QON 14, 16 & 20 - Attachment A

QON 14, 16 & 20 - Attachment B

QON 14, 16 & 20 - Attachment C

Commonwealth Environmental Water Use 2011-12
as at 30 April 2012

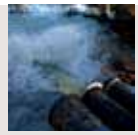
Financial Year	Catchment	Asset	Volume made available for use (GL)	Volume of Commonwealth Environmental Water Delivered (GL)	Volume of Partner Water Delivered (GL)	Total Volume Delivered (GL)	Comments
2008-09	Murray	Chowilla Floodplain[1]	1.70	1.70	0.35	2.05	
2008-09	Murray	Carpark Lagoons[1]	0.17	0.17	-	0.17	
2008-09	Murray	Lindsay Island	1.00	1.00	0.60	1.60	
2008-09	Murray	Paiwalla Wetland[1]	0.63	0.63	-	0.63	
2008-09	Murray	Markaranka Complex	2.23	2.23	-	2.23	
2008-09	Murray	Rocky Gully[1]	0.01	0.01	-	0.01	
2008-09	Barwon-Darling	Darling River	2.74	2.74	-	2.74	
2008-09	Murray	Hattah Lakes	2.12	2.12	2.77	4.90	
2008-09	Murray	Backwater Lagoon[1]	1.00	0.34	-	0.34	Asset water needs met with volume delivered
2008-09	Murray	Overland Corner	0.50	0.50	-	0.50	
2008-09	Murray	Murbpook Lagoon[1]	1.27	1.27	-	1.27	
2009-10	Murrumbidgee	Lowbidgee Floodplain[1]	7.14	7.14	3.51	10.65	
2009-10	Murray	Hattah Lakes	9.10	7.06	5.84	12.90	Completed for 2009-10 - continued in 2010-11
2009-10	Macquarie-Castlereagh	Macquarie Marshes	0.09	0.09	19.20	19.28	
2009-10	Murray	Millewa State Forest - Toupna Creek	1.50	1.50	0.50	2.00	
2009-10	Murray	Werai Forest	4.50	4.50	-	4.50	
2009-10	Murray	Wee Wee Creek Nampoo wetlands Grand Junction Cliffhouse wetlands Boeill Creek Floodplain Andruco Lagoon	1.75	1.75	2.39	4.13	
2009-10	Macquarie-Castlereagh	Macquarie Marshes	0.85	0.85	0.65	1.50	
2009-10	Murray	Chowilla Floodplain	7.85	7.35	-	7.35	
2009-10	Murray	Katarapko Creek	0.02	0.02	-	0.02	
2009-10	Murray	Lake Wallawalla	12.00	4.15	-	4.15	Completed for 2009-10 - continued in 2010-11
2009-10	Murray	Lake Albert	20.00	20.00	104.30	124.30	
2009-10	Murray	Paiwalla Wetland	0.24	0.24	0.14	0.38	
2009-10	Murrumbidgee	North Redbank	1.60	1.60	0.40	2.00	
2009-10	Murray	Morgan Conservation Park	0.32	0.32	-	0.32	
2009-10	Murray	Weila	0.22	0.22	-	0.22	
2009-10	Murray	Wigley Reach	0.25	0.25	-	0.25	
2009-10	Murrumbidgee	Yanga National Park	40.00	40.00	15.48	55.48	
2009-10	Murray	Overland Corner Complex	0.20	0.20	0.30	0.50	
2009-10	Ovens	King River	0.05	0.05	-	0.05	
2009-10	Murray	Molo Flat	0.33	0.33	-	0.33	
2009-10	Barwon-Darling	Darling River	37.99	37.99	-	37.99	
2009-10	Warrego	Upper Warrego River (Qld)	2.16	2.16	-	2.16	
2009-10	Warrego	Lower Warrego River (Qld)	10.00	10.00	-	10.00	
2009-10	Condamine-Balonne	Nebine Creek	4.46	4.46	-	4.46	
2009-10	Moonie	Moonie River	1.42	1.42	-	1.42	
2010-11	Murray	Hattah Lakes	9.34	9.34	2.53	11.87	Continued from 2009-10
2010-11	Murray	Lake Wallawalla	7.85	7.85	-	7.85	Continued from 2009-10
2010-11	Murray	Kulkurna	0.06	0.06	-	0.06	
2010-11	Murray	Coombool Swamp	0.51	0.51	1.00	1.51	
2010-11	Murrumbidgee	Yanga National Park	7.53	7.53	32.06	39.59	
2010-11	Gwydir	Gwydir Wetlands	3.06	3.06	-	3.06	
2010-11	Macquarie-Castlereagh	Macquarie Marshes	1.89	1.89	1.44	3.33	
2010-11	Murrumbidgee	Yanga National Park	13.29	13.29	21.62	34.91	
2010-11	Murray	Carpark Lagoons	0.15	0.15	-	0.15	
2010-11	Murray	Wakool River and Yallakool Creek	18.67	18.67	-	18.67	
2010-11	Lower Darling	Great Darling Anabranch	7.67	7.67	18.82	26.49	
2010-11	Warrego	Upper Warrego River (Qld)	6.05	6.05	-	6.05	
2010-11	Murrumbidgee	North Redbank	2.53	2.53	6.93	9.45	
2010-11	Murrumbidgee	Barren Box Swamp	3.00	3.00	0.30	3.30	
2010-11	Warrego	Lower Warrego River (Qld)	10.00	10.00	-	10.00	
2010-11	Lachlan	Merrimajeel Creek[1]	1.88	1.88	0.56	2.44	
2010-11	Lachlan	Merrowie Creek	2.15	2.15	0.86	3.01	
2010-11	Gwydir	Gwydir Wetlands	10.00	10.00	9.66	19.66	
2010-11	Moonie	Moonie River	1.42	1.42	-	1.42	
2010-11	Murrumbidgee	lower Murrumbidgee River	57.75	57.75	17.12	74.87	
2010-11	Goulburn-Broken	lower Goulburn River	52.44	52.44	-	52.44	
2010-11	Murray	Coorong, Lower Lakes	29.18	29.18	-	29.18	
2010-11	Macquarie-Castlereagh	Macquarie Marshes	25.00	25.00	170.98	195.98	
2010-11	Goulburn-Broken	Broken River	0.02	0.02	-	0.02	
2010-11	Murray	Jimaringle and Cockran Creeks	1.10	1.10	2.46	3.56	
2010-11	Loddon	Loddon River	0.43	0.43	-	0.43	Completed for 2010-11 - continued in 2011-12

Commonwealth Environmental Water Use 2011-12
as at 30 April 2012

Financial Year	Catchment	Asset	Volume made available for use (GL)	Volume of Commonwealth Environmental Water Delivered (GL)	Volume of Partner Water Delivered (GL)	Total Volume Delivered (GL)	Comments
2010-11	Campaspe	Campaspe River	2.14	2.14	-	2.14	Completed for 2010-11 - continued in 2011-12
2010-11	Murrumbidgee	Mid-Murrumbidgee Wetlands	109.25	109.25	49.88	159.13	
2010-11	Lachlan	Merrowie Creek[1]	14.63	2.45	0.78	3.23	Completed for 2010-11 - continued in 2011-12
2010-11	Lachlan	Merrimajeel Creek	5.10	0.25	0.09	0.35	Completed for 2010-11 - continued in 2011-12
2011-12	Loddon	Loddon River	1.56	1.56	5.20	6.76	
2011-12	Campaspe	Campaspe River	6.98	5.89	7.10	12.99	Flow needs met with volume delivered
2011-12	Lachlan	Merrowie Creek	-	11.36	4.02	15.38	Site needs met with volume delivered
2011-12	Lachlan	Merrimajeel Creek	-	4.92	0.65	5.57	
2011-12	Lachlan	Muggabah Creek	3.66	3.95	1.45	5.40	
2011-12	Macquarie-Castlereagh	Macquarie Marshes	40.00	40.00	100.00	140.00	
2011-12	Gwydir	Gwydir Wetlands	10.00	1.21	-	1.21	Water action was suspended on 21 October 2011 due to forecast heavy rainfall
2011-12	Murrumbidgee	North Redbank	17.80	17.80	-	17.80	
2011-12	Murray	Colligen Creek	5.50	5.50	1.72	7.22	
2011-12	Border Rivers	Severn River	1.00	1.00	-	1.00	
2011-12	Moonie	Lower Moonie floodplain	1.42	1.42	-	1.42	
2011-12	Warrego	Warrego River (Qld)	6.05	6.05	-	6.05	
2011-12	Warrego	Warrego River (NSW)	10.00	10.00	-	10.00	
2011-12	Warrego	Toorale National Park/Toorale State Conservation Area western floodplain	10.00	9.72	-	9.72	
2011-12	Warrego	Warrego River (NSW)	8.11	8.11	-	8.11	
2011-12	Goulburn-Broken	Broken River	0.05	0.05	-	0.05	
2011-12	Murray	Wakool River and Colligen Creek	7.50	7.50	6.88	14.38	
2011-12	Murray	Jimaringle & Cockran Creeks	3.00	3.00	2.62	5.62	
2011-12	Murray	Murray River	32.69	32.69	-	32.69	

[1] There have been minor accounting adjustments to the volumes delivered in these late season watering actions. This is due to more accurate hydrographic data becoming available from delivery partners since publication of relevant annual reports.

WATER MANAGEMENT



Annual Report of the Commonwealth Environmental Water Holder 2008–09

The *Water Act 2007* establishes the position of Commonwealth Environmental Water Holder (CEWH), to manage the Commonwealth's environmental water holdings, and to protect or restore environmental assets in the Murray-Darling Basin and in other areas where environmental water is held.

The Secretary of the Department of the Environment, Water, Heritage and the Arts has appointed Mr Ian Robinson as the CEWH. Mr Robinson also holds the position of First Assistant Secretary, Water Governance Division, in the department.

Activities of the Commonwealth Environmental Water Holder in 2008–09

CEWH Business Plan 2008–09

During the year, a CEWH Business Plan was prepared and made available to stakeholders. The plan was prepared to guide the first year of environmental watering. It outlined the nature of the function, arrangements during establishment and the proposed approach to prioritising and using water during the year.

First environmental water allocations

The amount of water available for use in any one year will depend on: the entitlement volumes in the holdings; the seasonal water allocations against those entitlements; and any carry over of allocations from the previous year. Entitlements are being acquired through programs managed by the department. They become part of the holdings when registered on state water registers.

For most of the past year, there were 24 gigalitres of entitlements in the Commonwealth holdings, which, due to extreme drought conditions, yielded 2.3 gigalitres of seasonal allocations. This was the first allocation of water against the holdings, and therefore 2008–09 was the first operational year for Commonwealth environmental watering.

By 30 June 2009, the Commonwealth's environmental water holdings had increased to 63.6 gigalitres (see Table 1).

During the year, the Commonwealth provided financial support for New South Wales to purchase Toorale Station (near Bourke, New South Wales) in return for transfer of Toorale's water licences to the Commonwealth, when this becomes possible under New South Wales water management legislation. Water from rainfall in February and March 2009 in the north of the Murray-Darling Basin provided environmental flows in the Darling River from Toorale to Menindee Lakes. Relevant jurisdictions agreed that the CEWH would determine the use of this water for environmental purposes. On this basis, 8.7 gigalitres was made available for use at specific sites within the southern-connected Basin.

Table 1. Commonwealth environmental water holdings (30 June 2009)

River System	*Security*	*Registered Entitlements Gigalitres (GL)*
NSW		
Gwydir	General	11.66
Lachlan	High	0.30
	General	14.17
Macquarie / Cudgegong	General	1.97
Murray	General	8.62
Murrumbidgee	High	13.74
	Supplementary	1.13
Namoi (Upper)	General	0.10
Namoi (Lower)	General	3.73
Victoria		
Campaspe	High	0.64
Goulburn	High	0.65
	Low	0.37
Murray	High	5.30
	Low	0.35
Ovens	High	0.05
South Australia		
Murray	High	0.79
Total		***63.57***

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Science based approach

Ensuring the maximum environmental outcome from the use of the environmental water holdings requires that decisions are based on the best available information. To assist with this, the department has established an Environmental Water Scientific Advisory Committee (EWSAC). The committee comprises prominent scientists and experts in relevant fields. Its advice and input is proving to be very important in implementing the CEWH's role.

The committee is providing advice to the CEWH on a range of issues, including a framework for determining Commonwealth environmental watering actions in the future, and criteria for prioritising environmental water delivery. A discussion paper has been prepared with the assistance of EWSAC, for the purposes of developing and consulting on a longer term approach to prioritisation.

Use of Commonwealth environmental water

Proposals for watering events during 2008–09 were received from the states and assessed against published criteria. The criteria included consideration of the ecological significance of the environmental assets; the expected ecological outcomes from the watering; and issues of risk and cost effectiveness. Consistent with the approach outlined in the business plan for extremely dry conditions, individual watering events were designed to avoid critical loss of threatened species and communities, maintain key refuges, and avoid irretrievable damage or catastrophic events.

The first use of Commonwealth environmental water occurred in March 2009, at Chowilla floodplain, South Australia. By 30 June 2009, 2.2 gigalitres of water allocated against the holdings had been used, in addition to the 8.7 gigalitres of water that had been sourced from the purchase of Toorale Station. In total, 10 sites across three jurisdictions received 10.9 gigalitres of water from Commonwealth programs (see Table 2). State government agencies and the Living Murray Initiative also provided a further 3.1 gigalitres for the watering actions that occurred at these sites.

Table 2. Commonwealth environmental water actions (2008–09)[1]

Site	*Commonwealth Allocated Water (GL)*
Chowilla Floodplains (SA) (Near Renmark, SA)	1.78
Carpark Lagoons, Katarapko (SA) (Near Berri, SA)	0.20
Paiwalla Wetland (SA) (Between Mannum and Murray Bridge, SA)	0.60
Rocky Gully (SA) (Near Murray Bridge, SA)	0.08
Markaranka Wetland Complex (SA) (Near Waikerie, SA)	2.23
Overland Corner Floodplain (SA) (Near Kingston-on-Murray, SA)	0.50
Murbpook Lagoon (SA) (Near Blanchetown, SA)	1.40
Lindsay Island (VIC) (On VIC/SA Border)	1.00
Hattah Lakes (VIC) (North-Western Victoria near Robinvale)	2.12
Backwater Lagoon (NSW) (In Wangumma State Forest, west of Wentworth, NSW)	1.00
	10.91

[1] A volume of 0.1 gigalitres from the holdings was carried over for use in 2009–10

The watering that was undertaken was generally aimed at protecting mature River Red Gum communities, pockets of healthy ecosystems in drought affected floodplains and wetlands, and refuges for threatened species. For example, the Ramsar listed Hattah Lakes and Lindsay Island in Victoria were chosen because these sites, in addition to having extensive River Red Gum areas, provide habitat for threatened species such as the Southern Bell Frog and the Regent Parrot. These are also target sites under the Living Murray Initiative and watering was implemented so as to complement the Living Murray Watering actions being managed by the Murray-Darling Basin Authority.

Delivery through state agencies has been conducted smoothly and with excellent cooperation. These agencies will be monitoring the effects of the watering actions and will provide results to the Commonwealth. As all watering occurred in the Autumn of 2009, it is too early at this stage to provide detailed reports. However, as an example, the early indications at the Hattah Lakes site were that almost 50 000 waterbirds were present after the watering, with green shoots reported on River Red Gums fringing the lakes.

Murray-Darling Basin environmental watering plan

The Murray-Darling Basin Authority (MDBA) was established during 2008–09. One of its new functions is the preparation of an environmental watering plan, as part of a broader Basin Plan. The activities of the CEWH will be conducted in accordance with this plan when it is put in place (expected to be 2011). Close consultation with the MDBA is occurring in the interim to ensure there is consistency of approach with the long term arrangements.

Environmental Water Holdings Special Account

The Environmental Water Holdings Special Account is established under section 111 of the *Water Act 2007* to facilitate the payment of costs, expenses and other obligations incurred in managing the environmental water holdings.

At the start of the 2008–09 financial year the special account balance was $2.02 million. Funding of $1.9 million was credited to the account during the financial year, and payments of $0.13 million for water delivery costs and charges were expended. As at 30 June 2009, the special account balance was $3.8 million. Further information on the special account is included in the department's 2008–09 financial statements.

Directions given to the Commonwealth Environmental Water Holder

There were no directions given to the CEWH by either the Secretary or the minister during 2008–09.

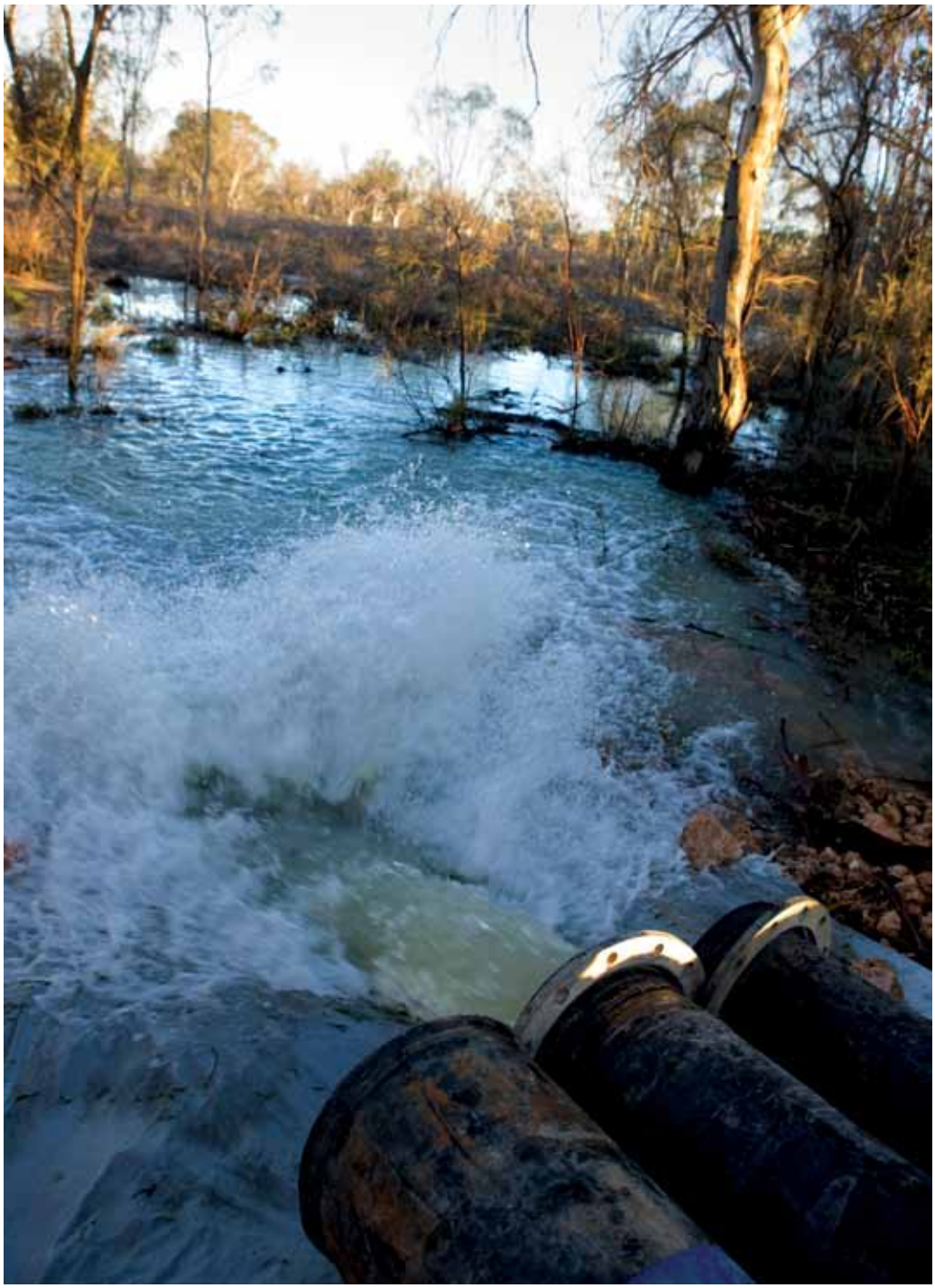
Future Outlook

Over the next year, the volume of water entitlements in the Commonwealth holdings is expected to grow significantly. As at 30 June 2009, in addition to the 63.6 gigalitres in the holdings, the department had exchanged contracts for a further 382.5 gigalitres approximately. The contracts will be settled and registered, and the allocations against these entitlements will become available for use in 2009–10 and beyond. It is also likely that some of the water entitlements purchased in 2009–10 will become available for use during the year. The first use of Commonwealth water in the northern Basin is also anticipated to occur in the next year.

Storage levels in the Murray-Darling Basin are at very low levels, following unprecedented drought conditions. This will continue to affect water allocations into 2009–10, even if seasonal conditions are more normal across the Winter-Spring period. In this context, watering options in Spring 2009 are expected to be limited. However, significantly greater volumes should be available in the Autumn of 2010.

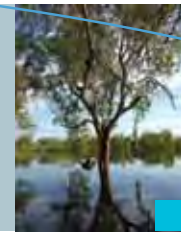
Carpark Lagoons Katarapko Floodplain, South Australia–Pre-watering. Photo: Mark Mohell

Carpark Lagoons Katarapko Floodplain, South Australia–Post-watering. Photo: Mark Mohell



Markaranka Wetland Complex, South Australia–Watering. Photo: Mark Mohell

Annual Report of the Commonwealth Environmental Water Holder 2009–10



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Activities of the Commonwealth Environmental Water Holder in 2009–10

Approach to environmental water use

The Commonwealth's approach to using its environmental water is aimed at achieving the best environmental outcomes across the Basin. It is based on the *Framework for determining Commonwealth environmental watering actions*, which was finalised and published in 2009–10, incorporating feedback from stakeholders provided through public consultation. The approach is described in the Commonwealth Environmental Water Holder 2009–10 Business Plan, made available to stakeholders early in the year.

For much of the Murray-Darling Basin the objectives for 2009–10 were those applying for an *extremely dry* period. These were: to avoid critical loss among threatened species; to avoid irretrievable damage or catastrophic events; and to provide drought refuges that will enable recolonisation as conditions improve.

Where wetter conditions prevailed, for example in some northern catchments over summer, the objectives were to support high-flow river and floodplain functional processes and to promote connectivity between the floodplain and river channel.

Potential watering options were identified in cooperation with Basin state governments and other environmental water managers, local groups (such as catchment management authorities, natural resource management boards and environmental water advisory groups), as well as land holders who put forward proposals for the Commonwealth's consideration.

The potential watering options were then assessed against agreed criteria: the ecological significance of the asset; the expected ecological outcomes from the proposed watering action;

the potential risks of the proposed watering action at the site and at connected locations; the long-term sustainability of the asset, including appropriate management arrangements; and the cost effectiveness and operational feasibility of undertaking the watering.

The assessment criteria were developed with input from stakeholders, including Basin state governments, and agreed by the Environmental Water Scientific Advisory Committee. This committee consisting of scientific experts was established in 2008 to advise the department and the Commonwealth Environmental Water Holder on environmental water issues. The decisions on 2009–10 environmental water use were informed by advice from the committee, which met six times during the year.

Environmental Water Scientific Advisory Committee

Advises the Commonwealth Environmental Water Holder and the department on the use of environmental water including:

- methods for determining relative priority of environmental assets
- areas that merit additional investigation, including additional research
- assessing the benefits of the use of environmental water.

The committee is chaired by Professor Barry Hart, and comprises eminent scientists and experts in fields such as hydrology, limnology, river operations management, river and floodplain ecology and the management of aquatic ecosystems.

Following decisions on use, the Commonwealth entered into arrangements with the relevant Basin state governments and other environmental water holders or catchment management authorities, to deliver the water. This delivery phase also involved coordination with river operators.

Cooperative arrangements for use of Commonwealth environmental water

Use of the Commonwealth's environmental water involves a high degree of cooperation with Basin state governments, other environmental water holders, the local community and others, particularly when identifying watering options and in the delivery and monitoring of outcomes. For example:

- The arrangements for the delivery of about seven billion litres of environmental water to Hattah Lakes in 2009–10 were typical of the Commonwealth's arrangements with delivery partners in Victoria.
- The identification of the watering action was undertaken in conjunction with the Mallee Catchment Management Authority (CMA), the Victorian Department of Sustainability and Environment, Parks Victoria and The Living Murray.
- The Mallee CMA delivered the Commonwealth's water into Hattah Lakes where it was coordinated with three billion litres from the Victorian Government, five billion litres from The Living Murray, and 400 million litres through the Australian Conservation Foundation. Monitoring is being undertaken by the Mallee CMA.

Agreed arrangements for monitoring the ecological responses and reporting to the Commonwealth on the environmental outcomes achieved were put in place with delivery partners and community groups. The results from the monitoring activities are being used to refine an adaptive management approach where the lessons learned from watering actions are informing future actions.

Lake Little Hattah, Hattah Lakes, Victoria—Prior to environmental watering, April 2009 (left) and following environmental watering, December 2009 (right). (Mark Mohell)

Environmental water available in 2009–10

The volume of water available to the Commonwealth for environmental use in 2009–10 was 187 gigalitres; more than 12 times the amount available in the previous year. The large increase was due to a number of factors such as: growth in the holdings; higher allocation rates; and significant rainfall events, mostly in the northern part of the Murray-Darling Basin.

The holdings grew from 64 gigalitres at the end of 2008–09 to 738 gigalitres at the end of 2009–10 (Table 1).

In the southern basin allocations were higher than in the previous year, although still well below long-term averages in most catchments. Allocations in the New South Wales Murray (general security) and the Goulburn (high security), were 27 and 71 per cent in 2009–10, compared with 9 and 33 per cent respectively in the previous year. The long-term averages in these catchments are 81 and 95 per cent respectively.

Significant rainfall events in the Macquarie and Murrumbidgee catchments in late 2009 and early 2010 allowed the Commonwealth to access water from its supplementary titles for the first time. Flood events in early 2010 in the northern Murray-Darling Basin also yielded good returns on unregulated titles.

Table 1. Commonwealth environmental water holdings			
River System	**Security**	**Registered entitlements Gigalitres (GL)**	
		30 June 2009	**30 June 2010**
Queensland[1]			
Border Rivers	Medium		5.53
	Unsupplemented		1.00
Moonie	Unsupplemented		1.42
Nebine	Unsupplemented		5.92
Warrego	Unsupplemented		16.05
New South Wales			
Gwydir	General	11.66	88.52
	Supplementary		19.10
Lachlan	High	0.30	0.73
	General	14.17	81.99
Macquarie/Cudgegong	General	1.97	57.39
	Supplementary		1.89
Murray	High		0.32
	General	8.62	171.56
Murrumbidgee	General	13.74	64.36
	Supplementary	1.13	20.82
Namoi (upper)	General	0.10	0.11
Namoi (lower)	General	3.73	6.10
Victoria			
Broken	High		0.02
	Low		0.01
Campaspe	High	0.64	5.12
	Low		0.40
Goulburn	High	0.65	53.69
	Low	0.37	10.38
Loddon	High		1.18
	Low		0.53
Murray	High	5.30	74.93
	Low	0.35	9.78

Table 1. Commonwealth environmental water holdings			
River System	**Security**	**Registered entitlements Gigalitres (GL)**	
		30 June 2009	**30 June 2010**
Ovens	High	0.05	0.07
South Australia			
Murray	High	0.79	38.89
Total		**63.57**	**737.80**

1 Figures for the Queensland unsupplemented entitlements represent the volumetric limit, or maximum allowable take, for those entitlements. These are annual volumetric limits with the exception of the Border Rivers, where the maximum specified take is three gigalitres over any three-year period.

Use of Commonwealth environmental water

The significantly larger volume of water available in 2009–10 provided the opportunity to expand the scope of environmental watering to protect or restore a broader range of environmental assets.

Of the 187 gigalitres available, 153 gigalitres were used during the 2009–10 water year. Wetlands and floodplains in the Murray, Murrumbidgee and Macquarie catchments received 97 gigalitres. These watering events built on and consolidated environmental water use in 2008–09, in some cases with much larger volumes, such as at Hattah Lakes in Victoria. The increased volume of available water also allowed the CEWH to provide water to a larger number of sites at greater volume. For example, significant amounts of water were provided for the first time to the Lowbidgee Floodplain in New South Wales (48.70 gigalitres) and Lake Albert in South Australia (20 gigalitres).

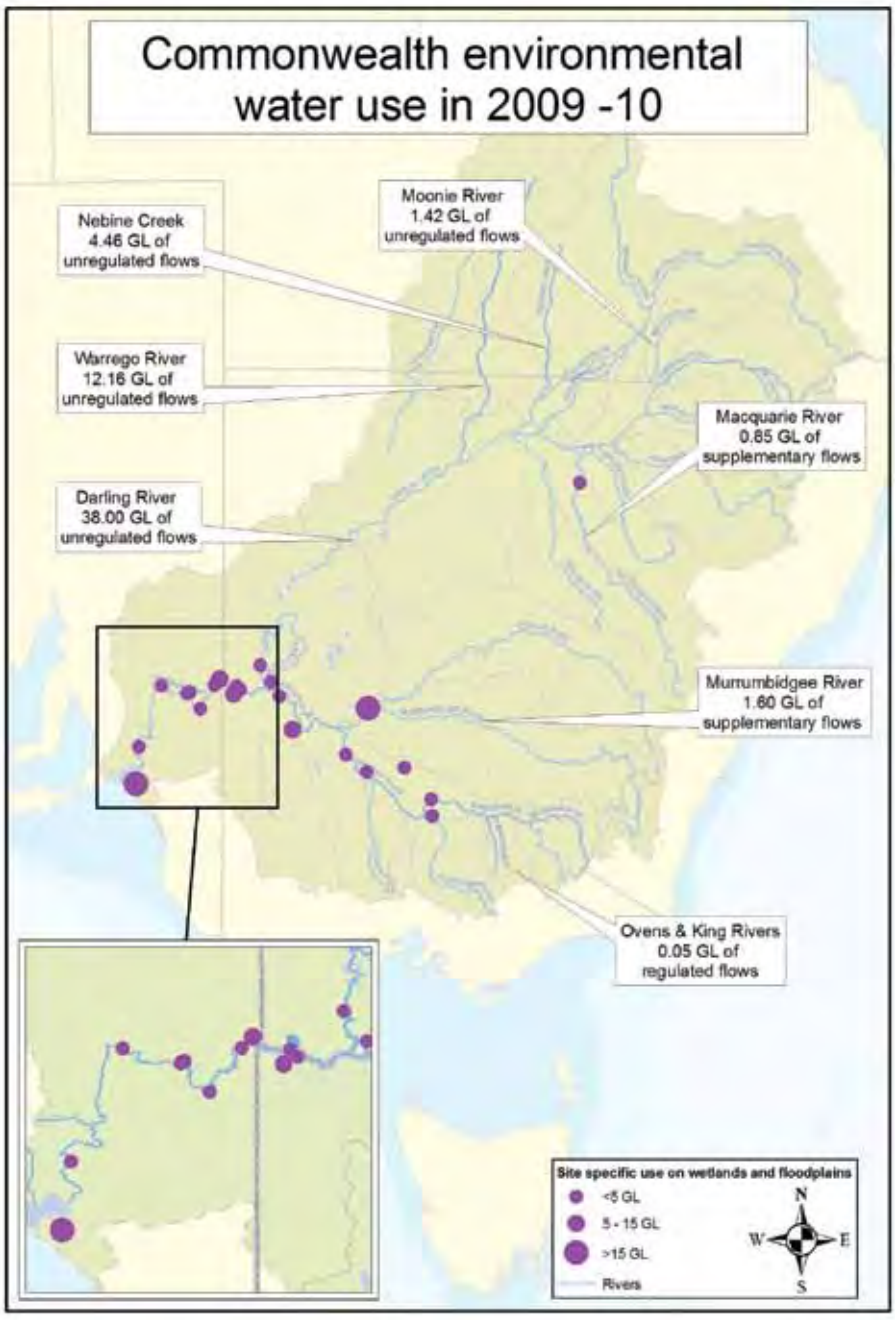
A further 56 gigalitres were directed as in-stream and overbank flows in the Warrego and Moonie rivers, Nebine Creek, and the Darling River and Ovens catchments. These flows represent a new and what will be an increasing feature of the Commonwealth's environmental watering activities in future years.

The use of Commonwealth environmental water throughout the year is increasing canopy cover in river red gums and providing refuges for native flora and fauna during the drought. It is also contributing to successful bird breeding events and helping to reduce the risk of acidification of Lake Albert. The in-stream and overbank flows contributed to connected system benefits as floodwaters filled flood-runners and anabranches and breached riverbanks.

A total of 34 gigalitres was carried over for delivery in 2010–11. Of this, 11 gigalitres was committed for use at Hattah Lakes, Lake Wallawalla and Chowilla Floodplain early in the new water year. Carrying over water enables late winter and early spring environmental needs to be met, when seasonal water allocations are expected to be low. The Commonwealth environmental water holdings are subject to the same carryover arrangements as equivalent titles held by irrigators.

Carpark Lagoons in the Katarapko Floodplains South Australia—Prior to environmental watering, South Australia, March 2009 (top); following environmental watering, April 2009 (middle); and six months after environmental watering (above), November 2009. (Mark Mohell)

Map 1: Location of environmental assets watered in 2009–10



Data Sources: Drainage Division, States, © Commonwealth of Australia (Geoscience Australia). © Murray-Darling Basin Authority 2010. Sustainable Yields Reporting Regions © CSIRO Land and Water 2010.

All data are presumed to be correct as received from data providers. No responsibility is taken by the Commonwealth for errors or omissions. The Commonwealth does not accept responsibility in respect to any information or advice given in relation to, or as a consequence of, anything contained herein. Map produced by: ERIN, DEWHA, July 2010.

Murray and Ovens catchments, New South Wales, South Australia and Victoria

Almost 48 gigalitres of Commonwealth environmental water were made available for use in the Murray catchment during the year (Table 2). The water was provided through several discreet events to river red gum forests, floodplain wetlands, streams of the upper Murray system and to Lake Albert, part of the Coorong, Lakes Alexandrina and Albert Ramsar site.

Table 2. Commonwealth environmental water use in the Murray and Ovens catchments

Wetlands and Floodplains	Commonwealth water delivered (GL)
Lake Wallawalla, near Mildura, Vic	4.14[1]
Hattah Lakes, near Mildura, Vic	7.06[2]
Werai State Forest, near Deniliquin, NSW	4.50
Top-up flows for nine wetlands along the lower NSW Murray (Andruco Lagoon, Boeill Floodplain, Brechin, Cliffhouse 1 and 2, Grand Junction, Kennaugh, Nampoo, Wee Wee Creek)	1.75
Millewa State Forest, near Deniliquin, NSW	1.50
Chowilla Floodplain, near Renmark, SA & NSW	7.23[3]
Lake Albert, at the Murray Mouth, SA	20.00
Morgan Conservation Park, near Morgan, SA	0.32
Molo Flat, near Waikerie, SA	0.33
Wigley Reach, near Renmark, SA	0.25
Paiwalla Wetland, near Murray Bridge, SA	0.24
Weila, near Renmark, SA	0.22
Overland Corner Complex, near Kingston-on-Murray, SA	0.20
Katarapko Creek Wetlands, near Berri, SA	0.02
In-stream and overbank flows	
Ovens & King rivers, near Wangaratta, Vic	0.05
Total	**47.80**

1 A further 7.86 gigalitres was carried over for use in early 2010–11.

2 A further 2.04 gigalitres was carried over for use in early 2010–11.

3 A further 1.07 gigalitres was carried over for use in early 2010–11.

The watering in the Murray catchment was aimed at: protecting mature river red gum and black box communities; reducing the risk of acidification of Lake Albert; and providing refuge during the drought for native flora and fauna, particularly migratory birds and other riverine ecosystem-dependent and threatened species such as the Australian painted snipe, the regent parrot, and the southern bell frog.

An example of one of the larger watering events occurred at the Ramsar-listed Hattah-Kulkyne Lakes in North-western Victoria, where Commonwealth water was provided to consolidate benefits from previous environmental watering events. In autumn 2009 one of the Commonwealth's first watering events, provided Hattah Lakes with 2.12 gigalitres in conjunction with Victorian and Living Murray water. Positive outcomes included the sighting of 29 species of waterbird (with over 3,200 individuals recorded) on the lakes, as well as a vigorous response from the river red gums fringing the lakes and along Chalka Creek. There were also reports of the regent parrot (listed as a vulnerable species under the *Environment Protection and Biodiversity Conservation Act 1999*) benefiting from improved river red gum habitat.

To build on this success and extend the ecological benefits, further environmental watering was undertaken in 2009–10. The Commonwealth delivered an additional 7.1 gigalitres to maintain the health of stressed river red gums and provide important drought refuges for waterbirds and other wetland-dependent species. This additional water allowed more of the 18 lakes to be filled and was undertaken in conjunction with The Living Murray program, which provided 5 gigalitres of water. The Victorian Government provided 3.1 gigalitres, and public donations provided 400 megalitres through the Australian Conservation Foundation.

The 20 gigalitres allocated to Lake Albert in early 2010 built on 170 gigalitres of water provided to the Lower Lakes from South Australia's environmental water reserve, 48.3 gigalitres from The Living Murray program and 100 gigalitres from the Darling River floodwaters to the Lower Lakes. This water has reduced the risk of acidification of Lake Albert, helped to reduce salinity levels below what they would otherwise have been, and maintained the lake as a refuge for significant populations of waterbird and other water-dependent species during the drought.

Murrumbidgee catchment, New South Wales

The Murrumbidgee catchment received nearly 49 gigalitres of Commonwealth environmental water during the year, provided in three separate events (Table 3).

Table 3. Commonwealth environmental water use in the Murrumbidgee catchment

Wetlands and Floodplains	Commonwealth water delivered (GL)
Lowbidgee Floodplain, near Balranald, NSW	
- watering event over spring and summer 2009–10	7.10
- supplementary event in March 2010	1.60
- watering event in autumn 2010	40.00
Total	**48.70**

Figures have been rounded.

In spring 2009, 4.90 gigalitres of environmental water was made available for Mercedes Swamp and the Twin Bridges Wetland complex on the Lowbidgee Floodplain. The watering initiated a breeding event of egrets and cormorants, which was sustained through the summer with an additional 2.19 gigalitres from the Commonwealth and approximately 3.40 gigalitres from the New South Wales Government.

In March 2010 good autumn rainfall resulted in a supplementary water event in which the Commonwealth released a further 1.60 gigalitres and the New South Wales Government 400 megalitres, to lower North Redbank. The water was provided to maintain wetland vegetation, including river red gum communities.

Following these two successful events, in late autumn a further 40 gigalitres of Commonwealth environmental water was provided to Yanga National Park. It was used in conjunction with over 30 gigalitres from the New South Wales Government, to inundate 13,000 hectares of national park including some areas that had not been flooded for 10 years. The mosaic of habitats watered, including open water and emergent aquatic vegetation, is rejuvenating important wetland systems that support a diverse range of plants and animals. It is also providing a refuge for waterbirds and native fish during the drought, particularly in the expanse of deep water in Tala Lake.

