Water Allocation Plan
FOR THE RIVER MURRAY PRESCRIBED WATERCOURSE
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PRESCRIBED WATERCOURSE
Water Allocation Plan
for the
River Murray Prescribed Watercourse

I, Ian Hunter, Minister for Sustainability, Environment, and Conservation,
hereby adopt this Water Allocation Plan pursuant to section 80(3)(a)
of the Natural Resources Management Act 2004.

Ian Hunter MLC
Minister for Sustainability, Environment and Conservation
Date: 3/10/17
## Contents

1 THE WATER ALLOCATION PLAN
   1.1 Objectives of the Draft Water Allocation Plan ................................................................. 1
   1.2 Background ...................................................................................................................... 2
   1.3 Review Process .............................................................................................................. 2

2 THE RIVER MURRAY PRESCRIBED WATERCOURSE ............................................................. 4
   2.1 Overview of the South Australian River Murray ............................................................. 5
   2.2 Assessment of Demand on Water Resources ................................................................ 19
   2.3 Health and Condition of the System ............................................................................. 34
   2.4 Climate Change Impacts ............................................................................................... 38
   2.5 Aboriginal Engagement in Water Management .......................................................... 40

3 NEEDS OF WATER-DEPENDENT ECOSYSTEMS ................................................................ 54
   3.1 Introduction .................................................................................................................... 54
   3.2 Background ................................................................................................................... 54
   3.3 South Australia's Environmental Water Planning Framework ..................................... 55
   3.4 Environmental Water Requirements Assessment ...................................................... 56
   3.5 Capacity of the Resource to Meet Environmental Water Requirements ..................... 63
   3.6 Environmental Water Provisions .................................................................................. 67
   3.7 Other Environmental Flows to South Australia, including Unregulated Flows ............. 70
   3.8 Alternative Practices to Support Dependent Ecosystems ............................................ 71
   3.9 Environmental Outcomes Expected from Plan Provisions ........................................ 71
   3.10 Achieving Best Ecological Outcomes through Plan Implementation ........................ 72

4 EFFECTS ON OTHER WATER RESOURCES ..................................................................... 73
   4.1 Eastern Mount Lofty Ranges Prescribed Water Resources Area .................................. 75
   4.2 Western Mount Lofty Ranges Prescribed Water Resources Area ................................ 76
   4.3 Marne Saunders Prescribed Water Resources Area ..................................................... 77
   4.4 McLaren Vale Prescribed Wells Area ........................................................................... 77
   4.5 Tintinara Coonalpyn Prescribed Wells Area ............................................................... 78
   4.6 Tatiara Prescribed Wells Area ..................................................................................... 78
   4.7 Mallee Prescribed Wells Area ...................................................................................... 78
   4.8 Peake, Roby and Sherlock Prescribed Wells Area ....................................................... 79
   4.9 Noora Prescribed Wells Area ...................................................................................... 79
   4.10 Clare Valley Prescribed Water Resources Area .......................................................... 80
   4.11 Barossa Prescribed Water Resources Area .................................................................... 80
   4.12 Non-Prescribed Resources ......................................................................................... 81

5 CONSUMPTIVE POOLS, WATER ACCESS ENTITLEMENTS AND WATER ALLOCATIONS .......... 82
   5.1 Objectives ..................................................................................................................... 82
   5.2 Available Water from the River Murray ....................................................................... 82
   5.3 Consumptive Pools ...................................................................................................... 83
   5.4 Water Access Entitlements ......................................................................................... 88
   5.5 Basis for Water Allocation ......................................................................................... 92
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>MANAGEMENT OF THE TAKE AND USE OF WATER</td>
<td>98</td>
</tr>
<tr>
<td>6.1</td>
<td>Objectives</td>
<td>98</td>
</tr>
<tr>
<td>6.2</td>
<td>Water Resource Works Approvals</td>
<td>98</td>
</tr>
<tr>
<td>6.3</td>
<td>Site Use Approvals</td>
<td>102</td>
</tr>
<tr>
<td>7</td>
<td>TRANSFERS OF WATER ACCESS ENTITLEMENTS AND WATER ALLOCATIONS</td>
<td>116</td>
</tr>
<tr>
<td>7.1</td>
<td>Objectives</td>
<td>116</td>
</tr>
<tr>
<td>7.2</td>
<td>General Principles</td>
<td>117</td>
</tr>
<tr>
<td>8</td>
<td>PERMITS</td>
<td>118</td>
</tr>
<tr>
<td>8.1</td>
<td>Drilling of Monitoring Wells</td>
<td>120</td>
</tr>
<tr>
<td>9</td>
<td>MONITORING AND EVALUATION</td>
<td>121</td>
</tr>
<tr>
<td>9.1</td>
<td>Objectives</td>
<td>121</td>
</tr>
<tr>
<td>9.2</td>
<td>Monitoring</td>
<td>129</td>
</tr>
<tr>
<td>10</td>
<td>CONNECTION WITH OTHER LEGISLATION</td>
<td>132</td>
</tr>
<tr>
<td>11</td>
<td>GLOSSARY AND ABBREVIATIONS</td>
<td>133</td>
</tr>
<tr>
<td>11.1</td>
<td>Glossary</td>
<td>133</td>
</tr>
<tr>
<td>11.2</td>
<td>Abbreviations</td>
<td>143</td>
</tr>
<tr>
<td>12</td>
<td>REFERENCES</td>
<td>145</td>
</tr>
<tr>
<td>APPENDIX A</td>
<td>REASONABLE IRRIGATION REQUIREMENTS</td>
<td>150</td>
</tr>
</tbody>
</table>
Figures

Figure 1: The River Murray Prescribed Watercourse boundary ................................................................. 4
Figure 2: Maximum entitlement components ............................................................................................ 7
Figure 3: Breakdown of wetland volumes ................................................................................................. 13
Figure 4: Overview of salinity impact zones ............................................................................................. 42
Figure 5: Lower Murray Reclaimed Areas Irrigation Management Zone (i) ........................................... 43
Figure 6: Lower Murray Reclaimed Areas Irrigation Management Zone (ii) ........................................ 44
Figure 7: Lower Murray Reclaimed Areas Irrigation Management Zone (iii) ......................................... 45
Figure 8: Upper Pike River Extraction Management Zone ........................................................................ 46
Figure 9: Anabranches and Backwaters – New Pump Prohibited Water Extraction Zone (i) ............... 47
Figure 10: Anabranches and Backwaters – New Pump Prohibited Water Extraction Zone (ii) .......... 48
Figure 11: Anabranches and Backwaters – New Pump Prohibited Water Extraction Zone (iii) .......... 49
Figure 12: Anabranches and Backwaters – New Pump Prohibited Water Extraction Zone (iv) .......... 50
Figure 13: Anabranches and Backwaters – New Pump Prohibited Water Extraction Zone (v) .......... 51
Figure 14: Anabranches and Backwaters – New Pump Prohibited Water Extraction Zone (vi) .......... 52
Figure 15: Tributary Wetlands of Lake Alexandrina – New Pump Prohibited Water Extraction Zone (vii) .... 53
Figure 16: Prescribed Water Resources Areas and Prescribed Wells Areas ............................................ 74
Figure 17: Finnis River and Tookayerta Creek Prescribed Water Resources and areas of overlap .......... 101
Figure 18: Angas Bremer Irrigation Management Zone and Prescribed Wells Area ............................ 103
Figure 19: SA Water River Murray diversions, discharge points and aqueducts Sheet 1 .................... 113
Figure 20: SA Water River Murray diversions, discharge points and aqueducts Sheet 2 ..................... 114
Figure 21: SA Water River Murray diversions, discharge points and aqueducts Sheet 3 ..................... 115
Tables

Table 1: Statutory timeline for water management of the River Murray Prescribed Watercourse ........2
Table 2: South Australia’s right to divert water from the River Murray for consumptive purposes under Schedule E of the Agreement .................................................................9
Table 3: Breakdown of consumptive pools ..........................................................14
Table 4: Link between Consumptive Pools, Schedule E Cap on Diversions and the Basin Plan BDL ......18
Table 5: Allocations and actual average demands for River Murray PWC water, 1996-97 to 2000-01 .................................................................27
Table 6: Allocations and actual average demands for River Murray PWC water, 2003-04 to 2007-08 .................................................................28
Table 7: The Long-Term Diversion Cap and actual average use of River Murray PWC water, 2010-11 to 2013-14 ............................................................................29
Table 8: Environmental Water Requirements of the South Australian River Murray Floodplain (DEWNR 2015) .................................................................60
Table 9: Environmental Water Requirements of the South Australian River Murray Channel (adapted from DEWNR 2015) .................................................................61
Table 10: Environmental Water Requirements of the Coorong, Lower Lakes and Murray Mouth (O’Connor, et al. 2015) .................................................................62
Table 11: Contribution towards River Murray Channel Ecological Targets at various median flows (ML/day), compared against entitlements (EF) (adapted from Wallace et al. 2014) ..........64
Table 12: Consumptive Pools, purposes, and Classes of unit share ........................................84
Table 13: Water Access Entitlements in each Consumptive Pool ........................................89
Table 14: Rates of application for the Lower Murray Reclaimed Irrigation Area Management Zone ...109
Table 15: Relevant authorities for Water Affecting Activities ..................................................119
Table 16: Evaluation and reporting ..............................................................................122
Table 17: Monthly average evaporation (epan) in millimetres (mm) .......................................151
Table 18: Monthly average effective precipitation in millimetres (mm) .................................152
Table 19: Crop factors ...............................................................................................153
1 THE WATER ALLOCATION PLAN

This document is the Water Allocation Plan (the Plan) for the River Murray Prescribed Watercourse (PWC). The Plan is a statutory instrument, and is written in line with the legal requirements of the Natural Resources Management Act 2004 (NRM Act). The NRM Act requires the South Australian Murray-Darling Basin Natural Resources Management Board (the Board) to prepare a water allocation plan for each of the prescribed water resources in its region. The NRM Act also requires the Board to review a water allocation plan at least once within 10 years, following its adoption.

The Plan provides for the sustainable management of water resources in the River Murray in South Australia, in accordance with the requirements in the NRM Act, and sets out the policies for a range of water allocation provisions, including:

- managing consumptive pools;
- principles for allocating during dry conditions;
- water entitlements;
- water allocations; and
- water trading.

The Plan is an essential instrument to help protect the economic, social, cultural and environmental needs of the River Murray PWC for future generations, and aims to provide secure and equitable access to water for all users.

1.1 Objectives of the Draft Water Allocation Plan

The Plan sets out the way in which the water resources of the River Murray PWC can be managed through principles addressing the take and use of water. Outlined below are the objectives of the Plan. To achieve and measure these objectives, the Plan sets out policies (see Chapters 5 to 8) and monitoring and evaluation requirements (see Chapter 9).

a. Provide allocations that contribute to the water needs of water-dependent ecosystems (WDEs).

b. Allocate water in a sustainable and equitable manner between the different users.

c. Promote the efficient use of water from the Prescribed Watercourse.

d. Contribute to fulfilling South Australia’s obligations under Basin-wide plans and legislation.

e. Contribute to the prevention of loss of condition, number or extent of refuge habitats and dependent aquatic biota of floodplains, wetlands, and sites of significance.

f. Contribute to the prevention of adverse impacts on water quality.

g. Contribute to the prevention of increased soil salinity and acid sulfate soils, and associated land management issues.
1.2 Background

The River Murray PWC was declared as a proclaimed watercourse on 10 August 1978 under the *Water Resources Act 1976* (now administered under the NRM Act as a prescribed watercourse) and delineated in GRO Plan 926/78 (sheets 1 to 13). The first Water Allocation Plan for the River Murray PWC was introduced on 1 July 2002 – this was the first ever water allocation plan for the River Murray to be adopted by the then Minister for Environment and Conservation, the Hon John Hill MP.

A brief history of the key statutory events since the prescription of the resource, is outlined below in Table 1.

**Table 1: Statutory timeline for water management of the River Murray Prescribed Watercourse**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 August 1978</td>
<td>Prescription of River Murray Watercourse</td>
</tr>
<tr>
<td>1 July 2002</td>
<td>First Water Allocation Plan for the River Murray Prescribed Watercourse adopted</td>
</tr>
<tr>
<td>12 January 2004</td>
<td>Minor amendments to the first Plan</td>
</tr>
<tr>
<td>2007</td>
<td>Minor amendments to the first Plan</td>
</tr>
<tr>
<td>August 2008</td>
<td>Concept Statement for second Water Allocation Plan for the River Murray Prescribed Watercourse adopted</td>
</tr>
<tr>
<td>15 July 2009</td>
<td>Amendments to the first Plan</td>
</tr>
<tr>
<td>January 2011</td>
<td>Minor amendments to the first Plan</td>
</tr>
<tr>
<td>November 2014</td>
<td>Draft of the second Water Allocation Plan for the River Murray Prescribed Watercourse released for public comment</td>
</tr>
</tbody>
</table>

1.3 Review Process

Review of the Water Allocation Plan for the River Murray PWC commenced in 2007. At that time, the NRM Act required that water allocation plans be reviewed within five years. The review considered all existing policies in the Plan, and involved targeted consultation with River Murray licensees. The review process also included engagement with various regional representative bodies; the Board and Board staff involved with implementing aspects of the Plan; the River Murray Advisory Committee (RMAC) and representatives from the Department of Environment, Water and Natural Resources (DEWNR), formerly the Department for Water, Land and Biodiversity Conservation. The review determined that a new Plan needed to be developed.
Following the review, and in accordance with former section 78 of the NRM Act, the Board prepared the ‘Concept Statement for the Water Allocation Plan for the River Murray Prescribed Watercourse’ (South Australian Murray-Darling Basin NRM Board 2008). The concept statement set out the proposed content of this Plan and identified issues and topics for community discussion and consultation during its development. This Plan is based on the concept statement and has taken into account community feedback on the concept statement.

Preparation of the Plan has been undertaken in close consultation with the community through RMAC – an advisory committee to the Board consisting of representatives with a range of skills and diversity of social, economic, environmental and cultural interest in the River Murray. RMAC’s involvement in the development of the Plan has included:

- providing advice to the Board on development of the Plan;
- ensuring broad stakeholder involvement;
- facilitating key stakeholder input on content of the Plan; and
- assisting with engaging and educating stakeholders on the Plan.

The review and amendment of the Plan takes into account learnings from the drought, and aims to consolidate drought-related and other state policies into the Plan.

Consideration has been given to the Murray-Darling Basin Plan (Basin Plan) throughout the development of this Plan. The Plan has incorporated the Basin Plan Trading Rules as they came into effect on 1 July 2014. The 2011 water allocation plan was granted transitional status as a water resource plan for the purposes of the Water Act 2007 (Cth) (Water Act). This Plan aims to make further progress towards the requirements of the Basin Plan but is not intended to meet all Basin Plan requirements at this time. Compliance with the Basin Plan requires that South Australia develops a water resource plan for the South Australian River Murray by 30 June 2019. It is intended that a new Water Allocation Plan for the River Murray PWC will be adopted by 30 June 2019 which will meet Water Act and Basin Plan requirements. For more information about Basin Plan requirements, see Section 2.1.4.

This Plan replaces the Water Allocation Plan for the River Murray Prescribed Watercourse (as amended January 2011).
2 THE RIVER MURRAY PRESCRIBED WATERCOURSE

The River Murray PWC, covered by this Plan, encompasses the River Murray channel from the Victorian border down to and including Lakes Alexandrina and Albert, and portions of Currency Creek and the Rivers Finiss, Angas and Bremer. The boundaries of the area covered by the draft Plan are shown below, in Figure 1.

Figure 1: The River Murray Prescribed Watercourse boundary
2.1 Overview of the South Australian River Murray

The River Murray in South Australia sits at the end of the Murray-Darling Basin system and is the state’s largest reliable surface water resource. The River Murray is essential to supporting internationally significant ecosystems, nationally important economies, culture, and way of life. South Australia diverts around 7 percent of the Basin’s extracted surface water resources.

As the River Murray is heavily utilised by other states before reaching South Australia, water sharing arrangements and inter-jurisdictional agreements largely dictate the volume and pattern of River Murray flow to South Australia. This means there are constraints on how South Australia manages its take and use of water from the River Murray PWC.

During the drought between 2001 and 2010, over-allocation and resultant low flows had significant negative impacts on the River Murray in South Australia, with parts of the system on the brink of collapse. The Water Act provides the framework for the Basin Plan and is a step towards securing a healthy and sustainable working river for the future of all that rely on it, including the environment.

The Murray-Darling Basin Agreement 2008 (the Agreement) is now incorporated into the Water Act and sets out the arrangements for sharing the waters of the River Murray system between the Basin states. Its purpose is to promote and coordinate effective planning and management for the equitable, efficient and sustainable use of the water, land and other resources of the Murray-Darling Basin.

The Basin Plan (see Section 2.1.4.1) introduces a mechanism for a coordinated approach to the management of water resources within the Murray-Darling Basin. The Basin Plan aims to build upon existing approaches to managing the River Murray system, and recognises that a balance between the environment, economies and communities is important to provide for a healthy working river. The Murray-Darling Basin Plan: South Australian Implementation Strategy 2013 – 2019 (DEWNR, 2013) is in place to guide South Australia’s implementation of the Basin Plan and related programs by 2019.

The water available to South Australia is determined by the Murray-Darling Basin Authority (MDBA) in accordance with the Agreement. Sections 2.1.1 to 2.1.4 aim to provide the context for the management of the River Murray in South Australia by outlining arrangements in the Agreement, the Murray-Darling Basin Cap (the Cap) (contained in Schedule E of the Agreement), and by noting the immediate impacts of the Basin Plan. These sections also detail how South Australia manages the water it receives pursuant to the NRM Act and with consideration of the Agreement and the Basin Plan.

2.1.1 The Murray-Darling Basin Agreement

Water sharing arrangements relating to the River Murray have been in place since 1914, with the introduction of the River Murray Waters Agreement between the Commonwealth Government, New South Wales, Victoria and South Australia. Water sharing arrangements have fundamentally remained the same over time, with this agreement being superseded by the current Agreement.
The Agreement was first signed in 1987 and has the purpose of promoting and coordinating effective planning and management for the equitable, efficient and sustainable use of the water, land and other environmental resources of the Murray-Darling Basin. The agreement has evolved, with arrangements built on over time. The 2008 version of the Agreement is now incorporated into the Water Act.

Since the 2002 Plan, a number of Agreement components have been introduced that provide greater water security to South Australia. Critical Human Water Needs (CHWN) are now given the highest priority (see Section 2.1.1.2). Storage rights are now available to ensure CHWN can be met in dry times, as well as allowing storage for private carryover purposes (see Section 2.1.1.3).

2.1.1.1 South Australian Entitlement

Each year South Australia receives Entitlement of up to 1,850 GL, plus other ‘required flow’ including unregulated flows, water traded to South Australia (including environmental water deliveries) and other dilution flows as determined by the Agreement (see Section 3.7 for more about other required flow to South Australia).

Water provided to South Australia pursuant to the Agreement (including unregulated flows) is the only source of water recognised to be available from the River Murray Prescribed Watercourse. Principles in this Plan therefore relate only to these volumes. Rainfall and inflows to the river in South Australia are negligible and not considered a significant input.

The South Australian Entitlement is provided pursuant to the Agreement and is up to 1,850 GL per annum. The components of the Entitlement are shown in Figure 2 and are as follows:

- Clause 88(a) – Consumptive Entitlement up to 1,154 GL per year;
- Clause 88(b) – Dilution and Loss Entitlement of 696 GL per year (58 GL per month); and
- Clause 88(c) – additional quantities for dilution as determined by the Ministerial Council.

Consumptive Entitlement (up to 1,154 GL per year) is the maximum volume of entitlement for non-dilution and loss purposes provided to South Australia in any year and is distributed under the provisions in this Plan. This volume is only reduced during periods of low water availability across the River Murray system. While this component is commonly referred to as the ‘consumptive’ component of the South Australian Entitlement, it is not solely for consumptive purposes – some is specifically for the environment (see Section 3.5), and some must remain unallocated due to limits on surface water diversions in South Australia that are required under the Cap arrangements (see Section 2.1.2).

Dilution and Loss Entitlement (696 GL per year) is provided to meet conveyance losses to Wellington and provide salinity dilution. Under clause 88A of the Agreement, up to 13.92 GL (2 percent) may be used for other purposes if the available Entitlement is ≤900 GL. This volume includes the evaporative losses from wetlands permanently connected to the river.
South Australia has the right to store (defer) part of its Entitlement in the upstream major storages to meet requirements for future CHWN and private carryover. When deferred entitlement is delivered to South Australia in a later year, it is additional to the Entitlement available in the current year. For further information on storage rights, see Section 2.1.1.3.

Of the 1,154 GL Consumptive Entitlement, a volume of 834\(^1\) GL has been identified as the maximum amount of water available for consumptive purposes. The remaining volume is unallocated and has historically remained in the river to support dilution, loss and environmental purposes. In the future, this unallocated water may be required to help build South Australia’s CHWN reserve, as required by the Water Act.

The Plan provides objectives and principles for consumptive pools, water access entitlements and water allocations. The consumptive pools, associated unit shares and allocation criteria are set out under Chapter 5 of this Plan.

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\(^1\) This volume excludes the volume held on licence for managed wetlands (42.5 GL) as this use is not considered a consumptive purpose.
2.1.1.2 Critical Human Water Needs

The Water Act, Basin Plan and Agreement include obligations around Critical Human Water Needs (CHWN), recognising the importance of having explicit arrangements in place for low water availability conditions. CHWN are considered the highest priority water use, and water sharing arrangements between Basin states ensure water is set aside to deliver CHWN. The Basin Plan sets out volumes required to meet the CHWN of the communities that are dependent on the waters of the River Murray System, however each state is responsible for meeting its own needs. The stated volume for South Australia’s CHWN is 204 GL. This figure factors in the volume required for metropolitan Adelaide during periods of very low water availability in both the River Murray System and the Mount Lofty Ranges.

The actual required CHWN volume will be determined annually and provided from the Entitlement first and from deferred CHWN water held in the upstream major storages second (see Section 2.1.1.3). Water stored for CHWN is unlikely to be required when South Australia is receiving Entitlement of 1,850 GL, however will be important when South Australia receives less than Entitlement.

The consumptive pools set out in Section 5.3 are distinguished by whether they include CHWN water. The Metropolitan Adelaide (Class 6) and All Purpose Consumptive Pools (Class 1, 2 and 5) are the consumptive pools that relate to CHWN water. When South Australia is receiving less than Entitlement of 1,850 GL, CHWN will be given priority over other consumptive uses. The principles for allocating during dry conditions (see Sections 5.3.2 and 5.4.1) incorporate the Basin Plan requirement that CHWN be given the highest priority.

2.1.1.3 Storage Rights

South Australia’s storage rights are reflected in clause 91, clause 130 and Schedule G of the Agreement. The Agreement provides South Australia with the right to store (defer) part of its Entitlement in the upstream major storages and subsequently deliver it for CHWN and private carryover in a future year. South Australia can defer and store part of the 1,154 GL consumptive component of its 1,850 GL Entitlement. When the South Australian Entitlement volume is known, the Minister for Sustainability, Environment and Conservation can make decisions on how much of the consumptive component to defer and store.

South Australia is required to advise the Murray-Darling Basin Authority on a monthly basis of its plans to defer and deliver Entitlement, via a 12-month Deferred Water Storage and Delivery Plan. Planning to defer and later deliver stored water is subject to operational and river system considerations and constraints.

Decisions by South Australia to defer and store Entitlement take into account a number of factors, including but not limited to:

- available airspace in upstream storages;
- risks of spill or pre-release for flood mitigation;
- potential effects on other water users (including the environment);
- volume of underuse in the previous water-use year;
- the opening water allocation in the current water-use year; and
- potential water availability the following year.
The volume of Entitlement that has been deferred and stored by the state in a given year, as CHWN or private carryover, forms part of the volume available for delivery for consumptive purposes in a subsequent year (in addition to the South Australian Entitlement). Deferred water will only be delivered from storage once the Minister has made it available for use. Particularly in times when South Australia receives less than its full Entitlement, the Minister may determine to make volumes deferred for CHWN and private carryover available for use in the current water-use year.

The private carryover arrangements and how these allocations are calculated for individual water users are provided in Section 5.5.2 of the Plan – see Principles 50 to 61.

2.1.2 The Cap

The South Australian Government decided in 1969 to limit further consumptive diversions from the River Murray, based on the ecological and water quality needs of the river under low flow conditions. On 1 July 1997, the Murray-Darling Basin Ministerial Council established a permanent Cap on diversions of water used for consumptive purposes in river valleys within the Basin to protect and enhance the river environment and to ensure security to existing water users. South Australia’s right to divert water for consumptive use is set out under the Cap, contained in Schedule E of the Agreement (see Table 2).

Table 2: South Australia’s right to divert water from the River Murray for consumptive purposes under Schedule E of the Agreement

<table>
<thead>
<tr>
<th>Consumptive Purpose</th>
<th>Maximum Volume of Water (Gigalitres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water supply purposes delivered to metropolitan Adelaide and associated country areas through the Swan Reach-Stockwell, Mannum-Adelaide, and Murray Bridge-Onkaparinga pipeline systems</td>
<td>650 over any consecutive five-year period (average 130 per year)</td>
</tr>
</tbody>
</table>
| Lower Murray Swamp Irrigation | 94.2 per year consisting of:  
• 72.0 for irrigation, stock and domestic  
• 22.2 for environmental land management |
| Country Town Water Supply Purposes | 50 per year |
| Other Purposes | 449.9 (long-term average annual diversion, with annual cap targets calculated at the end of each water year, taking into account the climate, trade and held environmental water) |

The Wetland Consumptive Pool and Environmental Consumptive Pool are not part of the Cap, as the Cap is on diversions for consumptive purposes.

2.1.3 River Murray Consumptive Pools

The NRM Act requires that water allocation plans determine, or provide a mechanism for determining, from time to time, a consumptive pool or pools for the water resource. Water allocation plans are also required to set out principles associated with the determination of water access entitlements and for the taking and use of water, so that:

- an equitable balance is achieved between environmental, social and economic needs for the water; and
- the rate of the taking and use of the water is sustainable.
The Plan also needs to take into account the arrangements set out under the Agreement as outlined in Section 2.1.1.

A consumptive pool is defined by the NRM Act as the water that will from time to time be taken to constitute the resource, within a particular part of a prescribed water resource. A consumptive pool is generally comprised of water available for allocation for licensed purposes, water for stock and domestic use under section 124 of the NRM Act (where the River Murray adjoins or runs through the land), and water authorised for use by the Minister under section 128 of the NRM Act.

The Plan provides objectives and principles for the management of water access entitlements within consumptive pools, and the principles for allocating water based on the water access entitlement held. This allows for a licensing system which regulates the taking of water from the resource within sustainable limits.

A number of consumptive pools are set out for the River Murray, and water access entitlements are established within each consumptive pool. A water access entitlement provides a right to a share of the consumptive pool it is from, and allocations are granted against that entitlement based on the volume of water made available to that consumptive pool.

South Australia has contributed 876.5 GL to consumptive pools. The remainder of the 1,850 GL remains unallocated to maintain compliance with the Cap, and in recognition that when receiving South Australian Entitlement of 1,850 GL, additional water is required for dilution and loss purposes to maintain river health.

The 876.5 GL is broken down into a number of consumptive pools from which water access entitlements can be granted. See Table 3 for a breakdown of the volumes in each consumptive pool and class. The reason for multiple consumptive pools is to allow different rules for each around accessing water and making water available.

### 2.1.3.1 Metropolitan Adelaide Consumptive Pool

The former Class 6 now forms the Metropolitan Adelaide Consumptive Pool, and relates to the supply of water to metropolitan Adelaide and associated country areas through the Swan Reach – Stockwell, Mannum – Adelaide, and Murray-Bridge – Onkaparinga pipelines (as set out in Schedule E of the Agreement). In accordance with the Agreement, this Plan recognises that water access entitlements and water allocations that relate to this consumptive pool cannot be traded. The first 150 GL in this consumptive pool is recognised as being for CHWN in dry periods.

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2 This volume includes the volume held on licence for managed wetlands (42.5 GL). It does not include the volume attributable to unmanaged wetlands (approximately 157.5 GL).
2.1.3.2 All Purpose Consumptive Pool

The former Classes 1, 2, 3a, 3b, 4, 5, 7 and 8 are now included in the All Purpose Consumptive Pool. This consumptive pool is ‘all purpose’ and includes, but is not limited to:

- licensed purposes - CHWN, stock and domestic, urban water use (country towns), industrial, industrial dairy, irrigation, recreational, environmental and environmental land management within the Lower Murray Reclaimed Irrigation Area (LMRIA);
- unlicensed stock and domestic use; and
- purposes permitted under section 128 authorisations - such as road making, firefighting and application of chemicals to non-irrigated crops.

This consumptive pool consists of water access entitlements for Classes 1, 2, 3, 5 and 8. See Table 3 for a breakdown of each consumptive pool and class.

A total of 10 GL is included in the All Purpose Consumptive Pool for unlicensed uses authorised under the NRM Act. Although a water licence is not required, the volume needs to be recognised within a consumptive pool. A volume of approximately 6.1 GL is included in Class 1 for unlicensed stock and domestic use and for water use authorised under section 128 for the purposes of exercising native title rights and interests. The volume for exercising native title rights and interests is indicative only and may be refined following engagement with relevant Aboriginal groups (see Section 2.5). A volume of approximately 3.9 GL is included in Class 3 for other non-licensed use including road making, firefighting and application of chemicals to non-irrigated crops.

Classes 1, 2 (up to 34 GL) and 5 are recognised as being for CHWN in dry periods.

The previous Classes 3a, 3b, 4 and 7 are now included in the All Purpose Consumptive Pool, as Class 3. Class 3b related to the historical administration of the Ground Water (Qualco-Sunlands) Control Act 2000 prior to the unbundling of water rights. A separate class for water used within the Qualco-Sunlands irrigation area allowed a set volume of irrigation water to be traded within the scheme, with no other irrigation water to be traded in. The need for a separate class of water was in recognition of the high risk of waterlogging and salinisation of land and increased levels of salinity in the River Murray caused by irrigation of land in the Qualco-Sunlands irrigation area. Since unbundling, this distinction is no longer required as the application of water is managed through site use approvals within the Qualco-Sunlands irrigation area.

The previous Class 8 is retained, and is included in the All Purpose Consumptive Pool. The volume of water in this class is set out in the Agreement and is specifically for environmental land management in the Lower Murray Reclaimed Irrigation Areas. Water access entitlements and water allocations related to Class 8 cannot be traded and expire upon the change in owner or occupier of land on which the water allocation is used.

