River Murray system
annual operating plan

2016–17 water year
1 June 2016–31 May 2017
Acknowledgement of the Traditional Owners of the Murray–Darling Basin

The Murray–Darling Basin Authority acknowledges and pays respect to the Traditional Owners, and their Nations, of the Murray–Darling Basin, who have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. The MDBA understands the need for recognition of Traditional Owner knowledge and cultural values in natural resource management associated with the Basin.

The approach of Traditional Owners to caring for the natural landscape, including water, can be expressed in the words of Darren Perry (Chair of the Murray Lower Darling Rivers Indigenous Nations) —

the environment that Aboriginal people know as Country has not been allowed to have a voice in contemporary Australia. Aboriginal First Nations have been listening to Country for many thousands of years and can speak for Country so that others can know what Country needs. Through the Murray Lower Darling Rivers Indigenous Nations and the Northern Basin Aboriginal Nations the voice of Country can be heard by all.

This report may contain photographs or quotes by Aboriginal people who have passed away. The use of terms ‘Aboriginal’ and ‘Indigenous’ reflects usage in different communities within the Murray–Darling Basin.
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1. Introduction

The River Murray system annual operating plan for the 2016–17 water year (1 June 2016 to 31 May 2017) provides context and describes how the River Murray system (the system) may be operated under a number of inflow scenarios in the coming year.

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

This plan contains:

- Chapter 1 – A brief description of the legislative framework relevant to the operation of the River Murray system
- Chapter 2 – Key objectives and constraints in operations
- Chapter 3 – System status at 1 June 2016 and potential water availability in 2016–17
- Chapter 4 – Summary of water sharing and significant river operations during the 2016–17 water year under a range of scenarios
- Chapter 5 – Outlooks for River Murray system operations during 2016–17
- Chapter 6 – Graphs for a range of scenarios at individual structures and reaches
- Chapter 7 – A calendar of events
- Chapter 8 – Advice on where to find further information on the River Murray system.

The actual conditions that occur in the 2016–17 water year will inevitably be different to the scenarios presented in this plan, and therefore actual river operations will also be different to any projection presented. In particular, the patterns of environmental water delivery and use during 2016–17 are uncertain; and the impacts on the scenarios in this operational plan may be appreciable. Nevertheless, these scenarios provide a useful indication of the breadth of potential river operations in the 2016–17 water year.

This document will be formally reviewed by the MDBA and the Water Liaison Working Group in October 2016. The jurisdictions regularly discuss system planning, through the Water Liaison Working Group, and account for actual conditions as the season progresses in order to fine-tune system operations. This plan will be updated if there are significant changes.

At the opening of each water year the MDBA undertakes a formal planning process with the Water Liaison Working Group to ensure adequate planning is in place prior to this operating plan being made public. At its meeting on 26 May 2016 the Water Liaison Working Group noted that minimum releases from Hume and Dartmouth Reservoirs were planned for June and July 2016, with some additional releases of environmental water from Hume Reservoir likely from July onwards. Water in transit in the Murrumbidgee River in May was expected to increase Lake Victoria’s storage volume throughout June, and no inter-valley trade (IVT) account water was planned to be called until spring 2016. If there are significant operations being proposed early in the 2016–17 water year the MDBA will make these public.

LEGISLATIVE FRAMEWORK

The MDBA coordinates 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, and operations are undertaken in accordance with decisions of the Murray–Darling Basin Ministerial Council and the Basin Officials Committee. In this respect the MDBA acts on behalf of the joint governments in operating the River Murray system to meet their requirements.

This Annual operating plan is consistent with the:

- Water Act 2007 including the Murray–Darling Basin Agreement
- Relevant decisions of Ministerial Council and Basin Officials Committee
- Objectives and Outcomes for River Operations in the River Murray system as determined by Basin Officials Committee
- The Basin Plan 2012 (in particular Chapters 9 and 11)
- MDBA corporate plan
- MDBA asset management plan
- MDBA asset agreement
- States policies and laws
- Memoranda of understanding with Constructing Authorities.

The Annual operating plan has regard to:

- Basin annual environmental watering priorities
- Priorities of the Southern Connected Basin Environmental Watering Committee
- The Living Murray operational scenarios
- Commonwealth Environmental Water Holder environmental watering plans
- Southern Basin state watering plans (where provided).

In the event of any conflict between these documents or between the Annual operating plan and these documents, the MDBA will seek the advice of jurisdictions as appropriate.

KEY DIFFERENCES TO LAST YEAR’S PLAN

Annual Operating Plans aim to cover the full range of potential inflow and demand conditions that might be observed in any particular year. However, compared with last year, some of the differences worth noting are listed below:

- Opening storage levels are lower than at this time last year – see section 3.1
- The ‘very wet’ scenario has been removed and in its place a ‘very dry’ scenario has been added. This provides more useful information in those drier years where system operations can be complex. Very wet years are characterised by prolonged periods of spill and with limited decisions required about bulk transfers from headwater storages
- A commercial arrangement between Snowy Hydro Limited and Murray Irrigation Limited is in place and further details can be found in section 5.6.
2. Objectives and constraints

2.1 Key objectives

The governments of the Commonwealth, NSW, Victoria and South Australia, via the Basin Officials Committee (BOC), have responsibility for the high-level decision-making in relation to river operations. They perform this by setting objectives and outcomes for MDBA to achieve. The document entitled “Objectives and Outcomes for River Operations in the River Murray System” can be found on the MDBA website.

In many instances, river operations require the balancing of competing needs on a day-to-day basis. The following broad objectives have been set by the BOC when carrying out river operations:

- **Water storage and delivery and accounting** — To operate the River Murray system efficiently and effectively in order to deliver state water entitlements, while conserving water and minimising undesirable losses; and to maximise the water available to the Southern Basin states, after providing for operating commitments in the River Murray system.

- **River Murray Operations (RMO) assets** — To ensure that RMO assets allow MDBA to manage and deliver water that is fit for the purpose for which it is to be used, efficiently, effectively and safely.

- **People and communities** — To contribute to the safety of communities along the River Murray as well as the economic, social, environmental and cultural activities of people using the River Murray system.

- **Environment** — To contribute to the protection and, where possible, restoration of priority environmental assets and ecosystem functions within the River Murray system.

- **Communication and information management** — To ensure that MDBA, in operating the River Murray system; uses the best available data, tools and systems; keeps all stakeholders with an interest in the MDBA’s river operations well informed of its plans and activities; acts transparently; and is accountable for its actions in accordance with the Agreement.

If, on any occasion, the 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, the MDBA shall consult with the jurisdictions. The MDBA will aim to achieve an appropriate balance between conflicting objectives, taking into consideration the prevailing circumstances, in accordance with the advice or decision of the jurisdictions.

2.2 System attributes

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, including:
There is extreme variability in the weather of the Murray–Darling Basin, and consequently the 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 climate is changing and the River Murray system has experienced record-breaking droughts, summer floods, and extreme temperatures in the last decade. The Bureau of Meteorology reports that southeast Australia has experienced a decline in late autumn and early winter rainfall since the mid-1990s. The traditional river system planning methods (adopted in this document) use observed historical inflow and demand patterns as a foundation. Such observations may no longer represent the variability of future seasons and the MDBA works closely with the Bureau of Meteorology to ensure the latest information on trends and outlooks are factored into the operation of the River Murray system.

Demand patterns along the River Murray System are constantly evolving due to new irrigation developments and changing crop types. The MDBA together with the Water Liaison Working Group will continue to monitor trends in demand patterns and adjust operations accordingly.

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.

The amount and location of water carried-over from year to year is changing as entitlement holders adapt to new and evolving 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 depending on needs and natural flow triggers. This is difficult to encapsulate in the operational plans so a range of plausible watering assumptions have been made to test deliverability.

There may also be short-term issues along the river, which are difficult to foresee, that can require a rapid response. Some issues affecting river operations develop within weeks (e.g. blue–green algal blooms), or within days (e.g. a sudden increases in salinity, or a fish kill due to poor water quality). 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 that require an immediate response.

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

- Mitta Mitta River downstream of Dartmouth Reservoir: approximately 10,000 ML/day at Tallandoon
- Hume Reservoir to Yarrawonga Weir: 25,000 ML/day at Doctors Point
- release from Yarrawonga Weir (due to ‘Barmah Choke’): approximately 10,000 ML/day (currently, when watering of the Barmah–Millewa Forest is desirable, regulated releases of up to 3.3 m gauge height at Tocumwal (~18,000 ML/day) may be targeted subject to a range of conditions and timing)
River Murray system - Annual operating plan 2016–17

- inlet to Lake Victoria (Frenchmans Creek): up to 10,000 ML/day depending on the water level in Lake Victoria
- outlet from Lake Victoria (Rufus River): up to 10,000 ML/day depending on river and lake levels (although at rates above 7–8,000 ML/day, erosion along the Rufus River needs to be taken into consideration).
- Edward River downstream of Stevens Weir: 2,700 ML/day (not applicable when watering of Werai Forest is desirable)
- Lower Darling River downstream of Menindee Lakes: 9,000 ML/day (although rates may be reduced to improve NSW water supply reliability at Menindee Lakes)
- outlet to lower Darling River from Lake Menindee: less than 4,000 ML/day depending on level in Lake Menindee.

The constraints above are limits which are not targeted to be exceeded by normal river operations. These flows are not, however, automatic targets and lower flow rates will often be appropriate given the circumstances at the time.

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 River in Victoria (operated by Goulburn-Murray Water) and the Murrumbidgee River and Billabong Creek in NSW (operated by WaterNSW), including the delivery of water held in inter-valley trade accounts (known as IVT or Valley Accounts) as a result of permanent and temporary water trade to the Murray
- tributaries that are primarily unregulated, such as the Kiewa and Ovens Rivers
- the Darling River in NSW, including any operations of the Menindee Lakes when directed by NSW (see Section 6.6).

This coordination is important, as water released from storages within the 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 an increasing number of weirs in recent years to assist in meeting environmental and water delivery objectives. These operations may not always match the expectations of local communities that may have previously experienced near constant weir pool levels for long periods of time. Changing weir pool levels will increase in frequency in the future for a range of purposes, including to achieve improved ecological outcomes. River operations may lead to changes in weir pool levels, after consideration is given to balancing objectives in Section 2.1

Long travel times. In the reach from Hume Reservoir to Lake Victoria, there is limited capacity in weirpools for re-regulation or release of flows into the River Murray – even with the increasing variability of weirpool levels. The typical flow time between Hume Dam and Lake Victoria under regulated flow conditions is 25 days – far longer than it is possible to reliably forecast weather conditions. 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. The combination of long travel times and limited re-regulation capacity limits the level of control that the 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 consumptive orders for short periods of time. For example, a ‘rain rejection’ can result if water orders are cancelled, due to significant rainfall along the river, after the water has already been released. Subsequent out-of-bank flows are possible, particularly in the Barmah–Millewa Forest (discussed further in Section 6.3).
3. Potential water availability

3.1 System status on 1 June 2016

3.1.1 Catchment Condition
The Murray–Darling Basin received rainfall in 2015–16 that was generally close to average or drier (Figure 1). Overall the distribution of rainfall was similar to the previous year, 2014–15, including below to well below average rainfall across the northern Victoria catchments which flow into the River Murray. The upper Murray region, which provides runoff into the major headwater storages of Dartmouth and Hume, experienced generally below-average rainfall. In the northern Basin, the upper Darling catchments received generally average to below average rainfall for the year, with many locations in south-east Queensland still in drought conditions following three consecutive failed summer wet seasons.

Figure 1: Rainfall deciles 1 June 2015 to 31 May 2016 (source: Bureau of Meteorology)
Temperatures were well above average throughout the Basin in 2015–16 (Figure 2). These comparatively hot conditions led to high rates of surface water evaporation, reduced generation of runoff and exacerbated water shortages in those regions experiencing low rainfall.
The relatively hot and dry conditions across south-east Australia during 2015–16 were in part due to one of the three strongest El Niño events since 1950. El Niño conditions persisted well into 2016, with sea surface temperatures in the tropical Pacific only cooling to neutral levels in May. International climate models indicate that the tropical Pacific Ocean will continue to cool with the possibility of La Niña conditions forming in winter. Typically, La Niña conditions are associated with above average winter-spring rainfall over northern, central and eastern Australia. In addition to a potential La Niña, warmer ocean temperatures in the Indian Ocean have established a negative Indian Ocean Dipole pattern. A negative Indian Ocean Dipole is typically associated with above average rainfall and cooler than average daytime temperatures across southern Australia during winter-spring.