Egret at Twin Bridges, Yanga National Park, New South Wales, November 2009—Following environmental watering. (James Maguire, New South Wales Department of Environment, Climate Change and Water)

Macquarie-Castlereagh catchment, New South Wales

The Macquarie-Castlereagh catchment received 933 megalitres of Commonwealth environmental water during the year, provided in two separate events (Table 4).

Table 4. Commonwealth environmental water use in the Macquarie-Castlereagh catchment

Wetlands and Floodplains	Commonwealth water delivered (GL)
Macquarie Marshes, near Dubbo, NSW	
- watering event in spring 2009	0.09
- supplementary events in summer 2009–10	0.85
Total	**0.93**

In conjunction with the New South Wales Government, a spring watering event directed 19.28 gigalitres, including 87.2 megalitres of Commonwealth environmental water, to Buckiinguy Swamp, Mole Marsh, Monkeygar Swamp and the southern part of the North Macquarie Marshes Nature Reserve. Good rain in the catchment in December 2009 and February 2010 resulted in two supplementary water events where the Commonwealth Environmental Water Holder accessed 845.6 megalitres, which with the contribution of the New South Wales Government provided a total of 1.5 gigalitres of environmental water to the Marshes along Gum Cowal.

The water provided in 2009–10 achieved biodiversity outcomes by improving tree health and providing drought refuge to frogs and birds including great egrets and cormorants. The successful breeding of approximately 800–1,000 pairs of egrets was assisted by summer rains, tributary inflows and environmental flows that all played a role in providing a secure food source for breeding adults and juvenile birds. Several thousand waterbirds were also counted foraging in the south marsh areas in spring. Water couch, common reed and spike rush communities had significant growth and set seed, which is important for resilience. Eight species of frogs were recorded.

Macquarie Marshes, New South Wales, October 2009—Following environmental watering. (Professor Richard Kingsford)

Darling catchment, New South Wales

As a result of the major rainfall events in the northern part of the Murray-Darling Basin in late 2009 and early 2010, 38 gigalitres of water accrued against the Toorale Station water titles for environmental use at the direction of the Commonwealth (Table 5).

This water provided benefits to in-stream habitats along the Darling River and to riparian ecosystems.

Table 5. Environmental water use in the Darling catchment (Toorale titles)

In-stream flows	Water delivered (GL)
Darling River, NSW	38.00
Total	**38.00**

Warrego, Moonie and Nebine catchments, Queensland

The Commonwealth's unregulated water entitlements in the Warrego and Moonie Rivers and Nebine Creek provided environmental water as part of the floods from January to April this year. In total, 18 gigalitres of the in-stream flow in these rivers was attributed to the Commonwealth's entitlements (Table 6).

Table 6. Commonwealth environmental water use in the Warrego, Moonie and Nebine catchments

In-stream and overbank flows	Commonwealth water delivered (GL)
Warrego River, Qld (approximately 400 km of river)	12.16
Moonie River, Qld (approximately 230 km of river)	1.42
Nebine Creek, Qld (approximately 70 km of river)	4.46
Total	**18.03**

While the Commonwealth's environmental water was a small component of the total flows in the Queensland rivers, it contributed to the benefits from those floods, including filling of waterholes in the main river channels and distributaries, and the inundation of floodplains and associated wetlands. In the Warrego system, where in-stream flows of 12.16 gigalitres were recorded against Commonwealth entitlements, floodwaters filled the vast Cuttaburra Basin in North-western New South Wales. This area includes the nationally significant Yantabulla Swamp, an important regional drought refuge and a breeding area for ducks and colonial waterbirds.

Outcomes from use of the Commonwealth's environmental water

Monitoring and reporting on outcomes is being undertaken to determine the ecological impacts of the Commonwealth's environmental watering program and to refine an adaptive management approach to use of the Commonwealth's environmental water holdings. The approach involves working closely with state government agencies and local organisations,

including catchment management authorities, who undertake monitoring and provide the information to the department.

Although the watering program is at an early stage, monitoring of environmental responses detected encouraging changes including improving tree growth, decreased salinity, and benefits to a range of plants and animals. An inaugural report on the preliminary outcomes from the first use of Commonwealth environmental water in 2008–09 was published in March 2010. It is available on the department's website at www.environment.gov.au/water/publications/action/cewh-outcomes-report-2008-09.html. Ecological outcomes can take time to materialise and further benefits will be reported over time. Outcomes from the use of water in 2009–10 will be reported in early 2011.

With input from the Environmental Water Scientific Advisory Committee, the department is developing a longer-term monitoring and evaluation framework that will align with the requirements of the Murray-Darling Basin Plan being developed by the Murray-Darling Basin Authority (MDBA). Once the Basin Plan is operational, annual reports of the Commonwealth Environmental Water Holder will report achievements against the objectives of the MDBA's environmental watering plan.

Shepherding environmental water

The Commonwealth is working with Basin states to put in place water shepherding arrangements across the Murray-Darling Basin. The focus is on priority unregulated river systems such as the Barwon-Darling system in New South Wales and the Lower Balonne system in Queensland. In addition, the department is working with other state and Commonwealth agencies to ensure that the Basin Plan and the Murray-Darling Basin Agreement provide for shepherding of water for the environment.

These shepherding arrangements will: protect the Commonwealth's environmental water from diversion by others; allow it to be directed by the Commonwealth so as to achieve the best environmental outcomes; and provide for accurate accounting of the environmental water. In implementing these arrangements, the rights of other entitlement holders will not be diminished.

Environmental Water Holdings Special Account

The Environmental Water Holdings Special Account is established under section 111 of the *Water Act 2007* to facilitate the payment of costs, expenses and other obligations incurred in managing the environmental water holdings.

At the start of 2009–10 the special account balance was $3.89 million. Funding of $2.23 million was credited to the account during the financial year, and $1.099 million was expended on annual water entitlement fees, allocation trading and delivery costs. As at 30 June 2010, the special account balance was $5.027 million.

Further information on the special account is included in the department's 2009–10 financial statements.

Directions given to the Commonwealth Environmental Water Holder

There were no directions given to the Commonwealth Environmental Water Holder by the Secretary of the Department of the Environment, Water, Heritage and Arts or the Minister for Climate Change, Energy Efficiency and Water during 2009–10.

Keeping the community informed

The Commonwealth's approach to managing and using its environmental water is set out in the Commonwealth Environmental Water Holder Business Plan, which is updated at the start of each water year. The 2008–09 Annual Report of the Commonwealth Environmental Water Holder and the Commonwealth Environmental Water 2008–09 Outcomes Report were also made available during 2009–10.

Details of the Commonwealth's environmental water holdings have been available throughout the year and are updated monthly on the website at www.environment.gov.au/water/policy-programs/cewh/index.html. The website has also been updated to provide information on decisions on usage as they have been made.

In 2009–10, the Commonwealth Environmental Water Holder and representatives from the department made more than 30 visits to environmental assets and catchments in all jurisdictions across the Murray-Darling Basin and participated in 23 community information sessions on *Water for the Future*. These visits and other meetings provided the opportunity for discussions with irrigation, environmental and other representative organisations, and members of the community.

Future outlook

To date Commonwealth environmental water use has for the most part focused on achieving objectives for extremely dry conditions with relatively small volumes of environmental water available.

Over 2009–10 the holdings grew considerably in size and growth is expected to continue in 2010–11. As at 30 June 2010, in addition to the 737.80 gigalitres of registered entitlements in the holdings, the department had exchanged contracts for a further 150.43 gigalitres. The contracts will be settled and registered, and the allocations against these entitlements will become available from 2010–11. It is also expected that further water entitlements will be acquired in 2010–11 and allocations against those entitlements will begin to be available during the year.

The outlook for the southern Murray-Darling Basin remains dry but even if water allocations remain low, the much larger holdings mean that larger volumes of water will be available for active environmental management than has previously been the case.

An increasingly large water portfolio will make the tasks of managing the holdings, identifying watering options, deciding on the best use of the available water, and managing the delivery, as well as monitoring and reporting on outcomes, more challenging over the coming year.

At the same time, these larger volumes will provide the CEWH with the opportunity to expand the scope of the environmental watering activities that can be undertaken. It is likely that in-stream flows in rivers and streams, in addition to larger floodplain inundation events, will become an increasingly important part of the program. The larger volumes will also enable the CEWH to achieve more for the environment. Monitoring of the Commonwealth's environmental water use to date provides early indications of the types of benefits that can be expected in the future.

Twin Bridges, Yanga National Park, New South Wales, November 2009— Following environmental watering. (James Maguire, New South Wales Department of Environment, Climate Change and Water)

ANNUAL REPORT
COMMONWEALTH ENVIRONMENTAL WATER

Wetlands in the Yanga National Park after Commonwealth environmental watering, November 2010.
(Tanya Doody, Commonwealth Scientific and Industrial Research Organisation–Land and Water)

The *Water Act 2007* (Water Act) established the position of Commonwealth Environmental Water Holder (CEWH) to manage the Commonwealth's environmental water holdings to protect or restore environmental assets in the Murray-Darling Basin (the Basin) and other areas where environmental water is held. The Water Act requires that the minister be given a report each financial year on the management of Commonwealth environmental water.

Overview

Since 2009, 554 gigalitres of Commonwealth environmental water has been delivered for the environment across the Basin, of which 387 gigalitres was delivered in 2010–11. Commonwealth environmental water has been delivered with approximately an additional 417 gigalitres contributed by state governments, the Living Murray program, and from private donations. The water has contributed to a range of ecological benefits for rivers, wetlands and floodplains.

During 2010–11 there was a significant change in conditions across the Basin compared to previous years. After one of the most severe droughts on record, the Basin received substantially above average rainfall. Some areas of the Basin, including catchments in northern Victoria and southern Queensland, received record rainfall. The approach to the use of Commonwealth environmental water during the year was adapted to provide the best possible environmental outcomes in the new circumstances.

The focus of 2010–11 water use was to capitalise on the environmental benefits of rainfall by building on natural river flows, and also by providing river freshes in autumn and early winter when rainfall was lower. This was a significant change in approach compared to previous years, where water was mainly used to support important refuges during the recent drought.

During the year the Australian National Audit Office (ANAO) completed a performance audit of the use of Commonwealth environmental water. The ANAO concluded that there were adequate arrangements within the department to support timely and effective decisions by the Commonwealth Environmental Water Holder. The report also noted that further development of these arrangements would be required as the volume of Commonwealth water increases.

In 2010–11 local partnership arrangements to support the future use of Commonwealth environmental water across the Basin were further developed. Commonwealth environmental water use was also better integrated with the environmental water arrangements of state jurisdictions and local level management and advisory bodies.

During the year environmental water delivery documents were developed to identify scalable water use options. The documents provide information on the environmental assets and potential water use in particular catchments. As management of environmental water is an adaptive process it is expected that these use options will be developed over time.

Three hundred and thirty-six gigalitres of Commonwealth environmental water was carried over to 2011–12 and with good allocations expected, there will be increased opportunities in the future to build on previous outcomes.

Commonwealth environmental water being released from Burrinjuck Dam, Murrumbidgee River, by State Water NSW, June 2011.

How Commonwealth environmental water is managed

Commonwealth environmental water is being used to help achieve a healthy, working Basin. It is improving the health of ecological assets and contributing to river flows that connect the Basin and support ecological processes.

The Commonwealth's aim in using environmental water is to achieve the best outcomes for the whole Basin. Decisions on use are guided by the *Framework for determining Commonwealth environmental watering actions* which was published in 2009–10. The framework foresees a range of different water availability scenarios (extreme dry, dry, average and wet) and guides the approach to environmental watering accordingly (see Table 1).

Table 1: Ecological objectives for the use of Commonwealth environmental water under different water resource availability scenarios

	Extreme dry	Dry	Median	Wet
Ecological watering objectives	Avoid damage to key environmental assets	Ensure ecological capacity for recovery	Maintain ecological health and resilience	Improve and restore healthy and resilient aquatic ecosystems

Decisions on the use of Commonwealth environmental water

Decisions on the use of Commonwealth environmental water are informed by advice from the Environmental Water Scientific Advisory Committee (EWSAC). Decisions are made after consultation with a range of groups, including delivery partners such as Basin state governments, Catchment Management Authorities, environmental water managers and river operators in catchments across the Basin.

Decisions on water use are made through a number of key steps:

1. Developing options for the use of water—potential watering options are identified in cooperation with state agencies, other environmental water managers, local groups (such as catchment management authorities, natural resource management boards and environmental water advisory groups) and landholders.
2. Assessing potential actions—potential watering actions are assessed against published criteria:
    - ecological significance of the asset to be watered
    - expected ecological outcomes from the proposed watering action
    - potential risks of the proposed watering action at the site and at connected locations
    - long-term sustainability of the asset, including appropriate management arrangements
    - cost-effectiveness and operational feasibility of undertaking the watering.

3. Seeking local and expert advice—in making decisions on Commonwealth environmental water use, local expertise and advice from the EWSAC and river operators is obtained, including on the environmental need, current conditions and potential delivery arrangements.
4. Delivery arrangements—the Commonwealth enters into arrangements with delivery partners (Basin state governments and other environmental water holders, river operators, or catchment management authorities) to deliver the water and monitor the outcomes.

Environmental Water Scientific Advisory Committee

EWSAC advises the Commonwealth Environmental Water Holder and the department on the use of environmental water including:

- methods for determining relative priority of environmental assets
- areas that merit additional investigation, including additional research
- assessing the benefits of the use of environmental water.

EWSAC comprises scientists and experts in fields such as hydrology, limnology, river operations management, river and floodplain ecology and the management of aquatic ecosystems.

Members in 2010–11:

- Professor Barry Hart (Chair) – Water Science Pty. Ltd
- Professor Angela Arthington – Griffith University
- Mr David Dole– consultant
- Dr Ben Gawne – Murray-Darling Freshwater Research Centre
- Professor Richard Kingsford – University of New South Wales
- Dr Michael Stewardson – University of Melbourne
- Associate Professor Keith Walker – University of Adelaide
- Associate Professor Robyn Watts – Charles Sturt University

Commonwealth environmental water available for use in 2010–11

The southern-connected Basin experienced one of its wettest years on record in 2010–11 and the timing of rainfall was unusual, with significant summer rainfall (see Figure 2). Inflows to the River Murray system were twice the long-term average. There was also exceptional and prolonged wet conditions during spring and summer in the northern Basin and several systems experienced record or near record flow events.

Because of the higher rainfall and increase in the size of the Commonwealth environmental water holdings, there was substantially more water available for use than in previous years. At the end of 2010–11 the Commonwealth environmental water holdings were 992.9 gigalitres (see Table 2), compared to 737.8 gigalitres at the end of 2009–10. The volume of water available to the Commonwealth for environmental use in 2010–11 was 777.9 gigalitres, including 744.2 gigalitres of allocations and 33.7 gigalitres carried over from 2009–10 (see Figure 1).

Table 2: Commonwealth environmental water holdings in the Murray-Darling Basin (at 30 June 2011)

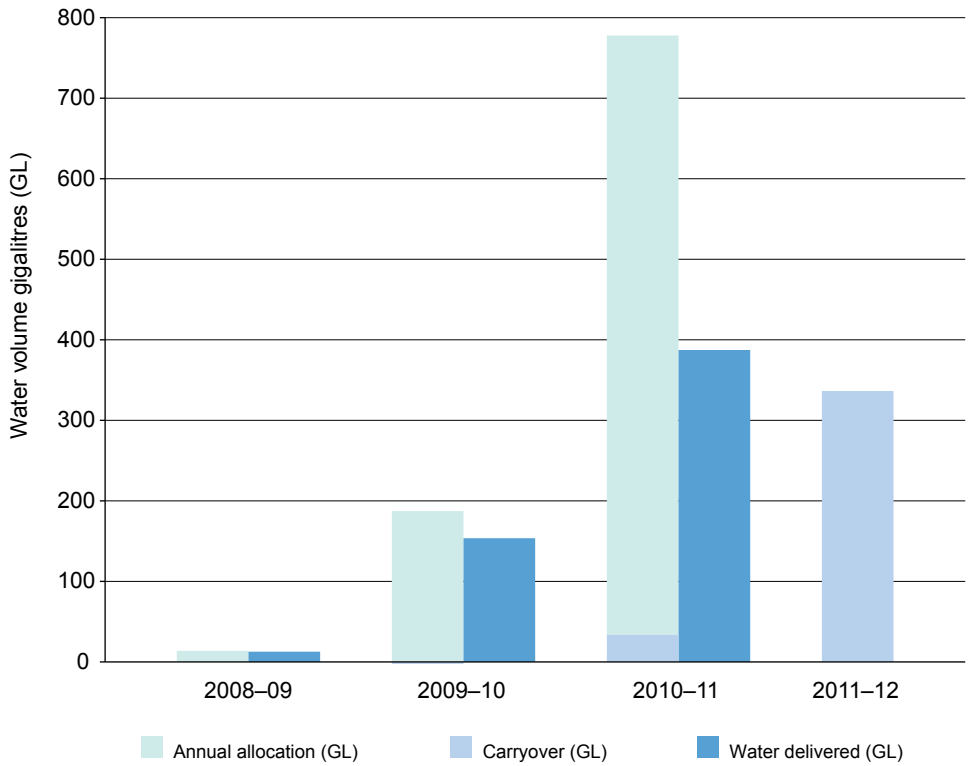
Catchment	State	Security/ reliability	Registered entitlements gigalitre (GL)
Murray	**New South Wales**	High	0.66
		General	209.94
	Victoria	High	140.08
		Low	11.13
	South Australia	High	69.39
Loddon	**Victoria**	High	1.56
		Low	0.53
Campaspe	**Victoria**	High	5.78
		Low	0.40
Goulburn–Broken	**Victoria**	High	100.50
		Low	10.53
Ovens	**Victoria**	High	0.07
Murrumbidgee	**New South Wales**	High	0.30
		General	100.77
		Supplementary	20.82
Lachlan	**New South Wales**	High	0.73
		General	82.71
Lower Darling	**New South Wales**	General	0.49
Barwon–Darling	**New South Wales**	Unregulated	14.60
Macquarie–Castlereagh	**New South Wales**	General	71.41
		Supplementary	1.89
Namoi	**New South Wales**	General	6.20
Gwydir	**New South Wales**	High	0.38
		General	89.53
		Supplementary	19.10
Border Rivers	**Queensland**	Medium	8.73
		Unregulated	1.00
	New South Wales	General	0.27

Table 2 continued

Catchment	State	Security/ reliability	Registered entitlements gigalitre (GL)
Moonie	**Queensland**	Unregulated	1.42
Condamine–Balonne	**Queensland**	Unregulated	5.92
Warrego	**Queensland**	Unregulated	16.05
TOTAL			**992.87**[1]

1 The volume of water currently in the holdings is less than the 1 118 gigalitres secured under Water for the Future, which includes water entitlements secured under contract, but not yet formally transferred to the Commonwealth.

Figure 1: Commonwealth environmental water availability and use at 30 June 2011



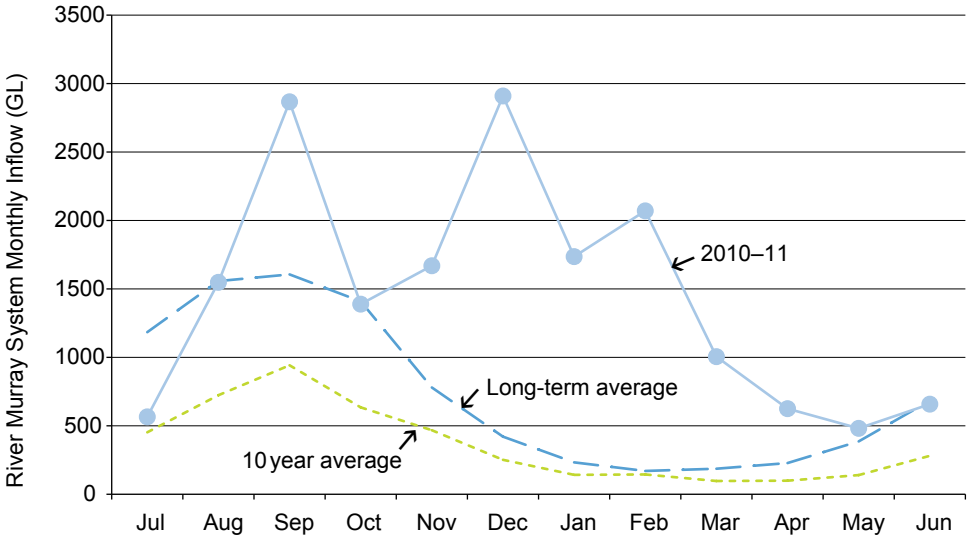
Note: Data has been updated since previous annual reports in accordance with revised accounting treatment of some entitlements and water use. Carryover figures are gross volumes that do not account for evaporative losses.

Use of Commonwealth environmental water in 2010–11

The approach to water use during 2010–11 was adapted in response to changing conditions through the year. The main aim of watering actions during 2009 and through to spring 2010, was to avoid permanent damage to key environmental assets during a period of drought. However, from spring 2010 to the end of 2010–11, the main aim was to complement much improved rainfall and natural flows to help improve ecological condition and restore the health and resilience of environmental assets and aquatic ecosystems.

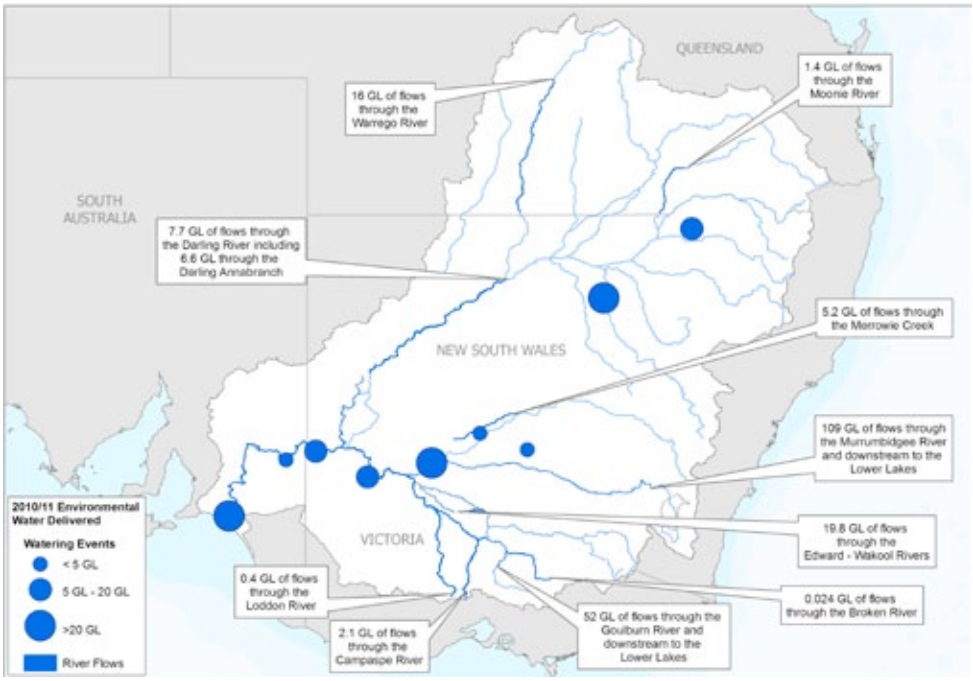
Because there was a larger volume of available water, river connectivity could be promoted and high flow river and floodplain functional processes could be supported. 387 gigalitres were delivered during the 2010–11 water year, summarised in Appendix A. Details of all watering actions undertaken in 2010–11 are provided at Appendix B. An additional graphical depiction of watering locations is provided at Figure 3.

Figure 2: Inflows to the southern-connected Basin in 2010–11 (excluding Snowy and Darling River inflows)



Source: Murray-Darling Basin Authority.

Figure 3: Location of Commonwealth environmental watering in the Murray-Darling Basin in 2010–11



Catchment summaries

Murray catchment

The Murray catchment experienced one of its wettest years on record during 2010–11. As a result, there was widespread inundation and storage levels are significantly improved going into 2011–12.

A total of 66.8 gigalitres of Commonwealth environmental water was delivered to sites and provided as river flows through the catchment during the year (see Appendix B, Table 1). In addition, river flows provided in the Murrumbidgee, Goulburn and Lower Darling flowed into the Murray, providing ecological benefits downstream to the Murray Mouth.

Commonwealth environmental water was used in the Murray catchment to build on the environmental benefits of significant rainfall and higher flows that occurred during the year. A wide range of environmental watering actions were undertaken in the Murray during 2010–11—wetlands were inundated, ephemeral creeks were watered, and fish were given refuge habitat as river flows. Watering actions in the Murray catchment were primarily aimed at:

- supporting mature river red gum and black box communities
- improving water quality
- providing refuge for native flora and fauna
- assisting native fish movement
- improving freshwater and estuarine environments.

Goulburn–Broken, Campaspe and Loddon catchments

Summer inflows into Victorian catchments were the highest on record. A total of 55 gigalitres of Commonwealth environmental water was provided as freshes over autumn and winter 2011, when rainfall in these catchments was lower (see Appendix B, Table 2).

Watering actions were aimed at providing longitudinal connectivity for native fish; maintaining aquatic habitat for macroinvertebrates; maintaining permanent connecting flow for water quality, principally salinity and dissolved oxygen, and supporting in-stream values by supplementing flows.

Murrumbidgee catchment

There were a number of significant rainfall events through the winter and spring of 2010 in the Murrumbidgee catchment, with a major to moderate flood in the upper- and mid-river reaches in December 2010. In 2010–11 there were a number of opportunities to use significant volumes of water in large-scale environmental watering events.

A total of 193.3 gigalitres of Commonwealth environmental water was delivered to sites within the Murrumbidgee catchment and provided as river flows through the catchment during the year (see Appendix B, Table 3). This brings the total amount of Commonwealth environmental water delivered to sites and the Murrumbidgee catchment to over 242 gigalitres since Commonwealth environmental watering began in 2009.

Inundation of a wetland on the Murrumbidgee River—time lapse photos from a webcam over a 10 day period when Commonwealth environmental water was delivered, June 2011.

Case study 1: Murrumbidgee River system

In winter 2011 at a time of lower rainfalls, hundreds of wetlands along the Murrumbidgee River, from Gundagai through to the Murray River, benefited from the largest Commonwealth watering action to date. Over 161 gigalitres of water (including nearly 110 gigalitres of Commonwealth environmental water) was provided as river flows to benefit the Murray system as far downstream as the Lower Lakes. Despite good rainfall over the last nine months, the ecological response in parts of the Murrumbidgee had been limited. The watering action sought to address this by providing a good wetting through to spring for the river and many fringing wetlands. The watering action provided freshwater flows that contributed to:

- Maintaining ecological health and resilience—the water will support the survival of river red gums, black box and littoral zone seedlings that have germinated in response to the floods over the 2010–11 water year.
- Providing a pathway for nutrients to be supplied into the river—this will support the food chains of higher trophic species such as fish, frogs and waterbirds and help these species to build condition in preparation for spring breeding activities.
- Reconnecting wetlands and lagoons along the Murrumbidgee River and Yanco Creek system—water provided to the Murrumbidgee River will allow higher flows to enter the Yanco Creek system, including Yanco, Colombo, Forest and Billabong creeks. Flows will create additional habitat for wetland dependent species, allow for increased movement and contribute to creating suitable breeding habitat for frog species.
- Promoting natural riverine processes—environmental water generated Murrumbidgee River flows downstream of Burrinjuck Dam, contributing to healthy biofilms (collections of microorganisms that live on hard surfaces in the river channel), and also improving fish habitat.

Lachlan catchment

During 2010–11, the Lachlan catchment experienced its first significant flows in over a decade. Significant rainfall in the catchment caused large volumes of water to flow through to the Great Cumbung Swamp at the end of the system. A total of 7.0 gigalitres of Commonwealth environmental water was delivered to sites and provided as river flows within the Lachlan catchment during the year (see Appendix B, Table 4).

During spring and summer 2010–11, Commonwealth environmental water was used to build on natural flows and supported bird breeding events at Merrowie Creek and Merrimajeel Creek in the Booligal Wetlands. This was the first significant bird breeding event in the Booligal Wetlands since 2000. The event included bird breeding of approximately 64 000 pairs of straw-necked ibis and 600 pairs of the migratory glossy ibis, as well as royal spoonbills, white ibis and freckled ducks. Further Commonwealth environmental water was delivered to Merrowie and Merrimajeel creeks in winter 2011.

Strawnecked Ibis eggs, Booligal Blockbank Swamp, during period when Commonwealth water was used, November 2010. (Michelle Crossley, landholder–Riverside, Booligal)

Macquarie–Castlereagh catchment, New South Wales

Since 1 July 2010 over 900 gigalitres of water from significant rainfall has reached the Macquarie Marshes. This water has filled the Macquarie Marshes for the first time in over a decade and inundated 175 000 hectares. As a result of the water flows, over 100 000 pairs of colonial nesting water birds in 12 colonies bred during the year.

In March and April 2011, 26.9 gigalitres of Commonwealth environmental water, along with 112 gigalitres of environmental water from the New South Wales Government, was delivered to the Macquarie Marshes (see Appendix B, Table 5). This watering action contributed to the significant waterbird breeding event and supported a wide range of vegetation communities, including river red gums.

Barwon–Darling catchment

Darling River flows peaked in late March 2011 following the third largest flood in the last 25 years. Over 1 000 gigalitres flowed into the nationally significant Talyawalka Anabranch and Teryawynia Creek wetlands over summer to autumn 2010–11.

Case study 2: Lower Darling

In 2010–11 in response to a proposal from an interested landholder, 7.6 gigalitres of Commonwealth environmental water was used to complement flooding flows and contribute to river flows in the Darling River to Menindee Lakes and downstream to the Darling Anabranch (see Appendix B, Tables 6).

Environmental water that was provided by the Commonwealth, the Living Murray program and the New South Wales Government was used to create a flow down the Great Darling Anabranch and connect to the Murray River. This was the first time that the Anabranch had received significant flows in over a decade, and the water was absorbed in the Anabranch by streams and wetlands.

Gwydir catchment

During 2010–11, the Gwydir catchment experienced increased flows compared to recent years, but lower increases relative to other parts of the Basin. Some parts of the Gwydir Wetlands were inundated from rainfall for the first time in over a decade.

The objective for use of Commonwealth environmental water in 2010–11 was to support six to eight months of continuous wetland inundation across a large portion of the Gwydir Wetlands. This would promote the recovery of wetland vegetation and create habitat for threatened and migratory species.

A total of 13 gigalitres of Commonwealth environmental water was delivered in August 2010 and February to March 2011 to help to achieve the objective for the Gwydir Wetlands (see Appendix B, Table 7).

Warrego and Nebine catchments

The Warrego catchment received above average rainfall during summer 2010–11. Summer stream-flow at Cunnamulla in the mid-catchment was the third highest by volume in the last 20 years.

A total of 16 gigalitres of Commonwealth environmental water was delivered within the Warrego catchment during the year (see Appendix B, Table 8). Since 2009 more than 32.6 gigalitres of Commonwealth environmental water have been used to complement natural flows in the Warrego and Nebine catchments. This water made a small but valuable contribution to the ecological benefits of flow events in these systems.

In the Upper Warrego, Commonwealth environmental water complemented natural flow events that occurred between September and April, with benefits including reconnection of waterholes in the Warrego River Waterholes site. In the Lower Warrego, water used in October 2010 contributed to the first post-winter flow in the system, which is known to be a critical spawning cue for native fish species. During March to April 2011 water was used to contribute to an overbank flow that charged the Warrego River distributory system and Yantabulla Swamp.

Moonie catchment

During summer 2010–2011 the Moonie River catchment received above-average rainfall. Summer stream-flow at Nindigully in the lower catchment was the highest by volume since at least 1970. A very large rainfall event in late December provided significant overbank flows to the Moonie River floodplain.

A total of 1.4 gigalitres of Commonwealth environmental water was delivered to the Moonie catchment in December 2010 (see Appendix B, Table 9). Whilst this is a small volume compared to other river inflows, it contributed flows to the floodplain of the lower Moonie River which benefited vegetation, waterbirds and native fish, whilst also initiating carbon and nutrient exchange.

Progress on key issues

Working with others

In 2010–11, partnership arrangements that support the use of Commonwealth water across the Basin were expanded in scope and provided increased opportunities for water use.

There was also improved coordination of Commonwealth environmental water use. This is due to the environmental water arrangements of state jurisdictions and local-level bodies, such as environmental water advisory groups, and catchment management authorities. A key indicator of this integration is that, in addition to the 554 gigalitres of Commonwealth environmental water delivered since 2009, approximately a further 417 gigalitres has been contributed by delivery partners.

Community Consultation

Management of environmental water is an adaptive process and there will always be areas of potential improvement. We are particularly seeking community views on:

- environmental assets and the health of these assets
- the prioritisation of environmental water use
- potential partnership arrangements for the management of environmental water
- potential arrangements for the monitoring, evaluation and reporting of environmental water use.

Comments and suggestions are very welcome and can be provided to: ewater@environment.gov.au.

Case study 3: Edward–Wakool River System (New South Wales)

The recent trial watering action in Jimaringle and Cockran creeks in the Murray catchment is an example of how the local community can be involved in Commonwealth environmental watering.

Local landowners helped to organise consent to the action on private land, provided valuable information on local conditions and helped to monitor the flow fronts and inundation extent. As a result over 3.5 gigalitres of water, including 1.1 gigalitres from the Commonwealth, was delivered to environmental assets through existing irrigation infrastructure.

The watering action was identified and organised by the NSW Murray Catchment Management Authority (CMA), local staff of the NSW Office of Environment and Heritage, Murray Irrigation Limited (MIL) and the department. The Jimaringle and Cockran Creeks Action Plan was launched by the CMA and MIL 4 February 2011. The plan was the basis for considering the watering action and was delivered to environmental assets through existing irrigation infrastructure.

Inundation of riparian vegetation in the Edward-Wakool river system, May 2011.

Environmental water delivery documents

An important element of planning work undertaken in 2010–11 was the development of water use documents for most catchments of the Basin. These documents will provide scalable water use strategies that support efficient water use in different water availability scenarios and ecological conditions. Along with proposals provided by delivery partners and others, the documents will be a key input to water use planning. The material will be updated as further information is received and proposals are developed.

Monitoring, evaluating and reporting on the use of Commonwealth environmental water

In June 2011 the department released a discussion paper for consultation on a proposed framework for monitoring, evaluation and reporting (MER) on the use of Commonwealth environmental water. The paper proposes an approach to MER that supports good governance, accountability and adaptive management, and contributes to the knowledge base for use of environmental water. The framework proposes three levels of MER:

- Operational level MER to assess whether water is being delivered in a way that is consistent with stated ecological and hydrological objectives.
- Intervention level MER to assess the ecological response to Commonwealth environmental water at an asset scale.
- Program level MER to aggregate the results of site-specific intervention MER and incorporate contextual information provided at a catchment and Basin scale to assess the overall ecosystem outcomes of Commonwealth environmental watering.

In 2010–11 operational monitoring was undertaken for all actions to ensure that water was delivered in the way that was planned, and to manage risks. Ecological response monitoring was undertaken in selected areas where Commonwealth environmental water was used, including the Murrumbidgee River and Edward-Wakool area. Ecological monitoring is primarily being undertaken by scientific institutions, including Charles Sturt University, and the local offices of state water, environment and fisheries agencies.

Section of the Gwydir Wetlands taken shortly after Commonwealth environmental water was used, October 2010.

Reporting on the outcomes of the use of Commonwealth environmental water

A report on the outcomes from the use of Commonwealth environmental water in 2009–10 was published in March 2011. The report is available on the department's website.

An outcomes report for 2010–11 is expected to be published in late 2011. Other information about the outcomes of water use will be provided on the department's website as it becomes available.

Environmental water shepherding

The Commonwealth is working with Basin states, initially New South Wales and Queensland, to develop and implement water shepherding arrangements. These arrangements will provide for the legal protection, effective use, and accurate accounting and reporting of environmental outcomes for Commonwealth environmental water used in unregulated rivers.

Agreements are in place with both New South Wales and Queensland on the implementation of water shepherding. A key principle of these agreements is that shepherding of the Commonwealth's environmental water will neither enhance nor diminish the property rights of other water users.

Environmental Water Holdings Special Account Update 2010–11

The Environmental Water Holdings Special Account is established under section 111 of the *Water Act 2007* for the payment of costs, expenses and other obligations incurred in managing Commonwealth environmental water holdings.

At the start of 2010–11 the Special Account balance was $5.027 million. Funding of $23.976 million was credited from the Sustainable Rural Water Use and Infrastructure Program to the account during the financial year, and $5.369 million was expended on annual water entitlement fees, allocation trading and delivery costs. At 30 June 2011 the Special Account balance was $23.499 million. The key expenses in 2010–2011 are outlined in Table 3 below.

Table 3: Environmental water holdings Special Account expenses

Category of expense	Total costs
Fees and charges for holdings and allocations and for maintaining and providing for the replacement of rural water infrastructure[1]	$4.961 million
Water delivery (such as pumping)	$0.407 million
Monitoring and evaluation	$0.040 million
Development of environmental registers and other systems[2]	$0.095 million
Total	**$5.504 million**

Notes:

1 Fees and charges include $3.432 million for annual water entitlement fees and $1.530 million for allocation use fees.

2 The Commonwealth received a contribution of $0.053 million from the Murray-Darling Basin Authority towards the expense of $0.148 million on the development of environmental registers and other systems.

Directions given to the Commonwealth Environmental Water Holder

No directions were given in 2010–11 to the Commonwealth Environmental Water Holder by either the minister or the secretary of the department.

Outlook for 2011–12

The volume of Commonwealth environmental water available in 2011–12 is likely to be substantially greater than in 2010-11, taking into account allocations and water carried over from 2010–11. As a result an increased range of water use options will become possible. Watering actions will continue to be directed to the objectives set out in the prioritisation framework for different water availability scenarios.

Partnership arrangements will continue to be developed that support efficient and effective use of water. There will be ongoing opportunities for local groups to bring forward suggestions as to how environmental water could be used and managed.

The Basin Plan is expected to be finalised in 2012. Commonwealth environmental water is required to be managed in accordance with the Environmental Water Plan, which will be set out in the Basin Plan.

