Australian Government

MURRAY–DARLING BASIN AUTHORITY

River Murray System Annual Operating Plan

2011-12 Water Year
1 June 2011 – 31 May 2012

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

The River Murray System Annual Operating Plan for the 2011-12 water year (1 June 2011 to 31 May 2012) provides context and describes how the River Murray System (the System) may be operated under a number of assumed scenarios in the coming year.

The scenarios have been prepared by the Murray-Darling Basin Authority (MDBA or the Authority) with input from the Australian Government and the States of New South Wales, Victoria and South Australia through MDBA's Water Liaison Working Group.

The contents of this summary include:

- Chapter 2 - A brief description of the legislative framework relevant to the operation of the River Murray System;
- Chapter 3 – Key objectives and constraints in operations;
- Chapter 4 – System status at 1 June 2011 and potential water availability in 2011-12;
- Chapter 5 – Summary of river operations during the 2011-12 water year under a range of scenarios;
- Chapter 6 – Detailed river operations during 2011-12 under range of scenarios (individual structures, reaches and issues);
- Chapter 7 – A calendar of events; and
- Chapter 8 – Further information on the River Murray System

The actual conditions that occur in the 2011-12 water year will inevitably be different from these scenarios, and therefore river operations will also be different to any projection presented. Nevertheless, these scenarios should provide a useful indication of potential river operations in the 2011-12 water year. This document may be updated during the year if there is a significant change. The States will also receive updates on a regular basis through the Water Liaison Working Group to take into account what happens as the season progresses.

In the event that this plan has not been finalised prior to the start of the 2011-12 water year (1 June 2011), river operations would continue according to actions outlined in this plan and/or following past practice. In addition, this plan will also apply in the early months next water year (2012-13) until the 2012-13 River Murray System Annual Operating Plan is finalised.

2 LEGISLATIVE FRAMEWORK

MDBA co-ordinates the operation of the River Murray System to provide water to the States of New South Wales, Victoria and South Australia in accordance with the Water Act 2007 *(Cth.),* and the Murray-Darling Basin Agreement ('the Agreement') which is a schedule to the Act.

State water entitlements are determined in accordance with Part XII of the Agreement – Distribution of Waters. MDBA must attain approval of the jurisdictions for any proposed river operations that may have a material impact on State water entitlements and which are not consistent with prior practice.

There is extensive prior practice in relation to river operations. Over decades, practices and rules have been developed to manage the River Murray System, and also provide for variations in specific circumstances. Some of these are at a system or multi-storage scale, some relate to individual storages, and others relate to specific locations along the river. In many instances river operations often involve balancing competing objectives on a day-to-day basis. This is discussed further in Chapter 3.

3 SOME KEY OBJECTIVES AND CONSTRAINTS IN OPERATIONS.

3.1 Key Objectives

River operation often involves balancing competing objectives on a day-to-day basis. The following objectives need to be taken into consideration by MDBA when carrying out river operations:

Structural safety and maintenance – Operate the structures along the River Murray System in accordance with their fundamental design parameters and having the highest regard for the safety of downstream communities. The structures also require regular maintenance and at times there is a need for upgrades as the structures age, or as Occupational Health and Safety and engineering standards (e.g. the Australian National Committee on Large Dams guidelines) become more stringent through time. River operations need to ensure that the structural and operational integrity of dams, weirs and other structures is maintained. In addition, the maintenance and improvement of the flow management structures along the River Murray System is scheduled, as far as possible, to not restrict the flexibility needed for river operations required at the time.

Water orders - deliver and account for the water orders of each Southern Basin State in a timely, transparent and efficient manner.

Water security - maintain and, when the need arises, enhance, the security of supply of water to Southern Basin States.

Water trade - facilitate the transfer of water entitlements and allocations between States and between valleys.

Environmental watering - facilitate the implementation of environmental watering activities, including where practicable, overbank flows.

Other environmental outcomes - mitigate significant adverse environmental events, such as fish kills, unseasonal watering, algal blooms, river bank erosion and soil acidification, and where possible trial the implementation of the *Environmental Guidelines* that are being developed for the River Murray System.

Water quality - mitigate events that may adversely affect the quality of water available for urban, irrigation, industrial, stock and domestic, and environmental use.

Flooding - manage floods to conserve water and manage impacts on third parties.

Aboriginal cultural heritage - facilitate the protection of Aboriginal cultural heritage, in accordance with relevant cultural heritage management plans and by other means.

Navigation and recreation - maintain adequate river depth for navigation and recreational use, in accordance with the Agreement.

Connectivity with other valleys - to take account of and co-ordinate with inflows from tributaries to the River Murray, including regulated catchments such as the Snowy Mountains Scheme and the Goulburn, Murrumbidgee and the Darling Rivers.

If, on any occasion, MDBA is unable to achieve one or more of the objectives above, in whole or in part, because of a conflict between those objectives and one or more other objectives, MDBA, after consulting with the States, will aim to achieve an appropriate balance between conflicting objectives, taking into consideration the surrounding circumstances.

3.2 System constraints

Some key considerations in River Murray System operations are: the considerable variability of both inflows and usage; weir pool operations; the long travel times; and system constraints such as the Barmah Choke. Each is briefly discussed below.

Considerable variability of both inflows and usage. Operations of the River Murray System occur in the context of considerable variability:

- There is extreme variability in the weather of the Murray-Darling Basin, and the river inflows to the River Murray System are amongst the most variable in the world. Short-term rainfall forecasts have improved substantially over recent years and are used to support operational decisions. Medium term rainfall forecasts and run-off forecasts are also improving and serve as a useful guide to what might happen in the future.
- The water market has become increasingly active during recent years, and this growth is expected to continue into the future. The impacts of trade on the timing and location of water demand will become clearer with time.
- Increasingly, trade mechanisms are being used to account and deliver environmental water. An alternative approach needs to be developed in the medium to longer term.
- The amount and location of water carried-over from year to year is changing as entitlement holders adapt to new carryover policies.
- The amount of water available for environmental purposes is increasing and its timing and location of use is expected to vary greatly between years.
- There may also be short-term issues along the river, which are difficult to foresee, that can require rapid response. Some issues affecting river operations develop within weeks (e.g. blue-green algal blooms), or within days (e.g. a salinity spike, or a fish kill). Some of these issues can potentially be mitigated by river operations, particularly in years when water is relatively abundant.
- Very rarely, there are emergency river operations carried out (such as the 1996 emergency release from Hume Reservoir) that require an immediate response.

The coordination of inflows. The operation of the River Murray System occurs in coordination with:

- the Snowy Mountains Scheme (operated by Snowy Hydro Limited) – the Snowy Water Licence allows Snowy Hydro substantial flexibility over its day to day release pattern whilst fulfilling water supply targets on an annual basis;

- regulated tributaries, particularly the Goulburn Rivers in Victoria (operated by Goulburn-Murray Water) and the Murrumbidgee River and Billabong Creek in NSW (operated by NSW State Water), including the delivery of water held in inter-valley trade accounts (Valley Accounts) as a result of water being traded to the Murray;
- tributaries that are primarily unregulated, such as the Kiewa and Ovens Rivers in Victoria; and
- the Darling River in NSW, including any operations of the Menindee Lakes directed by NSW.

This coordination is important, as water released from storages within MDBA's control needs to be managed in conjunction with other regulated and unregulated inflows to the system in order to optimise outcomes.

Weir pool operations. Drawing on or raising weir pools has become a more common practice at some weirs in recent years to assist in meeting environmental or water delivery objectives. These operations may not always match the expectations of local communities that may have previously experienced constant or near constant weir pool levels. River operations may lead to changes in weir pool levels after consideration is given to balancing objectives in Section 3.1 in the context of the circumstances of the time.

Long travel times. From Hume Dam to Lake Victoria there is limited capacity for re-regulation or release of flows into the River Murray. The typical flow time between Hume Dam and Lake Victoria is 25 days, and it is therefore likely that weather conditions will change over this time period and there will be variability in river transmission losses and demand for water. This limited re-regulation capacity affects the level of control that MDBA has over the flow regime in much of the River Murray, particularly in years of average and high inflows, or during extended hot spells when the available water in the river may be less than orders for short periods of time. Once the water has been released, and there is significant rainfall along the river and hence water orders are cancelled ('a rain rejection'), subsequent out of bank flows are possible, particularly in the Barmah-Millewa Forest (discussed further in Chapter 6).

System flow constraints. At various locations in the River Murray System there are flow constraints, which may apply during periods of regulated release, which if breached, may have social and environmental impacts depending on timing. Some of these constraints include:

- Mitta Mitta downstream of Dartmouth: approx 10,000 ML/day at Tallandoon
- Hume to Yarrawonga: 25,000 ML/day at Doctors Point
- Release from Yarrawonga Weir (due to "Barmah Choke"): approx 10,400 ML/day (*not applicable when watering the Barmah-Millewa Forest*)
- Inlet to Lake Victoria: up to 10,000 ML/day depending on level in Lake Victoria
- Outlet from Lake Victoria: up to 10,000 ML/day
- Edward River downstream of Stevens Weir: 2,700 ML/day
- Darling River downstream of Menindee Lakes: 9,000 ML/day
- Outlet to Darling from Lake Menindee: up to 4,000 ML/day depending on level in Lake Menindee

4 POTENTIAL WATER AVAILABILITY IN 2011-12

4.1 System status on 1 June 2011

In 2010-11, a large area of the Murray-Darling Basin received its highest rainfall on record and most of the Basin experienced very much above average rainfall (FIGURE 1). This has dramatically reversed the extreme dry conditions of recent years, with floods occurring multiple times along parts of the Murray, Barwon-Darling, Condamine, Murrumbidgee, Goulburn, Ovens, Campaspe, Loddon and many other rivers in the Basin.

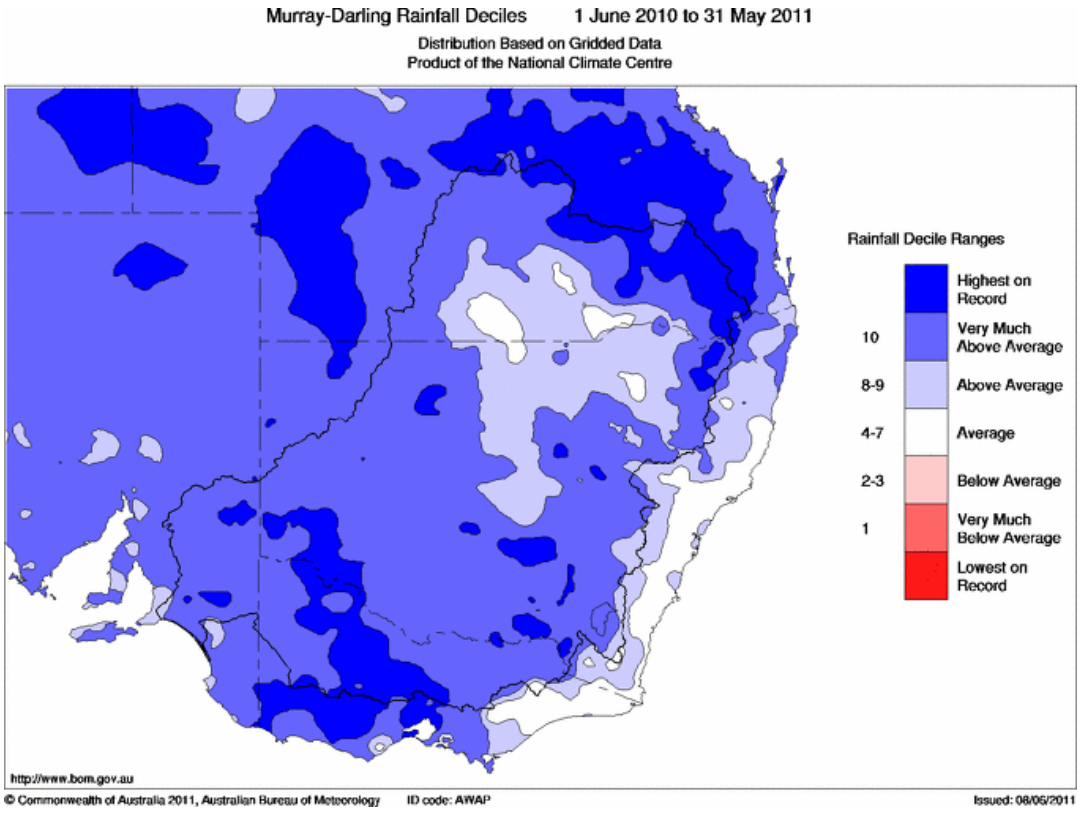

FIGURE 1 Rainfall Deciles – 12 months 1 June 2010 to 31 May 2011

Inflows to the River Murray system, and to Menindee Lakes, during 2010-11 were 23,000 GL, which is within the highest 9% of records (FIGURE 2). In the south of the Basin, River Murray System inflows (excluding Snowy releases and Menindee inflows) totalled 17,130 GL during the year, which has an Annual Exceedance Probability (AEP) of 8% (i.e. the % of years with a greater inflow), compared with the long-term average of 9,230 GL (FIGURE 3). Total inflows to Menindee Lakes were about 5,870 GL, which has a AEP of 9% and is nearly three times higher than the long-term average of 2,000 GL (FIGURE 4).

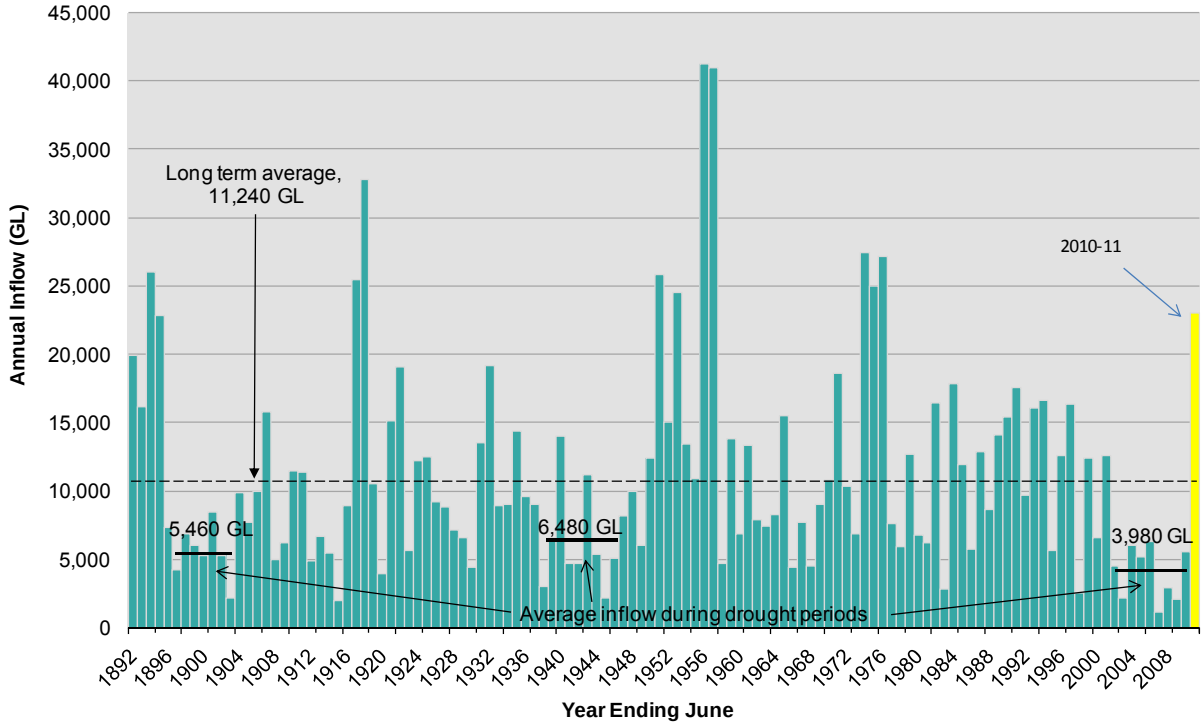

FIGURE 2 **All inflows to River Murray (including inflows to Menindee but excluding Snowy Mountains Scheme) since 1892 assuming modelled current conditions.**

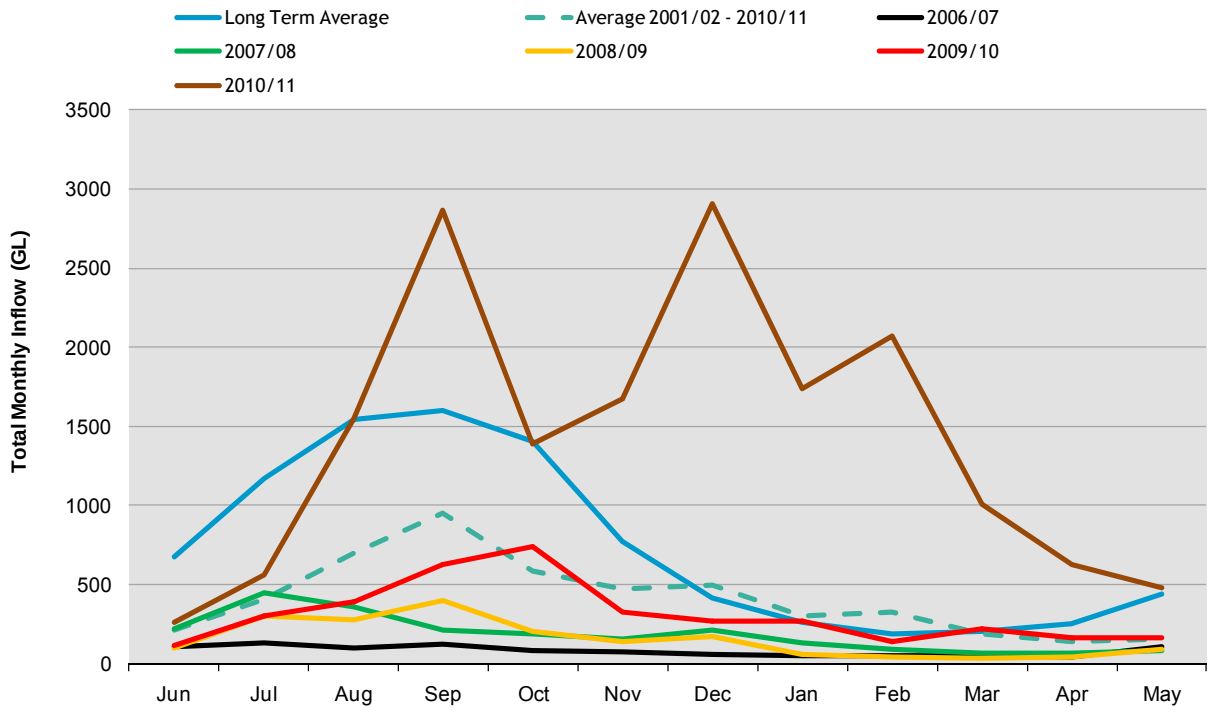

FIGURE 3 **River Murray System inflows (excluding inflows to Menindee and Snowy Mountains Scheme) - recent years and long-term averages**

Although the total inflow in 2010-11 was within the range experienced over the past 118 years, the inflow pattern was very unusual. Inflows in winter/spring (up to end November) were modest with an AEP of about 35%, however the inflow over summer (December 2010 to February 2011) was about 6,700 GL, which was more than double the previous summer record inflow of 2,930 GL during the summer of 1992-93. Although there was below-average rainfall in the south of the Basin for the period from March to June, the catchment remains primed increasing the possibility of high inflows in the coming winter and spring.