2.1.3.3 Wetland and Environmental Consumptive Pools

Two consumptive pools arise from the former Class 9 entitlements – the Wetland Consumptive Pool and the Environmental Consumptive Pool. The Wetland Consumptive Pool is for the purpose of managing wetlands within the 1956 flood boundary that are permanently connected at normal pool level; the Environmental Consumptive Pool is for environmental purposes as defined in the Water Act 2007 (Cth).
The annual evaporative losses from the wetlands permanently connected at normal pool level have been estimated to be 200 GL. Without any regulation, this 200 GL is effectively diverted and taken from the river to replace evaporative losses. Hydrologically this water must be taken from the first water provided to the state, that is, from the 696 GL Dilution and Loss Entitlement.

Prior to the adoption of the River Murray Water Allocation Plan in 2002, there was no licensing of wetlands, nor any allocations made to them (with the exception of a National Parks and Wildlife Service licence for pumping into Tolderol). For those wetlands managed for environmental purposes, the actual approach was generally determined by individual wetland managers and was not subject to formal regulation. As the number of wetland management projects along the river increased, implementation of a coordinated approach became important.

The 2002 Plan established a maximum of 200 GL for wetland management purposes. In 2009, when the 2002 Plan was unbundled, this became 200,000,000 unit shares (at 1 kL per share) in Class 9.

Water access entitlements could be granted by the Minister for wetlands that could be managed (explained further below), with the remaining water access entitlements for unmanaged wetlands remaining unassigned.

Following a review of how wetland water is accounted for\(^3\), it is recognised that the 200 GL of evaporative losses is accounted for from the Dilution and Loss Entitlement (696 GL). The portion that can be managed is included in a consumptive pool and requires a licence. Water access entitlements are issued to reflect the volume required for managed wetlands.

The volume attributable to unmanaged wetlands is accounted for from the Dilution and Loss Entitlement, and is not included a consumptive pool. This is because the evaporation of water in these wetlands cannot be managed. This volume is approximately 157.5 GL.

Construction of regulating infrastructure on wetlands allows them to be managed with a more natural wetting and drying regime. This results in water savings, as less water is needed for a wetting and drying regime than if the wetlands remained permanently connected to the river. The evaporation volume for that wetland (based on when it was connected to the river) is placed on a licence, with water access entitlements being assigned based on that volume (at 1 kL per unit share).

A portion of the water access entitlements arising from managed wetlands has been transferred to the Commonwealth of Australia, as a result of water savings achieved via wetland works undertaken through the Riverine Recovery Project (RRP). The volume transferred is the evaporation volume for that wetland (based on when it was connected to the river) less the volume now required to manage that wetland through a wetting and drying regime. These works are still underway as at the date of adoption of this Plan. The number of water access entitlements in the Environmental Consumptive Pool that the Commonwealth of Australia will hold are likely to increase as the RRP progresses.

The Wetland Consumptive Pool comprises of the portion of water access entitlements attributable to managed wetlands, less the water access entitlements transferred to the Commonwealth of Australia. This reflects the volume required to manage South Australia’s

\(^3\) Since consultation on a draft version of this Plan, a review of accounting for wetland water was undertaken. Revised information is included in the Plan as a result of this work.
wetlands with a wetting and drying regime going forward. The water access entitlements are likely to increase over time as more regulating infrastructure is built through RRP.

As at 20 December 2016, approximately 42.5 GL from Class 9 has been placed on licence for managed wetlands. Of this volume, 5.2 GL of water savings have been transferred to the Commonwealth of Australia. The 42.5 GL for managed wetlands is a portion of the 200 GL originally assigned to evaporation from all connected wetlands.

While the number of water access entitlements are likely to change over time as more wetlands become managed, the total of the two consumptive pools and the volume attributable to unmanaged wetlands will remain equal to the original 200 GL volume for evaporative losses. See Figure 3 for a breakdown of the wetland volumes.

![Figure 3: Breakdown of wetland volumes](image)

**2.1.3.4 Consumptive Pools Breakdown**

Table 3 shows the history of water access entitlements, which were originally reflected as a ‘purpose’ in the 2002 Plan, then a ‘class’ in the 2009 unbundled Plan, and in this Plan as ‘consumptive pools’. The number of shares from the ‘classes’ of water are not changing in the conversion to ‘consumptive pools’. The table also shows the volumes included in the All Purpose Consumptive Pool for unlicensed water use (Classes 1 and 3). This water use was previously part of the unallocated portion of Entitlement, but it requires inclusion in a consumptive pool. Table 3 also indicates where a consumptive pool is recognised as relating to CHWN.
<table>
<thead>
<tr>
<th>Consumptive Pool</th>
<th>Previous Class</th>
<th>Previous purpose</th>
<th>Unit Shares*</th>
<th>Volume (GL)</th>
<th>CHWN</th>
<th>Comments*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metropolitan Adelaide Consumptive Pool (Class 6)</td>
<td>Class 6</td>
<td>Urban water use – metropolitan Adelaide and associated country areas</td>
<td>130,000,000</td>
<td>130.000</td>
<td>Y up to 150 GL</td>
<td></td>
</tr>
<tr>
<td>All Purpose Consumptive Pool (Class 1)</td>
<td>Class 1</td>
<td>Stock, domestic, stock and domestic</td>
<td>8,368,162</td>
<td>8.368</td>
<td>Y</td>
<td>0.012 GL is held for TLM 0.075 GL is held by the Commonwealth of Australia</td>
</tr>
<tr>
<td>Nil</td>
<td>Unlicensed stock, domestic, stock and domestic, section 128 authorisations for native title purposes</td>
<td>Nil</td>
<td>6.063</td>
<td>Y</td>
<td>Previously part of unallocated portion of Entitlement</td>
<td></td>
</tr>
<tr>
<td>All Purpose Consumptive Pool (Class 2)</td>
<td>Class 2</td>
<td>Urban – country towns</td>
<td>50,000,000</td>
<td>50.000</td>
<td>Y up to 34 GL</td>
<td></td>
</tr>
<tr>
<td>All Purpose Consumptive Pool (Class 5)</td>
<td>Class 5</td>
<td>Industrial &amp; dairy</td>
<td>5,568,841</td>
<td>5.569</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>All Purpose Consumptive Pool (Class 3)</td>
<td>Class 3a</td>
<td>Irrigation (other than Qualco)</td>
<td>543,969,767</td>
<td>543.970</td>
<td>N</td>
<td>6.614 GL is held for TLM 145.760 GL is held by the Commonwealth of Australia</td>
</tr>
<tr>
<td>Class 3b</td>
<td>Irrigation in Qualco</td>
<td>21,038,369</td>
<td>21.038</td>
<td>N</td>
<td>Previously part of the unallocated portion of Entitlement</td>
<td></td>
</tr>
<tr>
<td>Nil</td>
<td>Section 128 authorisations (other than for native title purposes)</td>
<td>Nil</td>
<td>3.937</td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class 4</td>
<td>Recreation</td>
<td>4,423,526</td>
<td>4.423</td>
<td>N</td>
<td>0.043 GL is held by the Commonwealth of Australia</td>
<td></td>
</tr>
<tr>
<td>Class 7</td>
<td>Environment (TLM)</td>
<td>38,366,550</td>
<td>38.367</td>
<td>N</td>
<td>The majority of shares are held for TLM</td>
<td></td>
</tr>
<tr>
<td>All Purpose Consumptive Pool (Class 8)</td>
<td>Class 8</td>
<td>Environmental land management</td>
<td>22,200,000</td>
<td>22.200</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Wetland Consumptive Pool</td>
<td>Class 9</td>
<td>Wetlands</td>
<td>37,277,335</td>
<td>37.277</td>
<td>N</td>
<td>37.3GL is held on licence for managed wetlands. This is a portion of the 200 GL included in the 2002 Plan for wetlands (formerly Class 9). The unmanaged portion of the 200 GL is not included in the consumptive pool (see Section 2.1.3.3).</td>
</tr>
<tr>
<td>Environmental Consumptive Pool</td>
<td>Class 9</td>
<td>Wetlands (water savings achieved through RRP)</td>
<td>5,224,800</td>
<td>5.225</td>
<td>N</td>
<td>The Commonwealth of Australia holds entitlements through water savings achieved from RRP (5.2GL), formerly Class 9.</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>866,437,350</td>
<td>866.437</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Number of unit shares available as at 20 December 2016

* Entitlements held for TLM and by the Commonwealth of Australia are as at 14 March 2017
2.1.4 New Arrangements Arising from the Basin Plan and the 
*Water Act 2007* (Cth)

2.1.4.1 The Murray-Darling Basin Plan

The Murray-Darling Basin Plan (Basin Plan) was adopted by the Commonwealth Minister on 22 November 2012, during the review period of this Plan. It now guides the management of water across the Murray-Darling Basin.

The Basin Plan is being put into effect through the following key elements:

- sustainable diversion limits (SDLs) that limit the amount of surface water that can be taken from the Basin for consumptive use;
- an environmental watering plan that guides how water is to be applied to maximise environmental outcomes;
- a water quality and salinity management plan to guide river management and longer term planning and management;
- water trading rules to facilitate efficient and effective water markets across the Basin;
- water resource planning requirements to guide the development and implementation of state water resource plans which will implement SDLs and water resource management arrangements consistent with the Basin Plan;
- an SDL adjustment process which allows SDLs to be adjusted up or down within defined limits;
- the development of a constraints management strategy to identify projects to remove or relax physical and operational constraints to environmental water delivery; and
- a monitoring and evaluation plan to measure the Basin Plan’s effectiveness.

The Basin Plan also identifies the volumes of water required for CHWN for those areas that are dependent on the water resources of the River Murray system.

Importantly, the Basin Plan includes management objectives to help guide the achievement of improved environmental outcomes in South Australia, including maintaining Murray Mouth openness and flows to the Coorong, supporting healthy floodplains and maintaining water levels in the Lower Lakes above 0.0 metres AHD for 100 percent of the time and above 0.4 metres AHD for 95 percent of the time.

Long Term Environmental Watering Plans and Annual Environmental Watering Priorities for each Water Resource Plan area are now required to guide the delivery of environmental water. A *Long Term Environmental Watering Plan for the South Australian River Murray Water Resource Plan Area* was published in November 2015.
The Commonwealth of Australia holds a significant volume of water for environmental purposes through water recovery programs (see Section 2.1.4.3). Environmental water is also held on licence for The Living Murray program (TLM)\(^6\) and as a result of water savings from managed wetlands through the RRP. Non-government organisations and private donors also contribute to water delivered for environmental purposes. For further information about environmental water, see Chapter 3.

In accordance with the Basin Plan, South Australia is required to develop Water Resource Plans (WRPs) for the following areas:

- South Australian River Murray (all surface water resources in the area);
- South Australian Murray region (all surface and groundwater water resources in the area, excluding the surface water resources of the South Australian River Murray); and
- Eastern Mount Lofty Ranges (all surface and groundwater resources in the area).

WRPs align water management with elements of the Basin Plan. The WRPs will be made up of several components – the next Plan will be one component of the South Australian River Murray WRP.

As outlined in Section 1.3, full compliance with the Basin Plan is required by 2019. As such, the Plan makes progress towards some of the requirements of the Basin Plan, but policies are not intended to meet all Basin Plan requirements at this time. The next review of the Plan will take into account full requirements of the Basin Plan.

### 2.1.4.2 Sustainable Diversion Limits

SDLs have been set out in the Basin Plan and will be implemented through accredited WRPs. For the River Murray in South Australia, the Basin Plan requires implementation of the new SDLs by 2019, with 183.8 GL to be recovered for the environment. A significant portion of this water has already been recovered.

The Australian Government is investing in irrigation efficiency infrastructure and water purchase to recover water to ‘bridge the gap’ to the new SDLs. It is also possible to adjust the SDLs – the Basin Plan includes a mechanism that allows for SDLs to be increased or decreased, but must ensure equivalent or better environmental, social and economic outcomes from any adjustment. Further information on SDLs is available at [www.mdba.gov.au](http://www.mdba.gov.au).

The final SDL volume for the River Murray prescribed watercourse will not be known until the SDL adjustment mechanism is finalised.

Table 4 shows the link between each consumptive pool and the relevant Cap(s) on Diversions as defined under Schedule E of the Agreement.

\(^6\) For more information on the TLM program, please refer to Section 2.2.2.6
Table 4 also shows the consumptive pools that include volumes that formed part of the Baseline Diversion Limit (BDL) calculation for the Basin Plan. The BDL reflects the existing diversion limits established by the Cap. It includes all water pumped, diverted or intercepted for consumptive purposes. BDLs do not include environmental diversions, such as those under entitlements recovered through TLM. This is a key difference with the long-term Cap(s) on diversions. The volume of water (10 GL in total) authorised to be taken for stock and domestic purposes, and purposes authorised pursuant to section 128 of the NRM Act, were also not included in the BDL.

Another difference is that the BDL is expressed as a long-term average. In South Australia, the current Caps are a combination of a long-term average, annual limits and a rolling 5-year limit. As a result, these different limits were required to be transformed into a single, long-term average limit, which is the BDL.

Table 4 highlights that Class 9 water access entitlements for wetlands were not part of the BDL. Small components of Class 1 and Class 3a, and most of Class 7, were not included in the determination of the BDL, as these volumes are held for TLM. However, within Class 7 some volume was included as the use is regarded as consumptive. For further information about environmental water, see Chapter 3.

SDLs are defined as a reduction from the relevant BDL. As such, the BDL is adjusted for water recovered to ‘bridge the gap’, and any SDL adjustment mechanisms to produce the SDL. Therefore, use against those water access entitlement volumes held for consumptive purposes within the same classes used to determine the BDL will also be evaluated in terms of SDL compliance.
Table 4: Link between Consumptive Pools, Schedule E Cap on Diversions and the Basin Plan BDL

<table>
<thead>
<tr>
<th>Consumptive Pool</th>
<th>Previous Class</th>
<th>Previous purpose</th>
<th>Schedule E (Cap on Diversions)</th>
<th>BDL</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Purpose Consumptive Pool (Class 1)</td>
<td>Class 1(^7)</td>
<td>Stock, domestic, stock and domestic</td>
<td>All other purposes; Lower Murray Swamps 544.1 GL</td>
<td>518 GL</td>
</tr>
<tr>
<td>All Purpose Consumptive Pool (Class 5)</td>
<td>Class 5</td>
<td>Industrial and dairy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Purpose Consumptive Pool (Class 3)</td>
<td>Class 3(^a)</td>
<td>Irrigation (other than Qualco)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Purpose Consumptive Pool (Class 3)</td>
<td>Class 3b</td>
<td>Irrigation in Qualco</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Purpose Consumptive Pool (Class 3)</td>
<td>Class 4</td>
<td>Recreation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Purpose Consumptive Pool (Class 3)</td>
<td>Class 7(^9)</td>
<td>Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Purpose Consumptive Pool (Class 8)</td>
<td>Class 8</td>
<td>Environmental land management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Purpose Consumptive Pool (Class 2)</td>
<td>Class 2</td>
<td>Urban – country towns</td>
<td>Country Towns 50 GL</td>
<td>48 GL</td>
</tr>
<tr>
<td>Metropolitan Adelaide Consumptive Pool</td>
<td>Class 6</td>
<td>Urban water use – metro</td>
<td>metropolitan Adelaide 650 GL over 5 years</td>
<td>100 GL(^{10})</td>
</tr>
<tr>
<td>Wetland Consumptive Pool &amp; Environmental Pool</td>
<td>Class 9</td>
<td>Wetlands(^{11})</td>
<td>Not applicable</td>
<td></td>
</tr>
</tbody>
</table>

\(^{2.1.4.3}\) Commonwealth Environmental Water Holder

The Water Act established the position of Commonwealth Environmental Water Holder (CEWH). The Commonwealth Environmental Water Office (CEWO) assists the CEWH to manage environmental water to protect or restore the environmental assets of the Murray-Darling Basin and to meet a number of objectives, including to give effect to international agreements (Water Act 2007 (Cth)).

The CEWH manages water that has been recovered by the Commonwealth of Australia in the form of water entitlements, either through water buy backs or projects funded to create water savings. As at 14 December 2016, the Commonwealth of Australia holds a total of 2,473,978 ML of registered entitlements across the Murray-Darling Basin (CEWH, 2016).

\(^7\) These numbers are extracted directly from Schedule 3 of the Basin Plan, but are subject to review in accordance with section 7.23 of the Basin Plan, and as outlined in Position Statement 3D Changes to BDL (MDBA 2015) and MDBA Technical Report 2011/01 (MDBA 2011).

\(^8\) A small component of Class 1 and Class 3a are held for TLM purposes and these volumes were excluded from the calculation of the BDL.

\(^9\) The majority of Class 7 is held for TLM and was excluded from the calculation of the BDL.

\(^10\) To be confirmed once a new climate adjusted Cap model for Metropolitan Adelaide is approved.

\(^11\) Class 9 entitlements are not accountable under Schedule E and do not form part of the BDL. There is currently 42.5 GL on licence (for managed wetlands). Of this, the Commonwealth of Australia holds some entitlements through water savings achieved from RRP (~5.2 GL).
The Commonwealth of Australia holds approximately 146 GL of South Australian water access entitlements (as at 14 March 2017). The majority of water access entitlements are held in the former class 3a (145.8 GL), with the remainder held in the former class 1 (0.075 GL) and class 4 (0.043 GL).

Under the Basin Plan, the CEWH is required to manage and deliver water in accordance with the Basin-wide environmental watering plan. The development of long-term watering plans by Basin states will also inform the planning and use of environmental water.

The Basin Plan contains a number of matters that the CEWH must have regard for when planning environmental watering. The MDBA, the CEWH and Basin states need to work together to ensure the best possible use of environmental water. Water recovered from within South Australia by the Australian Government may be used for environmental purposes across the Basin, and in accordance with the provisions in the Water Act.

In South Australia, water set aside for the environment in this Plan will also be needed to complement other environmental water such as that held by the Commonwealth of Australia to protect and restore ecological assets (see Section 3.6 for more on environmental water provisions). South Australia will work closely with the CEWH and the MDBA in environmental water planning and delivery processes to ensure the best environmental outcomes for the state, recognising that during periods of low flow, water available to the CEWH is limited and water must be shared between ecological assets across the Basin.

2.2 Assessment of Demand on Water Resources

Section 76(4)(d) of the NRM Act provides that a water allocation plan must assess the capacity of the resource to meet the demands for water on a continuing basis. This section assesses the demand for water from the River Murray PWC and the capacity of the resource to meet that demand.

2.2.1 Needs of Water Users

The River Murray PWC area is part of a region that is home to approximately 66,000 people (ABS 2007-2011), or 4 percent of South Australia’s population. The River Murray further supports another 1.5 million South Australians, or 89 percent of the State’s population, supplying water for industries and urban and town water use. The River Murray supports highly valuable ecological communities, and is important to social and cultural needs. There is a high demand for consumptive use from the River Murray, and the river also supports nationally and internationally important wetlands and floodplains.

The main economy for communities along the length of the River Murray is primary production, followed by value adding manufacturing, with approximately $2.2 billion produced through food and wine production (Regional Development Australia 2013). Tourism is a major industry in the region, providing $200 million annually to the Murraylands and Riverland. Agriculture (including irrigated horticulture) is the main industry in the Riverland. While retail and health care have become the dominant industries towards the lower end of the Murray, agriculture is still a large economy in this region (Regional Development Australia 2013).
The River Murray underpins the majority of the South Australian economy as an essential part of the public water supply. Some of the larger industry sectors supported by the public water supply include Manufacturing, Construction, Financial Services and Healthcare/Social Services sectors. Together these industries contribute more than $23.3 billion to the Gross State Product.

River Murray water is provided through five pipelines supplying Adelaide and a number of regional towns, as well as direct offtakes for the major towns along the river. River Murray water services the Lower North, Barossa Valley, Eyre Peninsula, Yorke Peninsula, Clare and Whyalla, Port Augusta, Woomera and surrounding towns. The upper area of the south-east is also serviced by River Murray water, through the Tailem Bend to Keith pipeline. SA Water services horticulture, industry, farming, commercial and residential customers.

The River Murray is recognised as two irrigation regions – the Riverland and the River Murray below lock 1. The Riverland region has a high dependence on irrigation, with wineries, packing sheds and food processing being reliant on a consistent supply of irrigated crops. The Riverland is a large wine producing region, and is also well known for the production of citrus, stone fruit, almonds and vegetables.

The main industries in the River Murray below Lock 1 region are agriculture (both irrigated and dryland), retail trade and manufacturing. Boating, fishing and tourism industries are also key around Lake Alexandrina and Lake Albert. The dairy sector in the Murray Swamps and Lake Alexandrina and Lake Albert region has declined in recent years, with dryland farming and viticulture now dominating.

Irrigation trusts (Trusts), which involve the sharing of infrastructure between a number of irrigators, are a common method of distributing River Murray PWC water for licensed purposes. There are two types of Trusts, those that are officially established under the Irrigation Act 2009, and those that are established through a private operating arrangement between neighbours or districts.

The Trust is the holder of all water entitlements – members are not licensed individually, but hold sub-allocations within the Trust. Trusts established under legislation are responsible for the setting of charges, rates, and by-laws, which can only occur by a majority vote of its members. It is up to the Trusts to establish rules and operating agreements with individuals within the Trust to ensure that the Trust can meet the conditions of any licensing instruments.

The River Murray supports the industries mentioned above and also supports ecosystems. A healthy river is essential to supporting economic and environmental needs (see Chapter 3 for more information about environmental water requirements). The natural environment in the Riverland region consists of diverse flora and fauna, including river red gum and black box forests.

Wetlands are important to the river environment as they perform functions such as improving water quality, reducing the impact of floods, providing vital refuge, nursery and habitat areas for many species, and replenishing the groundwater (Department for Environment and Heritage & Department of Water Land and Biodiversity Conservation, 2003). Wetlands also provide cultural, economic and social benefits to the community.
There are three Wetlands of International Importance (designated under the Ramsar Convention) along the River Murray in South Australia. These are: Coorong, Lake Alexandrina and Lake Albert; Riverland; and Banrock Station Wetland Complex. Including the three Wetlands of International Importance, there are 14 nationally recognised wetlands and floodplains in the River Murray PWC area (Environment Australia 2001).

The River Murray below Lock 1 includes the Coorong, Lake Alexandrina and Lake Albert, recognised under the Ramsar Convention. This region also has significance for the life and culture of the Ngarrindjeri people. Low flows to Lake Alexandrina, Lake Albert and the Coorong have impacted on the health of the region, and during the drought severe impacts were experienced. It is recognised that the community, the environment, and social and cultural life would benefit from the restoration of flows in the River Murray (MDBA 2010).

The River Murray is important to the beliefs, culture and business needs of all Aboriginal people in the region. Beliefs and water needs of Traditional Owner groups and other Aboriginal peoples in the region may vary and are considered as described in Section 2.5. The First Peoples of the River Murray and Mallee Region Native Title Claim covers 47,542 km² of lands and waters in South Australia, recognising non-exclusive rights and interests to parts of their traditional land in areas of the River Murray around Renmark, Berri, Barmera, Waikerie and Morgan. The Native Title determination recognises the River Murray and Mallee people’s rights to access, hunt, fish, camp, gather and use natural resources, amongst other things, in these lands and waters (Turner v State of South Australia 2011).

The River Murray is therefore vitally important socially, economically, culturally and ecologically to all South Australians.

Demand for water from the River Murray PWC can be broadly divided into the following categories:

- water use for licensed purposes (see Section 2.2.2);
- water use for non-licensed purposes (see Section 2.2.3); and
- environmental water requirements (see Section 3.4).

### 2.2.2 Water Use for Licensed Purposes

#### 2.2.2.1 Public Water Supply Purposes

The provision of water for public supply represents a significant licensed use of water from the River Murray PWC. SA Water can divert a maximum of 650 GL over any consecutive 5 year period¹², which equates to an average 130 GL per year, to provide water to metropolitan Adelaide and associated country areas via three pipelines (the Swan Reach - Paskeville pipeline, Mannum – Adelaide pipeline and Murray Bridge – Onkaparinga pipeline, as part of the Metropolitan Adelaide Consumptive Pool (Class 6) see Table 3). A further entitlement of 50 GL per annum is held by SA Water to supply urban water to other country towns not covered by the Metropolitan Adelaide Cap (particularly via the Morgan – Whyalla pipeline, Tailem Bend – Keith pipeline and direct Riverland town Water Treatment Plants under the All Purpose Consumptive Pool (Class 2), see Table 3).

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¹² This reflects the Cap as defined under Schedule E of the Agreement.
The reservoirs of the Mount Lofty Ranges catchment are the preferred source of water to metropolitan Adelaide, however like the River Murray System, annual inflows to the Mount Lofty Storages are highly variable. Annual diversions from the River Murray to supplement the provision of water to Adelaide are therefore also highly variable (between 10 percent and 90 percent). Over the last five years, 54 percent of South Australia’s urban water needs were supplied from the River Murray ranging from 36 percent during wet years in the Mount Lofty Ranges to 83.5 percent during dry years (SA Water Annual reports).

Water is provided to SA Water customers across the state for a variety of purposes, such as residential, industrial and commercial use (manufacturers, horticulture, retail sites and offices), and for public or community purposes such as watering parklands, school ovals, open spaces and sporting grounds.

2.2.2.2 Irrigation, Industrial and Recreational Purposes

Irrigation, industrial and recreational water use requires a licence and a water allocation to take water from the River Murray. These uses include intensive animal farming, mining and commercial use. These uses are included in this summary. Pursuant to Schedule E of the Agreement, the long-term Cap on diversions to be taken by South Australia (long-term average annual diversion) for these purposes is 521.9 GL\(^{13}\).

As outlined in Section 2.2.1, primary production is the main economy along the length of the river, with irrigated horticulture dominating in the Riverland. Communities are heavily reliant on water using industries and the River Murray is critical to the economy of the region.

In the 2013-14 water-use year, a total of 574.7 GL was allocated for these purposes. It is noted that a portion of these entitlements have been purchased by the Commonwealth of Australia for environmental watering purposes. In the 2012-13 water-use year, actual use for irrigation, industrial and recreational purposes was 406.3 GL.

The amount of water used for irrigation fluctuates depending on the following factors: water availability, market forces, and crop types and areas irrigated. For further detail on how these allocations have been used recently and in the past, see Section 2.2.4 (Historical Demand) and Section 2.2.5 (Present Demand).

2.2.2.3 Stock and Domestic Purposes

A water licence is required to take water from the River Murray PWC for stock and domestic purposes, except for occupiers of land which the River Murray adjoins or runs through. In the 2013-14 water-use year, a total of 8.3 GL of entitlements were attributable to licensed stock and domestic use.

Stock and domestic purposes includes the watering of stock (not kept through intensive animal farming), and household use including the watering of less than 0.4 of a hectare of land for non-commercial purposes.

\[^{13}\text{This volume is the total of the Other Purposes and the Lower Murray Swamp Irrigation (excluding the 22.2 GL for environmental land management) set out in the Cap (see Table 2), adjusted for permanent trade and held environmental water.}\]
2.2.2.4 Environmental Land Management Purposes

The Agreement requires that the South Australian Government ensure that at least 22.2 GL of the 94.2 GL for the Lower Murray Swamps is reserved for environmental land management purposes and is not transferred to another purpose. This requirement has been reflected in past River Murray Water Allocation Plans as a volume or number of shares for environmental land management. The Plan provides for 22,000,000 shares in the All Purpose Consumptive Pool (Class 8), which can be held by owners or occupiers of land within the Lower Murray Reclaimed Irrigation Areas (LMRIA).

Land within the LMRIA is typically lower than the river level, and as such is a natural discharge point for saline regional groundwater. An Environmental Land Management Allocation (ELMA) is provided to landholders to minimise the historical effects of high saline groundwater levels on irrigated pasture or on land that has been retired from irrigation within the LMRIA. More recently, it has become evident that the application of ELMA through flood irrigation assists with minimising the production of acid sulfate soils that generate acid water on rehydration. Acid water finds its way back into the river through subsurface drains and poses a water quality risk to SA Water offtakes at Mannum, Murray Bridge and Tailem Bend.

ELMA water provisions play an important role in the management of the land within the LMRIA. For further information on environmental land management issues and how ELMA assists in managing them, see Section 2.3.2.

2.2.2.5 Wetland Purposes

The hydrology of many wetlands along the River Murray was permanently changed in the 1920s and 1930s with the installation of weirs along the river. As a result of the weirs, water levels are no longer as variable and wetlands have gone from being seasonally to permanently inundated. This altered hydrology has changed the dynamics and the ecology of the affected wetlands.

Wetlands play a critical ecological role and perform functions such as water purification, flood mitigation, providing vital refuge, nursery and habitat areas for many species, and replenishing the groundwater. They are important culturally, socially and to economies along the river.

As set out in Section 2.1.3.3, the annual evaporative losses from existing permanent wetlands along the River Murray between the South Australian border and Wellington has been estimated at 200 GL. Two consumptive pools are in place, allowing water access entitlements to be granted for wetlands that can be managed via regulating infrastructure. In the 2013-14 water-use year, 42.5 GL was allocated to managed wetlands, or wetlands where infrastructure has been installed. This volume is a portion of the 200 GL estimated to be taken by wetlands through evaporative losses. The licensed share will increase over time as more wetlands are fitted with flow control regulators, for example, as part of the RRP.

The volume attributable to evaporative losses from wetlands with no management infrastructure are not subject to a water allocation or included in a consumptive pool, but are accounted for from the Dilution and Loss Entitlement. Water remains in-river and ‘assigned’ to those unmanaged sites as it is used each year. This way, the unmanaged use of water by wetlands is still accounted for even though it is not formally allocated on a licence.
2.2.2.6 Environmental Purposes

As a result of initiatives to provide more water to the environment, a range of allocation types are used for environmental purposes. Allocations to be used for environmental purposes have arisen from water buybacks and projects to achieve water savings. Environmental water is used to enhance river flows and improve the health of wetland and floodplains. This water is in addition to the 200 GL identified for wetlands.

The approach taken for the River Murray PWC is different to other prescribed water resources, where water is set aside for the environment first, then the remainder allocated to consumptive uses. In the case of the River Murray, users were already heavily reliant on the watercourse when environmental water requirements were quantified. As a result, water is held on licence for the environment, with the unallocated portion of Entitlement also being to the benefit of the environment, as an acknowledgement that environmental water requirements cannot be met at the current level of consumptive use.