Ian Robinson
Commonwealth Environmental Water Holder
July 2011

Appendix A—Commonwealth environmental water delivery volumes

Table 1: Summary of the volume of Commonwealth environmental water that has been delivered across the Basin from 2009 to 30 June 2011

Environmental water decisions and use total			
Catchment	Complex	Water delivered megalitres (ML)	
		Total C'wealth	Total partner
Murray	Barmah–Millewa Forest	1 500	500
	Coorong, Lower Lakes and Murray Mouth	49 183	104 300
	Riverland Chowilla	22 611	1 945
	Edward–Wakool River system	24 267	2 557
	Gunbower–Koondrook Perricoota Forests	–	–
	Hattah Lakes	18 524	11 146
	Murray catchment river flows	–	–
	Other Murray catchment sites	8 635	2 827
Murray		**124 721**	**123 275**
Lower Darling	Lower Darling catchment river flows	6 580	–
	Other Lower Darling catchment sites	–	–
Lower Darling		**6 580**	**–**
Loddon	Loddon catchment river flows	427	–
	Other Loddon catchment sites	–	–
Loddon		**427**	**–**
Campaspe	Campaspe catchment river flows	2 140	–
	Other Campaspe catchment sites	–	–
Campaspe		**2 140**	**–**
Goulburn–Broken	Lower Goulburn River floodplain	–	–
	Goulburn–Broken catchment River flows	52 440	–
	Other Goulburn–Broken catchment sites	24	–
Goulburn–Broken		**52 465**	**–**
Ovens	Ovens catchment river flows	50	–
	Other Ovens catchment sites	–	–

Table 1 continued

Catchment	Complex	Environmental water decisions and use total Water delivered megalitres (ML) Total C'wealth	 Total partner
Ovens		**50**	**–**
Murrumbidgee	Lower Murrumbidgee Floodplain	72 086	79 993
	Mid-Murrumbidgee River Wetlands	3 000	300
	Murrumbidgee catchment river flows	167 001	69 524
	Other Murrumbidgee catchment sites	–	–
Murrumbidgee		**242 087**	**149 817**
Lachlan	Booligal Wetlands	1 825	880
	Great Cumbung Swamp	–	–
	Lachlan Swamps	–	–
	Lachlan catchment river flows	–	–
	Other Lachlan catchment sites	5 196	1 147
Lachlan		**7 021**	**2 027**
Barwon–Darling	Barwon–Darling catchment river flows	41 826	–
	Other Barwon–Darling catchment sites	–	–
Barwon–Darling		**41 826**	**–**
Warrego	Warrego catchment river flows	28 210	–
	Other Warrego catchment sites	–	–
Warrego		**28 210**	**–**
Condamine–Balonne	Lower Balonne River Floodplain system	–	–
	Narran Lakes	–	–
	Condamine–Balonne catchment river flows	–	–
	Other Condamine–Balonne catchment sites	4 456	–

Table 1 continued

Catchment	Complex	Environmental water decisions and use total Water delivered megalitres (ML) Total C'wealth	Total partner
Condamine–Balonne		**4 456**	**–**
Macquarie-Castlereagh	Macquarie Marshes	27 821	131 886
	Macquarie–Castlereagh catchment river flows	–	–
	Other Macquarie–Castlereagh catchment sites	–	–
Macquarie–Castlereagh		**27 821**	**131 886**
Namoi	Namoi catchment river flows	–	–
	Other Namoi catchment sites	–	–
Namoi		**–**	**–**
Gwydir	Gwydir Wetlands	13 056	10 000
	Gwydir catchment river flows	–	–
	Other Gwydir catchment sites	–	–
Gwydir		**13 056**	**10 000**
Moonie	Moonie catchment river flows	2 830	–
	Other Moonie catchment sites	–	–
Moonie		**2 830**	**–**
Paroo	Paroo catchment river flows	–	–
	Other Paroo catchment sites	–	–
Paroo		**–**	**–**
Border Rivers	Border Rivers catchment river flows	–	–
	Other Border Rivers catchment sites	–	–
Border Rivers		**–**	**–**
Wimmera–Avoca	Wimmera River Terminal Wetlands	–	–
	Wimmera–Avoca catchment river flows	–	–
	Other Wimmera–Avoca catchment sites	–	–
Wimmera–Avoca		**–**	**–**
TOTAL – ALL		**553 690**	**416 905**

Appendix B—Basin catchment summary tables on the use of Commonwealth environmental water in 2010–11

Table 1: Commonwealth environmental watering actions for the Murray catchment

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Coorong, Lower Lakes and Murray Mouth	Lower Lakes	●	●		Contribute to: 1. Improving salinity in the Coorong and Lake Albert. 2. Extending the period of connectivity. 3. Providing passage for movement and cues for species. 4. Maintaining an open Murray Mouth. 5. Flushing salt and nutrients from the Murray-Darling Basin. 6. Recharging nutrient levels in the Coorong. 7. Maintaining the freshwater and estuarine environment.	March to April 2011	29 183		29 183

Table 1 continued

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Riverland Chowilla	Coombool Swamp		●		Avoid further loss of mature black box vegetation and provide critical drought refuge for the southern bell frog and waterbirds before the return of wetter conditions in spring.	July 2010	506	1 000	1 506
	Lake Walla-walla		●		Provide a significant drought refuge for water birds and other wetland-dependant species and to water fringing river red gum and black box woodlands.	July to September 2010	7 850		7 850
	Kulkurna		●		Avoid further loss of black box vegetation and provide a critical drought refuge for the southern bell frog and waterbirds before the return of wetter conditions in spring.	July 2010	57		57

Table 1 continued

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Edward-Wakool	Jimaringle and Cockran Creeks	●			1. 'Prime up' and wet the soil in the mid-section of the system. 2. Maintain or improve the health of riparian vegetation, particularly black box and river red gum. 3. Improve our understanding of inundation extents that can be achieved using small volumes of water delivered through strategic irrigation escapes.	April 2011	1 100	2 457	3 557
	Wakool River and Yallakool Creek	●			Assist native fish movement and improve water quality.	January to February 2011	18 667		18 667
Hattah Lakes	Hattah Lakes		●		Further inundate fringing river red gums, maximise soil profile recharge and provide drought refuge for waterbirds and other wetland-dependent species before the return of wetter conditions in spring.	July to September 2010	9 342	2 531	11 873

Table 1 continued

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Murray other	Katarapko Floodplain —Carpark Lagoons		●		Before wetter conditions in spring 2010, provide habitat for threatened fish, support long-lived vegetation, provide a drought refuge for threatened species and water dependent birds, and provide potential breeding habitat and conditions for frogs.	October to November 2010	154		154

Table 2: Commonwealth environmental watering actions for the Goulburn, Broken, Loddon and Campaspe catchments

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Loddon	Loddon River	●			1. Provide longitudinal connectivity for fish. 2. Maintain aquatic habitat for macroinvertebrates. 3. Maintain permanent connecting flow for water quality, principally salinity and dissolved oxygen.	June 2011 –ongoing	427		427

Table 2 continued

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Campaspe	Campaspe River	●			1. Provide longitudinal connectivity for fish. 2. Maintain aquatic habitat for macroinvertebrates. 3. Maintain permanent connecting flow for water quality, principally salinity and dissolved oxygen.	June 2011 –ongoing	2 140		2 140
Goulburn–Broken other	Broken River	●			Support in-stream values of the Broken River by supplementing flows.	May 2011	24		24
Goulburn–Broken River Flows	Goulburn–Broken River	●			Support the seasonal raising of water levels in the Lower Lakes and increase barrage outflows while maximising environmental benefits to the Goulburn River.	May to June 2011	52 440		52 440

Table 3: Commonwealth environmental watering actions for the Murrumbidgee catchment

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Lower Murrum-bidgee River wetlands	Lowbidgee —Yanga National Park		●	●	Improve wetland vegetation including river red gum communities, extend the duration of inundation and prime wetlands for spring watering before wetter conditions returning in spring.	August 2010	7 533	32 058	39 591
	Lowbidgee —Yanga Nature Reserve/ Park		●	●	Assist in halting the decline in health of black box and associated wetland vegetation and provide habitat for waterbird species.	September 2010	13 287	21 622	34 909
	Lowbidgee —North Redbank		●		Re-establish the black box wetland and associated vegetation and provide habitat for migratory and threatened water birds.	October 2010	2 525	6 925	9 450
Mid-Murrum-bidgee River wetlands	Barren Box Swamp		●		Improve river red gum and associated vegetation health and provide stable water levels for colonial waterbird breeding.	November to December 2010	3 000	300	3 300

Table 3 continued

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Murrum-bidgee River flows	Murrum-bidgee River replenish-ment	●		●	Provide suitable habitat for water-dependent species downstream of Maude Weir, and provide secondary benefits in the Murray River by increasing flows through to the Lower Lakes, Coorong and Murray Mouth.	February to March 2011	57 751	17 115	74 866
Murrum-bidgee	Mid-Murrum-bidgee Wetlands and the Yanco-Colombo-Billabong Creek system	●	●	●	1. Maintain ecological health and resilience. 2. provide a pathway for nutrients to be supplied into the river. 3. reconnect wetlands and lagoons along the Murrumbidgee River and Yanco Creek system. 4. promote natural riverine processes.	June to September 2011	109 250	52 409	161 659

Table 4: Commonwealth environmental watering actions for the Lachlan catchment

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Booligal Wetlands	Merrimajeel Creek—Booligal Swamp	●	●		Support a bird breeding event in the Booligal Wetlands.	October 2010	1 573	787	2 360
Lachlan—other	Merrowie Creek—Tarwong Lakes	●	●		Support a bird breeding event on Merrowie Creek and to inundate the Tarwong Lakes.	November to December 2010	2 145	855	3 000
Lachlan—other	Merrowie Creek	●	●		Support ecological values including birds, vegetation and fish, and Sloane's froglet.	June 2010–ongoing	3 051	292	3 343
Booligal Wetlands	Merrimajeel Creek—Murrumbidgil Swamp	●	●		Improve hydrological connectivity and provide habitat for threatened and migratory birds in the Murrumbidgil Swamp.	June 2011–ongoing	252	93	345

Table 5: Commonwealth environmental watering actions for the Macquarie–Castlereagh catchment

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Macquarie	Macquarie Marshes		●		Maintain and improve wetland vegetation, extend the duration of existing natural flows and prime wetlands for spring watering.	August 2010	1 888	1 442	3 330
	Macquarie Marshes		●		Maintain water levels to support the success of colonial bird breeding.	March to April 2011	25 000	110 594	135 594

Table 6: Commonwealth environmental watering actions for the Barwon–Darling and Lower Darling catchments

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Darling River Flows	Darling River and Great Darling Anabranch	●			Maximise the environmental benefits to the Darling River from a watering action involving delivery of environmental water to Menindee Lakes, i.e. to provide in-stream benefits including support for key ecosystem functions such as nutrient cycling and inundation of river benches. 7 672 megalitres, including 6 580 megalitres that flowed through the Darling Anabranch for the purpose of providing in-stream habitat, triggers for native fish breeding, and longitudinal connectivity between the Menindee Lakes system and the Murray River; and to support riparian vegetation health.	August to September 2010	7 672		7 672

Table 7: Commonwealth environmental watering actions for the Gwydir catchment

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Gwydir Wetlands	Gwydir Wetlands	●	●	●	Contribute to tributary flows to: 1. Inundate as much of the Lower Gwydir Wetlands as possible. 2. Wet as much of the Gingham Wetlands above the Gingham Bridge as possible.	August 2010	3 056		3 056
	Gwydir Wetlands	●	●	●	Support the inundation of the Gwydir Wetlands for two to four months to promote the recovery of wetland vegetation and create habitat for threatened and migratory listed species.	February to March 2011	10 000	10 000	20 000

Table 8: Commonwealth environmental watering actions for the Warrego catchment

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Warrego	Upper Warrego	●			Support near-natural flow regime in the upper catchment, extending lateral and longitudinal connectivity.	September to March 2011	6 050		6 050
	Lower Warrego	●		●	1. Contribute to the first post-winter flow–a critical spawning trigger for native fish species (October event). 2. Contribute to overbank flows.	October to April 2011	10 000		10 000

Table 9: Commonwealth environmental watering actions for the Moonie catchment

Location of watering action		Type of action			Objective of watering action		Water delivered megalitres (ML)		
Complex	Site	River flows	Inundation			Timing	C'wealth	Partner	Total
			Wetland	Floodplain					
Moonie River	Moonie River	●	●	●	Contribute to an overbank flow with benefits to floodplain vegetation, waterbirds and native fish, and also initiate carbon and nutrient exchange.	December 2010	1 415		1 415

Resources

The following resources relate to information referred to in Outcome 4, Sustainable Water Legislation.

Operational aspects of the WELS Act www.waterrating.gov.au

Reporting on the outcomes of the use of Commonwealth environmental water www.environment.gov.au/water/publications/action/cewh-outcomes-report-2009-10.html.

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AUSTRALIA

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Introduction

The first use of the Commonwealth's environmental water in the Murray-Darling Basin occurred in March 2009. During the 2008–09 year, in cooperation with our delivery partners, we provided water to ten wetlands and floodplains in three Murray-Darling Basin states. 10.9 gigalitres of Commonwealth environmental water was used at these sites. Approximately 4 gigalitres was also contributed to these sites by other sources including the states and territories or through *The Living Murray* program.

The provision of water to the environment represents an important achievement in the implementation of the Australian Government's *Water for the Future* initiative. Commonwealth environmental water that has been acquired through *Water for the Future* programs is being managed with the aim of achieving maximum environmental outcomes. Delivery of the water to the environment is occurring with strong cooperation between governments and other organisations, catchment management authorities and community groups.

This report has been prepared to provide information on the preliminary outcomes of environmental watering during 2008–09. As we are still very early in the process, a more complete picture of environmental outcomes will take more time to emerge. During this first year, the volumes of water provided and the sites selected for water were relatively small in scale, reflecting the prevailing drought conditions and the beginning of the water acquisition programs. Nevertheless, watering has already provided clear benefits to several important environmental assets.

Although the program is at a very early stage, monitoring programs have already detected encouraging changes such as improving tree health, decreasing salinity and benefit to populations of rare and endangered species.

In the coming years, the Commonwealth's environmental water holdings will grow substantially. This will give us an increased range of watering options and a much greater capacity to protect or restore environmental assets and improve overall ecosystem health. We will report regularly on the outcomes of the use of this water.

Ian Robinson
Commonwealth Environmental Water Holder

John Gorton Building King Edward Terrace Parkes ACT 2600
GPO Box 787, Canberra ACT 2601
Tel: +61 2 6275 9245 Fax: +61 2 6274 2360
Email: ian.robinson@environment.gov.au
www.environment.gov.au

Commonwealth Environmental Water

The position of Commonwealth Environmental Water Holder was established by the *Water Act 2007* to manage the Commonwealth's portfolio of environmental water entitlements. The objective is to protect or restore environmental assets of the Murray-Darling Basin, and other areas outside the Murray-Darling Basin where the Commonwealth holds water, to give effect to relevant international agreements.

Water that is held in the Murray-Darling Basin is required to be managed in accordance with the environmental watering plan that will be developed by the Murray-Darling Basin Authority. The water holdings consist of water entitlements purchased through the market or acquired through water savings due to infrastructure improvements.

The water entitlements being acquired by the Commonwealth retain their existing characteristics. This means that the Commonwealth is subject to the same rules, restrictions and fees as other holders of the same kind of title. The amount of water available for use therefore depends on the water entitlements acquired, and on seasonal water allocations.

The environmental watering plan will be part of the Murray-Darling Basin plan and will be developed in consultation with state governments and stakeholders.

Selecting sites for environmental watering

The Commonwealth Environmental Water Holder selected sites to receive environmental water based on proposals put forward by South Australia, Victoria and New South Wales. Advice on watering proposals was also provided by the Environmental Water Scientific Advisory Committee. This committee is a panel of scientific experts appointed to advise on the use of environmental water. It comprises eminent scientists and experts in fields such as hydrology, limnology, river operations management, river and floodplain ecology, and the management of aquatic ecosystems. More information is available at <http://www.environment.gov.au/water/policy-programs/cewh/committee.html>.

The objectives of the Commonwealth's environmental watering program depend on the prevailing climatic conditions. For example, in dry years the program will aim to ensure ecological capacity for recovery, while in wet years the program will aim to improve and extend healthy and resilient aquatic ecosystems. The 2008–09 year was extremely dry, so the primary objectives of the environmental watering program were to:

- avoid critical loss of threatened species
- avoid irretrievable damage or catastrophic events
- provide drought refuges to allow re-colonisation following the drought.

Further information on these objectives can be found in 'A Framework for Determining Commonwealth Environmental Watering Actions' at <http://www.environment.gov.au/water/publications/action/cewh-framework.html>.

Assessment criteria, developed in consultation with Murray-Darling Basin jurisdictions and the Environmental Water Scientific Advisory Committee, were used to determine which sites should be given priority. Key aspects of the assessment criteria were:

- the ecological significance of the asset to be watered, including the known presence of nationally threatened species

- the expected ecological outcomes from the use of the water, including an assessment of the current health of the asset and the likely response to watering
- a risk assessment that encompassed the likelihood and significance of negative outcomes from the watering, as well as the potential negative outcomes of not watering
- the cost effectiveness of the watering action, including an assessment of the contribution to the action by our delivery partners (e.g. financial, monitoring, management and water volume), and considering transmission losses and overall delivery costs.

The following ten sites were selected for watering in the 2008–09 year:

- Chowilla Floodplain (South Australia)
- Carpark Lagoons, Katarapko Floodplain (South Australia)
- Paiwalla Wetland (South Australia)
- Rocky Gully (South Australia)
- Markaranka Floodplain (South Australia)
- Overland Corner (South Australia)
- Murbpook Lagoon (South Australia)
- Lindsay Island (Victoria)
- Hattah Lakes (Victoria)
- Backwater Lagoon (New South Wales).

Location map: Commonwealth environmental watering events, 2008–09

Delivering and monitoring environmental watering

For each site, the relevant state department or Catchment Management Authority managed the delivery of the Commonwealth environmental water. These agencies are also monitoring the ecological responses and have reported to the Commonwealth on the preliminary outcomes of the watering. The full ecological benefit of environmental watering may take years or decades to emerge, so further environmental benefits are expected over time.

More information on the 2008–09 year environmental watering program and the Commonwealth Environmental Water Holder can be found at <http://www.environment.gov.au/water/policy-programs/cewh/index.html>.


Northern Territory
Queensland
Western Australia
South Australia
New South Wales
Australian Capital Territory
Victoria
Tasmania
Overland Corner Floodplain
Chowilla Floodplain
Markaranka Floodplain
Murbpook Lagoon
Carpark Lagoons on Katarapko Floodplain
Rocky Gully
Paiwalla Wetland

South Australia

Seven sites in South Australia received water from the Commonwealth environmental water holdings; these sites were:

- Chowilla Floodplain
- Carpark Lagoons on the Katarapko Floodplain
- Paiwalla Wetland
- Rocky Gully
- Markaranka Floodplain
- Overland Corner Floodplain
- Murbpook Lagoon.

The South Australian Murray-Darling Basin Natural Resources Management Board established a program to monitor groundwater, surface water and tree health in the areas that received environmental water. The program also counts the numbers of fish, frogs and birds at the watering sites, and monitors changes to the vegetation by taking photos.

Chowilla Floodplain

Carpark Lagoons on the Katarapko Floodplain

Paiwalla Wetland

Rocky Gully

Markaranka Floodplain

Overland Corner Floodplain

Murbpook Lagoon

Site 1: **Chowilla Floodplain**

'The watering program aimed to maintain the river red gums, understorey vegetation and a number of frog and waterbird species'

Background

The Chowilla Floodplain is located on the border of South Australia and New South Wales, north of Renmark. The area comprises large areas of river red gum (*Eucalyptus camaldulensis*) and black box (*Eucalyptus largiflorens*) woodland, and diverse wetland habitats. Many mature river red gums have died and the ecological health of the area has declined, due to the drought and the reduced flows down the River Murray. Saline groundwater and reduced soil moisture threaten the remaining river red gums and the understorey vegetation. If these trees die, many species of animals will lose their habitats.

The Chowilla Floodplain is part of the Riverland Ramsar Site, which is designated as a Wetland of International Importance under the Ramsar Convention (an intergovernmental treaty for conserving wetlands and their resources). It is also an icon site of *The Living Murray* program.

The Living Murray program is a partnership of the Australian Government and the governments of New South Wales, Victoria, South Australia and the Australian Capital Territory. Established in 2002, *The Living Murray* program aims to maintain the environmental health of six icon sites along the River Murray. These icon sites are:

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

Further information about *The Living Murray* program is available at <http://www.mdba.gov.au/programs/tlm>.

Aims

Several wetlands across the Chowilla Floodplain received environmental water in the 2008–09 year. The watering program aimed to maintain the river red gums and understorey vegetation, and to maintain habitat for a number of frog and waterbird species.

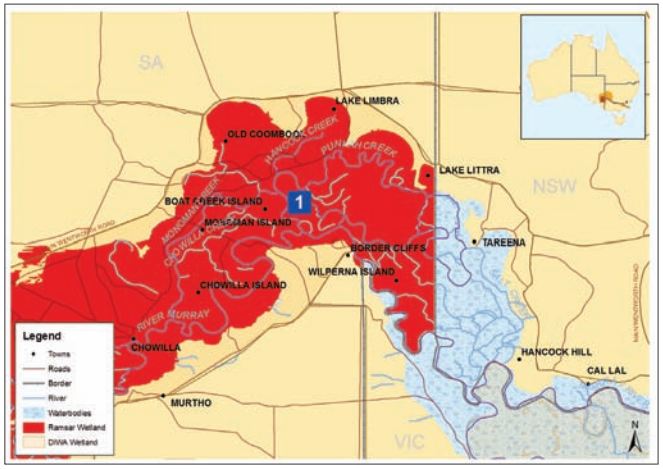
Outcomes

Shrubs like lignum (*Muehlenbeckia florulenta*) respond well to water in autumn; these understorey plants provide important habitat for frogs. Eight species of frogs are found on the Chowilla Floodplain, and seven of these species were found during surveys of watering sites. These species included the southern bell frog (*Litoria raniformis*), which is listed as 'vulnerable' under the *Environment Protection and Biodiversity Conservation Act 1999*.

Environmental watering — Chowilla Floodplain, 2008–09

Location	Environmental watering volume (megalitres)[1]	Delivery start date	Delivery finish date
Slaney Billabong	86	24 March 2009	8 April 2009
Lock 6 Depression	20	22 March 2009	30 June 2009
Brandy Bottle Waterhole	90	26 March 2009	13 June 2009
Chowilla Horseshoe	90	26 March 2009	5 April 2009
Gum Flat	1500	5 May 2009	30 June 2009
Total	**1786**		

[1] 1 megalitre = 1 million litres, 1 gigalitre = 1000 megalitres



Location map: Chowilla Floodplain

Site 1: **Chowilla Floodplain continued**

Surveys of waterbirds at Gum Flat, Brandy Bottle Waterhole, Slaney Billabong and Lock 6 Depression found that the additional water in the wetlands provided waterbirds a refuge from the drought and improved foraging opportunities for birds of prey.

The monitoring program also looked at the condition of tree species — including river red gum, black box and coobah *(Acacia stenophylla)* — at several locations across the Chowilla Floodplain. Most sites showed little change at this early stage — this is consistent with responses under other environmental watering programs, as tree health can be slow to improve when recovering from severe stress. The monitoring program will continue to monitor tree health in these areas.

Southern bell frog

The southern bell frog, also known as the growling grass frog, is one of the largest native frog species in Australia and is listed as 'vulnerable' under the *Environment Protection and Biodiversity Conservation Act 1999*. The habitat of the southern bell frog has become fragmented and degraded, in part due to altered flooding regimes. In some areas, the southern bell frog has become extinct; these extinctions have coincided with reduced flood frequency.

The *Environment Protection and Biodiversity Conservation Act 1999* recognises listed threatened species and ecological communities as matters of national environmental significance. A complete list of nationally listed species is available at <http://www.environment.gov.au/epbc/about/lists.html#species>.

The Act also recognises the migratory species listed in the:

- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)
- China–Australia Migratory Bird Agreement
- Japan–Australia Migratory Bird Agreement
- Republic of Korea –Australia Migratory Bird Agreement.

Site 2: **Carpark Lagoons, Katarapko Floodplain**

'Since May 2009, 773 birds from 16 different species have been observed at the site, and the monthly surveys of waterbirds have also observed some species breeding'

Background

The Carpark Lagoons are located on the Katarapko Floodplain, in the River Murray National Park, near Berri. The site has diverse floodplain and wetland habitats, supporting a large number of species.

The Carpark Lagoons are also the site of a river rehabilitation project called Katfish Reach. This is a collaborative project between the Murray-Darling Basin Authority, the local community and South Australian government agencies.

Aims

The Carpark Lagoons contain stands of living mature river red gums. The primary aim of the environmental watering at this site was to maintain the health of these trees.

Outcomes

The monitoring program observed an improvement in overall tree health and abundant growth of aquatic plants such as water milfoil (*Myriophyllum papillosum*). Since May 2009, 773 birds from 16 different species have been observed at the site, and the monthly surveys of waterbirds have also observed some species breeding.

Environmental watering — Carpark Lagoons, Katarapko Floodplain, 2008–09

Location	Environmental watering volume (megalitres)	Delivery start date	Delivery finish date
Carpark Lagoons/ Katarapko Floodplain	200	24 March 2009	3 April 2009

Location map: Carpark Lagoons, Katarapko Floodplain

Site 3: **Paiwalla Wetland**

'diversity, abundance and health of vegetation in the area has improved significantly'

Background

Paiwalla Wetland is located near Murray Bridge, between Lock 1 and Wellington. The wetland provides a refuge during drought for species such as frogs and waterbirds. The area used to be a dairy property, but over the past 10 years a local community group, Wetland Habitats Trust, has owned and managed the wetland, working to restore its environmental values. Environmental watering will play an important role in the continued restoration of the area.

Aims

Reduced flows down the River Murray and the falling water level of the river mean that there are fewer habitats available for birds, fish, frogs and other river wildlife, especially below Lock 1. Therefore, Paiwalla Wetland has become an important refuge for many species. The environmental watering program aimed to protect this area by improving the water quality.

Paiwalla Wetland supports small-bodied native fish, including the flathead gudgeon (*Philypnodon grandiceps*). This species is common throughout the lower Murray and is an important source of food for higher predators such as birds, turtles and other fish.

At least 23 species of waterbirds use Paiwalla Wetland. It is also a nesting ground for the broad-shelled turtle *(Chelodina expansa)*, which lays its eggs in the wetland fringes in autumn. The broad-shelled turtle is a threatened species in South Australia.

Outcomes

The monitoring program found that water quality improved after the environmental watering, with reduced salinity (the amount of dissolved salts in the water) and turbidity (cloudiness of the water due to suspended and dissolved particles).

Although it is still very early in the program, reporting has indicated that waterbirds, frogs and small-bodied native fish have responded well to environmental watering. After watering, 26 waterbird species were observed in the area, including six species listed as 'significant' in South Australia. The size of the frog population also increased — six frog species and abundant tadpoles were seen during monitoring.

Since a previous environmental watering project in February 2008, the diversity, abundance and health of vegetation in the area have improved significantly. A key target of the Paiwalla Wetland management plan is establishing more aquatic plants such as water milfoil. Now, for the first time since its initial environmental watering in 2003, Paiwalla Wetland has extensive beds of aquatic plants.

Environmental watering — Paiwalla Wetlands, 2008–09

Location	Environmental watering volume (megalitres)	Delivery start date	Delivery finish date
Paiwalla Wetland	606	25 March 2009	22 June 2009

Location map: Paiwalla Wetland

Site 4: **Rocky Gully**

‘It is also an important habitat for waterbirds, frogs and macroinvertebrates.’

Background

Rocky Gully is in the Mannum–Wellington region of the River Murray. It is one of the last remaining sites in the Murray-Darling Basin for Murray hardyhead (*Craterocephalus fluviatilis*), a species listed as ‘vulnerable’ under the *Environment Protection and Biodiversity Conservation Act 1999*. Rocky Gully has been identified as a high-priority site for managing Murray hardyhead and other threatened native freshwater fish species, because it provides a habitat that is unique in the region. It is also an important habitat for waterbirds, frogs and macroinvertebrates.

Aims

The site received a Commonwealth environmental water allocation to help maintain the wetland, and the fish and wildlife populations that it supports.

In particular, the environmental watering aimed to improve the habitat of Murray hardyhead. This was to be done by reducing salinity levels to a level that the species can tolerate and by increasing the water level in Rocky Gully. The reduced salinity and increased water levels would also improve the health of vegetation growing around the edge of the wetlands, an important habitat for Murray hardyhead.

Outcomes

The environmental watering decreased salinity levels in the surface water of the wetlands to a level that Murray hardyhead can tolerate. This improved environment meant that the fish could breed during the pre-spring breeding season. Further monitoring will confirm how many species benefited from the environmental watering, and whether their populations increased.

The monitoring program also observed that the vegetation around the edge of the wetland was healthier and more abundant after the watering.

Large areas of plants including samphires and paspalum were covered in water after the environmental watering and rainfall. These species provided important habitat for fish, including the Murray hardyhead.

Murray hardyhead

The Murray hardyhead (*Craterocephalus fluviatilis*) is a small native fish, which is listed as ‘vulnerable’ under the *Environment Protection and Biodiversity Conservation Act 1999*. It was once widespread and common throughout the lower Murray-Darling River system in South Australia, Victoria and New South Wales. Now it survives only in a few isolated locations in Victoria and South Australia. Rising salinity and declining water levels threaten these remaining locations.

Environmental watering — Rocky Gully, 2008–09

Location	Environmental watering volume (megalitres)	Delivery start date	Delivery finish date
Rocky Gully	11	3 April 2009	4 April 2009

Location map: Rocky Gully

'the monitoring program also observed that the vegetation around the edge of the wetland was healthier'

Site 5: **Markaranka Floodplain**

'species of birds have been observed including musk and freckled ducks, and regent parrots'

Background

The Markaranka Floodplain is situated on the River Murray, near Waikerie in South Australia. Mature river red gum trees surround the Markaranka wetlands, providing important habitat for birds, lizards and mammals.

Aims

Environmental watering at this site aimed to avoid the irretrievable loss of stands of river red gum and to provide refuge during drought for wetland species including:

- the southern bell frog and regent parrot (*Polytelis anthopeplus*), which are listed as 'vulnerable' under the *Environment Protection and Biodiversity Conservation Act 1999*
- water-dependent bird species, including the freckled duck (*Stictonetta naevosa*), blue-billed duck (*Oxyura australis*) and musk duck (*Biziura lobata*), which are threatened species under South Australia's *National Parks and Wildlife Act 1972*.

The river red gum trees at Markaranka showed signs of stress from the drought; without flooding many of these trees could eventually die. The drought is also affecting other vegetation, including wetland plants.

Outcomes

Monitoring after the 2008–09 environmental watering recorded at least three frog species at the site. The monitoring program observed large numbers of spotted grass frogs (*Limnodynastes tasmaniensis*) and eastern sign-bearing froglets (*Crinia parinsignifera*). The long-thumbed frog (*Limnodynastes fletcheri*) was observed in the area for the first time.

The watering has prompted regeneration and flowering of lignum; this species provides excellent habitat for wildlife including the southern bell frog.

River red gums

River red gum forests and woodlands grow next to river channels in the Murray-Darling Basin and provide important habitat for a wide range of animals. Tree hollows are used for nesting, flowers are used for food, and fallen dead branches provide habitat for animals and fish. River red gums require flooding to survive — changes in flooding volume and frequency are altering where river red gums grow in the Murray-Darling Basin.

Seventeen species of birds have been observed at the site following environmental watering including musk, blue-billed and freckled ducks, and regent parrots.

Environmental watering — Markaranka Floodplain, 2008–09

Location	Environmental watering volume (megalitres)	Delivery start date	Delivery finish date
Markaranka Floodplain	2236	13 May 2009	23 June 2009

Location map: Markaranka Floodplain

Site 6: **Overland Corner**

‘the water was also expected to create a refuge during drought’

Background

Overland Corner is situated on the River Murray Floodplain near Kingston-on-Murray. The area contains large stands of river red gum, and is known to support threatened species such as the regent parrot and southern bell frog. Overland Corner also supports the great egret *(Ardea alba)*, a migratory species listed under the *Environment Protection and Biodiversity Conservation Act 1999* and the China–Australia Migratory Bird Agreement.

Aims

The environmental watering program aimed to prevent permanent environmental damage in the area, such as significant loss of mature river red gums and other vegetation that depends on flooding. The water was also expected to create a refuge during drought and to help prevent salinisation of the wetland.

Outcomes

Frog surveys undertaken at Overland Corner following the environmental watering recorded six frog species, including large numbers of southern bell frogs. Monitoring indicates that the inundation of the temporary wetlands by the environmental watering was important for triggering frog mating and breeding.

Other frog species recorded on the floodplain were the eastern sign-bearing froglet, eastern banjo frog (*Limnodynastes dumerili*), spotted grass frog, painted frog (*Neobatrachus pictus*), Peron’s tree frog (*Litoria peronii*), and the long-thumbed frog.

Since the watering, vegetation has regenerated significantly (including the river red gums), providing excellent habitat for wetland animals such as frogs and ducks. Monitoring has identified a dense growth of native water milfoil, which provides habitat and food for a range of animals, and new growth of lignum, a preferred habitat plant for southern bell frogs.

‘The watering was absolutely vital for health of the wetland. There has been a tremendous response in the red gums and the amount of foliage that has grown, and some of these gums are 100–200 years old. We’ve seen a lot of waterbirds and waders. At one time there were 60 mountain ducks (Australian shelducks) on the wetland. There have also been wood ducks, teals and pink-eared ducks (which are listed species) nesting on the edge of the lagoon in the lignum. We have also seen an explosion in the frog population following the watering, with abundant tadpoles and frogs.’

Ron Boyce, President, Overland Corner Branch of the National Trust of South Australia

Environmental watering — Overland Corner, 2008–09

Location	Environmental watering volume (megalitres)	Delivery start date	Delivery finish date
Overland Corner	500	31 May 2009	24 June 2009

Location map: Overland Corner

Site 7: **Murbpook Lagoon**

'A number of waterbird species have been recorded at the wetland since the watering, including the Australian shelduck, black swan and musk and blue-billed ducks.'

Background

Murbpook Lagoon is located between Locks 1 and 2 on the River Murray, approximately 17 kilometres north of Blanchetown. The area contains large areas of river red gums and a number of significant species such as the southern bell frog, Australian shoveler (*Anas rhynchotis*) and the regent parrot.

Aims

The watering aimed to maintain the health of species such as the river red gums and coobah, and halt further salinisation of the wetland bed.

Outcomes

Water quality and groundwater monitoring found that prior to watering groundwater was flowing towards the wetland, increasing the risk of salinisation of the wetland bed. Following the watering, the salinity gradients are moving away from the wetland bed towards the river and salinity levels in the wetland have reduced.

A number of waterbird species have been recorded at the wetland since the watering, including the Australian shelduck (*Tadorna tadornoides*), Australian shoveler, black swan (*Cygnus atratus*), and musk and blue-billed ducks.

Spotted grass frogs and eastern sign-bearing froglets have been recorded in large numbers since the watering. Eastern banjo frogs and southern bell frog calls were also recorded.

Environmental watering — Murbpook Lagoon, 2008–09

	Environmental watering volume (megalitres)	Delivery start date	Delivery finish date
Murbpook Lagoon	1400	19 June 2009	29 June 2009

Location map: Murbpook Lagoon


Northern Territory
Queensland
Western Australia
South Australia
Lindsay Island
Hattah Lakes
New South Wales
Victoria

Victoria

Two sites in Victoria received water from the Commonwealth environmental water holdings; these sites were:

- Lindsay Island
- Hattah Lakes.

The delivery of environmental water to these sites was a cooperative effort between the Commonwealth, Victorian Government and *The Living Murray* program. A small volume of water was also generously donated by community members. The delivery of the water was coordinated by the Mallee Catchment Management Authority, in conjunction with Parks Victoria.

Lindsay Island

Hattah Lakes

Site 8: **Lindsay Island**

'a diversity of local refuge habitat types for waterbirds, frogs, fish and turtles'

Background

Lindsay Island is part of the River Murray floodplain between Locks 6 and 8, approximately 120 kilometres west of Mildura. Prolonged drought and water extraction from the River Murray have resulted in a serious decline of river red gum communities across the River Murray's northwest floodplain. In 2003–04, the Victorian Government established an emergency watering program to provide water to the stressed river red gums. The current Commonwealth environmental water program builds on existing Victorian Government and *The Living Murray* watering programs. Lindsay Island is also one of the six icon sites under *The Living Murray* program.

Historically, the river red gum communities on Lindsay Island have been sustained by regular floods, normally in spring, but this has not occurred naturally since 2000. With limited water available during the drought, areas of river red gums that have a good chance of survival have been targeted for environmental watering.

Aims

The aim of the watering at Lindsay Island was to prevent further decline in river red gum tree health. Some of the river red gums on Lindsay Island are up to 500 years old, and approximately 170 hectares of these wetlands were targeted for environmental watering. The watering also aimed to maintain drought refuges for birds, frogs, turtles and fish.

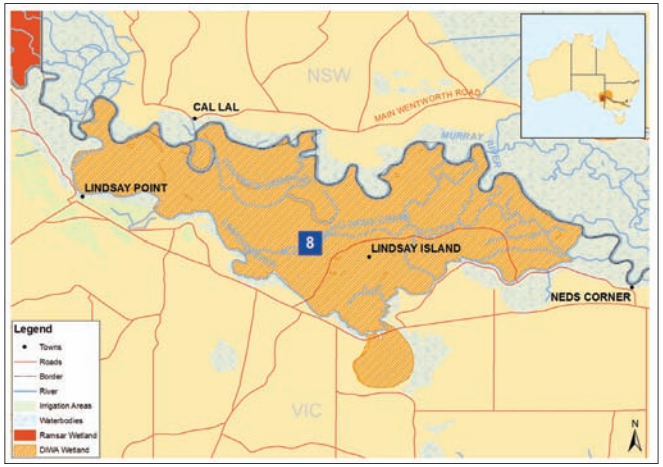
Outcomes

In the 2008–09 year, local environmental water managers have observed a moderate improvement in the canopy cover of river red gums at watered sites. This is in contrast to environmental watering in previous years where, due to the extremely stressed status of the trees, environmental water had achieved only a halt in the decline of tree health. Areas that did not receive water in the 2008–09 year have continued to decline.

Environmental watering provided significant drought refuge habitat and maintained a diversity of local refuge habitat types for waterbirds, frogs, fish and turtles. Species that have been observed since the watering include the Australian shoveler, hardhead duck (*Aythya australis*), great egret, white-faced heron (*Egretta novaehollandiae*), white-necked heron (*Ardea pacifica*), white-bellied sea-eagle (*Haliaeetus leucogaster*), Peron's tree frog and spotted grass frog. Water in Mullaroo Creek has supported its function as a nursery for Murray cod (*Maccullochella peelii peelii*).

Environmental watering — Lindsay Island, 2008–09

	Source	Environmental watering volume (megalitres)	Delivery start date	Delivery finish date
Lindsay Island	Victoria	600	14 Oct 2008	28 Oct 2008
	Commonwealth	1000	8 May 2009	11 June 2009
	Victoria	595		
	Total	2195		



Location map: Lindsay Island

Site 9: **Hattah Lakes**

'The Peron's tree frog and spotted marsh frog have also been recorded.'

Background

Hattah Lakes are a complex of 20 freshwater lakes fed by the River Murray downstream of Euston Weir. The lakes are located approximately 50 kilometres south–southeast of Mildura. When Hattah Lakes are full, they provide habitat for up to 47 waterbird species. With an abundance of plant and animal life, and river red gums, the site is an important community amenity. It is also internationally recognised, with 12 of the lakes part of the Hattah-Kulkyne Ramsar Site, which is designated as a Wetland of International Importance under the Ramsar Convention. The complex is also one of the six icon sites under *The Living Murray* program.

Hattah Lakes last received environmental water in 2006, when stressed river red gums urgently needed water to keep them alive. The watering resulted in a visible improvement in the health of the river red gums. It also triggered bird breeding.

