Coorong and Murray Mouth
May 2012	Ngarrindjeri Regional Authority were consulted on the Lower Lakes, Coorong and Murray Mouth icon site fact sheet and banner
May 2012	TLM and Coorong, Lower Lakes, Murray Mouth Murray Futures staff engaged with NRA representatives and approximately 20 monitoring service providers as part of a Ngarrindjeri cultural heritage training day at Camp Coorong
June 2012	Icon site coordinator met with the icon site Indigenous facilitator to discuss completed milestones in preparation for MDBA reporting

11 River Murray Channel

The River Murray is highly regulated. From the damming of its headwaters at Lake Hume until it reaches the Southern Ocean, it is constrained by a series of dams, weirs and barrages. The effects of this regulation accumulate over time, making the challenge of replicating natural flows and their effects difficult to achieve.

This past year has seen high rainfall, unregulated flows and flooding. For a time, the river threw off its constraints. Despite significant damage to private property and to river infrastructure, the ecological benefits have been significant, particularly coming after years of debilitating drought.

Flooding disrupted and delayed construction work on the Sea to Hume Fishway Program.

11.1 Icon site description and objectives

The River Murray Channel connects the riverine ecosystem and many floodplain and wetland ecosystems including the other five icon sites. Several threatened species and ecological communities rely on the River Murray Channel.

The River Murray Channel is over 2,000 kilometres in length, and includes the bed and banks of the river, the water within it, and the surrounding dependent riverine ecosystem. It connects headwaters, lowlands, the estuary and the ocean, delivering the water, sediment and nutrients required to maintain the integrity of these areas.

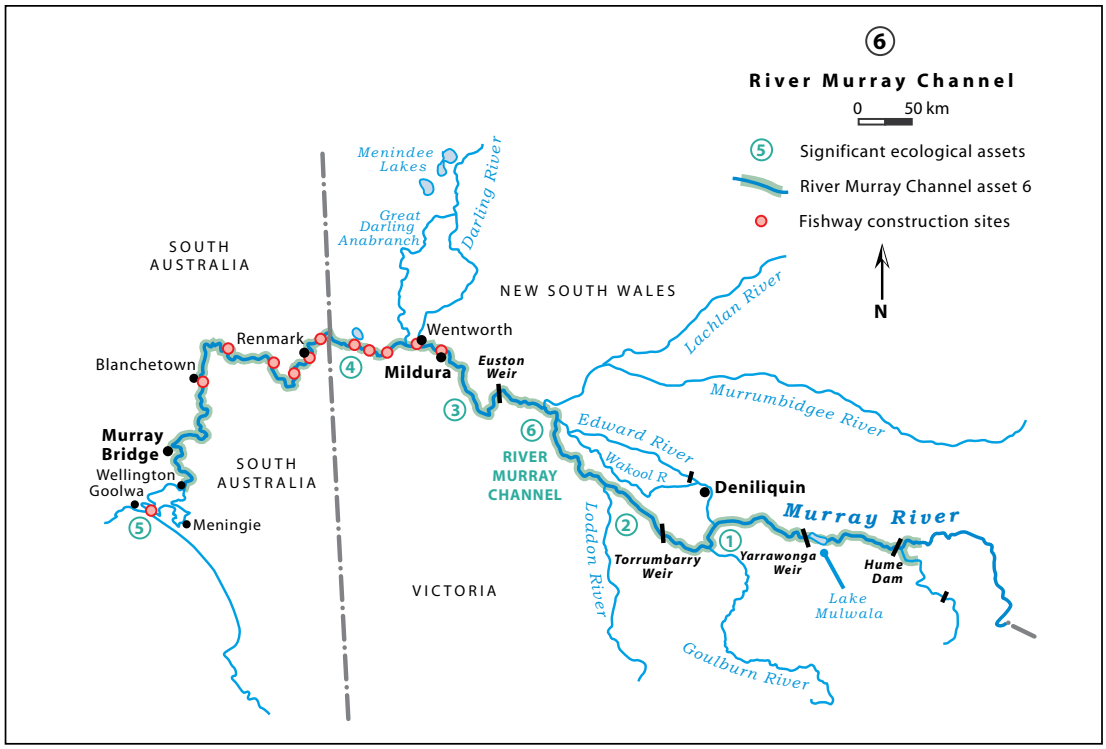

Figure 11.1 River Murray Channel icon site

Lake Mulwala and Yarrawonga Weir, which is the largest weir on the Murray (photo by Michael Bell © MDBA)

It is essential to consider the River Murray Channel together with its floodplain, wetland and estuarine systems, because the integrity of these systems depends on vital connections and exchanges of water, nutrients, organic material and organisms within river channel.

The Living Murray's objectives for the River Murray Channel are to:

- increase the frequency of ecologically significant flows during spring
- overcome barriers to migration of native fish species between the sea and Hume Dam
- maintain current levels of channel stability.

In line with other icon sites a review of the River Murray Channel 2006–07 Environmental Management Plan commenced in 2011–12. It is anticipated this review will conclude in 2012–13.

11.2 Enviromental watering and management

The water provided for the River Murray Channel is shown in table 2.1 and table 2.2.

11.3 Environmental works and measures

Work at this site is dominated by the Sea to Hume Fishway Program. This program aims to restore fish passage along the length of the River Murray and involves the construction of 12 new fishways along the river, as well as new fishways on the Edward River off take (NSW), Stevens Weir (NSW), and Tauwitchere Barrage (South Australia).

Work on the Sea to Hume Fishway Program continued during 2011–12, details of the sites are:

- Locks 2 and 4 — construction was interrupted by flood. Work has been scheduled to recommence in summer 2013–14
- Lock 11 (Mildura) — construction commenced but was interrupted by flood. Work has been scheduled to recommence in summer 2013–14
- Lock 15 (Euston) — construction was interrupted by flood. Work has been scheduled to recommence in summer 2013–14
- Edward River Offtake — construction of the fishway was completed in December 2011
- Stevens weir — this site has been very badly disrupted by the floods. Subject to flood levels, construction of the fishway is scheduled to be completed in September 2012.

11.4 Communication and community consultation

Table 11.1 Communication and consultation activities at the River Murray Channel icon site 2011–12

Date	Activities
July 2011–12	Consultation for developing the River Murray Channel Icon Site Environmental Water Management Plan
June 2012	Article in International magazine Water Power & Dam Construction — Hume-ward bound — detailing the Sea to Hume Fishway program

12 Priorities of The Living Murray program

12.1 Overview

The foundations of The Living Murray are now substantially in place: water recovery is almost complete and the infrastructure to be built under the works and measures program has been finalised, even if some of the work itself is yet to be completed.

There are a number of challenges which need to be considered as part of the future implementation of The Living Murray. While the list below is not exhaustive it identifies some of the major challenges for The Living Murray, including:

- reviewing the intergovernmental agreements of 2004, 2006 and 2009 and The Living Murray Business Plan of 2007
- aligning The Living Murray needs with the Basin Plan
- commissioning environmental works and measures after completion
- prioritising processes for environmental delivery to cater for real time needs
- monitoring environmental works and measures effectiveness
- improving reporting and accountability regarding the effectiveness of environmental watering.

Considerable work is already underway to address these issues and more is planned. The issues that are currently being addressed are detailed under the following sections.

12.2 Optimisation of The Living Murray Portfolio

In 2012, the Murray-Darling Basin Authority commissioned a review of The Living Murray entitlement portfolio. This review will:

- identify legal instruments to manage The Living Murray portfolio
- identify legal instruments that impede the management of the portfolio
- identify any risks to organising The Living Murray water and its timely delivery
- recommend improvements to the administration of The Living Murray portfolio.

An improved TLM portfolio database will be trialled during the 2012–13 watering year. This database is currently being developed. It is anticipated the new database will improve the accounting and management of available water, and will build in recommendations from The Living Murray Portfolio Review Project.

The Living Murray has undertaken a consolidation of some of its entitlements during 2012. It has reduced the number of entitlements held from approximately 98 to 45. This will improve efficiency and reduce the number of trades required to undertake watering actions ensuring watering activities can be undertaken more quickly, with reductions in cost and time spent conducting trades.

12.3 Review of the Murray–Darling Basin Agreement

The Basin Officials Committee has requested a Review of the Murray–Darling Basin Agreement (Agreement). The aim is to improve the management of water in the Murray–Darling Basin, in particular the shared water resources of the River Murray System.

Two projects within this review have direct relevance to The Living Murray: *Review of impediments to the management and delivery of environmental water under the Murray–Darling Basin Agreement* and the development of a *TLM Schedule to the Murray–Darling Basin Agreement*.

Review of impediments to the management and delivery of environmental water under the Murray–Darling Basin Agreement

The *Review of impediments to the management and delivery of environmental water under the Murray–Darling Basin Agreement* will investigate, identify and assess impediments imposed by the Agreement, together with related instruments and procedural documents, to the effective delivery of environmental water in the River Murray System. The objectives of the review are to:

- identify and assess impediments
- identify options to remove these impediments
- assess options to improve the management and delivery of environmental water

- identify the potential impacts of these options on State shares and third parties
- present these options to the Basin Officials Committee together with their potential impacts
- make recommendations to the Committee on which options may be pursued under the current Murray–Darling Basin Agreement, including an assessment of the potential impacts on the management and delivery of environmental water and on state shares and third parties
- provide a preliminary analysis and discussion to the Basin Officials Committee of options for achieving effective environmental watering in the longer term within a revised MDB Agreement or a new MDB Agreement.

Development of a TLM Schedule to the Murray–Darling Basin Agreement

The Living Murray Initiative incorporates the intergovernmental agreements of 2004, 2006 and 2009 together with The Living Murray Business Plan of 2007. These intergovernmental agreements and the Business Plan need to be reviewed.

As part of this, The Living Murray partner governments (under the Review of the Murray–Darling Basin Agreement) endorsed the development of a new agreement to govern the Living Murray Initiative, in July 2011. This agreement, once endorsed by Ministerial Council, will be included as a Schedule (*TLM Schedule*) to the Murray–Darling Basin Agreement (as Schedule 1 to the Water Act 2007).

The current functions performed by The Living Murray Initiative will need to be considered in the transition to the statutory requirements of the Environmental Watering Plan.

In March 2012, The Living Murray partner governments agreed to a Terms of Reference to guide the development of *The Living Murray Schedule.* The Living Murray Schedule will be progressed in three stages:

Stage 1: Review of past arrangements and identification of future requirements

Stage 2: Development of institutional and governance architecture

Stage 3: Legal drafting of The Living Murray Schedule and process for amending the Murray–Darling Basin Agreement.

The delivery of each stage of The Living Murray Schedule will be subject to review.

12.4 Alignment with the Basin Plan

The Living Murray initiative will need to align with the new Murray–Darling Basin Plan. For example, the Environmental Watering Plan is a mandatory component of the new Basin Plan. It sets out a framework for the planning, management and coordination of environmental water for the Murray–Darling Basin. While The Living Murray Initiative will need to align with this framework over time, the current level of planning and processes provide a solid foundation for the implementation of the Basin Plan in the River Murray System.

The review of current practices and procedures of implementing The Living Murray including planning, monitoring and reporting and how they align with requirements of the Basin Plan is a core component of Stage 1 of the development of The Living Murray Schedule.

In addition, joint governments are reviewing their full time investment in joint initiatives during the 2012-13 particularly in light of the implementation requirements of the Basin Plan.

12.5 Environmental watering trials

The Living Murray Initiative is moving from its developmental stage, including water recovery and building infrastructure, to maturity. Greater attention must now be given to optimising the use of environmental water. Operational trials are an important method to achieve this, reflecting a commitment to adaptive management.

The River Murray System Operations Review is developing environmental guidelines for river operations, including operational trials.

Operational trials could be used to:

- develop and refine operational guidelines
- test new operating procedures and guidelines
- guide future multi-site watering trials.

The synthesis of environmental and operational information from the 2010–11 and 2011–12 multi-site environmental watering trials is scheduled to commence in early 2012–13. This knowledge will help develop Environmental Guidelines in the River Murray System Operations Reference Manual. These may help develop specific objectives and procedures for River Murray System operations.

Environmental watering trials, such as River Murray operational trials and multi-site environmental watering trials, will be fundamental to the development of Basin annual priorities and the Basin-wide strategy required under the proposed Basin Plan.

12.6 Multi-site trials

The Basin Officials Committee has agreed to a third multi-site environmental watering trial on the River Murray during the 2012–13 year. Subject to water availability, and relying on natural triggers, approval has been given to release up to 1,000 GL from Hume Reservoir and 500 GL from tributaries.

This would be the largest coordinated watering in the Murray–Darling Basin to date.

It could involve the coordination of multiple water holders, including Riverbank (NSW), the Victorian Environmental Water Holder, the Commonwealth Environmental Water Holder and The Living Murray.

The 2012–13 multi-site environmental watering trial includes the following potential actions:

For all flow scenarios

1. releasing environmental water from Hume Reservoir in addition to that required to meet all other water use demands and requirements
2. estimating the environmental use from Hume to the South Australian border for releases of Hume Reservoir of 30%

During unregulated flows -

1. releasing environmental water from Menindee Lakes during periods of unregulated flow on the River Murray.

New South Wales has agreed not to declare supplementary access to environmental water when an environmental release triggers an unregulated flow.

The trial is designed to reduce the risk of environmental water being re-regulated and diverted for consumptive use while minimising the risk of third party impacts. Reporting will be undertaken during the event, including reporting on risks identified in the proposal. The Independent River Operations Review Group will be asked to review the trial on completion.

12.7 Monitoring

As the major works and measures are completed, there will be an increased need for monitoring activities to enable adaptive management. This will assist in the management of risks associated with the operation of these structures and maximise ecological benefits. Comprehensive monitoring of the operation of these unprecedented works will be fundamental to adaptive management. Reporting and communicating the outcomes of such monitoring is important to the scientific and wider community to ensure accountability and transparency regarding environmental management. Monitoring requires substantial resources but needs to be considered for the operation of the works to meet environmental objectives effectively. All future resourcing of The Living Murray activities will be subject to review during 2012–13.

13 References

Ward, KA and Chalmers, KD, 2012, Agency flood compliance monitoring in Barmah Forest: 2011–12 environmental watering event. Report prepared as part of The Living Murray intervention monitoring program for the Barmah–Millewa icon site, on behalf of the Murray–Darling Basin Authority, Canberra.

14 Acronyms

BMEC	Barkindji Maraura Elders Council
BP KID	Basin Plan Knowledge and Information Directory
CAMBA	China–Australia Migratory Bird Agreement
DEWNR	Department of Water, Environment and Natural Resources
DFW	Department for Water
EWG	Environmental Watering Group
EWMP	Environmental Works and Measures Program
GL	Gigalitre (billion litres)
IGA	Intergovernmental agreement
JAMBA	Japan–Australia Migratory Bird Agreement
KNYA	Kungun Ngarrindjeri Yunnan Agreement
LALC	Local Aboriginal Land Council
LLCMM	Lakes Alexandrina and Albert (the Lower Lakes), Coorong and Murray Mouth
LTCE	Long-term Cap equivalent
MDB	Murray–Darling Basin
MDBA	Murray–Darling Basin Authority
MDBC	Murray–Darling Basin Commission
MDFRC	Murray Darling Freshwater Research Centre
ML	Megalitre (thousand litres)
MLDRIN	Murray Lower Darling Rivers Indigenous Nations
NOW	New South Wales Office of Water
NRA	Ngarrindjeri Regional Authority
OAG	The Operational Advisory Group which comprises river operators, environmental water holders, site and river managers
OEH	Office of Environment and Heritage
RoKAMBA	Republic of Korea–Australia Migratory Bird Agreement
RMIF	River Murray increased flows
RMUF	River Murray unregulated flows
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Australian Government)
TLM	The Living Murray
TLMC	The Living Murray Committee
TLM IPP	The Living Murray Indigenous Partnerships Project
VEMP	Victorian Environmental Water Holder
YYNAC	Yorta Yorta Nation Aboriginal Corporation

15 Appendix A Overview of The Living Murray monitoring

River Murray System-scale monitoring

Monitoring at the River Murray system-scale is designed to determine if the health of the system has improved under The Living Murray program with 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 is to be conducted in October–November 2012. The survey will be linked to the Eastern Australia Aerial Waterbird Survey to provide context. On-ground waterbird surveys will also be conducted as part of icon site condition monitoring to assess those species that are not easily identified through the aerial survey
- a red gum and black box stand condition assessment has been implemented using remote sensing to allow annual reporting on stand condition.

Icon site condition monitoring

Monitoring will determine environmental change within individual icon sites over time. This will be used to determine if the objectives for each site (as articulated in the site Condition Monitoring Plan) are being met.

Monitoring and evaluation at the icon site–scale is based on annual surveillance of the fish, bird and vegetation communities. A consistent approach to monitoring has been developed and applied across the icon sites.

This approach helps inform the system-wide assessments. For example, the on-ground assessments of river red gum and black box at individual sites will provide key corroboration and calibration for the remote sensing assessments of red gum and black box stands.

Monitoring activities within each Condition Monitoring Plan are categorised into three groups: A, B and O.

'A' category monitoring uses standardised methods and are undertaken across icon sites. They include:

- fish condition monitoring using the Sustainable Rivers Audit methodology
- waterbird condition monitoring using a standard on-ground method to link with the annual aerial waterbird survey
- tree condition monitoring for red gum and black box using on-ground assessments linked to remote-sensing data.

'B' category monitoring uses site-specific methods that are appropriate to the characteristics of each site. For example, measuring understorey and aquatic vegetation and netting for fish on shallow wetlands.

'O' category monitoring activities are those relating to specific Icon Site objectives but less easily linked to TLM ecological objectives.

Intervention monitoring

Intervention monitoring assesses the ecological response to interventions or environmental management actions implemented under The Living Murray. In doing so, it provides the essential tool for understanding how the environment at icon sites responds to specific management actions. It also provides the foundation for adopting an adaptive-management approach to implementing The Living Murray.

Event monitoring has become important in managing environmental watering, to informing real-time decision making and in quantifying and minimising risks. This monitoring is focused on the specific objectives and risks of an environmental watering event. Monitoring takes place at selected sites over time.