Water is held on licence for the management of icon sites along the River Murray through The Living Murray program (TLM). TLM arose in recognition that to achieve a healthy, functioning river system, water that was previously taken out for consumptive purposes would need to be returned to the environment. TLM was set up by the Commonwealth and Basin States in 2002 as a long-term river restoration program. The South Australian icon sites are the Chowilla Floodplain, the Lower Lakes, Coorong and Murray Mouth, and the River Murray Channel (Murray-Darling Basin Authority 2011).

Water for TLM was sourced through buybacks from willing sellers, and works and measures have been undertaken to ensure the maximum benefit is achieved from the use of this water. Watering occurs at a number of sites along the River Murray to improve their health, specifically at the Chowilla, Lower Lakes, and Coorong and Murray Mouth icon sites. In the 2013-14 water-use year, a total of 45 GL\textsuperscript{14} of South Australian Entitlement was held for the environment through TLM.

Allocations are also held by the Commonwealth of Australia and the South Australian Minister for Water and the River Murray for environmental watering purposes. The delivery of water arising from these allocations is coordinated through state and Basin-wide environmental watering plans. For further information about environmental water, see Chapter 3.

2.2.3 Water Use for Non-Licensed Purposes

2.2.3.1 Stock and Domestic Use

Water is taken from the River Murray for non-licensed purposes, including stock and domestic use in limited circumstances. Section 124(4) of the NRM Act excludes the requirement for a water allocation to take water from a prescribed watercourse where water:

- is taken by the occupier of land from a watercourse that adjoins or runs through the land; and
- is used by the occupier for domestic purposes or for watering stock (other than stock subject to intensive farming).

\textsuperscript{14} Of the 45 GL held for TLM, 38.36 GL is held as water access entitlements in Class 7, with the remainder being entitlements held in Class 1 and Class 3a.
It is estimated that 6.1 GL is used for non-licensed purposes, and in dry periods this is accounted for in South Australia’s CHWN. In a year where South Australian Entitlement is 1,850 GL, this use comes out of the unallocated portion. To account for this volume of water, it has been included as a volume in the All Purpose Consumptive Pool (Class 1) (see Section 2.1.3.2). As a water allocation is not required for this use, a water access entitlement and unit shares are not applicable.

### 2.2.3.2 Aboriginal Water Needs

A notice has been published pursuant to section 128 of the NRM Act, authorising native title holders to take water from a prescribed water resource that is situated on the native title holders land or waters for the purpose of:

*personal, domestic, cultural, spiritual or non-commercial communal needs where they are doing so in the exercise or enjoyment of their native title rights and interests, providing that the taking does not involve stopping, impeding or diverting the flow of water for the purpose of collecting the water or diverting the flow of water from a watercourse.*

Access to and use of water from the River Murray PWC is therefore exempt from licensing for these purposes. This water use has been estimated and forms part of the 6.1 GL included as a volume in the All Purpose Consumptive Pool (Class 1) (see Section 2.1.3.2). The authorisation is limited to native title holders (including native title claimants) accessing water in the exercise or enjoyment of their native title rights and interests.

It is acknowledged that Aboriginal values and uses are not limited to the water authorised to be taken under the section 128 notice. Further engagement is required to identify Aboriginal objectives and outcomes, and to have regard to values and uses. Additional discussion is provided at Section 2.5.

Native title holders in the River Murray region are The First Peoples of the River Murray and Mallee Region, with a native title determination made in 2011. The River Murray in South Australia also passes through the Ngarrindjeri Native Title Claim area. The River Murray also currently passes through an area where there is no native title claim, but where Aboriginal peoples or groups identify with this area.

Section 2.5 outlines the current framework for ensuring that Aboriginal groups are consulted in water planning processes, and for ensuring that Aboriginal values and needs are considered in water planning into the future.

### 2.2.3.3 Other Non-Licensed Water Needs

Other non-licensed water needs include purposes such as public road making, firefighting, applying chemicals to non-irrigated crops or to control pests, and for artificial water bodies equal to or less than 190 m$^2$. These purposes are authorised pursuant to a notice published under section 128 of the NRM Act and accordingly a water allocation is not required. The volume of water used for these purposes is likely to be small and in some cases variable from year to year. This water use has been estimated to be 3.9 GL per annum and is included as a volume in the All Purpose Consumptive Pool (Class 3) (see Section 2.1.3.2).
2.2.4 Historical Demand

Primary production has historically been the main economy along the length of the river. The nature of crops grown (primarily grapevines, citrus, stone fruit, almonds and vegetables) has led to a high dependence on irrigation. The ability to diversify into dryland farming is difficult in the region due to low rainfall. Value adding industries, such as packing sheds and processing plants, also rely heavily on the regular supply of produce through irrigation.

Water is therefore a critical factor to maintaining the economies along the river, and this was evidenced during the drought between 2001 and 2010. Re-structuring of irrigation was seen during this period to ensure that production could still occur. Low levels of flow lead to restrictions on allocations, and the already efficient irrigators in South Australia had to operate with less water. Data shows that as diversions reduced during the drought period, the area of land irrigated also reduced (Adamson, Quiggin & Quiggin 2011). Industries that rely on high security water, such as perennial horticulture and dairy systems, were required to either resort to alternative management options (such as purchasing feed) or changing crops or area irrigated. The return of flows and the easing of restrictions on allocations saw a return to annual cropping.

Across the Basin, water trading facilitated the shift of water towards highest value use such as horticulture and viticulture, allowing these industries to remain in production. Reductions in water use was seen in rice, cotton, pasture and dairy, which saw water move from NSW (primarily the rice growing region) into Victoria and South Australia (CSIRO 2012). While the ability to purchase water allowed production to be maintained, this also increased costs – resulting in higher levels of debt for many growers (MDBA 2010).

Australian Government programs have also had an impact on irrigation in the region, with funding provided to purchase water entitlements from irrigators for the environment. The Sustainable Rural Water Use and Infrastructure Program purchased water saved through irrigation infrastructure and efficiency improvements. The Small Block Irrigators Exit Grant Package purchased water entitlements from willing sellers, allowing them to leave the irrigation industry. The water buybacks aimed to provide additional lasting water returns for the environment while helping to improve irrigation productivity and efficiency, and to secure a sustainable agricultural industry.

South Australians dependent on the public water supply were also impacted by the dry period. Permanent Water Conservation Measures were introduced in 2003. As drought conditions deteriorated, the level of water restrictions increased with Level 2 restrictions commencing on 23 October 2006 and escalating to Level 3 Enhanced Water Restrictions on 1 January 2007. Level 3 restrictions were not lifted until 1 December 2010 at which time permanent Water Wise Measures became the normal basis for water use from the public water supply. In response to the drought South Australia invested in many water security programs such as leakage reduction from pipelines and the Adelaide desalination plant to improve water security. SA Water customer consumption fell during the drought, and has remained at a lower level since 2009-10 (ABS 2011). The values included for Metropolitan Water Supplies and Country Town Water Supplies incorporate reduced usage during this period.
At the time of adoption of the first Plan on 1 July 2002, allocations endorsed on water licences granted under the *Water Resources Act 1997* were in excess of actual demand for water. Table 5 summarises allocations and actual average demands from the River Murray PWC between 1996-97 and 2000-01. The data represents use from prior to the drought and pre the 2002 Plan.

**Table 5: Allocations and actual average demands for River Murray PWC water, 1996-97 to 2000-01**

<table>
<thead>
<tr>
<th>Consumptive Pool</th>
<th>Allocation of water endorsed on licenses as at October 2001 (expressed as GL available for take and use in a water-use year)</th>
<th>Actual average demand 1996-97 – 2000-01 (expressed as GL taken and used in a water-use year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation</td>
<td>503.8</td>
<td>383.5</td>
</tr>
<tr>
<td>Lower Murray Reclaimed Areas</td>
<td>99.6</td>
<td>99.6</td>
</tr>
<tr>
<td>Irrigation</td>
<td>3.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Stock and Domestic</td>
<td>1.7</td>
<td>2.1</td>
</tr>
<tr>
<td>Recreation and Environmental</td>
<td>5.6</td>
<td>3.8</td>
</tr>
<tr>
<td>Metropolitan Water Supplies</td>
<td>130.0 (650.0 over a rolling 5-year period)</td>
<td>123.0</td>
</tr>
<tr>
<td>Country Town Water Supplies</td>
<td>50.0</td>
<td>36.0</td>
</tr>
<tr>
<td>Total</td>
<td><strong>794.1</strong></td>
<td><strong>650.4</strong></td>
</tr>
</tbody>
</table>

On 1 July 2008, 805 GL of water was authorised to be taken as allocations from the River Murray PWC (up from 794.1 GL in 2001). Table 6 indicates allocations and actual demand for water between 2003-04 and 2007-08. Volumes allocated in 2008 differ from 2001 volumes for a number of reasons. New allocations were granted on application for stock, domestic and industrial purposes, as there was available water within these classes. Prior to 2009 and the unbundling of water licences, allocations were able to be moved or transferred between classes. Allocations within classes therefore increased or decreased due to legitimate transfers between classes of water. Water entitlements for TLM or sold to the Commonwealth of Australia are counted as allocations from the original purpose.
Table 6: Allocations and actual average demands for River Murray PWC water, 2003-04 to 2007-08

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Allocation of water endorsed on licenses as at July 2008 (expressed as GL available for take and use in a water-use year)</th>
<th>Actual average demand 2003-04 – 2007-08 (expressed as GL taken and used in a water-use year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation</td>
<td>554.0</td>
<td>381.8</td>
</tr>
<tr>
<td>Industrial</td>
<td>4.2</td>
<td>2.8</td>
</tr>
<tr>
<td>Stock and Domestic</td>
<td>6.8</td>
<td>5.1</td>
</tr>
<tr>
<td>Recreation and Environmental</td>
<td>22.9</td>
<td>16.8</td>
</tr>
<tr>
<td>Metropolitan Water Supplies</td>
<td>130.0 (650.0 over a rolling 5-year period)</td>
<td>97.0</td>
</tr>
<tr>
<td>Country Town Water Supplies</td>
<td>50.0</td>
<td>31.3</td>
</tr>
<tr>
<td>Wetlands</td>
<td>15.8</td>
<td>13.3</td>
</tr>
<tr>
<td>Environmental Land Management</td>
<td>21.3</td>
<td>21.3</td>
</tr>
<tr>
<td>Total</td>
<td>805.0</td>
<td>569.4</td>
</tr>
</tbody>
</table>

* To remove the distortion associated with restrictions on the use of irrigation allocations since 2003-04, figures have been derived by assigning a percentage share of use in 2005-06 (the last year in which 100 percent allocations were issued) to the average demand over the 5-year period.

2.2.5 Present Demand

There is currently 785.6 GL of water held on licence for consumptive purposes associated with irrigation, industrial, commercial, recreational, stock and domestic, and urban and country town water supplies.

A further 45 GL was allocated for environmental purposes through TLM (from several Consumptive Pools), and 42.5 GL was allocated for wetland water use from Class 9 (now the Wetland Consumptive Pool and Environmental Consumptive Pool). At 30 June 2015, the Commonwealth of Australia held 129 GL of water on licence in South Australia.

Table 7 demonstrates five years of actual water use, 2010-11 to 2014-15, compared to the allowable diversions under the Cap, which gives a measure of present demand. Data from prior to 2010-11 is not included, as previous years were impacted by drought and restricted allocations due to continuing low water availability. Data represents post-drought use and is post the unbundling of water licences. Since 2010-11, and as at the date of adoption of this Plan, South Australia has received its Entitlement of 1,850 GL per annum and licence holders have received 100 percent allocation.

Table 7 demonstrates that in the past few years, South Australia’s consumptive use has been less than the cap on diversions.
Table 7: The Long-Term Diversion Cap and actual average use of River Murray PWC water, 2010-11 to 2014-15

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Metro Adelaide and Associated Country Areas 16</td>
<td>151.1</td>
<td>56.4</td>
<td>297.7</td>
<td>59.0</td>
<td>328.1</td>
<td>81.7</td>
<td>396.0</td>
<td>42.1</td>
<td>410.7</td>
<td>73.2</td>
</tr>
<tr>
<td>Country Town Water Supplies</td>
<td>35.6</td>
<td>34.2</td>
<td>36.0</td>
<td>35.7</td>
<td>39.4</td>
<td>37.4</td>
<td>36.5</td>
<td>35.4</td>
<td>37.0</td>
<td>35.8</td>
</tr>
<tr>
<td>Lower Murray Swamps</td>
<td>43.4</td>
<td>13.6</td>
<td>38.7</td>
<td>14.0</td>
<td>45.8</td>
<td>18.0</td>
<td>33.6</td>
<td>15.6</td>
<td>31.4</td>
<td>15.7</td>
</tr>
<tr>
<td>All Other Purposes</td>
<td>326.6</td>
<td>257.0</td>
<td>353.5</td>
<td>314.7</td>
<td>402.8</td>
<td>385.0</td>
<td>357.7</td>
<td>349.8</td>
<td>381.2</td>
<td>376.2</td>
</tr>
</tbody>
</table>

Consumptive water use in 2012-13 was higher than previous years due to climatic conditions – several heatwaves were experienced during summer and autumn of that year. As a result, the climate adjusted annual Cap target was higher, and South Australian diversions remained within the Cap target.

Environmental water was provided for the above five years in accordance with Annual Environmental Watering Plans for the South Australian River Murray, through water allocated for TLM, wetlands and to the Commonwealth of Australia.

2.2.6 Future Demand

The principal factors that are likely to affect future demand for water from the River Murray PWC are:

- trends in the crop type and area irrigated;
- improvements in water use efficiency;
- increasing responsibility to meet environmental demands for water; and
- climate change (see Section 2.4).

It is anticipated that over the next five years growth in demand from public water supply customers will be at a growth rate of 1.2 percent per annum. Due to improved water use efficiency this should equate to a growth in demand of 4.5 GL between 2016 and 2020.

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16 In accordance with the Agreement, an Annual Cap Target is determined each year based on the observed climate conditions and is adjusted for permanent and temporary trade and for the use of held environmental water. The adjustment for permanent and temporary trade includes trade from interstate and between the Lower Murray Swamps and All Other Purposes Cap valleys.

17 Annual Cap Target for metropolitan Adelaide is the maximum permitted use of 650 GL minus the total diversion over the previous 4 years.
2.2.6.1 Trends in Irrigated Crop Type and Area

It is likely that irrigated areas using water from the River Murray PWC will expand in the future, with major crop types including vines, citrus, tree crops and vegetables. However, as no more water will be granted for consumptive purposes (see Section 2.2.7), any expansion in irrigation area should be accommodated through existing allocations, improved water use efficiency, or water transfers.

Water availability and security will have an impact on the type and area of crops irrigated. Prior to the drought there was relative security of water supply from the River Murray, which encouraged the establishment of perennial horticulture and dairy systems. These systems have low levels of flexibility and require an ongoing supply of water. As seen during the drought, dairy producers resorted to buying in feed and experienced loss of capital, and areas dedicated to perennial crops reduced (Adamson, Quiggin & Quiggin 2011).

Growth in production is expected in the region due to its position on transport routes and the affordability of land. Diversification of industries is also expected, with improvements in technology and the growth of industries that reuse water (such as aquaculture) (Regional Development Australia 2013).

2.2.6.2 Improvements in Water Use Efficiency

Chapter 6 of this Plan includes criteria that requires water use for irrigation to be applied to the land efficiently. While it is recognised that South Australian irrigators are already highly efficient, these policies aim to facilitate improvements in current irrigation practices, resulting in more efficient use of water into the future.

Australian Government programs are also funding improvements in irrigation efficiency, such as the On-Farm Irrigation Efficiency Programme, with water saved through efficiency gains being purchased for return to the environment. The purchase of water entitlements in exchange for funding allows for on-farm improvements such as increased crop water use efficiencies, improved soil management and improved efficiency in irrigation systems.

A further $265 million has been committed by the Australian Government through the South Australian River Murray Sustainability Program. This program will result in the purchase of significant water for the environment, and will provide funding for irrigation industry assistance and regional economic development. The water entitlements to be purchased will result from water saved through business re-structuring and efficiency improvements.

2.2.6.3 Environmental Purposes

Environmental water demands have been a key focus of the Basin Plan, with SDLs proposed that reflect an environmentally sustainable level of water use for consumptive purposes. Meeting the proposed SDLs will involve the recovery of water for the environment. The provision of water to meet environmental water demands will contribute to maintaining the quality of water in the River Murray, and also contribute to maintaining the productive capacity of land on which River Murray water is used. Chapters 5 and 6 of this Plan provide for the taking and use of water for environmental purposes (such as wetland and floodplain rehabilitation).
Many initiatives are already in place to deliver environmental water, such as TLM. Annual Environmental Watering Plans have been developed by the South Australian Government since 2012-13. The Basin Plan introduces additional requirements for managing environmental water. Basin states will need to develop and implement long-term environmental watering plans and annual watering priorities in consultation with the MDBA. A framework for environmental water through the Basin Plan allows for a coordinated approach between the Basin states, to deliver environmental watering for maximum environmental outcomes.

The purchase of water entitlements for return to the environment has resulted in a substantial amount of water now being available to manage for environmental purposes. By setting priorities for where this water will be delivered, Basin states can work together with the MDBA to ensure that ecosystems are protected where possible.

Chapter 3 of the Plan provides further information around Environmental Water Requirements (EWRs) and the strategies in place to make the most of the environmental water that is available.

2.2.7 Capacity to Meet Demand

The assessment of the capacity of the River Murray PWC to meet existing and foreseeable future demands for water must take into account the South Australian Entitlement (see Section 2.1.1.1), the Murray-Darling Basin arrangements (see Section 2.1.1), and future SDLs under the Basin Plan (see Section 2.1.4.2), which place limits on the quantity of water South Australia can divert from the River Murray for consumptive purposes.

As described in Section 2.1.1.1 and Section 2.1.2, the Entitlement provides for Consumptive Entitlements and use is limited by the Cap and allocations. Current use under these limits indicates the resource is meeting the demand for licensed purposes and non-licensed stock and domestic uses (see Table 7). Demand by Aboriginal peoples has not yet been identified. A portion of the South Australian Entitlement is for environmental purposes (Wetland Consumptive Pool and Environmental Consumptive Pool, TLM and Commonwealth of Australia entitlements), although as indicated in Chapter 3, additional water is required to meet many of the environmental water requirements in South Australia, especially those relating to the floodplain and to flow, water levels and water quality in the Coorong, Lower Lakes and Murray Mouth region.

The annual average and annual median flows of the River Murray to South Australia are 6,750 GL per annum and 4,600 GL per annum respectively. During average or median flow conditions, the resource has greater capacity to provide for increased diversions without significant impact on the ecological health of the main channel of the river. However, the South Australian Government made a decision in 1969 to limit further consumptive diversions on the basis of the ecological and water quality needs to the river under low flow conditions.

The requirement to operate within the Cap (see Section 2.1.2), and in future with SDLs (see Section 2.1.4.2), means that no additional water will be granted for consumptive purposes. Any future demands for water for consumptive purposes will need to be met by intrastate or interstate transfers.
Schedule D to the Agreement and the Basin Plan Water Trading Rules provide for water rights holders to trade water entitlement and water allocation across state boundaries and among trading zones. This means that South Australian businesses relying on water from the River Murray can generally secure any additional water allocation from other water users in South Australia, New South Wales and Victoria. In future, it is likely that interstate transfers will provide opportunities for new irrigation development in South Australia.

There is a broad range of interstate water products available to South Australian water users, each with different characteristics such as their long-term average reliability. Overall, the estimated annual turnover of this ‘southern-connected system’ water market was around $1 billion in the 2014-15 water year (ABARES, 2016). This comprised $300 million in water allocation trade and $640 million in water entitlement trade. Water transfers into South Australia increase the South Australian Entitlement under the Agreement, and increase South Australia’s right to divert water for consumptive uses under the Cap on diversions.

2.2.7.1 Capacity to Meet Demand in Low Flow Conditions

By 2009-10, South Australia had received less than the Entitlement of 1,850 GL for the third year in a row. During the period of drought from 2001 to 2010, the environment suffered. Some areas, such as Lake Alexandrina and Lake Albert, were at risk of catastrophic harm. Consumptive use was restricted, which impacted on producers and the economy. Irrigation areas were restructured, and some irrigators chose to exit the industry, as facilitated through Australian Government funding. The South Australian Government introduced a River Murray Water Allocation Framework on an annual basis, and decisions were made on how to manage the limited flows coming over the border.

These dry conditions coincided with a period of dry conditions in the Mount Lofty Ranges. Metropolitan Adelaide demand was reduced through a series of water restrictions that had significant economic implications for industry, residential and local government sectors.

This period demonstrated that during low flow periods, the River Murray is unable to meet demand in South Australia. The impact of the drought on the environment, the economy, communities and individuals was extreme.

Since the drought, a number of factors have been put in place which can assist South Australia to prepare for dry periods, such as Basin Plan requirements, Annual Environmental Watering Plans, and the introduction of principles in this Plan around allocating during dry conditions and private carryover allocations (see Sections 5.3.2, 5.4 and 5.5.2).

In a dry period, water held on licence for both consumptive and environmental purposes is impacted by decisions around managing allocations. As seen during the drought, there was very little water available to deliver for environmental purposes.

To be Basin Plan compliant by 2019, South Australia will need to describe management during extreme dry periods through an allocation framework that provides a transparent, consistent and predictable allocations process for all levels of water resource availability. The amendment of the Plan has given an opportunity to revisit how South Australia provides for the allocation of water during dry periods. The community has also advocated for greater transparency around water use priorities in order for business decisions to be made during dry periods.
Principles guiding the allocation of water in dry periods are included in this Plan to provide transparency to water users and to satisfy obligations under the NRM Act, in particular section 76(4) which provides that:

*a water allocation plan must, among other things, (b) set out principles associated with the determination of water access entitlements and for the taking and use of water so that – (i) an equitable balance is achieved between environmental, social and economic needs for the water; and (ii) the rate of the taking of water is sustainable.*

The framework also considers national commitments through the Water Act and the Agreement.

### 2.2.8 Impacts of Changing Water Security

The Basin Plan requires the implementation of new SDLs that limit the amount of surface and ground water that can be taken from the Basin for consumptive use. Implementation of the new SDLs requires that for the River Murray, South Australia is required to recover 183.8 GL (long-term average annual yield) for the environment by 2019 (Government of South Australia 2013). Over half of this water recovery target has already been met. To achieve the remaining water recovery required, the Australian Government has committed to investment in water efficient infrastructure and purchases from willing sellers, as well as environmental works and measures that result in equivalent environmental outcomes with less water.

Research undertaken during the preparation of the Basin Plan investigated the socio-economic impacts of introducing SDLs and the reduction of water available for irrigation diversions. The impacts of variable water security was also explored. It was noted that during times of low water security, producers responded by reducing areas of perennial horticulture. The supply of water can also be directly related to the area of land under irrigation – during the drought, the area of land irrigated across the Murray-Darling Basin halved (Adamson, Quiggin & Quiggin 2011). Flexible operations are therefore required for many producers to remain viable.

Impacts of the introduction of SDLs on Indigenous values requires further exploration. While environmental flows will improve as a result of Basin Plan implementation, the link to indigenous water requirements is not well known. There is an opportunity to build on existing knowledge in this area, including ensuring that Indigenous values are considered in planning environmental watering, and exploring other ways to meet Indigenous water needs. For further information about how this may be facilitated, see Section 2.5.
In addition to SDLs, the policies included in this Plan that impact on consumptive users and water security include allocation decisions in periods of low water availability (see Sections 5.3.2 and 5.4), water trading rules (see Section 7.2), private carryover (see Section 5.5.2) and salinity zoning (see Section 6.3.1). These policies will be reviewed in the preparation of the South Australian River Murray WRP. Some are also being reviewed at a national level, through the implementation of the Basin Plan and national arrangements. For example, the Murray-Darling Basin Ministerial Council have requested the development of a new Basin Salinity Management Strategy (the Basin Salinity Management Strategy 2030 was published by the Murray-Darling Basin Ministerial Council in November 2015). At a broader level, the desalination plant is an asset that needs to be considered in South Australia’s water security. It is envisaged that more information will be available about these factors when undertaking the next review of this Plan.

2.3 Health and Condition of the System

The River Murray is a highly modified system and is subject to a number of factors that affect river health.

The following are issues facing the health of the river that require careful management.

2.3.1 Salinity

Salt occurs naturally in the Murray-Darling Basin and has accumulated over many thousands of years. Salt in the landscape is mostly deposited by rainfall occurring over very long periods, and is retained in the Basin due to the low elevations and slow natural drainage. The weathering of the Basin’s rocks deposited from ancient oceans that once covered parts of Australia also contributes to the distribution of salt within the landscape.

Within parts of the Murray-Darling Basin, saline groundwater naturally flows into rivers. Water flowing through the river system and out to sea through the Murray Mouth is the only natural means by which salt can leave the Murray-Darling Basin. An open Murray Mouth and adequate flows downstream are therefore vital to ensuring management of salt within the River Murray system.

The clearance of deep-rooted native vegetation from the landscape and replacement with irrigation of shallow rooted crops has increased drainage to underlying groundwater and resulted in increased localised saline groundwater discharge to the River Murray.

Increased River Murray salinities can have adverse impacts on:

- irrigated crops, resulting in damage and reduced yields;
- equipment, appliances and infrastructure by reducing their lifespan;
- the environment; and
- water for drinking supplies.

The Agreement recognises the need for cooperative management of salinity across the Basin. Under the Agreement, the Basin States have committed to ensuring that actions which increase salinity in the River Murray are offset by actions which decrease salinity in the River Murray.
The Basin Salinity Management Strategy (BSMS), and its forerunner the Salinity and Drainage Strategy, have provided an effective basis for managing salinity in the Murray–Darling Basin and have considerably reduced long-term average salinity levels (as measured at Morgan in South Australia).

The South Australian Government has invested in actions that have a positive impact on salinity, such as salt interception, to generate ‘credits’ to ensure that the salinity impacts from new or increased irrigation development in the South Australian River Murray (‘debits’) can be offset. However, the South Australian Government has limited opportunities to generate new salinity credits through development of cost effective salt interception schemes, hence South Australia’s balance on the salinity registers must be managed into the future.

To ensure that South Australia can maintain its balance on the salinity registers while providing for irrigation development, a River Murray Salinity Zoning Policy was implemented in 2003. The salinity zoning policy encourages irrigation development into lower salinity impact areas by managing the total volume of water that may be used for irrigation in the high salinity impact zone.

The River Murray Salinity Zoning Principles are detailed in Chapter 6 of this Plan, with an overview map showing the location of the zones (see Figure 4).

### 2.3.2 Lower Murray Reclaimed Irrigation Areas (LMRIA)

There are approximately 5,200 ha of flood irrigated agriculture on the former floodplain of the River Murray in South Australia, between the towns of Mannum and Wellington – this is known collectively as the Lower Murray Reclaimed Irrigation Area (LMRIA) (see Figure 5, Figure 6 and Figure 7). Most of this land was drained and developed for agriculture between 1880 and 1940, with levee banks constructed along the river’s edge to control flooding. Since completion of barrages to prevent seawater ingress at the mouth of the river in 1940, the reclaimed areas have been 1.0–1.5 m below the river level, enabling gravity fed flood irrigation (EPA 2013).

Maintaining river levels at a relatively constant level enabled the development of irrigation industries on the reclaimed swamps, however this also changed the hydrology in the area, with highly saline regional groundwater discharging at the swamps. Drainage channels and irrigation were utilised to keep the local watertable at around 1.0 m below the surface to alleviate salinity issues. A stable river level also allowed the build-up of acid sulfate soils, which did not pose a problem under saturated soil conditions through the practice of flood irrigation (EPA 2012).

During the drought, an inability to irrigate due to low water levels and restricted water allocations resulted in most of the LMRIA not being irrigated for substantial periods of time. Low water levels below Lock 1 also resulted in the groundwater level underneath the irrigation areas dropping. As a result, the heavy clay soils salinised and dried, causing cracking and slumping of soils, slumping of levee banks and the generation of acid sulfate soil conditions through exposure to oxygen, as well as major socio-economic impacts due to loss of farm production (EPA 2012).
The total area of productive farms remaining in the LMRIA is estimated to be 3,192 ha. Historically there was approximately 5,200 ha of productive irrigated farm land (EPA 2013), which was almost exclusively utilised for dairy production. Approximately 4,200 ha of this land was rehabilitated under the LMRIA rehabilitation project in 2008, with approximately 1,000 ha of land retired from farming and not rehabilitated (EPA 2013). Dairy production has reduced from approximately 5,000 ha to 1,866 ha – by approximately 63 percent (Philcox 2012) – due to impacts of drought together with changes in the dairy industry.

Experience shows that with repeated rewetting of these soils, combined with some rotary cultivation, they can again be suitable for flood irrigation and pasture productions (Philcox 2010, EPA 2013). It has become evident that the application of water assists with minimising the production of acid sulfate soils, which generate acid water upon rehydration, and also minimises the effects of rising saline groundwater on irrigated or retired land. Production of acid water finds its way back into the river through surface drains and poses a water quality risk to SA Water offtakes at Mannum, Murray Bridge and Tailem Bend, as well as an environmental risk to the River Murray.

To manage the historical effects of high saline groundwater levels on irrigated and non-irrigated land within the LMRIA, this Plan establishes a consumptive pool for Environmental Land Management Allocations (ELMA) – the All Purpose Consumptive Pool (Class 8). ELMA is also supported under Schedule E of the Agreement, which provides South Australia with the right to divert 22.2 GL for environmental purposes in the LMRIA. This water currently also supports the management of the risks from acid sulfate soils.

Water entitlements and allocations granted from the All Purpose Consumptive Pool (Class 8) are only available to owners and occupiers of land within the LMRIA, as this water is specifically needed to manage the development and impacts of acid sulfate soils and to manage rising saline groundwater. ELMA is especially critical to non-productive properties, as not actively applying water heightens the risk of acid sulfate soils developing and of land becoming salinised. Applying ELMA, and where relevant, irrigation water, to keep the soil profile wet minimises the risk of soil cracking and slumping, and the generation of acid sulfate conditions (EPA 2013). ELMA provides maximum benefit when taken in full each year. Principles and guidelines relating to the management of the LMRIA through ELMA are included at Sections 5.4, 5.5.1 and 6.3.3 of this Plan.