By autumn 2008, the remaining water in the lakes had disappeared. Without further delivery of environmental water, the ecological health of the site would have deteriorated and future ecological recovery would have been difficult.

Aims

The primary aim of environmental watering of Hattah Lakes was to provide drought refuge for a range of species. Examples of such species are small vegetation-dependent fish such as the western carp gudgeon (*Hypseleotris klunzingeri*) and flathead gudgeon, and water birds such as the little egret (*Egretta garzetta*), white-necked heron and painted snipe *(Rostratula australis)*. The watering also aimed to prevent further decline in stressed areas of river red gums.

Outcomes

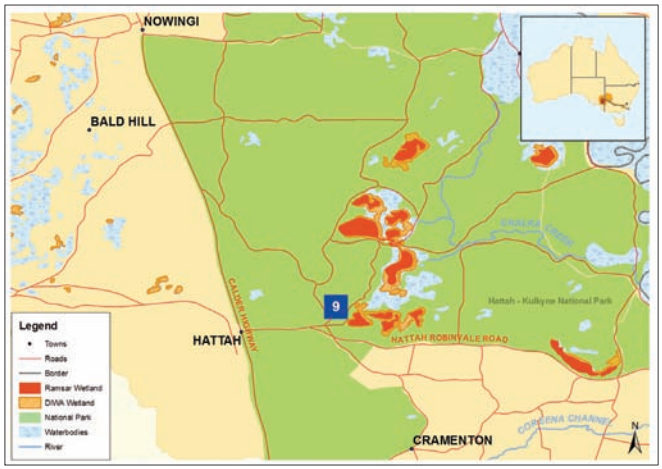
Water delivered to the Hattah Lakes complex filled Lake Lockie, Lake Little Hattah, Lake Hattah, Lake Yerang and Chalka Creek South — inundating an area of approximately 362 hectares.

The targeted areas of river red gums responded well with increased canopy cover and appeared to have healthier trunks and leaves. Green shoots have appeared on red gums that fringe the watered lakes. Aquatic vegetation has also responded strongly, supporting increased macroinvertebrate and fish communities.

Following the watering, waterbirds and water-dependent bird species flocked to the lakes. Monitoring coordinated by Mallee Catchment Management Authority has recorded species such as the hardhead duck, grey teal (*Anas gracilis*), pink-eared duck (*Malacorhynchus membranaceus*), Australian shoveler and great egret. With waterbird numbers estimated to be in the thousands, the lakes are now providing an effective and significant drought refuge. The Peron's tree frog and spotted grass frog have also been recorded.

Environmental watering — Hattah Lakes, 2008–09

	Source	Environmental watering volume (megalitres)	Delivery start date	Delivery finish date
Hattah Lakes	Commonwealth	2124	10 May 2009	27 June 2009
	The Living Murray program	1000		
	Victoria	1758		
	Donated water	16		
	Total	4898		



Location map: Hattah Lakes


Northern Territory
Queensland
Western Australia
South Australia
New South Wales
Backwater Lagoon
Australian Capital Territory
Victoria
Tasmania

New South Wales

One site in New South Wales was allocated water from the Commonwealth environmental water holdings; this site was:

- Backwater Lagoon.

The delivery of water was managed by the then Department of Water and Energy in cooperation with the then Department of Environment and Climate Change. The New South Wales Government monitored the outcomes of the watering.

Backwater Lagoon

Site 10: **Backwater Lagoon**

'improved growing conditions in the spring'

Background

Backwater Lagoon is located in the Wangumma State Forest, between the inlet and outlet of Lake Victoria, west of Wentworth. Backwater Lagoon is surrounded by woodlands dominated by mature river red gums, black box and coobah, and an understorey consisting mainly of severely drought-affected lignum, as well as saltbushes and forbs. In the past, Backwater Lagoon has supported a range of frog and bird species, including the great egret, a migratory species listed under the *Environment Protection and Biodiversity Conservation Act 1999* and the China–Australia Migratory Bird Agreement.

Aims

The primary aim of the watering was to provide drought refuge for frog and bird populations. Watering was conducted in autumn and early winter to minimise evaporation losses, recharge groundwater and establish good levels of soil moisture to allow vegetation to take full advantage of improved growing conditions in the spring.

Outcomes

An area of 12.5 hectares was inundated and filled Backwater Lagoon to capacity. This watering event also flooded a number of adjoining wetland depressions.

The monitoring program conducted by the New South Wales Government observed a number of waterbird species, such as the Australian shelduck, grey teal and Pacific black duck (*Anas superciliosa*), and a number of frog species, including the eastern sign-bearing froglet. This was consistent with previous watering, conducted as part of a Red Gum Rescue Project by the New South Wales Government, which also noted improved frog breeding and improved habitat for 19 waterbird species.

Improved water quality, confirmed by monitoring results, also contributed to an increase in the abundance of microcrustaceans and to good spring growth on a number of mature river red gums in the lagoon.

Waterbirds

Each year, Australia's wetlands and floodplains play host to a range of migratory waterbirds from countries such as China, Republic of Korea, Russia and Japan. Waterbirds depend on the wetlands for feeding, breeding and nesting. However, populations of waterbirds in the Murray-Darling Basin have declined in recent years. This decline has coincided with a decrease in the area of wetland habitat available for waterbirds to feed and breed.

Environmental watering — Backwater Lagoon, 2008–09

Location	Environmental watering volume (megalitres)	Delivery start date	Delivery finish date
Backwater Lagoon	1000	5 June 2009	28 June 2009

Location map: Backwater Lagoon

Acknowledgments

Australian Government

- Murray-Darling Basin Authority – *The Living Murray* Program

South Australia

- South Australian Murray-Darling Basin Natural Resources Management Board
- South Australian Department for Environment and Heritage
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- Overland Corner Branch of the National Trust of South Australia
- Overland Corner Wetland Rehabilitation Group

Victoria

- Victorian Department of Sustainability and Environment
- Mallee Catchment Management Authority
- Parks Victoria
- Sunraysia Bird Monitors

New South Wales

- New South Wales Department of Environment, Climate Change and Water

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Cover:	South Australian Murray-Darling Basin Natural Resources Management Board
Page 10:	Southern bell frog (Alexander Dudley)
Page 14:	Musk duck (Rebecca Gee)
Page 16:	Murray hardyhead (South Australian Murray-Darling Basin Natural Resources Management Board)
Page 18:	Freckled duck (Andrew Tatnell)
Page 21:	Regent parrot (Nick Rains)
Page 22:	Black swan (Nick Rains)
Page 26:	Great egret (Andrew Tatnell)
Page 28:	Perons tree frog (Rebecca Gee)
Page 34:	Pacific black duck (Rebecca Gee).

Australian Government

Department of the Environment, Water, Heritage and the Arts

Murray-Darling Basin Authority

Australian Government

Water for the Future

COMMONWEALTH ENVIRONMENTAL WATER

2009-10 Outcomes Report

(FRONT COVER)

WHITE EGRET AT TWIN BRIDGES, YANGA NATIONAL PARK, NSW

(November 2009) - Post-watering.

Photo by James Maguire (New South Wales Department of Environment, Climate Change and Water)

(OPPOSITE)

PERON'S TREE FROG, WIGLEY REACH, SOUTH AUSTRALIA

(October 2010)

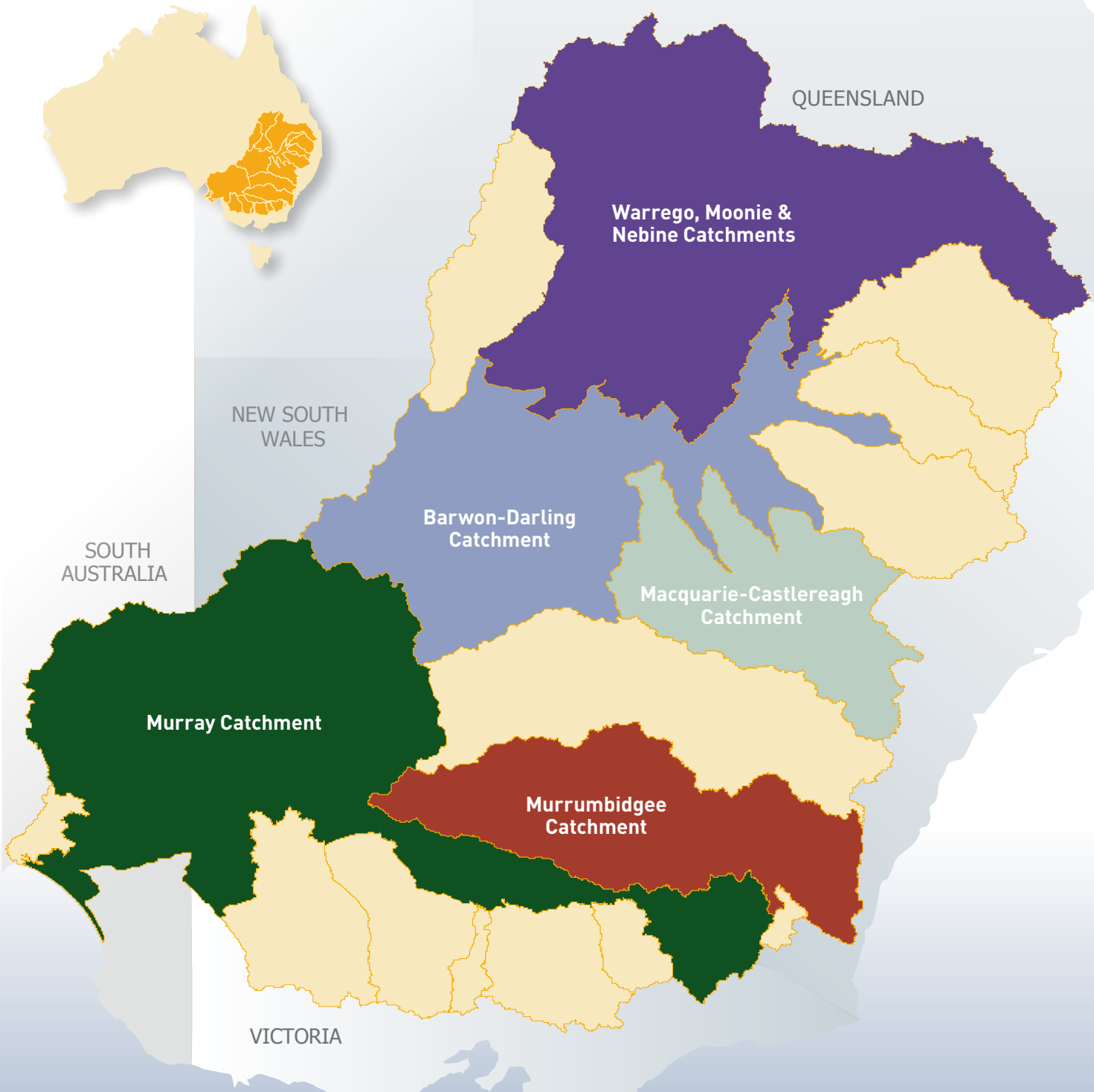
Photo by Callie Nickolai (South Australia Murray-Darling Basin Natural Resources Management Board)

ISBN 978-1-921733-18-5

COMMONWEALTH ENVIRONMENTAL WATER

2009-10 Outcomes Report

Contents


QUEENSLAND
Warrego, Moonie &
Nebine Catchments
NEW SOUTH
WALES
Barwon-Darling
Catchment
Macquarie-Castlereagh
Catchment
SOUTH
AUSTRALIA
Murray Catchment
Murrumbidgee
Catchment
VICTORIA

Introduction

The 2009-10 water year saw one of the worst droughts on record continue across much of the Murray-Darling Basin. Annual allocations of water against entitlements were low compared to long-term averages. However, the increased size of the Commonwealth environmental water holdings allowed an increase in the delivery of environmental water. In 2009-10, 154 gigalitres of Commonwealth environmental water was delivered, compared to 12.7 gigalitres in 2008-09.

Because of the drought conditions, the focus of 2009-10 watering was to avoid critical loss of threatened species, avoid irretrievable damage or catastrophic events, and maintain key refuges to allow recolonisation when conditions improve.

This outcomes report provides information on the early results of 2009-10 watering actions. While the full results of Commonwealth environmental watering will take some years to emerge, early monitoring indicates that environmental water has produced benefits, such as improved canopy cover and health in river red gums, as well as drought refuges for rare and endangered flora and fauna.

Environmental watering in 2009-10 also contributed to successful bird breeding events and helped to reduce the risk of acidification of Lake Albert, South Australia. In-stream flows following widespread rainfall across the northern Basin, contributed to connected system benefits. In some cases, floodwaters, which included a small amount of Commonwealth environmental water, filled flood-runners and anabranches.

Commonwealth environmental water is delivered with strong cooperation between governments and other organisations, catchment management authorities and local community groups. This approach takes advantage of local knowledge and on-ground capacity to manage water. It ensures the Commonwealth delivers targeted local benefits, while maintaining a Basin-wide perspective.

This report includes examples where environmental outcomes have been enhanced because of effective working relationships across the Basin. During 2009-10, Commonwealth environmental water was delivered with an additional 169 gigalitres from other sources including state delivery partners and *The Living Murray* program. We welcome water use proposals being brought forward by any group operating in the Basin and we will assess these against our published criteria.

Experience shows how water can be actively managed to reduce the risk of permanent damage to environmental assets during drought. Following significant rain in the spring of 2010, there will be major improvements in the availability of environmental water. Increasingly, there will be watering actions taken that achieve benefits across multiple sites, catchments and jurisdictions.

Watering actions that achieve connected system benefits are expected to become the major element of Commonwealth environmental water use. Larger volumes will enable the scope of environmental watering to expand and therefore protect or restore a broader range of connected environmental assets. The objective is to achieve maximum system benefits from the available water.

As the size and complexity of Commonwealth environmental watering actions increase, so too will the emphasis placed on monitoring, evaluation and reporting. All current use has monitoring arrangements in place and we will be seeking to further develop this approach in the coming year.

The considerable assistance provided over 2009-10 from state agencies, catchment management authorities and local groups is greatly appreciated. We look forward to building on these relationships in the future.

Ian Robinson
Commonwealth Environmental Water Holder
John Gorton Building King Edward Terrace Parkes ACT 2600
GPO Box 787, Canberra ACT 2601
Tel: +61 2 6275 9245 Fax: +61 2 6274 2360
Email: ian.robinson@environment.gov.au
www.environment.gov.au/water/policy-programs/cewh/index.html

TWIN BRIDGES, YANGA NATIONAL PARK, NEW SOUTH WALES FOLLOWING ENVIRONMENTAL WATERING
(November 2009)
Photo by James Maguire (New South Wales Department of Environment, Climate Change and Water)

Context

To prepare for a future with less water, the Australian Government is implementing its *Water for the Future* initiative. This includes a major focus on the Murray-Darling Basin, including purchasing water for the environment, investing in more efficient irrigation infrastructure and the development of a Basin Plan by the Murray-Darling Basin Authority. Water acquired through *Water for the Future* becomes part of the Commonwealth environmental water holdings and will offset the expected impact of new sustainable diversion limits, which will be applied under the Basin Plan.

Environmental watering has a key role in ensuring the Murray-Darling Basin is a sustainable and productive system. Delivering water for the benefit of the environment achieves ecological objectives and contributes to maintaining healthy rivers and water quality. Healthy rivers are also essential for maintaining the social and economic wellbeing of Basin communities.

Commonwealth environmental water

Decisions on the use of Commonwealth environmental water holdings are made by the Commonwealth Environmental Water Holder, a statutory position established under the *Water Act 2007*. Under the Act, the objective of Commonwealth environmental watering is to protect or restore the environmental assets of the Basin. Water held in the Basin is required to be managed in accordance with the environmental watering plan being developed as part of the Basin Plan.

The amount of water available for use depends on the water entitlements acquired, and on seasonal water allocations. The water entitlements being acquired by the Commonwealth retain their existing characteristics. This means Commonwealth entitlements are subject to the same rules, restrictions and fees as other entitlements of the same kind, including carryover arrangements.

Using and monitoring Commonwealth environmental water

Active management of environmental water provides additional benefits because there is flexibility to address the highest environmental needs. This is important because of the integrated nature of the Basin's ecosystems and varying hydrological and climatic conditions.

In recent years, the available Commonwealth environmental water has largely been used within that year given the critical drought circumstances. An example of active management in wetter years will be the carrying over of water allocations (within the rules of water sharing plans) to provide some insurance for environmental assets against future drought.

Commonwealth water is being managed from a Basin-wide perspective in coordination with environmental water held by others. Working with state governments and local advisory groups allows us to benefit from local knowledge.

For each site watered in 2009-10, the relevant state government department, catchment management authority or local community group managed the delivery of the Commonwealth environmental water. These organisations are also monitoring the ecological responses and have reported to the Commonwealth on the preliminary outcomes of the watering presented in this report.

NEW SOUTH WALES OFFICE OF WATER STAFF CONDUCTING SITE MONITORING FOLLOWING ENVIRONMENTAL WATERING AT WILLANCORAH, MACQUARIE MARSHES, NEW SOUTH WALES
(November 2009)
Photo by Kaya Michener (New South Wales Office of Water)

Deciding where to use environmental water

Potential water use options are assessed and prioritised through a rigorous process, using published criteria, the best available scientific information and advice from the Environmental Water Scientific Advisory Committee. This committee is a panel of scientific experts appointed to advise on the use of environmental water. It comprises eminent scientists and experts in fields such as hydrology, limnology, river operations management, river and floodplain ecology, and the management of aquatic ecosystems. More information on the committee is available at:

www.environment.gov.au/water/policy-programs/cewh/committee.html

The objectives of the Commonwealth's environmental watering program depend on the prevailing climatic conditions. For example, in dry years the program will aim to ensure ecological capacity for recovery, while in wet years the program will aim to improve and extend healthy and resilient aquatic ecosystems. The 2009-10 year was extremely dry for much of the Murray-Darling Basin, so the primary objectives of the environmental watering program were to:

- avoid critical loss of threatened species
- avoid irretrievable damage or catastrophic events
- provide drought refuges to allow re-colonisation following the drought.

In delivering environmental water against these objectives in 2009-10, the Commonwealth focused on maximising ecological responses at a range of key environmental assets across the Murray-Darling Basin. This was considered the best way to use a small volume of environmental water for a Basin-wide response to the drought.

Further information on the decision framework for water use can be found in 'A Framework for Determining Commonwealth Environmental Watering Actions' at

www.environment.gov.au/water/publications/action/cewh-framework.html

CHOWILLA FLOODPLAIN, SOUTH AUSTRALIA, PRIOR TO ENVIRONMENTAL WATERING
(February 2010)
Photo by Oline Video Media

Summary of Commonwealth environmental watering in 2009-10

The significantly larger volume of water available in 2009-10 compared to 2008-09, provided the opportunity to build on and expand the scope of environmental watering to protect and restore a broader range of environmental assets.

Of the 187 gigalitres available, 154 gigalitres was delivered during the 2009-10 water year. Wetlands and floodplains in the Murray, Murrumbidgee and Macquarie catchments received 98 gigalitres. These watering events built on and consolidated environmental water use in 2008-09, in some cases with much larger volumes, such as at Hattah Lakes in Victoria. Water was delivered in larger volumes at the Lowbidgee Floodplain in New South Wales (48.74 gigalitres) and at Lake Albert in South Australia (20 gigalitres).

A further 56 gigalitres was used to contribute to in-stream and overbank flows in the Warrego and Moonie Rivers, Nebine Creek, the Darling River and Ovens catchments. These flows represent a new and what will be an increasing feature of the Commonwealth's environmental watering activities in future years.

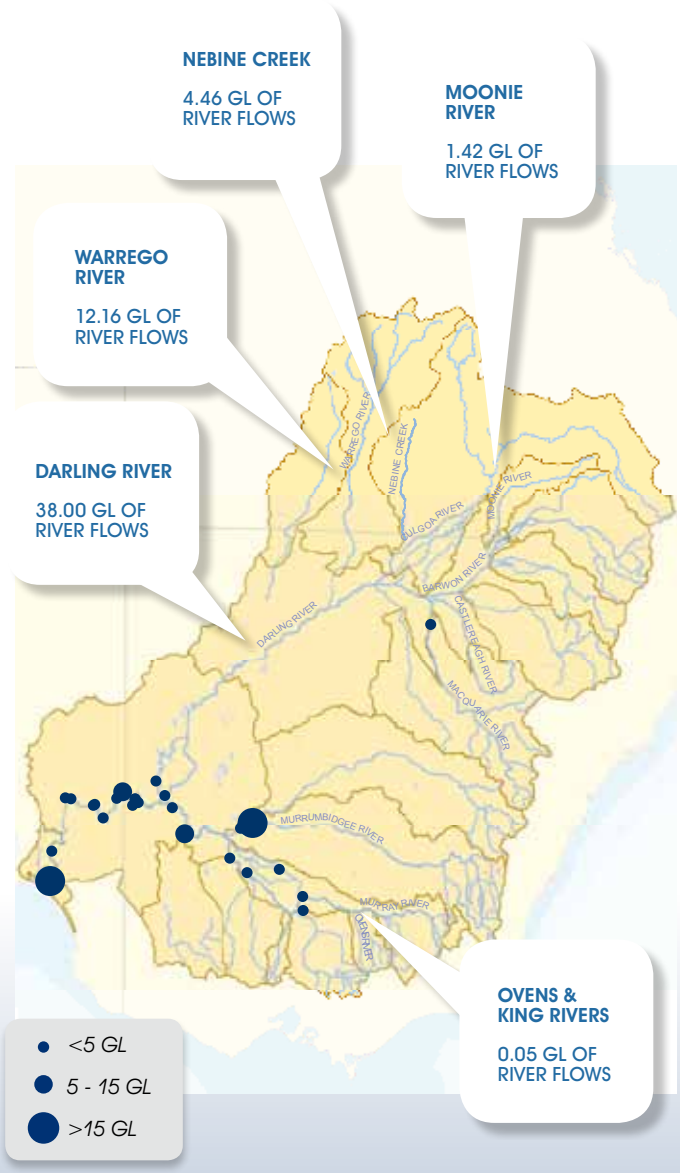
A total of 34 gigalitres was carried over for delivery in 2010-11. Of this, 11 gigalitres was committed for use at Hattah Lakes, Lake Wallawalla and Chowilla Floodplain early in the new water year. Carrying over water allowed late winter and early spring environmental needs to be met when seasonal water allocations were low.

AN EGRET FEEDING IN RESIDUAL POOLS AT TWIN BRIDGES, YANGA NATIONAL PARK, NEW SOUTH WALES FOLLOWING ENVIRONMENTAL WATERING

(October 2009)

Photo by James Maguire (New South Wales Department of Environment, Climate Change and Water)

The following sites received Commonwealth environmental water in the 2009-10 year:



Commonwealth environmental water delivered in 2009-10		
	Murray Catchment (wetlands, floodplains, in-stream and overbank flows)	Commonwealth water delivered (GL)
1	Chowilla Floodplain, near Renmark, SA & NSW	7.35
2	Hattah Lakes, near Mildura, Vic	7.06
3	Katarapko Creek Wetlands, near Berri, SA	0.02
4	Lake Albert, near the Murray Mouth, SA	20.00
5	Lake Wallawalla, near Mildura, Vic	4.15
6	Lower NSW Murray (Andruco Lagoon, Boeill Floodplain, Cliffhouse 1 and 2, Grand Junction, Nampoo, Wee Wee Creek)	1.75
7	Molo Flat, near Waikerie, SA	0.33
8	Morgan Conservation Park, near Morgan, SA	0.32
9	Ovens & King River, near Wangaratta, Vic	0.05
10	Overland Corner Complex, near Kingston-on-Murray, SA	0.20
11	Paiwalla Wetland, near Murray Bridge, SA	0.24
12	Toupna Creek, Millewa State Forest, near Deniliquin, NSW	1.50
13	Weila, near Renmark, SA	0.22

Commonwealth environmental water delivered in 2009-10		
14	Werai Forest, near Deniliquin, NSW	4.50
15	Wigley Reach, near Renmark, SA	0.25
	Total	47.93

	Murrumbidgee Catchment (wetlands and floodplains)	
16	North Redbank, Lowbidgee Floodplain, near Balranald, NSW	1.60
17	Yanga National Park, Lowbidgee Floodplain, near Balranald, NSW	47.14
	Total	48.74

	Macquarie-Castlereagh (wetlands and floodplains)	
18	Macquarie Marshes, near Dubbo, NSW	0.93
	Total	0.93

	Barwon-Darling Catchment (wetlands and floodplains)	
19	Darling River, NSW	37.99
	Total	37.99

Commonwealth environmental water delivered in 2009-10		
	Warrego, Moonie and Nebine (in-stream and overbank flows)	
20	Moonie River, Qld (approximately 230 km of river)	1.42
21	Nebine Creek, Qld (approximately 70 km of river)	4.46
22	Warrego River, Qld (approximately 400 km of river)	12.16
	Total	18.03
	Total 2009-10	153.62

Murray Catchment

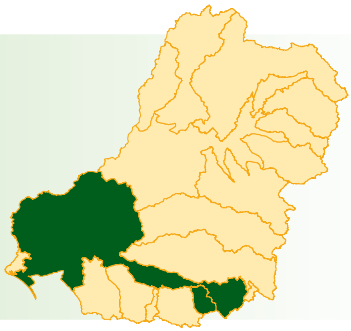
The Murray Catchment spans southern New South Wales, northern Victoria and south-eastern South Australia,. It represents 19.5 per cent of the total area of the Murray-Darling Basin. The catchment includes the River Murray and lower Darling River below Menindee, and extends the full length of the River Murray to the Southern Ocean.

CARPARK LAGOONS IN THE KATARAPKO FLOODPLAINS SOUTH AUSTRALIA - FOLLOWING ENVIRONMENTAL WATERING
(April 09)
Photo by Mark Mohell (Department of Sustainability, Environment, Water, Population and Communities)

Throughout the catchment there are many wetlands and river reaches that support a diverse range of flora and fauna. Areas of the Murray Catchment are recognised internationally and nationally under the Ramsar Convention and the Directory of Important Wetlands in Australia.

The Murray Catchment is home to some of the largest river red gum forests in Australia. The effects of drought, climate change, and high levels of extraction have reduced river flows in the catchment, resulting in a decline in the ecological health of many forests and their understorey vegetation. This decline is jeopardising the habitat of a diverse range of fauna, such as the threatened regent parrot (*Polytelis anthopeplus monarchoides*), that are dependant on the river red gum forests. The Murray-Darling Basin Authority Sustainable Rivers Audit (2008) reported overall ecosystem health of the Murray Catchment ranged from poor to very poor.

In 2009-10, the Murray Catchment received nearly 48 gigalitres of Commonwealth environmental water which was delivered to the following sites.



1 CHOWILLA FLOODPLAIN, SA & NSW

VOLUME: 7.35 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Support black box (*Eucalyptus largiflorens*) and understorey vegetation, and provide habitat for waterbird species. **SEASON:** Autumn-Winter 2010

2 HATTAH LAKES, VIC

VOLUME: 7.06 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Provide drought refuge for a range of species and prevent further decline in stressed river red gum (*Eucalyptus camaldulensis*) communities. **SEASON:** Spring 2009 & Autumn-Winter 2010

3 KATARAPKO CREEK WETLANDS, SA

VOLUME: 0.02 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Avoid further loss of mature river red gum vegetation and provide drought refuge and habitat for the southern bell frog (*Litoria raniformis*) and regent parrot. **SEASON:** Autumn 2010

4 LAKE ALBERT, SA

VOLUME: 20.00 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Reduce the risk of acidification in the lake. **SEASON:** Autumn 2010

5 LAKE WALLAWALLA, VIC

VOLUME: 4.15 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Support fringing river red gum and black box woodlands, and provide drought refuge for waterbirds. **SEASON:** Autumn-Winter 2010

6 LOWER AND MID NSW MURRAY (ANDRUCO LAGOON, BOEILL FLOODPLAIN, CLIFFHOUSE 1 AND 2, GRAND JUNCTION, NAMPOO, WEE WEE CREEK, NSW)

VOLUME: 1.75 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Support riparian vegetation and improve wetland habitat. **SEASON:** Spring 2009 & Autumn 2010

10 OVERLAND CORNER, SA
Volume 0.2 GL

1 CHOWILLA FLOOD PLAIN
Volume 7.35 GL

11 PAIWALLA WETLANDS
Volume 0.24 GL

2 HATTAH LAKES, VIC
Volume 7.06 GL

9 OVENS & KINGS RIVERS
0.05 GL OF RIVER FLOWS

7 MOLO FLAT, SA

VOLUME: 0.33 GL **ENVIRONMENTAL WATERING OBJECTIVE**: Provide important drought refuge for threatened wetland species, including the southern bell frog and regent parrot. **SEASON:** Autumn 2010

8 MORGAN CONSERVATION PARK, SA

VOLUME: 0.32 GL **ENVIRONMENTAL WATERING OBJECTIVE**: Support river red gums and provide drought refuge for regent parrots and southern bell frogs. **SEASON:** Autumn 2010

9 OVENS & KING RIVER, VIC

VOLUME: 0.05 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Improve in-stream habitat. **SEASON:** Autumn 2010

10 OVERLAND CORNER, SA

VOLUME: 0.2 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Prevent the loss of river red gum and lignum (*Muehlenbeckia florulenta*) communities, and provide habitat for threatened species including the regent parrot and southern bell frog. **SEASON:** Autumn 2010

11 PAIWALLA WETLAND, SA

VOLUME: 0.24 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Protect long-lived river red gums and provide refuge habitat to waterbird communities. **SEASON:** Autumn 2010

12 TOUPNA CREEK, MILLEWA STATE FOREST, NSW

VOLUME: 1.50 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Protect river red gum habitat and provide habitat for aquatic species, in particular the southern pygmy perch (*Nannoperca australis*). **SEASON:** Spring 2009

13 WEILA, SA

VOLUME: 0.22 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Support river red gum health and provide drought refuge for regent parrots and southern bell frogs. **SEASON:** Autumn 2010

14 WERAI FOREST, NSW

VOLUME: 4.50 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Provide drought relief for the creeks and fringing vegetation running through the forest including river red gum communities and aquatic plant species. **SEASON:** Spring 2009

15 WIGLEY REACH, SA

VOLUME: 0.25 GL **ENVIRONMENTAL WATERING OBJECTIVE:** Support river red gum health and provide drought refuge for regent parrots and southern bell frogs. **SEASON:** Autumn 2010

PRIOR TO

CARPARK LAGOONS, KATARAPKO FLOODPLAIN, SOUTH AUSTRALIA PRIOR TO ENVIRONMENTAL WATERING

(March 2009)

Photo by Mark Mohell (Department of Sustainability, Environment, Water, Population and Communities)

FOLLOWING

CARPARK LAGOONS, KATARAPKO FLOODPLAIN, SOUTH AUSTRALIA FOLLOWING ENVIRONMENTAL WATERING

(November 2009)

Photo by Mark Mohell (Department of Sustainability, Environment, Water, Population and Communities)

Feature site: Chowilla Floodplain

BLACKBOX AT COOMBOOL SWAMP ON THE CHOWILLA FLOODPLAIN, SOUTH AUSTRALIA FOLLOWING ENVIRONMENTAL WATERING (November 2010).

Photo by Erin Lenon (South Australian Murray-Darling Basin Natural Resources Management Board)

Background

The Chowilla Floodplain is situated north of Renmark on the border of South Australia and New South Wales. A large proportion of the 17,700 hectare floodplain is recognised internationally and nationally under the Ramsar Convention and the Directory of Important Wetlands in Australia. The Chowilla Floodplain is also part of an icon site of *The Living Murray* program.

The Chowilla Floodplain is the largest area of remaining natural riverine forest along the lower River Murray and contains a rich diversity of aquatic habitats. Drought and reduced flows in the River Murray have resulted in a significant decline in ecological health at Chowilla, including the death of mature river red gum and black box trees.

To improve the efficiency of water delivery to Chowilla Floodplain, construction has commenced on a major environmental flow regulator. The project is being funded through *The Living Murray Environmental Works and Measures* program and will help provide much needed water to up to 40 per cent of the floodplain.

Watering actions in 2009-10

The watering actions at Chowilla Floodplain were based on proposals put forward by the South Australian Department for Water to deliver water to Lake Limbra and Coombool Swamp, two large ephemeral lakes on the floodplain. A total of 7.35 gigalitres of Commonwealth environmental water was delivered to Chowilla Floodplain in autumn 2010. The watering of Coombool Swamp continued through winter, with a further 0.5 gigalitres contributed by the Commonwealth and 1 gigalitre of water contributed by the South Australian Government in the early part of 2010-11.

The Commonwealth and South Australian governments jointly funded the delivery of the environmental water to Lake Limbra and Coombool Swamp through metered pumps. Water delivery and ecological monitoring was managed by the South Australian Murray-Darling Basin Natural Resources Management Board.

Aims

The health of the Chowilla Floodplain has declined due to drought and the effects of salinity. Prior to environmental watering, Lake Limbra and Coombool Swamp had not received water for more than 10 years. The key aims of the Commonwealth environmental watering actions at Chowilla Floodplain were to support declining black box and understorey vegetation during the drought, and provide habitat for wetland dependent species such as waterbirds.

Outcomes

These watering actions built on previous Commonwealth environmental watering in which 1.70 gigalitres was delivered to Chowilla Floodplain in 2008-09. Commonwealth environmental water delivery in 2008-09 improved the health of aquatic and understory vegetation, which provided important habitat for frogs, including the threatened southern bell frog. The 2008-09 watering actions also provided drought refuge for waterbirds and improved foraging opportunities for birds of prey.

The environmental water delivered to the site in autumn 2010 inundated large sections of lignum, a native Australian shrub that provides important habitat for waterbirds and frogs. During preliminary monitoring, 25 species of waterbird were observed at Lake Limbra and Coombool Swamp, including the Australasian shoveler (*Anas rhynchotis*) and intermediate egret (*Ardea intermedia*), which are both listed as threatened under South Australian environmental law.

In July 2010, early monitoring of black box health at Lake Limbra and Coombool Swamp indicated a marginal improvement in health at that early stage. Recovery is expected to be slow due to the poor tree health at the time of watering, and is likely to require repeated watering to consolidate the benefits.

"Watering Limbra and Coombool is a positive first step in the long term recovery of these wetlands, which are planned to be inundated on a more frequent basis under operation of the Chowilla environmental regulator, currently under construction. It should be noted that while this site is showing early signs of improvement, the full benefits of watering these large sites would not necessarily be realised in one watering event."

(Erin Lenon, Chowilla Project Ecologist, South Australian Murray-Darling Basin Natural Resources Management Board)

RIVER RED GUMS ON THE RIVER MURRAY NEAR MARKARANKA FLOODPLAIN, SA
(November 2009)
Photo by Simon Banks (Department of Sustainability, Environment, Water, Population and Communities)

River red gum

Eucalyptus camaldulensis

River red gum forests tend to occur on deep heavy sedimentary soils. River red gums can grow up to 45 metres tall and have a smooth reddish brown, grey or white bark, which sheds regularly in distinctive long ribbons.

Throughout the Basin, the tree plays an important role in stabilising river banks, holding the soil and slowing flooding. River red gums also provide important habitat for a wide range of animals. Tree hollows are used for nesting, flowers are used for food, and fallen dead branches provide habitat for terrestrial mammals and fish.

Periodic flooding provides for seed dispersal, regeneration and growth. During the course of the last 100 years, river regulation and altered flooding regimes have impacted on the health of river red gum forests throughout the Basin. The Commonwealth has used environmental water to support river red gum forests at a number of sites throughout the Murray-Darling Basin, including Hattah Lakes, Overland Corner and the Macquarie Marshes.

A RIVER RED GUM ON THE MARKARANKA FLOODPLAIN, SOUTH AUSTRALIA FOLLOWING ENVIRONMENTAL WATERING

(November 2009)

Photo by Simon Banks (Department of Sustainability, Environment, Water, Population and Communities)

Feature site: Hattah Lakes

Background

Hattah Lakes is a complex of 20 freshwater lakes located approximately 50 kilometres south-east of Mildura, Victoria. The site is recognised nationally under the Directory of Important Wetlands in Australia and 12 of the lakes are recognised internationally under the Ramsar Convention.

Hattah Lakes provides important feeding, nesting and breeding habitat for more than 50 waterbird species, including the freckled duck (*Stictonetta naevosa*), pacific black duck (*Anas superciliosa*), grey teal (*Anas gracilis)* and Australian pelican (*Pelecanus conspicillatus*). The river red gum forests fringing the wetlands also provide habitat for the threatened regent parrot.

To make water delivery to Hattah Lakes more efficient, works funded through *The Living Murray Environmental Works and Measures* program are being constructed. These works will include lowering the inlet to Chalka Creek to allow more frequent flows from the River Murray into the lakes and a permanent pump station to deliver water at a low cost to the lakes during extended periods of low river flow. Regulators and levees will also be built to hold water at higher levels in the lakes.

Watering actions in 2009-10

The watering actions at Hattah Lakes were based on proposals put forward by the Victorian Department of Sustainability and Environment. A total of 15.56 gigalitres of environmental water was delivered to Hattah Lakes, of which the Commonwealth contributed 7.06 gigalitres, *The Living Murray* program contributed 2.34 gigalitres, the Victorian Government contributed 3.1 gigalitres and 0.4 gigalitres was contributed from public donations through the Australian Conservation Foundation.

The delivery of environmental water and ecological monitoring at Hattah Lakes was managed by the Victorian Department of Sustainability and Environment, the Mallee Catchment Management Authority and Parks Victoria.

PRIOR TO

HATTAH LAKES, VICTORIA PRIOR TO ENVIRONMENTAL WATERING

(April 2009)

Photo by Mark Mohell (Department of Sustainability, Environment, Water, Population and Communities)

FOLLOWING

HATTAH LAKES, VICTORIA FOLLOWING ENVIRONMENTAL WATERING

(November 2009)

Photo by Mark Mohell (Department of Sustainability, Environment, Water, Population and Communities)

Aims

The key aims of environmental watering at Hattah Lakes in 2009-10 were to provide drought refuge for a range of water-dependent species, such as waterbirds and frogs, and to prevent further decline in stressed river red gum forests. An additional aim was to build on the ecological benefits achieved from previous Commonwealth environmental watering actions in 2008-09. Four of the 13 lakes inundated in 2009-10 had not received water for 14 years.

Outcomes

These watering actions built on environmental watering in 2008-09, which delivered 4.9 GL to four lakes and included 2.12 GL of Commonwealth environmental water. Commonwealth environmental water delivery in 2008-09 supported river red gum forests that fringe the lakes and provided effective drought refuge for waterbirds. Aquatic vegetation responded strongly, supporting increased macroinvertebrate and fish communities.

River red gum health continued to improve following the 2009-10 watering actions at Hattah Lakes. By December 2009, the inundated area at the site was 586 hectares. The extent of inundation was increased during 2010 to approximately 1089 hectares. This led to a greater inundation of stressed river red gum forests and other wetland vegetation. The trees fringing the watered lakes have exhibited vigorous foliage growth and increased canopy cover. Monitoring conducted by the Mallee Catchment Management Authority has shown that aquatic vegetation is also responding well, supporting an increase in aquatic insects and frogs.