In the north of the Basin, there were also multiple flood events in the catchments of the Darling River. As a consequence, the Menindee Lakes commenced pre-release/flood operation on 6 December 2010 and, at the end of May 2011, were surcharged and held 1,930 GL (112% capacity). The floods have provided much needed water to floodplains along the Lower Darling and Great Darling Anabranch as well as the River Murray in South Australia. During flood operations, day to day management of Menindee Lakes is coordinated by the NSW Government.

System reserves have improved significantly in the last 12 months

(

FIGURE 5). The total MDBA active storage on 31 May 2011 was 7,560 GL (TABLE 1, which is above the long-term average. On 31 May 2011, there was also about 300 GL of water available to the Murray held in storages in the Murrumbidgee and Goulburn Valleys as a result of earlier net trade out of those valleys and into the Murray.

Total storage in the Snowy Mountains reservoirs (which are managed by Snowy Hydro) remains relatively low, with Lake Eucumbene storage being 1,212 GL (34% capacity).

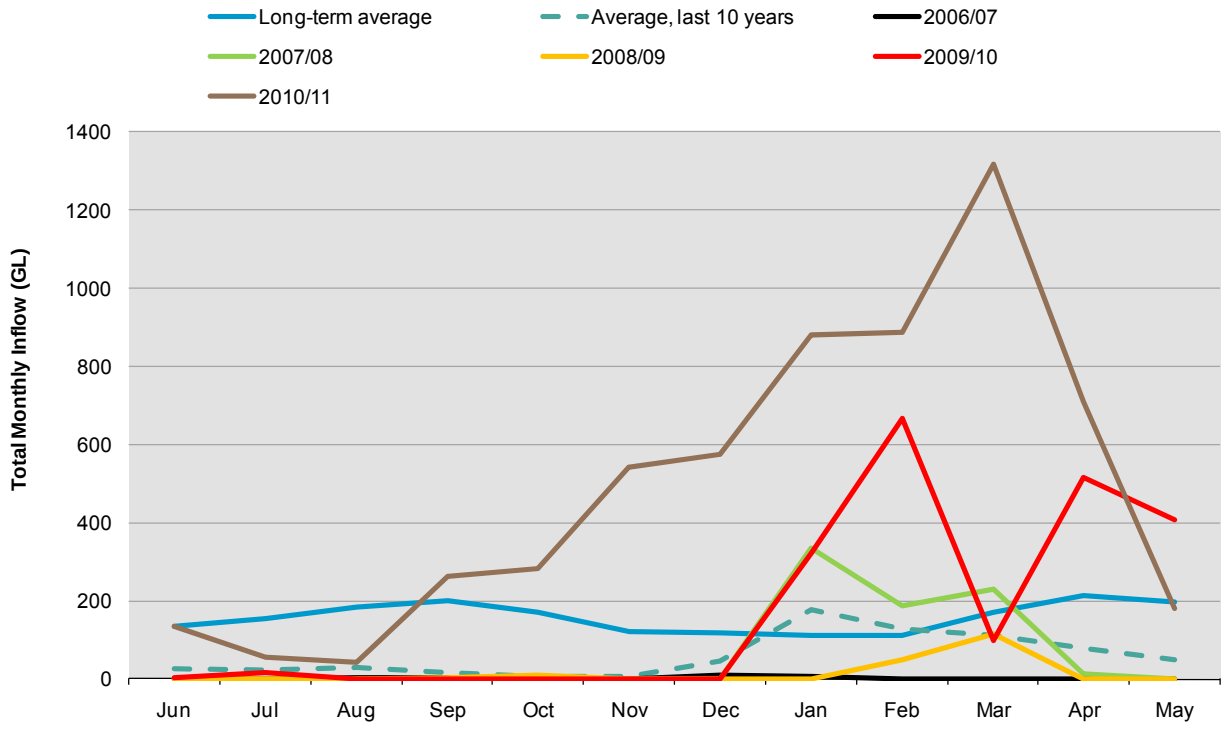

FIGURE 4 **Inflows to Menindee Lakes in recent years and long-term averages**

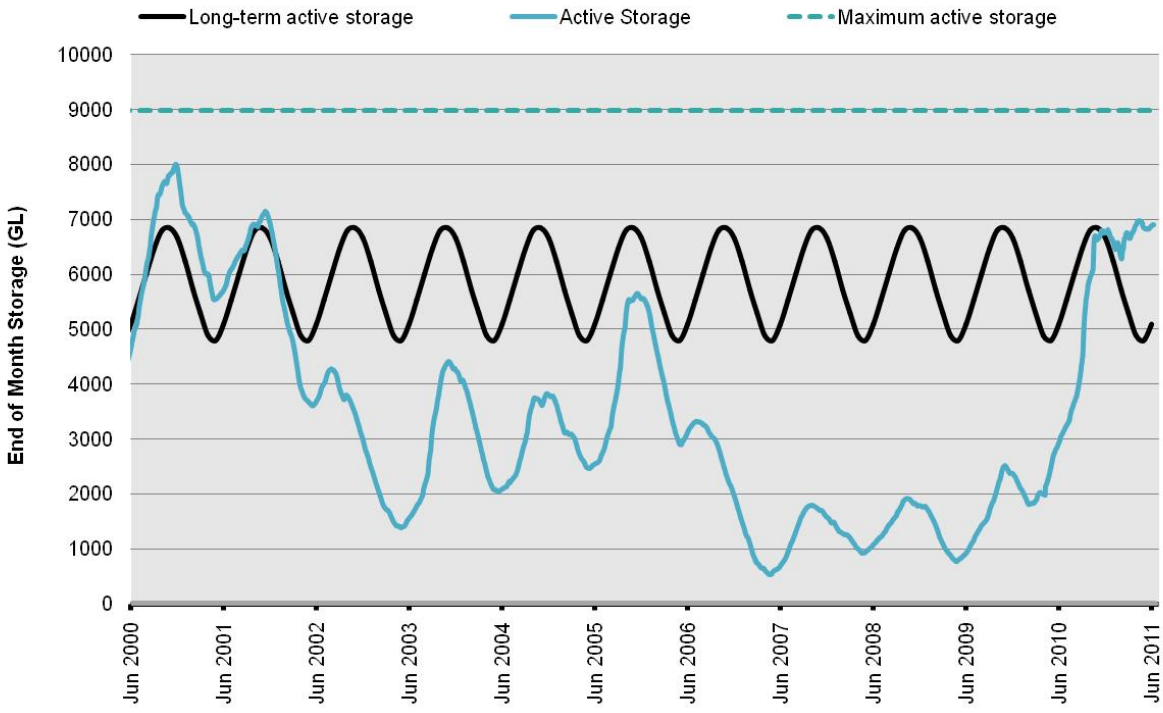

FIGURE 5 **MDBA active storage June 1996 to May 2011**

TABLE 1 Storage in MDBA major reservoirs on 31 May 2011

Major storage	Total capacity (GL)	Active capacity (GL)	Total water in storage (GL)	Percentage of total capacity	Active water in storage (GL)
Dartmouth Reservoir	3,856	3,785	2,445	63%	2,374
Hume Reservoir	3,005	2,975	2,810	93%	2,780
Lake Victoria	677	577	375	55%	275
Menindee Lakes	1,731*	1,251	1,930	112%	1,450
River Murray System Total	**9,269**	**8,588**	**7,560**	**82%**	**6,879**

* Menindee Lakes may be surcharged to a maximum of 2,050 GL under certain circumstances.

One of the major aims of River Murray operations is to keep as much water as possible in Dartmouth Reservoir where evaporation losses are minimised. As a result, storage in Dartmouth Reservoir increased over the 2010-11 year from 32% to 63% capacity.

The high inflows from downstream tributaries and rainfall across the irrigation areas has meant that releases from Hume Reservoir, to meet downstream diversion requirements, have been relatively low. This, coupled with high inflows over the year, resulted in Hume Reservoir spilling in October, November and December of 2010 and then again in February 2011. Since early March 2011, MDBA has been following pre-release procedures that have been in place since the 1990's, which towards the end of 2011-12 indicated that it was appropriate to target about 200 GL of airspace in Hume Reservoir.

Lake Victoria, at the end of May 2011 held 375 GL (55% capacity) and Menindee Lakes held 1,930 GL (112% capacity), which included 200 GL of surcharge.

4.2 Hydrological assumptions for the 2011-12 water year

The overall water availability for the River Murray System is determined by MDBA at the start of each water year (1 June) and then at least monthly during the year. Throughout the year, the overall water availability is calculated using data and models and assumptions agreed to by each of the jurisdictions. In recent years, as part of drought management, water availability assessments have been prepared twice monthly, even when improvements have been relatively small.

Each determination of annual water availability needs to take into account the available water that is in storage at the time, water in transit, the amount of water used in that water year so far, estimates of future inflows (both regulated and unregulated) and the losses that may be experienced in delivering water along the length of the River Murray System for the remainder of the year.

River Murray System scenarios for 2011-12

Since the inflows to the River Murray System cannot be known in advance, this plan addresses the operations that may be undertaken under six different scenarios that cover, in broad terms, the likely range of conditions that may be experienced during this year.

Each scenario has in-built assumptions regarding inflows from the Snowy scheme, unregulated inflows into Hume Reservoir, inflows into Dartmouth Reservoir and inflows from the tributaries, including the Kiewa, Ovens, Goulburn, Murrumbidgee, and Darling Rivers, conveyance (river losses), storage losses and usage patterns.

Generally, it is only the volume of water available under the 'worst case scenario' (and updates thereof) that is progressively allocated by the States to their water users. The other scenarios are used to provide indicative quantities of water availability to the States to assist yearly planning for water managers and customers should those wetter scenarios eventuate. The assumptions in each scenario could change in future years as data and models are updated.

The scenarios in this plan are based in information available at 15 June 2011. The scenarios include the impacts of rain up to this date and allow for a recession of inflows into late June 2011. The relative difference between inflows of each of the six scenarios can be compared in

FIGURE 6. The details of the six scenarios are provided in TABLE 2 and they are labelled according to the assumed River Murray System inflow as follows:

- the 'worst case scenario', assumes about 1,300 GL of River Murray System inflows, which is 650 GL more than the normal 'worst case scenario' adopted in recent years of 650 GL. The assumed inflows are greater due to forecast high inflows for the remainder of June 2011 and water in transit along the Murrumbidgee River that is expected to reach the Murray during July 2011;
- the 'dry' scenario, assumes River Murray System Inflows of about 2,900 GL, which is comparable to inflows in 2009-10;
- the 'moderate' scenario, assumes River Murray System Inflows of about 4,200 GL which is comparable to inflows in 2001-02;
- the 'near average' scenario, assumes River Murray System Inflows of about 6,300 GL which is comparable to inflows in 2005-06; and
- the 'wet' scenario, assumes River Murray System Inflows of about 11,200 GL which is slightly higher than in 2000-01; and
- the 'very wet' scenario, assumes River Murray System Inflows of about 18,100 GL which is slightly higher than in 2010-11.

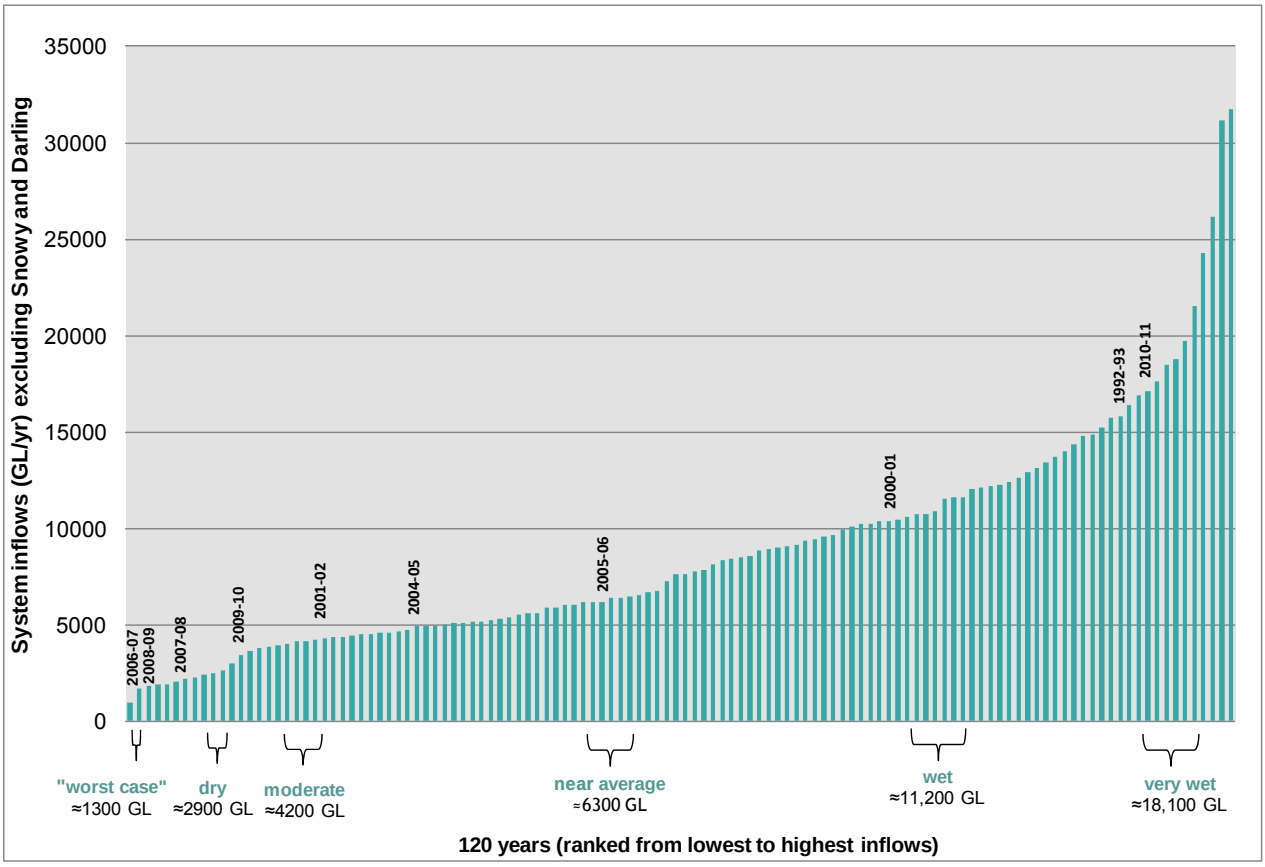

FIGURE 6 **Ranked historical system inflows showing years similar to each scenario**

TABLE 2 Detail of assumptions in each scenario for 2011-12 (all volumes in GL)

	worst case	dry	moderate	near average	wet	very wet
Inputs between June 2011 to May 2012						
Active MDBA storage on 1 June 2011	6887	6887	6887	6887	6887	6887
Storage in Valley Accounts on 1 June 2011	250	250	250	250	250	250
Change in water in transit on 1 June 2011	270	266	280	283	173	18
Inflows from Upstream of Albury (including SMS)	557	1910	2970	4060	6070	8425
Inflows from Upstream of Menindee	96	96	180	790	2790	6503
Inflows from Victorian tributaries	505	1080	1522	2240	4250	7337
Inflows from NSW tributaries	402	580	580	936	1800	3245
Commitments between June 2011 May 2012						
Conveyance losses upstream of SA Border	-800	-800	-1040	-1310	-1650	-2000
Conveyance losses along lower Darling River	-220	-200	-120	-120	-380	-1040
Conveyance Reserve for 2012-13	-225	-225	-225	-225	-225	-225
Storage losses upstream of the SA Border	-615	-660	-810	-926	-965	-980
Supply of South Australian Dilution and Loss Entitlement	-696	-696	-696	-696	-696	-696
Supply of transfer (trade) water to South Australia	-33	-33	-33	-33	-33	-33
Supply of Additional Dilution Flow	-438	-450	-630	-780	-1095	-1095
Supply of Unregulated Flow	-260	-470	-900	-2220	-6440	-15530
Minimum reserve for 2012-13	-480	-835	-835	-835	-835	-835
Total Murray allocatable water	**5200**	**6700**	**7380**	**8300**	**9900**	**10230**

Conveyance water (river losses)

The volume of water set aside for conveyance, which includes losses to evaporation and seepage along the river system, varies between scenarios. The 'worst case' and 'dry' scenarios assume 800 GL for conveyance between Dartmouth Reservoir and the South Australian Border and a further 180 GL between Menindee Lakes and the Murray at Wentworth. The 800 GL conveyance along the Murray takes a conservative approach and is slightly higher than losses experienced in recent dry years, i.e. about 750 GL in 2006-07 (FIGURE 7).