### 2.3.3 Upper Pike River Anabranch

The Pike River anabranch and floodplain is located within the Riverland region of South Australia and includes the floodplain from Paringa (near Lock 5) downstream to Lyrup village near Berri. It consists of a large anabranch system of approximately 6,700 ha with creeks, islands, billabongs, and other ephemeral floodplain water bodies. The Pike floodplain has been identified as a High Conservation Value Aquatic Ecosystem on a national level due to its unique ecological and hydraulic character and has four species of national significance: the southern bell frog, Murray cod, Malleefowl, and the regent parrot. It also contains an additional 18 species with state conservation significance. While it is highly modified and currently dominated by agricultural land use, irrigated horticulture and cropping and grazing land, the Pike floodplain has been identified as a key priority site for floodplain rehabilitation and protection (SAMDB 2014).
Irrigation development in the upper Pike River was enabled through the construction of Lock 5 in 1927 and the modification of Col Col embankment, which was originally built to provide a watering hole for stock but later expanded to provide water for irrigation extraction. There have been ongoing issues associated with ownership and management of the regulating structures on the upper Pike, water quality in Pike River, and low flows, which became inevitable with increasing irrigation development. In the past these were temporarily resolved with engineering and other measures such as de-snagging, dredging, and changing flow paths to increase flow. Irrigation development has continued to expand in the region, and problems associated with irrigation extraction have recurred.

The Pike River Land Management Group was formed to address concerns over the issues facing the Pike River area, and in partnership with Renmark to the Border Local Action Planning Association (RBLAP) a Land and Water Management Plan (LWMP) was developed (Australian Water Environments & Renmark to the Border LAP 2006). The LWMP documented the recurrent problems of the Pike River anabranch and floodplain, and requested assistance from the government to address them. The initial LWMP was developed in the 1990s and updated in 2006.

The three primary issues identified by the local irrigation community in the LWMP were:

- high salt loads in the Pike River anabranch;
- poor flow regime through the anabranch; and
- a degraded floodplain.

The Pike Implementation Plan (PIP) was developed in 2010. It outlines the ecological assets of the area and identifies a number of management objectives to improve the health of the Pike River anabranch and floodplain (Department for Water 2010b).

South Australian and Australian Government programs (such as the Riverine Recovery Project) are undertaking significant infrastructure upgrades to introduce additional water into the anabranch complex in order to reinstate a more natural flow regime, with the aim to maintain or improve the health of sites. While flows will increase into the upper Pike River as a result of these works, it is recognised that the extraction of water for consumptive use has the potential to decrease the intended environmental and water quality benefits associated with the additional water.

Investigations into a sustainable extraction limit in the upper Pike system have indicated that the current level of extraction in this area is nearing a point where negative impacts are predicted to be seen. As such, to ensure the health of the site is improved and existing users have a secure water supply, an Upper Pike River Extraction Management Zone (UPREMZ), (see Figure 8) has been established. Sections 6.2.2 and 9.2.2 of this Plan contain principles that apply to this management zone. The principles have the effect of establishing a resource condition indicator and monitoring take from the UPREMZ. Should the resource condition indicator be exceeded, the Minister will use best endeavours to determine the cause of the breach and identify options to mitigate the breach. Further investigation is proposed to manage extraction from the UPREMZ without negative consequences on the ecological values of the anabranch.
2.3.4 River Level Management

River regulation through the construction of dams and weirs has caused a significant change to the natural hydrology and water level patterns of the River Murray System. Since regulation, River Murray water levels have been managed around fixed weir pool water levels to ensure navigation, reliability of human water supplies, and access for all water users. Government water reform processes and strategies, including the Basin Plan and SA River Murray Annual Operating Plan, recognise that continuing to manage water levels at relatively stable levels has detrimental impacts on the ecology of the River Murray system. A range of strategies such as the SA Weir Pool Manipulation Project sets environmental objectives which require the introduction of wetting and drying cycles of connected wetlands to improve ecosystem function.

The 2013-14 South Australian Annual Environmental Watering Plan identifies the value of weir pool water level manipulation and recommends the implementation of small scale weir pool water level raising events in future. The strategy is implemented through the SA River Murray Annual Operating Plan which is a high-level document covering River Murray operations, including the delivery of environmental water.

As weir pool water level manipulation events are considered beneficial to the ecology of the River Murray, these events will become an important technique to improve floodplain and wetland health and connectivity. Trials will be undertaken through incremental weir pool raising and lowering events to monitor impacts on the riverine environment, and learnings will be incorporated into decisions around operating water levels in the future. It is likely that water levels will become more variable in the future, and the impacts on water quality and access will be considered. All water users will be informed of proposed actions well in advance of implementation.

Chapter 6 of this Plan includes principles that reflect the approach of incremental changes in water levels by maintaining the existing policies that prevent the installation of new infrastructure on backwaters or anabranches (any branch or body of water extending off of the main river channel) that may be more susceptible to water level variations. Additional irrigation or stock and domestic pumps will continue to be prohibited from these areas. The principles in Chapter 6 will protect existing water users from increasing extractions from a vulnerable source of water (i.e. backwaters), limit the impacts of water level manipulation events, and allow environmental water to be of benefit to floodplain and wetland health. Figure 9 to Figure 15 detail the anabranches and backwaters along the River Murray PWC where these principles apply.

2.4 Climate Change Impacts

While the water policy decisions included in this Plan were based on the most recent meteorological, hydrological and hydrogeological information and trends, the effects of climate change are not yet clearly defined and therefore it is difficult to know the consequences for future water allocation demand.
The climate is quite variable from year to year, and the El Niño and La Niña events during the past century have continued to produce hot droughts and cooler wet periods. Much of the work to set allocation limits and associated principles in this Plan has been based on historical data on resource availability. Future climate and hence water availability may not reflect historical patterns.

In addition, there is a trend towards hotter, drier conditions over large parts of south-eastern Australia, and there is strong consensus that these higher temperatures reflect climate change.

Modelling of climate change scenarios and resulting impact on water availability through the CSIRO Sustainable Yields Project for the Mallee region has predicted that under a long-term continuation of the recent (1997 to 2006) climate and current water sharing arrangements, average surface water availability for the Murray region is predicted to decrease by 30 percent by 2030 (CSIRO 2008). Furthermore, increasing temperatures and evaporation may increase demand for water, placing further stress on the water resources.

At present, there is considerable uncertainty about the quantum of climate change likely to be experienced and its impact on water availability and demand. Therefore the potential impacts of climate change have not been incorporated into this Plan, and it is expected that this will be reviewed in the future when further information is available.

Australian average temperatures are projected to rise by 0.6 to 1.5 °C by 2030, and, if greenhouse emissions continue at current levels, by 1.0 to 5.0 °C by 2070. Warming is projected to result in an increase in the number of hot days.

While total rainfall on the Australian continent has been relatively stable, the geographic distribution of rainfall has changed significantly over the past 50 years, with rainfall decreasing in south-eastern Australia. Droughts are expected to become more frequent in southern Australia, however, periods of heavy rainfall are still likely to occur (BOM 2012).

Management may lead to a change in planting seasons for annual crops to adjust and utilise the change in rainfall pattern. There may also be a demand for alternative crops to better suit the changed climatic conditions. Desirable characteristics of alternative crops are disease resistance, heat tolerance and lower water use.

Adequate monitoring and evaluation to support an adaptive management approach is of key importance to allow responsive management in the face of climatic uncertainty. Chapter 9 of this Plan sets out the minimum monitoring framework required to assess water demand, trends in water resource behaviour, environmental responses and the capacity of the resource to meet demands. Regular reviews of this Plan will allow for the measurement of the effectiveness of principles and policies so that changes can be incorporated as required.

In addition to the monitoring framework detailed in this Plan, principles have been included (see Sections 5.3.2 and 5.4) that aim to guide allocation decisions in times of low water availability. These principles will be refined over time, and will assist in responding to changes in climate.
In response to climate change projections, the Board has recently drafted the *Regional Adaptation Plan: A Climate Change Adaptation Plan for the South Australian Murray-Darling Basin (2014)* (the Regional Adaptation Plan). The Regional Adaptation Plan aims to show how the region can limit the impacts of climate change and make sure the region is adaptive and sustainable, and continues to be a place where people want to live, visit, invest, and conduct business. The Regional Adaptation Plan identifies areas of decision making that most need to consider climate change and priority adaptation options, and includes adaptation options for irrigated horticulture. Once released and implemented, the plan will be reviewed every 2-3 years, allowing for adaptive management and to consider new information around climate change projections and impacts.

### 2.5 Aboriginal Engagement in Water Management

Aboriginal peoples value water for cultural, social, environmental, spiritual and economic reasons. The concept of cultural flows is often used to describe part of these complex relationships for planning purposes.

There are a number of agreements at the state and regional level that provide a framework for Aboriginal engagement and for integrating and recognising social, spiritual and customary objectives and values in water planning, such as the *Kungun Ngarrindjeri Yunnan Agreement* (Ngarrindjeri Tendi Inc. et al. 2009) and the *River Murray and Crown Lands Indigenous Land Use Agreement* (Attorney General for the State of SA & River Murray and Mallee Aboriginal Corporation 2011).

The Ngarrindjeri People have been involved in the development of the Board’s *Natural Resources Management Plan*, and the Board is collaborating with the Ngarrindjeri People on the implementation of the *Ngarrindjeri Nation Yarluwar-Ruwe Plan (Caring for Ngarrindjeri Sea Country and Culture)* (Ngarrindjeri Tendi, HC & NTMC 2007).

The *Ngarrindjeri Nation Yarluwar-Ruwe Plan* has been prepared by the Ngarrindjeri people to help government agencies, natural resource managers, researchers, industry and the wider Australian community to better understand and recognise the rights and responsibilities to their Yarluwar-Ruwe (Sea Country), including the lower River Murray, Lakes, Coorong and adjacent marine and land areas.

Similarly, the *River Murray and Mallee Aboriginal Corporation (RMMAC) Strategic Plan 2013–2016* has been prepared to represent the First Peoples, and sets out objectives and strategies for working with government agencies and other stakeholders to achieve those objectives.

Existing arrangements have facilitated the involvement of Aboriginal groups in many on-ground projects in partnership with the Department and the Board. Projects are achieving on-ground outcomes and also contribute to capacity building of staff working on projects. There is an opportunity to build on these partnerships to ensure involvement in planning processes, as well as on-ground works. Engagement will also occur with these groups in the implementation of this Plan, for example in wetland management.
The Inter-Governmental Agreement on a National Water Initiative demonstrates a commitment by all states and territories to include Indigenous representation and incorporate Indigenous social, spiritual and customary objectives and strategies in water planning, and take account of the possible existence of native title rights to water. The Basin Plan, which provides an overarching plan for water management in the Murray-Darling Basin, requires that accredited WRPs must identify the objectives and outcomes of Indigenous people related to the management of water resources, and have regard to Indigenous values and uses of water as well as cultural flows (MDBA 2012). WRPs must also have regard to a range of other matters set out in Section 10.53 of the Basin Plan. The South Australian River Murray WRP is due to be completed by 2019, and the next version of this Plan will form a part of the WRP.

Indigenous values are considered in the Long-Term Environmental Watering Plan for the South Australian River Murray Water Resource Plan Area (DEWNR 2015), and the Board will continue to work with Traditional Owners to build on this knowledge. The Board is working towards identifying Aboriginal people’s objectives and desired outcomes and incorporating their values and needs into the Plan through the WRP process, to meet the requirements of the Basin Plan.

To further progress the involvement of the Ngarrindjeri in water planning, a Statement of Commitment (SOC) between the Ngarrindjeri Regional Authority (NRA), the Board, the South-East NRM Board and the Department has been signed. The SOC sets out a framework for how the parties will work together in water resource planning, particularly to meet the requirements of Chapter 10 Part 14 of the Basin Plan.

Further work with Indigenous groups will ensure the South Australian River Murray WRP (due 2019) and the future Water Allocation Plan for the River Murray Prescribed Watercourse has regard for Indigenous values and uses of water, and identifies Aboriginal people’s objectives and desired outcomes for the management of the water resources.

In working towards the South Australian River Murray WRP by 2019, the Board will be applying the following objectives in relation to Aboriginal engagement in water planning:

a. Acknowledge the connection between healthy land and waters and healthy people and culture.
b. Recognise indigenous values and incorporate indigenous expertise, capacity and cultural knowledge to inform management responses that relate to water planning.
c. Build upon existing relationships in relation to water resource management and involve Traditional Owners in the development of plans and procedures that relate to water.
Figure 4: Overview of Salinity Impact Zones
Figure 5: Lower Murray Reclaimed Areas Irrigation Management Zone (i)
Figure 6: Lower Murray Reclaimed Areas Irrigation Management Zone (ii)
Figure 7: Lower Murray Reclaimed Areas Irrigation Management Zone (iii)
Figure 8: Upper Pike River Extraction Management Zone
Figure 9: Anabranches and Backwaters – New Pump Prohibited Water Extraction Zone (i)
Figure 10: Anabranches and Backwaters – New Pump Prohibited Water Extraction Zone (ii)
Figure 11: Anabranches and Backwaters – New Pump Prohibited Water Extraction Zone (iii)
Figure 12: Anabranches and Backwaters – New Pump Prohibited Water Extraction Zone (iv)
Figure 13: Anabranches and Backwaters – New Pump Prohibited Water Extraction Zone (v)
Figure 14: Anabranches and Backwaters – New Pump Prohibited Water Extraction Zone (vi)
Figure 15: Tributary Wetlands of Lake Alexandrina – New Pump Prohibited Water Extraction Zone (vii)
3 NEEDS OF WATER-DEPENDENT ECOSYSTEMS

3.1 Introduction

The NRM Act requires that a water allocation plan undertake a range of assessments, including the needs of ecosystems dependent on water from the prescribed resource.

Specifically, section 76 (4)(a)(i) of the NRM Act states that a water allocation plan must include:

*an assessment of the quantity and quality of water needed by the ecosystems that depend on the water resource and the times at which, or the periods during which, those ecosystems will need that water.*

Section 76 (4)(aab) also requires that a water allocation plan include:

1. *an assessment of the capacity of the water resources to meet environmental water requirements;*
2. *information about the water that is to be set aside for the environment including, insofar as is reasonable practicable, information about the quantity and quality, the time when that water is expected to be made available, and the type and extent of the ecosystems to which it is to be provided; and*
3. *a statement of the environmental outcomes expected to be delivered on account of the provision of environmental water under the plan.*

Chapter 3 addresses the requirements of the NRM Act through summarising the environmental water requirements (EWRs) for representative water-dependent ecosystems of the River Murray PWC, based on the current level of scientific knowledge and understanding. The chapter will then broadly discuss the capacity of the resource to meet environmental water requirements – the water available to be set aside for environmental outcomes (environmental water provisions (EWPs)) and the extent to which that water is expected to achieve desired outcomes. In addition, the chapter will discuss other water that may be available that is not an environmental water provision, and actions that can be undertaken and supported through principles in the Plan, to assist in achieving environmental outcomes.

3.2 Background

The Murray-Darling Basin is one of Australia’s most significant cultural, environmental and economic areas. While the Basin has supported regional economic growth through river regulation and irrigated agricultural industry development, this has come at a considerable cost to the environment. The recent extreme drought highlighted the impacts that past water management decisions have had on ecosystem health.
High levels of water allocation and extraction from the rivers, wetlands, and backwaters of the Basin have resulted in widespread environmental decline. Regulation of the system, including maintaining static pool levels and mitigating flow peaks into storages, has also played a significant part in altering the ecology of the Basin. The impact of extractions and regulation are evident across the Basin in the form of salinisation, reduction in tree health and tree death, localised native species decline and loss, acidification of soils, and increased algal blooms. It has also altered ecosystem functions that are important to the Basin and the River Murray, such as fish breeding, bird and bee pollination, riverbank stability, the flushing of salt, and natural filtration by wetlands. In addition, there is a general loss of resistance and resilience of the ecosystem, which can lead to infestations of pest plants and animals and a reduced capacity of the ecosystem to cope with flow variability. All of these ecological components and functions are important to the health of the system and ultimately the long-term viability of the Basin’s communities and economy.

The Murray-Darling Basin Cap was introduced to cap surface water diversions by each of the states (see Section 2.1.2). However, even with consumptive extractions capped, extraction was at a level that saw the ecological condition continue to decline. The Basin Plan has been introduced to standardise rules between the states and to improve the balance between social, economic and environmental water uses (see Section 2.1.4.1). Water recovered for the environment, together with operational regimes that promote water level variability, will provide the ability to take a Basin-wide approach to achieving ecological outcomes and improving the health of the system, which will ultimately support communities and productive activity along the river.

The Plan provides the mechanism for the state to put in place policy provisions to protect water-dependent ecosystems through ensuring the security of environmental water and supporting flexible approaches to the use of that water. This will complement the operation of the Basin Plan.

### 3.3 South Australia’s Environmental Water Planning Framework

The Plan sets out policies to facilitate the provision and use of environmental water. A sophisticated planning framework is in place alongside the Plan that identifies environmental watering priorities for the ecosystems of the River Murray. The planning framework guides the delivery of environmental water to water-dependent ecosystems and sets out the expected outcomes from the delivery of the water.

Under the Basin Plan, a *Long-Term Environmental Watering Plan* (LTWP) has been prepared for the South Australian River Murray Water Resource Plan Area (DEWNR 2015). The LTWP specifies the priority environmental assets and functions and the environmental objectives, targets and EWRs needed for a healthy, functioning ecosystem for those assets over the longer term. It provides direction for the effective and efficient use of environmental water, and will guide decision making and coordination of environmental watering in the future.
Annual Environmental Watering Priorities are also prepared for the South Australian River Murray as a requirement of the Basin Plan. The Department prepares Annual Environmental Watering Plans, which consider the priorities for that particular year and how to effectively deliver and use the environmental water available. The priorities are guided by the overarching objectives, targets and EWRs in the LTWP and take into account previous environmental watering and conditions for the year ahead. All parties who hold South Australian water access entitlements for environmental use are involved in this annual planning process, and consultation occurs prior to finalising the annual plans.

The information included in this chapter, specifically in Sections 3.8 and 3.9, indicates that at Entitlement of 1,850 GL, the EWRs in the LTWP cannot be met. Entitlement does however provide important baseflow to build upon. The sources of water set aside for the environment are set out at Section 3.6 – Annual Environmental Watering Plans guide how this water can most effectively be used. This chapter of the Plan details the importance of unregulated flows (see Section 3.7) and a coordinated approach to environmental water delivery (see Section 3.10) to supporting healthy ecosystems.

3.4 Environmental Water Requirements Assessment

Water-dependent ecosystems are those parts of the environment, the species composition and natural ecological processes of which are determined by the permanent or temporary presence of flowing or standing water (ARMCANZ & ANZECC 1996). Although the various parts of the environment are intrinsically linked, for planning purposes, and as set out in Section 3.4.1, the water-dependent ecosystems of the River Murray are divided into three sections – the floodplain, channel, and the Coorong, Lower Lakes and Murray Mouth.

Water-dependent plants and animals have evolved in response to the water regime that they have been exposed to under natural conditions, and have become dependent on key water regime components to support important processes. Changes to environmentally important parts of the flow regime have led to changes in the condition and composition of the dependent ecosystems (Kingsford et al. 2011, Walker et al. 1994).

Prior to extraction and regulation of the Murray-Darling Basin, the water regime of the River Murray was highly variable. The diverse mosaic of habitats, variety of species, and functions of the River Murray are therefore adapted to and require a highly variable water regime. For example, in-channel flow events stimulate large-bodied fish such as golden pPerch (Macquaria ambigua ambigua) to spawn (Zampatti & Leigh 2013), while overbank flows stimulate the germination, growth and survival of long-lived vegetation such as river red gums (Eucalyptus camaldulensis ssp. camaldulensis) and black box (E. largiflorens) (Roberts & Marsten 2011).

While the river still experiences flooding and drought, under a regulated regime variability is highly reduced from natural variability, with weirs and river management creating more stable conditions. The lack of river rises and falls has had significant impacts on water-dependent ecosystems (Wallace et al 2014).
EWRs are defined under the NRM Act as those water requirements that must be met in order to sustain the ecological values of ecosystems that depend on the water resource, including their processes and biodiversity, at a low level of risk. The water regime required to meet EWRs includes a range of flow components, from cease to flow events to bank full flows to overbank flows, as well as groundwater inputs (Australian Government 2012).

EWRs can be expressed in terms of magnitude (size), frequency (how often), duration (length required), seasonality (when needed) and maximum time between events. Flow and water levels determine the extent of inundation of communities and habitats and the hydrological connectivity between them. Flow rates (expressed as volume/day) are commonly included in descriptions of the magnitude (e.g. Bloss et al. 2012), generally specified for the purposes of determining how much water is needed to meet the requirements of a portion of water-dependent ecosystems, or for determining what portion of a water-dependent ecosystem’s EWRs may be met for a given flow. Flow rates are not included in the description of EWRs unless they are a specific part of the requirements of a component or process (e.g. channel EWRs), or if they represent a suite of inundation and/or water quality outcomes required by the ecosystem components and processes (e.g. Coorong, Lower Lakes and Murray Mouth).

Frequency is expressed as an average recurrence of an event. The actual time between flow events may be longer or shorter than the average frequency. There are maximum times between events that should not be exceeded in order for the component or process to be maintained (e.g. recruitment for species with short life-cycles).

Seasonality is an important part of the flow regime, as many species and processes are responsive to seasonal effects such as temperature and day/night length and will not respond to flow events if they do not occur at the right time of year.

EWRs also include flows that maintain water quality within the requirements of species or communities (e.g. flushing flows that prevent salinisation through evaporation and acidification as a result of acid sulfate soil conditions developing).

3.4.1 Water-Dependent Ecosystems of the South Australian River Murray

For the purposes of determining EWRs of ecosystems that rely on water from the River Murray in South Australia, three priority environmental assets have been identified in the LTWP:

- The South Australian River Murray Floodplain;
- The South Australian River Murray Channel; and
- The Coorong, Lower Lakes and Murray Mouth.

A description of each is provided below (DEWNR 2015).

3.4.1.1 The South Australian River Murray Floodplain

The South Australian River Murray Floodplain asset (River Murray floodplain) covers an area of approximately 54,300 hectares and includes the area that is inundated when flows are between 40,000 ML/day and 80,000 ML/day (the area beyond the channel asset that can be managed with environmental water). The floodplain does not contain any areas of permanent water.
The River Murray floodplain comprises a mosaic of water-dependent and terrestrial habitats, including temporary wetlands, river red gum woodlands, black box woodlands, lignum shrublands, terrestrial shrublands and samphire woodlands. The River Murray floodplain supports many water-dependent species including native fish, frogs, waterbirds and macroinvertebrates, including species of conservation significance (Kilsby & Stegglès 2015).

The definition of the River Murray floodplain asset is in accordance with the Basin Plan definition, and is based on the feasibility of delivering environmental water. Modelling indicates that 80,000 ML/day QSA (flow at the South Australian border) is the maximum flow rate at which active management of environmental water can occur (DEWNR 2015). The objectives, targets and EWRs in this chapter for the River Murray floodplain relate only to this part of the floodplain.

The whole South Australian River Murray floodplain extends to the 1956 flood level and requires flows greater than 100,000 ML/day QSA to be fully inundated. While the area of floodplain requiring flows above 80,000 ML/day QSA is not recognised as part of the priority asset, it is still an area of high importance to South Australia and supports flora and fauna species with high conservation value. Unregulated flow events are important to inundate this part of the floodplain and maintain connectivity between habitats (DEWNR 2015).

3.4.1.2 The South Australian River Murray Channel

The South Australian River Murray Channel asset (River Murray channel) covers an area of approximately 28,800 ha from Wellington to the South Australian border. The River Murray channel includes the main river channel, permanently inundated wetlands and anabranches, and the area that is inundated at flows of 40,000 ML/day QSA. The River Murray channel is recognised as an icon site under TLM. The River Murray channel supports species of conservation significance, including endangered, vulnerable and rare plant species, and nationally threatened and protected fauna species.

3.4.1.3 Coorong, Lower Lakes and Murray Mouth

The Coorong, Lower Lakes and Murray Mouth (CLLMM) covers a total approximate area of 142,530 hectares and consists of Lake Alexandrina and Lake Albert, the lower reaches of the Eastern Mount Lofty Ranges tributaries, the Murray Mouth estuary and the Coorong. The CLLMM is recognised as a site of high ecological and cultural value through TLM and as a Wetland of International Importance under the Ramsar Convention.

Flows from upstream pass into Lake Alexandrina and out to the ocean via the Murray Mouth estuary. Freshwater outflows are required to keep the Murray Mouth open. A small channel connects Lake Alexandrina to Lake Albert. Both lakes are large, shallow, permanent lakes surrounded by fringing ephemeral wetlands. The lakes are separated from the Murray Mouth and Coorong via a complex of islands, channels and five barrages. The barrages prevent the ingress of saline water into the lakes and regulate lakes levels.

The Coorong receives inflows at the northern end from Lake Alexandrina and the Southern Ocean, and to the southern end via Salt Creek. Salinities range from fresh to hyper-saline within the site.
The CLLMM is the only estuary of the Murray-Darling Basin and provides a significant habitat for waterbirds, including a number of threatened and endangered species, including native fish species and ecologically significant vegetation species and communities.

3.4.2 Overview of EWRs for the River Murray

The natural flow regime of the River Murray was, before regulation, highly variable but showed pronounced seasonal variation. Peak flows in South Australia were usually in spring and early summer, reflecting the travel time for winter/spring run-off and snow-melt in the headwaters of the catchment. In the lower River Murray, the flow regime has experienced substantial reductions in magnitudes of mean and median annual flows and high-flows, substantial changes in variability and moderate changes in seasonality (MDBC 2008).

The LTWP, developed as a requirement of the Basin Plan for the South Australian River Murray water resource plan area, specifies the priority environmental assets and functions and the environmental objectives, targets and EWRs that are needed for a healthy, functioning ecosystem for those assets over the longer term. It provides direction for the effective and efficient use of environmental water, and will inform decision making and coordination of environmental watering in the future.

The EWRs set out in this chapter are taken from the LTWP. The LTWP has a timeframe of five years, and will remain in place until November 2020 or until a subsequent LTWP is released. Should the LTWP be reviewed earlier, the LTWP will reflect the most up to date knowledge on EWRs of the three River Murray assets.

For the River Murray priority environmental assets, objectives and targets have been determined and EWRs established as a basis for environmental water planning and delivery to achieve those objectives and targets. The ecological objectives, targets and EWRs set out in the LTWP represent what is needed to support each of the priority environmental assets in a healthy, functioning state (DEWNR 2015).

- Ecological objectives – provide a clear statement of what the delivery of the EWRs are intended to achieve. There are a number of objectives for each asset, with each objective focused on a key biotic group or ecological process – interdependencies are also important.
- Ecological targets – are nested within an ecological objective, and there may be more than one target per objective. As much as possible the targets are ‘SMART’ – specific, measurable, achievable, realistic and time-bound. This provides a means of assessing the change in condition and progress towards achieving the objectives.

3.4.2.1 River Murray Floodplain

The South Australian River Murray floodplain includes the temporary channels, wetlands and shedding floodplain from the South Australian border to Wellington. For the purposes of the LTWP the river channel and floodplain are distinguished by the area inundated at flow to South Australia of 40,000 ML/day under normal river operations. This is the approximate flow at which overbank flow occurs.
For floodplain habitats, river levels need to rise above normal pool level for the EWRs to be achieved. Flow regime is the critical driver of the floodplain ecosystem. Objectives, targets and EWRs have been determined by identifying key flow rates of a modelled ‘without development’ flow regime, applying the current understanding of the way that the ecosystem responds to flow events, the spatial distribution of habitats and the preferred water regime of ecosystem components (Kilsby et al 2015).

The EWRs for the River Murray floodplain are described in Table 8, as set out in the LTWP (DEWNR 2015). These EWRs describe the desired variable flow regime to meet the ecological objectives and targets defined in the LTWP.

Table 8: Environmental Water Requirements of the South Australian River Murray Floodplain (DEWNR 2015)

<table>
<thead>
<tr>
<th>EWR #</th>
<th>Median discharge (ML/day QSA)</th>
<th>Discharge variability (ML/day QSA)</th>
<th>Duration (days)</th>
<th>Preferred timing</th>
<th>Average return frequency (years)</th>
<th>Max interval (years)</th>
<th>Max rate of water level rise (m/day)</th>
<th>Max rate of water level fall (m/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50,000</td>
<td>45,000-55,000</td>
<td>30</td>
<td>Sep-Dec</td>
<td>1.6</td>
<td>5</td>
<td>0.05</td>
<td>0.025</td>
</tr>
<tr>
<td>2</td>
<td>60,000</td>
<td>55,000-65,000</td>
<td>30</td>
<td>Sep-Dec</td>
<td>2.0</td>
<td>5</td>
<td>0.05</td>
<td>0.025</td>
</tr>
<tr>
<td>3</td>
<td>70,000</td>
<td>65,000-75,000</td>
<td>30</td>
<td>Sep-Dec</td>
<td>2.6</td>
<td>5</td>
<td>0.05</td>
<td>0.025</td>
</tr>
<tr>
<td>4</td>
<td>80,000</td>
<td>75,000-85,000</td>
<td>30</td>
<td>Sep-Dec</td>
<td>3.6</td>
<td>5</td>
<td>0.05</td>
<td>0.025</td>
</tr>
<tr>
<td>5</td>
<td>80,000</td>
<td>75,000-85,000</td>
<td>60</td>
<td>Sep-Dec</td>
<td>7.6</td>
<td>8</td>
<td>0.05</td>
<td>0.025</td>
</tr>
</tbody>
</table>

3.4.2.2 River Murray Channel

A project was completed by the Goyder Institute for Water Research to establish EWRs for the River Murray channel as part of the development of the LTWP. Table 9, taken directly from the LTWP, outlines the specifications of each EWR (DEWNR 2015). The ranking system used to appraise the anticipated ability of each EWR to contribute towards the ecological targets is included in Section 3.5 (see Table 11).

The detailed ecological objectives and targets can be found in the LTWP. The EWRs will be refined over time through adaptive management.