Waterbirds have flocked to the lakes in their thousands since the water was delivered. Waterbird surveys undertaken by *The Living Murray* at the site have observed more than 3200 birds including state listed threatened species such as the Australasian shoveler, blue-billed duck (*Oxyura australis*) and musk duck (*Biziura lobata*). It was reported that waterbird diversity and abundance at Hattah Lakes peaked following the delivery of environmental water.

A survey of frog calls identified five frog species at Hattah Lakes: the Peron's tree frog (*Litoria peronii)*, eastern banjo frog (*Limnodynastes dumerilii*), plains froglet (*Crinia parinsignifera*), spotted marsh frog (*Limnodynastes tasmaniensis)* and the common spadefoot toad (*Neobatrachus sudelli*).

In addition to the ecological benefits of these watering actions, the regeneration of the wetlands is likely to provide social and economic benefits for the broader regional community, such as improved water quality, increased tourism and recreation opportunities for local communities.

Hattah Lakes, like many wetlands in the Murray-Darling Basin, has suffered from many years of drought, river regulation and over extraction. Environmental watering by the Commonwealth and others is helping to ensure the environmental values of this important site are maintained. The Commonwealth delivered a further 9.34 GL of environmental water to Hattah Lakes in early 2010-11 to continue to support the site.

HATTAH LAKES, VICTORIA FOLLOWING ENVIRONMENTAL WATERING
(December 2009)
Photo by Mark Mohell (Department of Sustainability, Environment, Water, Population and Communities)

Regent parrot

Polytelis anthopeplus monarchoides

The regent parrot (eastern subspecies) is listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. It is a slim, medium-sized parrot of about 37 to 42 centimetres in length. The males are a brilliant golden-yellow with a dark green back, blue-black flight feathers and a red band across the mid-wings. Female birds and juveniles are similarly patterned but are greener around the head and neck.

The regent parrot commonly uses tree hollows in river red gum forests and black box woodlands for nesting, usually in small colonies of up to 30 pairs within a short distance from permanent water. They forage on seeds, buds, flowers and sometimes on insect larvae, over large areas, sometimes up to 12 kilometres from their nests.

The population of regent parrots has declined due to clearance and degradation of large areas of breeding and foraging habitat, such as mallee and river red gum forests. Today, their continued survival is threatened by land clearing of nesting and foraging sites, long periods of drought, agricultural intensification and disease.

Surveys along the River Murray in South Australia in 1991 and again in 2003 indicated the number of breeding birds had declined by about 30 per cent during that 12 year period. It is estimated that the total population of breeding regent parrots is less than 2500.

By supporting river red gum forests, such as those at Hattah Lakes and Overland Corner, Commonwealth environmental water is helping to ensure there is habitat available for the long-term survival of this Australian bird species.

Information on the regent parrot was sourced from: *The Environment Protection and Biodiversity Conservation Act 1999* Regent Parrot Listing Advice, 16 July 2000; and the Birds Australia, Birds in Backyards website: http://birdsinbackyards.net/species/Polytelis-anthopeplus

REGENT PARROT AT HATTAH LAKES, VICTORIA FOLLOWING ENVIRONMENTAL WATERING
(January 2010)
Photo by Mallee Catchment Management Authority.

Feature site: Overland Corner

Background

Overland Corner is located on the River Murray floodplain north of Kingston-on-Murray, South Australia. The site has been managed by the National Trust of South Australia and the Overland Corner Wetland Group since 1997. Overland Corner is adjacent to the Banrock regent parrot breeding colony and provides important habitat for this threatened species. The site also provides habitat for 15 migratory bird species, including the Caspian tern (*Sterna caspia*) and great egret (*Ardea alba*).

The Overland Corner Wetland Group, a local community organisation, has made a significant contribution to the management of the site. In 2006, as part of a project to flood the wetland, the group found an old irrigation pump in a paddock and restored it for use at the site.

Watering actions in 2009-10

The watering actions at the site were based on proposals put forward by the South Australian Department for Water. Overland Corner received 0.5 gigalitres including 0.2 gigalitres contributed by the Commonwealth and 0.3 gigalitres contributed by the South Australian Government.

The environmental water delivery was managed by the South Australian Murray-Darling Basin Natural Resources Management Board. The water was delivered to Overland Corner using a private landholder's pump and ecological monitoring was undertaken by the Overland Corner Wetland Group in collaboration with the South Australian Murray-Darling Basin Natural Resources Management Board.

Aims

The 2009-10 environmental water delivery program at Overland Corner aimed to prevent the loss of river red gum forests and lignum communities, which were under severe stress due to the extended drought. This is important habitat for species, including the threatened regent parrot and southern bell frog. The watering also aimed to provide refuge and habitat for floodplain-dependent species, such as the Australasian shoveler and freckled duck.

Outcomes

The 2009-10 environmental watering at Overland Corner has built on the ecological benefits of previous watering actions in 2008-09 by reducing the decline of river red gums during the drought. Many river red gums have responded positively and fewer trees are showing signs of significant stress. River red gum saplings and juveniles have had the chance to become established as a result of the environmental watering.

Improvements in water quality were recorded immediately after environmental watering actions. Cleaner and clearer water allows sunlight to penetrate the water column to stimulate aquatic plant growth. Aquatic vegetation on the wetland bed, such as spiny lignum (*Muehlenbeckia horrida*), is now in good health.

Frog monitoring undertaken by the South Australian Murray-Darling Basin Natural Resources Management Board at Overland Corner indicated a rapid response to the watering action. The environmental watering and subsequent improvement in aquatic vegetation supported frog breeding.

Seven frog species were observed at the site, including the spotted marsh frog, plains froglet and eastern banjo frog. The painted frog (*Neobatrachus pictus*), which previously had only been recorded at one location within the wetland and is uncommon on the River Murray floodplain in South Australia, was found at three locations at Overland Corner. Large numbers of threatened southern bell frog tadpoles have also been observed at the site.

LIGNUM COMMUNITY, OVERLAND CORNER, SOUTH AUSTRALIA FOLLOWING ENVIRONMENTAL WATERING
(November 2009)

Photo by Simon Banks (Department of Sustainability, Environment, Water, Population and Communities)

Feature site: Paiwalla Wetland

PAIWALLA WETLAND, SOUTH AUSTRALIA FOLLOWING ENVIRONMENTAL WATERING
(November 2009)
Photo by Simon Banks (Department of Sustainability, Environment, Water, Population and Communities)

Background

Paiwalla Wetland is located on the River Murray Floodplain between the towns of Murray Bridge and Mannum in South Australia. The site forms part of the Lower Murray Swamps, which are nationally recognised under the Directory of Important Wetlands in Australia. The wetland was once an irrigated dairy property, but during the past 10 years the site has been owned and managed by Wetland Habitats Trust, a local community group. The Wetland Habitats Trust has worked to rehabilitate Paiwalla wetland and restore its original ecological values.

Paiwalla Wetland is nationally significant as it is one of a few sites in South Australia that support a population of southern purple-spotted gudgeon (*Mogurnda adspersa*), listed as threatened under South Australian environmental law. Several other threatened species are also found at the site including the nationally listed painted snipe (*Rostratula australis*). Wetland habitat has declined at the site due to lower river levels.

Watering actions in 2009-10

The watering actions at Paiwalla Wetland were based on proposals put forward by the South Australian Department for Water, with 0.38 gigalitres of environmental water delivered to the site. This comprised 0.24 gigalitres contributed by the Commonwealth and 0.14 gigalitres contributed by other sources, including 0.09 gigalitres from the environmental land management allocation to the Wetland Habitats Trust and 0.05 gigalitres from a private donation.

The Wetland Habitats Trust and the South Australian Murray-Darling Basin Natural Resources Management Board managed delivery of the water, jointly funded by the Commonwealth and South Australian Governments. The South Australian Murray-Darling Basin Natural Resources Management Board and the Wetland Habitats Trust monitored the ecological outcomes of the water delivery, including conducting surveys of bird, fish and frog populations. With the help of these local and state organisations, a total of 0.87 gigalitres of Commonwealth environmental water has been delivered to Paiwalla Wetland between 2009 and 2010.

Aims

The key aims of the 2009-10 environmental watering at Paiwalla Wetland were to provide refuge habitat for wetland-dependent communities during the extended drought, improve water quality and prevent the exposure of acid sulphate soils.

Outcomes

The 2009-10 watering action built on previous Commonwealth environmental watering in which 0.63 gigalitres was delivered to Paiwalla Wetland in 2008-09. Commonwealth environmental water delivery in 2008-09 improved water quality at the site, which benefited small-bodied native fish and supported frog breeding.

Following the environmental watering action in 2009-10, native water milfoil (*Myriophyllum*) germinated on inundated areas of the wetland and now covers a greater area. This has increased the foraging habitat for waterbirds, such as black swans (*Cygnus atratus*) and ducks, and for fish and tadpoles. Birds observed by the Wetland Habitats Trust during and after the water delivery included migratory waterbird species such as the glossy ibis (*Plegadis falcinellus*) and wood sandpiper (*Tringa glareola*). Musk ducks and black swans were observed nesting at the site.

The 2009-10 and earlier watering actions have improved the health of river red gums. Canopy density of these trees has improved and new growth is evident. The main lagoon at Paiwalla Wetland, which has benefited most from environmental watering, has shown the greatest improvement in tree health.

A total of seven species of frogs, including Peron's tree frog, eastern banjo frog, spotted marsh frog, common froglet (*Crinia signifera*), barking marsh frog (*Limnodynastes fletcheri*) and the threatened southern bell frog were recorded by the South Australian Murray-Darling Basin Natural Resources Management Board. Many of these species were found in high abundance.

Water quality at Paiwalla Wetland improved after the delivery of environmental water. Surface water salinity was significantly reduced, providing better conditions for breeding activity for small native fish and other species that inhabit the wetland. Species observed at the site following watering included the long-necked turtle (*Chelodina longicollis*), yabbies (*Cherax destructor*) and fish species, including carp gudgeon (*Hypseleotris*), flathead gudgeon (*Philypnodon grandiceps*), dwarf flathead gudgeon (*Philypnodon macrostomus*) and Australian smelt (*Retropinna semoni*).

Murray hardyhead
(Craterocephalus fluviatilis)

Murray hardyhead is a small native fish, which is listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.* It was once widespread and common throughout the lower Murray-Darling Basin in South Australia, Victoria and New South Wales. In New South Wales, there has only been one record of the Murray hardyhead in the last 30 years, and the species is thought to be locally extinct. Today, it is only known to survive in a few isolated locations in Victoria and South Australia.

The species is usually found in schools of distinct size classes. Juveniles are found throughout lakes, in open areas with fringing vegetation. Adults have been observed in shallow habitats including open sand banks. The species also appears to tolerate highly saline waters but requires lower salinity levels to breed.

Several introduced fish species, including common carp (*Cyprinus carpio*), goldfish (*Carassius auratus*) and eastern gambusia (*Gambusia holbrooki*) commonly occur with Murray hardyheads. The precise impact of these introduced species on Murray hardyheads is not known, but the species' small size and requirement for aquatic vegetation in which to spawn makes it particularly vulnerable to predation and habitat degradation.

Murray hardyhead breeding has occurred following Commonwealth environmental watering at Rocky Gully in South Australia.

Information on the Murray hardyhead was sourced from the *Environment Protection and Biodiversity Conservation Act 1999* Murray Hardyhead Listing Advice, 16 July 2000.

MURRAY HARDYHEAD.
Photo by South Australian Murray-Darling Basin Natural Resources Management Board

Feature site: Werai Forest

Background

Werai Forest is located on the riverine plains of the River Murray, 40 kilometres northwest of Deniliquin, New South Wales. The site covers a 12,000 hectare floodplain at the intersection of the Edward River with the Colligen Creek and Niemur River. Werai Forest is one of three forests that make up the New South Wales Central Murray State Forests site which is recognised internationally and nationally under the Ramsar Convention and the Directory of Important Wetlands in Australia.

The Werai Forest floodplain contains areas of low-lying marshes and channels which distribute water, but much of the forest is only ever flooded by overbank flows. River regulation and the construction of water regulators in the forest have significantly reduced the frequency and duration of flooding in the wetlands, negatively impacting on the natural wetland biodiversity within the forest.

Watering actions in 2009-10

The watering actions at Werai Forest were based on proposals put forward by the New South Wales Department of Environment, Climate Change and Water. In spring 2009, the Commonwealth delivered 4.5 gigalitres of environmental water to the site. The water delivery and monitoring was managed by the New South Wales Department of Environment, Climate Change and Water and the Murray-Darling Basin Authority.

Aims

The key aims of the water delivery were to provide drought relief for the wetland vegetation, including stands of common reed (*Phragmites australis*) and river red gum forests, and to improve overall wetland health.

Outcomes

Commonwealth environmental water achieved significant overall ecosystem improvements in the Werai Forest. Plant species in Werai Forest responded positively following the Commonwealth environmental watering action. River red gum health improved in the flooded areas. New growth and an increase in canopy density were observed. Growth and flowering of aquatic species, including common reed, common nardoo (*Marsilea drummondii*), spiny mudgrass (*Pseudoraphis spinescens*) and lignum, was observed after the water delivery. Warrego summer grass (*Paspalidium jubiflorum*) became more robust and seeded well in flooded areas.

Monitoring undertaken by the New South Wales Department of Environment, Climate Change and Water and Ecosurveys Pty Ltd indicated that the increased connectivity created by the watering action allowed fish to move upstream within the Werai Forest system. Hundreds of small fish were observed in flood runners after environmental water had receded from the majority of the forest floodplain area. This abundance of fish supported waterbirds, such as azure kingfishers (*Alcedo azurea*) and little pied cormorants (*Phalacrocorax melanoleucos*).

Other bird species observed foraging in the wetlands include the white-bellied sea-eagle (*Haliaeetus leucogaster*), grey teal, white-faced heron (*Egretta novaehollandiae*) and black-tailed native-hen (*Gallinula ventralis*). Nankeen night herons (*Nycticorax caledonicus*) and great cormorants (*Phalacrocorax carbo*) were observed roosting in the forest and pacific black ducks were observed with ducklings.

The improved wetland vegetation also provided habitat for many frog species, including the Peron's tree frog, plains froglet, spotted marsh frog and common froglet. Surveys reported the presence of frog egg masses among the aquatic vegetation and foraging tadpoles were observed. Long-necked turtles were also observed feeding in the wetlands.

LONG-NECKED TURTLE, WERAI FOREST, NEW SOUTH WALES FOLLOWING ENVIRONMENTAL WATERING
(December 2009)
Photo by Emma Wilson (New South Wales Department of Environment, Climate Change and Water)

Murrumbidgee Catchment

The Murrumbidgee Catchment covers an area of approximately 8.8 million hectares and spans a section of southern New South Wales and the Australian Capital Territory.

The Murrumbidgee Catchment has a diverse climate, including the alpine areas of Kosciuszko National Park and the Monaro Plains, the rich grazing and grain belts of the south west slopes and plains, and the shrublands and grasslands of the semi-arid western Riverina. The Murray-Darling Basin Authority Sustainable Rivers Audit, published in 2008, reported the overall ecosystem health of the Murrumbidgee Catchment as very poor.

The most extensive wetland area in the catchment is the Lowbidgee Floodplain, which covers an area of about 200,000 hectares. The Lowbidgee Floodplain is nationally recognised under the Directory of Important Wetlands in Australia and includes some of the largest lignum wetlands in New South Wales. River red gum forest dominates the floodplain vegetation, with black box on the margins.

The Lowbidgee Floodplain is one of several sites in the Murrumbidgee Catchment that supports a diverse range of waterbirds. The Lowbidgee is one of the most important breeding sites in eastern Australia for the straw-necked ibis (*Threskiornis spinicollis*). The wetland also provides critical breeding habitat for many other waterbirds, including the Australian white ibis (*Threskiornis molucca*), glossy ibis, royal spoonbill (*Platalea regia*) and great egret. The threatened southern bell frog is also found on the Lowbidgee Floodplain.

As the Murrumbidgee Catchment remained in drought in 2009-10, Commonwealth environmental watering actions focussed on maintaining drought refuge and sustaining healthy wetland communities. Almost 49 gigalitres of Commonwealth environmental water was delivered to North Redbank and Yanga National Park.

(ABOVE)

EGRETS AND IBIS DOWN STREAM OF TWIN BRIDGES, YANGA NATIONAL PARK, NEW SOUTH WALES FOLLOWING ENVIRONMENTAL WATERING

(November 2009)

Photo by James Maguire (New South Wales Department of Environment, Climate Change and Water)

(BELOW)

PAIR OF GREAT EGRETS, TWIN BRIDGES YANGA NATIONAL PARK

(November 2009)

Photo by James Maguire (New South Wales Department of Environment, Climate Change and Water)

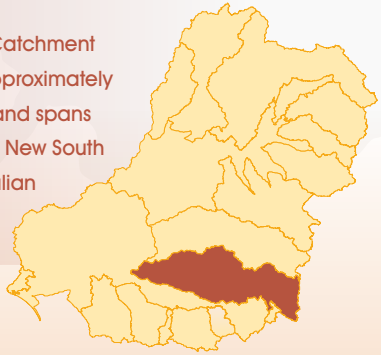
16 NORTH REDBANK

Volume 1.60 GL

17 YANGA NATIONAL PARK

Volume 47.14 GL

The Murrumbidgee Catchment covers an area of approximately 8.8 million hectares and spans a section of southern New South Wales and the Australian Capital Territory.



16 NORTH REDBANK

VOLUME: 1.60 GL **AIM**: To maintain wetland vegetation and river red gum communities to provide habitat for wetland species such as waterbirds, fish, frogs and turtles. **SEASON:** Autumn 2010

17 YANGA NATIONAL PARK

VOLUME: 47.14 GL **AIM:** To maintain and enhance the condition of river red gum forests and other critical habitat for wetland species, such as the threatened southern bell frog, and to support a colonial bird breeding event. **SEASON:** Spring 2009 to Summer 2009-10 & Autumn 2010 to Winter 2010

Feature site: North Redbank

LOOKING DOWNSTREAM FROM MURRUNDI AT SPRINGBANK BRIDGE INTO SPRINGBANK SWAMP, NORTH REDBANK FOLLOWING ENVIRONMENTAL WATERING
(March 2010)
Photo by Rachael Alderuccio (Local landholder)

Background

North Redbank is located in south-western New South Wales on the Lowbidgee Floodplain. The site consists of predominantly river red gum forests, healthy populations of which are becoming increasingly rare in the Murrumbidgee Catchment. The condition of North Redbank was poor and had been steadily declining, however, recent environmental watering is improving the health of some areas within the site.

Watering actions in 2009-10

The watering actions at North Redbank were based on proposals put forward by the New South Wales Department of Environment, Climate Change and Water. In autumn 2010, a total of 7 gigalitres of environmental water was delivered to North Redbank, including 1.6 gigalitres from the Commonwealth and 6.2 gigalitres from the New South Wales Government. Additional water was subsequently made available to the Redbank site by private land holders in the region.

The environmental water was delivered via the North Redbank Channel and was managed by the New South Wales Department of Environment, Climate Change and Water. Water quality and fauna response surveys were conducted by the New South Wales Department of Environment, Climate Change and Water and Charles Sturt University.

Aims

The purpose of the watering action was to maintain wetland vegetation, including river red gum communities, and to provide habitat for wetland species, such as waterbirds, fish, frogs and turtles. Prior to this action, most of the lower North Redbank area had not been inundated since 2005 and some sites had not been inundated since 2001.

Good soil moisture levels can help reduce transmission losses during subsequent watering actions and support increased seasonal vegetation growth. Another aim was to establish good levels of soil moisture at North Redbank to increase the ecological response to inundation in spring.

Outcomes

Following the 2009-10 watering actions, water quality improved, and salinity and acidity levels in the wetlands were within or close to the national guidelines for healthy lowland rivers. Fauna surveys demonstrated significant responses by wetland species, particularly fish. However, the full extent of the environmental benefits will take time to materialise, as there is a lag period before aquatic and fringing habitat vegetation responses become clear.

Some fish species responded rapidly to the availability of new habitat, which resulted from the environmental water delivery. As the site was flooded in early autumn, water temperatures were still warm enough to provide cues for the movement of

SPRINGBANK SWAMP, LOWBIDGEE FLOODPLAIN, NEW SOUTH WALES FOLLOWING ENVIRONMENTAL WATERING
(April 2010)
Photo by James Maguire (New South Wales Department of Environment, Climate Change and Water)

fish into the wetlands. Large numbers of juvenile native fish, including Australian smelt, bony bream (*Nematalosa erebi*), carp gudgeons and Murray-Darling rainbowfish (*Melanotaenia fluviatilis*), were detected entering the wetlands. Broad-shelled turtles (*Chelodina expansa*), long-necked turtles, yabbies and freshwater shrimp (*Paratya australiensis*) were also observed.

Thirteen bird species were recorded at sites within North Redbank, including the black-fronted dotterel (*Elseyornis melanops*), darter (*Anhinga melanogaster*), grey teal and white-faced heron. No waterbird nesting activity was noted during surveys undertaken in April 2010. Most waterbirds commence breeding in early spring, however, some species, such as black swans, are able to start breeding in any month with favourable conditions. In April, courting behaviour was observed during monitoring.

Commonwealth water helped maintain and restore the environmental values of North Redbank that had suffered the effects of drought. As water availability improves, aquatic vegetation is likely to become more established and invertebrate abundance is expected to increase, providing adequate food supply for a more substantial fauna response.

Feature site: Yanga National Park

Yanga National Park covers about 76,000 hectares of land alongside the Murrumbidgee River to the east of Balranald in south-western New South Wales. The park sits on the Lowbidgee Floodplain, which is nationally recognised under the Directory of Important Wetlands in Australia. The park has significant ecological values and is home to one of the largest populations of southern bell frogs in Australia. Yanga National Park is also an important drought refuge for many animals, including waterbirds and turtles.

Watering actions in 2009-10

The watering actions at Yanga National Park were based on proposals put forward by the New South Wales Department of Environment, Climate Change and Water. In 2009-10, the Commonwealth provided about 47 gigalitres of environmental water to Yanga National Park in conjunction with the New South Wales Government, which provided an additional 42 gigalitres. Key sites such as Mercedes Swamp, Twin Bridges Wetland and Piggery Lake first received water in spring 2009 and summer 2009-10.

The water delivery was managed and monitored by the New South Wales Department of Environment, Climate Change and Water.

Aims

A mosaic of open water and emergent aquatic vegetation habitats were watered in order to rejuvenate this important wetland system and support a diverse range of plants and animals. The watering in 2009-10 aimed to maintain and enhance the condition of river red gum forests and aquatic vegetation that provide critical habitat for wetland species. This was particularly important for supporting threatened fauna species, such as the southern bell frog. The watering actions in summer 2009-10 were specifically intended to sustain bird breeding at Mercedes Swamp and Twin Bridges Wetland.

Outcomes

Good rainfall in winter 2010, helped optimise the benefits provided by environmental watering at Yanga National Park and allowed environmental water to inundate a greater area of the floodplain than had been expected. Watering in autumn 2010, inundated some 13,000 hectares of both south and north Yanga National Park, including areas that had not been flooded for 10 years.

Monitoring following the 2009-10 environmental watering at Yanga National Park identified significant frog, fish and waterbird responses. The nationally threatened southern bell frog was observed breeding in the park and was identified at locations that had not received water since 2005. Other frogs, detected through visual and audio surveying, included the plains froglet, barking marsh frog and the spotted marsh frog. Following the watering action a survey of tadpoles indicated that frog breeding had occurred in the wetlands. The presence of long-necked turtles was also confirmed.

PRIOR TO

MERCEDES SWAMP, YANGA NATIONAL PARK, NEW SOUTH WALES PRIOR TO ENVIRONMENTAL WATERING

(October 2009)

Photo by James Maguire (New South Wales Department of Environment, Climate Change and Water)

FOLLOWING

MERCEDES SWAMP, YANGA NATIONAL PARK, NEW SOUTH WALES FOLLOWING ENVIRONMENTAL WATERING

(December 2009)

Photo by Jennifer Spencer (New South Wales Department of Environment, Climate Change and Water)

Great egrets and cormorants began breeding following the environmental watering in spring 2009. The Commonwealth made available more water during the 2009-10 summer months to ensure sufficient water levels were maintained for nest building and the eventual fledgling of the young. The environmental watering also benefited the numerous other waterbird species at the site. Waterbird species recorded included the Australasian shoveller, Australian shelduck (*Tadorna tadornoides*), chestnut teal (*Anas castanea*), musk duck, pink-eared duck (*Malacorhynchus membranaceus*), white-faced heron and Australian wood duck (*Chenonetta jubata*). There was also evidence that the grey teal was breeding in the park.

"The environmental watering of Yanga National Park helped support the first significant colonial bird breeding event in the Lowbidgee since 2005 and primed the wetland system to respond to the flooding flows, which have subsequently come. The large scale inundation of the park provided abundant winter feeding areas for waterbirds such as egrets, which have now established several larger rookeries in the National Park. The wetland system hasn't looked this good in years."

(James Maguire, Senior Wetlands and Rivers Conservation Officer, New South Wales Department of Environment, Climate Change and Water)

YANGA NATIONAL PARK, NEW SOUTH WALES FOLLOWING ENVIRONMENTAL WATERING

(August 2009)

Photo by James Maguire (New South Wales Department of Environment, Climate Change and Water)

Southern bell frog

Litoria raniformis

The southern bell frog (or growling grass frog) is listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. It is also protected under state environment legislation in New South Wales, South Australia and Victoria.

The southern bell frog is one of Australia's largest frog species, reaching up to 104 milimetres in length, with females usually larger than males. In general, they are olive to bright emerald green, with irregular gold, brown, black or bronze spotting. The groin and posterior of the thighs are turquoise blue, a colour thought to act as a predator deterrent. During the breeding season, males may become yellow or dark grey under the throat.

The southern bell frog was formerly found over much of south-eastern Australia. However, its range has declined significantly due to habitat fragmentation and degradation. The southern bell frog has become locally extinct in many parts of the Murray-Darling Basin, coinciding with reduced flood frequency.

The southern bell frog is dependent upon permanent freshwater lagoons for breeding. Submerged vegetation is important habitat for successful breeding, as it provides egg-laying sites, calling stages for males and food and shelter for tadpoles.

Commonwealth environmental watering at Yanga National Park in New South Wales supports southern bell frog breeding events and contributes to protecting this threatened species.

A SOUTHERN BELL FROG IN PIGGERY LAKE, YANGA NATIONAL PARK, NEW SOUTH WALES FOLLOWING ENVIRONMENTAL WATERING

(October 2009)

Photo by Simone Carmichael (New South Wales Department of Environment, Climate Change and Water)

Information on the southern bell frog was sourced from the *Environment Protection and Biodiversity Conservation Act 1999* Southern Bell Frog Listing Advice, July 2000; and the New South Wales Dept. of Environment, Climate Change and Water draft recovery plan for the Southern Bell Frog http://www.environment.nsw.gov.au/resources/nature/recoveryplanDraftSouthernBellFrog.pdf

Colonial nesting waterbirds

Colonial nesting waterbirds share two key characteristics: they gather together to breed and nest and they source some or all their food from aquatic environments. The wetlands, lakes, floodplains and rivers of the Murray-Darling Basin have supported a wide range of colonial nesting waterbirds, including cormorants, egrets, herons, ibis, spoonbills, ducks and pelicans, in the past.

Cormorants, egrets and herons tend to build stick nests in trees next to or overhanging water. Many duck species build nests in tree hollows. Ibis build their nests in lignum bushes or, like spoonbills and bittern, they may trample down aquatic vegetation such as rushes and reeds to form nesting platforms. Pelicans and swans tend to build their nests on land, generally on islands surrounded by deep water where they are safe from predators. Although the nesting habitat and behaviour of colonial waterbirds differ between species, all species require habitat inundation events to trigger breeding activity.

In the Murray-Darling Basin, Australian fauna and flora evolved to exist in a boom and bust environment, and are responsive to natural cycles of flood and drought. These cycles have been disrupted by keeping the landscape either too wet or too dry through river regulation and modification of the landscape.

One aim of environmental water use is to replicate natural water variability and flows in order to help colonial nesting waterbird lifecycles. Commonwealth environmental water has supported colonial waterbird breeding events through initial water provision and subsequent top up flows. Breeding at sites such as Yanga National Park is a good indication of what can be achieved.

Information on colonial nesting birds was sourced from "Relationships between waterbird ecology and river flows in the Murray-Darling Basin" by Anthony Scott, CSIRO Land and Water, 1997 and http://www2.mdbc.gov.au/livingmurray/mfat/waterbirds/zd _ nesting.htm

A WHITE EGRET AT TWIN BRIDGES, YANGA NATIONAL PARK, NEW SOUTH WALES FOLLOWING ENVIRONMENTAL WATERING
(November 2009)
Photo by James Maguire (New South Wales Department of Environment, Climate Change and Water)

Macquarie-Castlereagh Catchment

The Macquarie-Castlereagh Catchment is located in central western New South Wales. The catchment covers about 8.5 million hectares and makes up about 6.9 per cent of the total area of the Murray-Darling Basin. The catchment includes the Castlereagh, Macquarie and Bogan River valleys.

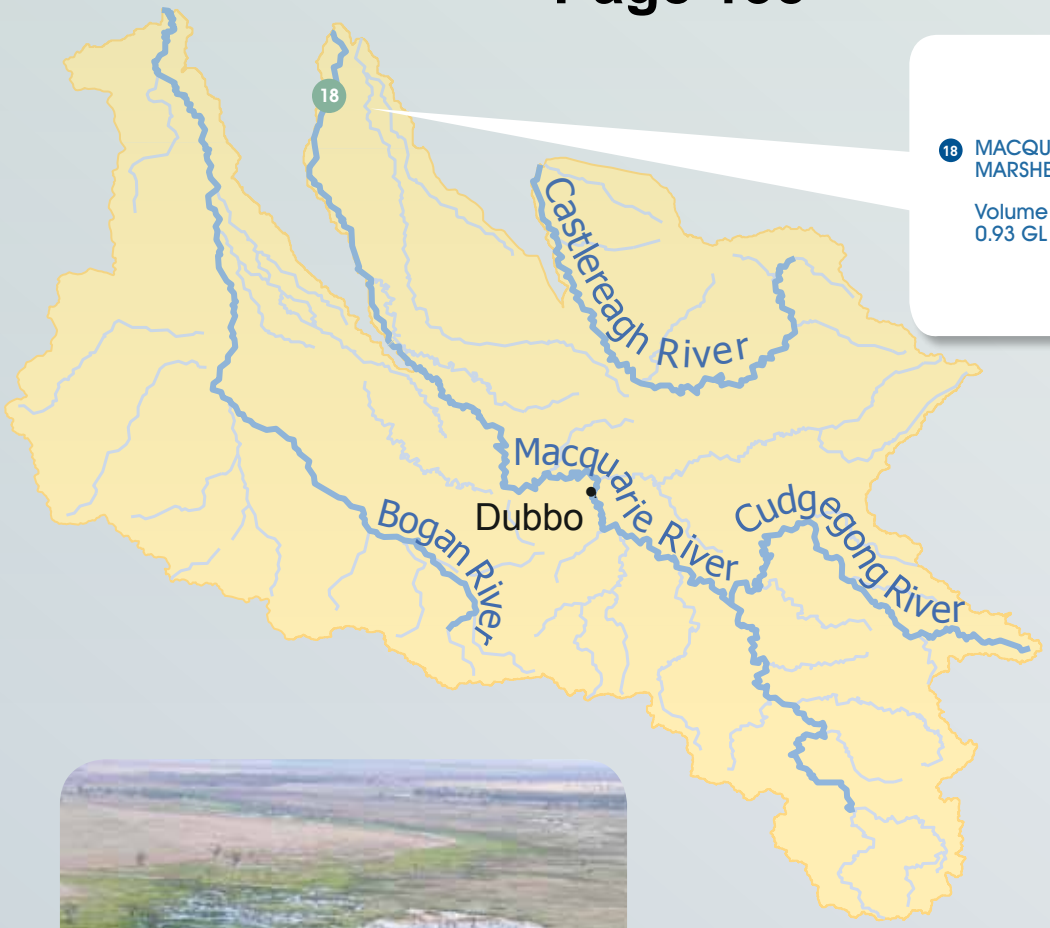
The landscape of the Macquarie-Castlereagh Catchment varies markedly from east to west. The tablelands in the east are characterised by steep, densely vegetated ranges and cleared grazing lands. The western slopes have cleared hills graduating to flatter lands, with some pockets of remnant vegetation. The plains area is characterised by flat landscapes and the occasional rocky outcrop. The Murray-Darling Basin Authority Sustainable Rivers Audit, released in 2008, reported the overall ecosystem health of the Macquarie-Castlereagh Catchment was very poor.

The Macquarie Marshes, one of the largest and most important wetlands in the Murray-Darling Basin, is located approximately 75 kilometres northwest of Coonamble, New South Wales. The Macquarie Marshes is one of the last remaining inland semi-permanent wetlands in New South Wales and is made up of swamps, lagoons, channels and floodplain. The Macquarie Marshes is recognised internationally and nationally under the Ramsar Convention and the Directory of Important Wetlands in Australia.

The Macquarie Marshes support a number of flood-dependent vegetation communities. These include river red gum forests, water couch (*Paspalum distichum*) grasslands, extensive beds of common reed, coolibah (*Eucalyptus coolibah*), black box, lignum, native cumbungi (*Typha domingensis and Typha orientalis*) and river cooba (*Acacia stenophylla*). The marshes support over 300 plant species, including nationally threatened basalt peppercress (*Lepidium hyssopifolium*).

A diverse array of wildlife, including birds, frogs, reptiles and fish, rely on the habitat provided by the Macquarie Marshes. The site is important habitat for native fish species including threatened species, such as the silver perch (*Bidyanus bidyanus*) and Murray cod (*Maccullochella peelii peelii*). The site also provides habitat for a large number of waterbird species, such as the glossy ibis, Australasian bittern (*Botaurus poiciloptilus*) and brolga (*Grus rubicunda*).

When flooded, the marshes become one of the most important sites in Australia for the breeding of colonial water birds, particularly in terms of the number of nests, frequency of breeding and the diversity of species breeding. The Macquarie Marshes also act as a refuge in dry periods by providing significant habitat for nesting birds when many other inland wetlands and waterways have dried out.



18 MACQUARIE MARSHES

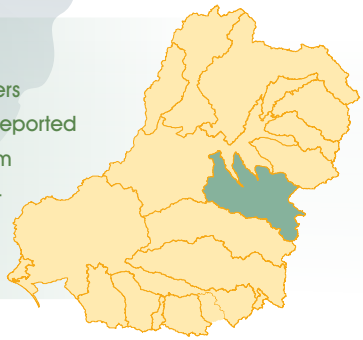
Volume
0.93 GL

WILGARA, A PRIVATELY OWNED RAMSAR SITE, ON THE MACQUARIE MARSHES, NEW SOUTH WALES
(January 2010)
Photo by Tim Hosking (New South Wales Department of Environment, Climate Change and Water)

NSW

MACQUARIE MARSHES, NEW SOUTH WALES FOLLOWING ENVIRONMENTAL WATERING
(October 2009)
Photo by Richard Kingsford.

The Murray-Darling Basin Authority Sustainable Rivers Audit, released in 2008, reported that the overall ecosystem health of the Macquarie-Castlereagh Catchment is very poor.



Watering actions in 2009-10

The watering actions at the Macquarie Marshes were based on proposals put forward by the New South Wales Department of Environment, Climate Change and Water. The Commonwealth provided about 1 gigalitre of environmental water to the Macquarie Marshes in spring 2009 and summer 2009-10. The New South Wales Government concurrently delivered about 20 gigalitres of environmental water to the marshes. These environmental flows were made possible following three significant regional rainfall events.

The water delivery was managed and monitored by the New South Wales Department of Environment, Climate Change and Water with support from the Macquarie and Cudgegong Environmental Flows Reference Group, which includes local community representatives. Highlighting the effectiveness of this arrangement, the chair of the reference group has written: *"The group would like to express its appreciation and acknowledge the benefit of any additional water contributed by the Commonwealth to the marshes. The continued good communication between all those involved is appreciated by all members of the Environmental Flows Reference Group."*

Aims

The key aim of the environmental watering action in the Macquarie Marshes is to relieve the effects of severe prolonged drought and improve the health of river red gum forests and aquatic vegetation.

Outcomes

Wetland vegetation, such as common reed, water couch and common spike rush (*Eleocharis acuta*), increased in cover and abundance following the 2009-10 environmental watering at the Macquarie Marshes. River red gums responded positively with an improvement in canopy density. Other floodplain vegetation, such as lignum and river cooba communities and water couch, also responded well and now provide nesting habitat for colonial waterbirds, such as egret, heron and ibis.

The improved vegetation health encouraged frog and bird breeding events. The Macquarie and Cudgegong Environmental Flows Reference Group reported eight frog species at the site, including the Peron's tree frog, spotted marsh frog, eastern banjo frog and barking marsh frog. Most of these species were calling, which signified breeding activity. The Macquarie and Cudgegong Environmental Flows Reference Group also identified grassy paddocks and reeds at the site as important habitat for the process of metamorphosis from tadpole to frog.

Several thousand waterbirds flocked to the Macquarie Marshes post-watering including brolga, yellow-billed spoonbill (*Platalea flavipes*), pacific heron (*Ardea pacifica*), pacific black duck and grey teal. The environmental water delivery triggered breeding events for a number of waterbird species. Also, a nesting colony of cattle egrets (*Ardea ibis*), intermediate and great egrets of between 800 and 1000 nests has been successfully established at the site.

The Macquarie and Cudgegong Environmental Flows Reference Group reported high numbers of juvenile carp and small numbers of native fish in the marshes following the actions. The breeding response of native fish will become clearer through continued monitoring as native fish typically take longer to respond to changes in condition than carp.

PRIOR TO

MOLE MARSH, MACQUARIE MARSHES, NEW SOUTH WALES PRIOR TO ENVIRONMENTAL WATERING

(September 2009)

Photo by Kaya Michener (New South Wales Office of Water)

FOLLOWING

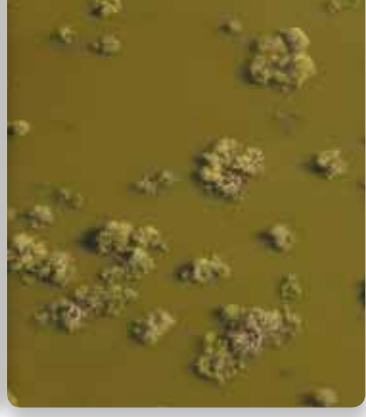
MOLE MARSH, MACQUARIE MARSHES, NEW SOUTH WALES DURING SITE MONITORING FOLLOWING ENVIRONMENTAL WATERING

(November 2009)

Photo by Kaya Michener (New South Wales Office of Water)

Barwon-Darling Catchment

The Barwon-Darling Catchment is a large dryland river system that extends from the Queensland border to the River Murray near the border of New South Wales and South Australia.