Consecutive years of below-average rainfall and elevated temperatures have contributed to a decline in deep level soil moisture throughout large parts of the Murray–Darling Basin (Figure 3). These antecedent conditions meant that even though parts of the River Murray system received average rain in 2015–16, the combination of relatively high temperatures, high evaporation and dry catchments resulted in reduced runoff into storages.
3.1.2 Inflows in 2015–16

Inflows in 2015–16 were well below the long-term average for every month of the year (Figure 4). Peak inflows to the River Murray system are generally received during the late-winter and spring months of August to October, enabling storages to fill prior to the main irrigation season. However, similar to 2014–15, inflows during this important three-month period were again very low in 2015–16, being just 31% of the long-term average (or 90% annual exceedance probability, i.e. the % of years in the historical record with greater inflow).

Total inflows to the River Murray system for 2015–16 were 3,040 GL (excluding Menindee, Snowy Mountains Scheme, IVT and environmental water delivered via tributary inflows), which has an annual exceedance probability of 91% (Figure 5). The median annual inflow for the River Murray system is 7,880 GL.

There was very little inflow to the Menindee Lakes system for the third year in a row, with only about 76 GL flowing into the lakes in 2015–16. For the three years since June 2013, the inflow has totalled less than 300 GL. This inflow sequence is now the lowest on record – exceeding the previous lows experienced during the Millennium drought. Looking at 120 years of historical levels, it is unprecedented to see extremely low inflows for three years in a row with no ‘recovery’ event. Further information is available from NSW Department of Primary Industries (DPI) website.
Figure 4: River Murray system inflows—recent years and long-term averages

Note: inflows exclude Menindee inflows, Snowy Mountains Scheme releases, and inter-valley transfers of consumptive and environmental allocations and are based on modelled current conditions.

Figure 5: River Murray system inflows—water year totals (to end May) since 1892

Note: inflows exclude Menindee inflows, Snowy Mountains Scheme releases, and inter-valley transfers of consumptive and environmental allocations and are based on modelled current conditions.
3.1.3 Active storage

River Murray system active storage at end May 2015 was 3,780 GL (44% capacity) (Figure 6) spread across Dartmouth Reservoir, Hume Reservoir and Lake Victoria. Modest rainfall in winter 2015 helped boost active storage levels to a peak volume for the year of 4,490 GL (52% capacity) in late September. Following this, dry conditions and reasonable allocations (taking into account carryover from the previous year), resulted in large volumes of water being released from storages for the remainder of the water year. As of 31 May 2016, the active storage volume was 2,540 GL, which is about 2,500 GL less than the long-term average for the end of the water year.

Figure 6: MDBA active storage June 2000 to May 2016.

This graph shows the sum of active storage in Dartmouth and Hume Reservoirs, Lake Victoria and the Menindee Lakes. Menindee Lakes only contributes to MDBA active storage when the storage volume is above 640 GL.

The storage in the MDBA major reservoirs on 1 June 2016 is shown in Table 1. Menindee Lakes storage volume was less than 640 GL and therefore not available to the MDBA. On 1 June 2016, there was also approximately 140 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 these valleys and into the Murray.

Total storage in the Snowy Mountains reservoirs (managed by Snowy Hydro Limited) remains modest. Lake Eucumbene storage has fallen in the past year from around 54 to 36% capacity.
Table 1: Storage in MDBA major reservoirs on 1 June 2016

<table>
<thead>
<tr>
<th>Major storage</th>
<th>Total capacity (GL)</th>
<th>Active capacity (GL)</th>
<th>Total water in storage (GL)</th>
<th>Percentage of total capacity</th>
<th>Active water in storage (GL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dartmouth Reservoir</td>
<td>3,856</td>
<td>3,785</td>
<td>1,713</td>
<td>44%</td>
<td>1,642</td>
</tr>
<tr>
<td>Hume Reservoir</td>
<td>3,005</td>
<td>2,982</td>
<td>738</td>
<td>25%</td>
<td>715</td>
</tr>
<tr>
<td>Lake Victoria</td>
<td>677</td>
<td>577</td>
<td>303</td>
<td>45%</td>
<td>203</td>
</tr>
<tr>
<td>Menindee Lakes*</td>
<td>1,731</td>
<td>1,251</td>
<td>49</td>
<td>3%</td>
<td>0</td>
</tr>
<tr>
<td>River Murray system total</td>
<td>9,269</td>
<td>8,595</td>
<td>2,803</td>
<td>30%</td>
<td>2,560</td>
</tr>
</tbody>
</table>

*Menindee Lakes may be surcharged to 2,050 GL under certain circumstances. Water will not be available to the MDBA until the volume next exceeds 640 GL.

3.1.4 Critical human water needs and conveyance reserve

The MDBA has declared that the River Murray system is under ‘Tier 1’ conditions. This means that ‘normal’ water sharing arrangements are in place at the start of 2016–17 water year. Tier 1 arrangements can be expected to apply in all but extremely dry periods when enough water is available to meet critical human water needs (NSW 61 GL, Victoria 77 GL and South Australia 204 GL) and enough water (1,596 GL conveyance water) is available to operate the river system to deliver critical human water needs.

In Tier 1, a conveyance reserve of 225 GL is also set aside for the next year to safeguard the delivery of critical human water needs into the future. The full conveyance reserve for 2017–18 has been set aside at the start of 2016–17 by the states; and each state has sufficient water to meet its critical human water needs in 2016–17.

Tier 1 water sharing arrangements are likely to continue for 2016–17. If inflows are extremely low in 2016–17, then critical human water needs would only be expected to be in jeopardy if such dry conditions continue into 2017–18. The probability of this occurring is low but nonetheless a possibility. The MDBA will closely monitor conditions and liaise with partner governments to monitor risks and adjust plans accordingly in the knowledge that drought security is reliant on forward planning and the management of reserves.

3.2 Hydrological assumptions for 2016–17

The annual water availability for each state is determined by the MDBA prior to the start of each water year (1 June) and then updated at least monthly throughout the year. The annual water availability for each state is determined in accordance with the water sharing provisions of the Murray–Darling Basin Agreement and is calculated using data, models and assumptions agreed to by each of the jurisdictions. In some instances, water availability assessments are prepared twice monthly to assist allocation announcements by the states.

Each determination of water availability takes into account the available water that is in storage at the time, the water in transit, the amount of water used in that water year so far, assumptions of future inflows (both regulated and unregulated) and the losses that may be experienced in storing and delivering water along the length of the River Murray system for the remainder of the year.
3.2.1 River Murray system scenarios for 2016–17

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 in 2016–17. Each scenario has in-built assumptions for inflows from the Snowy Scheme, unregulated inflows into Dartmouth and Hume Reservoirs and inflows from the tributaries; including the Kiewa, Ovens, Goulburn, Murrumbidgee, and lower Darling Rivers, conveyance (river losses), storage losses and usage patterns and volumes.

The supply of water to the environment is now a major feature of River Murray system operations and, due to the nature of environmental water delivery, significant uncertainties exist on how this water will be delivered in the 2016–17 water year. These scenarios include assumptions on both consumptive and environmental use and any differences between actual and assumed use may change operations.

The scenarios provide indicative quantities of water availability to the states to assist planning and risk management by water managers and system operators. They are not an accurate outlook for determining the potential allocations that States might announce throughout the year. Entitlement holders should regularly seek the latest information available from their respective water authority on announced allocations and outlooks for improvement. The assumptions in each scenario could change in future years as data and models are updated.

The scenarios in this plan are based on information available at 1 June 2016. The scenarios include the impacts of rain up to this date and allow for a recession of inflows into late June 2016. The relative difference between the inflows of each of the six scenarios can be compared in Figure 7.

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:

- an ‘extreme dry’ scenario which assumes about 860 GL of River Murray system inflows. The ‘worst case’ scenario determined under the Basin Plan totals 650 GL, however inflows could not reasonably be expected to fall to such low levels in 2016–17 as it would require extreme dry conditions to persist over two years. For comparison the lowest inflows on record (2006–07) totalled about 914 GL, including Menindee inflows. It is conceivable that if very dry conditions are observed in 2016–17, MDBA may adopt the ‘worst case’ scenario for operational planning in 2017–18
- a ‘very dry’ scenario, assumes River Murray system inflows of about 2,000 GL, which is comparable to inflows in 2008–09
- a ‘dry’ scenario, assumes River Murray system inflows of about 3,000 GL, which is comparable to inflows in 2015–16
- a ‘moderate’ scenario, assumes River Murray system inflows of about 4,400 GL which is comparable to inflows in 2014–15
- a ‘near average’ scenario, assumes River Murray system inflows of about 8,000 GL which is comparable to inflows in 2012–13
- a ‘wet’ scenario, assumes River Murray system inflows of about 14,500 GL which is comparable to inflows in 2011–12
Figure 7: River Murray system inflows – ranked water year totals since 1892

Note: The extreme dry scenario, highlighted in red, is lower than the lowest inflow on record. Inflows include Menindee inflows but exclude Snowy Mountains Scheme releases, inter-valley transfers and environmental water; and are based on modelled current conditions.

3.2.2 Conveyance water (river losses)

The volume of water set aside for conveyance, which includes losses due to evaporation and seepage along the river system, varies between scenarios. The ‘extreme dry’ and ‘dry’ scenarios assume 850 GL for conveyance between Dartmouth Reservoir and the South Australian border. The 850 GL conveyance along the River Murray takes a conservative approach and is higher than losses experienced in recent dry years, i.e. about 750 GL in 2006-07, but does reflect losses observed in the last few years which have seen record summer and early autumn temperatures.

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

The 850 GL assumes that:

- river flows are at 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
• any additional net losses caused by varying weir pool levels for environmental benefit are debited to environmental entitlement holders.

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 1,050 GL assumed in the ‘wet’ scenario (Table 2). The pattern of actual losses, in both location and time, can be very different to those assumed in this operational plan.

The conveyance loss, under regulated conditions, along the River Murray in South Australia upstream of Wellington (just upstream of Lake Alexandrina) is included as part of the South Australian 696 GL Dilution and Loss entitlement. The proportion of evaporation and other losses between the SA border and Wellington compared with flows to the Lower Lakes will vary from year to year depending on evaporation, extent of inundation and local rainfall. For ‘extreme dry’ planning purposes, it is assumed that about half of the 696 GL is lost and the other half flows to the Lower Lakes.