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

16 Appendix B The Living Murray monitoring projects in 2011–12

The table below shows the budget for The Living Murray environmental monitoring in 2011–12, by broad monitoring type (system scale monitoring, condition monitoring and intervention monitoring) and by icon site.

The Living Murray monitoring budget 2011–12

TLM Environmental Monitoring 2011-2012	Corporate Plan budget	Identified Cost (exc. GST)	Balance
River Murray System-scale monitoring – Mapping Stand Condition		75,214	
River Murray System-scale monitoring – Aerial Waterbird Survey	110,000	42,757	
River Murray System-scale monitoring – Fish Community Assessment		0	
Total	**110,000**	**117,971**	**-7,971**
Icon Site Condition Monitoring – Barmah Forest	323,000	125,105	15,895
Icon Site Condition Monitoring – Millewa Forest		182,000	
Icon Site Condition Monitoring – Gunbower Forest	395,000	286,000	-163,000
Icon Site Condition Monitoring – Koondrook–Perricoota Forest		272,000	
Icon Site Condition Monitoring – Hattah Lakes	321,000	302,000	19,000
Icon Site Condition Monitoring – Lindsay–Wallpolla Island	898,000	382,000	17,000
Icon Site Condition Monitoring – Chowilla Floodplain		499,000	
Icon Site Condition Monitoring – Lower Lakes, Coorong and Murray Mouth	576,000	552,000	24,000
Icon Site Condition Monitoring – River Murray Channel	300,000	0	300,000
Total	**2,813,000**	**2,600,105**	**212,895**
Intervention Monitoring – Barmah	2,562,679	75,000	**-342,832**
Intervention Monitoring – Millewa		75,000	
Intervention Monitoring – Gunbower		159,000	
Intervention Monitoring – Koondrook–Perricoota		297,000	
Intervention Monitoring – Hattah Lakes		19,000	
Intervention Monitoring – Lindsay–Wallpolla Island		39,000	
Intervention Monitoring – Chowilla Floodplain		407,151	
Intervention Monitoring – Lower Lakes, Coorong and Murray Mouth		226,200	
Intervention Monitoring – River Murray Channel		0	
Icon Site Monitoring project total equals $1,297,351)		0	
Intervention Monitoring – Shared projects (blackwater)		120,000	
Intervention Monitoring – Ongoing committments from 2010-11		280,095	
River Murray Fishway Assessment Program		818,065	
Edward River Fishway Assessment Program		40,000	
Resnagging Monitoring		350,000	
Total	**$2,562,679**	**2,905,511**	
Compliance Monitoring (Available for use in water measurement component of Intervention Monitoring).	**169,000**	**0**	**169,000**
TLM environmental monitoring – Total	**5,654,679**	**5,623,587**	**31,092**

17 Appendix C The Living Murray monitoring reports on MDBA's BPKID

The next table shows reports, commissioned under The Living Murray monitoring program, made publicly available on MDBA's Basin Plan Knowledge and Information Directory (BPKID) and TLM website to date.

You ID	Report Title	Author
1587	The Living Murray tree condition survey: Gunbower–Koondrook–Perricoota Forests final report	Backstrom, A, Jolly, K, & Bennetts, K
1588	Cultural conservation of freshwater turtles in Barmah–Millewa Forest	Beesley, LS, Howard, KM, Joachim, L, & King, AJ
1589	Sentinel wetland and understorey monitoring in Gunbower–Koondrook–Perricoota Forests	Bennetts, K & Jolly, K
1590	TLM implementation report and IAG report 2009-10	
1591	Gunbower Forest fish monitoring surveys: autumn 2010	Rehwinkel, R, Sharpe, C, & Wallace, T
1592	Barmah–Millewa fish condition monitoring: 2010 annual data summary	Rourke, M, Raymond, S, & Tonkin, Z
1593	Monitoring understorey vegetation response to flooding in Barmah–Millewa Forest, 2009/10: progress report summer 2009/10	Ward, P
1594	Monitoring understorey vegetation response to flooding in Barmah–Millewa Forest, 2009/10: progress report autumn 2010	Ward, P
1595	Monitoring understorey vegetation response to flooding in Barmah–Millewa Forest, 2009/10: progress report winter 2010	Ward, P
1596	Monitoring understorey vegetation response to flooding in Barmah–Millewa Forest, 2009/10: progress report spring 2010	Ward, P
1597	Quarterly report: Reedy Lagoon spring waterbird monitoring November 2010.	Webster, R
1598	Quarterly report: autumn bird monitoring within Gunbower–Perricoota–Koondrook Forest June 2010. A Living Murray icon site	Webster, R
1599	Quarterly report: summer bird monitoring within Gunbower–Perricoota–Koondrook Forest May 2010. A Living Murray icon site	Webster, R
1600	Quarterly report: winter bird monitoring within Gunbower–Perricoota–Koondrook Forest September 2010. A Living Murray icon site	Webster, R
1601	Terrestrial bird populations in Barmah–Millewa Forest: a comparison between 1999-2002 and 2008	Webster, R
1602	Evaluation of a visual assessment method for tree condition of eucalypt floodplain forests	Souter, NJ, Cunningham, S, Little, S, Wallace, T, McCarthy, B, & Henderson, M
1603	An analysis of 2005-2010 waterbird survey data for Linsday–Wallpolla Islands and Hattah Lakes	Cook, D & Jolly, K
1604	Monitoring vegetation and waterbird response to 2009 watering of Reedbed North Wetland, Barmah–Millewa Forest	Hudson, K
1605	Monitoring vegetation and waterbird response to 2009 watering at Pollack's Swamp, Gunbower–Koondrook–Perricoota Forests	Hudson, K
1606	Monitoring vegetation and waterbird response to 2009 watering of Douglas Swamp and Walthours Swamp, Barmah–Millewa Forest	Hudson, K
1607	Assessment of water quality risks associated with managed flooding of a large scale floodplain-wetland complex	Wallace, T & Lenon, E
1608	Lindsay-Wallpolla frog and aquatic vegetation surveys 2009–2010	Bayes, E, Cook, D, Jolly, K & Robertson P

You ID	Report Title	Author
1609	River Murray Fishway Assessment Program annual report June 2010: for the Murray–Darling Basin Authority	New South Wales Department of Primary Industries, The Victorian Department of Sustainability and Environment and the South Australian Research and Development Institute
1610	Monitoring of resnagging between Lake Hume and Yarrawonga	Lyon, J, Nicol, S, Kearns, J, Bird, T, Stuart, I, Todd, C, O'Mahony, J, Hackett, G, Cable, T, Kitchingman, A & Raymond, S
1611	Monitoring of resnagging between Lake Hume and Yarrawonga: Angler Diary Program	Arthur Rylah Institute for Environmental Research
1612	Zooplankton response to watering of an off-channel site at the Lower Lakes and implications for Murray hardyhead recruitment	Wedderburn, S, Shiel, R, Hillyard, K & Brookes, J
1613	Macrobenthic invertebrate survey 2008: Murray Mouth, Coorong and Lower Lakes Ramsar site	Baring, R, Dittmann, S, Dutton, A, Gannon, R, Cummings, C, Humphries, J & Hunt, T
1614	Gunbower Forest environmental flows: final monitoring report	Beattie, P
1615	Spring floristic survey in Gunbower Forest and Pollack's Swamp: flooding enhancement of Gunbower Forest project monitoring program implementation sentinel wetland and understorey surveys	Bennetts, K & Backstrom, A
1616	Gunbower Forest summer wetland floristic survey: flooding enhancement of Gunbower Forest project monitoring program implementation sentinel wetland and understorey surveys	Bennetts, K & Cook, D
1617	Chowilla fish assemblage: condition monitoring summary 2009	Murray-Darling Basin Authority (MDBA)
1618	Habitat requirements, distribution and colonisation of the tubeworm (Ficopomatus enigmaticus) in the Lower Lakes and Coorong	Dittmann, S, Rolston, A, Benger, SN & Kupriyanova1, EK
1619	The Living Murray condition monitoring at Lindsay, Mulcra and Wallpolla Islands 2008/09	Henderson, M, Wallace, T, Campbell, C, Johns, C & Kattel G
1620	Impact of drought and river regulation on the spawning and recruitment of diadromous Galaxias maculatus and Pseudaphritis urvillii, in the Coorong estuary, Australia	Jennings, PR, Bice, CM, & Zampatti, BP
1621	The Living Murray condition monitoring at Hattah Lakes 2008/09	Kattel, G, Campbell, C, Johns C, Sharpe, C, Henderson, M & Wallace, T
1622	Understanding and quantifying the ecological benefit of dredging the Murray Mouth	Lester, R, Webster, I, Fairweather, P & Langley, R
1623	Coorong bird data summary report for Lake Albert Region: 2003 – June 2009 summary	Letch, D
1624	Coorong bird data summary report for Lake Alexandrina region: 2003– June 2009 summary	Letch, D
1625	Coorong bird data summary report for North Lagoon region: 200– June 2009 summary	Letch, D
1626	Coorong bird data summary report for South Lagoon region: 2001– June 2009 summary	Letch, D
1627	Lower Lakes vegetation condition monitoring 2008–09	Marsland, KB & Nicol, JM
1628	Chowilla icon site floodplain vegetation monitoring, 2008–09 interim report	Marsland, K, Nicol, J, & Weedon, J
1629	Condition monitoring of indicator bird species in the Lower Lakes, Coorong and Murray Mouth icon site: Coorong and Murray Mouth estuary 2009	Paton, DC & Rogers, DJ
1630	Gunbower Forest fish monitoring surveys 2008–09	Rehwinkel, R & Sharpe, C
1631	Monitoring the waterbirds of Lakes Albert and Alexandrina, for the Living Murray Lower Lakes, Coorong and Murray Mouth icon site condition monitoring program	Rogers, DJ, Paton, DC & Bailey, CP
1632	Barmah-Millewa fish condition monitoring: 2007–2009 milestone report	Rourke, M & Tonkin, Z
1633	Chowilla Floodplain: 2008 – 2009 icon site condition report	South Australian Murray-Darling Basin Natural Resources Management Board

You ID	Report Title	Author
1634	Management of flows to the Southern Ocean to provide diatoms for off-shore cockle community: summer conditions	Seuront, L & Leterme, SC
1635	Monitoring understorey vegetation response to flooding in Barmah–Millewa Forest: 2008–09 final report	Ward, P
1636	Condition monitoring of threatened fish species at Lake Alexandrina and Lake Albert (2008–2009)	Wedderburn, S, & Barnes, T
1637	Lower Lakes, Coorong and Murray Mouth (LLCMM) icon site condition monitoring for black bream, greenback flounder and small mouthed hardyhead in the Coorong: 2008–09	Ye, Q, Short, D, Bucater, L & Wellman, N
1638	Ecological outcomes of managed flooding and control structures at Webster's Lagoon	Wallace, T, Walters, S, Ellis, I, Tucker, M & Campbell, C
1639	River Murray fishway assessment program annual report: May 2009	New South Wales Department of Primary Industries, The Victorian Department of Sustainability and Environment and the South Australian Research and Development Institute
1640	Environmental requirements for managing successful fish recruitment in the River Murray valley: review of existing knowledge	King, AJ, Ramsey, D, Baumgartner, L, Humphries, P, Jones, M, Koehn, J, Lyon, J, Mallen-Cooper, M, Meredith, S, Vilizzi, L, Ye, Q, & Zampatti, B
1641	Fish spawning in the lower River Murray icon sites, South Australia: with reference to drought intervention monitoring	Bucater, L, Cheshire, K & Ye, Q
1642	Literature review and identification of research priorities to address retaining floodwater on floodplains and flow enhancement hypotheses relevant to native tree species	Johns, C, Reid, CJ, Roberts, J, Sims, N, Doody, T, Overton, I, McGinness, H, Rogers, K, Campbell, C & Gawne B
1643	Literature review and identification of research priorities to address retaining floodwater on floodplains and flow enhancement hypotheses relevant to understorey and aquatic vegetation	Capon, SJ, James, CS, Mackay, SJ & Bunn, SE
1644	Literature review and development of experimental designs to address waterbird hypotheses on flow enhancement and retaining floodwater on floodplain interventions	Brandis, K, Roshier, D, & Kingsford, RT
1645	Literature review and identification of research priorities to address food web hypotheses relevant to flow enhancement and retaining floodwater on floodplains	Brookes, J, Aldridge, K, Ganf, G, Paton, D, Shiel, R & Wedderburn, S
1646	Monitoring of resnagging between Lake Hume and Yarrawonga: project report June 2009	Arthur Rylah Institute for Environmental Research
1647	Monitoring of resnagging between Lake Hume and Yarrawonga: Milestone 4	Lyon, J, Nicol, S, Kearns, J & O'Mahony, J
1648	The impact of drought on the distribution of fish communities in the Mullaroo Creek-Lindsay River complex	Sharpe, C, Wallace, T, Fraser, P & Vilizzi, L
1649	Effect of weir pool lowering below Lock 1 including the lower lakes -vegetation, nutrients and wader habitat	South Australian Department of Water, Land and Biodiversity Conservation
1650	Lower River Murray lowering 2003-08: vegetation	Walter, M & Souter, N
1651	Investigation into wader habitat in the Lower Lakes	Dittmann, S, Earl, J & Dutton, A
1652	The influence of drying-reflooding cycles on nutrient fluxes from wetland sediments of the Lower River Murray	Aldridge, KT & Brookes, JD
1653	Spatial and temporal variations in larval fish assemblages between locks 1 and 6 in the River Murray, South Australia: with reference to drought intervention monitoring 2007	Cheshire, K & Ye, Q
1654	Native fish spawning in the Lake Hume-Yarrawonga restoration reach of the River Murray: 2009 milestone report	Tonkin, Z, Lyon, J & Hackett, G
1655	Lower River Murray weir pool raising 2005–06: synthesis	Souter, N & Walter, M
1656	Lower River Murray weir pool raising 2005–2006: biofilm component	Souter, N, Walter, M, & Wen, L
1657	Lower River Murray weir pool raising 2005–2006: vegetation component	Souter, N, & Walter, M
1658	Recruitment of golden perch and selected large-bodied fish species following the weir pool manipulation in the River Murray, South Australia	Ye, Q, Cheshire, K & Fleer, D

You ID	Report Title	Author
1659	Larval fish assemblages below locks 5 and 6, in the River Murray, South Australia from 2005 to 2007: with reference to water manipulation trials	Cheshire, K & Ye, Q
1660	Lower River Murray weir pool raising 2005–06: groundwater component, DWLBC technical note 2007/15	Berens, V, Wen, L, Walter, M & Souter, N
1661	Gunbower Forest floristic monitoring: autumn survey	Bennetts, K & Backstrom, A
1662	Threatened fish populations in the Lower Lakes of the River Murray in spring 2007 and summer 2008	Bice, C, Wilson, P & Ye, Q
1663	The Living Murray condition monitoring at Lindsay, Mulcra and Wallpolla Islands 2007–08	Henderson, M, Campbell, C, McCarthy, B, Vilizzi, L, Wallace, T & Sharpe, C
1664	Chowilla icon site: floodplain vegetation monitoring 2007–08 interim report	Marsland, KB, Nicol, JM & Weedon, JT
1665	The Living Murray condition monitoring of Hattah Lakes 2007–08	McCarthy, B, Tucker, M, Campbell, C, Henderson, M, Vilizzi, L, Wallace, T & Walters, S
1666	2007 winter monitoring of the southern Coorong	Paton, DC & Rogers, DJ
1667	2008 icon site condition report Lower Lakes, Coorong and Murray Mouth	South Australian Murray-Darling Basin Natural Resources Management Board
1668	Chowilla Floodplain and Lindsay–Mulcra–Wallpolla Islands: 2008 icon site condition report	South Australian Murray-Darling Basin Natural Resources Management Board
1669	Barmah–Millewa fish condition monitoring 2008 annual summary and refuge habitat report	Tonkin, Z & Rourke, M
1670	Forest health assessment with satellite multi-spectral imagery in the Gunbower–Koondrook–Perricoota icon site (GKPIS): final Report	Turner R, & Kathuria, A
1671	Monitoring understorey vegetation response to flooding in Barmah-Millewa Forest: 2007–08 final report	Ward, P
1672	Quarterly report: autumn bird monitoring within Gunbower–Perricoota–Koondrook Forest June 2008. A Living Murray icon site	Webster, R
1673	Quarterly report: spring bird monitoring within Gunbower-Perricoota-Koondrook Forest December 2008. A Living Murray icon site	Webster, R
1674	Quarterly report: summer bird monitoring within Gunbower-Perricoota-Koondrook Forest March 2008. A Living Murray icon site	Webster, R
1675	Quarterly report: winter bird monitoring within Gunbower–Perricoota–Koondrook Forest August 2008. A Living Murray icon site	Webster, R
1676	Quarterly report: summer bird monitoring within Barmah–Millewa Forest March 2008. A Living Murray icon site	Webster, R
1677	Quarterly report: autumn bird monitoring within Barmah–Millewa Forest June 2008. A Living Murray icon site	Webster, R
1678	Quarterly report: spring bird monitoring within Barmah–Millewa Forest December 2008. A Living Murray icon site	Webster, R
1679	Quarterly report: winter bird monitoring within Barmah–Millewa Forest August 2008. A Living Murray icon site	Webster, R
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1686	Raising the bar: monitoring the response of larval fish communities to water level manipulations, below locks 5 and 6 in the River Murray, South Australia, interim report to the Department of Land Water Biodiversity and Conservation	Cheshire, K & Ye, Q
1687	Understorey vegetation monitoring of the Chowilla river red gum watering sites	Nicol, JM, Weedon, JT & Marsland, KB
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1701	Chowilla icon site fish assemblage condition monitoring 2005–2008	Zampatti, B, Leigh, S and Nicol, J
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Audit of The Living Murray Implementation 2011-12

Report of the Independent River Operations Review Group

The Hon. Tony Burke
Chair, Murray–Darling Basin Ministerial Council
PO Box 6022
House of Representatives, Parliament House
Canberra ACT 2600

24 September 2012

Dear Minister

We have pleasure in submitting to you our *Audit of The Living Murray Implementation 2011–12*.