The Barwon-Darling Catchment is a large dryland river system that extends from the Queensland border to the River Murray near the border of New South Wales and South Australia. Key characteristics of the Barwon-Darling Catchment include its low gradient and large floodplains, seasonal variability, and arid to semi-arid conditions. About 30 per cent of the catchment is covered with open woodlands, timbered areas, shrublands and native pastures.

Important wetlands, rivers and floodplains within the catchment include the Menindee Lakes system and Talyawalka wetlands, which are nationally recognised in the Directory of Important Wetlands in Australia. The Menindee Lakes system sits about 200 kilometres north of the junction of the Murray and Darling Rivers. The system is comprised of nine lakes, including Lake Pamamaroo, Lake Wetherell, Lake Menindee and Lake Cawndilla.

The Talyawalka wetlands comprise the Talyawalka Anabranch wetlands of the Darling River and its tributary, Teryawynia Creek. These wetlands include numerous intermittent wet and dry lakebeds and are representative of a semi-arid inland floodplain wetland system. When inundated, the lakes provide habitat for more than 10,000 waterbirds. The main vegetation in the area includes black box, river red gum, lignum and canegrass (*Eragrostis australasica*). The Murray-Darling Basin Authority Sustainable Rivers Audit (2008) reported the overall ecosystem health of the Barwon-Darling Catchment was poor.

Watering actions in 2009-10

Following a major rainfall event in northwest New South Wales and southwest Queensland in early 2010, 38 gigalitres of water that would historically have been diverted for consumption at Toorale Station, was allowed to flow through the Darling River system. The aim of the 2010 action was to maximise flows through the Darling River, providing ecological benefits in the channel and to adjacent floodplains and wetlands.

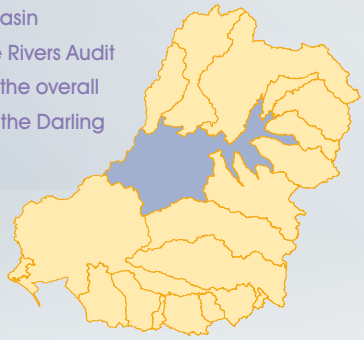
Outcomes

Environmental flows from Toorale Station provided benefits to in-stream habitats and riparian ecosystems along the Darling and lower Warrego Rivers. Riparian ecosystems on the property's western floodplain were extensively inundated and refreshed during the watering.

The water from Toorale Station's entitlements flowed down the Darling River providing in-stream environmental benefit and extending the area and duration of flooding along the Darling River and its floodplains, billabongs and anabranches.

STRAW-NECKED IBIS NESTING ON LIGNUM, WESTERN FLOODPLAIN, TOORALE STATION, NEW SOUTH WALES
(May 2010)
Photo by Terry Korn (New South Wales Department of Environment, Climate Change and Water)

The Murray-Darling Basin Authority Sustainable Rivers Audit (2008) reported that the overall ecosystem health of the Darling Catchment is poor.



COOLIBAH WETLAND, WESTERN FLOODPLAIN, TOORALE STATION, NEW SOUTH WALES
(May 2010)
Photo by Terry Korn (New South Wales Department of Environment, Climate Change and Water)

Warrego, Moonie & Nebine Catchments

The Warrego, Moonie and Nebine Catchments are located in Queensland and northern New South Wales.

The Warrego Catchment spans the area from the Carnarvon Range at the most northerly point of the Murray-Darling Basin to the Darling River in northern New South Wales. It covers a total area of about 7.6 million hectares. There are a number of nationally important wetlands in the Warrego Catchment. These wetlands are generally in good condition, though some have been affected by grazing and sedimentation.

The Moonie Catchment is located predominantly in south western Queensland and extends over the border into northern New South Wales. The catchment covers a total area of about 1.5 million hectares and is one of the most heavily cleared catchments in southern Queensland. Waterholes in the catchment, such as the Thallon waterholes, provide important aquatic habitats that can support up to 20,000 waterbirds.

The Nebine Catchment is situated in southern Queensland and covers about 3.8 million hectares. One per cent of the catchment lies over the border in northern New South Wales. The Nebine Catchment is made up of Nebine, Mungallala and Wallam Creeks and is characterised by predominantly flat terrain and low rainfall.

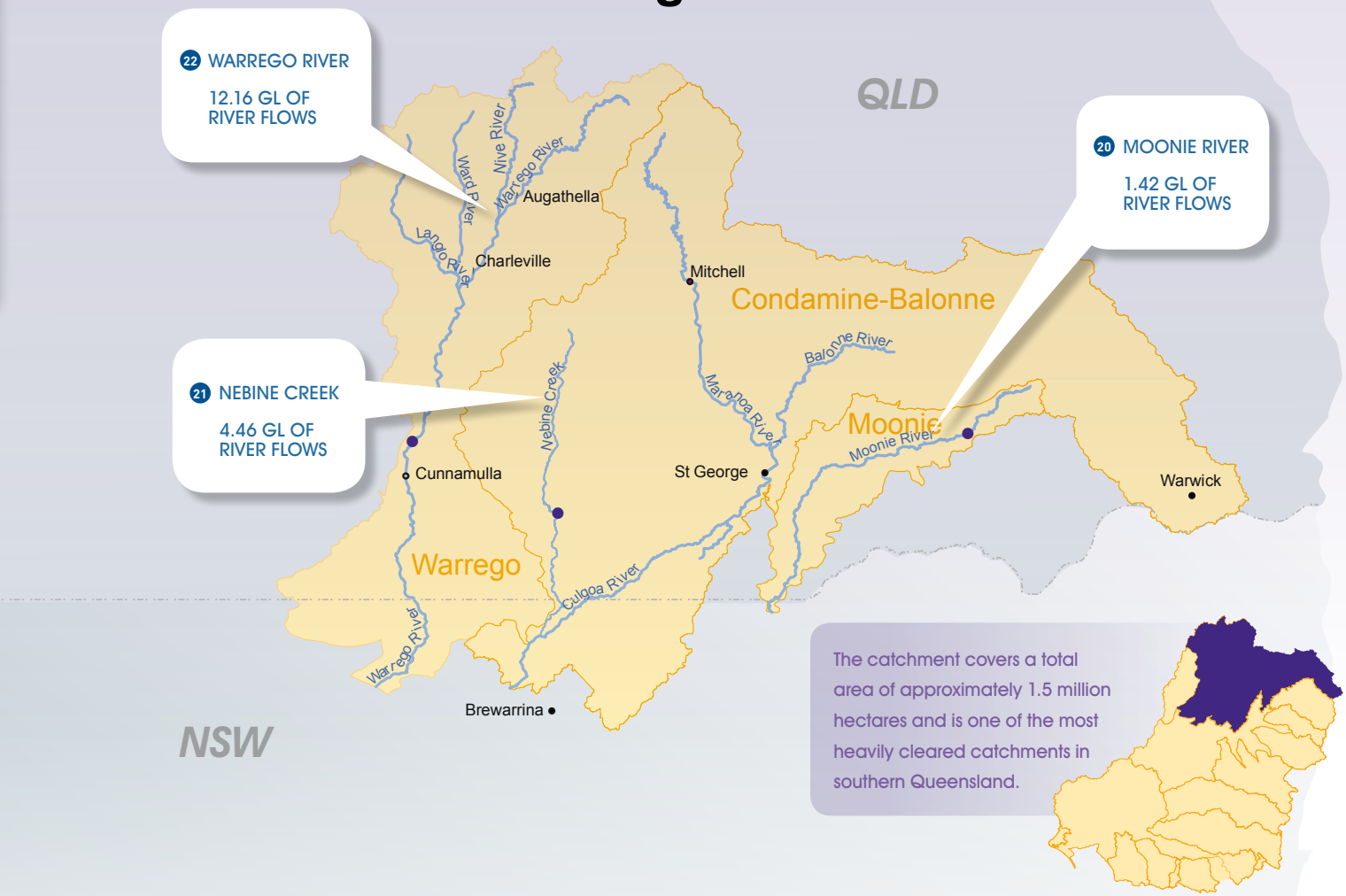
Watering actions in 2009-10

The Commonwealth's unregulated water entitlements in the Warrego, Moonie and Nebine Catchments flowed through the system as part of the floods from January to April 2010. In total, 18.03 gigalitres of the in-stream and overbank flow in these rivers was attributed to the Commonwealth's entitlements. While the Commonwealth's environmental water was a very small component of the total flows in southern Queensland, it contributed to the benefits from those floods, including filling of waterholes in the main river channels and distributaries, and the inundation of floodplains and associated wetlands.

Outcomes

In the Warrego Catchment, in-stream flows of 12.16 gigalitres of Commonwealth environmental water contributed to floodwaters that filled the vast Cuttaburra Basin in north western New South Wales. This area includes Yantabulla Swamp, which is nationally recognised in the Directory of Important Wetlands in Australia and provides a significant regional drought refuge and breeding area for ducks and colonial waterbirds.

YANTABULLA SWAMP, NEW SOUTH WALES
(March 2010)
Photo by Melissa Hull (New South Wales Department of Environment, Climate Change and Water)



In the Moonie Catchment, the Commonwealth water contributed to flows that substantially inundated large portions of the river system. The Moonie flood was a long duration, multi-peaked event that extensively watered the lower floodplain and filled waterholes throughout the system.

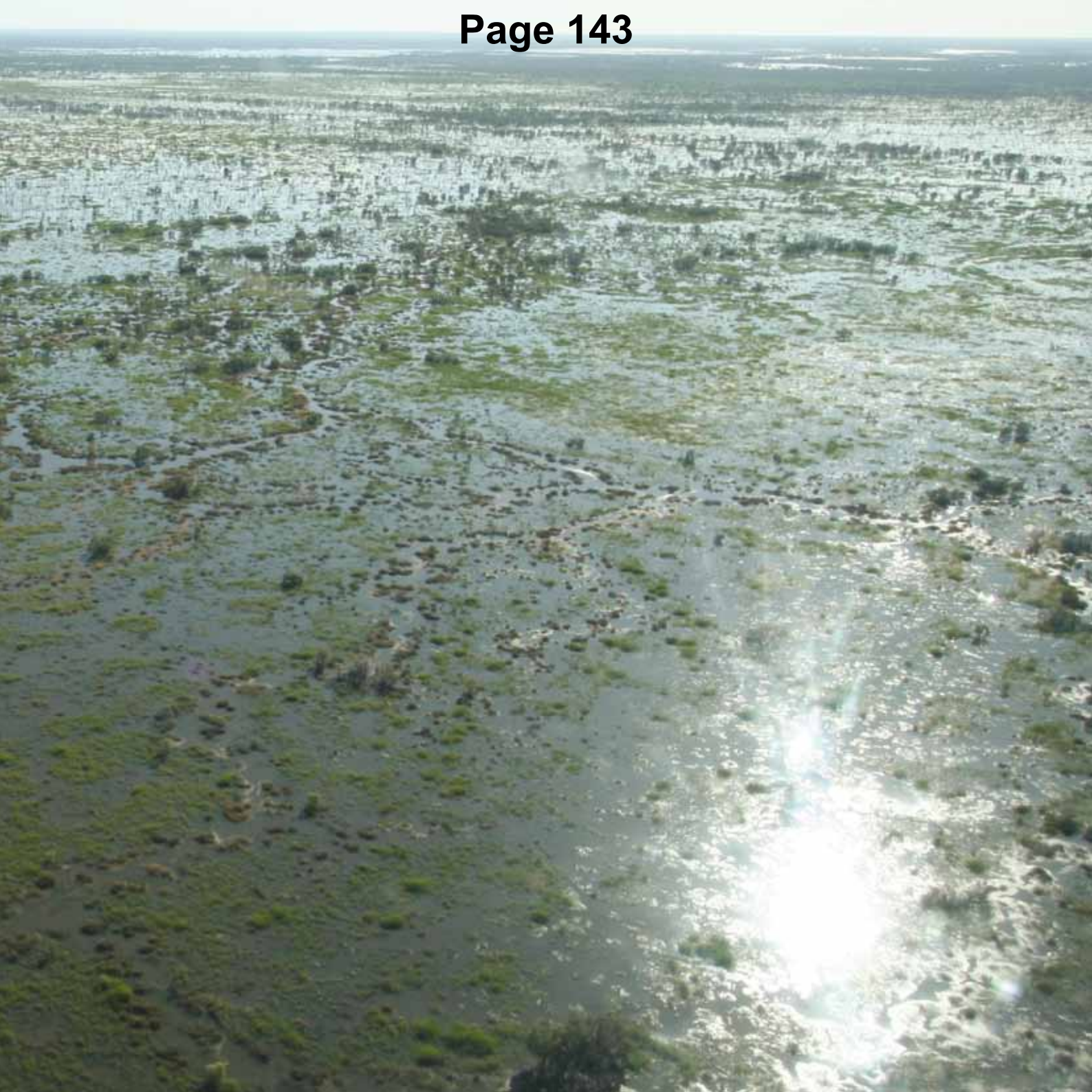
In Nebine Creek, Commonwealth water augmented natural floods providing almost 5 per cent of total flood flows in the lower reaches. This flood provided water to key ecological assets in the western portion of the Culgoa River floodplain, including the Queensland Culgoa Floodplain National Park and the New South Wales Culgoa National Park.

Unlike much of the southern Basin, these river reaches are unregulated and do not rely on large public storages to control water releases. The Commonwealth works closely with the Queensland Government to ensure Commonwealth environmental water is accurately accounted for and that this water provides optimal environmental benefits as it passes through the system.

FLOODWATERS AT YANTABULLA SWAMP, YANTABULLA, NEW SOUTH WALES

(March 2010)

Photo by Melissa Hull (New South Wales Department of Environment, Climate Change and Water)



Acknowledgments

Australian Government

- Murray-Darling Basin Authority

South Australia

- South Australian Murray-Darling Basin Natural Resources Management Board
- South Australian Department for Water
- South Australian Department of Environment and Natural Resources
- Overland Corner Branch of the National Trust of South Australia
- Overland Corner Wetland Rehabilitation Group
- Wetlands Habitat Trust and Paiwalla Pty. Ltd.

Victoria

- Victorian Department of Sustainability and Environment
- Mallee Catchment Management Authority
- North East Catchment Management Authority
- Goulburn-Murray Water
- Parks Victoria
- Sunraysia Bird Monitors

New South Wales

- New South Wales Department of Environment, Climate Change and Water (including the Office of Water and the National Parks and Wildlife Service)
- Murrumbidgee Catchment Management Authority
- Murray Catchment Management Authority
- Central West Catchment Management Authority
- New South Wales State Water Corporation
- Forests New South Wales

Queensland

- Queensland Department of Environment and Resource Management

We would also like to acknowledge the considerable assistance provided over 2009-10 from local groups and landholders to the environmental watering actions, including allowing access to land, provision of infrastructure and monitoring of ecological responses.

Data Sources:

Drainage Division, States, Rivers

Sustainable Yields Reporting Regions

Map produced by:ERIN
Department of the Sustainability, Environment, Water, Population and Communities, November 2010

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Murray-Darling Basin Authority

Australian Government

Commonwealth Environmental Water

Commonwealth Environmental Water

2010–11 OUTCOMES REPORT

OUTCOMES REPORT – OVERALL CONTEXT

The primary objective of Commonwealth environmental water use is to protect and restore the environmental assets of the Murray–Darling Basin. This means improving the conditions of the whole ecosystem including its connected elements. A healthier Basin will be more sustainable for the communities and industries that rely upon it.

The 2010–11 Commonwealth Environmental Water Outcomes Report provides information on early results from water use, including the impacts on particular plant and animal species. These results are important not just because of the species themselves but because these are indicators of wider river and wetland health and associated benefits.

For example, increased numbers of native fish indicate improved water quality and recovering native vegetation along rivers will improve bank stability and reduce soil erosion.

Commonwealth Environmental Water has supported important scientific monitoring on the responses to environmental flows.

For example, biofilms such as algae and microorganisms were monitored in parts of the Murrumbidgee as these organisms are often the first to respond and recover from stress caused by low flows. Improved knowledge about the immediate responses to environmental water use can inform future actions.

To take advantage of local knowledge and expertise, the Commonwealth has partnered with community groups, catchment management authorities and state agencies to implement the watering programs. Such partnerships are critical to ensure that local knowledge and expertise are included in the assessment of options.

(FRONT COVER)

MACQUARIE MARSHES SHORTLY AFTER A PERIOD OF ENVIRONMENTAL WATERING (OCTOBER 2010)

Photo by Dr Simon Banks, Department of Sustainability, Environment, Water, Population and Communities

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(OPPOSITE)

PERON'S TREE FROG (*LITORIA PERONII*), YANGA NATIONAL PARK FOLLOWING THE USE OF COMMONWEALTH ENVIRONMENTAL WATER (FEBRUARY 2011)

Photo by Tanya Doody, Commonwealth Scientific and Industrial Research Organisation – Land and Water

Commonwealth Environmental Water

2010–11 OUTCOMES REPORT

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Lachlan

Murray

Murrumbidgee

Wimmera–Avon

Avoca–Loddon

Goulburn Broken

Ovens

Campaspe

VICTORIA

INTRODUCTION

This outcomes report provides information on the early results of the use of Commonwealth environmental water in 2010–11 and revisits some key areas where water was delivered in earlier years.

The 2010–11 water year was characterised by a significant change in rainfall and river flow conditions across the Murray–Darling Basin. After one of the most severe droughts on record the Basin received substantially above-average rainfall. Some areas of the Basin, including catchments in northern Victoria and southern Queensland, received record rainfall, with floods occurring in the Murray, Barwon–Darling, Murrumbidgee, Goulburn, Ovens, Campaspe, Loddon and many other rivers in the Basin.

The approach to the use of Commonwealth environmental water had to adapt during the year to provide the best possible environmental outcomes under rapidly changing circumstances. The pattern of rainfall was unusual with modest inflows in the winter/early spring period (up to October) and very high rainfall and river flows during late spring/summer (late October 2010 to February 2011). In combination with an increased size of Commonwealth environmental water holdings, this provided for a large increase in the amount of Commonwealth environmental water available for use.

In 2010–11 more than 387 gigalitres of Commonwealth environmental water was delivered to environmental assets across the Basin. Water was used primarily to capitalise on the ecological benefits of high rainfall and increased river flows experienced across the Basin. The aim of Commonwealth environmental watering was to support the ecological recovery of riverine and wetland communities following years of extended drought.

Given the very wet conditions, Commonwealth environmental water was only a small proportion of total river flows. In many cases this makes it difficult to directly attribute outcomes to the additional water. The information provided in this report does however indicate that Commonwealth environmental water contributed to some key outcomes including:

- contributing to river flows through the southern-connected Basin that support key system processes including nutrient cycling and the export of salt from the Basin
- contributing to river flows that connect and support rivers, wetlands and floodplains of the Murrumbidgee, Lower Darling and Lachlan catchments
- supporting water bird breeding at key sites across the Basin
- supporting fish communities affected by blackwater in the Edward–Wakool system and Murrumbidgee river.

The large natural flows in 2010–11 met many environmental demands, meaning that it was not necessary in many areas to supplement or extend the flows. More than 300 gigalitres of water was carried over for use in subsequent years.

Macquarie Marshes shortly after a period of environmental watering (October 2010).
Photo by Dr Simon Banks, Department of Sustainability, Environment, Water, Population and Communities.

Commonwealth environmental water will be available in 2011–2012 to continue to support ecological recovery and build resilience in environmental assets. Many areas of the Basin were affected by low flows for an extended period, so it will take some years to see the expected improvement in environmental health.

The large increase in available water in 2010–11 highlighted the importance of partnerships to the delivery of Commonwealth environmental water. Environmental water partners (including community groups, catchment management authorities and state agencies) provided expertise and knowledge about local conditions, the water needs of environmental assets and information that supported the efficient and effective delivery of water.

The assistance provided to us is greatly appreciated and we look forward to building on these relationships into the future.

Ian Robinson
Commonwealth Environmental Water Holder
John Gorton Building, King Edward Terrace, Parkes ACT 2600
GPO Box 787, Canberra ACT 2601
Tel: + 61 2 6275 9245 Fax: + 61 2 6274 2360
Email: ian.robinson@environment.gov.au

COMMONWEALTH ENVIRONMENTAL WATER

River regulation and extraction of water has changed river flows in the Murray–Darling Basin. Changes in flow volume and timing have led to increases in salinity, blue–green algal blooms and affect water quality, wetlands, red gum forests, native fish and waterbirds.

Healthy rivers are essential to underpinning the economy and a vibrant Basin community. Without sufficient water the Basin's ecosystems will continue to deteriorate, threatening the viability of industries, cities and towns.

The Australian Government is implementing its Water for the Future initiative to better balance the water needs of communities and the environment. This includes acquiring water for the environment and investing in more efficient irrigation infrastructure. Water rights acquired by the Australian Government become Commonwealth environmental water. Commonwealth environmental water will help meet an environmentally sustainable limit on water use to be set in the Murray–Darling Basin Authority's final Basin Plan.

The Lower Darling Anabranch at Wentworth shortly after a period when Commonwealth environmental water was used (December 2010). Photo by Paul Doyle, Department of Sustainability, Environment, Water, Population and Communities.

Commonwealth environmental water at the end of 2010–11 accounted for less than 3 per cent of the total long-term average river flows in the Murray–Darling Basin. The water is of particular value because it is additional environmental water that in many cases can be actively managed over different sites and time.

ACTIVE MANAGEMENT

Commonwealth environmental water is being actively managed in response to changing conditions. Active management includes:

- delivering water to complement river flows from rainfall
- using infrastructure to deliver water
- working with river operators to better manage environmental flows
- holding carryover for use in future years
- transferring water allocations between catchments to where it is needed most
- future trading of water (both sale and acquisition).

In planning watering actions, local expertise and advice from catchment management authorities and river operators is obtained with respect to environmental need, current conditions and potential delivery arrangements. The feasibility and cost of delivering water, and risks such as flooding and blackwater are also taken into account. This approach provides for effective and efficient use of environmental water so that environmental objectives can be achieved with the minimum amount of water.

HOW COMMONWEALTH ENVIRONMENTAL WATER WAS USED IN 2010–11

The southern-connected Basin experienced one of its wettest years on record in 2010–11 and the timing of rainfall was unusual. Below average rainfall was experienced early in the year followed by significant summer rainfall (figure 1). Inflows to the River Murray system were more than twice the long-term average. The southern system had the wettest summer on record with Renmark recording more than five times its seasonal average of rain. There were also exceptional and prolonged wet conditions during spring and summer, and several systems experienced record or near record flow events.

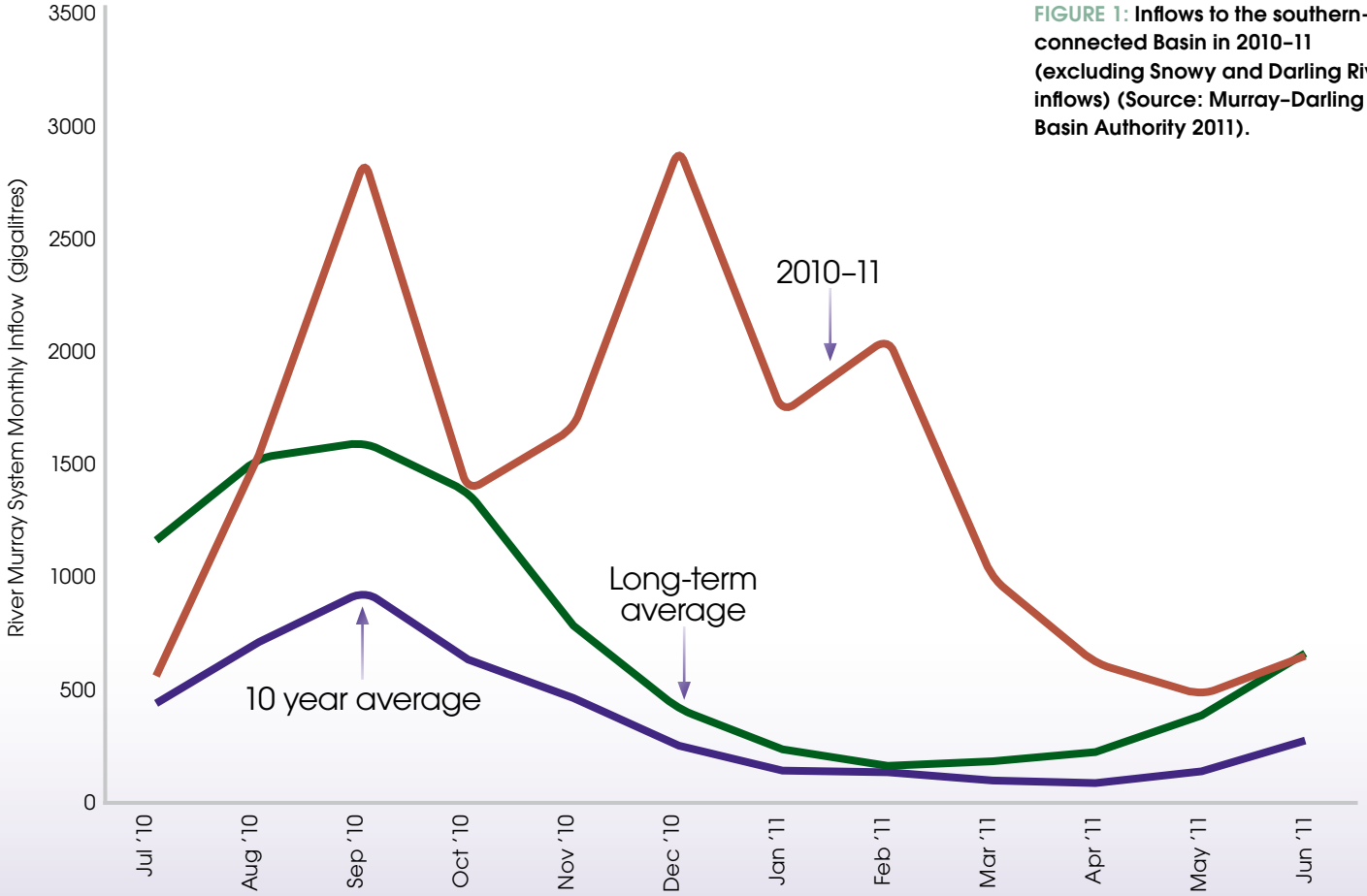


FIGURE 1: **Inflows to the southern-connected Basin in 2010–11 (excluding Snowy and Darling River inflows) (Source: Murray–Darling Basin Authority 2011).**

Cochran Creek before and during a period when Commonwealth environmental water was used (March and April 2011).
Photos by Rebecca Gee, Department of Sustainability, Environment, Water, Population and Communities.

The approach to Commonwealth environmental watering varies depending on Basin conditions and the volume of water available (see table 1). From the first use of Commonwealth environmental water in 2009 through to the spring of 2010, conditions across most of the Basin were extremely dry and water was primarily used to provide drought refuges and avoid permanent damage to key environmental assets.

The change to wetter conditions across the Basin from the spring of 2010 to autumn 2011 meant the focus of water use shifted to support ecological recovery following the drought. This was done by capitalising on the environmental benefits of rainfall by building on natural river flows, in particular by piggy-backing on rainfall through summer and providing river freshes in autumn and early winter when rainfall was lower.

A total of 387 gigalitres of Commonwealth environmental water was delivered in 2010–11. More than 340 gigalitres was provided as river flows to connect the system and support ecological processes, with the remainder used at key environmental assets such as wetlands.

Figure 2 shows the location and volumes delivered in 2010–11. For details of all watering actions undertaken in 2010–11 please refer to the 2010–11 Commonwealth Environmental Water annual report which can be found at: **www.environment.gov.au/ewater**

TABLE 1: **Ecological objectives for the use of Commonwealth environmental water under different water resource availability scenarios.**

	Extreme Dry	Dry	Moderate	Wet	Very Wet
Ecological watering objectives	Avoid damage to key environmental assets	Ensure ecological capacity for recovery	Maintain ecological health and resilience of aquatic ecosystems	Improve the health and resilience of aquatic ecosystems	Build future capacity to support ecological health resilience

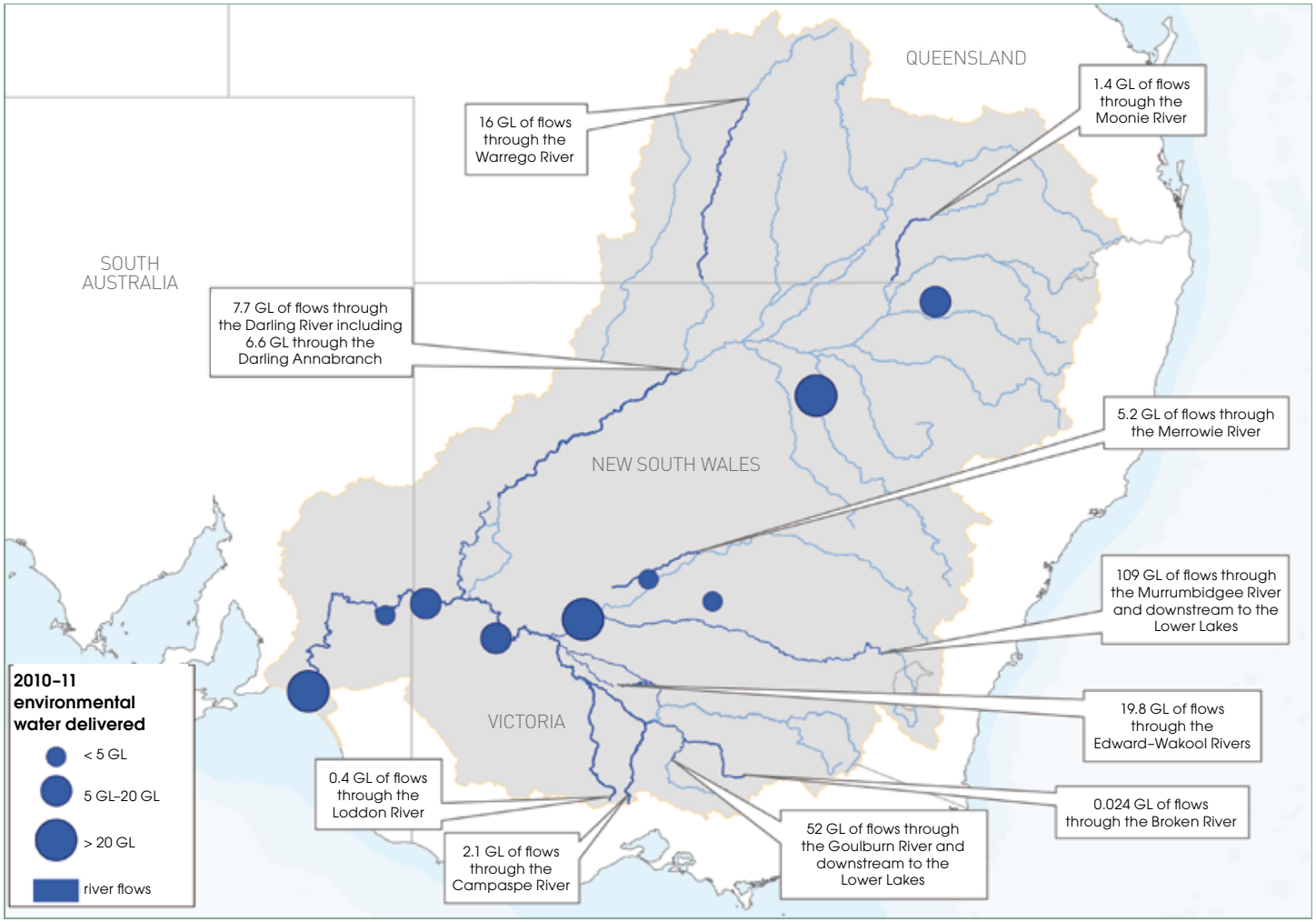
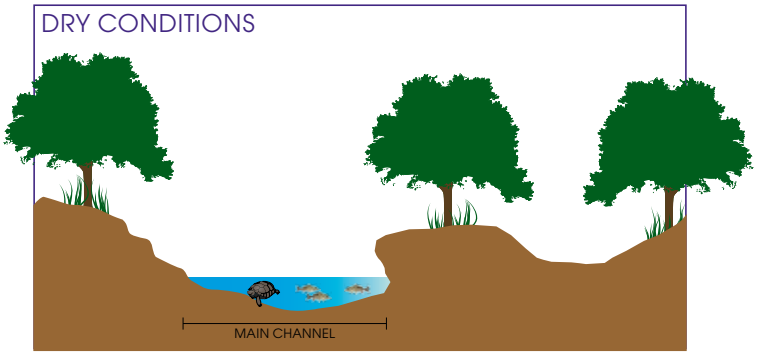


FIGURE 2: **Summary of Commonwealth environmental watering for 2010–11.**

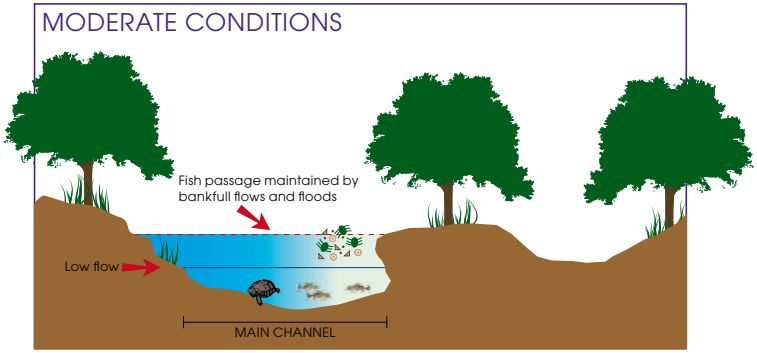
HOW ENVIRONMENTAL WATER IS USED IN DIFFERENT CONDITIONS

The flora and fauna of Australia have evolved to take advantage of the variable natural flows of our aquatic ecosystems. Different flow regimes provide different ecosystem functions that cumulatively meet requirements for the survival and development of water-dependant species. Environmental water can improve ecosystem health by providing more natural flow and inundation conditions that allow different ecological processes to occur.

The Darling Anabranch during a period when Commonwealth environmental water was used (December 2010).
Photo by Dr Simon Banks, Department of Sustainability, Environment, Water, Population and Communities.



During droughts there may be no connection between wetlands across a landscape. Environmental water directed from the main channel may provide low flows, flushing waterholes, improving water quality, and providing refuges for plants and animals.



In moderate conditions when there is low flow in the main channel, environmental water may be used to provide in-channel river flows. This increases connectivity along the river channel and may improve the amount of habitat available by engaging secondary channels.

During wetter times environmental water may be used to improve the connectivity between floodplain wetlands and the main channel. This is important for exchange of nutrients, sediments and genetic material to support biodiversity. Environmental water may be used to maintain water levels in wetlands and floodplains by piggy-backing on peak flows or slowing the recession following the peak. The opportunities for overbank flows may be limited by delivery constraints, such as channel or outlet capacity and the need to avoid undesired flooding of private land or infrastructure.

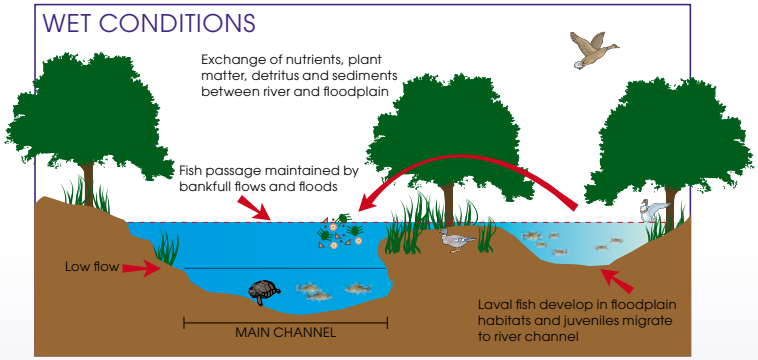


FIGURE 3: **Examples of how Commonwealth environmental water may be used under different climate scenarios (adapted from Mussared 1997).**

SOUTHERN MURRAY–DARLING BASIN

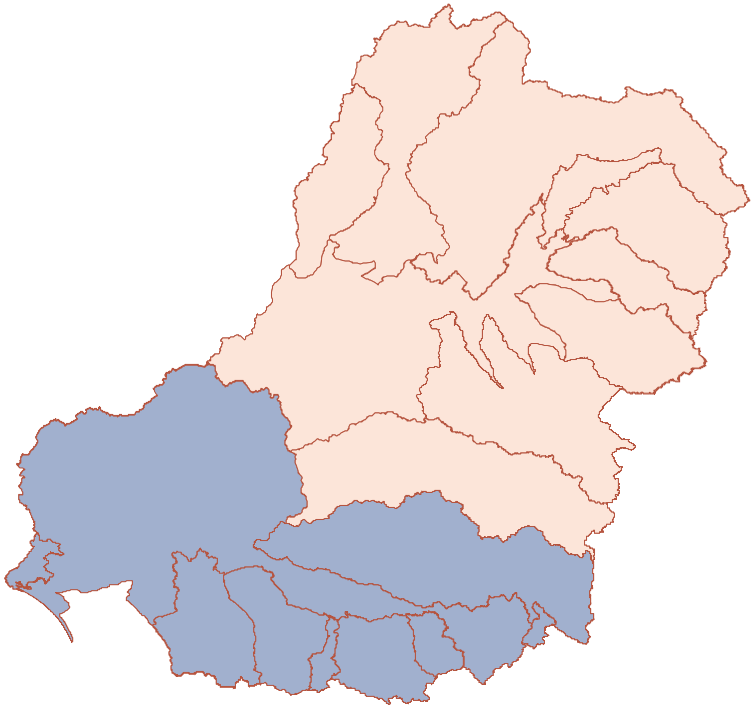
The southern Murray-Darling Basin includes the Murray, Murrumbidgee, Edward–Wakool, Kiewa, Ovens, Goulburn, Broken, Campaspe, Loddon, Avoca, and the Lower Darling (south of Menindee Lakes) river catchments.

These are highly-regulated rivers that flow through a variety of landscapes. The headwaters of the Murray, the Murrumbidgee and Goulburn catchments originate in the wetter, cooler climate of the Australian Alps before flowing westward into the warmer, drier climate of the floodplains. The catchments in the southern Murray-Darling Basin are generally cooler than the northern catchments with the highest rainfall occurring in winter and spring.

Watering actions during 2010–11 in the Murrumbidgee, Edward–Wakool, Murray, Goulburn, Campaspe, Loddon and Darling Anabranch all contributed to river flows from the upper reaches of each of these catchments through to the Murray Mouth. More than 315 gigalitres was delivered to sites within the southern Murray–Darling Basin as river flows.

Providing water as river flows supports connecting processes that benefit the whole system, as well as the health of specific environmental assets. This is because the degree of river-floodplain connectivity regulates the amount of terrestrial material, including sediments, nutrients, and dissolved and particulate organic matter that is transported into the river system (Tockner et al. 1999). Connectivity allows the movement of carbon and nutrients from the floodplain to the river channel and is likely to be a key process that helps environmental assets recover following drought (Lake 2003).

In the Murrumbidgee River two river flow actions were undertaken in 2010–11. The first action in late summer delivered 58 gigalitres of water as river flows to provide suitable habitat for water-dependant species following detrimental impact from blackwater. The second action in winter 2011 delivered more than 161 gigalitres of water providing river flows right through the Murrumbidgee system and as far downstream as the Murray Mouth (see page 12).