In the drier scenarios, the pattern of losses is skewed towards the summer months when evaporation is expected to be higher. The volume and pattern of water set aside for conveyance will be regularly reviewed by MDBA and altered to suit the actual conditions as they develop.

The 800 GL assumes that:

- river flows are at, but not in excess of, channel capacity through the 'Barmah choke' for at least a short period during the year;
- all major wetlands affected by regulated flows are connected at some stage of the year; and
- weir pools are held at normal operating levels.

If conditions are wetter, then conveyance losses will be higher due to increased overbank flow and flooding and consequential evaporation and seepage on the floodplain. Consequently, the wetter scenarios assume higher conveyance losses, with about 1,300 GL assumed in the 'near average' scenario (FIGURE 7) and 2,000 GL assumed for the 'very wet' scenario.

The conveyance loss along the River Murray in South Australia upstream of Wellington is included as part of the South Australian 696 GL Dilution and Loss entitlement. How much evaporates or is otherwise lost between the border and Wellington (just upstream of Lake Alexandrina) and how much flows to the lake will vary from year to year depending on a range of factors including: evaporation, extent of flooding and local rainfall. For "worst case" planning purposes it is assumed that about 50% of the 696 GL is lost and the other 50% flows to the Lower Lakes.

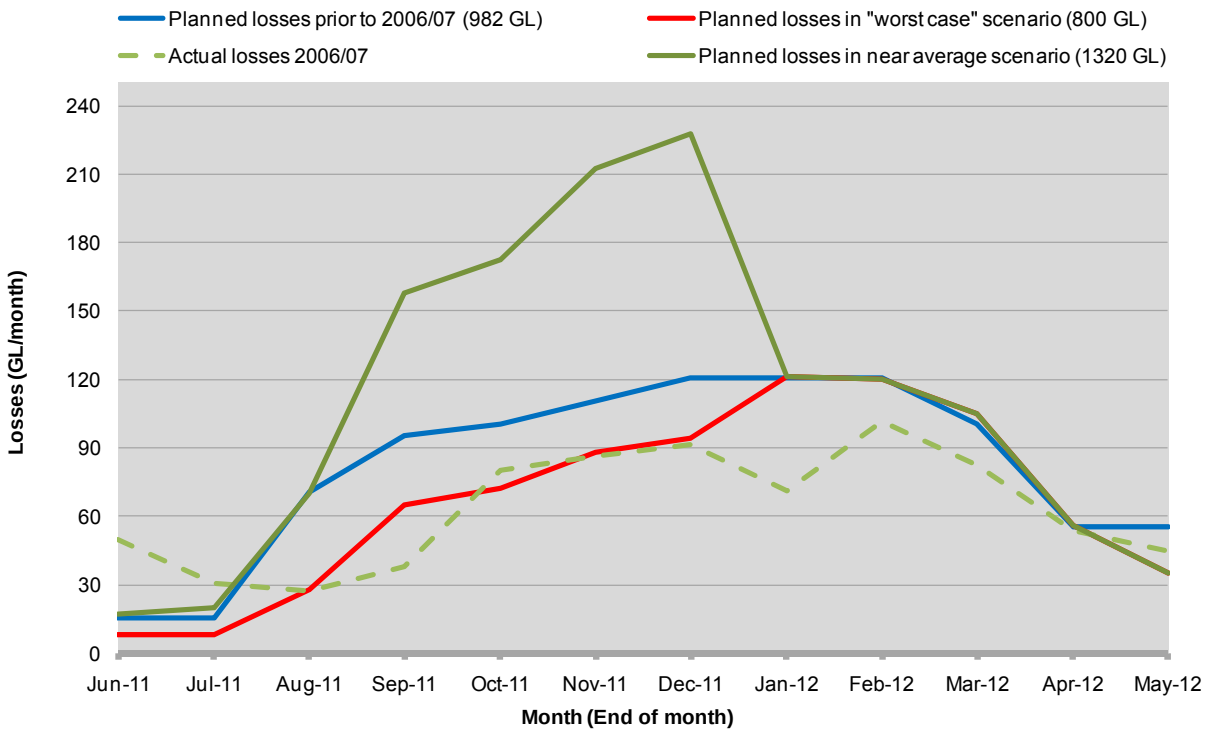

FIGURE 7 Assumptions for conveyance losses upstream of the South Australian border

Conveyance Reserve

In response to the extreme drought conditions in recent years, the Water Act (2007), had provisions to improve security of supplies under a repeat, or even worse drought conditions. Two Schedules to the Murray-Darling Basin Agreement have been enacted in this regard.

Ministerial Council approved the Schedule to Account for South Australia's Storage Right (Schedule G), the Schedule for Water Sharing (Schedule H) and associated consequential amendments to the Agreement on 15 June 2011. The default date of effect for the Schedules will be the commencement of the next water year on 1 June 2012, unless the Ministerial Council determines otherwise. South Australia has proposed such a determination and a proposed

date of effect of 1 September 2011 is being presented to Basin Officials Committee for its consideration.

On the expectation that the Schedules will take effect on 1 September 2011, and to avoid any associated reduction in State's water availability at that time, jurisdictions requested MDBA to allow for the Schedules in this Annual Operating Plan. In so doing, this plan therefore implements a conveyance reserve of 225 GL in each of the scenarios. This reserve aims to preserve water in storage now so that it can eventually be utilised in future years to assist in the delivery of critical human needs water should there be a return to extremely dry conditions.

Storage losses

Assumptions of evaporative losses from storages vary for each scenario, being about 710 GL in the 'worst case' scenario and then increasing in the wetter scenarios (980 GL in 'very wet' scenario) due to the much larger wetted surface area, particularly over summer, with increased water in storage. The majority of the assumed evaporative loss is at Menindee Lakes (400-600 GL). High summer rainfall, as occurred in 2010-11, can significantly reduce evaporative losses.

5 SUMMARY OF WATER SHARING AND SIGNIFICANT OPERATIONS FOR 2011-12

State water entitlements and significant decisions on river operations are primarily driven by the timing and location of inflow events and usage patterns. For the six scenarios outlined in Section 4.2 of this plan, TABLE 3 provides a summary of water availability; TABLE 4 provides a summary of important operational decisions that may need to be made while TABLE 5 provides outlooks to assist environmental management.

The water sharing arrangements (Tier 1) between States, which are in effect for 2011-12, are outlined in Part XII of the Murray-Darling Basin Agreement.

TABLE 3 Summary of Water Availability under each scenario

WATER AVAILABILITY	'worst case'	Dry	Moderate	Near average	Wet	Very Wet
Sharing rules at end of May 2011	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
Indicative water entitlements at end May 2012						
NSW	1910 GL	2530 GL	2830 GL	3370 GL	4220 GL	4100 GL
VIC	2140 GL	3020 GL	3400 GL	3780 GL	4530 GL	4980 GL
SA	1154 GL	1154 GL	1154 GL	1154 GL	1154 GL	1154 GL
SA Dilution & Loss	696 GL	696 GL	696 GL	696 GL	696 GL	696 GL
Carryover trade delivery to SA	33 GL	33 GL	33 GL	33 GL	33 GL	33 GL
Conveyance Reserve for 2012-13	225 GL	225 GL	225 GL	225 GL	225 GL	225 GL
Forecast Minimum Reserve at end May 2012	480 GL	835 GL	835 GL	835 GL	835 GL	835 GL

WATER AVAILABILITY	'worst case'	Dry	Moderate	Near average	Wet	Very Wet
Special Accounting	3 States commence special accounting in August	No special accounting for entire year	No special accounting for entire year	No special accounting for entire year	No special accounting for entire year	No special accounting for entire year
Internal spill at Lake Victoria (Vic to NSW)	0 GL #	0 GL #	<10 GL #	20 GL #	50 GL #	0 GL #
Lindsay River Allowance	Normal Lindsay River Allowance from 1 July 2011	Normal Lindsay River Allowance from 1 July 2011	Normal Lindsay River Allowance from 1 July 2011	Normal Lindsay River Allowance from 1 July 2011	Normal Lindsay River Allowance from 1 July 2011	Normal Lindsay River Allowance from 1 July 2011
Additional Dilution Flow	≈ 440 GL #	≈ 450 GL #	≈ 630 GL #	≈ 780 GL #	1095 GL (all year)	1095 GL (all year)
Unregulated Flows	≈ 260 GL	≈ 470 GL	≈ 900 GL	≈ 2220 GL	≈ 6440 GL	≈ 15,530 GL
Assumed usage **NSW** **VIC** **SA Ent. Delivered**	# 1700 GL 1400 GL 1850 GL *	# 1900 GL 1500 GL 1850 GL *	# 1900 GL 1500 GL 1850 GL *	# 1900 GL 1500 GL 1850 GL *	# 1900 GL 1500 GL 1850 GL *	# 1300 GL 1200 GL 1850 GL *
End of season active storage	≈1700 GL #	≈3400 GL #	≈4100 GL #	≈5200 GL #	≈6700 GL #	≈8000 GL #

Highly dependent on the timing of improvements in water availability and usage patterns

* South Australia may defer some of its entitlement flow with the introduction of South Australia's Storage Right (Schedule G) and the introduction of formal carryover arrangements in South Australia.

TABLE 4 Summary of significant river operations under each scenario

RIVER OPERATIONS	'worst case'	Dry	Moderate	Near average	Wet	Very Wet
Expected Dartmouth release above minimum	~ 1060 GL, commencing Oct/Nov up to 5,000 ML/day.	<50 GL - some release for power generation or if Snowy Creek flow is very low	<50 GL - some release for power generation or if Snowy Creek flow is very low	<50 GL - some release for power generation or if Snowy Creek flow is very low	<50 GL - some release for power generation or if Snowy Creek flow is very low	Potential pre-releases and harmony transfers from Dartmouth to Hume. Plus <50 GL release for power generation or if Snowy Creek flow is very low.
Dartmouth Storage end May 2012	~1450 GL	~2600 GL	~2800 GL	~3000 GL	~ 3400 GL	~ 3700 GL
Hume storage	low levels (<10% capacity) in autumn increased chance of algal bloom	low levels (~10-20% capacity) in autumn increased chance of algal bloom	Spill until August, moderate levels (~30% -50% capacity) over summer/autumn	Spill until September, moderate levels (~30-50% capacity) over summer/autumn	Spill until November-December, higher levels (>50% capacity) over summer/ autumn	Spill until November-December, higher levels (>50% capacity) over summer/autumn
Use of Goulburn Valley Account	At the end of June 2011, it is expected that there will be 235 GL in the Goulburn Valley Account (from net trade out of the valley). In the near average and wetter scenarios a spill from Lake Eildon could reduce this to about 100 GL. It is most likely that Goulburn Valley Account water will be called by MDBA between December 2011 and April 2012. MDBA will liaise closely with the Goulburn Broken CMA and Goulburn-Murray Water during the 2011-12 water year to adaptively manage MDBA requests for the delivery of water from the Goulburn to meet irrigation demands along the River Murray, alleviate duration of high flows through the Barmah 'choke' and also, where possible, to meet the environmental aims along the Goulburn, Broken and Campaspe Rivers (see Section 6.3).					

RIVER OPERATIONS	'worst case'	Dry	Moderate	Near average	Wet	Very Wet
Use of Murrumbidgee Valley Account	At the end of June 2011, it is expected that there will only be 15 GL in the Murrumbidgee Valley Account (from net trade out of the valley). As to allow for possible back trade there is no planned delivery of this to the Murray. If there are significant volumes of trade to the Murray then MDBA will liaise closely with NSW in regard to delivery rates and timing. Any delivery of Valley account via the Snowy Mountains Scheme (SMS) will be subject to actual and forecast storage volumes in Hume Reservoir and channel capacity constraints through the Barmah Choke.					
Operation of Weir pools (see Section 6.2 for details)	Potential for Lake Mulwala to be lowered at end of year to conserve water in upper storages	Normal regulated weir pool variability	Normal regulated weir pool variability, with some flood operations	Normal regulated weir pool variability, with some flood operations	Normal weir pool variability, including major flood operations	Normal weir pool variability, including major flood operations
Lake Victoria Operating strategy and Cultural Heritage	Normal levels but may not quite fill.	Normal levels but may not quite fill.	Spilling until November	Spilling until December	Spilling for majority of year	Spilling for majority of year
	Operations will need to minimise the length of time the Lake Victoria level is high and be consistent with the LVOS. Under wetter scenarios it may be possible to hold Lake Victoria at lower levels, if unregulated flows to South Australia are persisting.					
Lake Victoria 250 GL reserve at end May 2011.	May require additional release from upper storages. MDBA to advise BOC early in 2011 MC: 103 (4)	Able to be met	Able to be met	Able to be met	Able to be met	Able to be met

TABLE 5 Summary of significant environmental operations under each scenario

ENVIRONMENTAL OPERATIONS	'worst case'	Dry	Moderate	Near average	Wet	Very Wet
Assumed Environmental flow release from Hume	450	500-600	500-600	500-600	500-600	500-600
Barmah-Millewa Environmental Water Allocation	292 GL in EWA. All borrowed and not available.	342 GL in EWA. Both NSW and Victorian shares available but flow triggers for release not met.		342 GL in EWA. Both NSW and Victorian shares available and triggers for release met and significant volume used.		342 GL in EWA. Both NSW and Victorian shares available and triggers met. May not need to be used and some carried over to the following year.
Below minimum flow/height levels	Not expected to be required	Not expected to be required	Not expected to be required	Not expected to be required	Not expected to be required	Not expected to be required
Lower Lakes	May temporarily fall below 0.55 m AHD if very hot, dry summer	Variations, where possible, between 0.55 and 0.8m AHD to assist reducing salinity at Lake Albert				
Wakool System (NSW Decision)	Normal operations					

ENVIRONMENTAL OPERATIONS	'worst case'	Dry	Moderate	Near average	Wet	Very Wet
River Salinity	Potential for high salinity levels following extensive flooding of the Lower Murray					
Flooding	In channel flows	Small chance of small flood into Barmah-Millewa Forest, otherwise in channel.	Increased chance of small flood into Barmah-Millewa Forest and central Murray area.	Flooding into Barmah-Millewa Forest and central Murray area.	Extensive and prolonged flooding along entire River Murray System	Extensive and prolonged flooding along entire River Murray System
Blackwater	Unlikely	Unlikely	Potential for minor blackwater event but dissolved oxygen levels not too low	Potential for significant blackwater event with very low dissolved oxygen levels. MDBA may call on Murray Irrigation escapes and co-ordinate environmental water releases where possible to provide dilution		
Chance of blue-green algal blooms along river	There is always a chance of blue-green algal blooms forming somewhere along the River Murray System. Algal blooms generally form during the summer and persist into autumn and have been observed to form in both high flow and low flow years, however the more extensive blooms have been observed more often during dry years. River Murray Operations may be able to assist in dispersing algal blooms in weir pools with 'pulsed' flows on some occasions. However, this is not always feasible, particularly when water is scarce.					

6 RIVER MURRAY SYSTEM OPERATIONS FOR 2011-12

6.1 No changes to minimum flow rates expected

As part of drought operations between 2006 and 2010 the minimum flows or river levels were temporarily reduced at some locations to conserve water (TABLE 6). During 2011-12 it is *not* expected that flows will need to be reduced below normal minimum targets, unless there are unforeseen or emergency circumstances. However, if it is a very dry spring and summer then flow rates close to minimums may occur for extended periods in the River Murray System upstream of Wentworth, whilst MDBA preferentially draws on water from Menindee Lakes rather than Hume Reservoir to minimise evaporative losses.