At 30 June 2012, there was 479.9 GL LTCE listed on the Environmental Water Register. There remains a further 7.1 GL LTCE currently on the Eligible Measures Register for NSW package B, which is expected to be moved to the Environmental Water Register during 2012–13, bringing the total of recovered water to 487 GL LTCE, compared to the water recovery target of 500 GL LTCE.

During 2011–12 a total 274 GL of the 451 GL of available water was allocated for use at icon sites from entitlements held by The Living Murray program. A volume of 157 GL was carried over for future use.

A senior official in the ACT Government advised IRORG that he is confident that the ACT's commitment to contribute 2 GL to the water recovery target will be placed on the Environmental Water Register by March 2013.

The cost of the works and measures component of TLM have increased by an estimated $30.6 million, largely due to the flooding of works in 2011–12. Rescheduling of construction following this setback has been carried out efficiently by MDBA and the contracting governments.

The 2011–12 audit has concluded that seven of the 21 recommendations carried over from previous reports have either been addressed, or are no longer significant, or are outside of IRORG's terms of reference. Eleven previous recommendations are being addressed and show significant progress (six of which may be resolved in the coming year). Three previous recommendations need further development and/or modification.

There are 14 recommendations arising from this report.

We trust that this audit is of value to you and the Ministerial Council.

Yours sincerely

Peter Hoey Kim Alvarez Terry Hillman Garry Smith

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Figures

Acknowledgements

Members of IRORG gratefully acknowledge the contributions made to assist the 2011–12 review. Verbal and written contributions were provided by officials from the relevant jurisdictions and from the Authority. All TLM partners embraced the independent audit process and offered thoughtful contributions and ideas for improvement in addition to factual information.

Authority staff also supported the audit process extensively, providing their time, information, data and documentation to assist the auditors in their task. The opinions and findings in this report are, however, entirely IRORG's own.

List of Abbreviations

ACT	Australian Capital Territory
Agreement	The Murray–Darling Basin Agreement
Authority	Murray–Darling Basin Authority
BOC	Basin Officials Committee
CEWH	Commonwealth Environmental Water Holder
EWG	Environmental Watering Group
GL	Gigalitre
IAG	Independent Audit Group
IRORG	Independent River Operations Review Group
LTCE	long-term Cap equivalent
MDBA	Murray–Darling Basin Authority
MSEWT	Multi-site environmental watering trial
NSW	New South Wales
OAG	Operations Advisory Group
RMO	River Murray Operations
SA	South Australia
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Commonwealth)
TLM	The Living Murray

Summary

The Living Murray (TLM) program is a partnership between the Commonwealth, New South Wales, Victorian, South Australian and ACT governments through which approximately 500 GL long-term Cap equivalents (LTCE) of water, previously allocated to consumptive use, is acquired and deployed collaboratively, to support the ecosystems of six 'icon' sites along the River Murray. Works and measures, aimed at increasing the efficacy of the available environmental water, are also being developed as part of TLM.

A monitoring program has been established to report on the management of environmental water and the ecological benefits of its use, and to provide learnings on which to base increased efficiency and effectiveness in the use of TLM water and future Basin-wide environmental water management.

This audit of the implementation of TLM is prepared by the Independent River Operations Review Group (IRORG) as an interim measure pending a review by the Murray–Darling Basin Authority (MDBA) of all of its independent audit processes. It includes the examination of documented plans and reports — including, importantly, the draft TLM Annual Implementation Report 2011–12 (as of 31 July 2012) and written submissions from TLM partners — and briefings and interviews with TLM officers at MDBA and partner organisations. The terms of reference of this audit required IRORG to express an opinion, in relation to the 2011–12 water year on whether the:

1. TLM Portfolio was managed efficiently
2. TLM environmental water delivery was managed effectively
3. TLM Works and Measures Program was managed efficiently and effectively
4. TLM monitoring process was managed effectively
5. TLM Implementation Report is a fair representation of TLM implementation.

IRORG also scrutinised progress in addressing recommendations from previous TLM audits.

Portfolio management

A further 7.1 GL (LTCE) is potentially available to TLM from water recovery projects underway but yet to be completed, bringing the total volume on the Environmental Water Register to 487 GL (LTCE); very close to the initial goal of 500 GL. The ACT also advised that it is expecting to shortly lodge a formal proposal for delivery of a further 2 GL of water recovery to meet its target commitments, which, if completed would take total water recovery to 489 GL.

As at 1 July 2011, 85.5 GL of water was held in TLM's account and, during 2011–12, a further 366 GL was added. During that period 274.1 GL was delivered to TLM sites leaving, after allowance for evaporation loss and spills, 156.7 GL to be carried over into 2012–13.

It is IRORG's opinion that the TLM water portfolio was efficiently managed in 2011–12. It is also noted that the MDBA has a number of initiatives under way including an improved portfolio management database and a review of the entitlements held by TLM, which are also expected to support improved management of the portfolio.

Environmental water delivery

Collaborative arrangements with other environmental water holders, coordinated under TLM, resulted in 425 GL being made available to create a significant inundation event in Barmah–Millewa Forest with return flows from that site being allocated to the Lower Lakes (the 2011–12 multi-site environmental watering trial).

During the Barmah–Millewa Forest watering event high catchment inflows and resultant high river levels in the region enabled sustaining a bird breeding event to be added to the initial ecological objective of the environmental water allocation; support of floodplain vegetation. Still later (November 2011) a third objective, enhanced recruitment of native fish, was added to the watering event, supported by additional environmental water. Whilst not calling into question the potential ecological value of achieving these outcomes and acknowledging the ecological understanding and operational flexibility that made this facultative management response possible, IRORG considers that these apparently reactive decisions should be made within a strategic

framework that had already considered scenarios including the hydrological events of the type that transpired in 2011–12 and mapped management responses against objectives prioritised in reference to those scenarios. Such a strategic approach should limit any risk of sub-optimal use of environmental water through opportunity costs and un-managed environmental third-party impacts.

The collaborative use of environmental water from a number of sources was fundamental to the success of environmental watering at the Barmah–Millewa Forest in 2011–12 and is likely to continue to be fundamental to multi-site watering programs. As the initial phase of TLM nears completion, attention needs to be paid to relaxing the tying of TLM water to icon sites.

IRORG considers that the current situation may be unnecessarily limiting, both in the development of multi-site watering programs and in the progression towards environmental watering at the scale of the Basin Plan. IRORG notes the change to the delegation to the Executive Director to allow her to approve watering actions to any sites recommended by EWG during 2011–12, and annually, subject to MDBA approval.

Improvements in environmental water delivery also require further advances in developing agreed assessments of return flow from floodplain sites.

Works and measures

Progress has been achieved during 2011–12 despite setbacks resulting from flooding. Increased costs, estimated at $30.6 million, are largely due to the flooding of works, but the rescheduling of construction following this setback has been carried out efficiently by MDBA and the contracting governments.

Infrastructure development will be completed progressively at icon sites, the last scheduled for completion in 2013–14. The necessary operational documentation is currently being developed. The commissioning of infrastructure will also require the use of water. This is expected to be approximately 5.5 GL in 2012–13. Arrangements are yet to be made to establish a level of priority for this water within TLM objective-setting processes, and this may require high-level decisions in the very near future.

In addition to issues relating to its commissioning, further work is needed in positioning the operation of infrastructure within the TLM framework. This will include clear understanding of the potential role of each installation shared amongst TLM environmental managers and information regarding environmental opportunities and risks associated with each. IRORG concludes that each environmental manager will need to be familiarised with all TLM works and measures if they are to take part in prioritisation decisions. Testing and monitoring the ecological performance of works and measures is another area of TLM program that needs development.

Monitoring

Monitoring is an essential part of 'learning-by-doing'; vital if the investment in TLM is to realise maximum benefit in terms of effectiveness and efficiency in utilising environmental water across the Murray–Darling Basin.

Several recommendations from past audits relate to TLM monitoring and the interpretation and reporting of results. IRORG notes that these issues are the subject of current projects and looks forward to their resolution during 2012-13. The completion of five Environmental Water Management Plans and their contribution to clarifying setting and prioritisation of targets and to water regime planning is also noted. The plans also provide a practical synthesis of current knowledge linking hydrology to important components of the Murray ecosystem.

Progression towards developing more complex watering strategies will be aided if knowledge gained in confronting institutional and operational issues in deploying environmental water can be synthesised formally and linked back to proposed or potential watering requirements in a way that maximises the practical value of those learnings.

2011–12 Implementation Report

A draft of the Implementation Report was provided to IRORG on 31 July 2012 who sought comment from TLM partners in face-to-face meetings with jurisdictional officers (21–23 August 2012) and, if desired, in writing by 3 September. Partners were also invited to comment on progress against recommendations from past audits. Though comments were generally favourable, some frustration was expressed regarding the rate of progress. A high priority was directed towards recommendations from previous audits dealing with:

- resolution of issues which hinder the management of large volumes of environmental water
- TLM governance
- TLM objective setting processes, technical scrutiny of monitoring, reporting
- resourcing TLM beyond the water acquisition and works construction phase.

The structure of the report reflects the shift from a water-acquisition phase to one of developing effective environmental flow regimes and measuring and recording resultant ecological improvements at icon sites. This shift is amplified by the concomitant change from severe drought conditions to a period of high flows.

Reporting of outcomes at the individual site level remains at a very general level, probably reflecting the constraints of reporting within the single year. For the sake of transparency and the maintenance of the notably good relations with regional communities, continued clear and factual reporting of outcomes is required.

Other issues

TLM is at a point of flux, reflecting the developing relationships between partners, the evolution towards basin-wide environmental management and a significant increase in the number of owners of environmental water and the volumes that they control. This trend will continue as environmental management moves to a Basin-wide scale and includes a full suite of climatic conditions.

TLM represents a model on which this level of management can be based providing some of its processes can transmute to operate at the required scale and complexity. Amongst other things, this will require a robust system of governance capable of facilitating the participation of all major owners of environmental water and a transparent process for collaboratively managing public resources to achieve agreed ecological outcomes.

This process would need to be based on an adaptive management framework, similar to that of TLM but on a Basin-scale, which ensures a continued improvement in efficiency and effectiveness of environmental water use through a system of learning-by-doing that is evident to participating governments and the Basin community.

Recommendations

Twenty one recommendations from earlier audits have been carried through to the 2011–12 audit. IRORG notes that there has been considerable activity in addressing these during the past year and that:

- seven are either completed, no longer significant, or do not fall within IRORG's current terms of reference
- 11 are showing significant progress — IRORG expects that 6 of these will be completed by the time of the next TLM audit
- three require further development or modification (2010.04, 2011.03, 2011.11).

The current audit has resulted in 14 recommendations of which 13 are new, as follows:

Addressing past recommendations

2012.1 A high priority is directed towards recommendations from past audits dealing with:

i. resolution of issues which hinder the management of large volumes of environmental water

ii. TLM governance

iii. TLM objective setting processes, technical scrutiny of monitoring, reporting

iv. resourcing TLM beyond the water acquisition and works construction phase.

2012.2 The ACT finalise its water recovery contributions during 2012–13.

Portfolio management

2012.3 That the MDBA develop appropriate techniques to enable the estimation and reporting of increased flows retained in stream and reaching icon sites as a result of:

i. the 350 GL of NSW Supplementary Water Access Licences held by TLM on the Lower Darling (250 GL) and the NSW Murray (100 GL)

ii. flows returning to the river from environmental water deliveries, which are protected from diversion and ultimately provide benefit to a downstream environmental asset.

Environmental water delivery

2012.4 TLM Annual Environmental Watering Plans need to be quite specific on environmental watering priorities for the year, but at the same time provide for a process by which other agreed watering objectives might also be addressed as opportunities arise.

2012.5 The MDBA give consideration to developing formal event plans for each specific watering action.

2012.6 Available TLM water in any one year should be combined with available water from as many other water owners as possible, especially and including the large water holdings of CEWH.

2012.7 The use of TLM water should be extended beyond the six icon sites.

Works and measures

2012.8 A program of site visits and briefings be developed to ensure that environmental water managers and planners from all jurisdictions can build an understanding of the nature, scope and operational attributes of the works and measures to support effective environmental water planning.

2012.9 Appropriate volumes be included in the allocation of TLM water as and when required to enable the efficient commissioning of new infrastructure.

2012.10 A structured program of ecological performance testing of new works and measures, together with appropriate monitoring, should be integrated into the annual TLM environmental watering and monitoring planning processes.

Monitoring

2012.11 The remaining Environmental Water Management Plan, the River Murray Channel, be completed and that the Environmental Water Management Plans, as living documents, form the basis for agreed conceptual models and management hypotheses underlying environmental watering of TLM sites. A subset of the stated objectives for each site should be identified and quantified as the basis for intervention monitoring of individual TLM events.

2012.12 Attention be given to maximise learning in resolving water management issues (institutional and operational) through compliance monitoring of TLM events, and consideration be given to means of optimising the collaborative input of operational and ecological expertise in interpreting and applying this new knowledge.

Implementation report

2012.13 In preparing watering plans for all icon sites, ecological objectives should be annotated with quantifiable targets and an indication of an appropriate decadal watering regime expected to support achievement of these targets.

The future of TLM

2012.14 The MDBA should investigate the potential of the TLM model to be suitably developed as a basis for the implementation of environmental watering aspects of the Basin Plan. The investigation should include (but not be limited to):

i. governance models that support collaborative action by all owners of environmental water

ii. the development of shared and transparent watering strategies on large time and space scales

iii. mechanisms by which knowledge and learnings can be shared and applied in refining environmental management of the Basin.

1 Introduction

1.1 Background to The Living Murray

The Living Murray (TLM) Initiative was originally established in 2002 by the Murray–Darling Ministerial Council, to address concerns in relation to the degradation of the River Murray system.

On 14 November 2003, the Ministerial Council took the 'First Step' decision to recover an annual average volume of 500 GL of water, which was to be used to address the declining health of the River Murray system. The initial focus of efforts to address the declining health of the system was on maximising environmental benefits for six significant ecological assets – the icon sites, which are:

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

The manner in which this ambitious task was to be tackled and how it was to be funded were set out in a series of inter-governmental agreements between New South Wales, Victoria, South Australia, Australian Capital Territory and the Commonwealth, which were signed in 2004, 2006 and 2009.

The MDBA and jurisdictions are now engaged in the preparation of a Basin Plan, which will extend the focus for addressing the declining health of our river systems beyond the icon sites to a Basin-wide scale. Environmental water management is experiencing rapid growth and change and the future role of the existing TLM program is not yet fully resolved. Despite this uncertainty, TLM remains an important program, not just because it is improving the environmental condition of important sites, but also because it is the largest multi-jurisdictional multi-site environmental water delivery program in the Basin, and can inform the emerging practice of environmental water delivery.

1.2 The Living Murray program

The Living Murray is a partnership between the Commonwealth, New South Wales, Victorian, South Australian and ACT governments. To date, TLM partner governments have collectively committed nearly $1 billion towards the initiative.

The Living Murray program targets six icon sites for environmental restoration, including the main channel of the River Murray itself. These sites were chosen for their significant ecological, cultural, recreational, heritage and economic values.

The main elements that combine to form the overall TLM program are:

- Water recovery and portfolio management:This covers water recovery actions, which are undertaken by the jurisdictions in accordance with the processes established in the TLM Business plan. It also encompasses the ongoing management of the water portfolio created through the water recovery projects.
- Environmental water delivery:This program element includes the planning for and delivery of environmental water to the target sites. Many of these activities are informed by the guidance of the Environmental Watering Group.
- Environmental works and measures:The environmental works and measures is a major program of infrastructure creation to assist in improving river health by enabling best possible use of recovered water. Works are delivered under the MDBA's arrangements with the State constructing authorities.
- Monitoring and reporting:The TLM program seeks a high level of accountability and transparency. Extensive monitoring of program activities and environmental outcomes achieved is intended to support an adaptive management approach. Publicly available reporting, review and auditing also support these objectives.

1.3 Terms of reference

The 2007 TLM Business plan sets out arrangements for auditing of the program. Clause 203 of the Business plan sets out the audit requirements as:

203. Auditing will be conducted to meet the requirements of clause 78 of the Intergovernmental Agreement, which states that:

The following will be subject to annual external auditing to the satisfaction of the MDB Ministerial Council:

i) *Financial records of expenditure accredited against funding commitments under the Intergovernmental Agreement;*

ii) *Financial records of any temporary or permanent trade of recovered water;*

iii) *Registries of recovered water;*

iv) *Environmental management of recovered water; and*

v) *Management of the impacts on the Long Term Diversion Cap which result from the recovery and delivery of water under the Intergovernmental Agreement.*

From 2004–05 through until 2010–11, the audit of the TLM program was undertaken by the Independent Audit Group (IAG). In its 2010–11 audit report, the IAG made recommendations on future audit and review needs. In 2012, the Authority decided that the 2011–12 audit of TLM implementation would be undertaken using the combined expertise of the Independent River Operations Review Group (IRORG) and the IAG. Mr Terry Hillman of the IAG assisted IRORG in undertaking the 2011–12 audit.

The Murray–Darling Basin Authority has also indicated that the 2011–12 audit of TLM Implementation will be an interim arrangement to allow sufficient time to develop rigorous and comprehensive audit arrangements, commencing in the 2012–13 water year.

The terms of reference adopted by the Murray–Darling Basin Authority for the 2011–12 audit of TLM implementation are provided in appendix 1.

1.4 Objectives for the audit

The objective of the interim audit is for the auditors to express an opinion, in relation to the 2011–12 water year, on whether the:

1. TLM Portfolio was managed efficiently
2. TLM environmental water delivery was managed effectively
3. TLM Works and Measures program was managed efficiently and effectively
4. TLM monitoring process was managed effectively
5. TLM Implementation Report is a fair representation of TLM implementation.

IRORG also scrutinised progress in addressing recommendations from previous TLM audits.

1.5 Audit process and criteria

The general approach adopted for the audit was in line with the terms of reference and involved discussion of the audit program and clarifying issues with the MDBA; working with the MDBA to identify evidence required to conduct the audit and consultation with TLM partner governments via meetings and written submissions as necessary.