315 GIGALITRES WAS DELIVERED WITHIN THE SOUTHERN MURRAY-DARLING BASIN AS RIVER FLOWS.

Dr Skye Wassens from Charles Sturt University has been monitoring the ecological response to this action:

... the biggest benefit is actually to do with connectivity, so when you release a large slug of water you are connecting the wetlands that border the river to the river, and you are creating this sort of pathway for animals, aquatic animals and nutrients and energy to move around the system and to sort of re-organise themselves. So creating connectivity during a large flow is really critical to allow organisms back into wetlands that have been dry. And also to allow the movement of nutrients and carbon that have been accumulating in wetlands during those dry periods to move back into river systems which feed some of those riverine food chains that many organisms depend on.

Dr Skye Wassens, 2011

In the Lower Darling, 47 gigalitres was delivered as river flows to the Great Darling Anabranch (of which six gigalitres was Commonwealth environmental water), providing connection through to the River Murray for the first time in nearly a decade. This water inundated wetlands and floodplains along the anabranch, contributing to a range of benefits including improved habitat for breeding of fish, birds and frogs and the regeneration of vegetation.

Fifty-two gigalitres was also provided as river flows from the Goulburn River downstream to the Murray Mouth, delivered in conjunction with 29 gigalitres directed to the Lower Lakes. Mr Wayne Tennant, Goulburn–Broken Catchment Management Authority, Strategic River Health Manager has seen some of the benefits of Commonwealth environmental water:

Since the high flows, the river has been teeming with aquatic life, especially macro-invertebrates, which will provide another important food source for our native fish stocks.

Wayne Tennant, quote from Goulburn–Broken Catchment Management Authority media release 25 October 2010

At the Lower Lakes this water delivery provided benefits to aquatic ecosystems and contributed to the health of the river system. This included contributing to maintaining an open Murray Mouth to export salt, providing valuable nutrients to aquatic communities, and helping the movement of fish species. The benefits of these flows are reflected in improved conditions at the Lower Lakes and Coorong as outlined on page 26.

Yanga National Park after a period when Commonwealth environmental water was used (December 2010).
Photo by Paul Doyle, Department of Sustainability, Environment, Water, Population and Communities.

MURRUMBIDGEE RIVER SYSTEM

There were significant rainfall events through spring 2010 and summer 2011 in the Murrumbidgee catchment, with a major flood in the upper and mid-river reaches in December 2010 which inundated large areas of floodplain – some of which had not been inundated for up to 10 years. The flood peaked at nearly 280 gigalitres per day at Gundagai on 4 December 2010 (figure 4). There have only been 12 floods that have exceeded this level in the past 125 years (New South Wales Office of Water 2011).

In 2010–11 the focus of Commonwealth environmental water delivery in the Murrumbidgee catchment was to restore connectivity along the river and to adjacent wetlands and floodplains. The aim was to protect and restore the wetland vegetation communities, improve river red gum forest and black box woodland communities, and maintain and improve ecosystem condition in the Murrumbidgee River channel. The Sustainable Rivers Audit has previously rated the overall ecosystem health of the Murrumbidgee catchment as very poor (Murray–Darling Basin Authority 2008).

More than 193 gigalitres of Commonwealth environmental water was delivered in five separate actions within the Murrumbidgee catchment in 2010–11.

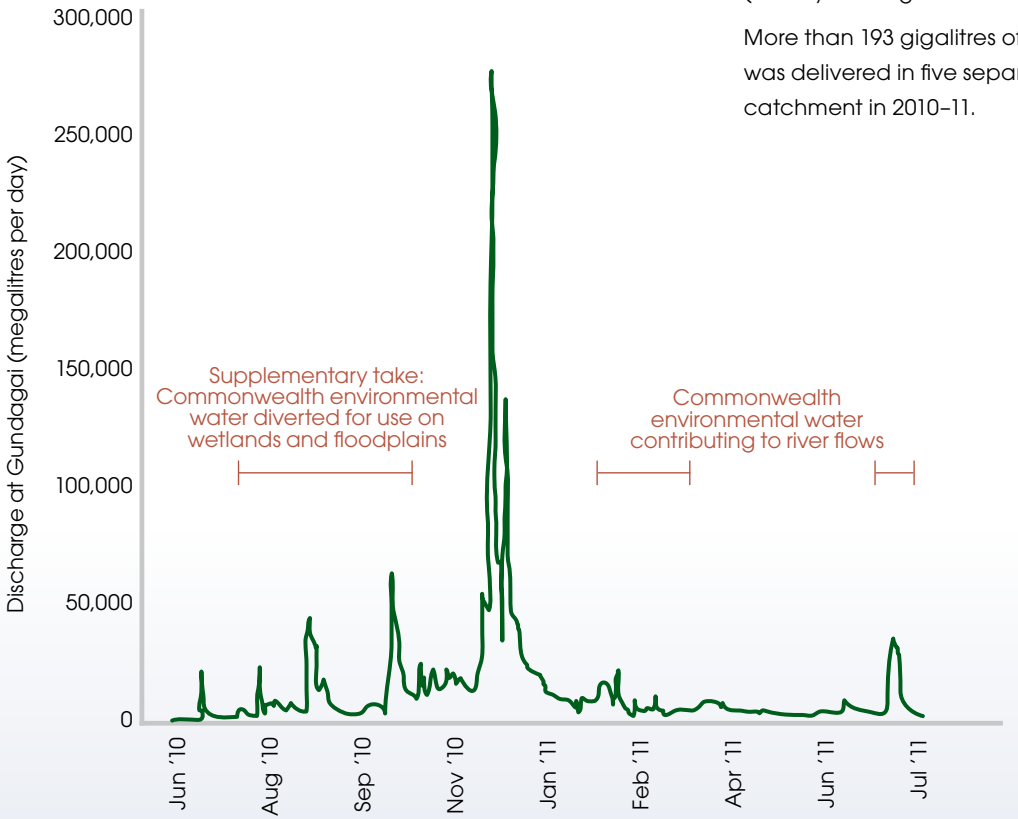


FIGURE 4: Timing of Commonwealth environmental water use in the Murrumbidgee River 2010–11.

Wetlands in the Yanga National Park after a period when Commonwealth environmental water was used (November 2010).
Photo by Tanya Doody, Commonwealth Scientific and Industrial Research Organisation – Land and Water.

LOWBIDGEE

Following small rainfall events early in 2010–11 more than 20 gigalitres of Commonwealth environmental water was delivered to wetlands in the Lowbidgee floodplain, including at Yanga National Park and Murrumbidgee Valley Nature Reserve. This action was aimed at extending inundation to improve wetland vegetation health including river red gum, black box and lignum communities. The action was followed by significant inflows from summer rainfall.

Monitoring of major waterbird colonies in the North Redbank system was undertaken in December 2010, February and March 2011 by New South Wales Office of Environment and Heritage and Charles Sturt University. Large egret and cormorant colonies in Tarwille and Steam Engine Swamp were still active in February 2011 and additional waterbird colonies were located at Two Bridges Swamp, in Yanga National Park, and in Nap Nap Swamp in the Nimmie–Caira system (Thomas et al. 2011).

The Lowbidgee Floodplain is home to the most significant population of the nationally vulnerable southern bell frog in New South Wales; however, due to a lack of water across the Floodplain in recent dry years the population has declined to very low numbers.

We now have these vulnerable frogs breeding in numerous wetlands in the Lowbidgee, and just recently researchers have re-discovered them in the mid-Murrumbidgee wetlands.

The recent flooding has provided the frogs with the opportunity to move away from drought refuge habitats and return to historic and preferred habitat areas which have been dry for many years.

Successful breeding and the survival of young frogs is necessary for the population to recover and this is dependent on having wetland habitat.

James Maguire (New South Wales Office of Environment and Heritage) taken from Water for the Environment News, June 2011.

MURRUMBIDGEE RIVER FLOWS – FEBRUARY TO MARCH 2011

As floodwater from the December 2010 flows receded and drained off the floodplain, the water quality in the Murrumbidgee River deteriorated. The blackwater generated had very low dissolved oxygen levels, which affects the ability of fish to inhabit these systems. Between late February and March 2011 approximately 58 gigalitres of Commonwealth environmental water was delivered to promote low-lying floodplain to river connectivity, support medium flow river and floodplain functional process and improve water quality, particularly for fish, in the Murrumbidgee River downstream of Maude Weir. Some of the benefits of using Commonwealth environmental water in this way are outlined on page 20.

MURRUMBIDGEE RIVER FLOWS – JUNE 2011

The mid-Murrumbidgee wetlands provide vital habitat and refuges for many threatened and migratory species of waterbird, frogs and other wildlife, including the nationally listed threatened southern bell frog.

Modelled natural flows show that there is a strong seasonal redistribution of flows in the Murrumbidgee River resulting from river regulation. As evidenced in figure 5, autumn and early winter is a period when river flows have been severely affected by development as rain and inflows are captured in dams.

At Gundagai, summer and autumn flows have been increased by river regulation and flows during winter and spring have been reduced (Frazier et al. 2003; Frazier and Page 2006; Murray 2008). The regulation of flows has also affected the frequency and duration of inundation of the mid-Murrumbidgee wetlands. For wetlands between Gundagai and Hay, with river connections higher than the level of regulated flows, there has been a halving of the average frequency of inundation (Frazier et al. 2003).

The overall response of frogs and aquatic vegetation to the flooding in summer 2010–11 from rainfall in the mid-Murrumbidgee wetlands was poor compared to areas that had been subject to a more frequently managed inundation (Wassens and Amos 2011). Scientists monitoring wetland conditions throughout the year recommended follow-up flooding to ensure the recovery of

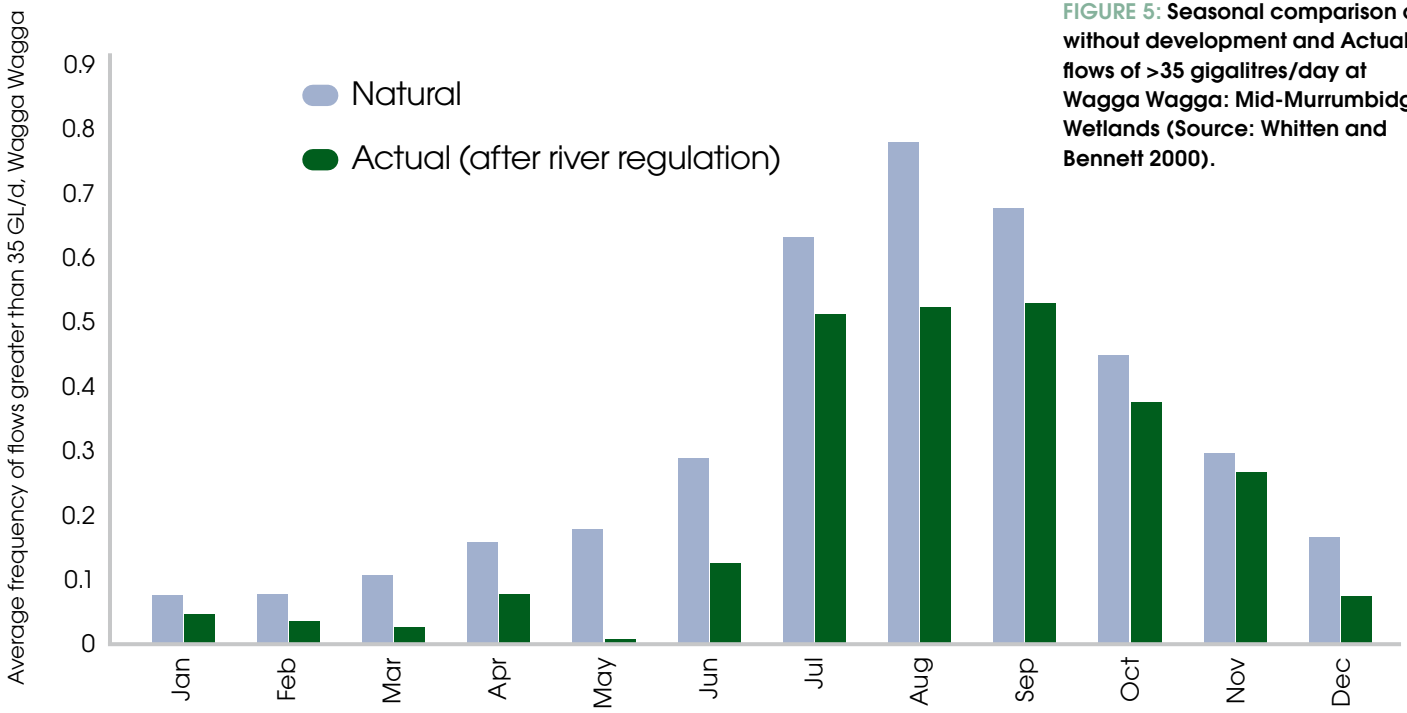
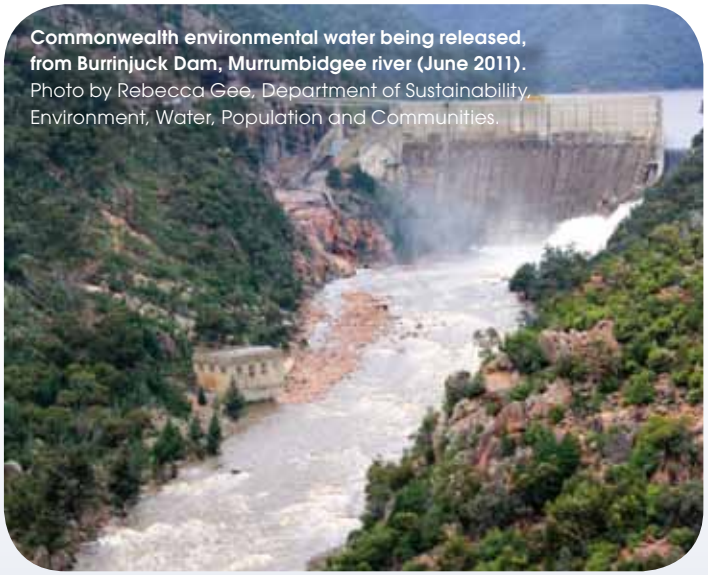


FIGURE 5: **Seasonal comparison of without development and Actual flows of >35 gigalitres/day at Wagga Wagga: Mid-Murrumbidgee Wetlands (Source: Whitten and Bennett 2000).**

aquatic plant communities (Wassens and Amos 2011). The June 2011 watering action sought to address this by providing a follow-up wetting that would enable water to persist in the wetlands over winter and through to spring.

In June 2011 nearly 110 gigalitres of Commonwealth environmental water was delivered to a watering action managed by New South Wales Office of Water, the New South Wales Office of Environment and Heritage and State Water Corporation, which totalled 161 gigalitres (including 23 gigalitres from The Living Murray program, 21 gigalitres from the New South Wales Environmental water allowance and 8 gigalitres from private donations) targeting the mid-Murrumbidgee wetlands.

It is estimated that approximately 120 gigalitres of water from the June 2011 watering event reached the South Australian border, extending the benefits of the flows into the Murray system as far downstream as South Australia's Lower Lakes and Coorong.



Commonwealth environmental water being released, from Burrinjuck Dam, Murrumbidgee river (June 2011). Photo by Rebecca Gee, Department of Sustainability, Environment, Water, Population and Communities.

MURRUMBIDGEE MONITORING

Aquatic vegetation, water quality, frogs, fish, and waterbirds were monitored in the mid-Murrumbidgee wetlands on three occasions between June (pre-flood) to August (post flood) by Charles Sturt University. The response to date has been as expected, with a stronger ecological response likely to be detected following further monitoring into summer.

Early results from the watering action reported by Charles Sturt University include:

- **Water quality** was assessed as good at all of the inundated wetlands with no evidence of low dissolved oxygen (blackwater) or high salinity at any of the wetlands.
- **Vegetation** cover remains low but there is evidence of germination by an increasing number of aquatic and semi-aquatic species which suggests that at least some species are beginning to recover following drought.
- **Waterbirds** were abundant with 26 species recorded. Dabbling ducks and fish-eating waterbirds such as little pied and little black cormorants were dominant.
- **Fish** communities were surveyed at seven wetlands in August. In contrast to earlier studies two native fish, carp gudgeon and Australian smelt, dominated fish communities and the native juvenile carp gudgeon were observed at a number of wetlands.
- **Frog species**, particularly the winter and early spring active frog species, including spotted marsh frog and plains froglet, have commenced breeding and egg masses were observed.
- **Water rats** were recorded at two of the wetlands that received environmental flows; this is the first time that this native species has been recorded in the mid-Murrumbidgee wetlands between Narrandera and Hay.

BIOFILMS

Biofilms are a group of algae, fungi and microorganisms that cover rocks, wood and sediments in aquatic systems. Biofilms are fundamental part of nutrient and biogeochemical processes and are a major food resource for higher order organisms including crustaceans, insects and some fish (Wassens et al. 2011). Often they are the first organisms to respond to and recover from stress. Information about biofilms can therefore help determine the response of the system to environmental water.

- **Biofilm response** to the environmental flow showed a short-term benefit to in channel communities, immediately following the watering event.

The first report by Charles Sturt University on this action has been made available on our website. A second report monitoring the response through summer will be available in the autumn of 2012.

A time-lapse webcam was also installed at Sunshower Lagoon, near Darlington Point, to help monitor ecological responses of this lagoon to the flows: www.environment.gov.au/ewater/gallery/webcam-sunshower.html

Images from the Sunshower Lagoon webcam showing use of Commonwealth environmental water over period of seven days commencing 18 June 2011.

USING COMMONWEALTH ENVIRONMENTAL WATER TO IMPROVE WATER QUALITY AND PROVIDE FISH HABITAT

Blackwater events occur naturally as a result of rapid breakdown of leaf litter from the forest floor causing water discolouration. The breakdown of leaf litter plays an important ecological role as it provides nutrients back into the river system thereby promoting the growth of many aquatic organisms (figure 6). However, at times, including after large floods, this process can be too vigorous resulting in very low dissolved oxygen levels that can have a detrimental impact on fish.

The unprecedented flows in spring and summer 2010–11 resulted in blackwater with low dissolved oxygen in many locations across the Murray and Murrumbidgee catchments. The severity and extent of the blackwater events were a result of these widespread floods washing a large accumulation of organic material (built up from years of drought) into the rivers. The low dissolved oxygen levels were also exacerbated by higher temperatures as the flooding continued into summer (Whitworth et al. 2011).

Measures to mitigate the blackwater event were taken where possible, but in many cases large volumes of additional water could not be used to dilute the blackwater event as most rivers were operating at full capacity or overbank.

Nevertheless, Commonwealth environmental water was used to reduce some of the short-term effects of blackwater and improve fish habitat. In February and March 2011, 58 gigalitres was delivered to the Murrumbidgee River so as to provide suitable habitat for water-dependent species downstream of Maude Weir.

In the Edward–Wakool system, Commonwealth environmental water was delivered in Wakool River during January to February 2011 to ameliorate the effects of a severe blackwater event. Water was delivered to the river through irrigation channels, providing refuge habitat for fish, including the nationally listed threatened Murray cod.

> *The Pastoral Times* (Deniliquin, Tuesday 5 July 2011) reported:
>
> *When blackwater was a problem earlier this year they [the Murray Catchment Authority using Commonwealth environmental water] shot extra flows down the Syphon and saved the lives of countless fish around Deniliquin.*

The Murray Catchment Management Authority and Charles Sturt University have undertaken monitoring that shows the creation of small refuges using Commonwealth environmental water (with dissolved oxygen levels above critical thresholds) improved the survival chances of fish (Watts et al. 2011).

In particular, monitoring by the Murray Catchment Management Authority and the NSW Department of Primary Industries confirmed the success of this watering action, showing that Murray cod were present in the upper Wakool River after the blackwater event. In other locations where delivery of freshwater was not possible, Murray cod were not detected.

It is important to note that Commonwealth environmental water will not always be able to be used to respond to blackwater events. Blackwater to some degree is a natural part of the ecological process and in major floods or droughts there will be a limit to what can be achieved. Environmental water can nonetheless improve water quality over the long-term and in some areas respond to particular quality problems.

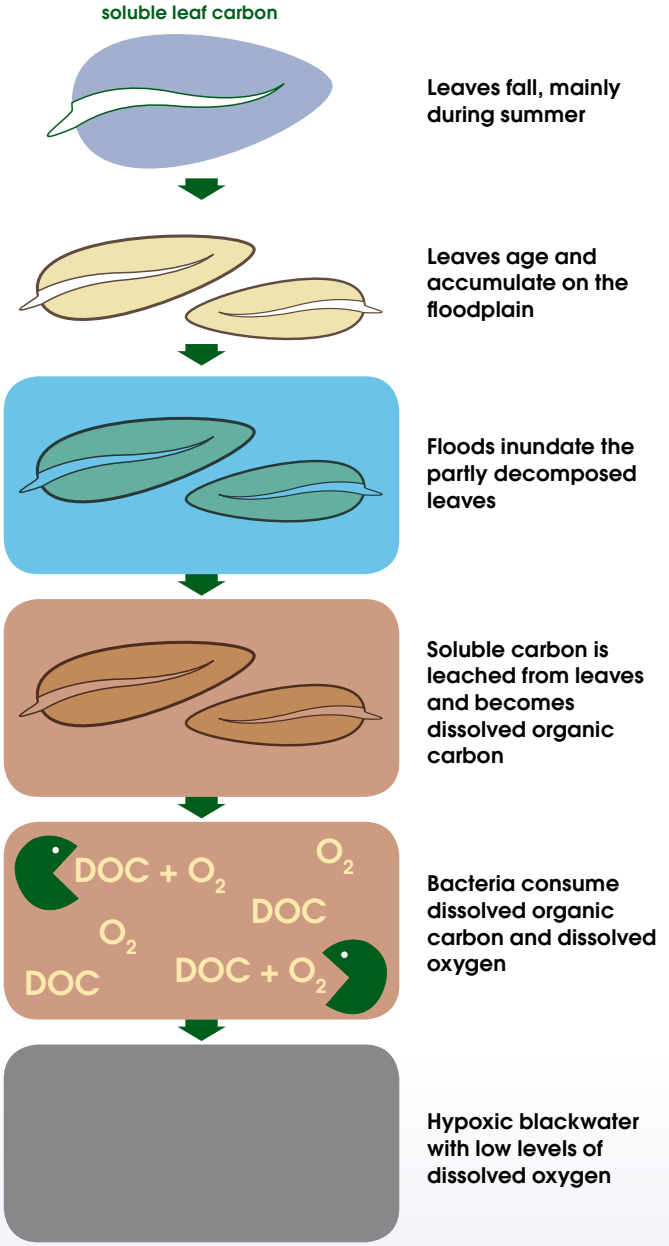


FIGURE 6: **A schematic of the development of hypoxic blackwater (modified from Whitworth et al. 2011).**

Commonwealth environmental water (brown water in foreground) creating fish refuge against blackwater (dark water near bank) in the Wakool River (February 2011).
Photo by Rebecca Gee, Department of Sustainability, Environment, Water, Population and Communities.

FISH MONITORING IN THE EDWARD–WAKOOL

Commonwealth Environmental Water is funding a fish monitoring project by scientists from the Narrandera Fisheries Centre (New South Wales Department of Primary Industries) and the Murray Catchment Management Authority.

This project seeks to provide a better understanding of how fish respond to flows and, therefore, how environmental water can be best managed in the Edward–Wakool system and elsewhere. The project has two components:

- electro-fishing, which tells us about the types and numbers of fish present
- acoustic tagging, which is used to track the movement of fish through the system.

Scientists have implanted a total of up to 140 Murray cod, golden perch, silver perch and carp with acoustic tags and monitored their movement in the Wakool River, Yallakool Creek and Edward River.

A number of studies have shown that movement is an important part of the breeding cycle for Murray cod (Humphries 2005; Lintermans 2007; Rodgers and Ralph 2011). It is thought that native fish move upstream immediately before spawning occurs to compensate for the downstream drift experienced by newly hatched fish larvae (Humphries, 2005). Other reasons for fish movement could be to find food, to avoid unfavourable conditions (such as blackwater) and colonisation of new habitats. These results are being used to help plan for environmental watering in the Edward–Wakool system in the future.

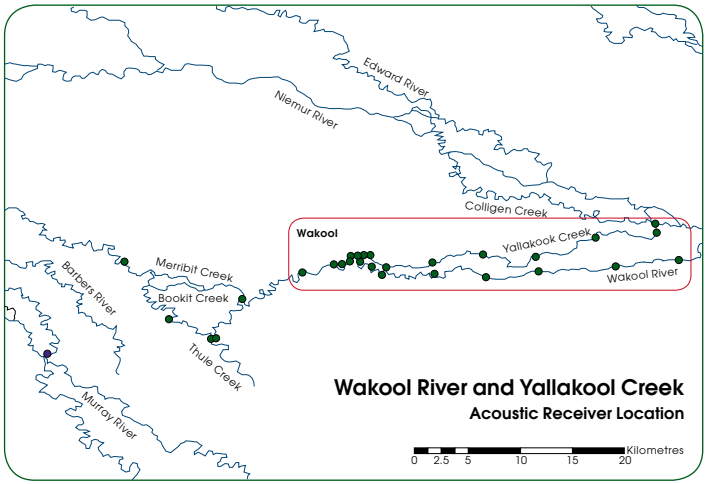
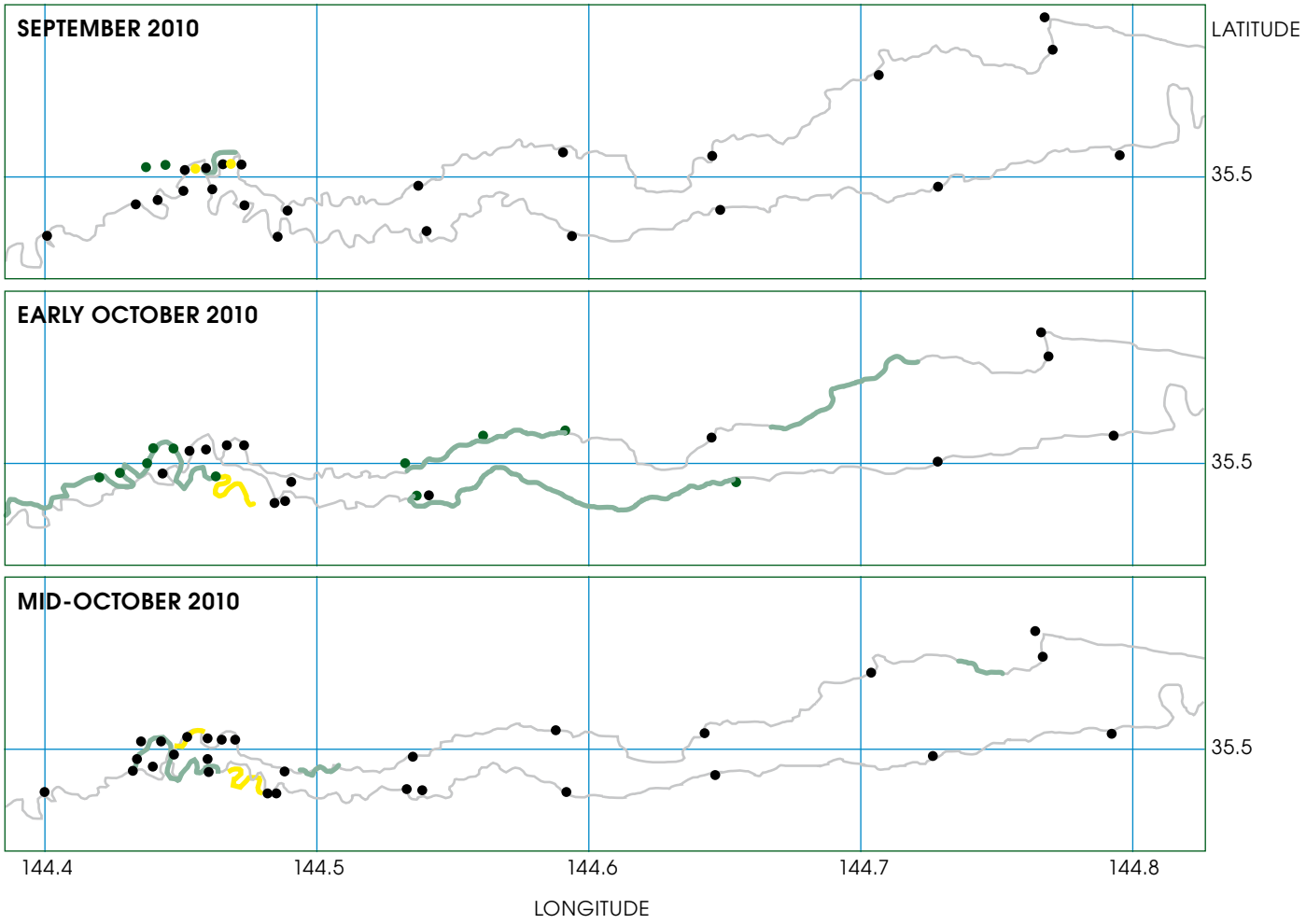


FIGURE 7 (A): **Map showing where the fish, including Murray cod, were studied in the Edward–Wakool system and the location of fish tracking receivers (the green dots).**

Fish monitoring at Possum Reserve (June 2010).
Photo by Ian Wooden, Narrandera Fisheries Centre.



The sequence of images in figure 7 (B) show fish moving in response to river flows in the Wakool system from September 2010 to October 2010.

Video footage of the sequence can be seen on the Commonwealth Environmental Water website at: www.environment.gov.au/ewater/southern/murray/fish-monitoring-project.html

FIGURE 7 (B): **The figures show the results from the acoustic fish tagging in the area of the Wakool river and Yallakool creek (area shown in Figure 7A). The black dots indicate the locations of fish tracking receivers. The longer the bold green line, the faster each individual fish is moving. The figures show that the native fish congregate in refuge pools when flows are low and steady (September 2010). When higher flows come through the system, fish move quickly up and down the river (early October 2010) before returning to the refuge pools when flows drop away (mid-October 2010). Commonwealth environmental water was used in January 2011 to provide refuge habitat for fish which reduced mortality.**

HATTAH LAKES

Hattah Lakes is a complex of 20 freshwater lakes located approximately 50 kilometres south-east of Mildura, Victoria. The site is recognised nationally under the Directory of Important Wetlands in Australia and 12 of the lakes are recognised internationally under the Convention on Wetlands of International Importance. Hattah Lakes provides important feeding, nesting and breeding habitat for waterbird species and supports river red gum forests fringing the wetlands.

Nine gigalitres of water was delivered in early 2010–11 while the area was still experiencing drought conditions. This action built on environmental watering in 2008–09 and 2009–10, during which more than nine gigalitres of water was delivered to help maintain wetland communities through the drought.

The benefits of maintaining the site through drought were demonstrated by monitoring undertaken following the return of wetter conditions.

In 2011 a total of 31 waterbird species were recorded, including: Australasian shoveler (*Anas rhynchotis*); eastern great egret (*Ardea modesta*), hardhead (*Aythya australis*); musk duck (*Biziura lobata*); nanekeen night heron (*Nycticorax caledonicus*); pied cormorant (*Phalacrocorax varius*), whiskered tern (*Chlidonias hybridus*) and white-bellied sea-eagle (*Haliaeetus leucogaster*). (Cook et al. 2011)

Five species of frogs were also recorded, including three species that recruited successfully. River red gum and black box stand condition improved, with increased foliage (Robertson 2011).

Regent parrot at Hattah Lakes during a period when Commonwealth environmental water was used (August 2010).
Photo by Dr Simon Banks, Department of Sustainability, Environment, Water, Population and Communities.

Hattah Lakes taken during a period when Commonwealth environmental water was used (August 2010).
Photo by Dr Simon Banks, Department of Sustainability, Environment, Water, Population and Communities.

Yellow rosellas at Hattah Lakes during a period when Commonwealth environmental water was used (August 2010).
Photo by Mallee Catchment Management Authority.

CARPARK LAGOONS

The Carpark Lagoons located on the Katarapko Floodplain near Berri, are a good example of where a relatively small amount of Commonwealth environmental water has been used repeatedly to achieve positive ecological outcomes. In October to November 2010, 154 megalitres of Commonwealth environmental water was provided to this area to provide habitat for threatened fish, support long-lived vegetation, and provide potential breeding habitat and conditions for frogs. This follows on from water in 2009 (0.2 gigalitres).

The South Australian Department of Environment and Natural Resources conducted monitoring surveys during 2010 to assess the ecological response of waterbirds, fish, frogs and vegetation. A total of nine species of waterbirds were recorded including water little pied cormorants, grey teal and hardhead ducks. These results indicate that there was a large amount of open water available as habitat and suitable food availability for these species. Species suited to shallow water and mud such as ibis, herons and spoonbills were recorded in lower numbers around the wetland as it dried down. Australian wood ducks and grey teal were observed with young, demonstrating the availability of suitable breeding habitat (Suitor 2011).

A total of 1,422 fish from nine species (seven native and two exotic) were observed from Carpark Lagoons including the small bodied native unspecked hardyhead (13 per cent of catch) and the large bodied golden perch which was present in small numbers in all sampling rounds and at all sites (Suitor 2011).

Four species of frogs were also identified during frog night-call surveys (these were peron's tree frog, eastern sign-bearing froglet, eastern banjo frog, spotted grass frog). Vegetation monitoring of the condition of black box and river red gum demonstrated that trees were in moderate to good health during this survey period. This demonstrates how Commonwealth environmental water is being used to maintain and improve the health of long-lived vegetation (Suitor 2011).

Overall these results indicate that the high flow events promoted a range of environmental benefits, including tree growth, waterbird breeding, lateral and longitudinal connectivity of the river, floodplain and wetland habitat and provided ideal conditions for fish movement.

Carpark Lagoons Katarapko Murray River National Park (Riverland, South Australia) before (above) and after (right) a period when Commonwealth environmental water was used (August and December 2010).
Photo by Lara Suitor, South Australian Department of Environment and Natural Resources.

LOWER LAKES AND THE COORONG

The Lower Lakes and Coorong have a diverse range of freshwater, estuarine and marine habitats. Many of the plants and animals found in this region are unique and many internationally migratory birds are also found here.

In early 2010 water levels in the Lower Lakes reached unprecedented low levels (figure 8), reflecting low inflows through the Basin during the extended drought. The impact of low water levels was significant, resulting in a ceasing of flows through the Murray Mouth, high salinity levels (figure 9) and poor water quality, particularly in Lake Albert, and high acid sulphate soil risks.

The 2010–11 flows in the River Murray were the best since 1993, delivering important environmental outcomes including the refilling of the Lower Lakes for the first time in four years. Commonwealth environmental water contributed to these flows.

Monitoring under the Murray Futures program, jointly funded by the Australian Government and South Australia, demonstrated some key outcomes for the Lower Lakes and Coorong during 2010–11:

- normal water levels for the first time in four years, which alleviated many of the acid sulphate soil risks and provided habitat for birds and other wildlife
- flows through the Murray Mouth, exporting salt and other nutrients
- improved circulation between the lakes and into the Coorong which improved water quality, including improved salinity levels in Lake Albert (figure 9)
- a higher abundance of fish in the first two weeks of the monitoring program in comparison with the combined results of the previous three years of monitoring data.

Although 2010–11 saw significant improvements in environmental conditions at the Lower Lakes and Coorong, recovery will take many years. This is reflected for example in the poor water quality that continues to affect Lake Albert (figure 9), with salinity levels many times higher than levels typically regarded as normal for freshwater environments.

The contribution of Commonwealth environmental water relative to the flows created by high rainfall during the year was small. However, environmental water will make an on-going contribution to these systems in the future including making them more resilient to future droughts.

South Lagoon, Coorong (January 2011).
Photo by Emma Wiadrowski, Department of Sustainability, Environment, Water, Population and Communities.