The EWRs in Table 9 describe the desired variable flow regime to meet the ecological objectives and ecological targets. Flows of a higher magnitude will meet the requirement for lower events. For example, at flows of 20,000 ML/day, the targets for 10,000 ML/day and 15,000 ML/day will have been met (Wallace et al. 2014).
Table 9: Environmental Water Requirements of the South Australian River Murray Channel (adapted from DEWNR 2015)

<table>
<thead>
<tr>
<th>EWR #</th>
<th>Median discharge (ML/day QSA)</th>
<th>Discharge variability (ML/day QSA)</th>
<th>Duration (days)</th>
<th>Preferred timing</th>
<th>Average return frequency (years)</th>
<th>Maximum interval (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10,000</td>
<td>7,000 - 12,000</td>
<td>60</td>
<td>Sep-Mar</td>
<td>1.05</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>15,000</td>
<td>15,000 - 20,000</td>
<td>90</td>
<td>Sep-Mar</td>
<td>1.33</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>20,000</td>
<td>15,000 - 25,000</td>
<td>90</td>
<td>Sep-Mar</td>
<td>1.8</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>25,000</td>
<td>20,000 - 30,000</td>
<td>60</td>
<td>Sep-Mar</td>
<td>1.7</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>30,000</td>
<td>25,000 - 35,000</td>
<td>60</td>
<td>Sep-Mar</td>
<td>1.8</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>35,000</td>
<td>30,000 - 40,000</td>
<td>60</td>
<td>Sep-Mar</td>
<td>1.8</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>40,000</td>
<td>35,000 - 45,000</td>
<td>90</td>
<td>Sep-Mar</td>
<td>2.1</td>
<td>3</td>
</tr>
</tbody>
</table>

3.4.2.3 Coorong, Lower Lakes and Murray Mouth

EWRs for the Coorong, Lower Lakes and Murray Mouth (CLLMM) region have been defined to maintain the system as a healthy, productive and resilient wetland of international importance (Lester et al. 2011). Further analysis in the development of the LTWP has led to four EWRs being identified for the CLLMM (see Table 10 taken from O’Connor et al 2015). The EWRs for the LTWP consider the EWRs described in Lester et al (2011) and Heneker (2010) that are needed to maintain salinities of <700 µS/cm and < 1000 µS/cm in Lake Alexandrina, but incorporate additional metrics to further describe the desired hydrological regime for the site (O’Connor et al 2015).

Flow-related requirements were identified for a wide range of indicator plants, animals, assemblages and processes, each of which were linked to the ecological outcomes. Implicit within the eight objectives and flow requirements for these indicators is a requirement for the Murray Mouth to remain functionally open in order that tidal variations in the Coorong are able to occur, diadromous fish are able to move through the Mouth, salt loads are able to be exported, and other critical processes are supported.

The EWRs required to maintain the CLLMM as a healthy, productive and resilient wetland of international importance are described in O’Connor et al. (2015) (see Table 10). In order to meet this overarching goal, the ecosystem needs to function as a whole and therefore all the ecosystem objectives need to be met. The EWRs are not aligned to individual ecological outcomes but have been grouped to describe the optimal requirements by which all the ecological outcomes are met. The flows required to meet these requirements are sufficient to keep the Murray Mouth functionally open. The varying water level regime ensures inundation of the low lying wetlands and connectivity between these and the lakes.
Timing of barrage flows, lake levels and Coorong South Lagoon water levels include the entire duration of each month specified (i.e. from the beginning of the first month to the end of the final month).

<table>
<thead>
<tr>
<th>Average return interval (years)</th>
<th>Maximum interval (years)</th>
<th>Annual barrage flow (GL/year)</th>
<th>Barrage flow timing</th>
<th>Lakes water level range (mAHD)</th>
<th>Lakes water level timing</th>
<th>Coorong South Lagoon water level (mAHD)</th>
<th>Coorong South Lagoon water level timing</th>
<th>Coorong South Lagoon duration (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-in-1</td>
<td>N/A</td>
<td>&gt;65018</td>
<td>Jul-Jun, with peak barrage outflows in Oct-Dec</td>
<td>0.4-0.75</td>
<td>Maximum lake levels Dec-Feb and minimum lake levels in Mar-May</td>
<td>0.0 to 0.2</td>
<td>Sep-Nov</td>
<td>≥90</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.2 to -0.4</td>
<td>Feb-Mar</td>
<td>n/a</td>
</tr>
<tr>
<td>1-in-2</td>
<td>N/A</td>
<td>&gt;315019</td>
<td>Jul-Jun, with peak barrage outflows in Oct-Dec</td>
<td>0.4-0.83</td>
<td>Maximum lake levels Dec-Feb and minimum lake levels in Mar-May</td>
<td>0.35-0.45</td>
<td>Sep-Dec</td>
<td>≥120</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 to -0.5</td>
<td>Mar-Apr</td>
<td>n/a</td>
</tr>
<tr>
<td>1-in-3</td>
<td>5</td>
<td>&gt;6,000</td>
<td>Jul-Jun, with peak barrage outflows in Oct-Dec</td>
<td>0.4-0.83</td>
<td>Maximum lake levels Dec-Feb and minimum lake levels in Mar-May</td>
<td>0.35-0.45</td>
<td>Sep-Jan</td>
<td>≥150</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 to -0.5</td>
<td>Feb-Apr</td>
<td>n/a</td>
</tr>
<tr>
<td>1-in-7</td>
<td>17</td>
<td>&gt;10,000</td>
<td>Jul-Jun, with peak barrage outflows in Oct-Dec</td>
<td>0.4-0.9</td>
<td>Maximum lake levels Dec-Feb and minimum lake levels in Mar-May</td>
<td>0.35-0.45</td>
<td>Sep-Feb</td>
<td>≥180</td>
</tr>
</tbody>
</table>

18 A total average barrage outflow of 2,000 GL/year over a three year rolling period (i.e. not less than 6,000 GL over three years) and not less than 650 GL/year in any one of the three years (Heneker 2010; Lester et al. 2011).

19 A total average barrage outflow of 4,000 GL/year over a three year rolling period (i.e. not less than 12,000 GL over three years) and not less than 3150 GL/year in any one of the three years (Heneker 2010; Lester et al. 2011).
3.5 Capacity of the Resource to Meet Environmental Water Requirements

Providing water for the environment is a fundamental step in establishing a balance between social, economic and environmental outcomes. The volume of 1,850 GL available under normal Entitlement is not adequate to meet any of the EWRs that are outlined in Section 3.4. Provisions for the environment are also limited based on historical allocation. However, the available provisions still play an important role in achieving desired ecological outcomes, especially within the River Murray main channel and pool-connected wetlands.

The South Australian Entitlement of 1,850 GL is delivered in a monthly pattern to best suit peak extraction periods (i.e. October to March). Flows vary daily within this delivery pattern, with average flows in December and January being 7,000 ML/day, down to 3,000 ML/day in May and June. This delivery pattern coincides with some ecological timing requirements, but as outlined in Section 3.6, EWPs set aside for the environment are limited. This is due to the requirement to balance environmental, social and economic needs through the water sharing arrangements under the Agreement. This highlights the importance of held environmental water (see Section 3.6.3), unregulated flow events (see Section 3.7), and achieving more through alternative solutions such as infrastructure, pumping and variable water delivery options (see Section 3.8) to benefit the environment and contribute towards EWRs.

Table 11 provides an example of the contribution that EWRs make towards ecological targets in comparison to Entitlement (in this case the River Murray channel EWRs). Where a target in the table is green, a large positive contribution to the target is achieved by the specified EWR. Where a target is orange, the EWR is unlikely to provide a detectable contribution.

Under normal Entitlement, for the majority of ecological objectives and targets, the contribution is expected to be unlikely or undetectable, as demonstrated by the majority of targets being orange. Between 20,000 ML/day and 30,000 ML/day a low to moderate positive contribution towards ecological targets is expected from most EWRs. Other targets, particularly in relation to recruitment and abundance of Murray cod, do not have a large positive contribution from even the highest in-channel EWR.

The Entitlement by itself does not meet any EWRs, but it does provide a baseflow on which held environmental water – from water recovery programs – can be added to achieve the discharge and duration for lower channel and CLLMM EWRs. A much greater volume is needed to meet the majority of EWRs, so environmental water will need to be delivered in conjunction with unregulated flows (DEWNR 2015). This highlights the importance to EWRs in South Australia of unregulated flows and water held by the CEWH and through TLM.

Coordination of environmental watering means that increasing the magnitude and/or extending the duration of higher flows can be achieved, for example by ‘topping up’ unregulated flows (see Section 3.7). South Australia’s annual environmental watering plans (see Section 3.3) set out how environmental water is proposed to be delivered to meet objectives and targets to ensure efficient and effective use of environmental water.
### Table 11: Contribution towards River Murray Channel ecological targets at various median flows (ML/day), compared against entitlements (EF) (adapted from Wallace et al. 2014)

<table>
<thead>
<tr>
<th>Type</th>
<th>Ecological Target</th>
<th>Contribution to Ecological Objective at median flows (ML/Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem processes</td>
<td>Open-water productivity shows a temporary shift from near zero or autotrophic dominance (positive Net Daily Metabolism) towards heterotrophy (negative Net Daily Metabolism) when QSA &gt;30,000 ML day⁻¹.</td>
<td>EF²⁰</td>
</tr>
<tr>
<td></td>
<td>Habitat across the range of velocity classes is present in the lower third of weir pools for at least 60 consecutive days in Sep–Mar, at a maximum interval of 2 years.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thermal stratification does not persist for more than 5 days at any time.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Basin Plan Target: Salt export, averaged over the preceding 3 years, is ≥2 million tonnes per year.</td>
<td></td>
</tr>
<tr>
<td>Water quality</td>
<td>Biovolume &lt;4 mm⁻³ L⁻¹ for all cyanobacteria, where a known toxin producer is dominant, or &lt;10 mm⁻³ L⁻¹ for all cyanobacteria where toxins are not present.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Basin Plan Target: Maintain dissolved oxygen above 50 percent saturation throughout water column at all times.</td>
<td></td>
</tr>
<tr>
<td>Biofilms</td>
<td>Median biofilm composition is not dominated (&gt;80 percent) by filamentous algae.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Median biofilm C:N ratios are &lt;10:1.</td>
<td></td>
</tr>
<tr>
<td>Riparian vegetation</td>
<td>In standardised transects spanning the elevation gradient in the target zone, 70 percent of river red gums have a Tree Condition Index score ≥ 10.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A sustainable demographic is established to match the modelled profile for a viable river red gum population in existing communities spanning the elevation gradient in the target zone.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Species from the Plant Functional Group ‘flood-dependent/responsive’ occur in 70 percent of quadrats spanning the elevation gradient in the target zone at least once every 3 years.</td>
<td></td>
</tr>
</tbody>
</table>

²⁰ Typically less than 7,000 ML/day.
Table 11: Contribution towards River Murray Channel ecological targets at various median flows (ML/day), compared against entitlements (EF) (adapted from Wallace et al. 2014)

<table>
<thead>
<tr>
<th>Type</th>
<th>Ecological Target</th>
<th>Contribution to Ecological Objective at median flows (ML/Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>EF²⁰</td>
</tr>
<tr>
<td>Fish</td>
<td>Population age structure of golden perch and silver perch includes YOY with sub-adults and adults in 8 years in 10.</td>
<td>Large positive contribution</td>
</tr>
<tr>
<td></td>
<td>Population age structure of golden perch and silver perch indicates a large recruitment event 2 years in 5, demonstrated by separate cohorts representing ≥30 percent of the population.</td>
<td>Contribution unlikely to be detectable or expected</td>
</tr>
<tr>
<td></td>
<td>Abundance (CPUE) of golden perch and silver perch increases by ≥30 percent over a 5-year period.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Population age structure of freshwater catfish includes YOY, with sub-adults and adults in 9 years in 10.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Population age structure of freshwater catfish indicates a large recruitment event 2 years in 5, demonstrated by separate cohorts representing ≥30 percent of the population.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Abundance (CPUE) of freshwater catfish increases by ≥30 percent over a 5-year period.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expected species occur in each mesohabitat (channel, anabranch, wetlands) in each weir pool/reach.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Population age structure of Murray cod includes recent recruits, sub-adults and adults in 9 years in 10.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Population age structure of Murray cod indicates a large recruitment event 1 year in 5, demonstrated by a cohort representing ≥50 percent of the population.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Abundance (CPUE) of Murray cod increases by ≥50 percent over a 10-year period.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Length-frequency distributions for foraging generalists include size classes showing annual recruitment.</td>
<td></td>
</tr>
</tbody>
</table>
Table 11: Contribution towards River Murray Channel ecological targets at various median flows (ML/day), compared against entitlements (EF) (adapted from Wallace et al. 2014)

<table>
<thead>
<tr>
<th>Type</th>
<th>Ecological Target</th>
<th>Contribution to Ecological Objective at median flows (ML/Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>EF^20</td>
</tr>
<tr>
<td>Wetland vegetation</td>
<td>Relative abundance and biomass of common carp do not increase in the absence of increases in abundance and biomass of flow-dependent native fish.</td>
<td></td>
</tr>
<tr>
<td>Wetlands</td>
<td>Native macrophytes from the emergent, amphibious and flood-dependent functional groups occur in 70 percent of quadrats spanning the elevation gradient in the target zone† at least once every 3 years.</td>
<td></td>
</tr>
<tr>
<td>Groundwater and soil</td>
<td>Inundation periods in temporary wetlands have unrestricted lateral connectivity between the river and wetlands in &gt;90 percent of inundation events.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Establish and maintain freshwater lenses in near-bank recharge zones.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maintain soil water availability, measured as soil water potential &gt; -1.5 MPa at soil depth 20–50 cm, to sustain recruitment of long-lived vegetation across the elevation gradient in the target zone.†</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduce soil salinity (measured as EC 1:5) to &lt;5000 µS cm⁻¹ to prevent shifts in understorey plant communities to salt-tolerant functional groups across the elevation gradient in the target zone.†</td>
<td></td>
</tr>
</tbody>
</table>

† The target zone is the area inundated by flows of 10,000-40,000 ML day⁻¹

EF = Electrical Conductivity at 25°C.

^ Expected species are those that were historically abundant (e.g. silver perch, freshwater catfish) and would not be considered beyond their extant range (e.g. trout cod), vagrants (i.e. spangled perch) or not expected to occur (e.g. mature Murray cod in temporary wetlands).

† Population age structure is inferred from length-frequency distributions and validated by otoliths where appropriate.

‡ Recent recruits are fish <2 years old.

§ Recruitment refers to survival and growth of the larvae and juveniles to YOY (young of year).

† CPUE is ‘catch per unit effort’ resulting from formal surveys using standard techniques (e.g. boat-mounted electrofishing, fyke nets).
3.6 Environmental Water Provisions

This section includes information about the water that is set aside for the environment by the Plan, and the environmental outcomes that are expected to be delivered by the provision of environmental water under this Plan.

The NRM Act requires a water allocation plan to achieve an equitable balance between social, economic and environmental needs for water, and that the rate of water taking and use is sustainable (section 76 (4)(b)(i) and (ii)). For the purposes of this plan, EWPs have been defined as those parts of environmental water requirements that can be met at any given time. This recognises that providing water to the environment is a part of water allocation and management, and that we must balance social, economic and environmental needs (ARMCANZ & ANZECC 1996).

The objects of the NRM Act include to assist in the achievement of ecologically sustainable development in the state by establishing an integrated scheme to promote the use and management of natural resources in a manner that, among other things21:

- recognises and protects the intrinsic values of natural resources;
- seeks to protect biological diversity and, insofar as is reasonably practical, to support and encourage the restoration or rehabilitation of ecological systems and processes that have been lost or degraded; and
- seeks to support sustainable primary and other economic production systems.

3.6.1 Overview

The South Australian Entitlement consists of a Dilution and Loss Entitlement (696 GL) and a Consumptive Entitlement (1,154 GL). The Dilution and Loss Entitlement is essential for meeting conveyance losses between the South Australian border and Wellington, and for providing salinity dilution throughout the River Murray in South Australia. The Consumptive Entitlement is divided into water to be taken for consumptive purposes, water specifically for allocation to the environment, and water that remains unallocated. Water for non-consumptive use (including the unallocated portion of Entitlement) has both an in-channel benefit and benefit to wetlands connected at pool level. Water for the environment, as set out in consumptive pools in this Plan, provides more specific, localised benefits.

Available environmental water can also be defined as ‘held’ and ‘planned’ environmental water, where:

- held environmental water is water available under a water access right or held on a water licence for the purposes of achieving environmental outcomes (Water Act 2007); and
- planned environmental water is water that is committed or preserved for achieving environmental outcomes through a plan or legislation, and cannot be used for any other purpose (Water Act 2007).

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21 Paraphrased from section 7(1) of the NRM Act.
This Plan provides for both held and planned environmental water. Held environmental water includes the water available via licences in the Wetland Consumptive Pool and the Environmental Consumptive Pool, and a proportion of the water licences held in the All Purpose Consumptive Pool that are specifically used for the environment (see Section 3.6.3).

Planned environmental water includes water set aside that is used in unmanaged wetlands. Unregulated flows may be left in the system to contribute to environmental outcomes and provide environmental benefit.

3.6.2 Wetlands

The regulation of the River Murray in South Australia through the installation of the weirs in the 1920s and 1930s resulted in permanent inundation of many wetlands between the South Australian border and Wellington. Since then, water has been used by these wetlands from the river each year. The annual evaporative losses from the wetlands permanently connected at normal pool level have been estimated to be 200 GL.

To improve the ecology of some pool-connected wetland sites, flow-control infrastructure has been installed within the channels that connect the wetlands to the river, to enable them to be temporarily disconnected, drawn-down or dried. Temporary drying allows for the consolidation of the bed and riparian plant establishment, and assists in controlling feral species such as carp. Management of each of the sites varies significantly, but each site has a management plan with a proposed hydrograph. These wetlands are referred to as ‘managed wetlands’. ‘Unmanaged wetlands’ are those that do not have flow-control infrastructure installed and remain permanently connected to the river.

As outlined in Section 2.1.3.3, this Plan sets out a consumptive pool for water required for managed wetlands (Wetland Consumptive Pool), and a consumptive pool for the volume of water savings arising from the installation of flow-control infrastructure (Environmental Consumptive Pool). The consumptive pools allow for allocations to be granted and the use to be licensed. The volume attributable to unmanaged wetlands is left in-river and accounted for from the Dilution and Loss Entitlement.

Where wetland flow-control infrastructure is installed on a site to enable management through wetting and drying, an allocation is required to cover the refill and evaporative losses attributed to the site. The water access entitlements on licence for managed wetlands are provided for on a water licence held by the Minister, and an allocation is provided based on the water available for allocation on an annual basis.

A portion of the shares on licence for managed wetlands have been transferred to the Commonwealth of Australia, where water savings have been achieved via infrastructure works through the RRP. A separate consumptive pool has been established for these shares – the Environmental Consumptive Pool. The RRP is still underway, as at the date of adoption of this Plan. As the project progresses, the Commonwealth of Australia shares that are held will increase.

The provision of water to managed wetlands through an allocation from the Wetland Consumptive Pool, and the reintroduction of a wetting and drying regime, will increase the distribution and abundance of aquatic plants and animals, and in doing so provide complex habitat for fauna, increasing the abundance of native fauna and promoting ecological processes such as breeding (DEWNR 2012a).
The volume for evaporative losses from unmanaged wetlands remains in-river but ‘assigned’ or ‘planned’ as an environmental provision to offset the evaporative losses. This volume is approximately 157.5 GL. The provision of water to unmanaged wetlands provides permanent habitat for fauna (refugia). This volume of water helps to maintain connectivity, support ecological processes and provide habitat for aquatic biota. Water is delivered to these areas through normal river operations.

The total volume of water for wetland management purposes is 200 GL, whether provided for from a consumptive pool or as part of dilution and loss.

### 3.6.3 Held Environmental Water

Held environmental water is water that is allocated for the purposes of achieving environmental outcomes. The volume of water held for the environment has increased considerably with the establishment of TLM and the CEWH, and with the purchase or acquisition of water from irrigators as part of Australian Government funded programs. A small amount of environmental water is held by non-government organisations and the Minister for Water and the River Murray.

As detailed in Section 2.2.2.6 of the Plan, TLM was established in 2002 to return water previously taken for consumptive purposes to the environment. Water was sourced through buybacks from willing sellers and is used at icon sites along the River Murray, including Chowilla and the Lower Lakes, Coorong and Murray Mouth. Approximately 45 GL of South Australian Entitlement was held for the environment through TLM in 2013-14.

Pursuant to the Basin Plan, and as detailed in Section 2.1.4.3, water used for consumptive purposes is being recovered across the Basin for the environment and is managed by the CEWH. The functions of the CEWH are:

> to be performed for the purpose of protecting or restoring the environmental assets of the Murray-Darling Basin; and other areas outside the Murray-Darling Basin where the Commonwealth holds water; so as to give effect to relevant international agreements. (Water Act 2007)

In accordance with the Basin Plan:

> the CEWH must perform its functions and exercise its powers in a way that is consistent with: a) the environmental watering plan; and b) the Basin-wide environmental watering strategy. (Commonwealth of Australia 2012)

For the River Murray in South Australia, a total of 183.8 GL is required to be recovered for the environment by 2019 under the Basin Plan. A significant portion of this water has already been recovered. As set out in Section 2.1.4.3, the Commonwealth of Australia holds approximately 146 GL of South Australian water access entitlements (as at 14 March 2017).

Water recovered through TLM and through the Basin Plan can be used within or outside of South Australia, and planning processes by the water holders determine which sites are watered from year to year.

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22 Of the 45 GL held for TLM, 38.36 GL arise from water access entitlements in the former Class 7. The remainder of entitlements are held in the former Class 1 and Class 3a.
The Minister for Water and the River Murray also holds a small held environmental water portfolio in respect of various agreements for environmental water provision and related purposes, including as part of an agreement with the Australian Government regarding the Adelaide desalination plant. Through this agreement, an environmental water reserve of 6 GL of permanent entitlement has been established, for use at priority sites along the River Murray in South Australia.

Held environmental water provides opportunities for managing the River Murray to achieve environmental outcomes and support water-dependent ecosystems. Allocating water for environmental purposes ensures that the volume of water available each year can be managed to achieve desired environmental outcomes described earlier. The Plan will assist in achieving environmental outcomes through principles that facilitate the allocation and required transfer of water, and through ensuring that holders of water for managed wetlands participate in a specified environment improvement program (see Section 3.10). This ensures that a coordinated approach is in place where water is used to achieve ecological outcomes at these sites.

### 3.7 Other Environmental Flows to South Australia, including Unregulated Flows

As specified in Section 2.1.1.1, South Australia typically receives volumes of flow each year above the Entitlement, including unregulated flows, water traded to South Australia (including environmental water deliveries), and other dilution flows as determined by the Agreement – such as Additional Dilution Flow (3 GL/day when storage triggers are met in the Menindee Lakes and Hume and Dartmouth Reservoirs) and Lindsay River Dilution Flow (~65 GL/year).

Apart from water traded to South Australia for consumptive purposes, this additional ‘required flow’ remains in the river system for environmental purposes. These flows are critical for meeting environmental watering priorities and objectives in South Australia, especially those relating to the floodplain and flow, water level and water quality in the CLLMM region.

A portion of the South Australian Entitlement remains unallocated, in recognition of being required to remain in the river to support dilution, loss and environmental purposes. This volume has environmental benefit to the Lower Lakes (including fringing wetlands) and the main river channel, for example through helping to support ecological processes and provide habitat for aquatic biota, and maintaining suitable water quality.

An unregulated flow event is defined on the Bureau of Meteorology website as a river flow that does not result from a controlled release made to service an allocation, or flows declared to be unregulated by the appropriate authority. Flow to South Australia that is in excess of the state’s monthly Entitlement and that cannot be captured in Lake Victoria is considered to be unregulated flow. It may occur when there is higher than average rainfall in the upper catchment of the Basin. Declaration of an unregulated flow in South Australia is undertaken by the Murray-Darling Basin Authority, according to rules set out in the Agreement. The Plan supports using unregulated flows to achieve a range of environmental objectives, particularly those outcomes that are described earlier in this section.
3.8 Alternative Practices to Support Dependent Ecosystems

In acknowledgement of the continuing decline of the riverine environment in South Australia, alternate practices have been initiated to further support water-dependent ecosystems. In this regard, significant effort and funding have been invested into ‘doing more with less’ through:

- infrastructure, which may be used to inundate large areas of floodplains to the same level as high flow events but at much lower flows;
- pumping, which can provide water to disconnected floodplains and wetland areas where a decline in health is evident, allowing the area to survive until the next natural high flow event occurs;
- flexible management of the weirs, to provide more natural variability to support riparian vegetation; and
- environmental water deliveries, which can potentially be managed in a way that creates a higher flow peak, extends the duration of a peak, provides additional water level variability, and has benefits to multiple sites as it flows through the system.

The Plan supports these endeavours by providing principles which are flexible for the purpose of achieving environmental outcomes (see Chapters 5 and 6).

3.9 Environmental Outcomes Expected from Plan Provisions

It is broadly acknowledged that EWPs from the South Australian Entitlement of 1,850 GL cannot keep all of the ecosystems of the River Murray in South Australia in good health. The provisions can, however, help to deliver targeted environmental outcomes at specific locations, and facilitate environmental projects such as TLM. Wetland provisions discussed in Section 3.6.2 provide for the replacement of evaporated water from unmanaged pool-connected wetlands, and allows for the implementation of wetting and drying regimes at those pool-connected wetlands with management infrastructure.

In managed wetlands, the water provided and the regime of water delivery contribute to the recruitment of native vegetation, provision of habitat for fauna, increased abundance of fauna, the promotion of ecological processes such as breeding, and control over populations of pest species. In unmanaged wetlands, the provision of water to wetlands provides permanent refuge for fauna.

The non-consumptive (unassigned) portion of Entitlement also has in-channel benefits and supports the Lower Lakes, through maintaining water quality and managing salinity levels, thereby supporting native flora and fauna.

Managing sites using the EWPs can have significant localised benefits, including improved riparian vegetation health, consolidation of sediments, and improved site biodiversity.
The EWPs set out by the Plan also provide a baseflow, which can be built upon when additional environmental water is available, for example unregulated flows or water delivered through Basin Plan implementation. To meet most EWRs, an unregulated flow event will have to occur, with environmental water used to boost the magnitude or duration of the event (DEWNR 2015). The environmental water planning framework determines how best to use the available sources of environmental water.

### 3.10 Achieving Best Ecological Outcomes through Plan Implementation

To maximise the benefits from environmental water, it is important to have a coordinated approach to the delivery and use of the water. The LTWP and the annual prioritisation process required under the Basin Plan provide for this coordinated approach. The South Australian Environmental Water Planning Framework is described in Section 3.3. Sections 160(2)(b)(ii) and 164B(2)(b)(ii) of the NRM Act help to facilitate this coordinated approach through provisions that require that a person who has the benefit of a relevant approval (site use or water resource works approval) participate in a specified environment improvement program.

To avoid duplication between the LTWP and the Plan, the specified environment improvement program focusses on managing wetlands and disposal basins for ecological outcomes in the South Australian River Murray. It outlines participation requirements of approval holders such as the development and review of wetland management plans, monitoring and reporting water use, and gathering ecological outcomes information.

The Plan supports a coordinated approach by including linkages to the specified environment improvement program where water is used to achieve ecological outcomes in managed wetlands and specified disposal basins.
4 EFFECTS ON OTHER WATER RESOURCES

Section 76(6) and (7) of the NRM Act requires the Plan to include an assessment as to whether the taking or use of water from the River Murray PWC will have a detrimental effect on the quality or quantity of water that is available from any other water resource. This may include water resources in neighbouring prescribed and unprescribed areas. The neighbouring water resource areas are outlined in Figure 16. Water resources from the following areas are considered in this chapter:

- Eastern Mount Lofty Ranges;
- Angas Bremer;
- Western Mount Lofty Ranges;
- Marne River and Saunders Creek;
- McLaren Vale;
- Tintinara Coonalpyn;
- Tatiara;
- Mallee;
- Peake, Roby and Sherlock;
- Noora;
- Clare Valley;
- Barossa Valley; and
- Non-Prescribed Resources.

If a detrimental effect is occurring or is likely to occur, then the Plan must take account of the needs of those dependent on the affected resources. The Plan addresses the detrimental effect of taking water from the River Murray PWC on other water resources, users and the environment through principles in the Plan. Where a principle is included to address the detrimental impact on another water resource caused by the taking of water from the River Murray PWC, the detail is set out in this chapter.
Figure 16: Prescribed Water Resources Areas and Prescribed Wells Areas
4.1 Eastern Mount Lofty Ranges Prescribed Water Resources Area

The Eastern Mount Lofty Ranges (EMLR) Prescribed Water Resource Area (PWRA) occupies an area of 2,845 km$^2$ and incorporates the eastern slopes of the Mount Lofty Ranges and the Murray Plains, which lie within the Murray-Darling Basin.

The EMLR PWRA incorporates the Angas Bremer Prescribed Wells Area (PWA), which is located on the western side of Lake Alexandrina.

4.1.1 Interconnection with the River Murray PWC

The EMLR PWRA contains sixteen surface water catchments, from which numerous rivers and streams drain into Lake Alexandrina and the River Murray. Of these, the River Murray PWC boundary incorporates the lower reaches of Currency Creek, Tookayerta Creek, and the Rivers Finniss, Angas and Bremer.

Conditions in the River Murray and Lake Alexandrina directly affect water quality, unique habitats, and licensee access to water in the lower reaches of the streams within the EMLR PWRA. Any increased extraction from the lower River Murray could have local impacts on water quality, ecosystems and water access.

The Water Allocation Plan for the Eastern Mount Lofty Ranges (EMLR Plan) includes principles that protect low flows (at or below the threshold flow rate) to provide part of the environmental water requirements in the EMLR. Threshold flow rate principles apply to watercourses in the EMLR catchments, including Finniss and Tookayerta catchments, setting out that flows below the local threshold flow rate cannot be extracted. Extraction limits also apply to catchments, and allocations are not to be granted beyond these limits. These principles aim to protect the environmental assets in this region (South Australian Murray-Darling Basin NRM Board 2013).

River Murray licensees have not been subject to these requirements, and extraction of low flows by River Murray licensees where the prescribed areas adjoin may affect environmental water requirements, and existing water users.

It is important that this Plan includes principles that align with the principles in the EMLR Plan, to ensure the local issues in the lower River Murray that impact on the EMLR PWRA are addressed.

Principle 64 provides that water cannot be extracted from a new extraction point within 100 metres of a tributary wetland of Lake Alexandrina (as delineated in Figure 15). This principle also provides that the capacity of existing pumping infrastructure within this area cannot be modified to increase the maximum flow rate of that infrastructure. This principle aims to limit increased levels of extraction from this location.

Principle 66 is included to ensure that the taking of new or additional water allocations that apply to new or existing River Murray water resource works approvals, where an extraction point is located within the Finniss River or Tookayerta Creek upstream of where Winery Road crosses these watercourses, is aligned with the principles in the EMLR Plan.

It is proposed to review this situation more closely in the next review of the Plan, to ensure that consistent policies are in place for water users on either side of the boundary, with the aim of protecting ecosystems from the impacts of low flows.
4.1.2 Angas Bremer Prescribed Wells Area

There are two aquifers within the Angas Bremer PWA – a shallow, generally saline unconfined aquifer, and a deeper confined limestone aquifer, which is primarily used for irrigation, but also supplies water for stock and domestic use. The taking or use of water from the River Murray PWC can affect both aquifers in two ways.