For reasons of efficiency and completeness, the analysis, consultation and reporting on the Review of River Operations, TLM Implementation Audit and Multi-Site Environmental Watering Trial (MSEWT) were undertaken concurrently by IRORG for 2012.

The process for preparing the 2011–12 audit of the implementation of TLM was as follows:

- IRORG met with MDBA officers in March 2012 to plan the general approach to the audit
- in July 2012, IRORG received briefings and presentations from MDBA officers on TLM issues and achievements during 2011–12
- MDBA officers prepared the first draft of the Implementation Report. This was due to be provided to jurisdictions and IRORG on 13 July 2012 but was not available until 31 July 2012
- jurisdictions were invited to submit comments on the draft Implementation Report

- in August 2012, IRORG met with representatives from all jurisdictions. In addition to verbal submissions, IRORG invited jurisdictions to make additional written submissions on key issues
- the final set of jurisdictional comments on the draft Implementation Report was provided to the MDBA and IRORG on 18 September 2012
- IRORG submitted its audit report in accordance with its terms of reference on 24 September 2012/9/12.

As a consequence of the process and timelines detailed above, the MDBA was unable to finalise its Implementation Report prior to the deadlines for completion of this audit report. Accordingly, this report has been based on the 31 July 2012 draft TLM Annual Implementation Report 2011–12, together with any additional information provided by MDBA officers and jurisdictions.

The primary source of information for this audit was the draft TLM Implementation Report; however, IRORG was also provided with copies of other relevant documentation including papers prepared for the Environmental Watering Group (EWG), the Basin Officials Committee (BOC), reports on river operations and the MSEWT, together with previous audit reports to assist it in performing the audit.

In order to form an opinion on the effectiveness and efficiency of the 2011–12 TLM implementation activities, the following criteria were used to support the assessments:

- consistency with relevant plans and proposals including annual environmental watering plans; specific watering proposals and operating plans; icon site Environmental Water Management Plans and The Living Murray Outcomes Evaluation Framework
- agreements by high level committees, including the principles to achieve multi-site watering agreed by BOC.

For some program elements, additional specific criteria were developed, and are set out in the appropriate section of the audit report.

2 Previous audit recommendations

The Living Murray audit of 2010–11 made 12 new recommendations regarding the conduct of the program and identified a further nine recommendations from previous audits that appeared not to have been addressed completely. Three of the 12 recommendations from 2010–11 were primarily a refocusing of issues raised in earlier audits.

In August 2012, partner jurisdictions were invited to comment on the current relevance of these 21 recommendations and progress to date. Written responses were received from the Commonwealth Environmental Water Office, Victoria, and South Australia. The MDBA TLM team also reported on actions to address these recommendations during 2011–12. This information plus IRORG's assessment are summarised in appendix 2.

Of the 21 unresolved recommendations seven refer to issues relating to water recovery, five relate to ongoing accounting and water management, three relate to governance and auditing, three relate to planning, objective setting and prioritisation, and three relate to data management and information transfer.

Water recovery

Now that the water acquisition phase of TLM is virtually completed, it is desirable that as many as possible of the outstanding audit recommendations are resolved — either addressed or declined — preferably before June 2013. The acquisition of environmental water has continued rapidly throughout the Basin and the urgency for other authorities to learn from TLM water acquisition process is largely passed. However there remains a need to review the program as a whole and finalise the TLM accounts.

Ongoing accounting and water management

Institutional issues relating to accounting for holding and distributing environmental water still require attention. TLM, particularly multi-site watering trials, provide both challenges and experience in addressing these issues. During 2011–12 there has been notable progress towards resolving problems at an appropriate level and an increased awareness of their significance amongst TLM partners. Key studies are currently underway with results expected before June 2013. The consequences of changes in partner funding have yet to be resolved and this (and the ramifications for future management and monitoring activities) needs urgent attention on the completion of the Joint Funding Review.

Governance and auditing

Prior to 2010–11, TLM dealt with the need to acquire significant volumes of water (as allocations) but were able to deploy only small volumes of environmental water primarily to sustain refugial communities at icon sites. Since that time, with virtually all the planned TLM water acquisition achieved and significant volumes of environmental water available for deployment, TLM has faced radically different challenges.

Past audits have indicated that the first phase of TLM has been executed successfully. The current recommendations are aimed at ensuring that the transition to the integration of works and measures and planning to deliver multi-site/multi-year environmental watering regimes occurs with maximum efficiency and effectiveness. For the program to continue to be successful it is essential that the structures and organisational processes of TLM have the capacity to support this transition with a Basin-wide environmental watering strategy as the ultimate goal.

Planning, objective setting and prioritisation

These tasks have increased in complexity exponentially since the early years of using very limited volumes of environmental water to support icon sites through extreme drought. Future environmental management will result in further complexity as the operation of infrastructure and the development of multi-year watering regimes proceeds. IRORG wishes to emphasise the significance to future environmental water management, of a clear and shared understanding of the decision making and responsibilities associated with planning and delivering TLM outcomes.

Data management and information transfer

Considerable advances have been made during 2011–12 in managing monitoring data and investigations of the efficacy of TLM monitoring program are underway. As an expensive but essential process, monitoring needs to be continuously refined as part of an adaptive management process and learnings from the analysis of the program need to be shared and applied in future TLM activities. TLM has an outstanding record in engaging communities associated with icon sites and it is important that, in addition to making data available, information is synthesised and made accessible to the community.

IRORG finds that progress has been reported against almost all recommendations carried forward from previous audits. Only three of the seven water recovery recommendations need to be carried forward. A number of studies are currently dealing with aspects of environmental water planning and data and information handling. It is envisaged that a number of recommendations, some dating back to 2007–08, will be addressed by the end of 2012–13. This should lead to more effective monitoring programs and more widely shared and understood targets for environmental watering. Learnings from these projects are also needed to support the progression to multi-site/multi-year watering regimes.

2.1 Recommendations

The effects of changes to partner state funding arrangements are yet to be fully understood. As soon as practicable, and certainly well before the end of 2012–13, these should be clarified and the ramifications for TLM, including the resolution of outstanding audit recommendations, should be analysed and understood.

2012.1 It is recommended that a high priority is directed towards recommendations from past audits dealing with:

i. resolution of issues which hinder the management of large volumes of environmental water

ii. TLM governance

iii. TLM objective setting processes, technical scrutiny of monitoring, reporting

iv. resourcing TLM beyond the water acquisition and works construction phase.

3 The Living Murray portfolio management

The Living Murray First Step decision in 2003 agreed to address over-allocation through a program of water recovery for the environment. The objective adopted was to recover an average of 500 GL/year for environmental purposes.

The water recovered for the environment under TLM is in the form of a range of different water access entitlements of varying reliabilities. The indicative target expenditure to acquire these water entitlements for TLM purposes is $700 million. This water portfolio is a valuable asset that needs to be accounted for and managed effectively to optimise the environmental benefits that can be achieved.

This section deals with TLM water recovery and the management of TLM water portfolio, including trade and carryover.

3.1 Water recovery and investment

The Living Murray Business Plan (May 2007) established indicative targets for water recovery and investment for all jurisdictions. The water recovery target of 500 GL is measured in terms of long-term Cap equivalents (LTCE). At 30 June 2012, the program had recovered 479.9 GL, which is 1 GL higher than the volume reported in the 2010–11 audit. The additional 1 GL came from South Australia and was the only water recovery added to The Living Murray Environmental Water Register in 2011–2012. A summary of progress against the indicative targets is shown in table 1.

Only two further projects are currently listed on the Eligible Measures Register and remain to be completed. These projects are the NSW package B, which will yield a further 7.1 GL and finalisation of the listing of water already recovered through the Lake Mokoan water recovery package. Completion of these measures will bring the total water recovery to 487 GL which represents 97% of the target 500 GL. The shortfall has been attributed to several factors including changes in the market price of water, changes to water market rules and changes to project budgets.

The investments in water recovery measures are audited annually by the Australian National Audit Office. Table 1 provides a summary of the actual investment in water recovery measures by each jurisdiction, compared to the agreed investment targets. At the time of completion of this audit report, the Australian National Audit Office financial audit had not been completed so IRORG is unable to report on its findings.

The notable omission in table 1 is the lack of any finalised water recovery proposals or investment from the ACT. In previous audits of The Living Murray Implementation, the IAG has made a number of recommendations aimed at encouraging the ACT to finalise its contributions to TLM water recovery.

Table 1 Progress against TLM investment and water recovery targets as at 30 June 2012

Jurisdiction	Indicative investment target ($ million)	Actual investment at 30 June 2012 ($ million)	Indicative water recovery target (GL LTCE)	Actual volume recovered at 30 June 2012 (GL LTCE)
New South Wales	115	113.1	249	217.9
Victoria	115	114.8	214	219.5
South Australia	65	67.9	35	42.5
ACT	5	0	2	
Australian Government (SEWPaC)[1]	200	199.6	-	-
Australian Government (MDBA)	200	200.0	-	-
TOTAL	**700**	**695.4**	**500**	**479.9**

1 Water recovered by the Australian Government (SEWPaC and MDBA) is apportioned across state targets according to the source of water recovery on completion of the measure.

As part of the 2011–12 audit process, IRORG met with a senior official from the ACT Government who advised that the ACT has undertaken a range of water savings measures, which involved significant investment in excess of the $5 million investment target, that would allow it to reduce ACTEW's entitlement by a volume equivalent to 2 GL of LTCE. This saved water would then provide the basis for issue of an entitlement to the MDBA for TLM purposes.

IRORG was also advised that a draft proposal for this water recovery package has also been prepared, however in order for these water savings to become available as a callable entitlement for delivery to the TLM icon sites, the saved water needs to be shepherded down the Murrumbidgee into Burrinjuck Reservoir where it can be recognised as a regulated entitlement. IRORG understands that arrangements to enable this water shepherding to occur are yet to be developed or agreed between the ACT and NSW. Despite the lack of agreement on this important water management issue, the ACT senior official was confident that the ACT water recovery measures could be fully resolved within six months (i.e. by March 2013).

During the IAG's 2010–11 audit, the ACT advised that it had also considered the alternative option of purchasing 2 GL of existing water access licences on the Murrumbidgee River to cover its TLM contribution, however at that time the ACT decided to pursue the water savings alternative described above. IRORG was advised that the ACT is now giving further consideration to this option, as an alternative to the water savings/shepherding option discussed above.

3.2 Portfolio management

As noted above, the TLM water portfolio is a valuable asset. The terms of reference for this audit require IRORG to provide an opinion on whether the TLM portfolio was managed efficiently.

In order to form an opinion on the management of the portfolio, IRORG identified some key criteria that it would expect to be met if the portfolio was being managed efficiently. These criteria are:

- the maintenance of accurate records of entitlements owned, allocations received and water used or transferred, in an efficient format
- ready availability of data on the water portfolio to support environmental delivery decision making
- evidence of active planning to maximise environmental outcomes from portfolio, which might include a strategy for use in the current year versus carryover, and consideration of the costs of carryover in terms of both forfeiture of water and additional charges (e.g. for spillable water accounts in Victoria) compared to the environmental benefits that may be achieved.

The volume of water in TLM water accounts as at the 1st July 2011 was 85.5 GL, consisting of 88.8 GL of water unused at the end of the 2010–11 season, less 3.3 GL of deduction for evaporative losses, allowances and forfeiture.

Water allocations made against the TLM regulated entitlements in the 2011–12 season added 332 GL. In addition a further 34.3 GL of unregulated allocation was available bringing the total available for use during the year to 451.4 GL.

A total of 274.1 GL of TLM regulated and unregulated allocations were used during the year to water various icon sites. After allowing for usage and an additional 20.7 GL of seasonal spill and forfeitures on volumes carried over, the total volume unused at the end of the 2011–12 season and available for carryover into 2012–13 was 156.7 GL.

The TLM portfolio was managed under the guidance of the EWG's TLM Annual Environmental Watering Plan 2011–12. Table 2 provides a summary of the TLM portfolio water availability and use for 2011–12.

Table 2 The Living Murray water portfolio availability and use 2011–12

	Total allocation (GL)	TLM regulated allocation(GL)	TLM unregulated allocation(GL)
Opening water carried over from 2010–11	88.79	88.79	-
Forfeitures on opening carryover	3.31	3.31	-
Net carryover water	85.48	85.48	-
Water allocation for 2011–12	365.96	331.66	34.30
Total TLM water available for 2011–12	451.44	417.14	34.30
Seasonal spills and forfeiture	20.69	20.69	-
Water usage during 2011–12	274.06	239.76	34.30
Water allocation carried over to 2012–13	156.69	156.69	-

The TLM Implementation Report provides further detail on the volumes of TLM water committed to environmental deliveries from each water source where TLM holds entitlements. Information is also provided on the volumes committed to various TLM environmental sites, together with volumes provided by other environmental water holders.

3.3 Observations and conclusions

Water recovery

As at 30 June 2012, 479.9 GL LTCE of water had been recovered, against an indicative target of 500 GL LTCE. Total investments of $695.4 million had been made by the jurisdictions to recover this water. An audit by the Australian National Audit Office to confirm the accuracy of the financial information reported in relation to water recovery investments was not completed at the time of preparation of this report.

The ACT has not yet met its water recovery commitments under the targets established in The Living Murray Business Plan. It is noted that a number of previous audits have made recommendations in relation to completion of water recovery activities, particularly in relation to finalisation of the ACT commitments. There are relatively high transactional costs associated with the processes necessary to list and then accredit eligible measures for inclusion on the environmental water registers. Given the relatively minor volumes remaining to be recovered, IRORG is of the view that all reasonable efforts should be made to complete all water recovery activities in 2012–13.

Whilst the choice of the most appropriate water recovery measures to put forward for consideration ultimately rests with the ACT, IRORG is of the view that the option of purchasing existing Murrumbidgee entitlements has some benefits in relation to clarity and simplicity. Purchase of existing entitlements avoids the need to develop special exchange rates to convert the 'one-off' ACT water savings product into LTCE volumes. It also removes the need to develop and implement ongoing water shepherding measures which may be complex and difficult to apply and verify.

Portfolio management

The MDBA maintains detailed records of volumes available through carryover, allocations received, forfeitures and usage of allocation for all the entitlements that make up the portfolio. Detailed records are also maintained of the volumes, timing and reasons for all transfers of allocation between the various allocation accounts used. IRORG was provided with summary spread sheets showing all this information at water source level for 2011–12.

There appear to have been no issues involving the transfer of water between accounts in readiness for the planned watering events. The amalgamation of entitlements appears to have been the main contributor to this improvement.

The EWG was also regularly provided with status reports on the water available under the TLM portfolio and forecasts of likely future water availability (as appropriate), to support the development of watering plans and proposals.

Review of the EWG meeting papers and watering plans also indicates that carryover was considered as part of the planning for water availability in 2011–12 but did not have a strong focus beyond 2012. IRORG also notes that the restricted water availability through the millennium drought had effectively eliminated any requirement to consider carryover as part of portfolio management until higher allocations were first received in 2010–11.

In the planning for 2012–13, the MDBA and the jurisdictions have recognised that with the larger portfolio and larger environmental demands as construction of works begins to be completed at some sites, there is a need to consider environmental water demands over a number of years in order to decide an appropriate carryover policy.

IRORG was advised that this was discussed extensively during the planning period (late in 2011–12 for 2012–13 watering actions) to ensure the TLM portfolio was used in the best manner. The changes to the rules governing the allocation of River Murray Improved Flows have been part of these discussions as they will play an important role in future carryover policies for TLM.

Table 2.1 of the Implementation Report includes references to 250 GL of NSW Lower Darling Supplementary Water Access Licence and 100 GL of NSW Murray Supplementary Water Access Licence which form part of the TLM portfolio. The arrangements for these licences ensure that the allocations that would have been extracted when it was held for consumptive purposes remain in the river, to boost River Murray unregulated flow events. No volumes are ascribed to these licences, as a modelling process is required to estimate the volumes that would have been taken under them for consumptive use, and therefore the amount of water retained in-stream.

Whilst noting the difficulties in providing real time estimates of this in-stream volume, IRORG believes that inclusion of a 'best estimate' of the volume retained in-stream would add value to the Annual Implementation Report by providing a more complete picture of the volumes of water returned to the environment through the TLM program activities. This issue of estimating the volume of water retained in-stream for environmental purposes is also relevant to assessment of the Cap on diversions, and it is understood that suitable approaches to the estimation of these volumes are under discussion between NSW and the MDBA. Resolution of the Cap management issues may offer improved reporting options.'

In relation to the Multi-Site Environmental Watering Trial, the Implementation Report also notes *'It is not possible to measure the return flows from Barmah--Millewa Forest, or the volume of environmental water which reached the Lower Lakes. However, the long period of unregulated flows during the event provide confidence that environmental flows were not re-regulated or diverted for consumptive use en route to the Lower Lakes.'*

IRORG recognises the difficulties associated with direct measurement of these return flows under overbank flow conditions. Nevertheless, IRORG would encourage the MDBA to make some estimate of these return flow volumes and consider how they can be reported (with appropriate caveats in relation to accuracy) to provide a more complete picture of the amount of water being delivered into environmental assets as a result of the TLM program.

It is IRORG's opinion that the TLM water portfolio was efficiently managed in 2011–12. It is also noted that the MDBA has a number of initiatives underway including an improved portfolio management database and a review of the entitlements held by TLM, which are also expected to support improved management of the portfolio.

3.4 Recommendations

It is recommended that:

2012.2 The ACT finalise its water recovery contributions during 2012–13.

2012.3 That the MDBA develop appropriate techniques to enable the estimation and reporting of increased flows retained in stream and reaching icon sites as a result of:

i. the 350 GL of NSW Supplementary Water Access Licences held by TLM on the Lower Darling (250 GL) and the NSW Murray (100 GL)

ii. flows returning to the river from environmental water deliveries, which are protected from diversion and ultimately provide benefit to a downstream environmental asset.