TABLE 6 Minimum Flow rates at key locations

Standing Procedure	Normal minimum	Temporary minimum between 2006-10
Minimum release from Hume Dam	600 ML/day	400 ML/day
Minimum target flow at Doctors Point	1200 ML/day	800 ML/day
Minimum release from Yarrawonga Weir	1800 ML/day	1500 ML/day
Minimum flow at Edward River off take	100 ML/day	80 ML/day
Minimum flow at Gulpa River off take	80 ML/day	30 ML/day
Minimum release from Stevens Weir	150 ML/day	130 ML/day
Minimum river height at Swan Hill	0.6 m local gauge height	0.5 m local gauge height
Minimum release from Euston Weir	2500 ML/day + Sunraysia Demand	1500 ML/ day

6.2 Weir pool level manipulation

Weir pool manipulations may be implemented for a number of reasons including;

- the need to supply downstream water requirements when there are very hot conditions and demands are high;
- to minimise evaporation rates;
- to temporarily store water rather than allow it to pass downstream;
- for construction and maintenance programs; and
- to provide variation in water levels to minimise bank erosion and to flood or dry adjacent wetlands.

The timing and extent of weir pool manipulations are difficult to predict as they are significantly influenced by short-term weather conditions. TABLE 7 outlines variations in weir pools that have occurred since 2005. It is possible that weir pool manipulations of these magnitudes will be implemented at some stage in 2011-12. It is also possible that larger weir pool manipulations, outside of these ranges, may be implemented. TABLE 7 also provides indicative

levels (in brackets) that have the potential to impact on water quality and access. In the event that a weir pool needs to be manipulated outside its normal operating range then jurisdictional representatives would be notified via the WLWG. The public would be notified through the River Murray Weekly Report and in some circumstances via media releases.

Under high flow or flood events such as those observed during 2010-11 many structures may be inundated or removed, therefore the ability to undertake weir pool manipulations will be limited.

For Lake Mulwala it is expected that the lake level will be managed within its normal operating range (124.6 to 124.9 m AHD), except if required for the control of the invasive weed *Egeria Densa,* or during periods of flooding or emergency situations.

There is the potential for raising of the pool upstream of Lock 8 during the autumn of 2012 by up to 50cm. This action would be undertaken in conjunction with TLM works currently being constructed on Mulcra Island to assist in delivering environmental water to that area of the floodplain. The implementation of this action would depend on the availability of environmental water and the completion of the Mulcra Island works.

TABLE 7 **Variations in weir pool levels since 2005. Values in brackets refer to weir pool level variations that may have significant impacts on river management such as water quality and water access.**

Weir	FSL	Weir Pool Lowering	Weir Pool Raising
Lake Mulwala	124.9 m	30 cm (20 cm)	25 cm
Torrumbarry Weir (Lock 26)	86.05 m	40 cm (25 cm)	no surcharge
Euston Weir (Lock 15)	47.6 m	30 cm (25 cm)	no surcharge
Mildura Weir (Lock 11)	34.4 m	10 cm (10 cm)	5 cm
Wentworth Weir (Lock 10)	30.8 m	10 cm (10 cm)	10 cm
Kulnine (Lock 9)	27.4 m	20 cm (25 cm)	25 cm (15 cm)
Wangumma (Lock 8)	24.6 m	50 cm (50 cm)	60 cm (50 cm)
Rufus River (Lock 7)	22.1 m	15 cm (15 cm)	25 cm
Murtho (Lock 6)	19.25 m	10 cm (8 cm)	15 cm (10 cm)
Renmark (Lock 5)	16.3 m	10 cm (8 cm)	50 cm (35 cm)
Bookpurnong (Lock 4)	13.2 m	10 cm (4 cm)	30 cm
Overland Corner (Lock 3)	9.8 m	10 cm (3 cm)	15 cm
Waikerie (Lock 2)	6.1 m	10 cm (8 cm)	20 cm
Blanchetown (Lock 1)	3.2 m	10 cm (10 cm)	15 cm

6.3 Delivering environmental water

The scenarios in this plan rely on assumptions on the location and timing of water use along the river system. For irrigation and urban water supplies there is a long history of use that can be

analysed to develop forecasts under the different scenarios. However, at this stage, there is no history of use available to assist the forecasting of recently acquired environmental water.

The environmental water holders have provided an indication of how some smaller parcels of their water are expected to be used. The Living Murray (TLM) Annual Watering Plan 2011-12 can be found at *http://www.mdba.gov.au/files/publications/TLM-Watering-Plan-2011-12.pdf.* At the time that this RMS Annual Operating Plan was being developed (June 2011) TLM was also considering a larger multi-site watering proposal that would rely on an additional release from Hume Reservoir, similar to the Barmah-Millewa Environmental Allocation (B-M EWA), and aiming to fill in gaps between high flow events from the Ovens River, ensure appropriate recession rates to promote successful waterbird breeding and provide flow variability to assist fish migration and spawning.

A combination of B-M EWA and Living Murray water was used in this manner in 2010-11 during a prolonged period of unregulated flow and as such the ecological benefits of the environmental water released from Hume Reservoir were felt at many other wetland systems along the River Murray System all the way to the Coorong and Murray Mouth in South Australia. Approvals required from the Basin Official Committee to facilitate a large multi-site watering will be sought early in the water year.

For all scenarios in this Operating Plan it is assumed that between 450 and 600 GL of environmental water would be released from Hume Reservoir to achieve the multi-site watering. The environmental water has been assumed to be released at relatively low flow rates, between and following flood peaks, to primarily target low lying wetland systems. The releases are also assumed to be made in a manner that minimises the potential for delays to the significant works program that is being undertaken along the River Murray System (see section 6.10). However, if these works are already suspended or delayed due to flooding by unregulated flows then this may provide an opportunity to release environmental water at higher flow rates.

Barmah-Millewa Environmental Water Allocation (B-M EWA)

NSW and Victoria will carry over about 96 GL of B-M EWA into 2011-12. In addition, on 1 July 2011 both NSW and Victoria need to credit the B-M EWA with a further 25 GL due to the triggering of the lower security water as a result of the Hume Natural inflow between 1 January 2009 and 1 July 2011 being about 9,125 GL, which is greater than the 8650 GL trigger level.

As a result both States will have an initial commitment of 121 GL (242 GL in total) to the B-M EWA on 1 July 2011. Then for every 2% that Victorian HRWS increases, each State will need to contribute another 1 GL to the B-M EWA. When the Victorian HRWS reaches 100%, then the maximum volume that both NSW and Victoria will need to allocate to the B-M EWA in 2011-12 will be 171 GL each (96 + 25 + 50), which provides a total of 342 GL.

As there was a temporary borrow by both States of the B-M EWA in 2010-11 then up to 200 GL of B-M EWA in each State will not spill from Hume in 2011-12. As such all of the potential maximum volume of 342 GL will not spill from Hume Reservoir in 2011-12.

Both NSW and Victoria have indicated that it is possible that they may need to again temporarily borrow the B-M EWA in 2011-12. It is likely that the B-M EWA would be fully repaid

under all but the “worst case” scenario and would be triggered for use under the wetter scenarios.

Under a ‘near average’ scenario the release of the B-M EWA (to be approved by NSW and Victoria) combined with a large multi-site watering proposal described above, could provide significant environmental benefits along the entire river system, including the Coorong and Murray Mouth in South Australia.

Environmental inflows from the Goulburn River

This plan acknowledges and will, where possible, assist in the implementation of the Goulburn River Seasonal Watering Proposal for 2011-12 developed by the Goulburn-Broken Catchment Management Authority. This watering proposal aims to “*continue the ecological recovery, particularly focussed on the winter/spring flows which were so absent during the drought years. This involves providing increased minimum flows up to 830 ML/day at Murchison and a good spring fresh to 5,600 ML/day at Murchison (and desirably another winter/spring fresh)*”. It also aims to, where possible, provide “*improved summer/autumn minimum flows of 940 ML/day at McCoys Bridge and one or two freshes to 5,600 ML/day are also proposed, using inter valley transfers or environmental entitlements”*.

The environmental inflows to the River Murray from the Goulburn River during spring as described above are also expected to provide ecological outcomes along the River Murray downstream of the confluence between the two rivers.

This plan also acknowledges and will, where possible, assist in the implementation of the lower Broken Creek Seasonal Watering Proposal for 2011-12 developed by the Goulburn-Broken Catchment Management Authority.

MDBA River Operations staff will liaise closely with the Goulburn Broken CMA and Goulburn-Murray Water during the 2011-12 water year to adaptively manage MDBA requests for the delivery of inter valley trade water from the Goulburn River to assist, where possible, meeting environmental objectives along the Goulburn and Campaspe Rivers and the lower Broken Creek.

6.4 Snowy Mountains Scheme

Each year the Murray and Murrumbidgee Rivers receive water from the Snowy Mountains Scheme (SMS) from releases for power generation. The annual volume of water to be released from the Snowy Mountains Scheme is outlined in Schedule F of the Murray-Darling Basin Agreement.

Assumptions have been made for inflows from the Snowy Mountains Scheme in each of the six scenarios but for commercial reasons this cannot be disclosed in a public document.

6.5 Dartmouth Reservoir

Key considerations when operating Dartmouth Reservoir are the holding of reserves for later years and the transfer of this water to Hume Reservoir within the channel capacity of the Mitta Mitta River. Based on the storage level on 31 May 2011, indicative storage volume and

monthly releases for Dartmouth Reservoir under the six scenarios are shown in

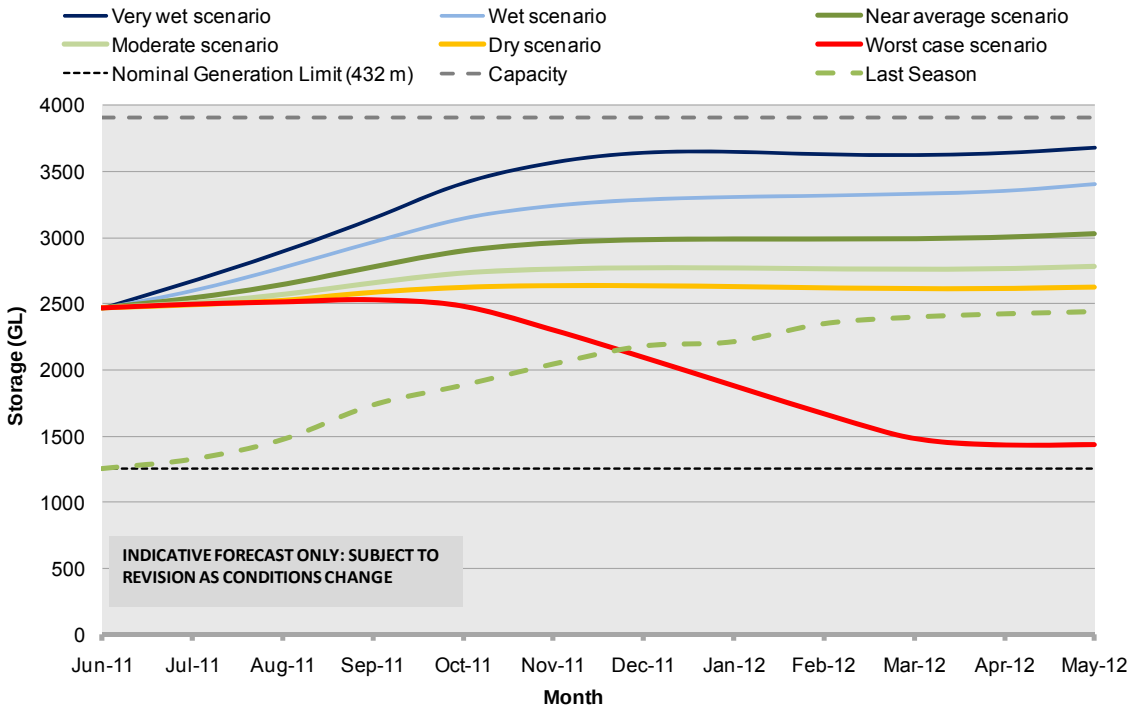

FIGURE 8 and FIGURE 9.

Under the 'very wet' scenario, the storage volume is expected to peak at about 3,700 GL (~96% capacity), and this assumes about 160 GL of 'harmony' transfers between Dartmouth and Hume Reservoir (see below). Inflows greater than those assumed in the 'very wet' scenario (which are similar to those in 2010-11) would be required for Dartmouth Reservoir to spill in 2011-12.

When storage in Dartmouth is high, 'harmony' transfers are made to benefit the Mitta Mitta Valley through increased flood protection, higher flows over summer and higher ground water levels. Harmony transfers can also benefit the operations of the Dartmouth power station and benefit recreation and tourism at Lake Hume through raised lake levels over summer.

Pre-releases from Dartmouth are considered in conjunction with the operation of Hume in its spilling or flood phase and may be required in 2011-12 if conditions exceed the very wet scenario. Pre-releases at Dartmouth should not unnecessarily reduce Hume's share of the total available airspace, or aggravate flooding if it is already occurring downstream of Hume. The method of calculating what is appropriate is generally based on sharing any available channel capacity downstream of Hume for releases from the two storages so that they are likely to become full at about the same time in late spring. For large events, priority might be given to providing airspace in Hume Reservoir in view of the large flood mitigation capacity afforded by the free overflow spillway of Dartmouth Dam (note that much less flood mitigation is possible at Hume Dam as storage levels approach FSL).

Under the four scenarios between 'dry' and 'wet', it is expected that releases above minimums (200 ML/day at Colemans) would not be required to meet diversion requirements in 2011-12. However, there may be pulsed releases at less than 5,000 ML/day by the power station

operator for electricity generation or there may be greater than minimum releases if there are water quality issues along the Mitta Mitta River or if the flow at Tallandoon is expected to be below 600 ML/day leading to insufficient flow to assist diversions along the Mitta Mitta River.

Under the 'worst case' scenario, there may need to be up to 1,100 GL released from Dartmouth and the storage volume would reduce to about 35% capacity at the end of the year. In this 'worst case' scenario, inflows are set low and the demand has been set high.

Where possible, any significant transfers from Dartmouth to Hume Reservoir, will be made as a series of pulsed releases following the environmental guidelines recently developed by MDBA and Charles Sturt University, to enhance the ecological values of the Mitta Mitta River.

The pulsed releases, where required, will aim to be less than 5,000 ML/day, but higher releases of up to 10,000 ML/day at Tallandoon cannot be ruled out. Both the timing and release rates from Dartmouth will be greatly dependent on inflow and usage patterns and the storage volume in Hume Reservoir, however it is likely that they would not commence until October 2011.

Storage in Dartmouth Reservoir is expected to be above the operating level of the main Power Station in all scenarios and dam maintenance and improvement is not expected to significantly affect river operations in the 2011-12 water year.