- Direct application for irrigation – drainage water resulting from such irrigation may enter the shallow unconfined aquifer and potentially result in rising water tables. Water level monitoring has shown no evidence of any widespread or consistent rises in the water table due to irrigation, which is most likely due to the dominant use of highly efficient drip irrigation.
- Managed aquifer recharge (MAR) – River Murray water can be directly recharged into the confined limestone aquifer for later extraction during the irrigation season. The injection of River Murray water will locally increase water levels in the confined aquifer, and computer modelling has shown that in the long-term, groundwater salinities will locally decrease because the salinity of the River Murray water is lower than the native groundwater salinity.

Principles are included in the EMLR Plan (which incorporates the Angas Bremer PWA) to manage issues arising from the use of imported water, including where the use could have a detrimental impact on the productive capacity of the land, or on the condition, biodiversity or extent of water-dependent ecosystems.

Principles 73 to 81 are included in this Plan to address the issue of rising water tables and soil salinisation associated with irrigation in the Angas Bremer Irrigation Management Zone.

4.2 Western Mount Lofty Ranges Prescribed Water Resources Area

The Western Mount Lofty Ranges (WMLR) PWRA covers a total area of approximately 2,750 km², from Gawler in the north, to Middleton, and across to Cape Jervis on the south coast.

4.2.1 Interconnection with the River Murray PWC

There is no direct hydrological connection between the water resources in the WMLR PWRA and the River Murray PWC, therefore there will be no impacts from the taking or use of water from the River Murray PWC. However, water from the River Murray is used to provide water supplies for metropolitan Adelaide – pipelines discharge River Murray water directly into the rivers of the WMLR PWRA (SA Water 2012).

On average over the last five years, the reservoir catchments in the WMLR PWRA provided 54 percent of metropolitan Adelaide’s mains water supply. Depending on storage levels in SA Water reservoirs in the WMLR PWRA, the proportion of water taken each year from the River Murray varies from 10 percent to 90 percent. Accordingly, any reduction of inflows to reservoirs in the WMLR PWRA could increase reliance on the River Murray (noting that SA Water operates under Cap arrangements, which limits the volume of water that can be taken from the river. See Section 2.1.2).
In 2009, the South Australian Government released *Water for Good: A plan to ensure our water future to 2050*, which encourages the diversification of water supplies to reduce reliance on the River Murray and other rain-dependent water sources. To address the potential reduction of inflows to these reservoirs, and to limit demand on the River Murray, no new surface water or watercourse water will be made available for allocation, dam development or commercial forestry upstream of the reservoirs (Adelaide and Mount Lofty Ranges Natural Resources Management Board 2010).

4.3 Marne Saunders Prescribed Water Resources Area

The Marne Saunders PWRA is located approximately 70 km north-east of Adelaide, in the Eastern Mount Lofty Ranges. The Marne Saunders PWRA includes the townships of Springton, Eden Valley, Keyneton and Cambrai.

The Marne Saunders PWRA encompasses the catchments of the Marne River, including the North Rhine and Saunders Creek, and includes the underground water within these catchments. These water resources are used for a range of purposes including stock and domestic, irrigation, industrial, and recreational uses.

4.3.1 Interconnection with the River Murray PWC

The Marne River and Saunders Creek discharge to the River Murray. However, much of the flow generated in the hills zone is naturally lost from the watercourse on the plains zone as recharge to the underlying aquifers. Significant floods are required for flow to traverse the plains zones.

The primary direction of flow of underground water in the Murray Group Limestone aquifer is toward the east, where discharge occurs to the River Murray. Underground water extractions have minimal or no impact on the River Murray, as most of these are located more than 15 km west of the river (South Australian Murray-Darling Basin NRM Board 2010).

Due to the direction of surface water flow from the Marne Saunders PWRA towards the River Murray, it is not expected that the taking of water from the River Murray PWC will impact on water users in this area.

4.4 McLaren Vale Prescribed Wells Area

The McLaren Vale PWA covers an area of approximately 320 km$^2$. It is bound to the north by the Onkaparinga River, to the west by St Vincent Gulf and to the south-east by the Mount Lofty Ranges (Adelaide and Mount Lofty Ranges NRM Board 2007, Department for Water 2012).

4.4.1 Interconnection with the River Murray PWC

There is no direct hydrological connection between the water resources in the McLaren Vale PWA and the River Murray PWC. There will be no detrimental impacts on water users in the McLaren Vale PWA as a result of the taking or use of water from the River Murray PWC.
4.5 Tintinara Coonalpyn Prescribed Wells Area

The Tintinara-Coonalpyn PWA is located in the Upper South East of South Australia and covers an area of 3,423 km². Groundwater is used for irrigation as well as stock and domestic purposes (South East Natural Resources Management Board 2011).

4.5.1 Interconnection with the River Murray PWC

There is no direct hydrological connection between the water resources in the Tintinara-Coonalpyn PWA and the River Murray PWC. There will be no detrimental impacts on water users in this PWA as a result of the taking or use of water from the River Murray PWC. The River Murray provides water for the Tailem Bend to Keith pipeline, which provides reticulated supplies for the townships of Tintinara and Coonalpyn and also stock and domestic supplies for a large number of rural properties.

4.6 Tatiara Prescribed Wells Area

The Tatiara PWA is located in the Upper South East of South Australia and covers an area of 3,500 km². Groundwater is used for irrigation, stock and domestic purposes and the water supply for the township of Bordertown (South East Natural Resources Management Board 2012).

4.6.1 Interconnection with the River Murray PWC

There is no direct hydrological connection between the water resources in the Tatiara PWA and the River Murray PWC. There will be no detrimental impacts on water users in this PWA as a result of the taking or use of water from the River Murray PWC. The River Murray provides water for the Tailem Bend to Keith pipeline which provides reticulated supplies for the township of Keith and also stock and domestic supplies for a large number of rural properties.

4.7 Mallee Prescribed Wells Area

The Mallee PWA is located south and east of the River Murray PWC, within the South Australian Murray-Darling Basin. It encompasses the townships of Alawoona, Wanbi, Mindarie, Karoonda, Geranium, Parrakie, Lameroo, Parilla, Pinnaroo, Peebinga and Paruna. Underground water is extracted from the Mallee PWA for the purposes of irrigation, stock and domestic, mining, intensive farming and industry.

4.7.1 Interconnection with the River Murray PWC

The Mallee PWA includes the Pliocene Sands aquifer (Parilla Sands), overlying a Tertiary Limestone aquifer (Murray Group Limestone), in turn overlying a Tertiary Confined Sand aquifer (Renmark Group). These aquifers extend to the River Murray PWC. Water within these aquifers follows the very gradual watertable gradient of the Murray Basin toward the River Murray, where it discharges. The rate of movement of the underground water is very slow, approximately half a metre per year (SA Murray-Darling Basin NRM Board 2012).
Underground water extractions have minimal or no impact on the River Murray, as most of these are located more than 30 km south of the river.

The taking of water from the River Murray PWC will not impact on water users or water resources in this area.

4.8 Peake, Roby and Sherlock Prescribed Wells Area

The Peake, Roby and Sherlock PWA is located approximately 140 km south-east of Adelaide and covers an area of approximately 1,120 km² within the South Australian Murray-Darling Basin. It encompasses the townships of Peake, Sherlock, Coomandook and Netherton. Underground water is extracted from the Peake, Roby and Sherlock PWA for the purposes of irrigation, stock and domestic (including Peake town water supply) and intensive farming.

4.8.1 Interconnection with the River Murray PWC

The Peake, Roby and Sherlock PWA is underlain by two main aquifer systems, a shallow unconfined aquifer (Unconfined Murray Group Limestone) and the underlying confined aquifer (Buccleuch and Renmark Group). The unconfined and confined aquifers are separated by a low permeability aquitard (Ettrick formation). The lateral flow of water from these aquifers is in a westerly direction toward the River Murray PWC. The rate of movement is slow, taking thousands of years (SA Murray-Darling Basin NRM Board 2011).

The taking of water from the River Murray PWC will not impact on water users or the water resources within in this area.

The River Murray provides water for the Tailem Bend to Keith pipeline, which crosses the Hundred of Roby and provides reticulated supplies for a number of rural properties in the south-east area of the Peake, Roby and Sherlock PWA.

4.9 Noora Prescribed Wells Area

The Noora PWA extends 20 km west of the South Australian–Victorian border, and is bounded by the River Murray PWC to the north, and the Mallee PWA to the south. There is minimal use of the underground water for stock and domestic purposes due to the relatively high water salinity. A larger volume of extraction occurs for the Salt Interception Scheme (SIS), near Murtho, to divert saline water from the aquifer entering the River Murray PWC. Parts of the Noora PWA are supplied with reticulated River Murray water.

4.9.1 Interconnection with the River Murray PWC

Noora PWA is underlain by three water-bearing aquifers – Pliocene Sands aquifer (Loxton-Parilla Sands), the Tertiary Limestone Group (Murray Group Limestone) and the confined tertiary aquifer (Renmark Group). The lateral flow of the water within these aquifers is directly to River Murray PWC in the north. Irrigation using River Murray water on the highlands may result in drainage which could exacerbate natural groundwater flows to the floodplain. The Murtho SIS will mitigate these impacts.

The taking of water from the River Murray PWC is unlikely to affect the Noora PWA.
4.10 Clare Valley Prescribed Water Resources Area

The Clare Valley PWRA covers an area of approximately 700 km², and is located approximately 130 km north of Adelaide. The population of the Clare Valley region is approximately 5,000, with Clare providing the majority of commercial and business services in the region.

The major watercourses of the Clare Valley PWRA are the Hill River and Hutt River, which drain to the north into the Broughton River, and the Eyre Creek and Wakefield River which drain to the south (Northern and Yorke Natural Resources Management Board 2009).

4.10.1 Interconnection with the River Murray PWC

There is no direct hydrological connection between the water resources in the Clare PWRA and the River Murray PWC. There will be no detrimental impacts on water users in this PWRA as a result of the taking and use of water from the River Murray PWC.

The primary source of town water supplies in the region is the reticulated supply from the River Murray through the Clare Valley Water Supply Scheme, which is also used for irrigation of high value crops, including wine grapes.

The application of imported water within the Clare PWRA carries a risk of groundwater salinisation, but there does not appear to be any correlation between any observed rising salinity trends and application of this water (Department for Water 2010).

4.11 Barossa Prescribed Water Resources Area

The Barossa PWRA encompasses both the highland areas of the Mount Lofty Ranges and the Barossa Valley, and is located approximately 60 km north-east of Adelaide. The surface and watercourse water resources in the Barossa PWRA are characterised by high annual variability of flow. The North Para River is the major watercourse, which serves as a significant water supply for existing users and supports a range of ecosystems. There are a significant number of farm dams that are used for vineyard irrigation, and stock and domestic use. Groundwater is primarily used for irrigation, and is also used for commercial, industrial, and stock and domestic purposes (Department for Water 2010, Department for Water 2011).

4.11.1 Interconnection with the River Murray PWC

There is no direct hydrological connection between the water resources in the Barossa PWRA and the River Murray PWC. There will be no detrimental impacts on water users in this PWRA as a result of the taking and use of water from the River Murray PWC.

SA Water provides water from the River Murray for reticulated water supplies. In addition, Barossa Infrastructure Ltd (BIL) supplies up to 9,000 ML of supplementary irrigation water per annum from the River Murray through SA Water infrastructure (Barossa Infrastructure Limited 2016).
As this River Murray water is approximately one third of the average salinity of the groundwater resources used for irrigation, there will be a reduction in salt accessions to the shallow aquifers if there is a significant replacement of groundwater irrigation sources by water supplied through BIL. However, it is likely that any salt in irrigation water (whatever the source), will eventually reach the regional water table as a result of natural processes, and that this recharge will eventually discharge as base flows into catchment streams.

4.12 Non-Prescribed Resources

Non-prescribed groundwater resources lie adjacent to and beneath the River Murray PWC, which is the focus of regional groundwater discharge from the aquifer systems of the Murray Basin. These aquifers are generally saline and hence can contribute salt directly to the river or cause significant degradation of the floodplain.

4.12.1 Interconnection with the River Murray PWC

Prior to irrigation development along the River Murray, the regional groundwater flow gradients toward the river were low, and saline discharges to the river or floodplain would have also been relatively low. However, irrigation development has increased recharge to groundwater and established water table mounds which significantly enhanced the discharge of saline groundwater. However, the management of saline inflows to the river have been greatly improved through improved irrigation practices, infrastructure upgrades, and the establishment of salt interception schemes.
5 CONSUMPTIVE POOLS, WATER ACCESS ENTITLEMENTS AND WATER ALLOCATIONS

This chapter determines the consumptive pools for the River Murray PWC, and sets out the objectives and principles associated with the determination of water access entitlements and water allocations in the River Murray PWC.

For the purposes of Chapters 5-8 of the Plan:

- Any terms used in the Plan that are defined in the NRM Act carry the meanings given by the NRM Act.
- Any terms used in the Plan that are defined in the glossary carry the meanings given in the glossary unless otherwise specified.

5.1 Objectives

The following objectives apply to the determination of the consumptive pools for the River Murray PWC, and the determination of water access entitlements and water allocations from the River Murray PWC.

a. Provide allocations that contribute to the water needs of water-dependent ecosystems (WDEs).

b. Allocate water in a sustainable and equitable manner between the different users.

c. Contribute to fulfilling South Australia’s obligations under Basin-wide plans, agreements and legislation.

5.2 Available Water from the River Murray

The River Murray and its tributaries originate upstream of South Australia. Available water and the flow of the River Murray into South Australia is governed by the Agreement. Water provided to South Australia by the Agreement includes an annual Entitlement volume up to 1,850 GL (see Section 2.1.1.1).

The South Australian Entitlement is determined by the MDBA, based on water availability and the water sharing rules under the Agreement. This is the water available to South Australia for sharing between consumptive and non-consumptive purposes. Entitlement previously deferred under the Agreement may also be made available (see Section 2.1.1.2 and 2.1.1.3).
**General Principles**

1. The available water is made up of the following components:
   
a. Entitlement under clause 88 of the Agreement, as follows:
   
i. Clause 88(a) – Consumptive Entitlement up to 1,154 GL per year;
   
ii. Clause 88(b) – Dilution and Loss Entitlement of 58 GL per month (696 GL per year); and
   
iii. Clause 88(c) – additional quantities for dilution as determined by the Ministerial Council.

b. Volumes deferred and held by South Australia under the Agreement.

2. The sharing of available water shall be undertaken in accordance with the requirements of the NRM Act, the Water Act, the Agreement, and any inter-governmental agreements.

3. The sharing of available water shall aim to be consistent with the provisions of the Basin Plan.

**Dilution and Loss**

4. In accordance with the Agreement, the Dilution and Loss Entitlement under clause 88(b) shall be provided for this purpose only, except as provided for under clause 88A of the Agreement.

**5.3 Consumptive Pools**

Section 76(4)(ab) of the NRM Act provides that a water allocation plan must determine, or provide a mechanism for determining, from time to time, a consumptive pool or consumptive pools for the prescribed water resource. A water allocation plan may provide for the constitution of two or more consumptive pools, and assign a particular purpose to each consumptive pool.

A consumptive pool, as defined in the NRM Act, is *the water that will from time to time be taken to constitute the resource within a particular part of a prescribed water resource for the purposes of Chapter 7* (of the NRM Act). In other words, a consumptive pool is the water for consumptive use within a physically or geographically defined part of a water resource.

This section determines the consumptive pools in the River Murray PWC.

The River Murray PWC comprises four consumptive pools, as detailed in Table 12. Each of the four consumptive pools is made up of water in the River Murray from the Victorian border down to and including Lakes Alexandrina and Albert to the barrages – the geographic area is detailed in Figure 1. There are multiple consumptive pools for the River Murray PWC to recognise the need to have different management criteria, characteristics and purposes.

The water available to be taken from consumptive pools consists of water that may be taken pursuant to Chapter 7 of the NRM Act, including but not limited to:
• water that may be taken on account of existing water access entitlements under a water licence;
• water that may be taken for domestic purposes or for watering stock (other than stock subject to intensive farming) pursuant to section 124 of the NRM Act; and
• water that may be taken subject to an authorisation issued by the Minister pursuant to section 128 of the NRM Act.

**General Principles**

5. The River Murray PWC comprises the following consumptive pools as set out in Table 12

**Table 12: Consumptive pools, purposes, and classes of unit share**

<table>
<thead>
<tr>
<th>Consumptive Pool</th>
<th>Purpose and Definition</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metropolitan Adelaide</td>
<td>Water supply purposes delivered to metropolitan Adelaide and associated country areas through the Swan Reach – Stockwell, Mannum – Adelaide and Murray-Bridge – Onkaparinga pipelines in accordance with Schedule E of the Agreement</td>
<td>Class 6</td>
</tr>
<tr>
<td>All Purpose</td>
<td>All purposes, including but not limited to:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• the following licensed purposes: CHWN, stock and domestic, country towns, industrial, dairy, irrigation, recreational, environmental and environmental land management in the Lower Murray Reclaimed Irrigation Area (LMRIA)</td>
<td>Class 1</td>
</tr>
<tr>
<td></td>
<td>• Unlicensed stock and domestic use</td>
<td>Class 2</td>
</tr>
<tr>
<td></td>
<td>• Purposes permitted under section 128 authorisations such as road making, firefighting and application of chemicals</td>
<td>Class 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class 7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class 8</td>
</tr>
<tr>
<td>Wetlands²⁴</td>
<td>Management of wetlands within the 1956 flood boundary that are permanently connected at or below the flow associated with South Australia’s Entitlement, and can be managed through a wetting and drying regime</td>
<td>Class 9</td>
</tr>
<tr>
<td>Environmental²⁵</td>
<td>Environmental purposes as specified by the <em>Water Act 2007</em> (Cth)</td>
<td>Class 9</td>
</tr>
</tbody>
</table>

6. Each of the consumptive pools listed in Principle 5 (Table 12) relate to the area delineated on the plans deposited in the general registry office as GRO Plan 926/78 sheets 1 to 13. This area is defined in the notice published in the *Gazette* on 10 August 1978 as the *River Murray Proclaimed Watercourse*.

²³ For information purposes, the classes in this table align to the previous classes of water access entitlements in the previous Plan, and prior to that, the previous purposes, as follows:
• Class 1 (Stock, domestic, stock and domestic)
• Class 2 (Urban water use – country towns)
• Class 3 – Class 3a (Irrigation other than Qualco), Class 3b (Irrigation in Qualco), Class 4 (Recreation) and Class 7 (Environment)
• Class 5 (Industrial and industrial dairy)
• Class 6 (Urban water use – metropolitan Adelaide)
• Class 8 (Environmental Land Management)
• Class 9 (Wetlands and Wetland water savings achieved through the Riverine Recovery Program)

²⁴ Sourced from Dilution and Loss
²⁵ Sourced from Dilution and Loss when the state receives below full Entitlement and from the unallocated portion of Entitlement at all other times.
7. As a result of the provisions of the Water Act, the Commonwealth of Australia may use its environmental water holdings in accordance with that Act.

5.3.1 Water Available for allocation from a consumptive pool

Under section 146(4) of the NRM Act, the Minister must determine, from time to time, the volume of water that is to be made available for allocation from a consumptive pool.

The total volume of allocation available in a water-use year will be determined by the number of unit shares held and the volume of water that has been determined by the Minister to be available for allocation from the consumptive pool to which the water access entitlement relates.

The volume of water available for allocation from each consumptive pool will therefore vary from time to time.

Principles for guiding the Minister in determining the volume of water available for allocation from each consumptive pool in a dry period are outlined in Section 5.3.2.

General Principles

8. In a year when South Australia receives its full Entitlement of 1,850 GL, and/or any additional quantities of water, the Minister should endeavour to determine a volume of water available for allocation from each consumptive pool equivalent to the unit shares displayed in column three Water Access Entitlements (in unit shares) of Table 13, where 1 unit share equals 1 kL.

9. An exemption to Principle 8 may apply to the Metropolitan Adelaide Consumptive Pool in some years, consistent with the requirement of Schedule E of the Agreement, which allows for 650 GL use over five consecutive years.

5.3.2 Water available for allocation from a consumptive pool during dry times

The following section provides objectives and principles aimed at guiding the Minister in determining the volumes of water available for allocation from each consumptive pool when South Australia receives below full Entitlement.

It is further aimed at providing the community with greater transparency around the Minister’s allocation decision making.

Objectives

In determining the volume of water available for allocation from each consumptive pool, the Minister shall consider the following objectives.

a. Maintain allocations arising from water access entitlements for Class 3 in the All Purpose Consumptive Pool as high as reasonably practical.

b. Minimise social and economic impacts of allocation decisions on industries, business and communities that are reliant on River Murray water.

c. Consider the volume of water available as carryover.
d. Establish a reserve for CHWN in the following water-use year as early as possible, having regard to the requirements of all water users in the current water-use year.

e. Minimise the likelihood of long-term damage to the resource such as acidification, salinisation, deterioration in water quality, species loss and riverbank collapse.

General Principles

10. In determining the volumes available for allocation from each consumptive pool pursuant to section 146(4) of the Act, during dry conditions when the water available for allocation is limited and the South Australian Entitlement is less than 1,850 GL, the Minister should, in so far as it is possible, make his determination in accordance with the principles set out in this section.

11. Principles 1 to 4 inclusive also apply during dry conditions.

12. Consistent with clause 88A of the Agreement, the Minister may consider assigning a volume of up to 13.92 GL (two percent of 696 GL) for purposes other than dilution and loss.

Critical Human Water Needs

13. In accordance with the Basin Plan, CHWN from the River Murray is equal to 204 GL per year. This provides:

   a. 54 GL from the All Purpose Consumptive Pool\textsuperscript{26}; and

   b. 150 GL from the Metropolitan Adelaide Consumptive Pool\textsuperscript{27}.

14. After accounting for the 696 GL available under 88(b) of the Agreement, the Minister should ensure, in so far as it is possible, that CHWN in the current water-use year are provided next from the water available to South Australia.

15. In determining the volume that should be made available for allocation for CHWN, at or around the start of the water-use year, and with each improvement in water availability, the Minister should endeavour, in so far as it is possible, to:

   a. Consider the volume required for the current water-use year and the following water-use year;

   b. Consider all sources of water available for CHWN (including the Adelaide Desalination Plant, Mount Lofty Ranges storages and upstream deferred water) and the net economic, social and environmental benefits and costs associated with each source; and

   c. Make any reduction in requirements for CHWN in either the current water-use year or for a reserve in the following water-use year available for non-CHWN purposes.

\textsuperscript{26} Comprising 20 GL for Class 1 (including non-licensed stock and domestic use) and Class 5; and 34 GL for Class 2.

\textsuperscript{27} 150 GL for Class 6.
**Increases to Consumptive Allocations**

16. The water available for consumptive use for purposes other than CHWN is the greater of:
   a. The water available to South Australia under Principle 1.a.i. as determined by the Murray-Darling Basin Authority
      Less
      Any part of the water available to South Australia under Principle 16.a. that is considered to be required for CHWN for the current water-use year or the following water-use year under Principle 15
      Less
      Any volume made available under Principle 12
      Less
      any additional volume to that made available under Principle 12 that is required to supply Class 3 non-licensed consumptive use; and
   b. Zero kL.

**Metropolitan Adelaide Consumptive Pool**

17. When determining the volume of water available for allocation for CHWN from the Metropolitan Adelaide Consumptive Pool, the Minister may consider a lesser volume than the CHWN volume determined under Principle 15 for the Metropolitan Adelaide Consumptive Pool for the current water-use year.

18. In accordance with the Basin Plan and Principle 13.b., when determining the volume of water available for allocation for CHWN from the Metropolitan Adelaide Consumptive Pool, the Minister should ensure that this does not exceed 150,000,000 kL.

**All Purpose Consumptive Pool**

19. The Minister should endeavour, in so far as it is possible, to determine a volume of water available for allocation from the All Purpose Consumptive Pool that:
   a. Is at least equal to:
      The total volume of shares held for the CHWN requirements for Classes 1, 2 and 5
      Plus
      Two percent of the value of shares held for Classes 3 and 8; and
   b. Does not exceed the lesser of:
      i. Water available under Principle 16
         Plus
         The volume determined under Principle 19.a.; and
      ii. The total volume of shares held for Classes 1, 2, 3, 5 and 8 at the time of determination.
20. The Minister should endeavour, in so far as it is possible, to determine a volume of water available for allocation from the All Purpose Consumptive Pool that enables allocations from Class 8 water access entitlements to be at the highest level possible to effectively manage land, salinity, acid sulfate soil issues and to maintain levee banks in the LMRIA.

**Wetland Consumptive Pool**

21. The Minister should endeavour, in so far as it is possible, to determine a volume of water available for allocation from the Wetland Consumptive Pool equivalent to the unit shares displayed in Column 3 Water Access Entitlements (in unit shares) of Table 13, where 1 unit share equals 1 kL.

**Environmental Consumptive Pool**

22. When determining the volume of water made available for allocation from the Environmental Consumptive Pool, the Minister should endeavour, in so far as it is possible, to determine a volume equivalent to the unit shares displayed in Column 3 Water Access Entitlements (in unit shares) of Table 13, where 1 unit share equals 1 kL, and consistent with the Water Management Partnership Agreement (WMPA) between South Australia and the Commonwealth (including the RRP Schedule).

### 5.4 Water Access Entitlements

Water access entitlements in each of the four consumptive pools will be expressed as number of units of a total number of unit shares. The total number of unit shares in each consumptive pool is detailed in Table 13.

Water access entitlements in the Wetland Consumptive Pool are based on the volume that is required for managed wetlands as a result of the installation of regulating infrastructure, including RRP works. As more wetlands become managed through the installation of regulating infrastructure, the volume required to manage these wetlands will increase. This means the number of water access entitlements granted on licence will increase.

Water access entitlements in the Environmental Consumptive Pool arise through works on wetlands through the RRP that allow them to be managed using a lower volume than when they were unmanaged (see Section 2.1.3.3). The volume required to manage each wetland prior to regulation is determined, and the savings resulting from regulation are then granted to the Commonwealth of Australia to use for environmental purposes across the Basin, on the basis that 1 unit share equates to 1 kL. Additional water access entitlements may therefore be granted on a licence as more infrastructure is installed on wetlands. Water access entitlements in the Environmental Consumptive Pool are based on the water savings that have been achieved through infrastructure works under RRP as at the date of adoption of this Plan.

Notice of any additional water access entitlements to be included in the Wetland Consumptive Pool and the Environmental Consumptive Pool as a result of the installation of regulating infrastructure will be published by the Minister in the *Gazette*. 
General Principles

23. The following principles relate to the water access entitlements that arise from the consumptive pools in Table 13.

Table 13: Water Access Entitlements in each consumptive pool

<table>
<thead>
<tr>
<th>Consumptive Pools and Purposes</th>
<th>Classes</th>
<th>Water Access Entitlements (unit shares)</th>
<th>Non-licensed consumptive use(^\text{28}) (kL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metropolitan Adelaide</td>
<td>Class 6</td>
<td>130,000,000</td>
<td></td>
</tr>
<tr>
<td>All Purpose</td>
<td>Class 1</td>
<td>8,368,662</td>
<td>6,062,495(^\text{29})</td>
</tr>
<tr>
<td></td>
<td>Class 2</td>
<td>50,000,000(^\text{30})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class 3</td>
<td>607,798,212</td>
<td>3,937,505(^\text{31})</td>
</tr>
<tr>
<td></td>
<td>Class 5</td>
<td>5,568,841</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class 8</td>
<td>22,200,000</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>693,935,215</td>
<td>10,000,000</td>
</tr>
<tr>
<td>Wetland</td>
<td>Class 9</td>
<td>37,287,335</td>
<td></td>
</tr>
<tr>
<td>Environmental</td>
<td>Class 9</td>
<td>6,594,800</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>867,817,850</td>
<td>10,000,000</td>
</tr>
</tbody>
</table>

24. In a year when South Australia receives its full Entitlement of 1,850 GL per year, it is likely that 1 unit share will receive 1 kL of water.

25. A water access entitlement cannot be converted (on application of the holder) to become an entitlement of any other consumptive pool.

26. A water access entitlement cannot be converted (on application of the holder) to become an entitlement of any other class.

27. No new water access entitlements will be made available in respect of the Metropolitan Adelaide Consumptive Pool and the All Purpose Consumptive Pool.

Metropolitan Adelaide Consumptive Pool

28. Under the Agreement, the Metropolitan Adelaide Consumptive Pool is comprised of a maximum use volume of 650 GL over any consecutive five-year period\(^\text{32}\).

Class 8 in the All Purpose Consumptive Pool

29. When considering granting water access entitlements that relate to Class 8 within the All Purpose Consumptive Pool, the Minister should take into account the purpose of the water use and whether that use is likely to contribute to the objectives for the LMRIA set out in Section 5.5.1.

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\(^{28}\) Includes water used for non-licensed stock and domestic supply, and Ministerial authorisations under section 128 of the NRM Act, such as water for firefighting and road making.

\(^{29}\) Stock and domestic – where the prescribed watercourse adjoins or runs through the land; and a section 128 authorisation for exercising native title rights and interests.

\(^{30}\) As outlined in Schedule E of the Agreement.

\(^{31}\) Section 128 authorisations e.g. road making, firefighting, application of chemicals.

\(^{32}\) As outlined in Schedule E of the Agreement.
30. The number of water access entitlements that may be granted to an applicant from Class 8 in the All Purpose Consumptive Pool shall be calculated based on the rates in Table 14 for the particular irrigation area where the land is located, and the relevant area of land owned or occupied.

31. A water access entitlement that relates to Class 8 within the All Purpose Consumptive Pool will expire upon the change in owner or occupier of land on which the water allocation is used.

**Wetland and Environmental Consumptive Pools**

32. The total number of unit shares of water access entitlements in the Wetland Consumptive Pool and the Environmental Consumptive Pool set out in Table 13 reflect the total Managed Wetland Volume and the total Water Savings Volume as at the date of adoption of the Plan, where 1 unit share is equivalent to 1 kL.

33. The Minister shall, by publication in the *Gazette*, give notice of additional water access entitlements to be included in the Wetland Consumptive Pool and the Environmental Consumptive Pool as a result of the installation of wetland infrastructure, pursuant to the calculation set out in Principle 34.