4 The Living Murray environmental water delivery

One of the five objectives of the interim audit is for the auditors to express an opinion, in relation to the 2011–12 water year, on whether The Living Murray environmental water delivery was managed effectively. Effectiveness is defined in our terms of reference as the achievement of the objectives or other intended effects of activities at a program or entity level.

The MDBA enhanced the effectiveness of the application of available TLM water by negotiating the inclusion of other water owners in a multi-site environmental watering trial; in particular the NSW and Victorian owners of the two components of the Barmah–Millewa Forest Environmental Water Allocation. In this way, the MDBA was able to use a TLM contribution of 120 GL as a base to assemble 425 GL of water, to achieve environmental benefits in the Barmah–Millewa Forest and beyond.

4.1 Objectives of The Living Murray environmental water delivery

IRORG notes that the draft TLM Implementation Report (31 July 2012) states in section 2.4 that *'A proposal for environmental delivery to Barmah-–Millewa Forest, and the subsequent return flows from the forest being delivered to the Lower Lakes was ranked as the highest watering priority under The Living Murray Annual Environmental Watering Plan 2011–12.'*

IRORG could not find any definitive statement in the TLM Annual Environmental Watering Plan that awards the Barmah–Millewa Forest, together with return flows to the Lower Lakes, its highest watering priority for 2011–12. In response to a question put to the MDBA, IRORG was advised that the statement in section 2.4 draft TLM Implementation Report was an error, and will be corrected in the final report.

While the TLM Annual Watering Plan outlined the broad strategy for 2011–12, which was to prioritise those watering actions that were most likely to deliver the best environmental benefits, given water availability and operational constraints, there was always the possibility of larger watering actions to maximise opportunities to deliver environmental water to multiple sites. Smaller watering proposals would also be considered a priority where the ecological health of high value sites needs to be consolidated and maintained. This work was undertaken by the EWG which met 16 times from February 2011 to January 2012.

The TLM Annual Watering Plan was based on various water resource availability scenarios (extreme dry to wet), but did not consider the range of possible other contributors of environmental water, or anticipate and prioritise transient events such as bird breeding and fish spawning at icon sites.

The initial prioritisation process was undertaken by EWG in May 2011. It was agreed not to include the priorities in the TLM Annual Environmental Watering Plan so these priorities could be reviewed and modified throughout the year to ensure TLM responded appropriately to actual flow conditions that developed throughout the water year.

Watering proposals were then refined and incorporated into a draft multi-site strategy that was developed in July–August 2011. It was a draft working document that aimed to provide system wide environmental benefits using both site and system based environmental objectives

With respect to the Barmah–Millewa Forest, the draft TLM Implementation Report and The Living Murray Annual Environmental Watering Plan both agree that the objective for TLM environmental watering was *'healthy vegetation in at least 55% of the area of the forest including virtually all giant rush, moira grass, river red gum forest, and some river red gum woodland'*. However, by August–September 2011 a colonial bird breeding event commenced in the forest during a period of natural flooding.

The primary objective of TLM and other sources of water was switched to a different ecological objective, contained within the Barmah–Millewa Forest Environmental Water Management Plan*: 'promote and/or sustain successful breeding events for thousands of colonial and migratory waterbirds in at least 3 years in 10 by inundating selected floodplain and wetland areas to provide suitable nesting and feeding habitat'*.

Another augmentation from the primary vegetation objective and the secondary bird breeding objective was made in November 2011 when a pulse flow of 20 GL/day to promote fish breeding was introduced to address a third ecological objective of the Barmah–Millewa Forest Environmental Water Management Plan: *'promote successful recruitment of native fish species by improving flow variability in spring and early summer to replicate natural cues, and inundation of floodplain and wetland areas to provide breeding and nursery habitat'.*

An examination of EWG advices in the relevant period (August to November 2011), shows that while there was recognition that Barmah–Millewa Forest and Lower Lakes proposals were the highest ranked (see EWG 45 outcomes, 29 September 2011), the EWG was highly responsive to the rapidly changing circumstances. Hence, IRORG does not accept the comment from one jurisdiction that *'Increasingly, the active management of the TLM water (and the week-by-week decisions) is being devolved to an informal operational advisory group that is facilitated by the MDBA RMO.'* On the contrary, IRORG believes that the establishment of the Operational Advisory Group (OAG), together with its advisory role, has been of considerable benefit to the opportunistic use of TLM water as part of a greater combined contribution involving water held by other water owners.

4.2 Outcomes

A total of 120 GL of TLM water (part of a parcel of 425 GL) was delivered to the Barmah–Millewa Forest between October 2011 and January 2012. As stated earlier, the original primary objective was vegetative health; however, this was superseded by the urgent need to support a major bird breeding event. During November, the OAG noted that conditions were conducive for fish breeding. This would require a pulse of an additional 20 GL to provide cues for fish spawning. On 17 November 2011 EWG recommended that 20 GL be provided for fish pulse at Barmah–Millewa Forest, and this was approved. Results of any intervention monitoring of vegetation health, or bird or fish recruitment, associated with this event are yet to be interpreted and reported.

Downstream of the Barmah–Millewa Forest, TLM water was delivered to other icon sites:

- 6.1 GL of TLM regulated entitlement (together with 4.9 GL from the VEWH) was delivered to Gunbower Creek in November and December 2011 to improve the health of water fringing vegetation, as part of an objective to increase the area of healthy wetland vegetation. An additional 0.6 GL of TLM water was delivered to top up permanent wetlands in the Gunbower Forest, thereby supporting bird breeding and wetland vegetation.
- 3 GL of TLM water was delivered to Coombool Swamp on the Chowilla Floodplain in January 2012 to provide vegetation outcomes. 2 GL of TLM unregulated water entitlement (together with 3 GL of RMUF) was delivered as a pulse to Lake Wallawalla in the Lindsay River system in March and April of 2012 to water stressed vegetation and to consolidate gains from 2010–11.
- The Lower Lakes, Coorong and Murray Mouth received beneficial flows from a variety of sources which all contributed to lowering salinities in both Lakes, improving fish passage and keeping the Mouth open throughout 2011–12. TLM contributed 110.1 GL of regulated allocation and 32.3 GL of unregulated entitlement to the Lower Lakes, Coorong and Murray Mouth icon site. In addition, significant unreported volumes of return flows from the Barmah–Millewa Forest MSEWT also contributed to environmental flows reaching the Lower Lakes.

One jurisdictional partner observed that the multi-site watering event was aimed at achieving outcomes at Barmah–Millewa, with downstream outcomes occurring by default. It is true that, to date, objectives targeted by multi-site watering have been strictly site-related and, as such, the assessment of ecological outcomes does not reflect the multi-site nature of the event. (In other words it is irrelevant to the assessment of outcomes whether they were achieved through a multi-site event or through separate, unrelated, waterings.) Two points are worth noting here. First, though intervention monitoring may not distinguish between multi-site and single site watering events, at this stage, compliance monitoring and the institutional and operational learnings gained from it certainly should. Second, future multi-site events, particularly when the ecological response of the sixth icon site (the River Murray Channel) gains higher priority, may well address targets that are beyond objectives linked to a single site.

4.3 Observations and conclusions

TLM Annual Environmental Watering Plans

The changing of objectives for TLM water delivery in 2011–12 as on-ground opportunities arose is understandable, but this was not planned for. The TLM Annual Environmental Watering Plan was finalised in August 2011, well before the MDBA and jurisdictions could have specific knowledge of the timing of transient events such as bird breeding and fish spawning. However, such events could have been anticipated in the various water resource availability scenarios on which the plan was based. IRORG does not share the view, expressed by some jurisdictional officers, that planning for large scale environmental watering is neither possible nor useful.

Without an overarching, transparent and scenario-based plan, together with an agreed protocol through which variations to plans can be assessed, there is no way to be sure that opportunity costs (i.e. would the 20 GL have done more good elsewhere) or third-party ecological disbenefits (e.g. drowning of some vegetation, blackwater) were properly evaluated.

The development of annual watering plans provides the priorities for the application of TLM water. IRORG observes that future TLM Annual Environmental Watering Plans need to:

i. incorporate within the water resource availability scenarios (extreme dry to wet) the possibility of the occurrence of a range of transient events such as bird breeding and fish spawning

ii. include scenarios which include the range of possible contributors of environmental water, from TLM only, to all water holders

iii. clearly set out TLM environmental watering priorities to meet key icon site Environmental Water Management Plan objectives. This particular delegation is submitted for approval to the Chief Executive, MDBA, on advice of the Environmental Watering Group and The Living Murray Committee, each year with The Living Murray Annual Water Plan

iv. clearly set out a process by which other icon site Environmental Water Management Plan objectives might be addressed and prioritised as opportunities arise.

IRORG is also conscious of the need to ensure that planning documents are fit for purpose. The annual environmental watering plan should include the environmental watering objectives, priorities and how these might best be satisfied under a range of plausible scenarios. Inclusion of extensive detail on particular actions or decisions that may be required under each scenario is not considered efficient or desirable. Details at this level will inevitably be incorrect, as scenarios are a representation of a range of possible outcomes, but experience tells us that actual conditions will never exactly match the planning scenarios.

Decisions on specific watering actions must be informed by the actual conditions that are encountered. The other major drawback of developing overly detailed annual watering plans is that the detail is likely to obscure the key issue in the annual plan, which should be the environmental watering objectives and their relative priorities.

There are a range of details that do need to be clearly specified in relation to environmental water delivery actions. This could include:

- the specific environmental objectives targeted in an event
- estimates of areas of wetland etc. to be watered and durations of watering that are expected to achieve the nominated objectives
- sources of water for the event and committed volumes available for delivery
- water accounting procedures that will apply to the event
- monitoring requirements for the event, covering monitoring of water delivery (e.g. flows delivered, areas of wetland inundated, duration etc.) together with monitoring needed to assess the environmental outcomes achieved
- risks and risk management actions proposed
- communications, consultation, co-ordination and reporting processes for the event.

The development of specific event plans would help provide clarity to all jurisdictions on what is planned to occur, and when circumstances require changes to the plan, it should be clearer to all parties on what changes are proposed, why and what the amended plan is in its entirety. IRORG observed that an operating strategy which covered these types of issues was developed for the MSEWT, but it was not formally approved. IRORG believes that formalising event plans as part of environmental water management and developing a suitable template to guide their production offers considerable potential benefits.

Managing TLM water jointly with other sources

The MDBA enhanced the effectiveness of the application of available TLM water (274 GL in 2011–12) by negotiating the inclusion of other water owners in a MSEWT. It is axiomatic that the availability of more water for multiple sites provides more opportunities and greater flexibility.

TLM water is 'tied' to icon sites

The Living Murray Initiative commenced in 2004 with the aim of demonstrating ecological benefits of the First Step Decision at targeted locations:

> The priority for investment under this Agreement is the recovery of water to implement the Living Murray First Step decision in regard to achievement of specific environmental objectives and outcomes for six significant ecological assets; Barmah–Millewa Forest, Gunbower and Koondrook-Perricoota Forests, Hattah Lakes, Chowilla floodplain (including Lindsay-Wallpolla), the Murray Mouth, Coorong and Lower Lakes, and the River Murray Channel, through recovered water (refer Clause 21) being built up over a period of five years to an estimated requirement of an average 500 GL/year.[2]

One jurisdiction commented that TLM's tied relationship with the icon sites will limit its alignment with the objectives of the Basin Plan's environmental watering plan.

IRORG observes that the First Step goals have largely been met. The tying of TLM water to the icon sites is only appropriate if these sites are the most valuable environmental assets that can be commanded by the TLM portfolio. Otherwise, the tying of TLM water may limit its effectiveness in future environmental waterings within the River Murray system.

IRORG notes that the delegation to the Executive Director was changed in 2011–12, to allow approval of watering actions to any sites recommended by the EWG. This particular delegation is submitted for approval to the Chief Executive, MDBA, on advice of EWG and The Living Murray Committee, each year with the TLM Annual Water Plan.

Effectiveness of water delivery

As to whether the TLM environmental water delivery was managed to achieve the objectives or other intended effects of activities at a program or entity level, IRORG concludes that the priority of environmental delivery to Barmah–Millewa Forest, and the subsequent return flows from the forest being delivered to the Lower Lakes was met. However, in terms of ecological objectives of watering, for the Barmah–Millewa Forest these changed between August and November 2011, from vegetation to water birds and then fish, all changes based on the consideration of, and recommendations from, the EWG.

IRORG has confirmed that the other three sites where TLM water was delivered (Gunbower, Chowilla and Lower Lakes, Coorong and Murray Mouth) were ranked as the next highest priorities for environmental water delivery, after the Barmah–Millewa Forest. The 31 July 2012 draft TLM Implementation Report is incomplete on outcomes. The report was clear on volumes applied, where and for what purpose, but IRORG was unable to determine from the information provided what was actually achieved. This difficulty could be addressed in a review of the TLM audit process. While it is outside of our terms of reference for this audit, IRORG is available to discuss with MDBA possible improvements to the audit process.

Whatever environmental outcomes were achieved in the Barmah–Millewa Forest and at other icon sites, the specific impact of TLM return water on the Lower Lakes, Coorong and Murray Mouth has not been be determined.

The MDBA undoubtedly enhanced the effectiveness of the application of available TLM water at the Barmah–Millewa Forest (274 GL in 2011–12) by negotiating the inclusion of water from other water owners. Overall, IRORG is of the view that the TLM environmental water delivery was effectively managed, subject to the limitations noted above.

2 Clause 17 of the *Intergovernmental Agreement on Addressing Water Overallocation and Achieving Environmental Objectives in the Murray–Darling Basin, 2004*.

4.4 Recommendations

It is recommended that:

2012.4 TLM Annual Environmental Watering Plans need to be quite specific on environmental watering priorities for the year, but at the same time provide for a process by which other agreed watering objectives might also be addressed as opportunities arise.

2012.5 The MDBA give consideration to developing formal event plans for each specific watering action.

2012.6 Available TLM water in any one year should be combined with available water from as many other water owners as possible, especially and including the large water holdings of CEWH.

2012.7 The use of TLM water should be extended beyond the six icon sites.

5 The Living Murray Works and Measures Program

The Living Murray Environmental Works and Measures Program is an investment in works and measures that aims to improve the health of the River Murray system by making the best possible use of the water available and optimising the benefits of any water recovered. The infrastructure being constructed under this program will be used to facilitate the delivery and management of water at icon sites and support ecological processes aimed at achieving the environmental objectives of the Ministerial Council's First Step Decision. The infrastructure covered by the program includes water regulating structures, water delivery channels, completion of the Sea to Hume Fishway program and complementary works and measures.

5.1 Observations and conclusions

The program was originally conceived as an eight year project, commencing in 2003 and scheduled for completion in 2011. The current estimated cost of the program is $318.4 million, which represents an increase of $30.6 million over the estimated cost reported for 2010–11. Total expenditure to the end of June 2012 was approximately $222 million, and the program is now expected to be completed in 2013–14.

Progress achieved in 2011–12 is detailed in section 4 of the Implementation Report. The MDBA advised that flooding had caused considerable delays to works in 2011–12. Flooding affected works to varying degrees from July 2011 through until May 2012. Flooding impacts included loss of access for critical investigations, delaying the start of construction, suspension of construction and damage to incomplete works.

The key causes leading to the increased costs of $30.6 million are summarised as follows:

- $27 million additional costs due to flooding of works
- $3.2 million resulting from a review of costs for the Hattah Lakes project
- $0.4 million of funding for additional works at Lindsay Island Stage 1 confirmed by the Victorian Government and incorporated into project budgets.

Overall, IRORG observes that the works are being undertaken using well established arrangements through the state constructing authorities and despite the difficult construction conditions experienced throughout 2011–12, there has still been significant progress achieved. The MDBA has also been actively rescheduling works to minimise the risk of interruptions and deliver the program efficiently.

There has also been progress on the development of operational documentation. As the construction activities move towards completion over the next two financial years, there will need to be a greater focus on operational aspects of the works and measures.

It appears that environmental managers generally have a reasonably good understanding of what works are being undertaken in their own jurisdiction and how they may operate to contribute to the achievement of the environmental objectives for the particular site, but there appears to be a relatively low understanding of these issues for works being undertaken in other jurisdictions. Environmental managers from all jurisdictions will need to develop an understanding of the operational capabilities of all the works and measures and how they may be best used to achieve environmental objectives in order to be able to develop effective, integrated watering plans that optimise outcomes across multiple sites.

The other challenges identified in moving from the construction phase into the operational phase for works and measures are issues related to the allocation of TLM water for commissioning, the appropriate level of monitoring for these works and their environmental performance testing.

As works are completed, some will require a structured testing program, known as commissioning, to ensure that they work effectively across their intended service range. The concern expressed in relation to this issue is that commissioning will in some cases require the delivery of water to sites to test infrastructure; however, these sites may not be the highest priority for environmental water delivery at the time of completion of construction of infrastructure. IRORG was advised that relatively modest volumes are required for commissioning.

In 2012–13, it is estimated that some 5.5 GL may be required. It could be argued that putting this volume into lower priority sites represents a failure to optimise benefit from the TLM portfolio. IRORG believes that this concern takes too narrow a view of optimisation. Over the longer term, utilisation of the works and measures offers substantial opportunities to achieve improved outcomes from available environmental water.

Commissioning the works is a necessary component of being prepared to achieve this longer term optimisation of environmental water. Additionally, it is important for the efficient delivery of the works and measures program that commissioning is not unduly delayed so that any issues can be identified within the defects liability period set out in the construction contracts and where relevant, remedied by the contractor.

The TLM environmental works and measures include major pieces of infrastructure which will be able to facilitate the managed delivery of water to valuable environmental assets on a scale not previously experienced within the Basin. This creates potential for significant opportunities and significant risks. Examples of some of the potential risks arising from use of the works and measures include the risk of significant water quality issues related to flood enhancement at Koondrook–Perricoota forest, or uncertain impacts on fish or carbon transport related to managed flooding of the Chowilla wetlands.

IRORG believes there is a need to design an ecological performance testing program that will allow these issues to be tested in a structured fashion and potential risks identified and management strategies developed. Such a testing program will also need to consider the monitoring required to identify any potential risks or performance issues. Since the works and measures are an integral part of The Living Murray program, there is also a need for this ecological performance testing and monitoring requirements to be integrated within the wider TLM water delivery and monitoring strategies.