Table 2: Detail of assumptions in each scenario for 2016–17

<table>
<thead>
<tr>
<th>Item</th>
<th>Type</th>
<th>Extreme dry (GL)</th>
<th>Very dry (GL)</th>
<th>Dry (GL)</th>
<th>Moderate (GL)</th>
<th>Near average (GL)</th>
<th>Wet (GL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active MDBA storage on 1 June 2016</td>
<td>Input</td>
<td>2,560</td>
<td>2,560</td>
<td>2,560</td>
<td>2,560</td>
<td>2,560</td>
<td>2,560</td>
</tr>
<tr>
<td>Water available from Valley Accounts</td>
<td>Input</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td>140</td>
</tr>
<tr>
<td>Change in water in transit between 1 June 2016 and 31 May 2017</td>
<td>Input</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>Inflows from upstream of Albury (including Snowy Scheme release assumptions)</td>
<td>Input</td>
<td>830</td>
<td>1,640</td>
<td>2,460</td>
<td>3,350</td>
<td>4,480</td>
<td>6,210</td>
</tr>
<tr>
<td>Inflows from upstream of Menindee</td>
<td>Input</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>700</td>
<td>2,700</td>
</tr>
<tr>
<td>Inflows from Victorian tributaries</td>
<td>Input</td>
<td>230</td>
<td>660</td>
<td>890</td>
<td>1,400</td>
<td>2,600</td>
<td>4,400</td>
</tr>
<tr>
<td>Inflows from NSW tributaries</td>
<td>Input</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td>460</td>
<td>1,020</td>
<td>2,030</td>
</tr>
<tr>
<td>Conveyance losses upstream of SA Border Commitment</td>
<td>Commitment</td>
<td>-850</td>
<td>-850</td>
<td>-850</td>
<td>-850</td>
<td>-860</td>
<td>-1,050</td>
</tr>
<tr>
<td>Conveyance losses along lower Darling River Commitment</td>
<td>Commitment</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-10</td>
<td>-200</td>
</tr>
<tr>
<td>Conveyance Reserve for 2017–18 Commitment</td>
<td>Commitment</td>
<td>-225</td>
<td>-225</td>
<td>-225</td>
<td>-225</td>
<td>-225</td>
<td>-225</td>
</tr>
<tr>
<td>Storage losses upstream of the SA Border Commitment</td>
<td>Commitment</td>
<td>-220</td>
<td>-250</td>
<td>-270</td>
<td>-290</td>
<td>-410</td>
<td>-740</td>
</tr>
<tr>
<td>Supply of South Australian Dilution and Loss Entitlement Commitment</td>
<td>Commitment</td>
<td>-696</td>
<td>-696</td>
<td>-696</td>
<td>-696</td>
<td>-696</td>
<td>-696</td>
</tr>
</tbody>
</table>
3.2.3 Storage losses

Assumptions of evaporative losses from storages vary for each scenario, being about 220 GL in the ‘extreme dry’ scenario and then increasing in the wetter scenarios (740 GL in ‘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 in the wetter scenarios is at Menindee Lakes (110-400 GL). High summer rainfall, as occurred in 2011–12, can significantly reduce evaporative losses, but this has not been assumed in the scenarios.

3.2.4 South Australia’s Storage Right (Schedule G)

In response to the extreme drought conditions in 2006 and 2007, the Water Act (2007) includes provisions to improve security of supplies under a repeat, or even worse drought conditions. Two Schedules (Schedules G and H) to the Murray–Darling Basin Agreement have been enacted in this regard. These Schedules allow South Australia to store water, without risk to Victorian and NSW water security, in order to safeguard the delivery of critical human water needs to South Australia during periods of severe drought. Additionally there are provisions for setting water aside for private carryover under Schedule G. South Australia has a Private Carryover Policy to guide the allocation of this water.

During 2015–16, South Australia set aside around 140 GL for critical human water needs and private carryover from the Entitlement Flow. Taking into account the volume set aside in previous years and after deductions for evaporation, the total volume of South Australian storage right as of 1 June 2016 is 194 GL. Of this 194 GL, 142 GL is stored in Dartmouth, 10 GL in Hume, and 42 GL in Lake Victoria. Water held in South Australia’s Storage Right is the first to spill, should physical spills or pre-flood releases occur at the relevant storage.

Depending on prevailing conditions in 2016–17, South Australia may either seek to call upon some of their storage right (particularly the private carryover component), or alternatively add to their storage right through further deferral. These decisions will be informed by a number of factors including water availability, weather outlook and flow and water level requirements below Lock 1. South Australia will advise the MDBA of their monthly deferred water storage plans throughout the year. This operating plan assumes deferral of 15 GL of South Australian entitlement in each of June and July 2016 (see Section 6.7 for further information).
4. Summary of water sharing and significant operations

The quantity of water made available to States 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 3.2.1 of this plan, Table 3 provides a summary of water availability while Table 4 provides a summary of important operational decisions that may need to be made. Outlooks and information related to environmental water management for the six scenarios are outlined in Section 5.4.

The water sharing arrangements (Tier 1) between states, which are in effect at the start of 2016–17, are outlined in Part XII of the Murray–Darling Basin Agreement.
### Table 3: Summary of water availability under each scenario

<table>
<thead>
<tr>
<th>Water availability</th>
<th>Extreme dry (GL)</th>
<th>Very dry (GL)</th>
<th>Dry (GL)</th>
<th>Moderate (GL)</th>
<th>Near average (GL)</th>
<th>Wet (GL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharing rules at end of May 2016</td>
<td>Tier 1</td>
<td>Tier 1</td>
<td>Tier 1</td>
<td>Tier 1</td>
<td>Tier 1</td>
<td>Tier 1</td>
</tr>
<tr>
<td>Indicative water availability: NSW ^</td>
<td>670</td>
<td>900</td>
<td>1,140</td>
<td>1,500</td>
<td>2,150</td>
<td>3,010</td>
</tr>
<tr>
<td>Indicative water availability: VIC ^</td>
<td>970</td>
<td>1,560</td>
<td>1,960</td>
<td>2,360</td>
<td>2,870</td>
<td>3,540</td>
</tr>
<tr>
<td>Indicative water availability: SA ^*</td>
<td>270</td>
<td>500</td>
<td>710</td>
<td>920</td>
<td>1,154</td>
<td>1,154</td>
</tr>
<tr>
<td>SA Dilution &amp; Loss</td>
<td>696</td>
<td>696</td>
<td>696</td>
<td>696</td>
<td>696</td>
<td>696</td>
</tr>
<tr>
<td>Conveyance Reserve for 2016–17</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
</tr>
<tr>
<td>Forecast Minimum Reserve at end May 2017</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>450</td>
</tr>
<tr>
<td>Trade Adjustment to South Australia at 1 June **</td>
<td>−20</td>
<td>−20</td>
<td>−20</td>
<td>−20</td>
<td>−20</td>
<td>−20</td>
</tr>
<tr>
<td>Special Accounting (Special accounting arrangements are set out in the Murray–Darling Basin Agreement and apply when water availability is relatively low)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW likely to remain in special accounting throughout year. Vic likely to commence special accounting in August and continue through year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW likely to remain in special accounting throughout year. Vic likely to commence special accounting in August but may exit before end of year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW likely to remain in special accounting throughout year. Vic likely to commence special accounting in August but may exit before end of year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW likely to exit special accounting before end of year. Vic unlikely to commence special accounting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW likely to exit special accounting before end of year. Vic unlikely to commence special accounting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net internal spill at all MDBA storages (Vic to NSW) ***</td>
<td>0^</td>
<td>0^</td>
<td>0^</td>
<td>330^</td>
<td>190^</td>
<td>20^</td>
</tr>
<tr>
<td>Additional Dilution Flow (see Section 6.6.1)</td>
<td>≈ 0^</td>
<td>≈ 0^</td>
<td>≈ 0^</td>
<td>≈ 0^</td>
<td>≈ 110</td>
<td>≈ 4,220</td>
</tr>
<tr>
<td>Unregulated Flows ##</td>
<td>≈ 0</td>
<td>≈ 0</td>
<td>≈ 0</td>
<td>1,090</td>
<td>1,580</td>
<td>1,700</td>
</tr>
<tr>
<td>Assumed usage: NSW ###</td>
<td>540</td>
<td>670</td>
<td>810</td>
<td>1,770</td>
<td>1,840</td>
<td>1,900</td>
</tr>
<tr>
<td>Assumed usage: VIC</td>
<td>820</td>
<td>1,260</td>
<td>1,520</td>
<td>1,850</td>
<td>1,850</td>
<td>1,850</td>
</tr>
<tr>
<td>Assumed usage: SA ent. delivered</td>
<td>970</td>
<td>1,200</td>
<td>1,410</td>
<td>1,850</td>
<td>1,850</td>
<td>1,850</td>
</tr>
<tr>
<td>End of season active storage (highly dependent on water use during 2016–17)</td>
<td>≈ 600^</td>
<td>≈ 1,000^</td>
<td>≈ 1,500^</td>
<td>≈ 2,200^</td>
<td>≈ 3,000^</td>
<td>≈ 5,800^</td>
</tr>
</tbody>
</table>

---
The indicative water availabilities in all scenarios of this table only assume the minimum guaranteed Snowy release for 2016–17 (i.e. Snowy inflow assumptions do not increase in wetter scenarios).

As at end May 2016, an additional 194 GL was available in South Australia’s storage right.

Trade Adjustment figure will increase South Australia’s Entitlement in 2016–17. Figure given is the volume forecast at 1 June and may change during the year.

NSW and Victoria each have access to half the capacity of each MDBA storage. When a state ‘fills’ its half, any additional inflow ‘internally spills’ to the other state.

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

When the flow or prospective flow of the River Murray at the South Australian border is unable to be regulated, South Australia will receive these additional flows above its entitlement flow as ‘unregulated flow’.

Includes use of allocations made available via Snowy Hydro Limited arrangement (see Section 5.6).

<table>
<thead>
<tr>
<th>Table 4: Summary of significant river operations under each scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>River operations</strong></td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Expected Dartmouth release above minimum</td>
</tr>
<tr>
<td>Dartmouth storage end May 2017</td>
</tr>
<tr>
<td>Hume storage</td>
</tr>
<tr>
<td>Use of Goulburn Valley Account</td>
</tr>
</tbody>
</table>

Use of Goulburn Valley Account

At the start of July 2016, it is expected that there will be around 90 GL in the Goulburn Valley Account (from net trade out of the valley). The Goulburn Valley Account water will be called by the MDBA throughout the water year as required, typically between the months of November and April. The MDBA will liaise closely with the Goulburn-Broken CMA and Goulburn-Murray Water during the 2016–17 water year to adaptively manage the MDBA requests for the delivery of water from the Goulburn to meet irrigation and environmental water 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 River, Campaspe River and Broken Creek (see Section 5.4.3).
### River operations

#### Use of Murrumbidgee Valley Account
At the start of July 2016, it is expected that there will be around 100 GL in the Murrumbidgee Valley Account (from net trade out of the valley). The Murrumbidgee Valley Account water will be called by MDBA throughout the water year as required, typically between the months of November and April. If conditions early in 2016–17 are dry Murrumbidgee Valley Account water may be called earlier than November. If there are significant volumes of trade to the Murray then the MDBA will liaise closely with NSW in regard to delivery rates and timing. It is possible that environmental water may be traded through the Murrumbidgee account and delivered at Balranald. In this event, the environmental trade volume would be called immediately upon the water being traded in and so would have a zero net effect on total volumes held within the Murrumbidgee account.

#### Operation of Weir pools (see Section 5.3 for details)

<table>
<thead>
<tr>
<th>River operations</th>
<th>Extreme dry</th>
<th>Very dry</th>
<th>Dry</th>
<th>Moderate</th>
<th>Near average</th>
<th>Wet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible operational manipulations at all weirs.</td>
<td>Possible operational manipulations at all weirs.</td>
<td>Possible operational manipulations at all weirs.</td>
<td>Some flood operations. Possible operational manipulations at all weirs.</td>
<td>Some flood operations. Possible operational manipulations at all weirs.</td>
<td>Flood operations. Possible operational manipulations at all weirs.</td>
<td></td>
</tr>
</tbody>
</table>

#### Lake Victoria Operating Strategy Cultural Heritage

<table>
<thead>
<tr>
<th>River operations</th>
<th>Extreme dry</th>
<th>Very dry</th>
<th>Dry</th>
<th>Moderate</th>
<th>Near average</th>
<th>Wet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal levels but may not fill</td>
<td>Normal levels but may not fill</td>
<td>Normal levels but may not fill</td>
<td>Spilling between August and September</td>
<td>Spilling between July and October</td>
<td>Spilling between July and December</td>
<td></td>
</tr>
</tbody>
</table>

All scenarios: Operations will need to minimise the length of time that the Lake Victoria level is high. Lake levels will need to 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 2016 (Section 6.5)

<table>
<thead>
<tr>
<th>River operations</th>
<th>Extreme dry</th>
<th>Very dry</th>
<th>Dry</th>
<th>Moderate</th>
<th>Near average</th>
<th>Wet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected to require additional release from upper storages. May not be able to be met.</td>
<td>Expected to require additional release from upper storages. May not be able to be met.</td>
<td>Expected to require additional release from upper storages. May not be able to be met.</td>
<td>May require additional release from upper storages. Likely to be able to be met.</td>
<td>Able to be met</td>
<td>Able to be met</td>
<td></td>
</tr>
</tbody>
</table>
5. System operations

5.1 Introduction

Water availability at the start of the season on 1 July 2016 will be very limited in Victoria and NSW, although carryover water will be available to many entitlement holders. Lower Darling water availability is expected to be very limited due to the low storage levels in the Menindee Lakes. Using the assumptions contained within this operating plan, full entitlement flow for South Australia is not assured until the near average scenario.