34. The number of additional water access entitlements in the Wetland Consumptive Pool and the Environmental Consumptive Pool will be calculated based on fit for purpose modelling undertaken by the Department for all regulated wetlands within the 1956 flood boundary, as follows:

\[
\text{Water Savings Volume} = \text{Unmanaged Wetland Volume} - \text{Managed Wetland Volume}
\]

Where:

Unmanaged Wetland Volume = the volume that evaporates from the wetland through permanent connection to the river channel

Managed Wetland Volume = the volume required, based on modelling, to manage the wetland over a five-year management period, through the installation of regulating infrastructure. This includes periods of variable water levels and/or drying. As the use by the wetland is variable over the five-year period, this is expressed as an annual average.

Water Savings Volume = the difference between the volume evaporating from the wetland in an unmanaged state, and the modelled annual average volume required by the wetland in a managed state.

Example for wetland X:

Unmanaged Wetland Volume = 5 GL
Managed Wetland Volume = 4 GL
Water Savings Volume = 5 GL – 4 GL = 1 GL

35. Any additional water access entitlements that may become available as a Managed Wetland Volume in accordance with Principle 34 will relate to the Wetland Consumptive Pool.
36. Any additional water access entitlements that may become available as a Water Savings Volume in accordance with Principle 34 will relate to the Environmental Consumptive Pool.

37. Additional water access entitlements that relate to the Wetland Consumptive Pool may only be granted by the Minister where regulating infrastructure is installed on a wetland within the 1956 flood boundary that is permanently connected at or below the flow associated with South Australia’s Entitlement, and where water savings as a result of the regulating infrastructure have been calculated in accordance with Principle 34.

38. In addition to Principle 37, the granting of additional water access entitlements from the Wetland Consumptive Pool shall only occur for wetland management where it will have, or will be likely to have, environmental benefits including:

   a. The reintroduction of a wetting and drying regime that reflects a more natural pattern of connectivity;
   
   b. An increase in the recruitment and survival of native flora and fauna in the wetland or wetlands;
   
   c. An improvement in the quality of water in the wetland or wetlands, and/or the River Murray;
   
   d. An increase or improvement in habitat for native fauna;
   
   e. The mitigation of any threatening processes;
   
   f. An improvement in the connectivity between the river and the floodplain;
   
   g. The promotion of nutrient exchange;
   
   h. Extending the duration or increasing the frequency of wetland inundation; and/or
   
   i. Providing critical refugia during extended dry periods.

39. Additional water access entitlements that relate to the Environmental Wetland Consumptive Pool may only be granted by the Minister where water savings arise as a result of the installation of regulating infrastructure on wetlands within the 1956 flood boundary through the Riverine Recovery Project.

### 5.4.1 Water Access Entitlements During Dry Conditions

When the water available to South Australia is restricted and the annual Entitlement is less than 1,850 GL, the water allocation arising from water access entitlements following the Minister’s determinations under section 146(4) of the NRM Act will be made in accordance with the principles below.
The purpose of CHWN will also be assigned to:

a. Class 1;

b. Class 2 – for the first 34,000,000 kL; and

c. Class 5;

within the All Purpose Consumptive Pool.

All Purpose Consumptive Pool

An allocation arising from Classes 3 and 8 water access entitlements of up to 0.02 kL per unit share will be provided from water made available.

Allocations arising from water access entitlements in the All Purpose Consumptive Pool will be distributed between classes of shares in the following priority order:

a. Class 1 and Class 5 water access entitlements up to 1 kL per unit share; and

b. Class 2 water access entitlements up to 0.68 kL per unit share; then

c. Pro-rata increase to Class 3 and Class 8 water access entitlements up to 0.68 kL per unit share; then

d. Pro-rata increase to Class 2, Class 3 and Class 8 water access entitlements up to 1 kL per unit share.

Environmental Consumptive Pool

Allocations made against Class 9 water access entitlements that arise from the Environmental Consumptive Pool must be used within South Australia when the Entitlement available under Principle 1.a. is less than 1,850 GL.

5.5 Basis for Water Allocation

The NRM Act provides that a person must not take water from a prescribed watercourse unless authorised to do so under section 128, or if they are entitled to take water for domestic purposes or for watering stock, or as part of a water allocation that relates to the relevant water resource.

A water allocation may be obtained on account of a water access entitlement under a water licence, as a carryover or under an Interstate Water Entitlements Transfer Scheme (IWETS). A water allocation will relate to a specified water resource and is obtained on account of a water access entitlement. The water allocation must be taken from the consumptive pool specified on the relevant water licence.

A water allocation issued by the Minister must be consistent with the relevant water access entitlement (or IWETS) in relation to the volume of water granted.
Water allocations will be issued for a period of no more than twelve months, and assigned to the water access entitlement shares based on the volume of water that has been determined to be available.

When South Australia receives its full Entitlement of 1,850 GL, it is expected that water will be allocated on a 1 kL per unit share basis (except for the Metropolitan Adelaide Consumptive Pool). In years where less than Entitlement is received, the Minister’s determination of the volume of water available for allocation will need to take into account the limited availability of water. Principles for determining the volume of water available for each Consumptive Pool in a dry period are outlined at Principles 10 to 22.

Water allocations are issued to holders of Interstate Water Entitlements Transfer Scheme (IWETS) entitlements in accordance with the terms and conditions relevant to the state of origin.

Water allocations will be issued on account of a water access entitlement in accordance with the provisions of the NRM Act and the following principles.

**General Principles**

44. Except for water access entitlements that relate to the Metropolitan Adelaide Consumptive Pool, the maximum volume of water that can be allocated in respect of a unit share is 1 kL.

45. The water allocations that relate to the Metropolitan Adelaide Consumptive Pool may exceed 1 kL per share, consistent with pre 1 July 2009 arrangements whereby the SA Water allocation for metropolitan Adelaide and associated country areas through the Swan Reach – Stockwell, Mannum – Adelaide and Murray Bridge – Onkaparinga pipelines is managed to reflect the intent of the relevant section(s) of Schedule E of the Agreement.

5.5.1 Environmental Land Management Allocations

Allocations that relate to Class 8 within the All Purpose Consumptive Pool are specifically for protecting land assets in the LMRIA and to prevent the generation of acid sulfate soils. Objectives and principles outlined below are in addition to those set out in Section 5.1.

**Objectives**

The following objectives relate to water allocations obtained on account of water access entitlements from Class 8 within the All Purpose Consumptive Pool. ELMA is to be used to:

a. Contribute to the protection of environmental land assets (private and public) of the LMRIA.

b. Assist where possible to maintain water levels in the Lower Lakes above 0.4 metres AHD, to complement land management practices within the LMRIA.
General Principles

46. To contribute to environmental land management objectives, when determining allocations, consideration should be given to maintaining environmental land management allocations at the highest level possible.

47. A water allocation derived from water access entitlements from Class 8 within the All Purpose Consumptive Pool may be granted by the Minister and remains subject to Principles 48 and 49.

48. In accordance with section 148e(iii) of the NRM Act, a water licence that relates to Class 8 within the All Purpose Consumptive Pool shall only be granted on the basis that it will expire upon the change in owner or occupier of land on which the water allocation (that is obtained under the terms of the water licence) is used.

49. A water allocation derived from water access entitlements obtained from Class 8 within the All Purpose Consumptive Pool is considered the first water taken, prior to any other water allocation.

5.5.2 Private Carryover

South Australia’s storage rights are defined under clause 91 and Schedule G of the Agreement. The Agreement provides South Australia with the right to store (defer) a portion of its Entitlement in the upstream River Murray Storages and subsequently deliver this water for CHWN and private carryover in a future dry year(s).

The volume of Entitlement that has been deferred and stored by the state in a given year may become available for delivery in a subsequent year, in addition to the South Australian Entitlement for that year.

The volume that may be made available by the Minister for the purpose of private carryover pursuant to section 152(7) of the NRM Act will depend on the total volume of deferred private carryover remaining in storage from the previous water-use year. The volume of water in storage for the purpose of private carryover will depend upon storage spills and evaporation, and the amount of stored water required for the purpose of CHWN. There is no guarantee that private carryover will be available to those who do not use their full allocation in a given year.

Decisions by South Australia to defer the delivery of, and to store Entitlement, take into account a number of factors including but not limited to:

- available airspace in upstream storages;
- risks of spill or pre-release for flood mitigation;
- potential effects on other water users (including the environment);
- potential water availability the following year;
- volume of underuse in the previous water-use year; and
- the opening water allocation in the current water-use year.
Eligible Water Access Entitlement Holders

50. Carryover may only be granted in the current water-use year to those who held a South Australian water access entitlement on 30 June of the previous water-use year, subject to Principles 51 to 54.

51. Carryover is not available in respect of water allocations that relate to any of the following:

   a. Metropolitan Adelaide Consumptive Pool; or
   b. All Purpose Consumptive Pool (Class 1, Class 2 and Class 5).

52. Carryover is not available in respect of water allocations that relate to Class 8 within the All Purpose Consumptive Pool, as the water allocated may only be taken in the year of allocation for environmental land management purposes within the LMRIA.

53. Carryover is not available in respect of water allocations that relate to the Wetland Consumptive Pool or the Environmental Consumptive Pool.

54. Carryover may only be granted in respect of an individual water access entitlement if:

   a. water has been taken through a fully operational flow recording meter for the whole of the water-use year for which carryover is determined, unless the quantity of water taken can be determined on another basis to the satisfaction of the Minister; and
   b. final water meter reading(s) for the quantity of water taken during the previous water-use year have been provided to the Department by no later than 31 July of the current water-use year; or
   c. holders of water access entitlements for environmental purposes who cannot meter their water use have provided to the Department their final estimate(s) of water use for the previous water-use year by no later than 31 July of the current water-use year.

Carryover Entitlement

55. In making a determination on whether carryover is to be granted, the Minister shall have regard to information provided by the Murray-Darling Basin Authority, and consider only allocating private carryover when there is a low likely risk (less than a 10 percent chance) forecast that the water stored for carryover will spill from the storage in which it is held during the water year in which it is to be granted.
56. The maximum volume of carryover that may be granted to a water access entitlement holder will be determined on the following basis:

\[ \text{Carryover Volume} = \text{Unused Allocation} - \text{Storage Loss} \]

Where:

Carryover Volume = the volume of carryover allocation to be granted to an eligible water access entitlement holder

Unused Allocation = a water access entitlement holder’s unused water allocation (up to a maximum of 20 percent of water access entitlement), which may comprise water allocated against the water access entitlement, volumes of private carryover determined by the Minister and/or water traded to the water account from intrastate or interstate

Storage Loss = a volume equivalent to five percent of the Unused Allocation

57. Subject to Principle 55, if there is sufficient deferred water stored and made available by the Minister for the purpose of private carryover to provide for the maximum carryover volume as specified in Principle 56, that volume will be granted as carryover to eligible water access entitlement holders.

58. Subject to Principle 55, if there is insufficient deferred water stored and made available for the purpose of private carryover to grant the maximum volume of carryover as specified in Principle 56, a water access entitlement holder will be granted a proportional share of the volume of water stored for the purpose of private carryover, as follows:

\[ \text{Carryover Volume} = \text{Proportional Volume} - \text{Storage Loss} \]

Where:

Carryover Volume = the volume of carryover allocation to be granted to an eligible water access entitlement holder

\[ \text{Proportional Volume} = \text{Unused Allocation} \times \text{Proportional Share of Deferred Water Volume Made Available for Carryover} \]

Unused Allocation = a water access entitlement holder’s unused water allocation (up to a maximum of 20 percent of water access entitlement), which may comprise water allocated against the water access entitlement, volumes of private carryover determined by the Minister and/or water traded to the water account from intrastate or interstate

\[ \text{Proportional Share of Deferred Water Volume Made Available for Carryover} = \text{the volume of water stored and made available by the Minister for the purpose of private carryover} \div \text{the total volume of Unused Allocations from all water access entitlement holders} \]

Storage Loss = a volume equivalent to five percent of the Proportional Volume
### Proportional Volume

A water access entitlement holder’s Unused Allocation (up to a maximum of 20 percent of water access entitlement) \( \times \)

### Storage Loss

Volume of water stored and made available by the Minister for the purpose of private carryover

\[ \text{Total volume of Unused Allocations from all water access entitlement holders} \]

Volume equivalent to five percent of the Proportional Volume

---

**Example**

Unused allocation = 200 ML

Volume of water stored and made available by the Minister for the purpose of private carryover = 60,000 ML (60 GL)

Total volume of all water access entitlement holder’s unused allocations

\[
\left[ \frac{200 \times 60,000,000}{70,000,000} \right] - 5 \text{ percent} = (200 \times 0.857) - 5 \text{ percent} = 162.83 \text{ ML}
\]

59. The Minister will publish a carryover announcement in a media release and on the Department’s website.

60. There will be no impact or adjustment made to the volume of carryover granted to a water access entitlement holder if some or all of the carryover in storage spills during the water use year.

61. For accounting purposes, any allocation not eligible for carryover is considered the first water taken; the next allocation taken is deemed to be carryover.
6 MANAGEMENT OF THE TAKE AND USE OF WATER

This chapter sets out the objectives and principles for the sustainable taking and use of water from the River Murray PWC through water resource works approvals and site use approvals.

6.1 Objectives

The following objectives apply to the taking and use of water from the River Murray PWC.

- a. Promote the efficient use of water from the Prescribed Watercourse.
- b. Contribute to the prevention of loss of condition, number or extent of refuge habitats and dependent aquatic biota of floodplains, wetlands, and sites of significance.
- c. Contribute to the prevention of adverse impacts on water quality.
- d. Contribute to the prevention of increased soil salinity and acid sulfate soils, and associated land management issues.

6.2 Water Resource Works Approvals

The NRM Act provides that in the case of a prescribed water resource, a water resource works approval is required to construct, maintain or operate any works for the purposes of taking water from the water resource. A water resource works approval must specify the site where the works are authorised to be located and the nature and extent of the works that are authorised, and is attached to the land constituting that site. A water resource works approval may include conditions relating to the operation and management of the works.

The principal driver of the ecology of the River Murray, its floodplains and wetlands, is its hydrology. This includes flow rates, water levels, volumes, inundation area, frequency and duration of wetting and drying periods. To contribute to the needs of river ecosystem function, manipulating flow regimes and weir pool levels is utilised. Pumping infrastructure (including pumps on backwaters) is likely to be vulnerable to operational difficulties due to these changes. The following principles apply to water resource works approvals to manage the impacts of river management on infrastructure, and to manage the impacts of the take of water on ecosystems.
62. The Minister may not grant or vary a water resource works approval where the point of extraction of water lies on a backwater or anabranch of the prescribed watercourse (as delineated in Figures 9 to 14), where water was not being extracted from that point on or before 1 July 2002 (the date of adoption of the 2002 Plan).

63. Where water is extracted from a point that lies on a backwater or anabranch of the prescribed watercourse, works shall not be modified to increase the maximum flow rate in litres per second of existing pumping infrastructure.

64. Principles 62 and 63 also apply to the extraction of water from a point that lies on or within 100 metres of a tributary wetland of Lake Alexandrina (as delineated in Figure 15).

65. Principles 62 and 63 do not apply to water being delivered through infrastructure pursuant to a specified environment improvement program.

Approvals adjoining the Eastern Mount Lofty Ranges PWRA

66. It is a condition of all new and existing water resource works approvals where an extraction point is located on a watercourse of the Finniss River or Tookayerta Creek, within the River Murray PWC and upstream of where Winery Road crosses these watercourses (see Figure 17), that new or additional water allocations may only be taken where the taking of that water is compliant with Principles 33-46, 49-59 and 69-70 of the Water Allocation Plan for the Eastern Mount Lofty Ranges (where relevant).

6.2.1 Environmental Use

In accordance with section 160(1)(b)(ii) and 160(2)(b)(ii) of the NRM Act, where water is being delivered through infrastructure to achieve environmental outcomes, the relevant water resource works approval will be subject to the following conditions:

67. The Minister may require by way of notice in writing that the person who has the benefit of the water resource works approval participates in a specified environment improvement program.

68. The use of water must be measured and reported by a person who has the benefit of a water resources works approval to the Minister through the following mechanisms:

   a. Where water is being delivered through pumping infrastructure, water shall be taken and measured in accordance with the South Australian Licensed Water Use Meter Specification (DEWNR 2012b), or any subsequent version, with final meter readings to be submitted to the Department by no later than 31 July of the current water-use year.

   b. In all other cases, the taking of water is to be recorded using the best available information, which may include modelled values, with final estimate(s) of water use for the previous water-use year to be provided to the Department by no later than 31 July of the current water-use year.
6.2.2 Upper Pike River Extraction Management Zone

To address concerns around the impacts of increased level of extraction from the upper Pike River anabranch, the Upper Pike River Extraction Management Zone has been established (see Figure 8). The level of water extraction from this zone is to be monitored to ensure that resource condition indicators are not exceeded. Should the resource condition indicators be exceeded before a longer-term management approach is in place, the Minister will use best endeavours to determine the cause of the breach and identify options to mitigate the breach (see Section 9.2.2). Pursuant to section 161(1)(d) of the NRM Act, the Minister may vary a water resource works approval if this is deemed appropriate to prevent, reduce or address damage to the River Murray. Future management targets will be considered in consultation with the community in the next review of the Plan.

The following principle applies to water resource works approvals where the construction, operation and maintenance of pumping infrastructure is located within the Upper Pike River Extraction Management Zone:

69. If the resource condition indicator set out at Principle 109 is exceeded, the Minister may vary a condition of a water resource works approval where the approval applies to pumping infrastructure located in the Upper Pike River Extraction Management Zone if, in the Minister’s opinion, the variation is appropriate or desirable to prevent, reduce or address damage to the River Murray.
Figure 17. Finniss River and Tockayerta Creek Prescribed Water Resources and Areas of Overlap.
6.3 Site Use Approvals

The NRM Act provides that a site use approval must specify the place where the use is allowed, and other prescribed information relating to the proposed extent, manner and rate of use of water authorised by the approval.

A site use approval is attached to the land constituting that site. A site use approval is subject to conditions prescribed by the regulations, specified by the relevant water allocation plan or endorsed by the Minister.

The Minister may refuse to grant or vary a site use approval if it is contrary to the provisions of the relevant water allocation plan or if the use of the water would have an unreasonable impact on a water resource or other form of natural resource.

Site use approvals allow for management of localised issues that arise from the use of water.

For the purposes of managing the potential impacts of water use, the River Murray PWC has been divided into the following irrigation management zones:

- River Murray Irrigation Management Zone (this area covers the South Australian Murray-Darling Basin NRM Board region with the exclusion of the Angas Bremer Irrigation Management Zone and the Lower Murray Reclaimed Areas Irrigation Management Zone);
- Lower Murray Reclaimed Areas Irrigation Management Zone (see Figure 5, Figure 6, Figure 7); and
- Angas Bremer Irrigation Management Zone (see Figure 18).
Figure 18. Angas Bremer Irrigation Management Zone and Prescribed Wells Area
6.3.1 The River Murray Irrigation Management Zone

The River Murray Irrigation Management Zone covers most of the South Australian Murray-Darling Basin NRM Board region, excluding the Angas Bremer and Lower Murray Reclaimed Areas Irrigation Management Zones.

For the purposes of managing salinity impacts and meeting South Australia’s obligations under Schedule B of the Agreement, the River Murray Irrigation Management Zone contains four salinity management zones which are delineated in GRO Plan 25/2014. These are:

- High Salinity Impact Zone;
- Bookpurnong High Salinity Impact Zone (salt interception);
- Loxton High Salinity Impact Zone (salt interception); and
- Low Salinity Impact Zone.

An overview map showing the location of the four zones is detailed at Figure 4.

These zones were defined by modelling the impact of irrigation within 15 km of the River Murray to identify areas where irrigation drainage will have the greatest impact on River Murray salinity over the long-term.

Under the Agreement, South Australia is obliged to ensure that actions which increase salinity in the River Murray are offset by actions which decrease salinity in the River Murray. Salinity in South Australia is managed through a credit/debit system. Investment has been made in actions that generate ‘credits’ (for example salt interception), to ensure that the salinity impacts from new or increased irrigation development in the South Australian River Murray (‘debits’) can be offset. The credits are held by the South Australian Government. The credits are managed through the salinity zoning policy, which aims to maximise the potential for further irrigated agricultural development while minimising the associated salinity impacts.

The salinity zoning policy was introduced in 2003. A ‘prior commitment’ clause was included in the policy as a transitional arrangement for those who had commenced development in the High Salinity Impact Zone, allowing them to apply for approval for the additional water use. The policy has been in place for over ten years and it is timely to conclude the prior commitment arrangements. This will free up salinity credits that have been set aside for these claims. Principle 70.iii. sets out the eligibility for prior commitment and has the effect of concluding the arrangements at the expiry of six months from the date of adoption of the Plan.
The following principles apply to water use within the River Murray Irrigation Management Zone.

70. The Minister may not grant or vary a site use approval where it will result in an increase to the total volume of water that is authorised to be used for irrigation purposes on site use approvals, as at the date of adoption of this Plan, in any of the following areas:

   a. High Salinity Impact Zone or

   b. Scheme Area as defined in the *Ground Water (Qualco-Sunlands) Control Act 2000*

except where:

   i. The land on which the water will be used for the purpose of irrigation is within the Scheme Area as defined in the *Ground Water (Qualco-Sunlands) Control Act 2000* and the application complies with that Act; or

   ii. The water will be used for the purpose of irrigation, and the applicant can demonstrate to the Minister’s satisfaction that any potential salinity impacts of the water use will be appropriately offset for the purpose of the *Murray-Darling Basin Agreement 2008*, as set out in Schedule 1 of the *Water Act 2007* (Cth); or

   iii. An application is received prior to 5 pm on the nearest business day following six months after the date of adoption of this Plan, and the applicant can demonstrate to the Minister’s satisfaction, that:

      a. They were legally committed, or had committed significant financial or other resources to a development, project or undertaking involving the use of water at the proposed site between the period 1 July 2001 and 30 June 2003;

      b. They can demonstrate significant progress towards fulfilling that commitment since 30 June 2003; and

      c. The volume of water authorised to be used under the terms of the site use approval for the purpose of irrigation will not exceed the reasonable irrigation requirements determined in accordance with Appendix A.

71. The Minister may not grant or vary a site use approval for the purposes of irrigation in the Low Salinity Impact Zone, the Bookpurnong High Salinity Impact Zone (salt interception) or the Loxton High Salinity Impact Zone (salt interception), unless satisfied that:

   a. The volume of water authorised to be used under the site use approval for the purpose of irrigation will not exceed the reasonable irrigation requirements determined in accordance with Appendix A; and
b. South Australia has sufficient salinity credits available to offset the potential salinity impacts at the specific location specified in the application for the purposes of the Agreement.

**Conditions on Site Use Approvals**

72. All site use approvals for the purposes of irrigation are subject to the following condition:

   a. A person who has the benefit of a site use approval must use or apply water using water efficient technologies and techniques, appropriate for the particular circumstance and in accordance with industry best practice standards, and/or consistent with the *Pressurised Irrigation Best Management Practice Guidelines* (Rural Solutions 2013a).

6.3.2 **The Angas Bremer Irrigation Management Zone**

To address the issues of rising water tables and soil salinisation associated with irrigation, the following principles apply to the Angas Bremer Irrigation Management Zone, as delineated in Figure 18.

Principle 77 relates to a specified environment improvement program, pursuant to section 164B(b)(ii) of the NRM Act, whereby revegetation is recognised as a mechanism to offset the impacts that irrigation has on the land within the Angas Bremer irrigation Management Zone. Deep-rooted plants have the potential to intercept excess irrigation water before it reaches groundwater, and will help to manage shallow regional groundwater levels (Angas Bremer Water Management Committee 2013). Principles 73 and 74 set out the conditions that will apply to site use approvals for this zone.

73. A person who has the benefit of a site use approval for irrigation purposes must use or apply water using water efficient technologies and techniques, appropriate for the particular circumstance and in accordance with industry best practice standards, and/or consistent with the *Pressurised Irrigation Best Management Practice Guidelines* (Rural Solutions 2013a).

74. A person who has the benefit of a site use approval for irrigation purposes shall not use water for irrigation in the area within the Angas Bremer Irrigation Management Zone that is south of the red line in Figure 18 (Monitoring Boundary), unless:

   a. Where the total volume allocated to be taken on the property from all sources (including the River Murray PWC) in any one water-use year exceeds 500 ML, at least two water table monitoring wells are situated either within, or as close as practicable to, the area to be irrigated; or

   b. In any other case, at least one water table monitoring well is situated either within, or as close as practicable to, the area to be irrigated.

75. A water table monitoring well must not be constructed without a permit granted under section 127(3)(a) of the NRM Act.

76. For the purposes of Principle 74, a water table monitoring well must be constructed in accordance with Principles 100 and 101.
77. Where water is used for irrigation purposes in the Angas Bremer Irrigation Management Zone, non-irrigated vegetation must have been planted and nurtured at a rate of two (2) hectares for every 100 ML in accordance with the *Angas Bremer Irrigation Region Revegetation Booklet* (Angas Bremer Water Management Committee Inc. 2000). The non-irrigated vegetation must be planted with sufficient density to minimise the potential for water-logging on the land to be irrigated or on any other land in the Angas Bremer Irrigation Management Zone.

78. For the purposes of Principle 77:

   a. ‘planted’ means vegetation that has been planted, or will be planted, on relevant land (in the case of land not owned by the person who has the benefit of the approval, pursuant to a legally binding agreement or obligation);

   b. ‘nurtured’ means reasonable and practical measures are taken to maintain the health of the plants in a satisfactory condition, for example but not limited to, periodic weeding, feral animal control and minimal disturbance by grazing (in the case of land not owned by the person who has the benefit of the approval, pursuant to a legally binding agreement or obligation);

   c. ‘relevant land’ means land within the Angas Bremer Irrigation Management Zone that is:

      i. Owned by the licensee; or

      ii. Owned by another person, with the written consent of that person for the use of that land for activities in accordance with Principle 77; or

      iii. under the care, control and management of the relevant Local Council (under the *Local Government Act 1999*, the *Crown Land Management Act 2009* or other relevant legislation), the South Australian Murray-Darling Basin NRM Board, or a Minister, instrumentality or agency of the Crown; with the written consent of that Council, Board, Minister, instrumentality or agency for the use of that land for activities in accordance with Principle 77.

79. Areas planted prior to the date of adoption of this Plan within the Angas Bremer Irrigation Management Zone to meet the requirements of Principle 77, or similar Principles in the *Water Allocation Plan for the Eastern Mount Lofty Ranges*, *Water Allocation Plan for the Angas Bremer Prescribed Wells Area* or an earlier version of the *Water Allocation Plan for the River Murray Prescribed Watercourse*, will continue to be recognised for those purposes under this Plan.

80. Future plantings should be located upon relevant land in areas where there is a high risk of rising shallow watertables, for example but not limited to, where the shallow watertable is within four (4) metres of the land surface and preferably south of the red line in Figure 18, unless it can be demonstrated it is not practical to do so.
81. The maximum spacing between individual plants should not exceed 10 m, regardless of whether the planting is a single row or block. The area of plantings will be calculated by application of the following formulae:

a. The area of single row plantings is calculated as follows:

\[ A_{SR} = 10w \times (L + 10L) \]

Where:

\[ A_{SR} = \text{Area of single row planting (in m}^2) \]
\[ 10w = 10 \text{ metres} – \text{assumed width of mature trees (regardless of the species planted)} \]
\[ L = \text{Length of the row (in m)} \]
\[ 10L = 10 \text{ metres} – \text{allowance of additional length of 5 m either side of the first and last plant to be claimed and included in the row area calculation} \]

b. The area of block plantings is calculated as follows:

\[ A_B = (L + 5L) \times (W + 5w) \]

Where:

\[ A_B = \text{Area of the block planting (in m}^2) \]
\[ L = \text{Length of block planting (in m)} \]
\[ 5L = 5 \text{ metres} – \text{allowance of additional length of 5 m to be claimed and included in the block area calculation} \]
\[ W = \text{Width of block planting (in m)} \]
\[ 5W = 5 \text{ metres} – \text{allowance of additional width of 5 m to be claimed and included in the block area calculation (in m)} \]

6.3.3 Lower Murray Reclaimed Areas Irrigation Management Zone

The following principles apply to the use of water within the Lower Murray Reclaimed Areas Irrigation Management Zone, as delineated in Figure 5, Figure 6 and Figure 7. Principles 82 and 83 shall be recognised as conditions on the site use approvals for this zone.

82. A person who has the benefit of a site use approval must use or apply water using water efficient technologies and techniques, appropriate for the particular circumstance and in accordance with industry best practice standards, and/or consistent with the *EPA Guidelines for Lower Murray Reclaimed Irrigation Areas* (EPA 2013).

83. A person who has the benefit of a site use approval in this zone shall not apply water at a rate greater than 13.92 ML per hectare per water-use year over the authorised area.
84. In addition to Principle 83, a person who has the benefit of a site use approval using water allocations that relate to Class 8 within the All Purpose Consumptive Pool, shall:

a. Only apply water allocations relating to Class 8 on land of the LMRIA, as detailed in Figure 5, Figure 6 and Figure 7;

b. Apply water allocations relating to Class 8 for the purpose of protecting environmental land assets of the LMRIA;

c. Not use water from Class 8 on land upon which pasture is irrigated at a rate greater than the relevant rate applicable to the Irrigation Area (as set out in Table 14); and

d. Where pasture is not irrigated on the land upon which water allocations relating to Class 8 is to be used, the rate of application shall reflect a rate that is appropriate for managing the effects of rising saline groundwater on the particular land.

Table 14: Rates of application of water from Class 8 within the All Purpose Consumptive Pool for the Lower Murray Reclaimed Irrigation Area Management Zone

<table>
<thead>
<tr>
<th>Irrigation Area</th>
<th>Rate (ML/Ha)</th>
<th>Irrigation Area</th>
<th>Rate (ML/Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cowirra</td>
<td>6.49</td>
<td>Mobilong</td>
<td>4.68</td>
</tr>
<tr>
<td>Neeta North</td>
<td>6.14</td>
<td>Burdett</td>
<td>4.56</td>
</tr>
<tr>
<td>Baseby</td>
<td>6.44</td>
<td>Long Flat</td>
<td>4.46</td>
</tr>
<tr>
<td>Neeta</td>
<td>6.23</td>
<td>Long Island</td>
<td>4.22</td>
</tr>
<tr>
<td>Wall Flat</td>
<td>6.06</td>
<td>Swanport</td>
<td>4.15</td>
</tr>
<tr>
<td>Pompoota</td>
<td>5.86</td>
<td>Yiddinga</td>
<td>4.13</td>
</tr>
<tr>
<td>Mypolonga</td>
<td>5.50</td>
<td>River Glen</td>
<td>3.98</td>
</tr>
<tr>
<td>Burbridge</td>
<td>5.37</td>
<td>Monteith</td>
<td>3.87</td>
</tr>
<tr>
<td>Paiwalla</td>
<td>5.15</td>
<td>Kilsby</td>
<td>3.61</td>
</tr>
<tr>
<td>Glen Lossie</td>
<td>5.10</td>
<td>Woods Point</td>
<td>3.58</td>
</tr>
<tr>
<td>Toora</td>
<td>4.87</td>
<td>Westbrook</td>
<td>3.46</td>
</tr>
<tr>
<td>Jervois</td>
<td>2.96</td>
<td>Seymour</td>
<td>2.33</td>
</tr>
<tr>
<td>Finniss</td>
<td>1.38</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
6.3.4 Wetland Use

The following principles apply to the granting of site use approvals for wetlands.