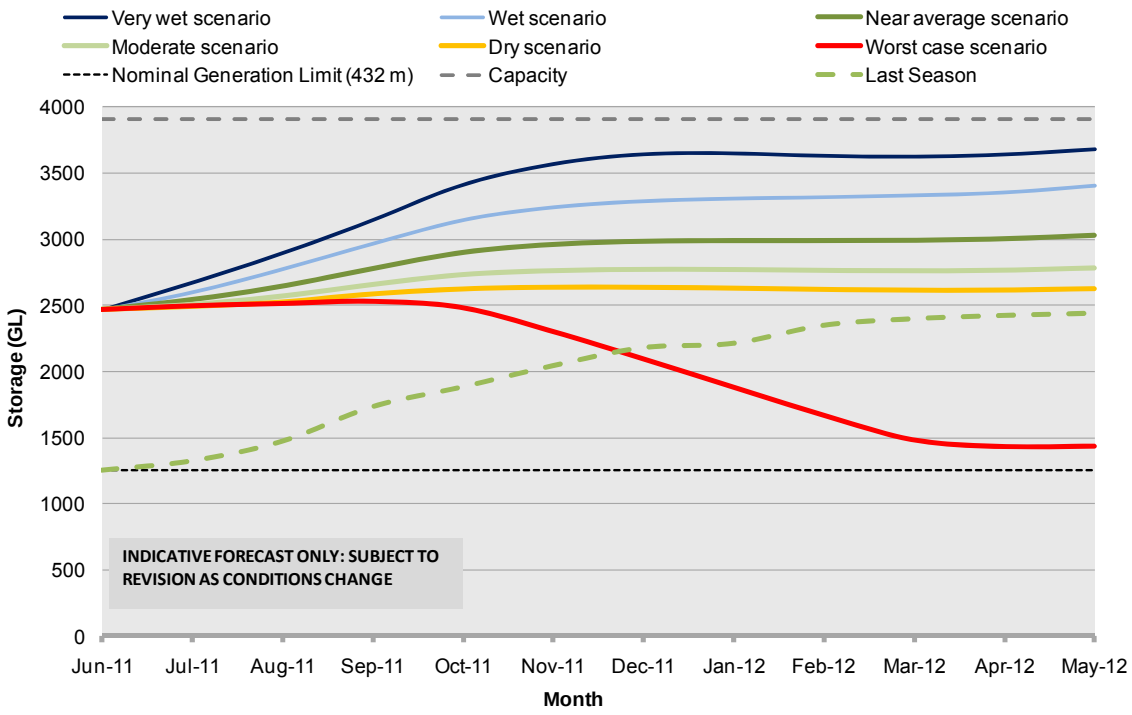

FIGURE 8 Dartmouth Reservoir storage outlook

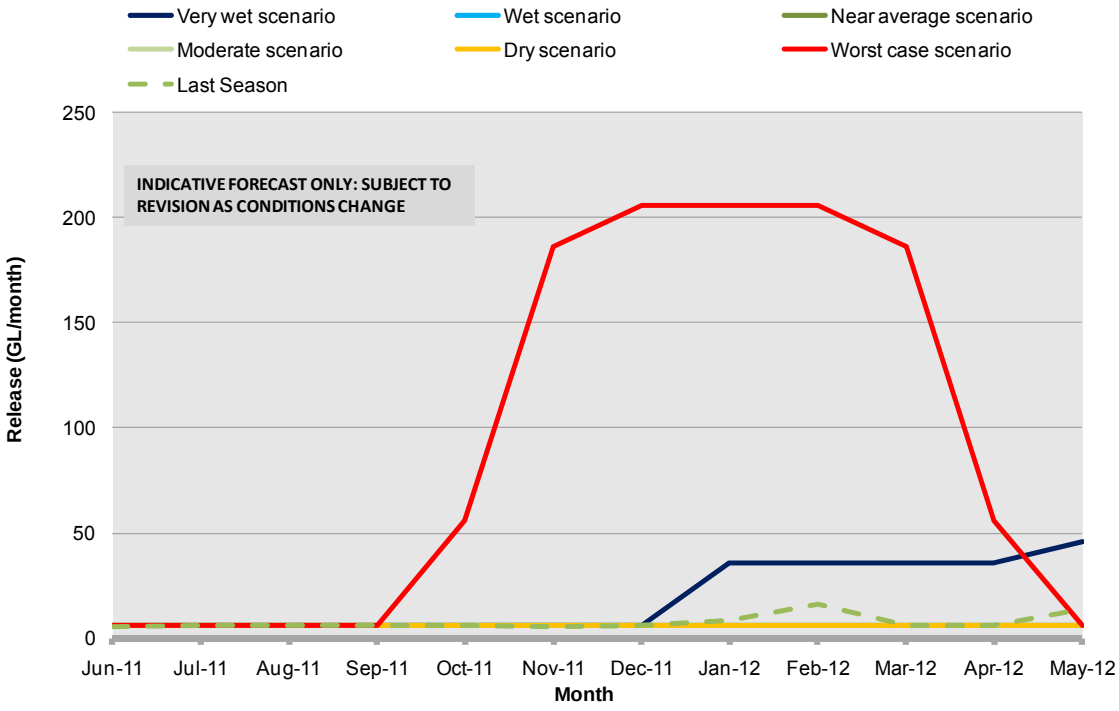

FIGURE 9 Dartmouth Reservoir release outlook

6.6 Hume Reservoir and flows at Doctors Point

Hume Reservoir is the primary regulating structure in the River Murray System. It stores inflows from the upper Murray catchment as well as water released from the Snowy Mountains Scheme and Dartmouth Reservoir. It then releases this water as needed, to supplement downstream tributary inflows, to meet the needs of NSW, Victoria and South Australia.

With Lake Hume effectively full on 1 June 2011

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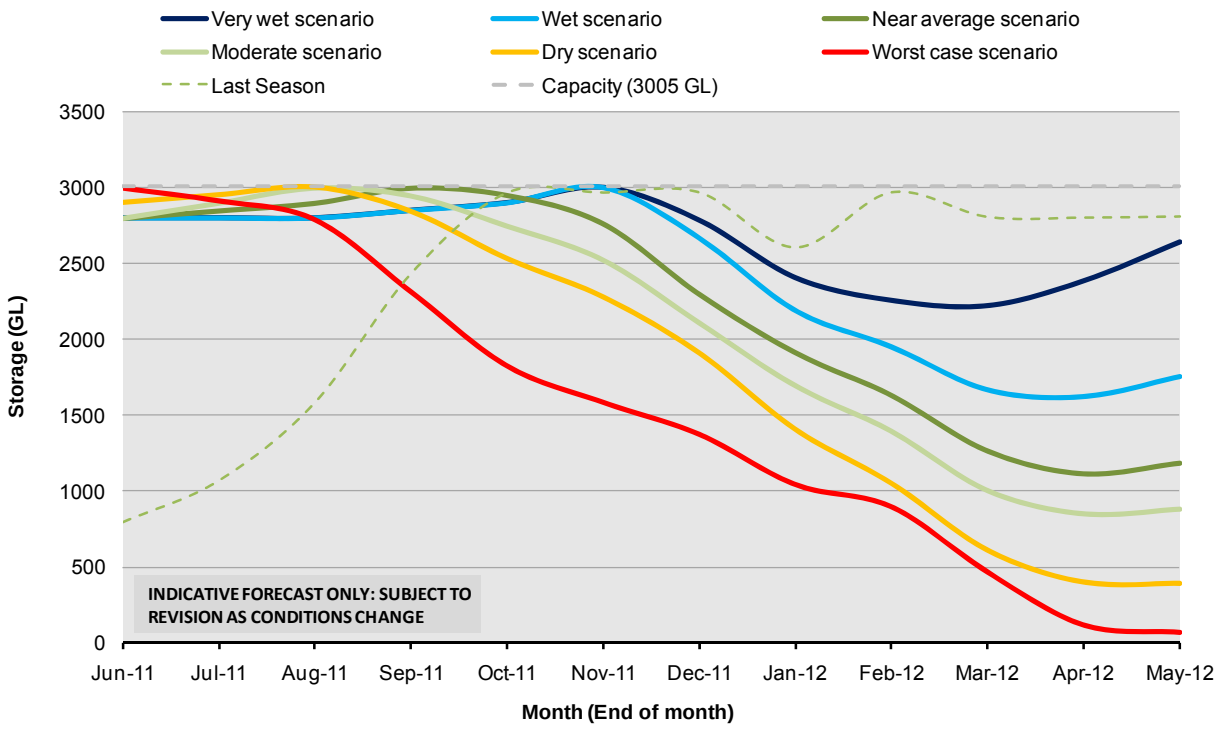

FIGURE 10) and catchments of the Upper Murray 'primed' there is an increased probability of significant flooding this winter/spring. Under the 'wet' scenario the flow at Doctors Point (near Albury) is likely to exceed an average 25,000 ML/day over a one month period and this could include peak flows above 40,000 ML/day (close to the minor flood level at Albury of 4.3 m) (FIGURE 11). Under almost all the scenarios, an individual rain event could see the flow at Doctors Point exceed 60,000 ML/day, which is just above the moderate flood level at Albury (4.9 m) and major flooding at Albury (5.5 m) is a possibility.

Given this outlook, and considering recent flood events throughout Australia and related inquiries including the examination of operations of Wivenhoe Dam, MDBA is reviewing flood operation methods at Hume Reservoir in consultation with the jurisdictions and the local landholders downstream of Hume Reservoir. Although Hume Reservoir does not have a dedicated flood mitigation role, the operation of the reservoir results in significant flood mitigation at times when the storage is not full.

As part of this review, MDBA is considering a proposal that aims to preserve valuable airspace to protect downstream communities from substantial damage caused by moderate and major floods. This would be achieved by passing smaller flow events though Lake Hume with possibly little or no attenuation if rainfall and streamflow conditions show this to be prudent. Such an operation could provide environmental benefits through a more natural variability and also improve flood mitigation outcomes in subsequent larger flood events

At the end of May 2011, the Hume Reservoir pre-release rules were being implemented and 200 GL of airspace was being actively targeted. However, the target volume of airspace will be

reviewed regularly in accordance with pre-release rules and may change over time depending on a range of factors.

Based on the storage level on 1 June 2011, indicative storage volumes for Hume Reservoir under the six scenarios are shown in

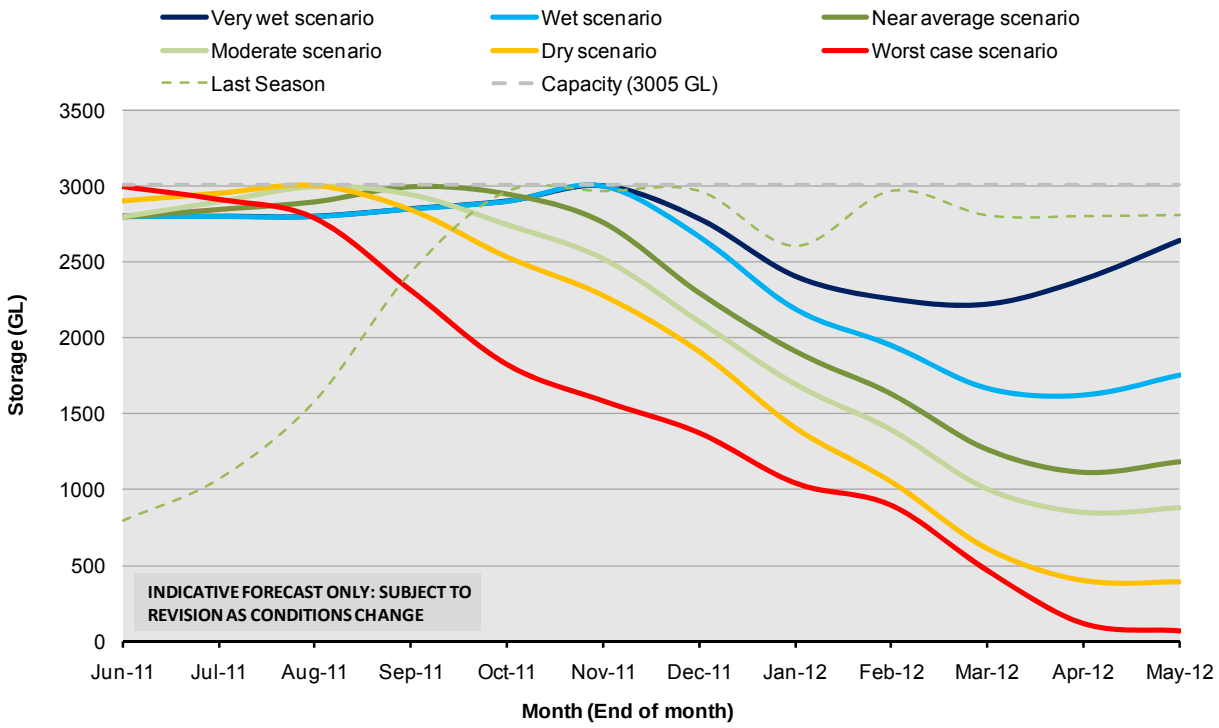

FIGURE 10. Hume Reservoir will remain effectively full and spilling until the demand for water (irrigation and/or environmental requirements) is greater than inflows. Under the dry scenarios Hume Reservoir may stop spilling in July or August but under the wetter scenarios it may not stop spilling until late spring or early summer. Even in the 'worst case' scenario, the volume in Hume Reservoir is expected to remain above 20% until end February 2012, which is considerably higher than levels experienced during the recent drought.

Remedial works at the southern training wall are planned to commence in November 2011 and continue until the end of 2013. These works will require a coffer dam in front of the southern training wall. MDBA will consider the works whilst undertaking flood operations and will liaise with BoM and advise NSW State Water in an effort to provide early warning (48 hours)of the potential for flood flows which may overtop the coffer dam.

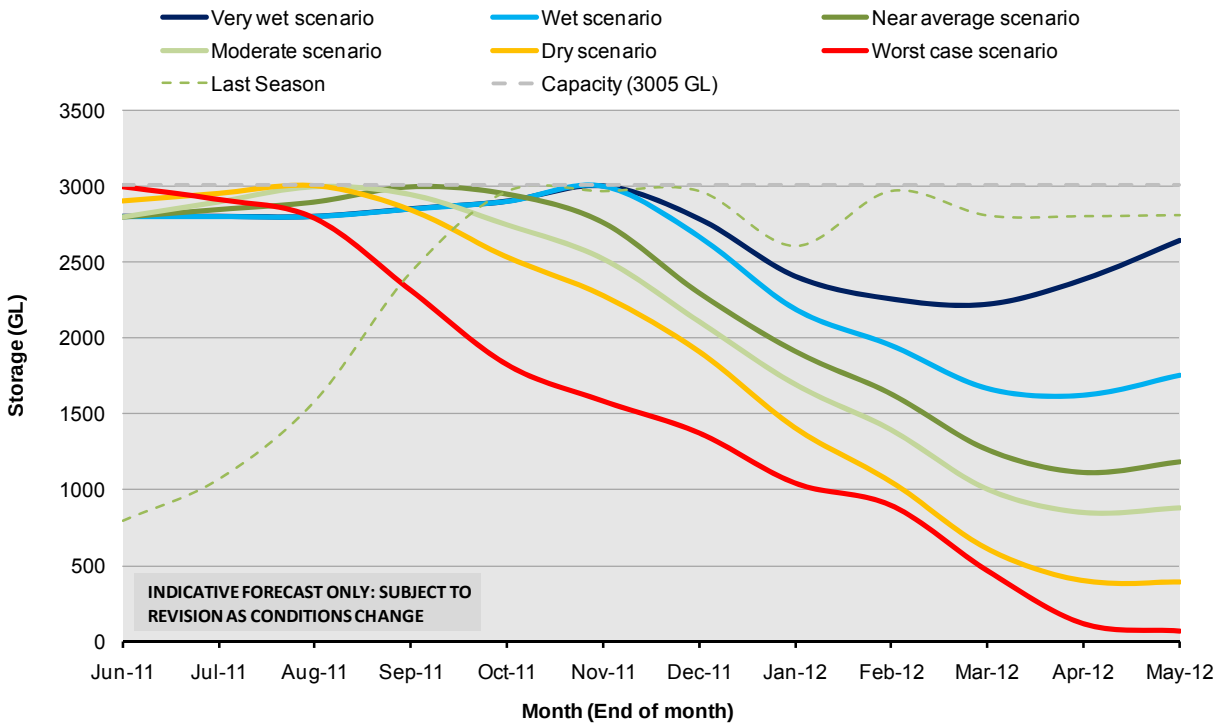

FIGURE 10 Hume Reservoir storage outlook

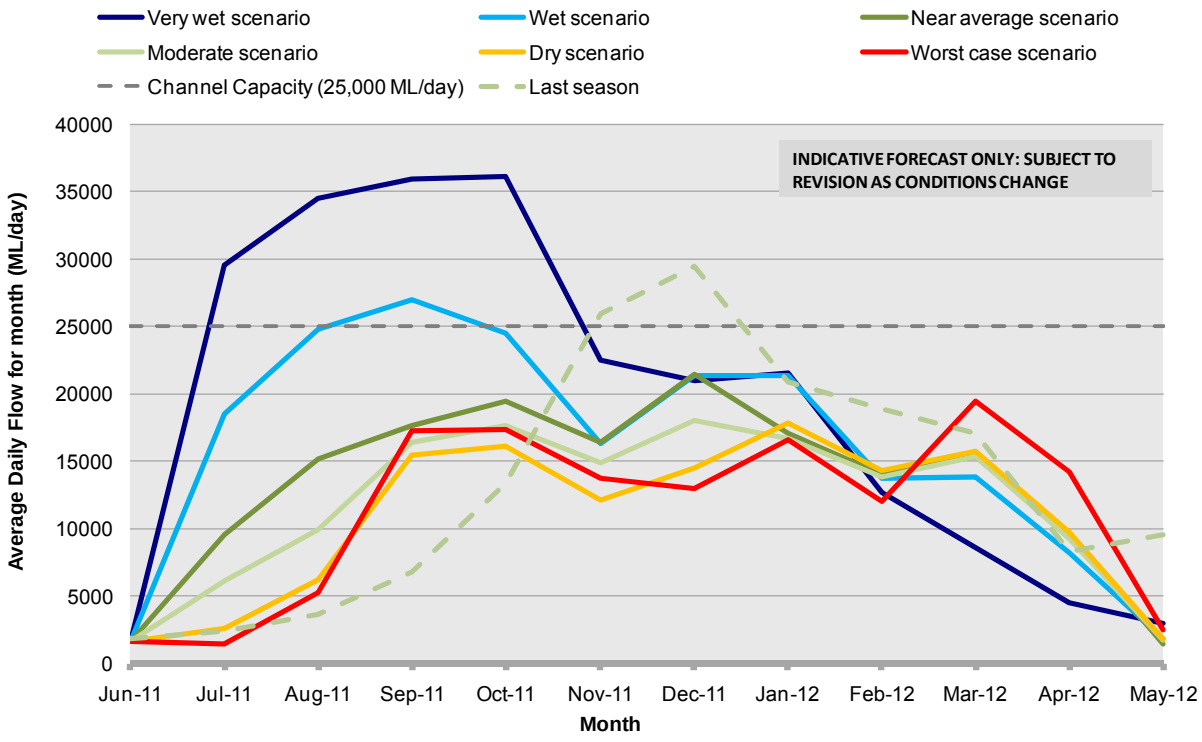

FIGURE 11 Hume Reservoir release outlook – flow at Doctors Point

6.7 Lake Mulwala and the Barmah Choke

Winter-Spring (up to mid December)

Lake Mulwala is currently drawn down to assist the control of the waterweed *Egeria densa* and is expected to be refilled during July and early August to allow diversions to the major offtakes. The refilling will require about 90 GL of water and is expected to be sourced from Hume spill and inflows from the Kiewa and Ovens Rivers.