It is expected that there will be limited irrigation demand in NSW unless there is significant winter and spring rainfall to boost allocation levels. However, some water users in the Murray Irrigation Limited area, and potentially other regions, may have access to water borrowed from Snowy Hydro Limited (see Section 5.6). In Victoria, initial irrigation demand is expected to be higher than NSW given the relative states’ water availability.

If dry conditions ensue, environmental water use in 2016–17 is expected to be focused on protecting key environmental assets and functions during this dry phase (this is discussed further in Section 5.4).

Despite the dry condition of the catchments late in 2015–16, it is possible that good rainfall can occur and under these scenarios it is possible that some parts of the River Murray system will experience overbank flows or flooding in 2016–17. This will be greatly influenced by the timing, location and intensity of rainfall events that cannot be forecast this far in advance. Further information on the potential for high flows and flooding is provided for each structure/reach in Section 6. As significant rain events unfold, the Bureau of Meteorology is responsible for issuing flood warnings for the River Murray system in NSW and Victoria, while the South Australian Department for Environment, Water and Natural Resources has the lead responsibility in South Australia.

5.2 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 5). During 2016–17 it is not expected that flows will need to be reduced below normal minimum targets unless there are unforeseen or emergency circumstances. However, depending on patterns of rainfall, irrigation demand, environmental watering and other circumstances, it is possible that flows close to minimum rates may occur for extended periods in the River Murray system upstream of the South Australian border.
Table 5: Minimum flow rates at key locations

<table>
<thead>
<tr>
<th>Standing procedure</th>
<th>Normal minimum</th>
<th>Temporary minimum between 2006–2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum release from Dartmouth Reservoir</td>
<td>200 ML/day</td>
<td>200 ML/day</td>
</tr>
<tr>
<td>Minimum release from Hume Reservoir</td>
<td>600 ML/day</td>
<td>400 ML/day</td>
</tr>
<tr>
<td>Minimum target flow at Doctors Point</td>
<td>1,200 ML/day</td>
<td>800 ML/day</td>
</tr>
<tr>
<td>Minimum release from Yarrawonga Weir</td>
<td>1,800 ML/day</td>
<td>1,500 ML/day</td>
</tr>
<tr>
<td>Minimum flow at Edward River offtake</td>
<td>100 ML/day</td>
<td>80 ML/day</td>
</tr>
<tr>
<td>Minimum flow at Gulpa River offtake</td>
<td>80 ML/day</td>
<td>30 ML/day</td>
</tr>
<tr>
<td>Minimum release from Stevens Weir</td>
<td>150 ML/day</td>
<td>130 ML/day</td>
</tr>
<tr>
<td>Minimum river height at Swan Hill</td>
<td>0.6 m local gauge height</td>
<td>0.5 m local gauge height</td>
</tr>
<tr>
<td>Minimum River Murray contribution to release from Wentworth Weir</td>
<td>700 ML/day</td>
<td>700 ML/day</td>
</tr>
</tbody>
</table>

5.3 Weir pool level manipulation

Manipulations of water levels in weir pools are 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 program
- to provide variation in water levels to minimise bank erosion
- for environmental benefit including the wetting and drying of adjacent wetlands and varying in-stream flow velocities.

Weir pool water level variations within normal operating ranges are becoming an increasingly common feature of routine river operations along the River Murray. Operational variations in weir pools that have occurred since 2005 (not including flood operations or major drawdowns) are outlined in Table 6. If a weir pool needs to be raised or lowered outside its normal operating range then state agencies would be notified via the Water Liaison Working Group. The public would be notified through the River Murray Weekly Report and via media releases where appropriate.

Under high flow or flood events, such as those observed during 2010–12, many structures may be inundated or removed and, in such circumstances, the ability to undertake pool manipulations would be limited.
Table 6: Operational variations in weir pool levels since 2005

<table>
<thead>
<tr>
<th>Weir</th>
<th>Full Supply Level (FSL)</th>
<th>Weir pool lowering</th>
<th>Weir pool raising</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Mulwala</td>
<td>124.9 m</td>
<td>30 cm</td>
<td>25 cm</td>
</tr>
<tr>
<td>Torrumbarry Weir (Lock 26)</td>
<td>86.05 m</td>
<td>40 cm</td>
<td>no surcharge</td>
</tr>
<tr>
<td>Euston Weir (Lock 15)</td>
<td>47.6 m</td>
<td>30 cm</td>
<td>60 cm</td>
</tr>
<tr>
<td>Mildura Weir (Lock 11)</td>
<td>34.4 m</td>
<td>10 cm</td>
<td>5 cm</td>
</tr>
<tr>
<td>Wentworth Weir (Lock 10)</td>
<td>30.8 m</td>
<td>10 cm</td>
<td>10 cm</td>
</tr>
<tr>
<td>Kulnine (Lock 9)</td>
<td>27.4 m</td>
<td>20 cm</td>
<td>25 cm</td>
</tr>
<tr>
<td>Wangumma (Lock 8)</td>
<td>24.6 m</td>
<td>80 cm</td>
<td>85 cm</td>
</tr>
<tr>
<td>Rufus River (Lock 7)</td>
<td>22.1 m</td>
<td>80 cm</td>
<td>55 cm</td>
</tr>
<tr>
<td>Murtho (Lock 6)</td>
<td>19.25 m</td>
<td>10 cm</td>
<td>40 cm</td>
</tr>
<tr>
<td>Paringa (Lock 5)</td>
<td>16.3 m</td>
<td>10 cm</td>
<td>50 cm</td>
</tr>
<tr>
<td>Bookpurnong (Lock 4)</td>
<td>13.2 m</td>
<td>10 cm</td>
<td>30 cm</td>
</tr>
<tr>
<td>Overland Corner (Lock 3)</td>
<td>9.8 m</td>
<td>10 cm</td>
<td>20 cm</td>
</tr>
<tr>
<td>Waikerie (Lock 2)</td>
<td>6.1 m</td>
<td>10 cm</td>
<td>50 cm</td>
</tr>
<tr>
<td>Blanchetown (Lock 1)</td>
<td>3.2 m</td>
<td>10 cm</td>
<td>50 cm*</td>
</tr>
</tbody>
</table>

^ Normal operating range up to 13 cm
* Normal operating range up to 30 cm
# Levels at Lock 1 are currently being managed around 10 cm below normal pool.

In 2016–17, a number of weir pool level manipulations are planned as detailed below in Table 7. These plans are current as of 1 June 2016. For the latest information on weir pool manipulations along the River Murray system upstream of the South Australian border refer to the latest MDBA media releases and River Murray Weekly Report. For the latest information on weir pool manipulations at Locks 1 – 6, refer to the South Australian Department of Environment, Water and Natural Resources website.

Table 7: Planned/potential weir pool manipulations in 2016–17

<table>
<thead>
<tr>
<th>Weir</th>
<th>Planned/potential operations in 2016–17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Mulwala</td>
<td>Expected to be managed within its normal operating range (124.6 to 124.9 m AHD), except during periods of flooding or emergency situations.</td>
</tr>
<tr>
<td>Torrumbarry Weir (Lock 26)</td>
<td>Planned drawdown by up to 40 cm during winter 2016. Possible drawdown at other times of the year for operational purposes.</td>
</tr>
<tr>
<td>Euston Weir (Lock 15)</td>
<td>Planned to be manipulated according to modelled natural flow cues* within the range of -40 cm below FSL to +60 cm above FSL. Expected to be managed at FSL over summer and March, and possibly other times of the year depending on river flow.</td>
</tr>
<tr>
<td>Mildura Weir (Lock 11)</td>
<td>Expected to be managed within normal operating range.</td>
</tr>
<tr>
<td>Wentworth Weir (Lock 10)</td>
<td>Planned to be held around +10 cm above FSL during the irrigation season while flows in the lower Darling remain low to assist lower Darling irrigators connected to the weirpool.</td>
</tr>
</tbody>
</table>
Weir | Planned/potential operations in 2016–17
--- | ---
Kulnine (Lock 9) | Planned to be manipulated according to modelled natural flow cues* within the range of -10 cm below FSL to +24 cm above FSL.
Wangumma (Lock 8) | Planned to be manipulated according to modelled natural flow cues* within the range of -100 cm# below FSL to +80 cm above FSL.
Rufus River (Lock 7) | Planned to be manipulated according to modelled natural flow cues* within the range of -80 cm# below FSL to +50 cm above FSL. The weir pool at Lock 7 may also need to be raised at some times when the Lock 6 pool level is above full supply level in order to ensure an adequate flow velocity through the Lindsay River and Mollaroo Creek.
Murtho (Lock 6) | May be raised as part of a Chowilla watering event. Raising will be dependent on the magnitude of flow to SA and the desired environmental watering scenario.
Paringa (Lock 5) | Depending on conditions, the level of the weir pool at Lock 5 is planned to be raised by up to 50 cm above FSL during spring 2016 (possibly earlier if unregulated flows are received), before being gradually lowered back to FSL by the end of November 2016. Lock 5 weir pool may also be raised as part of a Chowilla watering event.
Bookpurnong (Lock 4) | Expected to be managed within normal operating range.
Overland Corner (Lock 3) | Expected to be managed within normal operating range.
Waikerie (Lock 2) | Depending on conditions, the level of the weir pool at Lock 2 is planned to be raised by up to 75 cm# above FSL during spring 2016 (possibly earlier if unregulated flows are received), before being gradually lowered back to FSL by early December 2016.
Blanchetown (Lock 1) | Currently being held -10 cm below FSL to enable engineering investigations to be undertaken at the weir.

* Manipulations according to modelled natural flow cues are planned to be trialled at Locks 15, 9, 8 and 7 in 2016–17. Based on long-term average monthly inflows, modelled natural flow cues would likely result in these weir pools being raised in winter/spring then lowered in late summer/autumn.
# Additional approvals would be sought prior to trialling this weir pool level.

5.4 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 a limited history to assist in forecasting the use of recently acquired environmental water. As well, use is expected to change in the longer term as constraints to the delivery of environmental water are reviewed and lifted.

The scenarios in this plan are based on assumptions, after preliminary consultation with the Commonwealth and states, of how environmental water may be used. For the purposes of this operating plan only environmental watering activities utilising large volumes of water have been considered. Smaller parcels of environmental water not described in this operating plan are also expected to be used in 2016–17; however, these do not have a material impact on overall river operations.
Actual use will most likely differ from the assumed use although the scenarios should give an indication of what may occur. Further information and latest news on environmental water use in 2016–17 is available from the websites of the Victorian Environmental Water Holder, Commonwealth Environmental Water Office and the NSW Office of Environment and Heritage.

Table 8 provides outlooks related to environmental water management for the six different scenarios of this operating plan, with further information on key actions outlined below.

5.4.1 Release of environmental water from Hume Reservoir

In 2016–17, most bulk environmental water delivery in the Murray is expected to be as a release of environmental water from Hume Reservoir. The volumes of Hume releases assumed in this operating plan range from 260 GL in the ‘extreme dry’ scenario up to 500 GL in the ‘near average’ scenario (see Table 8). These releases would, where possible, follow a similar pattern to natural inflows (otherwise known as translucency flows). The releases are targeted at a broad-scale, low-level environmental watering event along the entire River Murray system all the way to the Coorong and Murray Mouth in South Australia.

In the ‘wet’ scenario there may, at times, be limited opportunity to release environmental water due to very high flow rates and the risk of flooding. However, as in recent years, environmental water may be released at low flow rates to fill in gaps between high flow events, to ensure appropriate recession rates, to promote successful waterbird breeding and to provide flow variability to assist fish migration and spawning. Some environmental water may also be used to dilute blackwater (where low oxygen levels affect in-stream biota), if it occurs.

Environmental water released from Hume Reservoir is expected to be used at multiple sites as it flows down the river system. For example, water released from Hume may be used to increase the flow through Gunbower Creek. Accounted return flows from Gunbower to the Murray might then be pumped into the Hattah Lakes, with the remainder then contributing to higher flows into South Australia. In April 2016, the Basin Officials Committee approved the water accounting and delivery arrangements for such a broad scale environmental watering in 2016–17.