IRORG is of the opinion that the works and measures program was managed efficiently and effectively.

5.2 Recommendations

In relation to the environmental works and measures program, it is recommended that:

2012.8 A program of site visits and briefings be developed to ensure that environmental water managers and planners from all jurisdictions can build an understanding of the nature, scope and operational attributes of the works and measures to support effective environmental water planning.

2012.9 Appropriate volumes be included in the allocation of TLM water as and when required to enable the efficient commissioning of new infrastructure.

2012.10 A structured program of ecological performance testing of new works and measures, together with appropriate monitoring, should be integrated into the annual TLM environmental watering and monitoring planning processes.

6 The Living Murray monitoring

Monitoring is essential to ensuring that the use of environmental water in achieving agreed ecological objectives is both efficient and effective. TLM monitoring is required to close the adaptive management cycle by testing that predicted outcomes of TLM interventions have occurred and by providing learnings upon which to base improvements in the management of environmental water and refinements in linking hydrological management with ecological outcomes. This does not deal with the technical details of monitoring activities at individual TLM sites, such as sampling design and interpretation of data. These are important issues which, IRORG understands, are the subject of other studies commissioned by MDBA.

Effective and efficient monitoring as part of the adaptive management of TLM sites is particularly important because:

- TLM constitutes a large-scale 'learning-by-doing' trial informing future sustainable management of the Murray–Darling and other river systems. Careful measurement and reporting of actions and outcomes is essential if TLM is to be an effective test-bed for Basin-wide management.
- monitoring the performance of 'whole-of-Basin' environmental water management in the future, necessary for transparency and on-going improvement, is likely to be a complex and expensive process and will require high levels of efficacy and parsimony. The Living Murray monitoring potentially has a key role in progressing towards these characteristics.

These are additional drivers reinforcing the need for efficiency and effectiveness in TLM monitoring.

6.1 Monitoring in an adaptive management framework

In natural resource management, monitoring programs close the adaptive management loop by providing information that can be used to improve the manager's understanding of the complex system to be managed and to refine the management actions needed to achieve the manager's objectives. Figure 1 provides one possible representation of the adaptive management framework that underlies TLM, emphasising the role of monitoring.

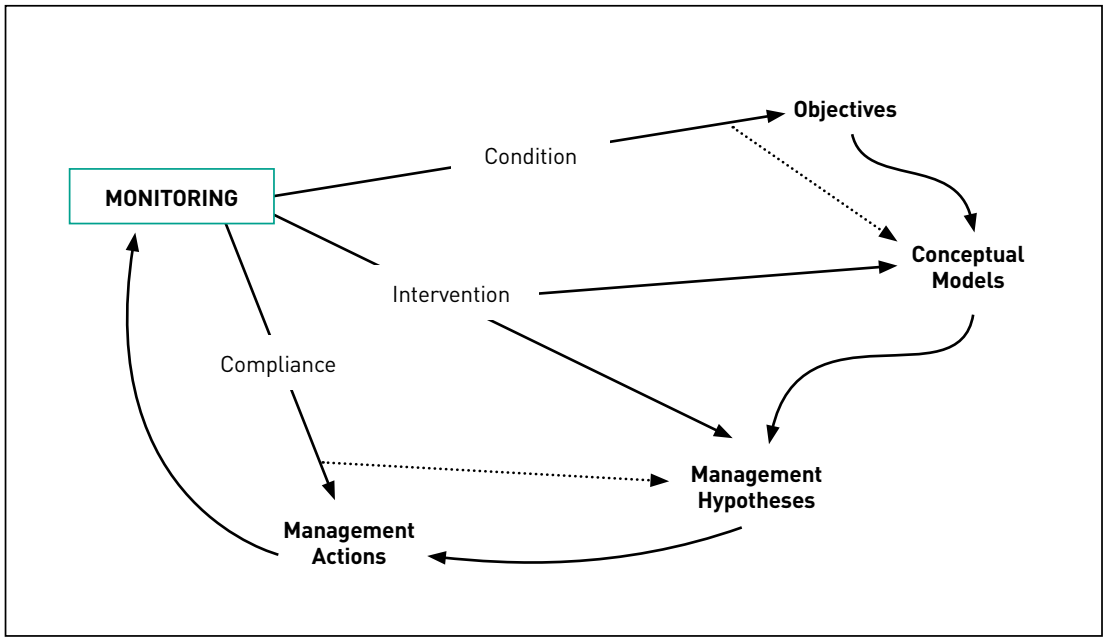

Figure 1 The role of monitoring in the adaptive management framework of TLM

This model of adaptive management incorporates three classes of monitoring distinguished by the part of the management framework on which they report:

- *Compliance monitoring* reports on the deployment of TLM environmental water (and, increasingly, the operation of TLM works and measures). It may include institutional issues of planning, accounting and physically delivering water, and is likely to be evaluated against the hydraulic/hydrological regime envisaged in individual site Environmental Water Management Plans. Information from compliance monitoring bears directly on current and future management actions and some learnings (e.g. regarding institutional and physical constraints) may contribute to refining future management hypotheses.
- *Intervention monitoring* reports on the ecological outcomes of TLM management actions — i.e. the success in achieving agreed ecological outcomes hypothesised to occur as a result of TLM interventions. Subjects for measurement are dependent on the agreed objectives for each site. Information from intervention monitoring test the management hypotheses that linked a prescribed watering regime to desired ecological outcomes, and also help to refine the conceptual models that seek to describe ecosystem response to hydrological regimes (in the Murray system). Intervention monitoring is often site/event based but some, e.g. river resnagging, may operate over extended periods (dependant on the hypothesis being tested).
- *Condition monitoring* usually measures ecological characteristics on a larger time/space scale and may report on factors other than those that make up the agreed objectives. In TLM, condition monitoring is carried out to report on ecological responses on a larger spatial scale than TLM sites and/or over an extended number of years. In time it may also give some indication of the effect of the program on the 'health' of the Murray ecosystem and provide some insurance against unintended and unexpected negative responses by non-target components of the ecosystem (emergents). In addition to informing managers about the performance of the whole program, condition monitoring can support reviews of shared objectives over time. It can also contribute to refinement of conceptual models as new knowledge is accumulated, though it should be noted that condition monitoring programs are not usually designed specifically to explore cause/effect relationships.

The distinction of these three classes of monitoring is relevant not only because of their different roles in the adaptive management framework but also because they tend to differ in terms of duration (compliance shortest, condition longest) and in the design and interpretation methods required. So for TLM it should be possible to synthesise and apply the learnings from compliance monitoring to environmental watering in the subsequent water year. This is unlikely to be the case for intervention monitoring and even less likely for condition monitoring results.

6.2 The Living Murray monitoring 2011–12

The framework for TLM monitoring is set out in the Outcomes Evaluation Framework (see appendix A, TLM Implementation Report). The program is divided into three operational sub-groups:

- large-scale (River Murray) condition monitoring
- icon site-scale condition monitoring
- 'intervention' monitoring, which incorporates ecological response (conventional intervention monitoring), compliance monitoring and risk evaluation.

In addition to monitoring projects, TLM has initiated and supported targeted research projects aimed at contributing to increased efficiency and effectiveness of the use of environmental water. These projects are aimed either at filling knowledge gaps relating to TLM environmental watering and thereby leading to the refinement of conceptual models and their consequent hypotheses or at factors which potentially limit the capacity of the ecosystem to respond to environmental watering. The study of hydrological requirements for small diadromous fish in the Coorong is an example of the former projects; the re-snagging project, Hume-Yarrawonga, is an example of the latter.

In 2011–12, TLM (and other) environmental water was delivered to Barmah–Millewa, Gunbower, Chowilla, and Lower Lakes, Coorong and Murray Mouth icon sites. Return flows from some of these sites would also have affected parts of the sixth icon site; the River Murray Channel between Hume Dam and the Lower Lakes. No deliveries were made to Koondrook–Perricoota or Hattah due to ongoing construction of environmental works. Details of monitoring activities are not provided but budget information (appendix B, TLM Implementation Report) indicates that:

- two large-scale monitoring projects were active during 2011–12 (stand condition monitoring for floodplain vegetation and waterbird community assessment)
- site-based condition monitoring was carried out at all icon sites except the river channel
- intervention monitoring was carried out at all icon sites except the river channel
- the fishways and re-snagging projects were progressed.

It is noted that site-based condition monitoring and intervention monitoring (compliance monitoring, ecological response or risk evaluation) occurred at Koondrook–Perricoota and Hattah — icon sites at which no environmental water was provided — however both sites were inundated as a result of high river levels during the period.

Favourable ecological outcomes have been reported in general terms (TLM Implementation Report 2011–12). High river levels resulting from continued wet conditions throughout the catchment created difficulties in ascribing observed outcomes to TLM interventions. This might be partly addressed by refinements to hypotheses and sampling designs that underlie the monitoring program but it is likely that causal relationships will remain confounded under such conditions.

Detailed reporting of ecological outcomes against objectives is likely to require more time than is available within the 'water year'. No learnings relating to compliance monitoring have been reported to date.

6.3 Observations and conclusions

It is noted that a number of projects are underway dealing with aspects of TLM monitoring program; several in response to earlier audit recommendations (see section 2 and appendix 2). It is expected that these will contribute substantially to enhancing learnings from TLM and, as a consequence, to both the contribution of TLM to future environmental watering as part of the Murray–Darling Basin Plan and, in particular, to the development of the Basin Plan Monitoring, Evaluation, Reporting and Improvement programs.

It should also be noted that IRORG is required to comment on whether 'The Living Murray monitoring process was managed effectively' (see section 1.4 and appendix 1) rather than on the design or efficacy of specific monitoring actions. However, one jurisdictional partner has observed that, rather than being based on systematic and targeted intervention, the assessment of effectiveness tends to be based on ad hoc observations by on-ground site managers (e.g. bird breeding, fish spawning) and expert opinion. Regardless of accuracy, such perceptions are most effectively countered by well designed intervention monitoring, transparently reported and clearly interpreted.

During 2011–12 Environmental Water Management Plans were prepared for each of the icon sites except for the River Murray Channel. These contain details of the site, its physical description, conceptual models describing key flow-related ecological systems, recommended watering regimes for each ecological component and, importantly, refined ecological objectives. These documents appear to encapsulate current scientific knowledge effectively and provide a sound basis upon which to establish site-based intervention monitoring programs.

Different objectives may require different watering regimes and therefore may be affected differently by any individual watering event. Consequently, for the effectiveness of TLM watering to be monitored appropriately, it is necessary, for each watering event, to link monitoring actions to the individual objectives that TLM intervention is intended to address (see figure 1). Disciplining ecological monitoring in this way should lead to maximum efficiency.

Compliance monitoring is an important component of the adaptive management framework of TLM which should lead to increasing efficiency and flexibility in deploying environmental water to achieve ecological objectives. If TLM is to fulfil a role in leading to the effective rolling out of the Basin Plan, learnings from compliance monitoring of TLM events will need to be applied in refining all aspects of environmental water management including institutional as well as operational issues. This is particularly relevant for the complexities associated with multi-site watering but also needs to inform water deployment in various combinations of regulated and unregulated flow conditions. It is IRORG's opinion that there may have been an under-emphasis on developing knowledge regarding water management through monitoring TLM events. For the most part such learnings can be analysed and applied within the water year in which a TLM watering event takes place (unlike other monitoring outputs) thus providing a potential for relatively rapid refinement of management practice through adaptive management.

Care needs to be taken to ensure an appropriate balance between compliance and intervention monitoring; a balance that may need to be varied to reflect the relative novelty of the water management actions and environmental objectives associated with each event. For instance, an event that requires innovative solutions to issues in deploying water (including multi-site watering), particularly if targeted at relatively well-understood ecological objectives, may warrant an increased effort in measurement, analysis and interpretation of compliance monitoring.

Past audits have expressed concerns about the interpretation and reporting of monitoring results. During 2011–12 action commenced on several recommendations regarding monitoring that are outstanding from previous audits of TLM (see appendix 2). IRORG also notes the creation of a new position, Director of TLM monitoring, in 2011–12. This, plus an increased focus on synthesising learnings, both technical and organisational, from past TLM monitoring programs, indicates an intention to maximise the value of this work. IRORG believes this represents positive progress towards effective monitoring programs.

6.4 Recommendations

IRORG recognises that several past audit recommendations regarding the monitoring program are the subject of current investigations (see appendix 2). In addition, it is recommended that:

2012.11 The remaining Environmental Water Management Plan, the River Murray Channel, be completed and that the Environmental Water Management Plans, as living documents, form the basis for agreed conceptual models and management hypotheses underlying environmental watering of TLM sites. A subset of the stated objectives for each site should be identified and quantified as the basis for intervention monitoring of individual TLM events.

2012.12 Attention be given to maximise learning in resolving water management issues (institutional and operational) through compliance monitoring of TLM events and that consideration be given to means of optimising the collaborative input of operational and ecological knowledge in interpreting and applying this new knowledge.

7 The Living Murray Implementation Report

One of the five objectives of the interim audit is for the auditors to express an opinion, in relation to the 2011–12 water year, on whether the TLM Implementation Report is a fair representation of TLM implementation. IRORG has based its audit on a draft TLM Implementation Report, not the final report.

IRORG was provided with the draft of the 'TLM Implementation Report for 2011–12' on 31 July 2012. To address (in part) this objective, IRORG sought the opinions of the jurisdictions prior to, during and following our visits from 20–23 August 2012.

7.1 Jurisdictional comment and addenda

New South Wales, South Australia and Victoria provided comments in the form of tracked changes on the draft TLM Implementation Report. The Commonwealth, Victoria and South Australia provided additional written comments on the TLM program for 2011–12, the draft Implementation Report for 2011–12 and the past recommendations of previous audits.

With regard to the draft Implementation Report, all jurisdictions felt that it was a fair representation of TLM implementation for 2011–12. South Australia made a number of useful suggestions as to how reporting might be improved and also provided some substantial changes to the document. These changes mostly related to its two icon sites, and should be incorporated into the final Implementation Report.

New South Wales asked that the report, in several relevant places, note 'that the TLM Environmental Water Register includes 250 GL (23.1 GL/year LTCE recoverable at the Murray) of Lower Darling Supplementary Water Access entitlement'. A more accurate description was provided of the geomorphology of the Barmah–Millewa Forest, including the role played by the Cadell Fault, the Gulpa Creek and Edward–Wakool river system, and the Barmah Choke. Additional words were provided on the effect on the vegetation in the Barmah–Millewa Forest of Hume Dam operations.

The accuracy of the maps in the draft Implementation Report of both Barmah–Millewa Forest and Gunbower–Koondrook–Perricoota Forest icon sites was commented upon. Significant amendments were provided on the works and measures at the Koondrook–Perricoota Forest. Finally, New South Wales added information to the description of communication and consultation activities at Gunbower–Koondrook–Perricoota Forest icon site.

With regard to the recommendations from past audits, the 2010–11 audit report concluded that two of the 10 carried over recommendations have been addressed and are assessed as being completed. MDBA is responding to seven of the recommendations through specific reviews and commissioned studies yet to be completed. There are a further 14 recommendations arising from this 2011–12 audit report.

The comments received from jurisdictions on 21 carried over recommendations reflected a level of frustration about the slowness of addressing them (refer appendix 2). A high priority was directed towards recommendations from previous audits dealing with:

- resolution of issues which hinder the management of large volumes of environmental water
- TLM governance
- TLM objective setting processes, technical scrutiny of monitoring, reporting
- resourcing TLM beyond the water acquisition and works construction phase.

7.2 Assessment of The Living Murray Annual Implementation Report

7.2.1 Structure and content

The draft Annual Implementation Report 2011–12 follows the structure of reports from previous years but reflects the evolution of TLM in that water acquisition registration and accounting are de-emphasised in favour of more extensive treatment of progress (and problems) in construction of works and measures, the deployment of environmental water, and the response of icon site ecosystems.

The change to wet conditions from the extended drought that had prevailed since the commencement of TLM is also reflected in the subject matter of the report. The document submitted for review was an incomplete draft, lacking an executive summary and information on environmental watering and management to be finalised in consultation with jurisdictions. Table and figure numbers and their references in the text were also incomplete.

The report consists of two major sections reporting on activities and outcomes for the program as a whole and then for each of the icon sites. The first major section, dealing with The Living Murray as a whole, reports on:

- water recovery, infrastructure, governance and management
- environmental watering
- environmental monitoring
- environmental works and measures
- communication, community consultation and Indigenous partnerships.

The report on each icon site is organised under the headings:

- site description and objectives
- environmental watering and management
- environmental works and measures
- communication and community consultation
- Indigenous consultation.

7.2.2 Whole of program reporting

Water recovery, infrastructure, governance and management

A detailed assessment of this material is presented in section 3, earlier. The effects of flood events during 2011–12, in delaying the completion of infrastructure projects, were noted. The role and effectiveness of the OAG in the delivery of non-TLM as well as TLM environmental water was also noted.

Environmental watering

There is some difficulty in distinguishing the discussion of TLM water from environmental water from other sources in this section of the report — particularly as TLM water was combined (coordinated) with other water in achieving outcomes at TLM sites; especially Barmah–Millewa. As noted in the report — section 2.3 — 'environmental water owned and managed by other environmental water holders (CEWH, OEH and VEWH) is outside TLM Environmental Watering Planning Framework', however, it is included in tables of water use presented in this section. IRORG does not have the information to support an audit of these data. The report does, however, analyse the 2011–12 TLM water portfolio separately.

The subsection on water delivery is broken down according to the icon sites and includes some comment on the hydrology of sites that did not receive environmental water but were influenced by high river levels during the year. This is reasonable, given the site-specific issues involved in environmental water delivery. However IRORG believes that some analysis and discussion of the larger-scale issues of environmental water management for 2011–12, given the unusually high inflows and water storage, would have been instructive. [It is recognised, however, that at least some of this material may be developed in reporting on the multi-site watering trial.]