Large-scale environmental watering proposals for spring and early summer are being developed to facilitate watering of the Barmah-Millewa Forest and downstream wetlands. As such, the storage volume in Lake Mulwala and the release from Yarrawonga Weir during spring and early summer will be managed, where possible, to assist in achieving these environmental outcomes whilst meeting other diversion commitments.

Early in the 2011-12 water year flow rates downstream of Yarrawonga were in excess of channel channel capacity through Barmah Choke and all forest regulators had been short periods. Even if conditions returned to be similar to the 'worst case' or 'dry' there is expected to be further watering of the Barmah-Millewa Forest and flow expected to exceed channel capacity at some stage during spring 2011 (

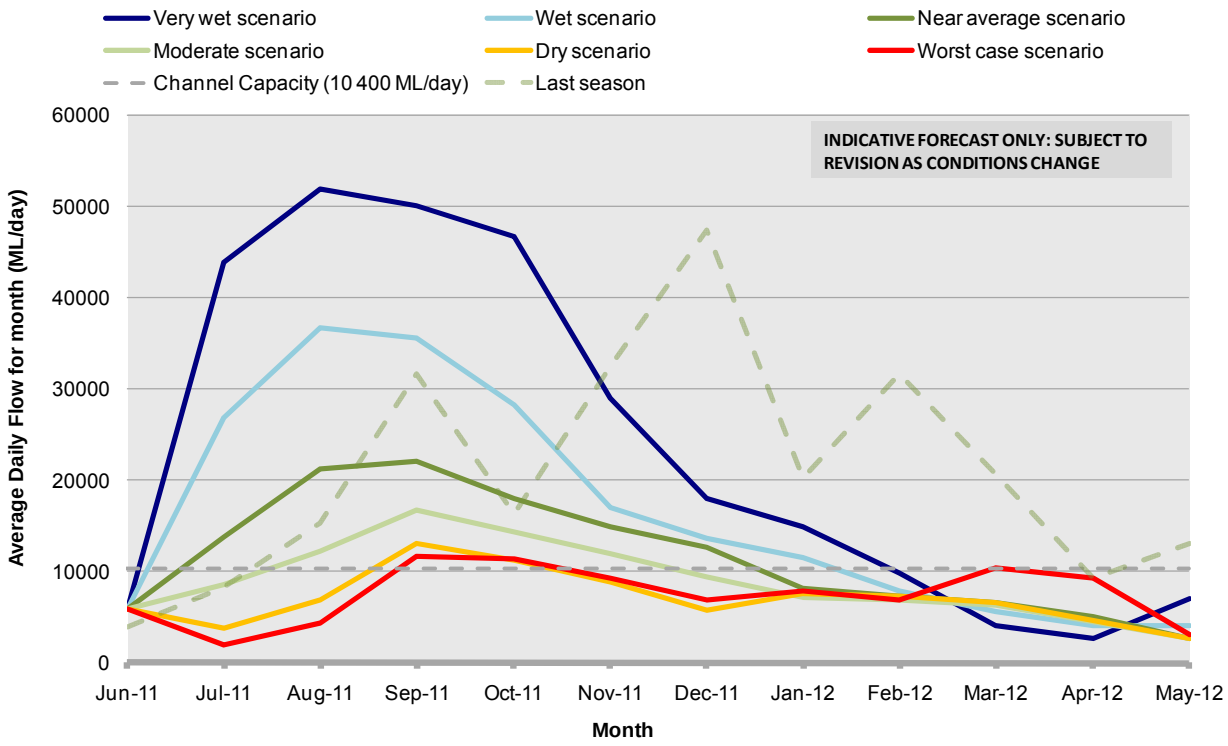

FIGURE 12). Under the wetter scenarios it is likely that there will be a significant flood in the forest at some stage during winter/spring and that this will be followed up with above channel capacity flows utilising environmental water for several months during spring and early summer. As in other years, it is expected that the environmental flows will mainly focus on maintaining critical flow rates between flood peaks, providing flow pulses to assist fish spawning and migration and implementing gradual recession rates to minimise bank slumping and allow waterbirds to complete nesting cycles.

Under wetter scenarios, there are likely to be significant inflow events from the Ovens and Kiewa Rivers and in such circumstances, the Lake Mulwala level and release will be managed in accordance with flood and emergency operating procedures, but again being mindful of the environmental water proposals and the potential release of the Barmah-Millewa EWA. Generally speaking, after Lake Mulwala is refilled inflow events can be expected to be passed 'straight through' Lake Mulwala in winter – spring with little mitigation as is the normal practice.

Summer (after mid December) and autumn

In 2011-12, it is expected that Lake Mulwala will be operated within its normal operating range (124.6 to 124.9 m AHD) during the irrigation season.

If there are summer inflow peaks and rain rejection events then they will be mitigated as per past practice (i.e. there is a potential to increase the lake level to 125.15 m AHD for short periods, a potential to draw down lake levels to 124.6 m AHD prior to rain events and also to utilise irrigation canals where possible).

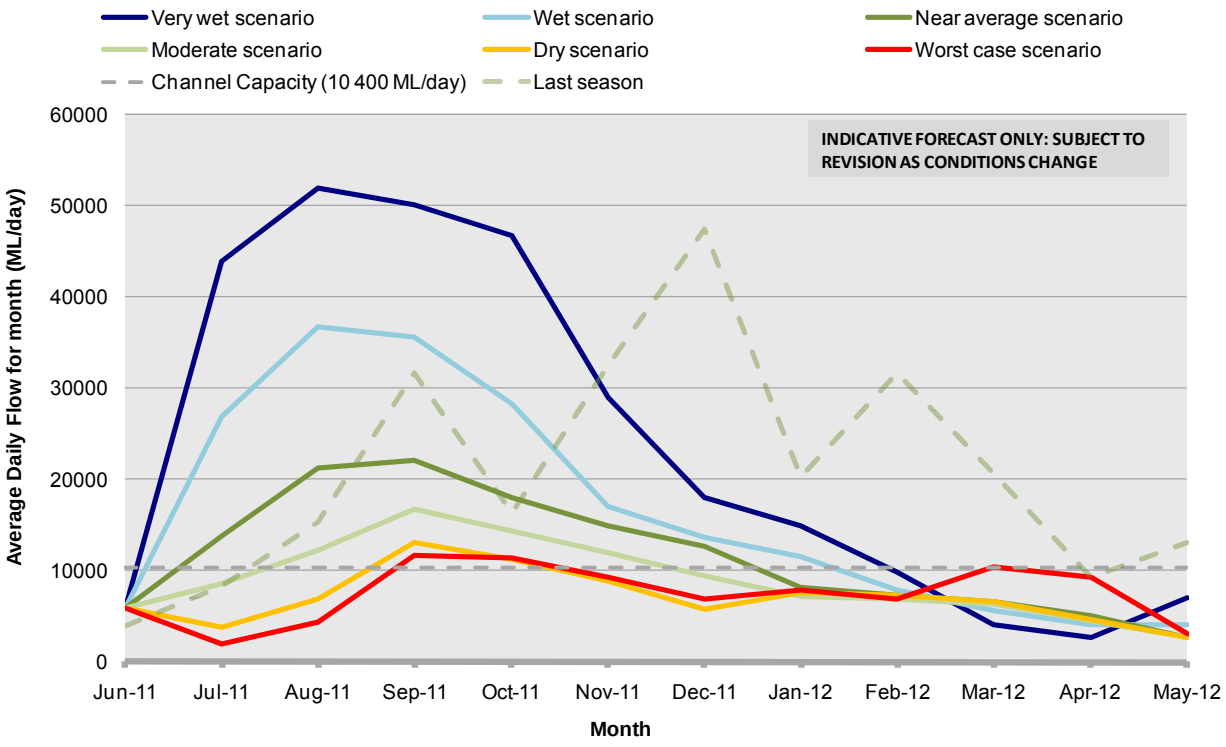

FIGURE 12 Yarrawonga Weir release outlook

Barmah Choke capacity constraints

The 'Barmah Choke' is a section of the River Murray (between Yarrawonga and Torrumbarry Weirs) that has the least capacity of any section of the river downstream of Hume Dam. The Barmah Choke is within an area of high ecological value, the Barmah-Millewa Forest.

Releases from Yarrawonga Weir in excess of 10,400 ML/day are sufficient to cause over bank flooding within the forest. About 2,000 ML/day of the 10,400 ML/day is directed to the north via the Edward River and Gulpa Creek, with the remainder (about 8,000 ML/d) flowing south along the Murray past Picnic Point and towards Echuca.

The Barmah Choke can create river operation issues during summer and autumn as the restricted channel capacity may limit the amount of water that can be delivered downstream (e.g. to the Torrumbarry Irrigation Area, Sunraysia, and South Australia). These issues are likely to arise when there is a lot of water in Dartmouth and Hume reservoirs, and hence allocations and demand are high, but the tributary inflows downstream of the Barmah Choke (eg from the Goulburn and Murrumbidgee Rivers) are low and there is little water available in the downstream storages (Lake Victoria and the Menindee Lakes).

With large volumes of water currently held in Menindee Lakes, the rule preventing trade of allocations from above to below the Choke continues to be relaxed, however MDBA will undertake fortnightly reviews of the relaxation, which may result in the need to reinstate restrictions to trade across the Choke at anytime during the water season.

6.8 Lake Victoria

A critical constraint on the use of Lake Victoria is that it must be operated and managed to minimise disturbance to Aboriginal cultural heritage and to protect burials that may be exposed by erosion of the foreshore. MDBA will fulfil the intent of the Lake Victoria Operating Strategy (LVOS) (MDBC, 2002) and the Lake Victoria Cultural Landscape Plan of Management (revised 2007) that were developed under the Section 90 consent and Section 87 Permit that is provided by the NSW Department of Environment and Heritage.

Lake Victoria is expected to fill (or nearly fill) at some stage during the spring/early summer under all scenarios (FIGURE 13). Storage is expected to be in excess of 25.5 m AHD (≈500 GL or 74% capacity) in July and then be filled as late as possible in a manner that is consistent with the LVOS. If conditions are conducive, the lake may be temporarily drawn down as far as 24.4m (≈385 GL) during August 2011 to facilitate field work required as part of a cultural heritage study to be conducted by the University of Melbourne.

Unregulated flows to South Australia were occurring at the commencement of the water year. The persistence and magnitude of further unregulated flows will depend on seasonal rainfall. In the ‘moderate’ and wetter scenarios unregulated flows could last for prolonged periods of time. The lake is expected to be gradually drawn down during the autumn in a manner that is consistent with the LVOS.

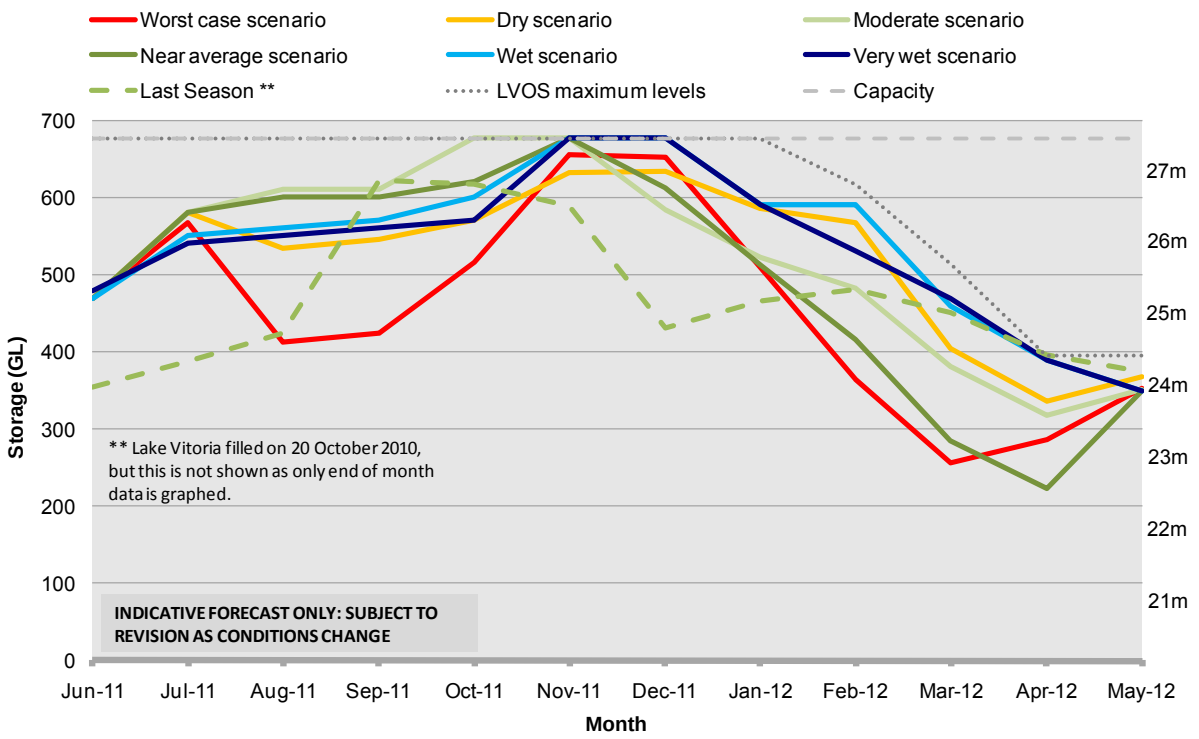

FIGURE 13 Lake Victoria storage outlook

Clause 103 of the M-DB Agreement requires that the first 250 GL of minimum reserve be held in Lake Victoria at the end of May each year. This could be implemented under all scenarios however to save water under a “worst case” scenario MDBA may seek Ministerial Council approval to store some of this minimum reserve in upstream storages.

The Menindee Lakes and Lake Victoria harmony rules will influence the volume in Lake Victoria and this is discussed further in Section 6.9.

6.9 Menindee Lakes

As at 31 May 2011 the Menindee Lakes had a stored volume of 1,930 GL and were being managed managed by NSW as part of flood operations. Under the 'worst case' and 'dry' plan assumes inflows of 96 GL in June/July and then no further inflows for the year. However higher inflows are assumed in the wetter cases from August onwards
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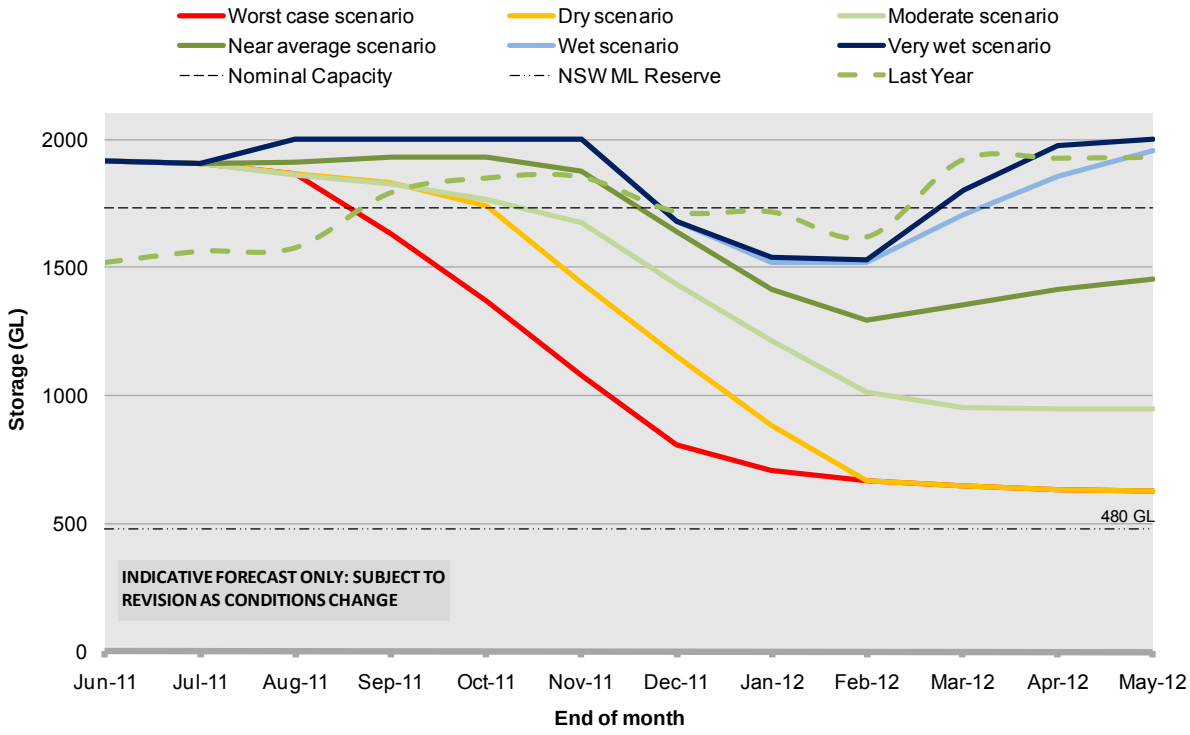

FIGURE 14).

Under the wet and very wet scenarios, Menindee Lakes may be in flood operation and be surcharged for considerable periods of time over the coming year, noting that the lakes should not be surcharged between 1 January and 1 March unless the flow at Weir 32 would otherwise exceed the downstream channel capacity of 20,000 ML/d.