5.4.2 Barmah-Millewa Forest

There are two potential environmental watering events proposed for Barmah-Millewa Forest in 2016–17. The first involves providing environmental water through the forest regulators on both the NSW and Victoria side to enable low level inundation and watering of crucial wetland and creek refuges in Barmah-Millewa Forest. This event is planned to be undertaken sometime across July to November in scenarios where the flow rate through Barmah-Millewa Forest remains less than channel capacity (i.e. no natural overbank event).

In the wetter scenarios, overbank flow into the Barmah–Millewa Forest is likely to occur naturally and the forest regulators will be opened to allow passage of water as per standard operations. In this scenario natural overbank flows through the forest may then be supplemented by environmental water releases. As in other years, it is expected that any environmental flows will mainly focus on maintaining critical flows after flood peaks, providing flow pulses to assist fish spawning and migration, implementing a gradual recession of flows to minimise bank slumping and allowing waterbirds to complete breeding cycles (see Section 6.3.1 for further information).
Table 8: Summary of significant environmental operations under each scenario

<table>
<thead>
<tr>
<th>Environmental operations</th>
<th>Extreme dry</th>
<th>Very dry</th>
<th>Dry</th>
<th>Moderate</th>
<th>Near average</th>
<th>Wet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assumed environmental water release from Hume</td>
<td>~260 GL</td>
<td>~290 GL</td>
<td>~320 GL</td>
<td>~370 GL</td>
<td>~500 GL</td>
<td>~250 GL</td>
</tr>
<tr>
<td>River Murray Increased Flows held in Snowy storages in 2016–17</td>
<td>As of June 1, approximately 500 GL River Murray Increased Flows is held within Snowy storages. No significant volumes of RMIF, if any, are expected to be called upon in 2016–17.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assumed environmental water release from tributaries</td>
<td>Goulburn River ~130 GL Murrumbidgee River ~0 GL</td>
<td>Goulburn River ~140 GL Murrumbidgee River ~0 GL</td>
<td>Goulburn River ~190 GL Murrumbidgee River ~0 GL</td>
<td>Goulburn River ~270 GL Murrumbidgee River ~0 GL</td>
<td>Goulburn River ~190 GL Murrumbidgee River ~0 GL</td>
<td>Goulburn River ~150 GL Murrumbidgee River ~0 GL</td>
</tr>
<tr>
<td>Barmah–Millewa Environmental Water Allocation</td>
<td>~460 GL in EWA. Opening balance will be fully borrowed by NSW and mostly borrowed by Vic. Payback to commence once allocations improve. Trigger for releases due to length of time since last EWA release is met. However, decisions on release will take into account prevailing conditions.</td>
<td>~480 GL in EWA. Opening balance will be fully borrowed by NSW and mostly borrowed by Vic. Payback to commence once allocations improve. Trigger for releases due to length of time since last EWA release is met. However, decisions on release will take into account prevailing conditions.</td>
<td>~550 GL in EWA. Opening balance will be fully borrowed by NSW and mostly borrowed by Vic. Payback to commence once allocations improve. Trigger for releases due to length of time since last EWA release is met. However, decisions on release will take into account prevailing conditions.</td>
<td>~560 GL in EWA. Opening balance will be fully borrowed by NSW and mostly borrowed by Vic. Payback to commence once allocations improve. Trigger for releases due to length of time since last EWA release is met. However, decisions on release will take into account prevailing conditions.</td>
<td>~560 GL in EWA. Opening balance will be fully borrowed by NSW and mostly borrowed by Vic. Payback to commence once allocations improve. Trigger for releases due to length of time since last EWA release is met. Other flow triggers may also be met.</td>
<td>~610 GL in EWA. Opening balance will be fully borrowed by NSW and mostly borrowed by Vic. Payback to commence once allocations improve. Possible spill of EWA. Trigger for releases due to length of time since last EWA release is met. Other flow triggers may also be met.</td>
</tr>
</tbody>
</table>
## Environmental operations

<table>
<thead>
<tr>
<th>Volume of environmental water assumed to be delivered over the SA border (including upstream return flows)</th>
<th>Extreme dry</th>
<th>Very dry</th>
<th>Dry</th>
<th>Moderate</th>
<th>Near average</th>
<th>Wet</th>
</tr>
</thead>
<tbody>
<tr>
<td>~470 GL</td>
<td>~520 GL</td>
<td>~610 GL</td>
<td>~770 GL</td>
<td>~630 GL</td>
<td>~580 GL</td>
<td></td>
</tr>
</tbody>
</table>

### Lower Lakes
Water levels will be managed to target above 0.5 m AHD (see Section 6.8). Barrage releases to the sea are planned to be maximised in order to manage salinity levels in the Coorong and to assist with maintaining an open Murray Mouth. Operations, where possible, will vary lake levels between 0.50 and 0.85 m AHD to assist reducing salinity at Lake Albert.

### River salinity
Environmental entitlement holders will assess salinity risks of watering activities and, if required, use additional environmental water to boost dilution in the few months after any significant overbank flow event in the lower River Murray.

### Overbank flows and flooding

<table>
<thead>
<tr>
<th>In channel flows</th>
<th>In channel flows</th>
<th>Chance of overbank flow into central Murray forests, otherwise in channel</th>
<th>Increased chance of overbank flows into central Murray forests</th>
<th>Extensive overbank flows into central Murray forests and other parts of the River Murray system</th>
<th>Extensive and prolonged overbank flows along large sections of River Murray system</th>
</tr>
</thead>
</table>

### South Australian Lower Murray Irrigation Area (LMRIA) Acid Drainage
Potential for water quality problems from acid drainage during summer and autumn if flow to SA is close to or less than the entitlement flow and when the flow over Lock 1 is less than 2,500 ML/day (target based on current SA modelling).

Sufficient dilution from unregulated flow is likely to prevent most water quality issues associated with acid drainage. However potential water quality problems during summer and autumn remain due to increased chances of lower flow conditions.

### Blackwater
Potential for localised blackwater event.

Potential for significant blackwater event with very low dissolved oxygen levels. The MDBA may 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 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 some weir pools with ‘pulsed’ flows on some occasions. However, this is not always feasible, particularly when water is scarce.
5.4.3 Environmental inflows from the Goulburn River

As has been in the case in recent years, significant environmental inflows from the Goulburn River are again expected in 2016–17. This operating plan assumes volumes ranging between 130 – 270 GL depending on the relevant scenario (see Table 8). All of this environmental water is assumed to be subsequently delivered to South Australia, thereby providing ecological outcomes along the River Murray downstream of the confluence of the two rivers.

Environmental inflows from the Goulburn River are planned to be primarily delivered throughout the year in the form of elevated baseflows, along with targeted ‘freshes’ (short periods of within-channel higher flows), in spring and autumn. Smaller volumes of environmental water are also expected to enter the River Murray from lower Broken Creek and the Campaspe River throughout the year.

After prioritising operational requirements, IVT water held in the Goulburn system may be utilised to meet environmental objectives in the Goulburn and Campaspe Rivers and lower Broken Creek. Co-ordination of the delivery of IVT water with environmental and operational flows will be undertaken by the MDBA River Operations staff alongside Goulburn-Murray Water, Goulburn Broken Catchment Management Authority and relevant environmental water holders.

5.4.4 Environmental inflows from the Murrumbidgee River

This plan does not factor in any environmental inflows from the Murrumbidgee River in 2016–17. Although there is consideration being given to a significant environmental watering event in the Murrumbidgee in winter-spring 2016, at the time of writing it was unclear what, if any, flows from this event would be passed into the River Murray.

Any large delivery of environmental water from the Murrumbidgee may require alterations to River Murray system operations. The MDBA River Operations staff will liaise closely with WaterNSW, NSW DPI Water and the NSW Office of Environment and Heritage during the 2016–17 water year to adaptively manage the delivery of IVT water and any environmental inflows that do eventuate from the Murrumbidgee River.

5.4.5 Gunbower Creek and Gunbower Forest

The Gunbower Forest, on the River Murray floodplain downstream of Echuca, is an important river red gum wetland complex. Environmental water can be delivered along the length of Gunbower Creek for fish outcomes, or diverted from Gunbower Creek into the forest floodplain. Water from forest watering events returns back to Gunbower Creek before re-joining the River Murray near Koondrook township.

Flows through Gunbower Creek are expected to be provided throughout the year in all but the ‘extreme dry’ scenario. Of the total flow through the creek, the net use is expected to be about 20-30 GL, with the remaining volume returning to the River Murray for downstream users.

For Gunbower Forest, only the ‘wet’ scenario assumes a significant watering of the floodplain, in which unregulated overbank flows may be supplemented with around 10-30 GL of environmental water.

For more information and the latest updates see North Central CMA’s Gunbower Forest page.
5.4.6 Koondrook–Perricoota Forest

The environmental works at Koondrook–Perricoota Forest provide an opportunity for water to be diverted into the upstream end of the Koondrook–Perricoota State Forest where it flows through the forest into the Wakool system. Structures located within the forest allow for some water to be returned directly to the River Murray, but only during very large watering events. In 2014–15, there was a small-scale commissioning of works at Koondrook–Perricoota which inundated approximately 4,500 ha of creeks and wetlands.

Opportunity may arise in 2016–17 to deliver environmental water to wetlands and areas of Koondrook-Perricoota Forest which have not received water in many years. Such an event, if it was to occur, would not be expected to provide any significant return flows to the Wakool River. This operating plan assumes that around 30 GL of environmental water will be delivered to the forest in most scenarios. For the purposes of this operating plan, no water is assumed to return to the Wakool River in any scenario.

5.4.7 Watering of Hattah Lakes

A relatively small scale environmental watering event is planned at Hattah Lakes for 2016–17 that will focus on commissioning newly constructed fishways. In the wetter scenarios a moderate filling of semi-permanent wetlands may also be implemented. Associated environmental water use is likely to be around 20-35 GL. Inflows to Hattah in each of these scenarios is assumed to take place in spring 2016.

For more information and the latest updates see Mallee CMA’s Hattah Lakes page.

5.4.8 Watering via Mulcra works

Lindsay–Wallpolla and Mulcra Islands are comprised of three adjacent anabranch systems in north-west Victoria. In 2016–17 small scale watering is planned to focus on baseflows, small wetlands and providing in-channel freshes, with around 5 GL assumed to be used in most scenarios.

For more information and the latest updates see Mallee CMA’s Lindsay Island page.

5.4.9 Environmental water delivered across the South Australian border

Significant volumes of environmental water are assumed to be delivered across the South Australian border in each of the scenarios of this operating plan, ranging from 470 GL in the ‘extreme dry’ scenario to 770 GL in the ‘moderate’ scenario (see Table 8). This environmental water is assumed to be comprised of water originating from Hume releases (see Section 5.4.1), Goulburn system return flows (see Section 5.4.3), and other environmental water delivered across the border utilising trade mechanisms. These volumes are considered to be in addition to South Australian entitlements owned by environmental water holders. Further detail on the assumed pattern of this environmental water delivery to South Australia is described in Section 6.7.

Depending on the timing of delivery, environmental water delivered across the South Australian border may be targeting environmental outcomes at Chowilla, other lower Murray floodplain sites, and/or the Coorong and Lower Lakes.

The Basin Officials Committee has again approved the regulated release of water from Menindee Lakes (if available) during unregulated flows in the River Murray — to target higher environmental flow rates at the South Australian border. Due to the low storage volume of
Menindee Lakes entering into 2016–17, no release of water for this purpose has been assumed in this operating plan.

5.4.10 Watering via Chowilla works
Further testing of the Chowilla floodplain infrastructure is planned to be undertaken during spring 2016 if flows exceed 15,000 ML/day over the South Australian border for a significant duration. Volumes used could range between 10 and 32 GL. If flows across the border do not reach these levels then environmental water may be pumped to up to seven priority wetlands on the Chowilla Floodplain from September to December. For more information and the latest updates see the SA Department of Environment, Water and Natural Resources Chowilla website.

5.5 Barmah Choke trade restriction
Standard policy does not permit the net trade of allocations from above the Barmah Choke to downstream to protect the delivery of downstream water entitlements. Without the trade restriction, a potentially large volume of trade water, in addition to the normal downstream demand, is likely to exceed the limited channel capacity through the Barmah Choke.