Environmental monitoring

Unlike the 'watering' section that precedes it, the environmental monitoring analysis contains a discussion of the wider issues pertaining to intervention and condition monitoring, potentially leaving reporting on individual site-based monitoring to the second half of the document. The section discusses the fact that ecological monitoring (as distinct from compliance monitoring) is likely to reflect the combined impact of environmental releases plus other hydrological drivers particularly associated with high river levels reflecting climatic conditions. This is less relevant for cases such as Barmah–Millewa where environmental water was used to sustain ecologically critical elements of unregulated flows that would otherwise be suboptimal. However, a challenge remains to link specific ecological outcomes to the application of environmental water in a way that provides the community with reassurance regarding the efficacy of TLM watering.

Field observations were made as part of two basin-wide condition monitoring programs during 2011–12; waterbird community assessment and floodplain vegetation condition monitoring. Rigorous analysis of the results of these observations is yet to be published, but the report indicates a very positive response to earlier wet conditions, amongst river red gum and understory communities following the extended drought. The natural lag between watering event and measureable ecological response — particularly such responses as vegetation growth and successful recruitment to bird and fish communities — precludes useful reporting of such responses within the water year.

A need to manage environmental water to ameliorate 'environmental third-party damage' from blackwater events and potential increases in carp populations has also been identified and discussed by the Environmental Watering Group.

Environmental works and measures

An analysis of progress and issues relating to the works and measures program is presented in section 4 of this report. The TLM Implementation Report indicates that, despite disruption at several sites by high river levels and consequent flooding, the program is planned to be completed in 2013–14, with works at Gunbower–Koondrook–Perricoota Forests and Hattah Lakes completed before October 2012 and during 2012–13 at the Chowilla site except for the Lindsay Island regulators. Plans for commissioning these works are yet to be reported.

Communication, community consultation and Indigenous partnerships

Communication and consultation are guided by an annual Communication and Consultation Strategy that sets objectives and seeks to create opportunities for members of the public and stakeholders to contribute through icon site consultation reference groups. TLM material is routinely posted on the MDBA website as part of an extensive communication service.

Key documentation such as site-based Environmental Water Management Plans and the Annual Environmental Watering Plan are readily accessible on the MDBA's website. Nearly 150 technical reports, based on TLM monitoring and investigations (see appendix C, TLM Implementation Report), are publicly available on the MDBA's Basin Plan Knowledge and Information Directory on the same website (though the title of the directory may confuse the casual seeker of information). In addition less technical material aimed at explaining the TLM approach and reporting ecological outcomes in plain English are prepared and made publicly available. Public consultation activities are primarily carried out at the individual icon site scale.

The Living Murray program recognises the value of Indigenous knowledge in seeking to sustain the Murray ecosystem and also the special needs of Traditional Owners in their relationship with the river. This is enshrined in The Living Murray Business Plan and influences the Environmental Water Management Plans for each site. Exchange with Traditional Owners is supported through Indigenous facilitators and cultural heritage monitors who work in collaboration with TLM icon site managers.

7.2.3 Activities and outcomes at individual icon sites

This section of the report deals with each icon site in turn. The content is significantly strengthened in 2011–12 by the completion and publication of Environmental Water Management Plans for almost all icon sites. This has resulted in concise descriptions of each site, the special circumstances and ecological characteristics (and therefore management goals) that pertain to each, a refinement of ecological objectives and water requirements, and considerable progress towards defining operating and watering regimes designed to sustain the site ecosystem.

The 2011–12 Implementation Report contains a considerable amount of material that would not be expected to vary year-on-year — enabling the report to be a stand-alone document – but comparatively less information that relates to events, actions and outcomes specific to 2011–12. This reflects the fact that much of the information needed to report on activities during 2011–12, particularly data arising from ecological monitoring of responses involving a significant time-lag (e.g. fish recruitment), is unavailable within the water year.

No details of environmental watering and management (i.e. compliance monitoring) are reported for any of the icon sites in the current draft (31 July 2012) of the Implementation Report 2011–12.

There are no ecological outcomes reported for individual icon sites. Anecdotal information presented in the 'whole-of-program' section supports the view that their ecosystems have responded positively to the favourable hydrological conditions including those experienced during 2011–12. Any successful recruitment of colonial waterbirds at Barmah–Millewa, observed during 2011–12, might be ascribed to the addition of environmental water to ambient flows maintaining adequate water levels in at the nesting sites. At other sites discriminating the outcomes of TLM watering from ecological responses driven by high river levels during 2011–12 is problematic at the current level of reporting.

There are no current works and measures projects at Barmah–Millewa or the Lower Lakes, Coorong and Murray Mouth. Construction has continued at the remaining icon sites (including fishways on the River Murray Channel). Risk of disruption to infrastructure development resulted in Koondrook–Perricoota Forests and Hattah Lakes not being considered for allocation of environmental water during 2011–12. However, high inflows during the period resulted in structural damage or delays to infrastructure development at Koondrook–Perricoota, Hattah and Chowilla (Lindsay) and on fishways in the Murray River Channel.

A high level of engagement with regional communities has been maintained at the floodplain icon sites during 2011–12 and there appears to be general approval and support for the program amongst these communities. Interaction with the regional Indigenous community has been notably successful; the interchange of knowledge and views facilitated by expert support.

7.3 Conclusions and recommendations

Lists of site-specific environmental objectives, drawn from the newly prepared Environmental Water Management Plans, are presented for each icon site (except River Murray Channel) in the report. These represent the suite from which outcomes targeted by an environmental watering event can be selected. Currently this information is not reported in the Implementation Report and no links are made between chosen target outcomes and intervention monitoring. Reporting of individual watering events (or episodes) at this level should include:

- identification of those objectives from the Environmental Water Management Plan to be targeted by the watering event
- broad descriptions[3] of monitoring actions (e.g. 'waterbird recruitment', 'native fish movement') planned to measure progress towards those objectives.

IRORG is of the opinion that this more formal report structure would enhance the efficiency and parsimony of the monitoring program and maximise the learnings gained. A schematic of this process including the eventual reporting and interpretation of monitoring observations is presented in figure 2.

3 Details of sampling design etc. are not required at this point and results from intervention monitoring are likely not to be available on the time-scale of preparation of the Annual Implementation Report.

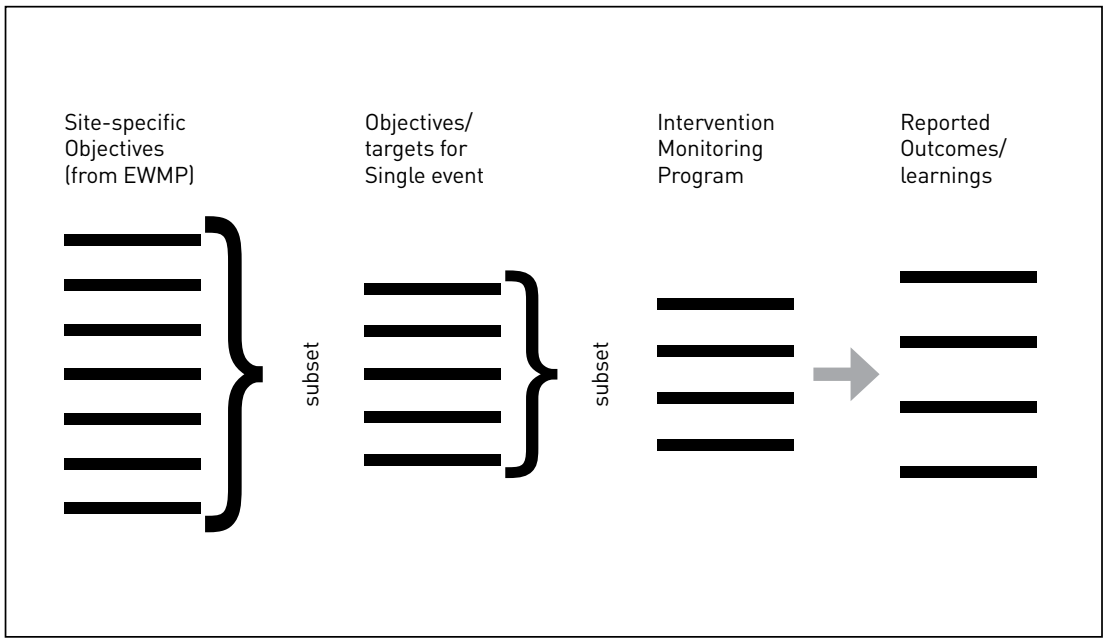

Figure 2 A process for reporting on the achievement of selected objectives prioritised from the Environmental Water Management Plans

Objectives listed for Koondrook–Perricoota in the Implementation Report (drawn from the Koondrook–Perricoota Environmental Water Management Plan) are annotated with quantifiable targets and an indication of an appropriate decadal watering regime expected to achieve those targets. This level of development can support scenario planning that is based on achieving desired watering regimes across multiple sites and years, and accommodates flexible priority setting responsive to seasonal factors and precedent hydrology. The same quality of information, including the water requirements of various components of the riverine ecosystem, is available for other icon sites.

2012.13 It is recommended that in preparing watering plans for all icon sites, ecological objectives should be annotated with quantifiable targets and an indication of an appropriate decadal watering regime expected to support achievement of these targets.

Several projects are underway seeking to refine the interpretation and reporting of TLM monitoring results. It is desirable that advances in this area continue to flow on to 'plain-english' reporting of progress and learnings from TLM — both in terms of the Implementation Report and, importantly, in communication with the Basin community. TLM's continued success in the engagement of icon site communities is noted in this regard.

IRORG is of the opinion that the draft TLM Annual Implementation Report 2011–12 provides a fair representation of the implementation of TLM, based on the information available at the time it was prepared (31 July 2012). IRORG also believes that the audit process would have greater value if final reporting was completed prior to the commencement of the audit.

8 The future of The Living Murray

The Living Murray Initiative commenced in 2004 with the aim of demonstrating ecological benefits of the First Step Decision at targeted locations: 'The priority for investment under this Agreement is the recovery of water to implement the Living Murray First Step decision in regard to achievement of specific environmental objectives and outcomes for six significant ecological assets; Barmah-Millewa Forest, Gunbower and Koondrook-Perricoota Forests, Hattah Lakes, Chowilla floodplain (including Lindsay-Wallpolla), the Murray Mouth, Coorong and Lower Lakes, and the River Murray Channel, through recovered water (refer Clause 21) being built up over a period of five years to an estimated requirement of an average 500 GL/year.'[4]

TLM has been based on a co-operative relationship between the Commonwealth, New South Wales, Victorian, South Australian and Australian Capital Territory governments. Five governments have shared the financial and managerial aspects of this initiative, an arrangement which has facilitated the implementation of the key elements of TLM:

1. development of a robust system of governance to ensure the optimal acquisition and application of environmental water at icon sites in order to maximise the ecological value of the 500 GL for the currently estimated shared investment of $1.02 billion. IRORG believes that the governance element of TLM will always be developing through lessons learned, but it is at a stage where it can be adopted now with confidence.
2. acquisition of 500 GL of water entitlements, at a cost of $0.7 billion, to be applied for environmental outcomes at six icon sites. The water acquisition for TLM is also very near completion.
3. works and measures to enable the efficient delivery of environmental water to icon sites has been delayed due to various factors, including disruption to construction caused by high flows. The completion of this element of TLM in 2014 is currently projected to cost $0.32 billion.

TLM is now at something of a 'cross roads' in its development. The water recovery and works phase, which has been a significant focus for activities of TLM, is nearing completion and priority for action is now turning to environmental water planning and delivery. The 2007 TLM Business Plan is widely seen as having 'expired' and being in need of review and updating.

The most significant challenges facing TLM (and indeed environmental water management in general) are not about water recovery; rather they relate to environmental water planning and large scale integration; water delivery; water accounting; reporting, accountability and transparency; monitoring and evaluation of actions to support truly adaptive management; and the financial sustainability of environmental water management. In order to address these challenges, TLM needs a new strategic direction that properly identifies these challenges and provides a prioritised action plan for dealing with them in a structured, managed fashion.

Whilst jurisdictions are relatively uniform in agreeing on the need to refresh and re-establish the strategic direction for TLM, there are other risks to its further development. The Basin Plan will create the need to develop Basin-scale plans and priorities and to integrate environmental water planning and delivery on a large scale. Some jurisdictions are reluctant to invest resources and effort in further development of TLM processes as they are concerned that this effort may be wasted and will need to be redeveloped to comply with a Basin Plan. This creates a significant risk of loss of momentum for TLM.

IRORG supports the need to have regard for the emerging direction for environmental water management under the Basin Plan; however, with a final plan yet to be approved, halting TLM development activity to await clarity on the plan provisions risks a period of inactivity which will put valuable environmental assets at risk of sub-optimal outcomes, and will encourage isolated or bi-lateral watering efforts, rather than addressing the real challenge of large scale integration and multi-lateral planning and implementation.

4 Clause 17 of the *Intergovernmental Agreement on Addressing Water Overallocation and Achieving Environmental Objectives in the Murray–Darling Basin, 2004.*

The Living Murray was conceived for a defined task and has done an excellent job of delivering the objectives embodied in the First Step Decision. Its current form will not meet all of the needs of the Basin Plan and its Basin-wide environmental watering strategy. Nevertheless, TLM is still the largest multi-jurisdictional, multi-site environmental water delivery program in the Basin and can inform the emerging practice of environmental water delivery and help develop capabilities and processes that will be essential for effective implementation of a Basin Plan.

One of the key areas for development is in relation to governance and accountability processes. The range of environmental water holdings and holders has grown significantly since TLM was first conceived, and the water entitlement structures within which environmental water ownership sits have developed significantly as a result of implementation of the National Water Initiative by jurisdictions. The accountability, reporting and decision making frameworks that apply to environmental water managers have developed significantly and arrangements for integrated water delivery need to have regard for all these obligations and allow water holders, that participate in large scale events, to meet their individual accountability obligations.

There are governance challenges in relation to ensuring accountability and respecting where authority lies, yet still pursuing a co-operative, collaborative model. Getting this governance balance right is essential, for whilst the Basin Plan provides for new decision making powers for the MDBA, the reality is that implementation of most environmental water delivery actions will still be a state responsibility and collaboration by all parties around a shared, integrated vision will still be an essential success factor. On its journey to effective environmental water delivery, the MDBA needs volunteers, not prisoners of legislative obligation.

Planning, prioritisation and integration at a large scale in both time and space will be significant challenges under a Basin Plan. This audit report makes some observations in relation to possible improvements to planning processes, but there will be a strong need to continue to develop planning techniques which are fit for purpose, provide sufficient certainty for action yet retain flexibility to respond to changing circumstances, and which can be developed at reasonable cost and effort.

Redevelopment of TLM processes as part of a transition path to implementation of the Basin Plan will be a significant challenge. A number of actions towards this end are already underway but there needs to be a clear action program developed and agreed to by the partners to ensure a strategic focus on the elements which will maximise benefits. It also represents a major change program which will challenge and potentially 'threaten' the status-quo.

IRORG suggests that the partners approach this challenge from the perspective of an organisational change plan and bring in appropriate skills to assist with these elements. Developing a transition to a Basin Plan Environmental Water Plan is not just about science, ecology, hydrology and legislation. It is also about relationships, partnerships, collaboration, equity and culture. Sufficient regard needs to be given to design and development of these intangible assets, which in the long run may be more important to success than the tangible works and water assets.

2012.14 It is recommended that MDBA investigate the potential of the TLM model to be suitably developed as a basis for the implementation of environmental watering aspects of the Basin Plan. The investigation should include (but not be limited to):

i. governance models that support collaborative action by all owners of environmental water

ii. the development of shared and transparent watering strategies on large time and space scales

iii. mechanisms by which knowledge and learnings can be shared and applied in refining environmental management of the Basin.

Appendix 1 Audit terms of reference

Terms of Reference for 2011/12 interim Audit of The Living Murray Implementation

Background

The Intergovernmental agreement *on addressing water allocation and achieving environmental objectives in the Murray-Darling Basin (IGA 2004)* provided $500 million over five years to address water overallocation in the MDB. This was referred to as the "First Step Decision" and the investment was aimed at recovering 500 GL of water for six "icon" sites.

The Intergovernmental Agreement 2004 and TLM Business Plan 2007 require an annual audit to be conducted. An annual audit is required *as high levels of accountability and transparency regarding investment decisions is necessary to maintain the confidence of investing jurisdictions, and more particularly, the Basin communities and other stakeholders*.

The Independent Audit Group (IAG) has audited the Cap implementation since 1996. In 2005 additional duties were assigned to IAG to audit TLM implementation. Seven annual *Audit of TLM implementation* reports have been produced by the IAG. The final audit conducted by the TLM IAG of the TLM Implementation report was for the 2010/11 year.

The IAG has audited progress of TLM implementation which has primarily focused on the water recovery of 500 GL LTCE under the "First Step Decision". Ongoing audit arrangements will reflect the maturity of TLM implementation from water recovery to environmental water delivery.

The audit of TLM Implementation for the 2011/12 water year will be an interim audit to allow sufficient time to develop rigorous and comprehensive audit arrangements, commencing in the 2012/13 water year.

Objectives

The objective of the interim audit is for the auditors to express an opinion, in relation to the 2011/12 water year, on whether the:

1. TLM Portfolio was managed efficiently;
2. TLM environmental water delivery was managed effectively;
3. TLM Works and Measures program was managed efficiently and effectively;
4. TLM monitoring process was managed effectively; and
5. TLM Implementation Report is a fair representation of TLM implementation

The report may also provide recommendations on TLM Implementation.

Approach and Methodology

The parties subject to audit are TLM partners regarding TLM implementation.

Without limiting the independence of the auditors, in arriving at their audit opinion, the auditors should consider:

1. The meaning of efficiency and effectiveness as defined in the Standard on Assurance Engagements, ASAE 3500, formulated by the Auditing and Assurance Standards Board:
    a. Efficiency-*the use of resources such that output is optimised for any given set of resource inputs, or input is minimised for any given quantity and quality of output; and*
    b. Effectiveness-*the achievement of the objectives or other intended effects of activities at a program or entity level.*
2. Suitable criteria to assess the audit objectives includes:
    a. Relevant plans and proposals including annual environmental watering plans, specific watering proposals and operating plans; and
    b. Agreements by high level committees, including the principles to achieve multi-site watering agreed by BOC.