As a general practice further inflows to Menindee Lakes can be expected to be stored preferentially in Lakes Wetherell and Pamamaroo (up to their surcharge level) then in Lakes Menindee and Cawndilla.

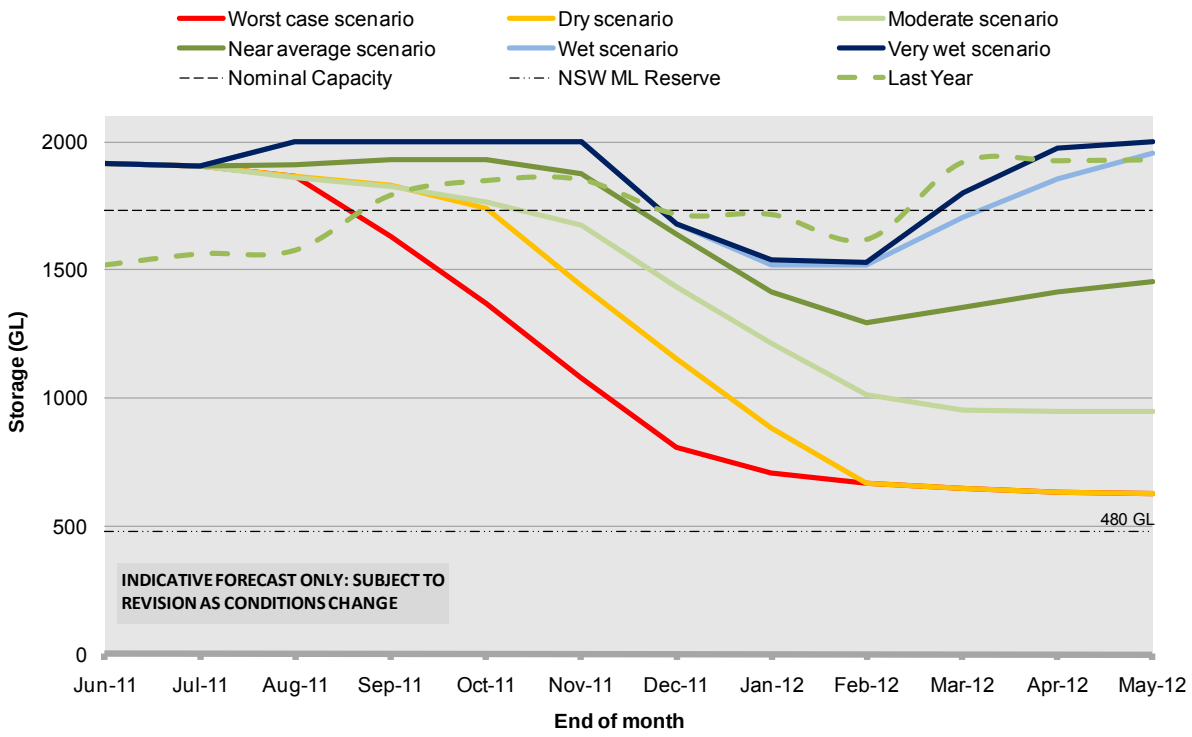

FIGURE 14 Menindee Lakes storage outlook

Under the drier scenarios the storage in Menindee Lakes is expected to be gradually drawn down to meet downstream requirements.

Releases from Menindee Lakes

Releases from Menindee Lakes

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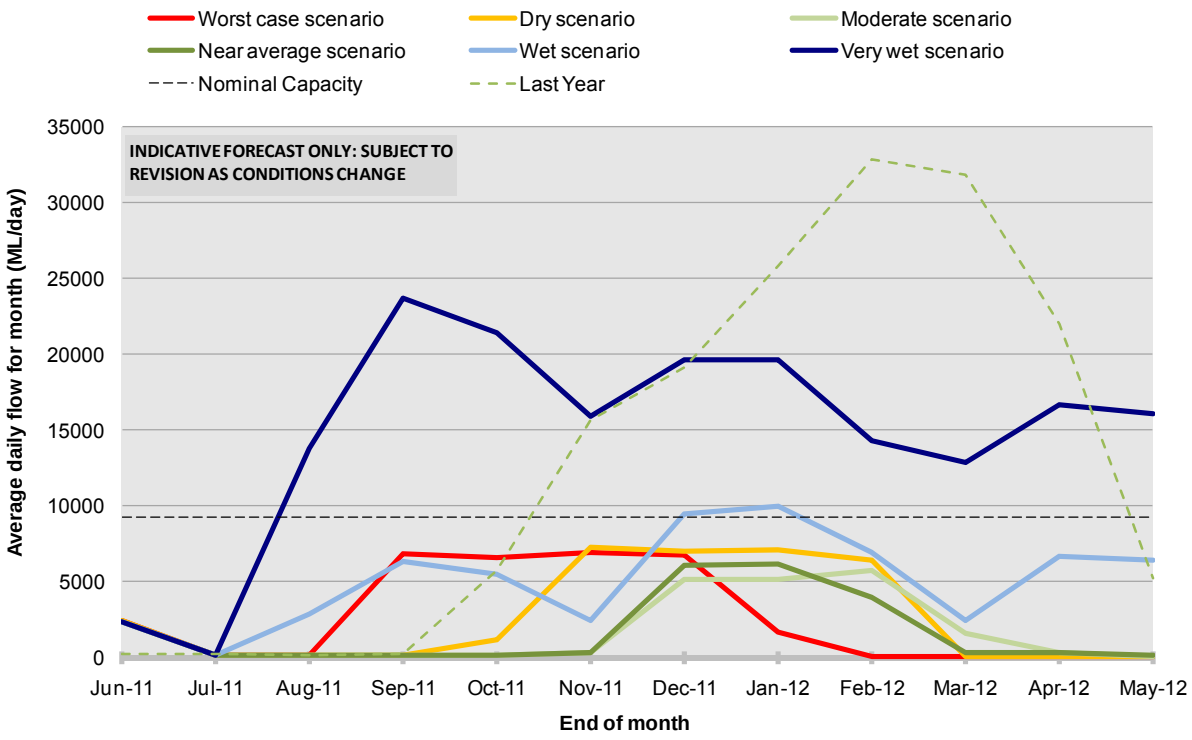

FIGURE 15) will be attributed to the respective allocations of NSW and Victoria according to Clause 120 of M-DB Agreement. The Lakes will be operated in harmony with Lake Victoria and this combined operation aims to reduce evaporative losses, whilst minimising the chance of spill from Lake Victoria. Further considerations affecting the operation will include the need to protect cultural heritage at Lake Victoria as well as longer-term security of water supply in the Lower Darling under a return to extreme dry conditions

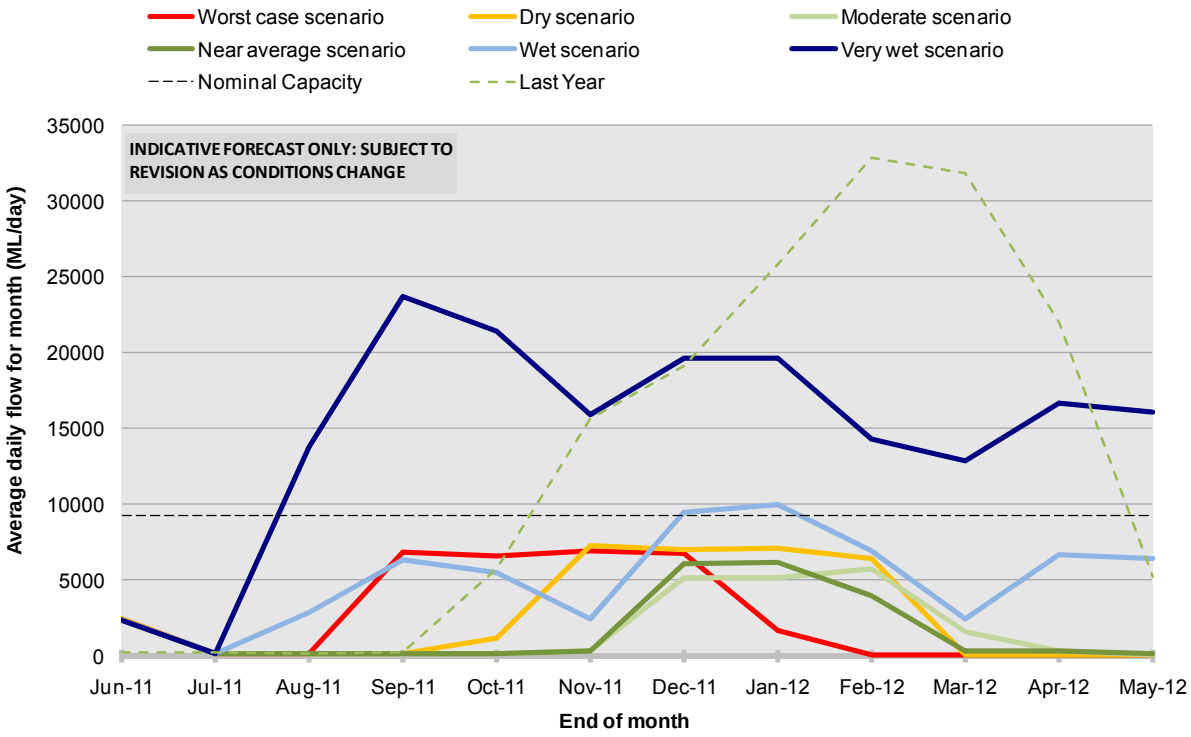

FIGURE 15 Menindee Lakes release outlook

Whilst Menindee Lakes are surcharged, the minimum release of 500 ML/day (compared with 200 ML/day when Menindee is not surcharged) will be targeted until higher releases are triggered by the 'Harmony Rules between Menindee Lakes and Lake Victoria'. These rules set out 'trigger' storage volumes in Lake Victoria for the end of each month (TABLE 8). If Lake Victoria storage is forecast to be below these volumes, due to insufficient flow in the River Murray, then releases from Menindee Lakes may be made to achieve the required storage volume in Lake Victoria.

TABLE 8 End of Month 'Trigger' storage volumes (GL) in Lake Victoria

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
660	500	140	180	180	180	180	340	500	680	680	680

The actual releases made from Menindee Lakes, and the subsequent levels in Lake Victoria will consider demands for water in South Australia and also the needs of the Lake Victoria Operating Strategy (LVOS). The LVOS requires the period of time that water level in Lake Victoria is held high to be minimised. The LVOS aims to minimise erosion at high lake levels and allow for revegetation to protect important cultural heritage.

Additional Dilution Flow (ADF) will also influence the operation of Menindee Lakes and Lake Victoria in 2011-12. The ADF rules were developed in 1989 using modelling of historical inflow sequences, prior to the most recent drought sequence, with the aim of reducing river salinities in South Australia. The intent of the rules is a 'use it or lose it' principle whereby additional water is delivered to South Australia rather than be lost as evaporation from Menindee Lakes. The ADF rules have a set of triggers described below:

South Australia will receive 3,000 ML/day above the daily equivalent of the monthly entitlement flow, whenever both of the following conditions are satisfied

a. the storage in Menindee Lakes exceeds the volumes within the given month as listed under Trigger Storage below (TABLE 9);
b. the combined storage in Hume and Dartmouth Reservoirs exceeds 2000 GL.

TABLE 9 Volume in Menindee Lakes required to trigger ADF

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1300	1300	1300	1300	1300	1650	1650	1500	1300	1300	1300	1300

ADF was delivered to South Australia for most of the 2010-11 water year. On 1 June 2011, storage in Menindee Lakes exceeded 1,650 GL and the combined storage in Dartmouth and Hume Reservoirs exceed 2,000 GL. Consequently ADF to South Australia of 3,000 ML/day above normal Entitlement Flow will continue into 2011-12.

The duration of the supply of ADF over the coming year will be driven by a number of factors, including:

- inflows from the upper Murray downstream of Hume;
- diversions by the upper States;
- the flow to South Australia;
- inflows to, and releases from, Menindee Lakes; and
- the impact of these factors on storage volumes at Lake Victoria and Menindee Lakes.

Two scenarios are described below in more detail to highlight potential outcomes.

ADF will be supplied and this is expected to reduce the forecast storage volume in Lake Victoria to below the target levels, which in turn will trigger releases from Menindee Lakes. This action will lower the volume in Menindee Lakes and consequently the ADF would cease when the storage in Menindee Lakes is below the ADF triggers (TABLE 9). Under the 'worst case' scenario, ADF is expected to cease about late October 2011.

Under the wetter scenarios the flow along the River Murray from tributaries downstream of Hume Reservoir may be sufficient to keep Lake Victoria above the End of Month trigger levels (TABLE 8) until later in the water year. In these scenarios, ADF may last for a longer timeframe (and if wet enough for all of 2011-12) as regulated releases from Menindee Lakes will be low and the storage volume will remain above the trigger levels for a longer period. This outcome could also eventuate if there are further inflows to Menindee Lakes throughout the year.

Generally, regulated release rates from Menindee Lakes will aim to be below about 6,000 ML/day at Weir 32 to minimise river losses and to preferentially draw from Lakes Menindee and Cawndilla, until the lakes return to NSW control. However, regulated releases of up to 9,000 ML/day at Weir 32 may be implemented if required. It is expected that, in all but the 'worst case' scenario, there will be water callable by MDBA in Menindee Lakes for all of 2011-12.

Flood releases are directed by NSW Office of Water and in general will pass inflows, whilst the Lakes are close to maximum surcharge level.

6.10 Maintenance/construction at Locks and Weirs and TLM sites

A summary of the major works along the River Murray System are provided in TABLE 10 and

TABLE 11. Most of the works were delayed in 2010-11 and while some have recommenced, other works have been suspended until the risk of further flooding reduces. Some of the works may impede navigation and they may be an influencing factor on the target flows for environmental releases (see Section 6.3).

TABLE 10 The Living Murray works to improve environmental outcomes

Site	Status as at 1 July 2011	Period of Construction	Critical Flow (ML/day) that may prevent or delay works
Koondrook Forest	Currently constructing	Throughout 2011-12	17,000 @ Torrumbarry Weir
Gunbower – Lower Landscape	Scheduled to commence	Spring 2011	17,000 @ Torrumbarry Weir
Gunbower – Hipwells Road	Detailed design phase	Potentially late 2011-12	Can be managed by irrigation offtakes
Hattah Lakes	Construction proposal to be submitted soon	Nov 2011 – Jun2012	36,000 @ Euston Weir
Mulcra Island	Remediation work required	Nov 2011 – March 2012	30,000 ML/day @ Lock 9
Lindsay Island	Detailed design stage	2012-13	N/A access for geo-tech and survey possible by boat
Chowilla Regulator	Construction suspended due to flooding	Recommence Nov 2011	17,000 ML/day @ SA Border
Slaney and Pipeclay Weirs	Works to begin when flows allow	Summer 2011-12	17,000 ML/day @ SA Border

TABLE 11 Works to improve current structures

Site	Status as at 1 July 2011	Period of Construction	Critical Flow (ML/day) that may prevent or delay works
Edward River offtake - fishway	Currently constructing	To be completed July 2011	Can construct at most flow rates
Stevens Weir - fishway	Currently constructing	6 months of clear construction period	About 1,000 ML/day @ Stevens Weir to install coffer dam then about 3,000ML/d to complete work.
Yallakool Creek Fishway	Currently constructing	6 months of clear construction period	May need to stop work if flooding along Edward River
Lock 15 (Euston) - navigable pass and piers	Currently constructing	Throughout 2011-12	35,000 ML/d @ Euston
Lock 11 (Mildura) – fishway	Currently constructing	Approx 3-4 months once recommence	11,000 ML/day @ Mildura
Lock 6 - Lock refurbishment	Minor works to be completed at low flows	1-2 months when conditions allow	Entitlement flow @ SA Border
Lock 5 – Navigable pass	Minor works to be completed at low flows	1-2 months when conditions allow	Entitlement flow @ SA Border
Lock 4 - Navigable pass and fishway	Will be assessed after Lock 2 works complete	TBC- needs 4-5 months of low flows.	20,000 @ SA Border
Lock 2 - Navigable pass and fishway	Remobilising at the moment	July 2011 – Sept 2011 if no flooding	25,000 @ SA Border

6.11 Flow to South Australia

South Australia will have access to full entitlement flows for all of 2011-12, and will also receive Additional Dilution Flow (ADF), unregulated flow and the supply of water traded to Australia
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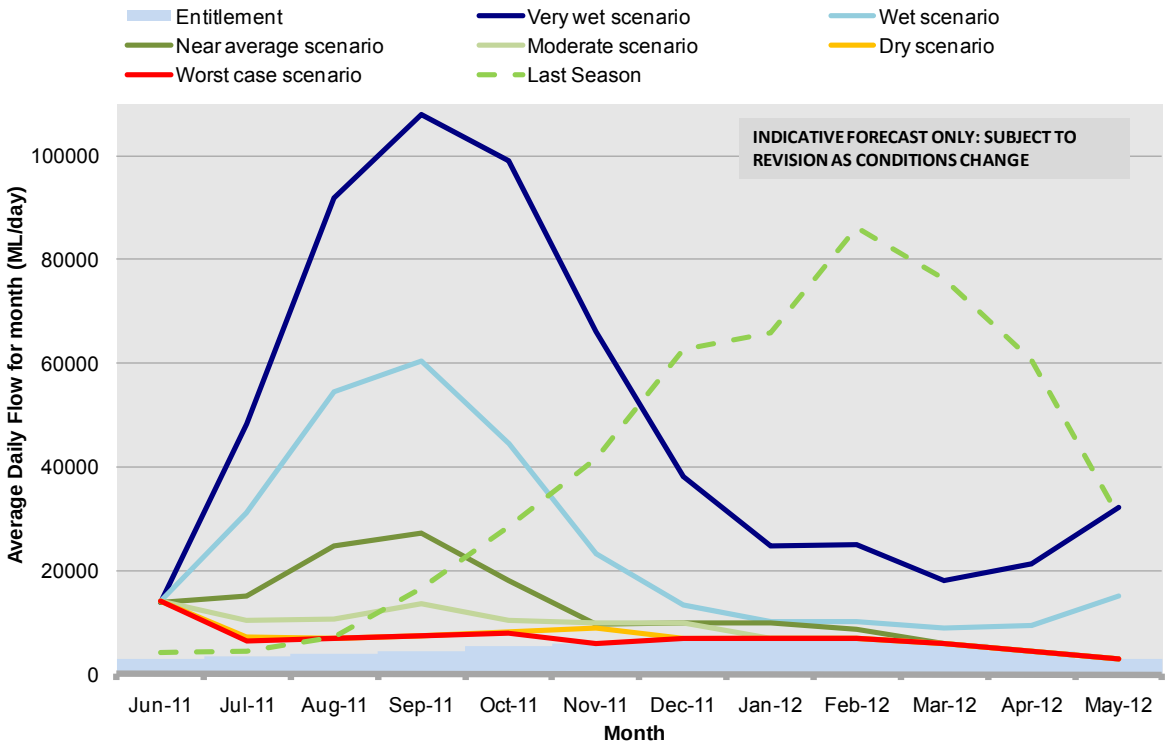

FIGURE 16). As indicated in Section 6.9, the supply of Additional Dilution Flow (ADF) of 3 000 ML/day is predicted under all water availability scenarios, although the total volume may vary between scenarios. ADF is expected to be delivered until October under the 'worst case' scenario, however in the wetter scenarios may last for all of 2011-12.