The default policy therefore means that trade downstream of the Choke may only occur when there has been sufficient matching trade in the opposite direction i.e. no net trade downstream. The MDBA has only relaxed this trade restriction in the past when there was a low risk of affecting the delivery of water to meet the normal downstream demand.

Each of the six scenarios of this operating plan considers the key drivers of water delivery through the choke including:

- current storage levels
- potential future inflows, demands and system losses
- the availability of water downstream of the Choke including in Menindee Lakes and from IVT calls from the Murrumbidgee and Goulburn Valleys
- end of season reserve requirements in Lake Victoria.

This operating plan shows that for a wide range of scenarios, channel capacity through the Barmah Choke (currently around 10,000 ML/day downstream of Yarrawonga Weir) would be reached, or nearly reached, for prolonged periods in 2016–17 to deliver required flows (Figure 12). As such, the normal restrictions to trade across the Choke will remain in place until seasonal conditions and demands allow. Exceptional circumstances that would lift the restriction may include an extreme dry scenario when total flows are unlikely to impact channel capacity limitations, or a very wet scenario in which large inflows into Menindee lakes occur which can be used to meet downstream River Murray system demands.

The MDBA and the Water Liaison Working Group will continue to monitor whether the trade restriction is required and will advise water users when conditions are such that the restriction can be relaxed. Further information on the trade rule and the latest information on the current capacity to trade across the choke can be found on the MDBA website.
5.6 Snowy Mountains Scheme

Each year Snowy Hydro Limited (SHL) has an obligation to release water to the Murray and Murrumbidgee catchments. The minimum annual volume of water to be released to each catchment from the Snowy Mountains Scheme, termed the Required Annual Release (RAR), is prescribed in the Snowy Water Licence (SWL) and outlined in Schedule F of the Murray–Darling Basin Agreement.

In non-drought sequence years, and in the absence of other arrangements, the RAR for the Murray will be 1,062 GL less water savings made to provide for environmental flows on the Murray and Snowy Rivers. However, since October 2006, the RAR has been reduced to take into account the reduced inflows into storages in the Snowy Mountains due to prevailing dry conditions. The RAR at the start of each year assumes that there will be a repeat of the worst inflows on record into SHL storages. Where inflows to the SHL storages are in excess of the worst on record, the increased inflows are passed onto the Murray and Murrumbidgee catchments via an increase in the RAR. The RAR is updated by SHL at least monthly.

Last year (2015–16), the Murray RAR increased from an opening value of 341 GL on 1 May 2015 to a closing value of 733 GL. Actual releases from SHL in 2015–16 were 931 GL. The 198 GL released in excess of requirements is referred to as Flex (an advance of 2016–17 releases), and reduces the RAR obligation in 2016–17. This operating plan has assumed conservative estimates for 2016–17 Murray RAR in each of the six scenarios, taking into account the Flex released in 2015–16.

For 2016–17 SHL has entered into a commercial arrangement with Murray Irrigation Limited (MIL) to make up to 200 GL water available as an advance (borrow) by MIL. MIL has arrangements in place to make this available to internal customers and corporate partners. A set of accounting arrangements and protections, which have been reviewed by joint governments, will be applied to ensure this commercial arrangement does not negatively impact upon the water reliability of other water users in the Murray and Murrumbidgee valleys, both this year and in future years.

The advance will be an option and exercise product. It is understood that the full 200 GL option volume has been taken up and participants who have taken an option will have to exercise that option by 1 August 2016. The exercised volume is guaranteed to be released from the Snowy Scheme in 2016–17. The exercised volume will be a borrow of ‘above target water’, which is water not required to be provided by Snowy Hydro as RAR, and will be accounted by as a Murrumbidgee to Murray Inter-Valley Transfer. It will be repaid in increments based on NSW Murray general security allocations in 2016–17 and possibly beyond, with repayments beginning when the announced allocation reaches 40%. Under the terms of the deal SHL will be able to release an additional 200 GL of Flex in 2016–17. Further information on Murray Irrigation’s 2016–17 Snowy advance project are available from Murray Irrigation’s website.

This operating plan has assumed that the full 200 GL Snowy advance that has been optioned will be exercised and released from Murray 1 into Hume Reservoir in 2016–17 under all scenarios. That volume is then assumed to be subsequently released from Hume throughout the irrigation season and diverted by Murray Irrigation customers. The implications of this arrangement on system operations are that Hume Reservoir is projected to have an elevated storage volume earlier in the season in all scenarios (Figure 10), and that bulk transfers of water from Dartmouth...
to Hume are not anticipated to be required until later in 2016–17 than may otherwise have occurred (Figure 9). Whilst this operating plan does not assume any Flex releases in 2016–17, MDBA will, as it normally does, closely monitor SHL releases throughout the season and reduce transfers from Dartmouth should Flex be observed or expected.

The Snowy System provides a connection between the Murray and Murrumbidgee catchments that can sometimes permit the transfer of water that is traded between these two catchments. In recent years there has been a considerable volume of trade from the Murrumbidgee to the Murray. Potentially, Murrumbidgee to Murray trade might be delivered to the Murray via Murray 1 Power Station. This delivery option may be implemented in 2016–17 if agreed by SHL and if there is sufficient airspace in Hume Reservoir and spare channel capacity through the Barmah Choke.

There is currently 502 GL of River Murray Increased Flows (RMIF) held in SHL storages. Arrangements which would allow the potential RMIF release to the Murray were agreed for 2015–16 but not implemented. Similar arrangements are expected to be in place for 2016-17 so that RMIF can be delivered if called upon to meet environmental objectives in the River Murray system.
6. Scenario graphs

In previous years, the River Murray system annual operating plan has included a ‘very wet’ scenario. Under the conditions of the ‘very wet’ scenario there is limited opportunity for operations to influence river flows and instead structures are typically simply passing inflows. Given the antecedent dry conditions prior to preparation of this operating plan, it was determined by the MDBA and the Water Liaison Working Group that there was more value in including a ‘very dry’ scenario that sits between the ‘extreme dry’ and ‘dry’ scenarios rather than the ‘very wet’ scenario.

6.1 Dartmouth Reservoir

Key considerations when operating Dartmouth Reservoir are the holding of reserves for later years and the transfer of water to Hume Reservoir within the channel capacity of the Mitta Mitta River. Based on the storage level on 1 June 2016, indicative storage volume and releases for Dartmouth Reservoir under the six scenarios are shown in Figure 8 and Figure 9.

![Figure 8: Dartmouth Reservoir storage outlook](image-url)
A large volume of water, around 1,640 GL, was required to be released from Dartmouth Reservoir during 2015–16 in order to meet downstream demands. This was the largest annual volume of release from Dartmouth since 2006–07, and was due to a combination of very low system inflows, lack of available water in Menindee Lakes together with moderate demands along the River Murray system.

As of 1 June 2016, Dartmouth Reservoir held 1,710 GL (44% capacity). None of the six scenarios considered in this operating plan project Dartmouth Dam to reach capacity in 2016–17. It is possible that inflows to the storage could be greater than those assumed in the ‘wet’ scenario, however even without material use it would take three years of average inflows to fill Dartmouth from its level of June 2016. Whilst flood operations are possible the likelihood is very low.

In 2016–17, if required, priority will 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 as storage levels approach full supply level). For more information on flood management at Dartmouth Dam see the MDBA’s Dartmouth Dam website page.

When storage in Dartmouth is high, ‘harmony’ transfers to Hume Reservoir may be made to provide the Mitta Mitta Valley with higher in-channel flows and increased flood protection for the following year. Harmony transfers can also benefit the operations of the Dartmouth power station and the recreation and tourism at Lake Hume through raised lake levels over summer and
autumn. Transfers are calculated to give the two storages about the same chance of filling in the future. Harmony transfers are not contemplated in the scenarios included in this operating plan.

In the ‘wet’ scenario, only minimum releases would be expected from Dartmouth Reservoir in 2016–17. In all other scenarios it is expected that ‘bulk’ releases (where transfers from Dartmouth to Hume Reservoirs are needed to meet demand downstream of Hume) would be required in 2016–17. Where operationally possible, these transfers are managed for environmental and community benefit.

The timing and release rates from Dartmouth will be greatly dependent on inflow and usage patterns and the storage volume in Hume Reservoir. Releases from the Snowy Mountains Scheme via Murray 1 power station contribute to Hume storage volume, and assumptions have been made on the pattern of these deliveries in 2016–17 (see Section 5.6 for further information).

In all of the scenarios of this operating plan it is expected that the release from Dartmouth Reservoir will be around the required minimum flow rate (200 ML/day) throughout June to August. At times during this period AGL electricity may elect to release a portion of their entitlement water from Dartmouth, in which case releases would be raised above minimum flows.

Under the ‘extreme dry’ scenario bulk transfers may begin in September. In the ‘very dry’, ‘dry’ and ‘moderate’ scenarios bulk transfers may commence in October, November and December respectively. In the ‘near average scenario bulk transfers may not begin until February 2017.

The ‘extreme dry’ scenario assumes the greatest volume of releases from Dartmouth for 2016–17 at around 1,450 GL. In this scenario the storage volume of Dartmouth could reduce to around 400 GL (10% capacity) by the end of the year.

Where possible, any significant releases or transfers from Dartmouth to Hume Reservoir will be made as a series of managed variable flows (also known as pulses) following the environmental guidelines for Dartmouth releases. Pulsing the releases from Dartmouth is designed to enhance the ecological values of the Mitta Mitta River. The pulsed releases, where required, will aim to be less than 7,000 ML/day; but higher releases of up to 10,000 ML/day at Tallandoon cannot be ruled out, particularly under the drier scenarios.

6.2 Hume Reservoir and flow at Doctors Point

Hume Reservoir is the primary regulating structure in the River Murray system. Hume is used to store inflows from the upper Murray catchment as well as water released from the Snowy Mountains Scheme and Dartmouth Reservoir. This water is then released as needed, supplemented by downstream tributary inflows, to meet the consumptive and environmental needs of NSW, Victoria and South Australia.

There is almost no ability to surcharge Hume Reservoir under normal flood operations and therefore, under wetter scenarios, a small volume of airspace will aim to be maintained to assist in limiting damage caused by moderate to major floods. This will be achieved by passing smaller flow events through Lake Hume, with possibly little or no attenuation, if rainfall and streamflow conditions show this to be prudent. Such an operation aims to provide improved flood mitigation outcomes in any subsequent larger flood event. For very large floods, there may be little or no capacity for Hume Dam to mitigate downstream flooding. More information on flood management at Hume Dam can be found on the MDBA website.
As of 1 June 2016, Hume Reservoir held 740 GL (25% capacity) and catchments of the upper Murray were relatively dry. Indicative storage volumes and releases for Hume Reservoir throughout 2016–17 under the six scenarios are shown in Figure 10 and Figure 11.

As shown in Figure 10, above average unregulated inflows will likely be needed for Hume to spill in 2016–17. However, the timing and duration of flood events cannot be predicted this far in advance. The flow rates presented in this plan (for example at Doctors Point in Figure 11) are daily average flows over the month and therefore do not reflect what may occur on a day to day basis with flood peaks.

Under the ‘wet’ scenario, Hume Reservoir reaches effective full supply volume (99% capacity) in October and remains at this volume into November. Increased demand for water (irrigation and/or environmental requirements) begins drawing Hume down from December onwards in the ‘wet’ scenario, with the end of year volume remaining at approximately 2,000 GL.

In the ‘moderate’ and drier scenarios, Hume is not expected to fill. In these scenarios the storage peaks in spring before increased demands begin drawing the storage down. In each of the ‘moderate’ and drier scenarios Hume is around 10 to 20% capacity by May 2017.

The flow at Doctors Point, in the Murray downstream of Hume Reservoir and the Kiewa River, is expected to be, on average, below channel capacity downstream of the dam (25,000 ML/day) in all scenarios of this operating plan (Figure 11). An average release of 15,000–20,000 ML/day is expected over summer in most cases. However, with no water available from the Menindee Lakes, flows near channel capacity rates may be required for short periods if demand is unusually high.