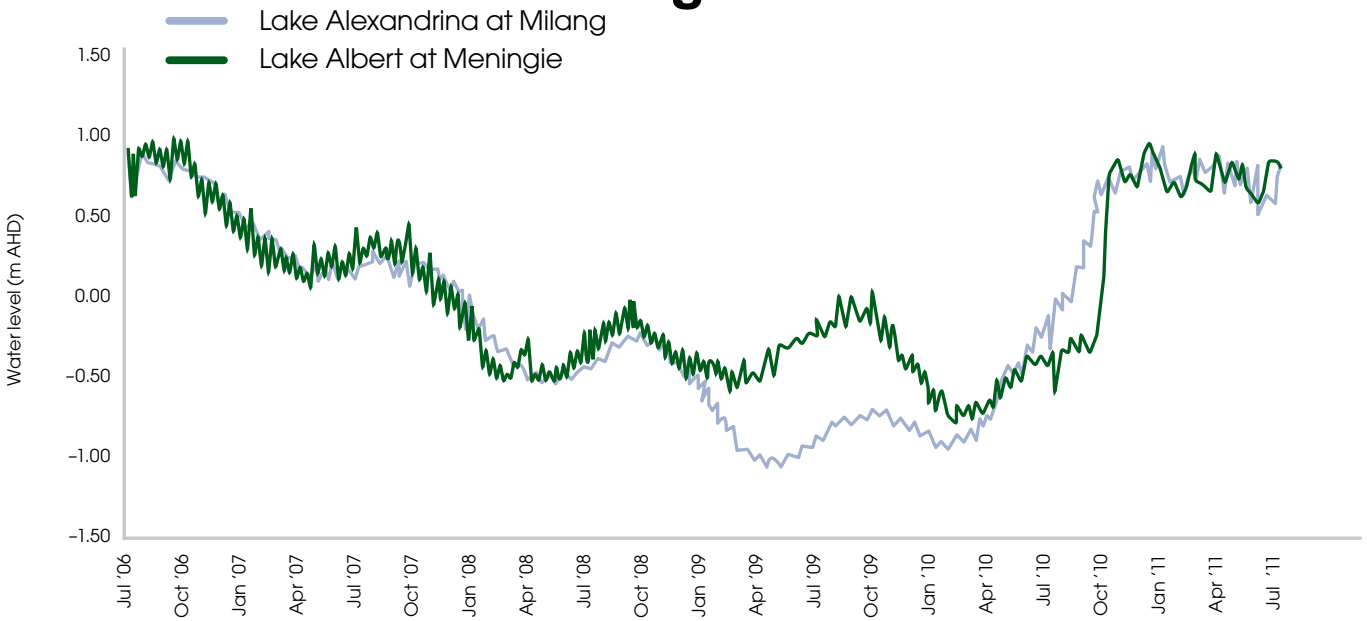


FIGURE 8: **Water levels in Lake Alexandrina and Lake Albert between July 2006 and June 2011 (Data sourced from Murray–Darling Basin Authority 2011).**

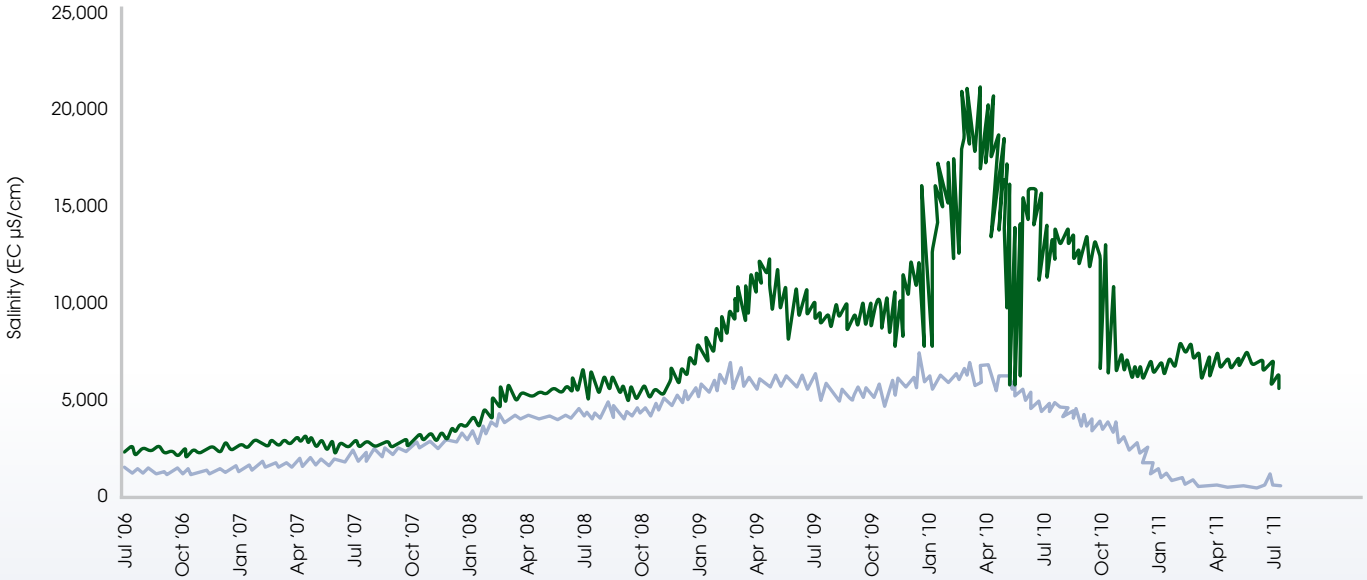
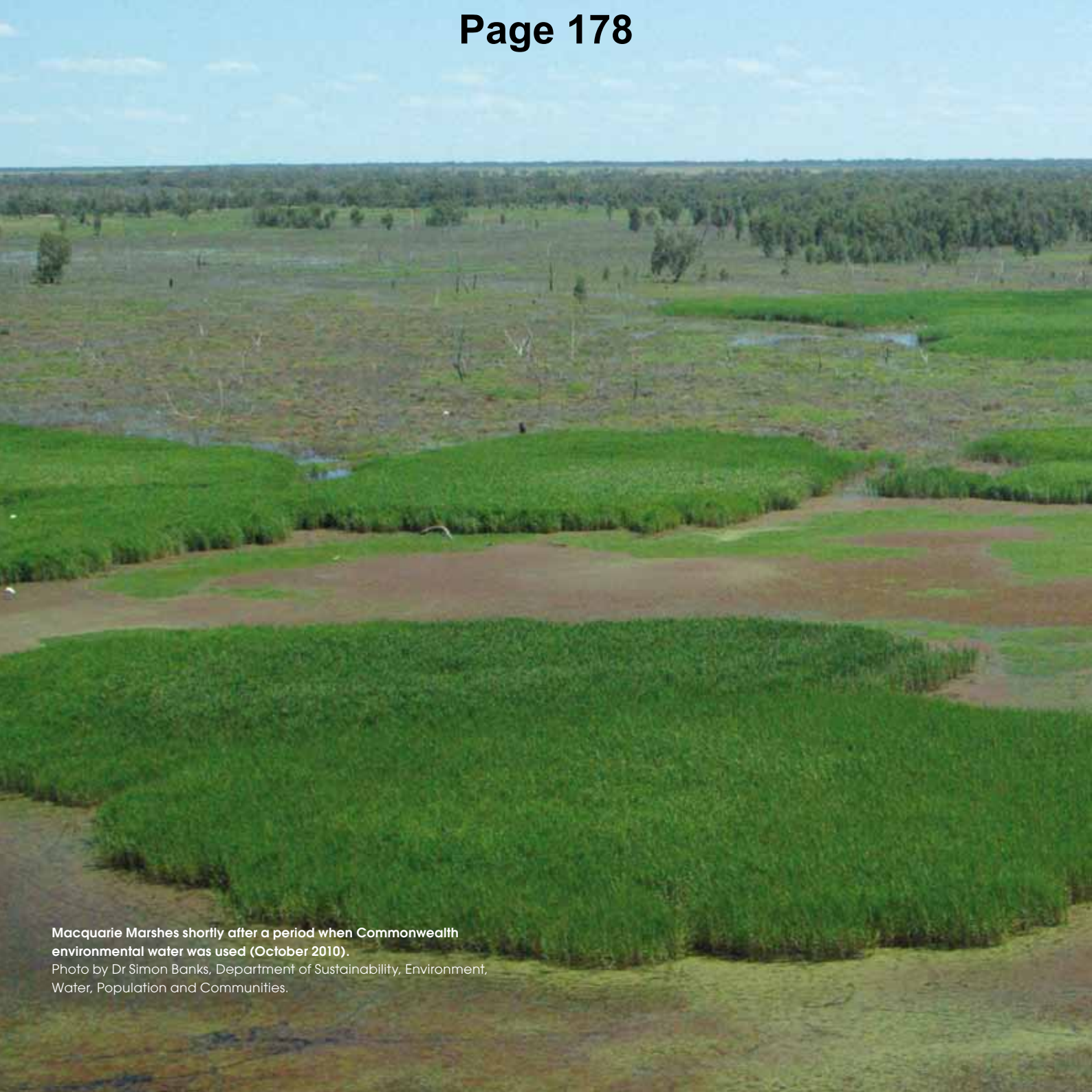
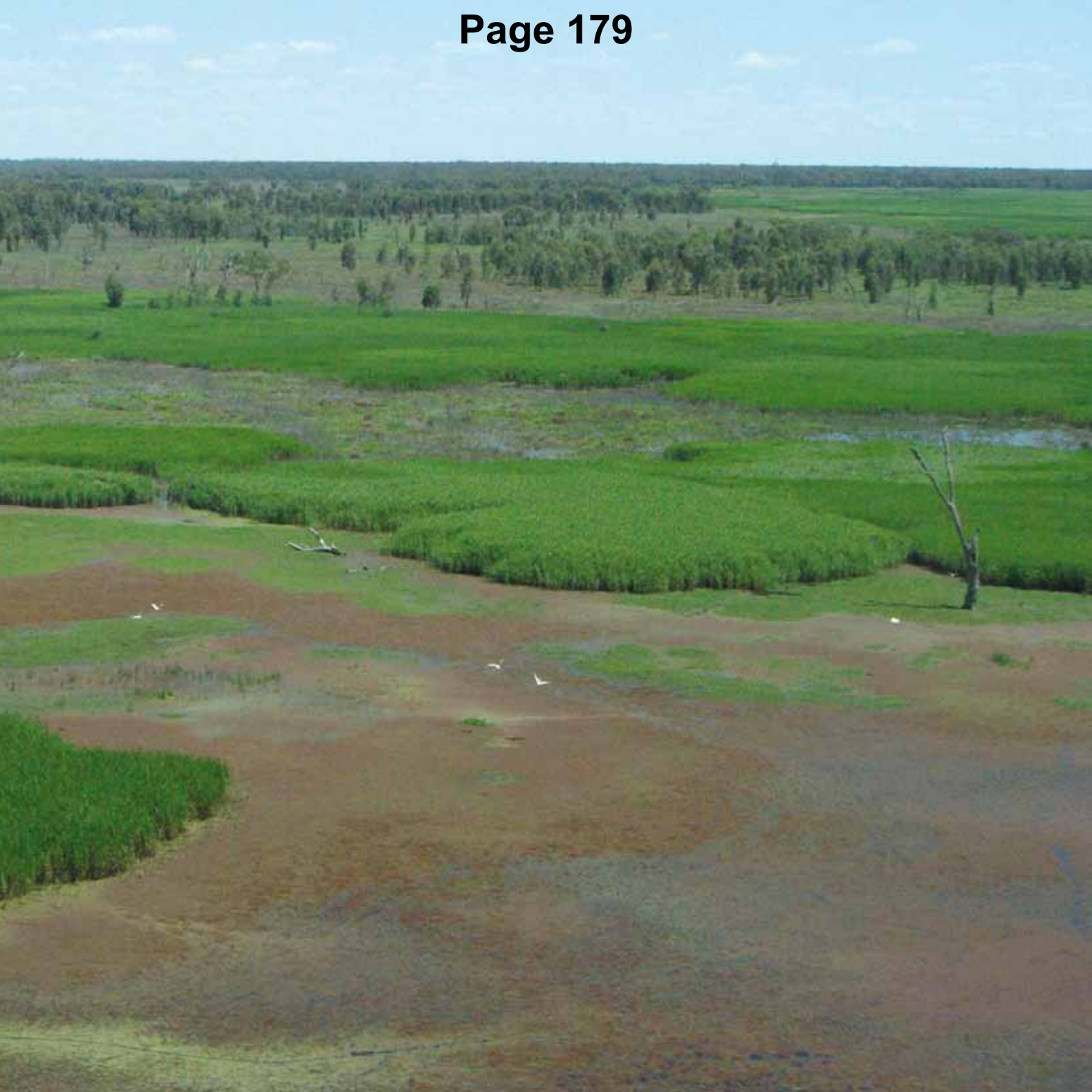


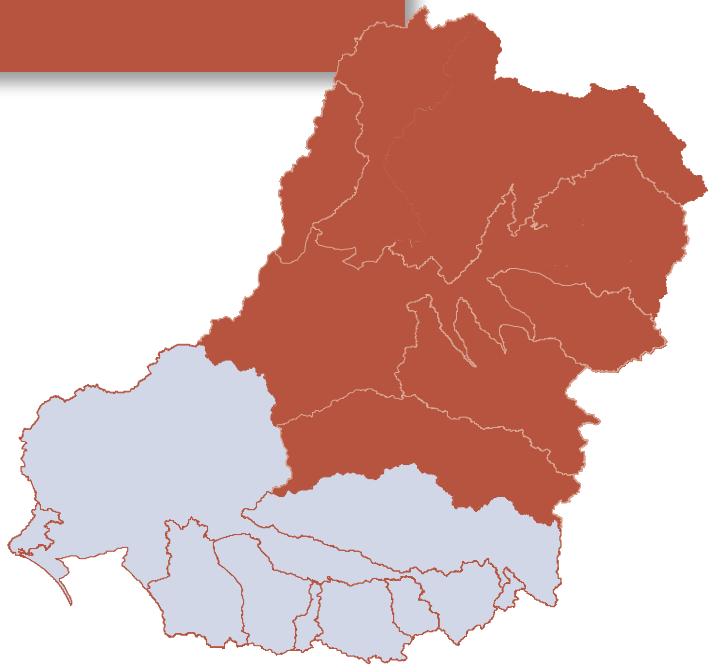
FIGURE 9: **Salinity levels in Lake Alexandrina and Lake Albert between January 2004 and November 2011 (Data sourced from Murray–Darling Basin Authority 2011).**



Macquarie Marshes shortly after a period when Commonwealth environmental water was used (October 2010).
Photo by Dr Simon Banks, Department of Sustainability, Environment, Water, Population and Communities.



NORTHERN MURRAY–DARLING BASIN



The northern Murray–Darling Basin encompasses an area of approximately 640,000 square kilometres, including southern Queensland and northern New South Wales, west of the Great Dividing Range. It includes the rivers and tributaries of the Balonne, Culgoa, Macintyre, Dumaresq, Severn, Gwydir, Namoi, Castlereagh, Lachlan, Macquarie, Bogan, Warrego and Paroo.

River flows in this region are naturally highly variable, typified by droughts and flooding rains.

The northern Basin in 2010–11 has both permanent and ephemeral wetlands including internationally listed sites such as Macquarie Marshes and Gwydir Wetlands. These wetlands are important breeding sites and provide food sources for thousands of plants and animals.

Commonwealth environmental water was used in wet conditions across the northern Basin. A number of actions were undertaken to provide in-stream benefits and improve system connectivity in the Barwon–Darling, Warrego and Moonie catchments.

Straw necked ibis eggs, Booligal Blockbank Swamp during a period when Commonwealth water was used (November 2010). Photo by Michelle Crossley, landholder – Riverside, Booligal.

MANY OF THE NORTHERN BASIN WATERING ACTIONS CONDUCTED THIS YEAR AIMED AT ENHANCING RIVER FLOWS FROM RAINFALL.

As most wetlands rely on water delivered by rivers or creeks, many of the northern Basin watering actions conducted this year aimed at enhancing river flows from rainfall.

The objectives of these watering actions included:

1. supporting the growth, reproduction and large-scale recruitment for a diverse range of flora and fauna
2. promoting higher floodplain-river connectivity
3. supporting high flow river and floodplain functional processes.

LACHLAN RIVER SYSTEM

During 2010–11 the Lachlan catchment experienced its first significant flows in more than a decade. Significant rainfall in the catchment caused large volumes of water to flow through to the Great Cumbung Swamp at the end of the system.

A total of seven gigalitres of Commonwealth environmental water was delivered to sites and provided as river flows within the Lachlan catchment during the year.

During spring and summer, Commonwealth environmental water was used to build on natural flows in Merrowie Creek to support a colonial nesting bird breeding event at Cuba Dam. At least 10,000 pairs of straw-necked ibis were recorded with high resolution digital vertical photography (*Lachlan Riverine Working Group 2011*). This water flowed through into the nationally significant Lake Tarwong, which had not held water since 2000. Lignum and a range of aquatic plants, such as milfoil, azolla and nardoo responded to the good conditions (New South Wales Office of Environment and Heritage 2011a).

The improved catchment conditions also resulted in the beeping toadlet, the spotted marsh frog and the banjo frog being recorded by New South Wales Office of Environment and Heritage staff. In addition, the Sloane's froglet (listed as vulnerable under the *New South Wales Threatened Species Conservation Act 1995*) was recorded near Tom's Lake in the Upper Merrowie Creek system (New South Wales Office of Environment and Heritage 2011a).

Commonwealth environmental water was also used in Merrimajeel Creek to support the first significant waterbird breeding event in the Booligal wetlands since 2000. Approximately 64,000 straw-necked ibis and around 1,000 glossy ibis nests were recorded (New South Wales Office of Environment and Heritage 2011a). This event resulted in approximately 120,000 young straw-necked ibis successfully fledged (New South Wales Office of Environment and Heritage 2011a; *Lachlan Riverine Working Group 2011*).

Booligal Blockbank Swamp shortly after period when Commonwealth environmental water was used (November 2010).
Photo by Paul Packard, New South Wales Department of Environment and Climate Change.

Since the flows occurred, large numbers of glossy ibis have been seen foraging in the Booligal wetlands. Royal spoonbills, white ibis and freckled ducks were also observed nesting in and around the colony. Grebes, cormorants and several other duck species, including the threatened blue billed duck, also responded to the good breeding conditions (New South Wales Office of Environment and Heritage 2011a).

To build upon improved catchment conditions, delivery of further Commonwealth environmental water into both Merrowie and Merrimajeel Creeks commenced during winter 2011 and continued into spring.

MACQUARIE MARSHES

In 2010–11 more than 900 gigalitres of water from significant rainfall reached the Macquarie Marshes. This water filled the marshes for the first time in over a decade and inundated 175,000 hectares. As a result of the water flows more than 100,000 pairs of colonial nesting waterbirds bred in 12 colonies during the year.

Twenty-five gigalitres of Commonwealth environmental water and 110 gigalitres of environmental water from the New South Wales Government was delivered in March and April 2011 to the Marshes to extend the period of inundation and support the success of colonial waterbird breeding (figure 10).

This watering action contributed to the completion of the significant waterbird breeding event and supported the continued ecological function of a wide range of vegetation communities including river red gums, fish and frogs. In effect, the water was used to make sure that the event was not abruptly concluded (figure 10).

More than 25 species of waterbird were observed breeding. The most numerous were the ibis and egrets which both completed two cycles of nesting. Thirty-five thousand straw-necked ibis nests were observed in the first cycle and double that number in the second cycle. Fifty thousand egret nests were observed in the second cycle including great, intermediate and little egrets (New South Wales Office of Environment and Heritage 2011a).

Vegetation response to watering was also positive with water couch and mixed marsh responding well to inundation. Importantly the river red gum canopy has generally shown an increase in density in large areas in the northern Marshes. There were also positive responses for frog breeding and opportunities for native fish dispersal were provided (New South Wales Office of Water 2011b).

This is a good example of coordination of different types of environmental water. Figure 10 shows how New South Wales environmental water and Commonwealth environmental water were coordinated to essentially smooth out flows to the Marshes. This has resulted in improved environmental outcomes compared to what would otherwise have been achieved.

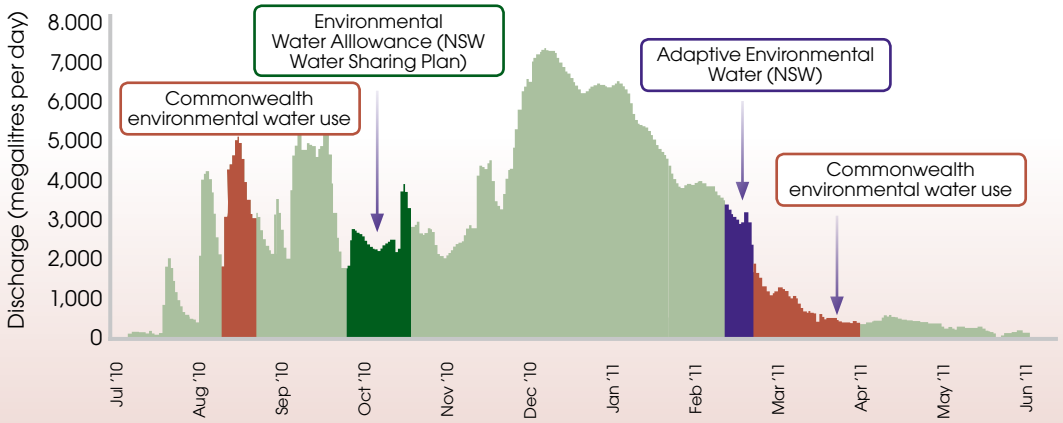


FIGURE 10: **Hydrograph showing the timing of Commonwealth environmental watering to the Macquarie Marshes during 2010–11 (Source: New South Wales Office of Environment and Heritage 2011b).**

Macquarie Marshes shortly after a period when environmental water was used (October 2010).
Photo by Dr Simon Banks, Department of Sustainability, Environment, Water, Population and Communities.

GWYDIR WETLANDS

During 2010–11 the Gwydir catchment experienced more moderate flows relative to other parts of the Basin. Even so, the Gwydir Wetlands were inundated by inflows from rainfall for the first time in over a decade. The Sustainable Rivers Audit has previously rated the overall health of the Gwydir Valley catchment as being poor (Murray–Darling Basin Authority 2008).

In spring 2010, three gigalitres of water was used to top up river flows. This watering action aimed to help boost soil moisture and vegetation growth in the area. A further 10 gigalitres was delivered from February to March 2011 which aimed to support six to eight months of continuous wetland inundation to promote the recovery of wetland vegetation and create habitat for threatened and migratory species.

In combination with natural flows, environmental water inundated 10,000 hectares of wetland vegetation, including one of the largest stands of water couch remaining in New South Wales, as well as large areas of marsh club rush and coolibah woodland, both listed ecological communities under the *New South Wales Threatened Species and Conservation Act 1995* (Department of Sustainability, Environment, Water, Population and Communities 2011).

This watering action was also designed to prime the wetlands so that when more widespread inundation does occur, it is more likely to trigger breeding of migratory waterbirds such as the glossy ibis, cattle egret and white ibis.

Monitoring conducted in October 2010 indicated coolibah woodlands, lignum and cooba stands showed evidence of recruitment in response to the environmental flows, with young seedlings and vigorous new growth recorded across the wetland system. Marsh club rush stands also increased by at least 10 per cent (New South Wales Office of Environment and Heritage 2011a).

Seventy-five waterbird species were observed in the wetlands in March 2011, including the Australasian bittern and the Australian painted snipe. Of these, six migratory species are listed under international agreements. One such bird, the Latham's snipe, migrates from as far away as Japan. Species including purple swamphens, dusky moorhens, masked lapwing, black winged stilt and many duck varieties were also observed nesting across inundated areas of the Gwydir Wetlands (New South Wales Office of Environment and Heritage 2011a).

Gingham Watercourse during a period when Commonwealth environmental water was used (August 2010).
Photo by Daryl Albertson, New South Wales Office of Environment and Heritage.

The Gwydir Wetlands shortly after a period when Commonwealth environmental water was used (October 2010).
Photo by Dr Simon Banks, Department of Sustainability, Environment, Water, Population and Communities.

WARREGO RIVER

The Warrego catchment received above average rainfall in summer 2010–11. Summer streamflow at Cunnamulla in the mid-catchment was the third highest by volume in the past 20 years.

Several Commonwealth environmental watering events through summer assisted the connection of waterholes in the upper and middle reaches and provided beneficial flows to the lower Warrego tributaries and Yantabulla Swamp.

A total of 16 gigalitres of Commonwealth environmental water was provided as in-stream flows within the Warrego catchment during the year. Since 2009 more than 32 gigalitres of Commonwealth environmental water has been used to complement natural flows in the Warrego and Nebine catchments. This water made a small but valuable contribution to the ecological benefits of flow events in these systems.

Section of the Lower Warrego River during a period when Commonwealth environmental water was used (October 2010).
Photo by Daniel Wingett, South West Natural Resource Management Ltd.

In the Upper Warrego in 2010–11 Commonwealth environmental water complemented natural flow events that occurred (figure 11), with benefits including reconnection of waterholes in the Warrego River.

In the Lower Warrego, water contributed to the first post-winter flow in October 2010, which is known to be a critical spawning cue for native fish species in this system (Balcombe et al. 2006). During March to April 2011, Commonwealth environmental water was used to contribute to a follow-up event that supported flows in lower level effluent channels in the Warrego River distributary system.

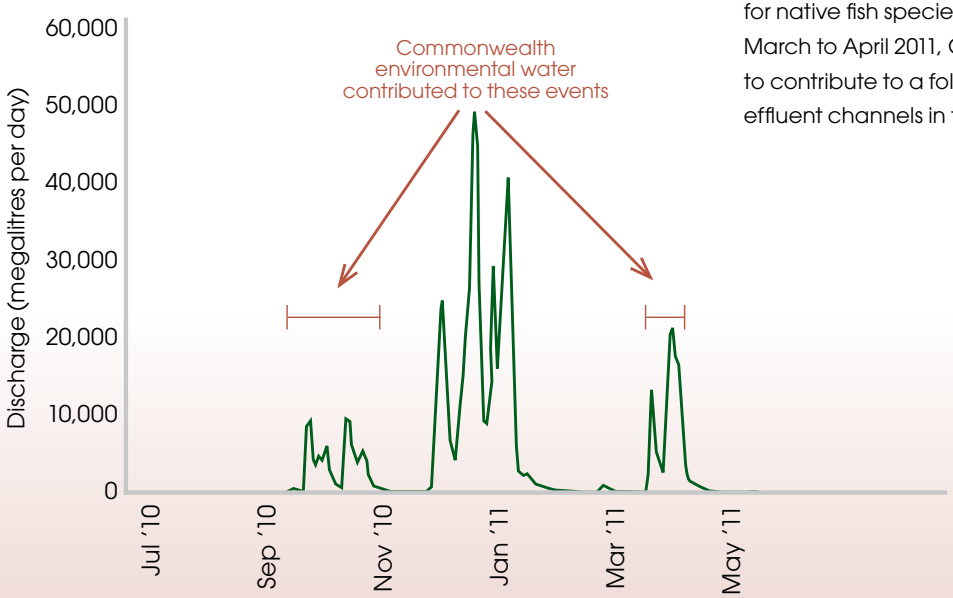


FIGURE 11: **Lower Warrego flows (at Cunnamulla) in 2010–11 and timing of the use of Commonwealth environmental water (Data sourced from Queensland Department of Environment and Resource Management 2011).**

The Lower Warrego River during a period when Commonwealth environmental water was used (October 2010).
Photo by Daniel Wingett, South West Natural Resource Management Ltd.

CASE STUDY: WATERBIRD OUTCOMES

The wetlands of the Murray–Darling Basin support threatened bird species (including the Australasian bittern and Australian painted snipe) and migratory bird species (such as the great egret, cattle egret and marsh sandpiper). Wetlands also provide important habitat and breeding sites for a number of other waterbirds. Commonwealth environmental water has contributed to outcomes for waterbirds across the Basin, including supporting the completion of colonial waterbird breeding events (figure 12).

Much of the flow in the Basin in 2010–11 resulted from extremely wet conditions, but this was supplemented with additional environmental water.

More than 100,000 hectares of the Macquarie Marshes have been inundated with water since spring 2010 and more than 100,000 nesting pairs of colonial waterbirds bred in the wetlands.

In the Booligal Wetlands approximately 120,000 young straw-necked ibis fledged after one of the biggest successful waterbird breeding events in these wetlands. Waterbirds were also breeding in the Murray, Murrumbidgee, Lowbidgee, Paroo, Narran and Gwydir wetlands including straw-necked ibis, royal spoonbills, cormorants, crested grebes, magpie geese, blue-billed ducks, Australasian bitterns, nankeen night herons, great egrets and glossy ibis.

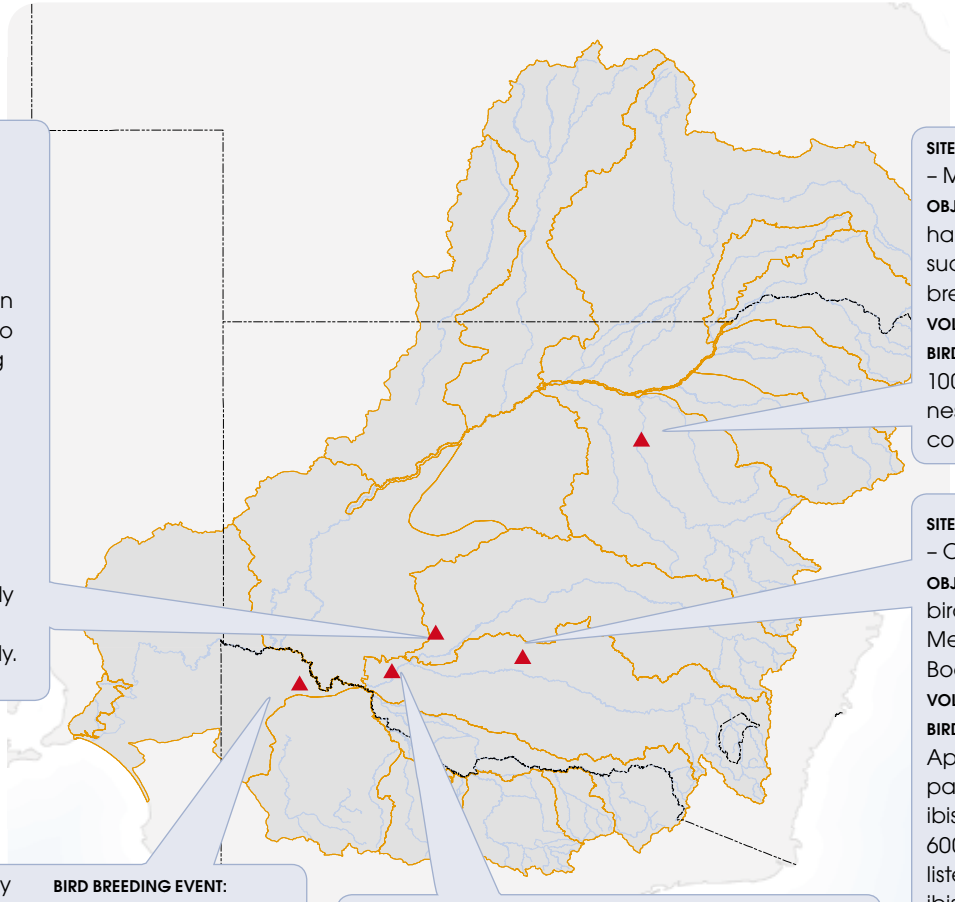
The Commonwealth is working closely with researchers, New South Wales Office of Environment and Heritage, the State Water Corporation, the New South Wales Office of Water and local landholders to manage and monitor waterbird sites.

The Director of the Australian Wetlands and River Centre at the University of New South Wales, Professor Richard Kingsford, is a scientist whose research over the last 20 years has focussed on waterbirds, wetlands and rivers in arid Australia. Professor Kingsford manages an aerial waterbird survey program that covers about a third of the continent and spans each of the southern states.

The Gwydir Wetlands during a period when Commonwealth environmental water was used (January 2011).
Photo by Jane Humphries, New South Wales Office of Environment and Heritage.

Professor Kingsford explains that increased flows at waterbirds sites benefit more than just the waterbirds (Kingsford 2011):

The waterbird community has responded spectacularly to the recent floods throughout the Murray–Darling Basin. They have been particularly affected by the lack of flows in the rivers but the floods have stimulated the entire food web resulting in top predators such as waterbirds capitalising on the food resources that come with flooding augmented by water held by Commonwealth Environmental Water.



SITE: Merrowie Creek (Tarwong Lakes) – November to December 2010.
OBJECTIVE: Support a bird breeding event on Merrowie Creek and to inundate the Tarwong Lakes.
VOLUME: 2.1 gigalitres
BIRD BREEDING EVENT: Over 10,000 nests had been established in the Merrowie Creek area. This breeding event of predominately straw-necked ibis was completed successfully.

SITE: Macquarie Marshes – March to April 2011.
OBJECTIVE: Provide suitable habitat to ensure the success of colonial bird breeding.
VOLUME: 25 gigalitres
BIRD BREEDING EVENT: Over 100,000 pairs of colonial nesting birds bred in 12 colonies.

SITE: Merrimajeel Creek – October 2010
OBJECTIVE: Support a bird breeding event on Merrimajeel Creek, in the Booligal Wetlands.
VOLUME: 1.6 gigalitres
BIRD BREEDING EVENT: Approximately 64,000 pairs of straw-necked ibis and approximately 600 pairs of the EPBC Act listed migratory glossy ibis successfully bred and fledged chicks on the Booligal Wetlands. Royal spoonbills and white ibis hatchlings, as well as nesting freckled ducks, were also observed.

SITE: Hattah Lakes – July to September 2010.
OBJECTIVE: Further inundate fringing river red gum, maximise soil profile recharge and provide drought refuge for waterbirds and other wetland-dependent species.
VOLUME: 7.3 gigalitres
BIRD BREEDING EVENT: Waterbird surveys showed 29 species and more than 3,200 waterbirds inhabited the lakes following water delivery, including the vulnerable musk and hardhead duck species, Australasian shoveler (duck) and great egret.

SITE: Lowbidgee–Yanga National Park – September 2010.
OBJECTIVE: Assist in halting the decline in health of black box and associated wetland vegetation and provide habitat for waterbird species.
VOLUME: 13.4 gigalitres
BIRD BREEDING EVENT: Water provided in winter/spring 2010 helped provide conditions for successful breeding in summer 2010–11, when 1,000 egret nests were recorded as well as over 2,500 cormorant nests.

FIGURE 12: **Key Commonwealth environmental watering actions in 2010–11 that supported bird breeding events.**

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We would like to thank the following environmental water partners as well as the numerous landholders who have contributed to the management of environmental water through ideas and suggestions as well as delivery of environmental water and monitoring of the results.

AUSTRALIAN GOVERNMENT

Murray–Darling Basin Authority

QUEENSLAND

Department of Environment and Resource Management

NEW SOUTH WALES

Border Rivers–Gwydir Catchment Management Authority

Environmental Contingency Allowance Operational Advisory Committee (Gwydir)

Department of Primary Industries (Fisheries)

Jimaringle–Cockran Creek Landholder Group

Lachlan Catchment Management Authority

Lachlan Riverine Working Group

Lower Murray–Darling Catchment Management Authority

Macquarie Environmental Flows Reference Group

Murray Catchment Management Authority

Murray–Lower Darling Environmental Water Advisory Group

Murray Irrigation Limited

Murrumbidgee Catchment Management Authority

Murrumbidgee Environmental Water Advisory Group

Namoi Catchment Management Authority

NSW Office of Environment and Heritage

NSW Office of Water

NSW State Water Corporation

VICTORIA

Coliban Water

Goulburn Broken Catchment Management Authority

Goulburn–Murray Water

Mallee Catchment Management Authority

North Central Catchment Management Authority

North East Catchment Management Authority

Victorian Department of Sustainability and Environment

Victorian Environmental Water Holder

SOUTH AUSTRALIA

SA Department for Water

SA Department of Environment and Natural Resources

SA Murray–Darling Basin Natural Resources Management Board

Lake Little Hattah during a period when Commonwealth environmental water was used (August 2010).
Photo by Alana Wilkes, Department of Sustainability, Environment, Water, Population and Communities.

REFERENCES

Balcombe, S., Arthington, A., Foster, N., Thoms, M., Wilson, G. and Bunn, S. (2006), Fish assemblages of an Australian dryland river: abundance, assemblage structure and recruitment in the Warrego River, Murray–Darling Basin, Marine and Freshwater Research, 57, pp. 619–633.

Cook, D., Jolly, K. and Osler, D. (2011). *The Living Murray Condition Monitoring*: Waterbird surveys of Lindsay, Mulcra and Wallpolla Island and the Hattah Lakes 2010/2011. Report for the Mallee Catchment Management Authority as part of a Murray–Darling Basin Authority funded project. Australian Ecosystems, Patterson Lakes, Victoria.

Department of Sustainability, Environment, Water, Population, and Communities (2011), *Wetlands Australia, National Wetlands update*, issue no. 19, Canberra, ACT.

Frazier, P. and Page, K. (2006), The effect of river regulation on floodplain wetland inundation, Murrumbidgee River, Australia, Marine and Freshwater Research, 57, pp. 133–141.

Frazier, P., Page, K., Louis, J., Briggs, S. and Robertson, A. (2003), 'Relating wetland inundation to river flow using Lansat TM data', *International Journal of Remote Sensing*, 24, pp. 3755–3770.

Goulburn Broken Catchment Management Authority media release: 'Breathing life back into our rivers', 25 October 2010. <www.gbcma.vic.gov.au/default.asp?ID=news_events&post=231&tpl=news_full> viewed 2 December 2011.

Government of South Australia, Department for Water media release: 'Flows bring exciting results for wildlife in the Lower Lakes', 4 April 2011.<www.waterforgood.sa.gov.au/wp-content/uploads/2011/04/web-ready-mr_flows-bring-exciting-results-ll.pdf > viewed 2 December 2011.

Humphries, P. (2005), 'Spawning time and early life history of Murray cod, *Maccullochella peelii* (Mitchell) in an Australian river', *Environmental Biology of Fishes*, 56, pp. 129–151.

Lachlan Riverine Working Group: *Lachlan Environmental Water Quarterly Newsletter*, March 2011, 3 pp.

Lake, P.S. (2003), 'Ecological effects of perturbation by drought in flowing waters', *Freshwater Biology*, 48, pp. 1161–1172.

Lintermans, M. (2007), *Fishes of the Murray–Darling Basin; An introductory guide*, Murray–Darling Basin Authority, Canberra ACT, 80 pp.

Murray, P.A. (2008), *Murrumbidgee wetlands resource book*, Report prepared for the Murrumbudgee Catchment Management Authority, 111 pp.

Murray–Darling Basin Authority (2008), *Sustainable Rivers Audit – Report 1: A report on the ecological health of rivers in the Murray–Darling Basin*, 2004–2007, 396 pp.

Mussared, D. (1997), *Living on Floodplains*, The Cooperative Research Centre for Freshwater Ecology, Report prepared for The Murray–Darling Basin Commission.

New South Wales Office of Water (2011), *Review of water management during the 2010 flood events in the Tumut River and Murrumbidgee River*, August 2011.

New South Wales Office of Environment and Heritage (2011a), Environmental water use in New South Wales, annual report 2010–11.

New South Wales Office of Environment and Heritage newsletter: *Water for the Environment News*, June 2011, 7 pp.

New South Wales Office of Environment and Heritage (2011b), Progress report on the Macquarie Marshes autumn 2010 environmental watering event. Unpublished report from New South Wales Office of Environment and Heritage to Commonwealth Environmental Water.

Robertson, P. (2011), *Monitoring the response of frog populations to autumn 2010 environmental watering at Lindsay–Wallpolla Islands and Hattah Lakes*. Report for the Mallee Catchment Management Authority as part of the Murray–Darling Basin Authority funded project 1603.

Rodgers, K. and Ralph, T. J. (editors) (2011), *Floodplain wetland biota in the Murray–Darling Basin: water and habitat requirements*, New South Wales Department of Environment, Climate Change and Water, 220 pp.

Suitor, L. (2011). *Ecological survey results for Carpark Lagoons* 2010–11. South Australian Department of Environment and Natural Resources.

Thomas, R., Spencer, J.A., Wassens, S., Lu, Y., Wen, L., Hunter, S., Iles, J. and Kobayashi, Y. (2011), *Environmental flow monitoring in the Lowbidgee wetlands and Macquarie Marshes in 2010–11. Testing wetland resilience: monitoring the response of iconic wetlands to reflooding following historic drought project*, Progress report for the NSW Catchment Action Program, Office of Environment and Heritage, Sydney, and Charles Sturt University, Wagga Wagga, March 2011.

Tockner, K., Pennetzdorfer, D., Reiner, N., Schiemer, F. and Ward, J. V. (1999), 'Hydrological connectivity, and the exchange of organic matter and nutrients in a dynamic river-floodplain system', Danube, Austria, *Freshwater Biology*, 41, pp. 521–535.

Wassens, S. and Amos, C. (2011), *Assessing the resilience of frog communities within river red gum forest: Final Report*. Report prepared for NSW Office of Environment and Heritage, Department of Premier and Cabinet, May 2011, Institute for Land, Water and Society, Charles Sturt University, 19 pp.

Wassens, S., Watts, R., Howitt, J., Spencer, J., Zander, A. and Hall, A. (2011), *Monitoring of ecosystem response to the delivery of environmental water in the Murrumbidgee system*, Report prepared for Department of Sustainability, Environment, Water, Population and Communities, October 2011, Institute for Land, Water and Society, Charles Sturt University, 46 pp.

Watts, R., Howitt, J., Kopf, K., Conallin, J. (2011), Dilution flows: lessons learned from the delivery of environmental water to the Edward–Wakool system via irrigation escapes, Presentation to the Department of Sustainability, Environmental, Water, Population and Communities.

Whitten, S. M. and Bennett, J. W. (2000), Farmer Perceptions of Wetlands and Wetland Management on the Murrumbidgee River between Wagga Wagga and Hay Including Mirrool Creek, University College UNSW, Canberra.

Whitworth, K., Williams, J., Lugg, A. and Baldwin, D. (2011), *A prolonged and extensive hypoxic blackwater event in the southern Murray–Darling Basin*, Final report prepared for the Murray–Darling Basin Authority by The Murray–Darling Freshwater Research Centre and NSW DPI (Fisheries), MDFRC Publication 30/2011, June, 127 pp.

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