Under the 'worst case' scenario, unregulated flows are expected to cease in July but would be extended until November under the near average scenario and could continue throughout 2011-12 under the wetter scenarios.

Under the drier scenarios, South Australia may need to manage monthly flows in order to build a reserve for critical human water needs of 201 GL and private carryover for 2012-13. In order to build this reserve, South Australia may defer some of its entitlement flow with the introduction of South Australia's Storage Right (Schedule G) and the introduction of formal carryover arrangements in South Australia.

Under the near average and wetter scenarios, there could be another significant flood along the Murray in South Australia. The very wet scenario assumes inflows greater than in 2010-11. It also assumes that there are floods along the Murray and the Darling Rivers that these floodwaters reach the South Australian border at about the same time to produce a flow in excess of 100,000 ML/day.

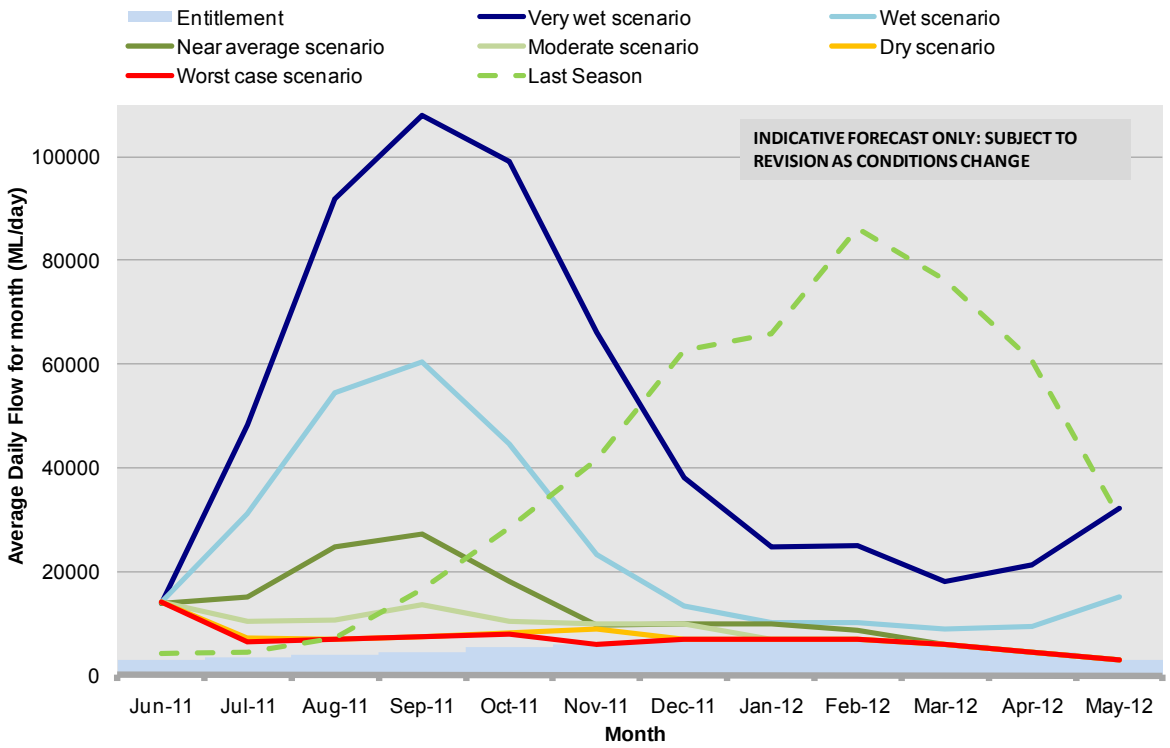

FIGURE 16 Flow to South Australia outlook

6.12 Lower Lakes and Barrage operation in South Australia

Lakes Alexandrina and Albert (Lower Lakes) are located upstream of five barrages located at Goolwa, Tauwitchere, Boundary Creek, Ewe Island and Mundoo Island. Historically, the Lower Lakes were generally a freshwater environment with occasional periods of seawater ingress from the Murray Mouth and Coorong.

During drought periods, prior to the construction of the barrages, higher salinities were recorded in the Lakes and further upstream to Murray Bridge however these periods were often short in duration. Until 2006-07 the Lower Lakes were operated mainly between 0.50-0.85m AHD and water would be discharged in most years from the barrages. With the extreme low River Murray system inflows observed in 2006-07, the Lower Lakes water levels fell to record low levels but recovered in to 0.7 m AHD by October 2010

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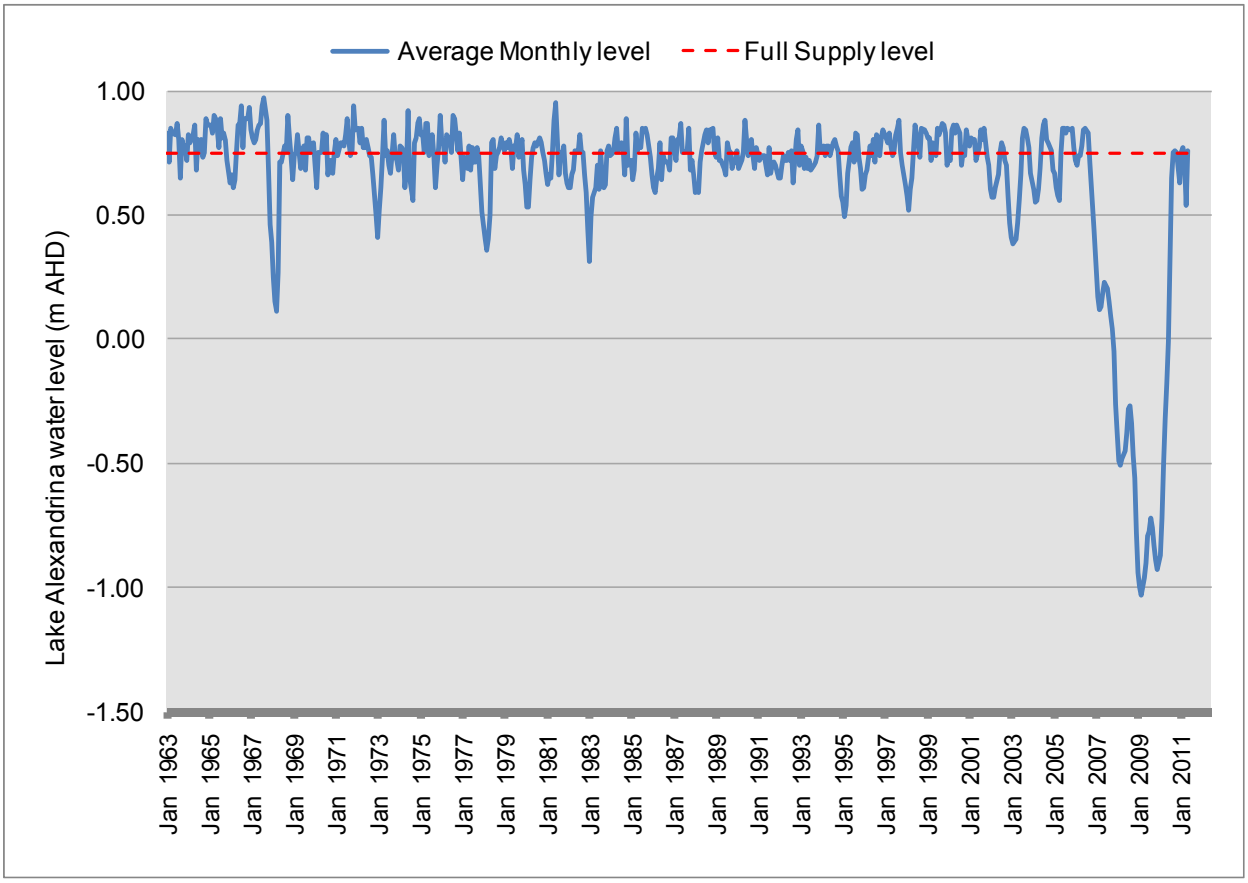

FIGURE 17).

With full entitlement flow, ADF and unregulated flows it is expected that the level of the Lower Lakes will be managed between 0.50 and 0.85 m AHD, however wind and tidal influences may result in lake levels temporarily going outside this range.

During 2010-11 there were managed variations to the release of water through the barrages in such a way as to vary the level of the Lower Lakes between 0.60 and 0.85 m AHD. This action aimed to improve salinity levels in Lake Albert and the Coorong however was very difficult to implement due to high water levels in the Coorong as a result of extremely high tides and the relative size of the Murray Mouth compared to the flow through the Barrages. It is aimed to repeat this action several times over 2011-12 if water availability and weather conditions permit.

The salinity at Milang Jetty in Lake Alexandrina at end June 2011 was about 550 EC units while, at Meningie on Lake Albert, the salinity has been slowly falling to about 6,000 EC units. Salinity levels in the southern lagoon of the Coorong have been steadily falling from about 180,000 EC units in early 2010 to about 115,000 EC units at end June 2011. Closer to the Murray mouth, salinity levels were about 50,000–60,000 EC units in early 2010 and fell to about 3,000 EC units with the high flows during autumn 2011. The salinity near the Murray mouth at the end of June 2011 was about 10,000 EC units.

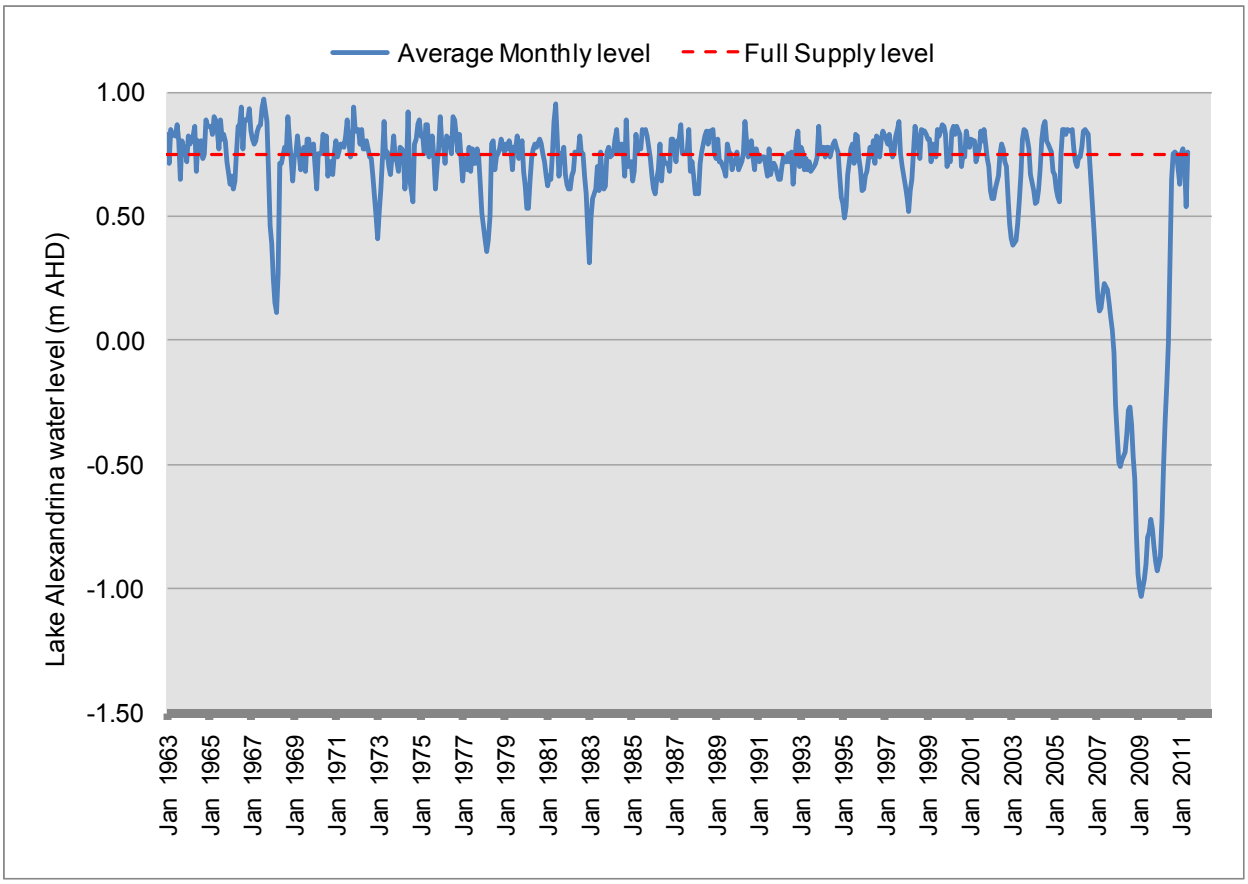

FIGURE 17 Behaviour of Lower Lakes 1962 to end May 2011

7 Calendar of events in 2011-12

Month	Major Works or Actions	Community events
June	Lake Mulwala drawdown for control of *Egeria* Commence filling Lake Victoria unless sufficient flows in transit	
July	Commence re-filling Lake Mulwala	
August	Expected increase in diversions as warmer weather arrives	
September		
October	Harmony transfers from Menindee Lakes to Lake Victoria may commence if conditions are dry Earliest date that transfers from Dartmouth to Hume Reservoir would commence.	
November		Lake Mulwala Power Boat festival—website not yet updated with 2011 dates - http://www.lakemulwalapower.com.au/
December		27–31 Dec 2011, Murray River Canoe Marathon, Yarrawonga to Swan Hill - http://www.murraymarathon.ymca.org.au/Pages/default.aspx
January		21–22 Jan 2012, Milang – Goolwa sailing regatta
February		Southern 80 water ski race at Echuca— website not yet updated with 2012 dates http://www.southern80.com.au/ SA Wooden Boat Festival (Goolwa wharf precinct) to be held 23–24 Feb 2013
March		Robinvale-Euston water ski classic— website not yet updated with 2012 dates http://www.waterskiracing.com/Robinvale.html
April		Mildura 100 water ski race— website not yet updated with 2012 dates http://www.milduraskiclub.org/ Annual Easter Fishing Competition—Moulamein
May	Normal end of irrigation season. Possible partial lowering of Torrumbarry Weir pool to minimise bank notching	

8 FURTHER INFORMATION ON RIVER MURRAY SYSTEM OPERATIONS

This annual operating plan will be reissued only if a significant amendment is required due to unforeseen circumstances.

Public updates on river operations within the water year will be provided in a number of forms, which can be accessed via the MDBA website (www.mdba.gov.au) including:

- the MDBA Weekly Report on river operations;
- live river data;
- water in storage;
- forecasts in relation to flows and salinity levels;
- media releases in relation to river operations; and
- special circumstances reports, such as drought updates.

MDBA will update its routine monthly operational plan, which contains the outlooks of potential storage behaviours and release rates, regularly throughout 2010-11. These updates of the operational plan will be shared with the jurisdictions via Water Liaison Working Group and will be forwarded to Basin Officials Committee as necessary.