In the ‘wet’ scenario, Hume is spilling throughout October and November. The average daily flow rates at Doctors Point in this scenario are around 23,000 ML/day in October and 15,000 ML/day in November.

Significant volumes of environmental water are planned to be released from Hume Reservoir in 2016–17 across all scenarios. Commencing in July 2016, around 260 GL environmental water is assumed to be released over winter and spring in the ‘extreme dry’ scenario, with larger volumes expected in wetter cases. Some of this water may be used to support watering of the Barmah–Millewa Forest (see Section 5.4.1); however a large proportion will be released from Hume at modest rates of up to an additional 10,000 ML/day, following natural inflow cues where operationally possible. These ‘translucent’ releases of environmental water will be managed at a flow rate below 25,000 ML/day at Doctors Point and below target flow rates downstream of Yarrawonga described in Section 6.3.1.
Figure 10: Hume Reservoir storage outlook

Figure 11: Hume reservoir release outlook—flow at Doctors Point

Note: flow rates are an average daily flow within the month and do not represent peak flow rates.
6.3 Lake Mulwala and the Barmah Choke

The ‘Barmah Choke’ is a section of the River Murray (between Yarrawonga and Torrumbarry Weirs) that has the lowest 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.

The restricted channel capacity through the Barmah Choke limits the amount of water that can be delivered downstream (e.g. to the Torrumbarry Irrigation Area, Sunraysia, and South Australia). Choke capacity is likely to be an issue during 2016–17 if demands are high and tributary inflows (excluding environmental water) downstream of the Barmah Choke (e.g. from the Goulburn and Murrumbidgee Rivers) remain low. The risk of a shortfall in supply is increased when there is little water available in the downstream storages (Lake Victoria and the Menindee Lakes). For information on the Barmah Choke trade restriction see Section 5.5.

Releases from Lake Mulwala, through Yarrawonga Weir, in excess of about 10,000 ML/day are sufficient to cause overbank flooding within Barmah-Millewa Forest. When 'in channel' flows are occurring, about 2,000 ML/day of the 10,000 ML/day is directed to the north via the Edward River and Gulpa Creek; with the remainder (about 8,000 ML/day) flowing south along the Murray past Picnic Point and towards Echuca.

A drawdown of Lake Mulwala is not planned for 2016–17. The lake was last drawn down in winter 2015, mainly to limit the extent of the aquatic weed, Egeria densa. A survey of the abundance and distribution of Egeria in April 2016 indicated the drawdown had been effective. Based on the results of previous drawdowns the lake should not need to be drawn down for Egeria management until winter 2019 or 2020. If, however, drawdown becomes necessary, MDBA will advise the community of any pool lowering via media releases and through our River Murray weekly report.

6.3.1 Winter and spring

The level in Lake Mulwala at the beginning of June 2016 was close to its normal operating level of 124.7 m AHD. Under all but the very dry scenarios, Lake Mulwala is expected to remain around this level through until the commencement of the irrigation season in August.

Significant inflows from the Ovens and/or Kiewa River in winter-spring 2016 may lead to unregulated overbank events in the Barmah–Millewa Forest. In this instance, these high flows may be followed up with environmental water release from Hume Reservoir to provide a gradual recession during spring and early summer. This managed watering of Barmah–Millewa Forest is most likely to occur in the ‘moderate’ and ‘wet’ scenarios (Figure 12). Environmental water releases for watering of Barmah–Millewa Forest, if they occur, are planned to target a flow rate downstream of Yarrawonga of up to 15,000 ML/day. Under certain conditions a higher flow rate downstream of Yarrawonga of up to 18,000 ML/day may be targeted with environmental water.

In the ‘extreme dry’ through to ‘moderate’ scenarios, translucent releases of environmental water from Hume Reservoir are likely to only contribute to flows within channel through the Barmah Choke. Additional environmental water on top of the translucent releases may also be supplied through the Barmah-Millewa Forest regulators whilst flow is in channel to facilitate watering of the major creek network of the forest. Even in the dry scenarios, a significant natural inflow event may result in overbank flows into the Barmah–Millewa Forest, which could be followed up by managed environmental flows.
During larger overbank flow events, the level of Lake Mulwala and releases from Yarrawonga Weir will be managed in accordance with flood operating procedures, being mindful of the environmental water proposals and the potential release of the Barmah–Millewa Environmental Water Allocation. Generally speaking, large inflow events can be expected to be passed ‘straight through’ Lake Mulwala in winter-spring with little mitigation as is the normal practice.

Figure 12: Yarrawonga Weir release outlook

*Note: flow rates are an average daily flow within the month and do not represent peak flow rates.*

### 6.3.2 Summer and autumn

In summer and autumn 2016–17, 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.

In most scenarios, it is expected that the release from Yarrawonga Weir will generally be at or near channel capacity at the Barmah Choke for extended periods from November 2016 onwards. These flow rates are likely to occur due to the need to transfer water from Hume to meet demands downstream of the Barmah Choke. These high flow rates increase the chances of summer flooding in the forest if there is a rainfall event that leads to a ‘rain rejection’ of ordered water. If there are summer inflow peaks or rain rejection events they will be mitigated, as per past practice, when flooding of the forest is not desirable (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 124.5 m AHD prior to rain events and also to utilise irrigation canals where possible).

In past years when flows through the Barmah Choke are at, or close to channel capacity, the MDBA has utilised available spare capacity in Murray Irrigation escapes to deliver additional
water downstream via Mulwala Canal. Recently Murray Irrigation Limited has sought to significantly increase its charges for use of Mulwala Canal by WaterNSW and MDBA. Until commercial issues are resolved the Mulwala Canal will not be used by the MDBA. This may result in periods through summer and autumn of regulated flows in excess of channel capacity but at rates that can be passed through various watercourses in the forest, without extensive overbank inundation. The MDBA may also utilise escapes in the Goulburn Murray Water network to transfer small volumes of water (up to 150 ML/day) downstream via lower Broken Creek. This operation would partially meet environmental flow objectives in lower Broken Creek, and any additional losses to the transferred water before it returns to the River Murray are planned to be paid for by environmental water holders.

Under all scenarios, flows downstream of Lake Mulwala will fall to 8,000 ML/day or less when inflows downstream of the lake are sufficient to meet all demands. This may also happen for short periods due to increased demand at Lake Mulwala or for longer periods if there is sufficient inflow to Menindee Lakes to satisfy demand downstream of Wentworth Weir and hence reduce the need for release from the upper Murray storages. These lower target flow rates downstream of Yarrawonga may affect some irrigators further downstream due to reduced river levels.

Lower target flow rates downstream of Yarrawonga Weir also have the potential to affect some recreational users further downstream. The MDBA will have regard to the requirements of recreational users and will aim to meet those requirements where they align with meeting other objectives but cannot guarantee river levels for recreational use. Recreational water users are encouraged to check flow forecasts on the MDBA website when planning their activities. Further information on recreation is also available on the MDBA website.

In all cases over summer and autumn, flows less than channel capacity will be targeted, if possible, to mitigate against rainfall rejection.

6.4 Euston Weir flow

At Euston Weir, below the confluence of the Murray and Murrumbidgee, flows are not expected to exceed a monthly average of 13,000 ML/day in the ‘moderate’ and drier scenarios in 2016–17 (Figure 13). In the ‘near average’ and ‘wet’ scenarios, natural freshes and flood events occur upstream in the Murray, Goulburn and/or Murrumbidgee which then flow through Euston Weir. In all scenarios, the monthly average flow at Euston is expected to be 10,000 ML/day or less from January to May 2017.
A critical consideration that influences the use of Lake Victoria is that it must be operated and managed to minimise disturbance to Aboriginal cultural heritage material and any burials that may be exposed by erosion of the foreshore must be protected. The MDBA will aim to fulfil the intent of the Lake Victoria Operating Strategy (LVOS) (MDBC, 2002) and the Lake Victoria Cultural Landscape Plan of Management (revised 2007) that are required by the Aboriginal Heritage Impact Permit issued by the NSW Office of Environment and Heritage.

The LVOS requires the period of time that the 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. However, in some circumstances such as when the MDBA cannot call on water from the Menindee Lakes, water security assumes a higher priority and the levels in Lake Victoria may exceed the storage values recommended in the LVOS.

A further consideration relating to Lake Victoria operations is Clause 103 of the Murray–Darling Basin Agreement, which requires that the first 250 GL of minimum reserve be held in Lake Victoria at the end of each May. Given the relatively dry conditions, and following determination from Ministerial Council, this obligation was not required to be met in 2015–16. Current planning indicates that it may again be prudent to waive this requirement in 2016–17 if conditions remain dry. This operating plan assumes that the requirement to hold the first 250 GL of minimum reserve in Lake Victoria will not be enforced in the three driest scenarios, however approval would be required from Ministerial Council prior to operating in this manner. A determination by
the MDBA on whether to approach Ministerial Council with such a request will be made later in 2016–17 following a review of system inflows throughout winter-spring and consultation with the Water Liaison Working Group.

As of 1 June 2016, Lake Victoria held 300 GL (45% capacity). Lake Victoria is expected to effectively fill (if not by tributary inflows then by bulk transfers from Hume) at some stage during the spring-early summer in the moderate and wetter scenarios (Figure 14). In most scenarios the storage is expected to be in excess of 24.5 m AHD (≈400 GL) by mid-June 2016 and then be filled as late as possible as recommended by the LVOS. In the three driest scenarios the lake may not be filled to full supply level in 2016–17. In all scenarios the lake is expected to be gradually drawn down during autumn in a manner that is consistent with the LVOS.

![Figure 14: Lake Victoria storage outlook](image)

### 6.6 Menindee Lakes Storage

At 1 June 2016 the Menindee Lakes Storage had a volume of 49 GL. Under the ‘moderate’ and drier scenarios, the plan assumes negligible inflows throughout 2016–17. Higher inflows are assumed in the ‘near average’ and ‘wet’ cases from August onwards (Figure 15).

As a general practice, 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. Under the ‘near average’ and drier scenarios, it has been assumed that the lakes will remain below 640 GL such that no water would be able to be accessed by the MDBA for the River Murray system. Under these conditions the storage in Menindee Lakes would be managed by WaterNSW to safeguard only local water supplies.
Figure 15: Menindee Lakes’ storage outlook

Note: No inflow has been assumed in the four driest scenarios and therefore the red, pink and yellow lines are hidden by the light green moderate scenario.

Although not displayed in the scenarios of this operating plan, there is still the possibility that conditions in 2016–17 are very wet, in which case Menindee Lakes may be in flood operations and be surcharged for considerable periods of time.

It should be noted that inflows to Menindee Lakes are often not ‘aligned’ to conditions across the headwaters of the Murray. It is therefore quite conceivable that one system can have wet conditions whilst the other is dry. Operations will be adjusted accordingly noting that priority is generally given to first draw water from Menindee Lakes before other headwater storages.

6.6.1 Releases from the Menindee Lakes Storage

Releases, if any, from Menindee Lakes (Figure 16) to the lower Darling River, will be attributed to the respective allocations of NSW and Victoria according to Clause 120 of Murray–Darling Basin Agreement. If the volume stored in the Menindee Lakes exceeds 640 GL at some time during 2016–17, the MDBA will be able to use water to supply the River Murray system until the storage volume next falls to 480 GL. In accordance with the provisions of the Murray–Darling Basin Agreement that have been endorsed by all Basin jurisdictions, the agreed operation of Menindee Lakes is to use the water in this storage in preference to the storages upstream, such as Hume and Dartmouth, due to higher evaporation and loss rates at Menindee.
If the volume stored does not exceed 640 GL, the water in Menindee Lakes will be managed by NSW to supply urban water to Broken Hill and Menindee and, potentially, to supply Lower Darling irrigators. Local water availability for Lower Darling entitlement holders will continue to be determined by NSW DPI Water in accordance with NSW policy.

If accessible to the MDBA as a shared resource, Menindee Lakes will be operated in conjunction with Lake Victoria, aiming to reduce evaporative losses whilst minimising the chance of spill from Lake Victoria. Further considerations affecting the operation include the need to protect cultural heritage at Lake Victoria as well as longer-term security of water supply in the Lower Darling and for Broken Hill should there be a return to extreme dry conditions. Releases may be lowered or reduced to rates where only releases from Lakes Menindee and Cawndilla are made to mitigate risks to Broken Hill’s water supply. Harmony transfers may be released in a variable pattern in order to benefit the ecology of the Lower Darling River.