3. Gathering sufficient appropriate evidence to objectively evaluate the criteria to support the contents of the audit report.
4. Recommendations on TLM implementation including previous recommendations by IAG and the Independent River Operations Review Group's (IRORG) regarding the Review of the Multiple Site Environmental Watering Trial.

As part of the approach auditors will need to:

1. Discuss the audit program and clarify any issues with the MDBA;
2. Work with the MDBA to identify evidence required to conduct the audit;
3. Meet with TLM partner governments as necessary;
4. Prepare a draft report and consider matters of fact from TLM partner governments, MDBA and relevant stakeholders; and

Prepare a final report.

In the 2011/12 interim audit of TLM implementation the following will be outside the scope of this report:

1. The Cap of environmental water use (this will be undertaken by the Independent Audit Group);
2. Technical discussions on TLM environmental water delivery (this will be written as part of IRORG *Review of the 2011/12 Multiple Site Environmental Watering Trial*);
3. Environmental monitoring as an assessment of the environmental outcomes of TLM water delivery outcomes; and
4. River operations (this is investigated in IRORG's annual review of River Murray Operations).

Anticipated outputs and deliverables of this audit

The expected deliverable from this audit will be a report to the Ministerial Council. The interim 2011/12 audit report will express the auditor's opinion on the performance of TLM implementation against the audit objectives.

The audit report should include:

- objectives, nature, time period covered by the audit, and scope of the audit, including any limitations;
- level of assurance provided by the report;
- description of the program or activity that was audited, including management responsibilities and accountabilities;
- criteria used, their source, and any disagreements with management on their suitability;
- observations made;
- recommendations made to point to the direction in which positive changes can be made;
- management comments including planned action in response to the audit; and
- conclusions reached against each audit objective including any qualifications, where applicable.

The report may also provide recommendations on future audit arrangements. This report will be made publicly available.

Anticipated outcomes directly resulting from the services

The outcome of the 2011/12 interim audit will be an enhancement in the degree of confidence of Ministerial Council, jurisdictional partners and the public on the efficiency and effectiveness of TLM Implementation for the 2011/12 water year.

The report recommendations on TLM implementation will assist TLM in improving its efficiency and effectiveness. The recommendations on future audit arrangements and processes will assist the development of ongoing audit arrangements.

Users of the outputs

The primary users of the project outputs include:

- Ministerial Council
- TLM partners
- Relevant programs within the MDBA.

Involvement of other organisations and the users of the outputs in the services

It is anticipated that MDBA staff and staff from TLM partners will participate in the audit in the following ways:

- Participate in discussions with the auditors, as required;
- Provide evidence to the auditors, as required;
- Provide submissions, as required; and
- Review and provide feedback on matters of fact for draft and final reports.

Dissemination of outputs to users

The Audit report will be made publicly available on the MDBA website.

Appendix 2 Status of active recommendations identified in previous The Living Murray audits

No.	Issue / recommendation	Jurisdictional comment Sept. 2012	MDBA comment and progress at June 2012	IRORG comment
1. WATER RECOVERY (7 recommendations)				
2011.01	The IAG draws attention to its recommendation 2010.01 and strongly recommends that the proposed review of water acquisition not be delayed further contingent on the completion of the Environmental Water Recovery Register.	***SA.*** Recommendation supported — still relevant.	A summary of learnings has been provided to joint governments, TLMC 8, 15 June 2011. No further review currently scheduled or budgeted for.	IRORG notes the progress update. No further action appears necessary on this issue at his time.
2011.02	The IAG recommends that ACT finalise its contribution to TLM in 2011–12.	***SA.*** Recommendation supported — urge finalisation.	MDBA has received proposal from ACT on 2 GL contribution to TLM.	Some progress noted. IRORG recommends finalisation by March 2013
2011.07	The IAG recommends that the option for reducing the Cap by scaling down the annual Cap targets in proportion to the LTCE recovered be considered by the States and approval sought from the MDBA if deemed appropriate.	***AG.*** Recommendation supported. ***SA.*** Still relevant and underway through Water Audit Panel.	This is being progressed through the inter-jurisdictional Cap working group. On the request of the working group, the Authority has undertaken modelling and prepared an investigation report that concludes that the scaling method is a better approach than the current method of adjusting the Cap by the volume of environmental water use.	IRORG notes progress and recommends that surveillance of this issue be the responsibility of the independent audit of the Cap.
2010.01	The IAG recommends that, with the completion of all water recovery measures in 2010–11, a review be undertaken to identify key drivers of success and lessons learned that may be applicable to the development and implementation of the Basin Plan.	***SA.*** Supported. Should still be undertaken.	*Refer to* 2011.01 A summary of learning's has been provided to joint governments, TLMC 8, 15 June 2011. No further review currently scheduled or budgeted for.	See 2011.01 above.
2010.02	*The IAG recommends* that before the end of 2010 the ACT formally submits its proposed water recovery measure to the MDBA together with relevant supporting documentation confirming its water saving activities so that these can be considered and as appropriate recognised as an eligible measure.	***SA.*** Supported.	MDBA has received proposal from ACT on 2 GL contribution to TLM	See 2011.02 above.
2009.01	Finalising TLM water recovery The IAG recommends that every effort be made to finalise The Living Murray water recovery program in 2009–10.	SA supports this — it should be finalised	There is currently no process to formally finalise water recovery program	IRORG recommends that water recovery from NSW Package B and the ACT be concluded as soon as practicable and that TLM Environmental Water Registers be finalised during 2012–13.

No.	Issue / recommendation	Jurisdictional comment Sept. 2012	MDBA comment and progress at June 2012	IRORG comment
2009.04	Diversion Cap adjustments The IAG recommends that the relevant jurisdictions work with the MDBA office to put in place appropriate Cap adjustments including for TLM recovered water entitlements and associated environmental water use for the 2009–10 water year.	***SA.*** No longer relevant — overtaken by Basin Plan	MDBA adjusts the Cap for environmental water recovery as per the method proposed by states and approved under the Cap adjustment protocol agreed by Ministerial Council in 2008. Currently the cap is adjusted mostly by the volume of environmental water use. MDBA is working with the states on agreeing to an alternative (pro-rata scaling down targets) method for adjusting the Cap.	. See 2011.07 above
2. ONGOING ACCOUNTING AND WATER MANAGEMENT (5 recommendations)				
2011.03	The IAG recommends that remaining issues relating to the management of large volumes of environmental water, including its use at multiple sites, and the integration of infrastructure be resourced and resolved as quickly as possible.	***AG.*** Recommendation remains a high priority. No evident progress since BOC meeting May 2012. ***SA.*** Recommendation supported. ***Vic.*** MDBA is progressing well on this but more work is needed – particularly on integrating new works into watering planning and prioritisation.	Package of issues addressed for 2012–13 multi-site environmental watering trial papers to BOC. Refining Annual Watering Plan and process to allocate water. Multi-Site Operational Strategy. Construction of infrastructure further delayed due to high river levels in 2011–12.	Progress and delays in infrastructure noted. A number of institutional and operational issues remain and IRORG recommends that their resolution is pursued as a matter of high priority and, where appropriate, independently of specific TLM watering activities.
2011.04	The IAG draws attention to its recommendation 2010.03 and strongly recommends that the proposed review of water entitlement characteristics not be delayed further contingent on the completion of the Environmental Water Recovery Register.	***AG.*** Recommendation supported. ***SA.*** Recommendation supported.	A review of TLM entitlement portfolio is currently being undertaken by Lawlab and is expected to be completed by August 2012.	Progress noted. To be reviewed after June 2013.
2011.08	The IAG recommends that current and planned reviews of operations and the Basin Agreement be augmented by an investigation of implications of the special characteristics of environmental water requirements, for policy, accounting, and operations in TLM and, consequently, for Basin-wide management.	***AG.*** Current review of MDB Agreement includes assessment of impediments to management and delivery of environmental water. ***SA.*** Strongly supported. Reviews underway. ***Vic.*** Underway as part of review of agreed work.	River Management Review has been agreed by joint governments as part of the negotiations of the Basin Plan. In particular has been progressed through multi-site information to BOC.	Progress noted. To be reviewed after June 2013.

No.	Issue / recommendation	Jurisdictional comment Sept. 2012	MDBA comment and progress at June 2012	IRORG comment
2010.03	The IAG recommends that once the make-up of the full TLM entitlement portfolio is known, and no later than during 2010–11, the MDBA office undertakes an analysis of the recovered water entitlement portfolio so that the full range of deployment opportunities and limitations associated with the portfolio are better understood.	***SA.*** Supported. Progress being made in rationalising the number of licenses.	A review of TLM entitlement portfolio is currently being undertaken by Lawlab and is expected to be completed by August 2012.	See 2011.04 above
2010.04	The IAG recommends that an analysis of ongoing costs of implementing TLM beyond the water recovery phase be undertaken to enable better understanding of, and planning for, TLM's future budgetary needs.	***SA.*** Supported. Great concern to ***SA.*** Needs ongoing commitment to commissioning works and monitoring operation, outcomes, and risks – important to maintain community support.	A review of budgetary requirements for TLM icon site management was performed to seek an indication of the funding needs for 2012–13 and out years. Information was collated and analysed and the Environmental Watering Group made recommendations on future funding and expected deliverables. With the 2012–13 NSW funding reduction, the funding amounts were adjusted significantly for NSW and Victoria. Funding for out years will depend on state commitments made in 2013, following the outcomes of the Joint Programs Review.	This recommendation is overtaken by more recent budgetary pressures. Further detail about the decision-making structure and information available is needed.
3. GOVERNANCE AND AUDITING (3 Recommendations)				
2011.09	The IAG recommends that, based on a wide range of potential watering scenarios, delegation schedules are developed for operation at the EWG, Operations Committee, and on-site manager levels. The work requires wide consultation but should be completed before December 2012.	***AG.*** Recommendation supported to increase clarity around TLM governance and accountability.***SA.*** Supported. Should be discussed and scoped by MDBA. ***Vic.*** Not aware of any progress.	Initiated work on The Living Murray schedule. Decision-making project by Tim Cummins. TLMC considering new decision making models for EWG.	Progress noted. IRORG reaffirms recommendation.

No.	Issue / recommendation	Jurisdictional comment Sept. 2012	MDBA comment and progress at June 2012	IRORG comment
2011.12	The IAG recommends that a future TLM audit process beyond 2011 should include: annual reports (by Jurisdictions) on water use, to be subject to periodic independent audit and periodic reporting and formal review of progress against ecological objectives, based on monitoring results	***SA.*** Recommendation supported. Still relevant ***AG.*** Currently limited to EWG papers and verbal reports from partners. No formal reviews of issues and learnings undertaken. ***Vic.*** Reporting period need not be annual but based on time-scale of objectives or targets.	IRORG conducting interim audit of TLM At the site and program level the EWG has agreed that each year by March each icon site will produce a synthesis report articulating the activities and outcomes and an interpretation within the flow context of that year. The icon site reports will be used by the MDFRC to compile a system wide or program report by July each year.	Note that TLM water may represent a varying proportion of environmental water including that used at TLM sites. Current ToR may preclude IRORG from commenting on monitoring results. IRORG endorses the proposed reporting structure and suggests wide dissemination of results
	the effect of TLM acquisition water and future environmental water on the Cap and in future Sustainable Diversion Limits to be concluded through the annual Cap audits during the transition period.		Cap audit will deliver on this recommendation.	See 2011.07 above
2010.05	*The IAG recommends* that as TLM moves from water recovery to environmental water management and in light of the impending transition to the Basin Plan, the roles of the various TLM groups (e.g.: EWG, TLMC and IAG) be reviewed and clarified to ensure that: TLM and Basin Plan activities are aligned their roles are coordinated with the emerging activities of CEWH and other environmental water managers policy constraints can be effectively addressed capacity for effective and real-time (timely) decision making is maintained.	***SA.*** Supported. SA is seeking greater coordination of environmental water planning in MDB and a reduction in duplication	Initiated work on The Living Murray schedule. Governance study by Tim Cummins. TLMC considering new decision making models for EWG.	Progress noted. Outcomes to be reviewed by IRORG after June 2013.

No.	Issue / recommendation	Jurisdictional comment Sept. 2012	MDBA comment and progress at June 2012	IRORG comment
4 PLANNING, OBJECTIVE SETTING, PRIORITISATION. (3 Recommendations)				
2011.10	The IAG recommends an analysis of the ecological objective setting processes of TLM and a review of the processes that determine ecological monitoring programs applied at icon sites.	***AG.*** Recent analysis indicates significant improvement required. Currently under discussion by EWG. ***SA.*** Work underway. Still relevant as infrastructure is completed and commissioned. ***Vic.*** Addressed in new EWMPs	Condition Monitoring Plans have been reviewed by Wayne Robinson (internal report) and a process will be undertaken in 2012–13 to refine objectives, point of reference and target for each parameter measured at each site. The appropriateness of the methods used will be evaluated and sensitivity analysis where appropriate will be initiated beginning with aerial waterbird surveys. It is anticipated that further reform of the intervention and compliance monitoring carried out by TLM will follow this initial work.	Significant advances in the preparation of EWMPs recognised. Reported activity deals mainly with monitoring and decision making within EWG. This is important and welcome. IRORG recommends that work continues in developing a shared transparent, objective and repeatable process for setting priorities and determining appropriate monitoring measures. The process needs to accommodate operation of infrastructure and multi-site/multi-year water regimes.
2008.02	Role and performance of the Environmental Watering Group (EWG) The IAG believes that the deployment of the very scarce reserve of environmental water during 2007–08 has been carried out well and that the available evidence indicates a high level of efficacy. The EWG has proven to be an effective vehicle for collaborative assessment and management of TLM allocations, although yet to be tested under conditions of relative plenty (when water may be available for allocation to lower priority uses). Much of the successful decision-making of the EWG is based on the expert judgement of its members and their advisers. Whilst acknowledging this, *the IAG recommends* that the EWG be invited to document the steps followed in prioritising their response to competing demands for environmental water and the principles upon which these steps are based, as a template for making similar decisions across Jurisdictions on a Basin-wide scale.	***SA.*** Documentation of EWG processes occurring in an ongoing manner. Recommendations on alternative decision making process for EWG were forwarded to TLMC for input. SA supports EWG role in TLM.	A trial of revised decision making at EWG is being proposed for 2012–13. This is based on a project to review decision-making models for environmental water management. This project is to inform a review of the decision-making model currently employed by the Environmental Watering Group	Progress noted. See comments on 2011–10 above.

No.	Issue / recommendation	Jurisdictional comment Sept. 2012	MDBA comment and progress at June 2012	IRORG comment
2008.03	Impact of prioritisation of the Environmental Works and Measures Program (EWMP) on the use and effectiveness of the environmental water portfolio. The prioritisation of the EWMP, including delisting of a number of projects and possible changes to budgets and time-lines, will result in changes to TLM's capacity to allocate and deliver environmental water to some icon sites. There is a significant risk that this will alter the relative ecological value (or benefit) of water distributed amongst icon sites and, therefore, a need to assess the impact of these changes on the achievement of environmental objectives and the use of environmental water. *The IAG recommends* that the MDBA TLM team assess the impacts of the EWMP prioritisation on the capacity to achieve the icon site environmental objectives and provide a report to the EWG and the IAG.	***SA.*** supports this assessment once all work is completed.	Original Stage 2 modelling included The Living Murray works and measures that states put forward at that time. To reflect the current positions (i.e. delisting Lindsay stage 2 and Dry lakes at Hattah and enlarging Koondrook scheme), our water resources model has been changed accordingly.	Progress noted. Capacity in place to respond to future completion of works and measures. Recommendation addressed.
5. DATA MANAGEMENT, INFORMATION TRANSFER (3 Recommendations)				
2011.05	The IAG recommends further publication of environmental monitoring results and methodology assessments as part of the broader transfer of learnings from TLM.	***AG.*** Discussed at EWG but not progressed to date. ***SA.*** Supported. Still relevant. ***Vic.*** Addressed. Improvement still needed in using the results.	Progress has been made on reducing the backlog of reports awaiting approval. Some 100 reports have been placed on BP-Knowledge and Information Directory available to the general public. The process of linking reports from The Living Murray web site to BP-KID has begun.	Progress in making reports available on the web is noted. This recommendation is substantially addressed when the process of linking to BP-Knowledge and Information Directory is complete.
2011.06	The IAG recommends consideration of the maximisation of value from environmental water recovery and deployment by making results and findings widely available.	***AG.*** Recommendation supported. ***SA.*** Supported. Still relevant ***Vic.*** Addressed for water deployment.	Progress has been made to improve communications on TLM, for example; TLM Story, Annual Environmental Watering report (also refer to response to 2011.05). Work has also commenced to improve reporting of the ecological outcomes through the icon-site synthesis reporting process.	Progress is noted. As for 2011.05, this recommendation will be largely addressed by linking of reports to Knowledge and Information Directory and implementation icon-site synthesis reporting process. The inclusion of a number of "plain-english" publications in the communication products is noted and welcomed.
2011.11	The IAG recommends that MDBA and TLM partners establish a forum whereby monitoring results can receive wider technical scrutiny, their value in increasing knowledge of ecology/flow relationships be fully realised, and their contribution in refining environmental flow management be maximised both in TLM and in the broader scale	***AG.*** High priority. No evidence of increased technical scrutiny of monitoring results or of their use in refining environmental flow management.***SA.*** Underway and still relevant.***Vic.*** Hope to achieve this with involvement of MDFRC	No action has occurred yet. However a process to synthesise data annually at the icon sites has been agreed by EWG. This process is designed to feed into a system wide synthesis of monitoring which could underpin the establishment of a forum as recommended.	Progress noted.

Appendix 3 Jurisdictional responses

Where requested, written responses from jurisdictional governments that participate in The Living Murray Initiative are published as an appendix to IRORG's audit report.

No responses were provided by jurisdictional governments for inclusion in this appendix.

Australian Government

MURRAY–DARLING
BASIN AUTHORITY