If Menindee Lakes are surcharged, the average minimum release of 500 ML/day (compared with 200–350 ML/day when Menindee is not surcharged) will be targeted until higher releases are needed to meet demand or are triggered by the ‘harmony’ procedures between Menindee Lakes and Lake Victoria. These procedures set out ‘trigger’ storage volumes in Lake Victoria for the end of each month (Table 9). If Lake Victoria storage is forecast to be below these volumes, then water may be released from Menindee Lakes to transfer to Lake Victoria.
Table 9: End of month 'trigger' storage volumes (GL) in Lake Victoria to initiate harmony transfers from Menindee Lakes

<table>
<thead>
<tr>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>660</td>
<td>500</td>
<td>140</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>340</td>
<td>500</td>
<td>680</td>
<td>680</td>
<td>680</td>
<td></td>
</tr>
</tbody>
</table>

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).

Additional Dilution Flow (ADF) may also influence the operation of Menindee Lakes and Lake Victoria. ADF aims to reduce river salinities in South Australia without significantly impacting on water availability. 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 procedures 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 10); and
b. the combined storage in Hume and Dartmouth Reservoirs exceeds 2000 GL.

Table 10: Volume (GL) in Menindee Lakes required to trigger Additional Dilution Flow

<table>
<thead>
<tr>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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</thead>
<tbody>
<tr>
<td>1300</td>
<td>1300</td>
<td>1300</td>
<td>1300</td>
<td>1300</td>
<td>1650</td>
<td>1650</td>
<td>1500</td>
<td>1300</td>
<td>1300</td>
<td>1300</td>
<td>1300</td>
</tr>
</tbody>
</table>

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

- inflows from the entire River Murray system
- diversions by the upper states
- the flow to South Australia
- environmental water demand in South Australia
- inflows to, and releases from, Menindee Lakes
- the impact of these factors on storage volumes at Lake Victoria and Menindee Lakes.

Generally, regulated release rates from Menindee Lakes will be below about 5,000 ML/day at Weir 32 to minimise river losses and to preferentially draw from Lakes Menindee and Cawndilla. However, regulated releases of up to 9,000 ML/day at Weir 32 may be implemented if required. In a very wet scenario, releases may exceed 9,000 ML/day due to inflows causing the lakes to spill. Flood releases are directed by NSW DPI Water and in general will pass inflows, whilst the lakes are close to full.
It is expected that water will be callable by the MDBA from the Menindee Lakes only if significant flooding occurs in the upper Darling River. For planning purposes, these high inflows to the Menindee Lakes have been assumed only in the ‘wet’ scenario.

6.7 Flow to South Australia

Based on the assumptions in this operating plan, full Entitlement Flow to South Australia in 2016–17 is only assured in the ‘near average’ and ‘wet’ scenarios (Figure 17). The ‘extreme dry’ to ‘moderate’ scenarios include delivery of the full South Australian dilution and loss allowance of 696 GL provided under clause 88b of the Murray–Darling Basin Agreement, along with reduced monthly entitlement volumes according to the scenario. Any water traded to South Australia will also be supplied and is in addition to the entitlement flow. In all cases, significant volumes of environmental water (470–740 GL) are expected to be delivered to South Australia. Periods of unregulated flow across the South Australian border are highly dependent on the timing of upstream inflow events and may occur in any scenario, even the ‘extreme dry’ case. Under the assumptions of this operating plan unregulated flow across the South Australian border only occurs in the moderate and wetter scenarios.

![Flow to South Australia outlook](image)

**Figure 17: Flow to South Australia outlook**

During periods where South Australia has less than full entitlement, decisions on the pattern of delivery of entitlement flows are made by the South Australian Department of Environment, Water and Natural Resources. The Minister for the River Murray is responsible for making South Australia River Murray allocation decisions, and a publically available Water Allocation Framework is provided on their [website](#).
Depending on water resource availability, South Australia may choose to manage monthly flows in order to build a reserve for critical human water needs and private carryover for 2017–18. South Australia can defer Entitlement Flow in accordance with South Australia’s Storage Right (Schedule G of the Murray–Darling Basin Agreement) and formal carryover arrangements in South Australia. This water would spill before NSW and Victorian entitlements – see the text on South Australia’s Storage Right in Section 3.2.4. South Australia will provide access to the private carryover component of water currently held within their Storage Right (up to a maximum of 60 GL).

In order to provide an indication of possible flows across the South Australian border this operating plan has made a number of assumptions. These include:

- South Australia to take full Entitlement Flow in June and July 2016, with their remaining entitlement spread evenly across the remainder of 2016–17 in all scenarios
- South Australia to defer 15 GL of entitlement in each of June and July 2016 in all scenarios, with no further deferral in 2016–17, unless conditions substantially change and portions of the SA Storage Right are spilt from Lake Victoria (see Section 3.2.4 for further information on South Australia’s Storage Right)
- South Australia to request delivery of 40 GL of the private carryover component of their storage right spread across the months of December to March in the three driest scenarios

Under the ‘extreme dry’, ‘very dry’ and ‘dry’ scenarios, unregulated flows are not expected to occur. In the ‘moderate’ scenario, modest volumes of unregulated flow may ensue through small inflow events from upstream. In the ‘near average’ and ‘wet’ scenarios, large upstream inflow events may result in prolonged unregulated flows. Under the wetter scenarios, there could be a significant flood along the River Murray in South Australia.

Water quality monitoring previously undertaken in the Lower Murray Reclaimed irrigation Area (LMRIA) has highlighted the presence of acid water in 14 of the 27 drainage discharge points that may potentially pose a health risk under low flow conditions. Modelling undertaken by SA Water indicates that the minimum flow target for dilution is 2,500 ML/day, and higher flows will provide greater dilution. The LMRIA Acid Drainage Working Group will be reconvened in 2016–17 due to the potential implications of reduced, or constrained flow to South Australia under the drier scenarios. Heavy metal concentrations may potentially increase under the ‘extreme dry’ to ‘moderate’ scenarios, which will require increased treatment by SA Water to protect public water supply. Under the ‘near average’ and ‘wet’ scenarios, there should be sufficient dilution from unregulated flows, environmental water and potentially ADF.

### 6.8 Lower Lakes and Barrage operation

Lakes Alexandrina and Albert (Lower Lakes) are upstream of five barrages located at Goolwa, Tauwitchere, Boundary Creek, Ewe Island and Mundoo Island.

With full Entitlement Flow, it is expected that the water 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 outside this range. In drier scenarios, the water levels may fall below 0.5 m AHD. Should water levels fall below 0.4 m AHD, then the planning phase of the Drought Emergency Framework for Lakes Alexandrina and Albert will commence. If sufficient volumes of unregulated
flows occur, then actions such as lakes cycling to remove salt from Lakes Alexandrina and Albert will be pursued.

Since late 2011, managed releases of water through the barrages have been undertaken in such a way as to vary the level of the Lower Lakes between 0.50 and 0.85 m AHD (Figure 18). These actions have aimed to improve salinity levels in the Coorong and Lake Albert (through lake level cycling operations). However, at times it has been very difficult to implement releases through the barrages due to high water levels in the Coorong due to tidal and storm influences.

In 2016–17, operation of water levels and releases will be consistent with arrangements to be agreed between the Commonwealth Environmental Water Office and the SA Department of Environment, Water and Natural Resources. Key objectives include managing environmental water to avoid the level of the Lower Lakes falling below 0.50 m AHD whilst also maximising, to the extent possible, barrage releases into the Coorong. This action is seeking to manage salinity levels in the Coorong.

Barrage fishways will be operated as the first priority for releases throughout 2016–17, with adjacent bays operated to provide attractant flow. When larger volumes are available, releases may be prioritised through Tauwitchere barrage, to influence salinity and water levels in the Coorong. Depending on the objectives for the delivery of environmental water, there may be occasions where water released from Goolwa barrage is prioritised over Tauwitchere barrage. During winter, priority may be given to releases through Goolwa barrage to enable fish passage, flow along the Goolwa Channel and the continued opening of the Murray Mouth. Barrage releases will aim to minimise sand ingress through the Murray Mouth, where possible.

In October 2002, a dredging operation commenced at the Murray Mouth to endeavour to maintain connectivity between the Goolwa Channel, the Coorong and the sea. With severe drought it was necessary to continue dredging until late 2010. A relatively large flood in early 2011 scoured out a significant volume of sand and increased the channel size through the mouth. Even with additional flows available through progressive implementation of the Basin Plan, there has been ongoing accumulation of sand inside the Murray Mouth as shown in Figure 19. Dredging at the Murray Mouth recommenced in January 2015 and will remain in place until sufficiently high flows are again able to scour out the Murray Mouth channel.
Figure 18: Lower Lakes levels since 2010–11 (not all data displayed for clarity of graph)

Figure 19: Murray Mouth sand volume and flow to sea
6.9 Maintenance and construction in 2016–17

A summary of the significant works planned or underway along the River Murray system in 2016–17 is provided in Table 11. Some of the works may impede navigation and they may be an influencing factor on the target flows for environmental releases (see Section 5.4). The critical flow rates mentioned in the Tables below will be reviewed as works progress at each of the sites.

Table 11: Significant works planned or underway in 2016–17

<table>
<thead>
<tr>
<th>Site</th>
<th>Status as at 1 June 2016</th>
<th>Period of construction</th>
<th>Critical flow (ML/day) that may prevent or delay works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lock 15 (Euston) refurbishment</td>
<td>Underway</td>
<td>January – July 2016</td>
<td>Approx. 13,000 ML/day</td>
</tr>
<tr>
<td>Erosion remedial works at Euston weir</td>
<td>Underway</td>
<td>February – July 2016</td>
<td>Approx. 13,000 ML/day</td>
</tr>
<tr>
<td>Katarapko Floodplain (near Lock 4 Bookpurnong)</td>
<td>New regulator at the mouth of Eckerts Creek (Bank J) to be constructed</td>
<td>August – December 2016</td>
<td>Approx. 40,000 ML/day</td>
</tr>
<tr>
<td>Lock 1 (Blanchetown)</td>
<td>Seepage issue recorded. Investigations ongoing. Options for remedial works under consideration</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
7. Calendar of Events in 2016–17

The following table lists events that the MDBA has been notified. Dates were correct at the time of publishing. However, readers are advised to check the most recent information with the event organisers for community events, or the MDBA website for information on major works.

Community organisations that have events to add to this calendar can notify MDBA via email to operationsreplies@mdba.gov.au. Information on how the MDBA takes account of recreational events in undertaking operations is available on the MDBA website.

<table>
<thead>
<tr>
<th>Month</th>
<th>Major works or actions</th>
<th>Community events</th>
</tr>
</thead>
<tbody>
<tr>
<td>June</td>
<td>Lock 15 (Euston) closed for refurbishment until mid-July</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>Lock 15 (Euston) closed for refurbishment until mid-July</td>
<td></td>
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<tr>
<td>August</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>22–23 October 2016 – Lake Hume boat race – Lake Hume. Website: humeboatclub.com</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22–23 October 2016 – Multi-Sport Festival Triathlon – Lake Mulwala. Website: ymmf.com.au</td>
</tr>
<tr>
<td>Month</td>
<td>Major works or actions</td>
<td>Community events</td>
</tr>
<tr>
<td>-------</td>
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</tr>
<tr>
<td>January</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>15–16 April 2017 – Mildura 100 water ski race. Website: milduraskiclub.org</td>
<td>15–16 April 2017 – Mildura 100 water ski race. Website: milduraskiclub.org</td>
</tr>
<tr>
<td>May</td>
<td></td>
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</tbody>
</table>
8. Further information

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

The MDBA will update a routine monthly operational plan, which contains outlooks of potential storage behaviours and release rates, regularly throughout 2016–17. These updates will be shared with the jurisdictions via Water Liaison Working Group.

Updates on river operations within the water year will be provided in a number of forms, which can be accessed via the MDBA website (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
- special circumstances reports.

Further information relating to River Operations can also be found on the MDBA website.