85. A site use approval may only be granted with respect to a wetland or wetlands:

   a. Where the water is proposed to be used consistent with the specified environment improvement program approved by the Minister;

   b. Where it will not cause, or be likely to cause, a significant increase in salinity of the River Murray except where the increase can be offset by an agreement, undertaking, or obligation for works, actions or practices or managed through an environmental improvement program to prevent increases in salinity; and

   c. If the Minister is satisfied that the wetland or wetlands will be managed with a hydrological regime that will have environmental benefits, which may include those listed in Principle 38.

6.3.5 Artificial Water Bodies

By notice published in the Gazette pursuant to section 128 of the NRM Act on 11 September 2008 (p. 4265), the Minister authorised the taking of water by means of excavation or infrastructure works adjacent to or within a prescribed watercourse for the purposes of:

- Creating or enlarging an artificial water body with a surface area equal to or less than 190 m²; or

- Maintaining the water level of an artificial water body with a surface area equal to or less than 190 m² (including to compensate for water lost from the artificial water body through evaporation);

where the water body is not used for the collection and subsequent taking of water, for example, a dam.

A water allocation is therefore required to create or enlarge an artificial water body with a surface area greater than 190 m². A water allocation will also be required to maintain the water level of the artificial water body on an annual (recurring) basis.

The following principles apply to site use approvals where a water allocation is required for the purpose of filling and maintaining an artificial water body.

86. A site use approval will only be granted for an artificial water body where a water allocation is used to create or maintain the water level of the artificial water body, and where the use of water will not cause or be likely to cause a significant increase in salinity of the River Murray.

87. All site use approvals granted for artificial water bodies are subject to the conditions set out in Principles 88 and 89.
88. If required by the Minister, by notice in writing, the person who has the benefit of the site use approval must develop an environmental improvement program in order to offset any increase in salinity of the River Murray that will arise as a result of the approved use.

89. Water shall not be used within an artificial water body where it will cause detriment to the environment.

90. When considering the volume authorised to be used under the terms of a site use approval pursuant to Principle 86, the following factors apply:

a. The water required to fill and maintain the artificial water body will be considered to be:

i. In the first water-use year (or part of that year) that the artificial water body is filled, a quantity of water that is at least equal to the volume of water required to fill the artificial water body; and

ii. A quantity of water to maintain the water level of the artificial water body to compensate for water lost through evaporation, as determined by Principle 90(c).

b. Without limiting Principle 90(a), where the artificial water body is created by enlarging an anabranch, backwater or other natural watercourse, the water allocation must provide for a quantity of water that is at least equal to the volume of water required to fill the enlarged area.

c. The volume of water lost through evaporation will be calculated at the rate of 1 kL per square metre of surface water, on the basis of:

i. Regional evaporation data from Lock 1;

ii. Surface area of the artificial water body;

iii. Evaporation pan factor of 0.75;

iv. 90th percentile net evaporation of 1000 mm; and

v. No offsets for stormwater or local catchment.

6.3.6 Water Use Outside of the South Australian Murray-Darling Basin NRM Board Region

The following principles apply to the granting of site use approvals for the use of River Murray PWC water on land outside of the boundary of the South Australian Murray-Darling Basin NRM Board region.
91. A site use approval may not be granted where:

   a. It will cause, or is likely to cause, a rise in the underground water level resulting in detrimental effects to ecosystems;

   b. It results, or is likely to result in, adverse effects on the natural flow or quality of another water resource (excluding effluent);

   c. It may adversely affect the productive capacity of the land, including salinity, waterlogging or perched water tables; or

   d. It may adversely affect water-dependent ecosystems.

92. Principle 91 does not apply with respect to land within the Torrens and Onkaparinga Aqueducts as defined in Figure 19, Figure 20 and Figure 21.

93. Principle 91 does not apply if a NRM Plan or water allocation plan applying to the region of the site use approval contains principles and policies about the granting of site use approvals.
Figure 19: SA Water River Murray diversions, discharge points and aqueducts Sheet 1
Figure 20: SA Water River Murray diversions, discharge points and aqueducts Sheet 2
Figure 21: SA Water River Murray diversions, discharge points and aqueducts Sheet 3
7 TRANSFERS OF WATER ACCESS ENTITLEMENTS AND WATER ALLOCATIONS

This chapter sets out the objectives and principles for the transfer (or trade) of water access rights (including water licences, water access entitlements and water allocations) within the River Murray PWC or under an Interstate Water Entitlements Transfer Scheme (IWETS).

A transfer may involve a change in ownership of a water access right and/or a change in the location at which water to which the right relates may be taken. It includes the transfer of the whole or part of a water access right for a limited (temporary) or permanent (absolute) period, and includes a transfer that does not involve the payment of consideration.

In setting out rules that permit and regulate the transfer of water access rights, the Plan seeks to further the objectives and outcomes in relation to trading in the market set out in section 5.07 of the Basin Plan. Transfer criteria contained in the Plan is consistent with the water trading rules contained in Chapter 12 of the Basin Plan.

7.1 Objectives

The following objectives apply to the transfer of water licences, water access entitlements and water allocations – including orders for water made under tagged water access entitlements within the River Murray PWC or under an Interstate Water Entitlements Transfer Scheme.

a. Enable the transfer of water rights in a sustainable manner.
b. Facilitate an efficient water market and opportunities for trading.
c. Contribute to the water needs of water-dependent ecosystems.
d. Contribute to fulfilling South Australia’s obligations under Basin-wide plans and legislation.
e. Recognise and protect the needs of the environment.
f. Contribute to the prevention of adverse impacts on water quality.
g. Contribute to the prevention of increased soil salinity and acid sulfate soils and associated land management issues.
7.2 General Principles

The following principles apply to the transfer of water access entitlements and water allocations (water licences) – including orders for water made under tagged water access entitlements within the River Murray PWC or under an Interstate Water Entitlements Transfer Scheme (IWETS).

94. Water access entitlements and water allocations that relate to Class 8 within the All Purpose Consumptive Pool (ELMA) and the Metropolitan Adelaide Consumptive Pool must not be transferred.

95. Water allocations obtained as carryover held against a South Australian water access entitlement under section 152(7) of the NRM Act may be transferred.

96. In accordance with the Basin Plan, the Minister may be entitled to restrict the trade of a water access entitlement or a water allocation:
   a. By imposing a restriction on changing the location at which the water to which the right relates may be taken; or
   b. By imposing a volumetric limit whose purpose or effect is to cap the total volume of water that may be traded out of the area.

97. Pursuant to the Basin Plan, any such restriction on trade by the Minister in accordance with Principle 96 will also apply to the order for water under a tagged water access entitlement, except for as follows:
   a. The restriction will not apply to a tagged water access entitlement which is established before 22 October 2010.
   b. The restriction will also not apply to a tagged water access entitlement established on or after 22 October 2010 and before 24 November 2012, for the duration of the period 1 July 2014 and 1 July 2019.

98. An exchange rate must not be applied to the trade of a water access entitlement except in the circumstances permitted under section 12.22 of the Basin Plan.

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33 A water allocation plan may set out policies and principles to assist in regulating the transfer of, or dealings with, water management authorisations, section 76(4d)(a) NRM Act.
34 Refer NRM Act section 3. IWETS means (a) a scheme for the transfer of entitlements between two or more states under the Agreement; or (b) an agreement between South Australia and one or more states or territory entered into under Chapter 7 Part 3 Division 6 of the NRM Act.
35 ELMA cannot be traded. Refer Agreement, Schedule E cl 7(2)(b).
36 Metropolitan Adelaide Consumptive Pool cannot be traded. Refer Agreement Schedule E cl 7(2)(a). Please note: the long-term diversion Cap for water supply purposes delivered to metropolitan Adelaide and associated country areas set out under Schedule E of the Agreement is currently under review.
37 This principle is included to be consistent with Basin Plan 2012 (Cth) sections 12.11 – 12.12.
38 This principle is included to be consistent with Basin Plan 2012 (Cth) sections 12.16, 12.17, 12.18 and 12.19.
39 This principle is included to be consistent with Basin Plan section 12.38. Also see Basin Plan Explanatory Statement para 760 which explains that 22 October 2010 was the first public draft of the rule related to tagged trade.
40 This principle is included to reflect Basin Plan 2012 (Cth) section 12.23.
8 PERMITS

A permit is required to undertake water affecting activities contained within section 127(3) of the NRM Act, and a permit may be required for activities listed in section 127(5) of the NRM Act.

This chapter sets out principles used to assess an application for a permit to undertake certain water affecting activities in the River Murray PWC.

The objectives and principles set out in this chapter operate in conjunction with the objectives and principles for assessing water affecting activity permit applications set out in the *South Australian Murray-Darling Basin Natural Resources Management Plan* (Regional NRM Plan). Under section 75(3)(k) of the NRM Act, the Regional NRM Plan must set out the matters that the Minister will consider when exercising the powers to grant or refuse permits for water affecting activities. In addition to the matters set out in the Regional NRM Plan, section 76(4)(h)(i) allows for this Plan to set out further principles that apply to the River Murray PWC regarding the granting of permits by the Minister. This chapter sets out principles to be considered in addition to those in the Regional NRM Plan.

As set out in the section of the Regional NRM Plan relating to water affecting activities:

> A water allocation plan may set out additional policies [in relation to water affecting activities] that the Board will take into account when considering an application for a permit. The policies in a water allocation plan may be different to the policies in the Regional NRM Plan. To the extent that a water allocation plan includes different policies, the policies in the Regional NRM Plan will not apply to that prescribed water resource.

A person may only undertake the activities listed in sections 127(3) or 127(5) of the NRM Act if the relevant authority shown in Table 15 has granted a permit to authorise the activity, or if section 129 of the NRM Act authorises the activity to be performed without a permit.

The NRM Act and the *Development Act 1993* have complementary roles in dealing with activities that are both a ‘water affecting activity’ and ‘development’ under the respective Acts. If development approval is required for an activity that would otherwise require a water affecting activity permit, the *Development Regulations 1993* set out arrangements so that the development approval process takes into account natural resources management issues, thereby requiring only one authorisation. That is, a separate water affecting activity permit application under the NRM Act would not be required.
## Table 15: Relevant authorities for water affecting activities

<table>
<thead>
<tr>
<th>Reference</th>
<th>Description of water affecting activity</th>
<th>NRM Act Section</th>
<th>Relevant Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 8.1</td>
<td>Drilling, plugging, backfilling or sealing of a well</td>
<td>127 (3)(a)</td>
<td>Minister</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>Repairing, replacing or altering the casing, lining or screen of a well</td>
<td>127 (3)(b)</td>
<td>Minister</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>Draining or discharging water directly or indirectly into a well</td>
<td>127 (3)(c)</td>
<td>Minister</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>The erection, construction, modification, enlargement or removal of a dam, wall or other structure that will collect or divert, or collects or diverts: Water flowing in a prescribed watercourse; or Water flowing in a watercourse in the Mount Lofty Ranges Watershed that is not prescribed; or Surface water flowing over land in a surface water prescribed area or in the Mount Lofty Ranges Watershed</td>
<td>127 (3)(d)</td>
<td>Board</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>The erection, construction, modification, enlargement or removal of a dam, wall or other structure that will collect or divert, or collects or diverts, water flowing in a watercourse that is not in the Mount Lofty Ranges Watershed and that is not prescribed or flowing over any other land that is not in a surface water prescribed area or in the Mount Lofty Ranges Watershed</td>
<td>127 (5)(a)</td>
<td>Board</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>The erection, construction or placement of any building or structure in a watercourse or lake or on the floodplain of a watercourse</td>
<td>127 (5)(b)</td>
<td>Board</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>Drainage or discharging water directly or indirectly into a watercourse or lake</td>
<td>127 (5)(c)</td>
<td>Board</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>Depositing or placing an object or solid material in a watercourse or lake</td>
<td>127 (5)(d)</td>
<td>Board</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>Obstructing a watercourse or lake in any other manner</td>
<td>127 (5)(e)</td>
<td>Board</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>Depositing or placing an object or solid material on the floodplain of a watercourse or lake near a bank or shore of a lake to control flooding from the watercourse or lake</td>
<td>127 (5)(f)</td>
<td>Board</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>Destroying vegetation growing in a watercourse or lake or growing on the floodplain of a watercourse</td>
<td>127 (5)(g)</td>
<td>Board</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>Excavating or removing rock, sand or soil from – Watercourse or lake or the floodplain of a watercourse; or An area near to the banks of a lake so as to damage, or create the likelihood of damage to, the banks of the lake</td>
<td>127 (5)(h)</td>
<td>Board</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>Using water in the course of carrying on a business in an NRM region at a rate that exceeds the rate prescribed by an NRM plan if the water has been brought into the region by means of a pipe or other channel</td>
<td>127 (5)(i) &amp; (j)</td>
<td>Minister</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>Using effluent in the course of carrying on a business in an NRM region at a rate that exceeds a rate prescribed by an NRM plan</td>
<td>127 (5)(j)</td>
<td>Minister</td>
</tr>
<tr>
<td>Regional NRM Plan</td>
<td>Undertaking commercial forestry</td>
<td>127 (5)(ja)</td>
<td>Minister</td>
</tr>
</tbody>
</table>
8.1 Drilling of Monitoring Wells

The following objectives and principles apply to permits for the activity of drilling or sealing a monitoring well under section 127(3)(a) of the NRM Act.

8.1.1 Objectives

a. To monitor the effects of using water from the River Murray PWC on other water resources.

8.1.2 Principles

99. Principles 100 to 101 apply to the construction of monitoring wells where these wells are required by Principle 74.

100. A permit may only be granted for the purpose of drilling or sealing a water table monitoring well where:

   a. The proposed well is completed to two (2) metres below the current standing water table to a maximum depth of six (6) metres;

   b. The proposed well is cased with 75 mm ID (internal diameter) Class 12 UPVC with three metres of slots directly above the bottom of the well, and a PVC bottom cap;

   c. The casing of the proposed well extends one (1) metre above the natural surface of the land;

   d. The slotted section of the proposed well is covered with a geotextile fabric commonly referred to as terra firma fibre cloth;

   e. The bottom metres of the annulus (area outside the casing) of the proposed well is backfilled with 1.5 mm graded sand;

   f. The annulus of the proposed well is backfilled with cement from the top of the graded sand (see above) to the surface; and

   g. The casing of the proposed well that extends above the natural surface of the land is protected by an outer sleeve of galvanised pipe 1.5 m in length, with a wall thickness of 4 mm and a screw-on top cap, and set into cement at the ground surface.

101. A permit may only be granted for the purpose of drilling or sealing a water table monitoring well where the proposed location of the monitoring well is:

   a. Within the property or area of land where allocated water is used for irrigation purposes; and

   b. At the lowest practicable point on that property or area of land.
9 MONITORING AND EVALUATION

Section 76(4)(d) of the NRM Act sets out that a water allocation plan must provide for regular monitoring of the capacity of the water resources to meet demands for water.

Monitoring and evaluation of water resources, water access entitlements, water use and water-dependent ecosystems provides a mechanism for assessing whether the Plan’s objectives are being met, helps to identify actions that need to be taken to protect the resource and dependent users, and improves knowledge. Together, this information allows informed improvements in water management, including changes to the Plan over time.

9.1 Objectives

Monitoring data is collected to achieve the following objectives:

1. To evaluate the assumptions that underpin the Plan to facilitate improvement

2. To evaluate the effectiveness of the Plan objectives, which are:

   a) Provide allocations that contribute to the water needs of water-dependent ecosystems (WDEs);
   b) Allocate water in a sustainable and equitable manner between the different users;
   c) Promote the efficient use of water from the Prescribed Watercourse;
   d) Contribute to fulfilling South Australia’s obligations under Basin wide plans and legislation;
   e) Contribute to the prevention of loss of condition, number or extent of refuge habitats and dependent aquatic biota of floodplains, wetlands, and sites of significance;
   f) Contribute to the prevention of adverse impacts on water quality; and
   g) Contribute to the prevention of increased soil salinity and acid sulphate soils and associated land management issues.

9.1.1 Evaluation and Reporting

Table 16 provides information on what, when and how the resource is monitored. It indicates the measures or tools that, through best endeavours, will be undertaken or used to assess the level to which the Plan is achieving the objectives. The management of River Murray PWC and its environment is shared across several programs within South Australia and the Commonwealth. The evaluation of this Plan intends to use, where possible, the monitoring data, information and reports from programs regarding the state or condition of the River Murray PWC and the outcomes of allocations, water availability and water use. Principles in Section 9.2 identify where additional information is required to assess if the objectives are being met.
### Table 16: Evaluation and reporting

#### Objective (a): Provide allocations that contribute to the water needs of water-dependent ecosystems (WDEs)

<table>
<thead>
<tr>
<th>Evaluation Question</th>
<th>Measure</th>
<th>Frequency/who</th>
<th>Explanation of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the water available to allocate to the WDEs?</td>
<td>Number and value of allocations from Wetland and Environmental Consumptive Pools</td>
<td>Annually, DEWNR</td>
<td>Allocations are for a 12 month period, and can be adjusted within the year. This measure indicates the level of activity and delivery of environmental allocations utilised for WDEs.</td>
</tr>
<tr>
<td></td>
<td>The Annual Environmental Watering Plan, SA’s River Murray Environmental Watering Report</td>
<td>Annually, DEWNR</td>
<td>The Plan indicates the priority wetlands/floodplains for watering and recommended watering requirements (regime, level of inundation, volume). The report indicate the sites that received watering and refers to monitoring that indicates changes to condition of WDEs. The reports also note any inhibiting or beneficial events (e.g. low flows, drought, unregulated flow or floods).</td>
</tr>
<tr>
<td></td>
<td>River Murray flows reports</td>
<td>Fortnightly, DEWNR</td>
<td>The flow reports indicate the volume of water coming into South Australia, if Entitlement is received, forecasts for increases or decreases in flows and storage capacities. This information supports management decisions for variations to the value of consumptive pool shares and diverting unregulated flows.</td>
</tr>
</tbody>
</table>

#### Objective (b): Allocate water in a sustainable and equitable manner between the different users

<table>
<thead>
<tr>
<th>Evaluation Question</th>
<th>Measure</th>
<th>Frequency/who</th>
<th>Explanation of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what extent have the model predictions eventuated?</td>
<td>Review actual conditions (from monitoring) to modelled scenarios. Recalibration of models with monitoring data</td>
<td>Review 1 in 5 years, DEWNR</td>
<td>Riverine Recovery project has designed several models to identify the appropriate extent for inundation and flows for creeks, wetlands and floodplains to improve riverine ecosystem health. River Murray flow and salt load models (Modflow) are used for Chowilla, Border to Lock 3, Lock 3 to Morgan, Waikerie to Morgan, Morgan to Wellington. The development of annual environmental watering priorities involves modelling of potential scenarios. A review of preferred delivery versus actual delivery is developed at the end of each water-use year.</td>
</tr>
<tr>
<td></td>
<td>River Murray flow reports</td>
<td>Fortnightly, DEWNR</td>
<td>Real-time water data can be viewed online. There are 100 real-time water data loggers located in the River Murray channel from lock 9 in NSW to the Coorong. The loggers record some or all of the following parameters – level (m), storage percent, EC, Ph, dissolved oxygen, air temperature, humidity, barometric pressure, wind speed and direction.</td>
</tr>
<tr>
<td></td>
<td>Real-time water data</td>
<td>Hourly, DEWNR</td>
<td></td>
</tr>
</tbody>
</table>
### Objective (b): Allocate water in a sustainable and equitable manner between the different users (continued)

<table>
<thead>
<tr>
<th>Evaluation Question</th>
<th>Evaluation Question</th>
<th>Evaluation Question</th>
<th>Evaluation Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what extent have the model predictions eventuated?</td>
<td>Ministers announcements on water available to consumptive pools</td>
<td>At least once a year, Gazette</td>
<td>Total volumes available for allocation are determined by the Minister from time to time and at least annually, based on conditions. Allocations can be compared against predictions. <a href="http://www.governmentgazette.sa.gov.au">www.governmentgazette.sa.gov.au</a></td>
</tr>
<tr>
<td>Licensing account reports</td>
<td></td>
<td></td>
<td>Expected Entitlement and demand of users is a basis for the distribution and value of Water Access Entitlements. Models and monitoring (of flow and demand) are used to assist in management decisions to alter entitlements, which ensure equity and sustainability for all users. WILMA is a database that tracks and stores information on water accounts, Water Access Entitlements, allocations, site use, metered use and trade information. A variety of reports can be extracted to indicate the actual activity of entitlements for comparison to modelled or expected conditions. WILMA is a confidential licensing system managed by DEWNR.</td>
</tr>
</tbody>
</table>

### Objective (c): Promote the efficient use of water from the Prescribed Watercourse

<table>
<thead>
<tr>
<th>Evaluation Question</th>
<th>Measure</th>
<th>Frequency/who</th>
<th>Explanation of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what level were efficient methods adopted by Water Access Entitlement holders?</td>
<td>Annual water use reporting</td>
<td>As required, DEWNR</td>
<td>The collection of water use data on particular crops, location and other scheduling details, can be used to interpret efficiency at a local and regional level and identify areas of improvement (efficiency adoption) over time. See Section 9.2.</td>
</tr>
<tr>
<td>Licensing account reports</td>
<td>Annually, DEWNR</td>
<td>Variations of site use volumes where site use volumes are in excess of requirements may be an indication of increasing efficiencies. This could also be said for allocation trades and returns to state or transferred to the commonwealth.</td>
<td></td>
</tr>
<tr>
<td>SA River Murray Environmental Watering Report</td>
<td>Annually, DEWNR</td>
<td>The consumptive pools available for wetlands and environment is currently considered less than required. Therefore the use of these allocations will need to be efficient and prioritised to particular areas, regime and ecosystem health and requirements.</td>
<td></td>
</tr>
</tbody>
</table>
**Evaluation Question**

To what level were efficient methods adopted by Water Access Entitlement holders?

Progress reports from on-farm irrigation efficiency programs

Annually, DEWNR

The uptake of the *On-farm Irrigation Efficiency Programme* aims to improve efficiency in irrigation, which returns allocations to the Commonwealth of Australia and the environment. While this program is not directly related to the Plan, this program promotes efficiency and can provide an indication of improved efficiencies.

**Evaluation Question**

What were the influences for this adoption?

Annual water use reporting

As required, DEWNR

Information requested through annual water use reporting. See Section 9.2.

Progress reports from on-farm irrigation efficiency projects

Annually, DEWNR

Progress reports and data from irrigation efficiency projects provide information regarding the level of water savings or efficiencies gained through financial incentives or business improvements.

SA’s River Murray Environmental Watering Report

Annually, DEWNR

The annual report on environmental watering outlines reasons for reduced water application, water application with multiple benefits, and where the use of hydrological models or infrastructure is used to promote the most efficient use of water.

<table>
<thead>
<tr>
<th>Objective (d): Contribute to fulfilling South Australia’s obligations under Basin-wide plans and legislation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evaluation Question</strong></td>
</tr>
<tr>
<td>Have the obligations under Basin-wide plans or legislation remained constant?</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Evaluation Question</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Was there the ability to assess the changing condition of the refuge habitats within the PWC?</td>
</tr>
<tr>
<td>There is sufficient water to meet and provide EWPs of the refuge habitats?</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Evaluation Question</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>What was known about the quality of the water within the PWC?</td>
</tr>
<tr>
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<td></td>
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<tr>
<td>Was there an understanding of how to manipulate the drivers of water quality to ensure it did not decrease?</td>
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</tbody>
</table>

43 Angas Bremer Water Management Committee Incorporated
<table>
<thead>
<tr>
<th>Evaluation Question</th>
<th>Evaluation Question</th>
<th>Evaluation Question</th>
<th>Evaluation Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was there an understanding of how to manipulate the drivers of water quality to ensure it did not decrease?</td>
<td>Upper Pike River flow regime</td>
<td>As required, DEWNR</td>
<td>Information gained from hydraulic modelling and ecological assessments indicate negative impacts to the upper Pike River ecosystems and water quality (salinity, pathogens, deoxygenation) begin to occur below certain volumes and velocity of flow (thresholds). The historic extraction of water for licensed purposes has been lower than the thresholds, although authorisations to use water, in the Upper Pike River Extraction Management Zone, are much higher. Even with the increased flows intended through the Riverine Recovery Project infrastructure works, if all authorisations were utilised and extracted it would cause significant negative impacts to the ecosystems and water quality. Monitoring of the water quality and flow through the upper Pike system is required, so that environmental and water quality protection action can be taken if extractions become too high or flows become too low. See Section 9.2.</td>
</tr>
<tr>
<td>Were stakeholders able to manage their resources to prevent decreases in water quality?</td>
<td>Annual water use reporting</td>
<td>As required, DEWNR</td>
<td>Information sourced on improved efficiency, reduced drainage, soil moisture monitoring, water quality, extraction season and rates (particularly for Upper Pike River Extraction Management Zone), use of EPA guidelines for Lower Murray River Irrigation Area. See Section 9.2.</td>
</tr>
<tr>
<td>Salt Inception Scheme (SIS)</td>
<td>Annually, SA Water</td>
<td>Results of salt loads intercepted.</td>
<td></td>
</tr>
</tbody>
</table>
### Objective (g). Contribute to the prevention of increased soil salinity and acid sulfate soils and associated land management issues

<table>
<thead>
<tr>
<th>Evaluation Question</th>
<th>Measure</th>
<th>Frequency/who</th>
<th>Explanation of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was there the ability to quantify soil salinity, acid sulfate soils and associated land management issues?</td>
<td>Baseline data available, Australian Soil Resource Information System (ASRIS), CSIRO.</td>
<td>As required, CSIRO, EPA</td>
<td>Due to drought conditions before and during 2008, acid sulfate soils issues became a significant issue. As a result CSIRO were commissioned to undertake studies contributing to the updating of ASRIS, assessment, identification and management publications. This has provided baseline data.</td>
</tr>
<tr>
<td></td>
<td>Annual Environmental Watering Plan</td>
<td>Annually, DEWNR</td>
<td>The plan identifies the environmental assets with soil salinity, acid sulfate or other land management issues. The severity and urgency of these issues are considered in the prioritisation of watering sites.</td>
</tr>
<tr>
<td></td>
<td>Riverine Recovery Program monitoring and evaluation</td>
<td>Annually, DEWNR</td>
<td>The Murray Futures and Riverine Recovery Program’s monitoring and evaluation programs have a variety of information that quantifies or identifies areas with soil salinity, acid sulfate or other land management issues that need to be managed as part of the riverine recovery.</td>
</tr>
<tr>
<td>Were stakeholders able to manage soil salinity, acid sulfate soils and associated land management issues? Reliant on:</td>
<td>Annual water use reporting</td>
<td>As required, DEWNR</td>
<td>Reporting will indicate the rates and application for areas with known acid sulfate soils issues such as Environment Land Management Allocations in the Lower Murray Reclaimed Irrigation Area and Upper Pike River Extraction Management Zone, Lakes Alexandrina and Albert, and any other area affected by ASS. See Section 9.2.</td>
</tr>
<tr>
<td></td>
<td>SA’s River Murray Environmental Watering Report</td>
<td>Annually, DEWNR</td>
<td>The report indicates if soil, water salinity, acid sulfate soils and associated land management issues are identified, and the management outcomes from the delivery of environmental water or unregulated flows.</td>
</tr>
<tr>
<td></td>
<td>SA Weir Pool Manipulation Project reports</td>
<td>Annually, DEWNR</td>
<td>Water level can be manipulated and delivered through infrastructure of locks, weirs and regulators. Where weir pool manipulation is undertaken to enhance water-dependent ecosystems, the actions and outcomes are reported.</td>
</tr>
<tr>
<td></td>
<td>River Murray flow reports</td>
<td>Fortnightly, DEWNR</td>
<td>The flow reports will indicate if water was available.</td>
</tr>
</tbody>
</table>
9.2 Monitoring

9.2.1 Annual Water Use Reporting

River Murray Irrigation Management Zone and Lower Murray Reclaimed Irrigation Management Zone

The following principles set out the conditions that will apply to relevant site use approvals.

102. If required by way of notice in writing from the Minister, a person who has the benefit of a site use approval, and has used water in the River Murray or Lower Murray Irrigation Management Zones, must provide to the Department by 31 August of each year an annual water use report for the previous water-use year.

103. An annual water use report required by Principle 102 must include the following data:

a. Location, time period or irrigation season dates, rate and volume of water applied;

b. Crop type or purpose for water application;

c. Type of irrigation or other water delivery system;

d. Use and type of soil moisture monitoring equipment, where utilised;

e. Drainage and groundwater salinity information, where measured;

f. Any changes to irrigation systems, equipment, crop type or area, or any other practice change that has contributed to variation in water use; and

g. Any other information required by the Minister.

Angas Bremer Irrigation Management Zone

Historically, the Angas Bremer Water Management Committee Inc. (the Committee) has, through private arrangements, collected and provided irrigation annual reports to the Department on behalf of the irrigators within this region. The Committee has the broad support of its community and takes an interest in ensuring water resources are used sustainably, through the development and implementation of innovative water management policies.

104. If required by way of notice in writing from the Minister, a person who has the benefit of a site use approval, and has used water in the Angas Bremer Irrigation Management Zone, must provide to the Minister by 31 August of each year an irrigation annual report for the previous water-use year.
The irrigation annual report required by Principle 104 must include the following data:

a. Volume of water allocated during the water-use year;

b. Volume of water actually used and recorded on each meter during the water-use year;

c. Volume of water actually used and recorded on each meter during the water-use year for the purpose of shallow saline watertable management;

d. Volume of water recharged for each meter in the twelve months prior to the 31 October of the water-use year;

e. Salinity of equipped production bores;

f. Location and area of each crop type irrigated;

g. Percentage of the total volume of water actually used on each crop type;

h. Drainage past the root zone (including the volume of water, the salinity and the concentration of nutrients);

i. Level of the watertable below the natural surface level of the land upon which the water endorsed on the approval is used measured in September, December, March and June of every water-use year;

j. Area and duration of any flooding (whether natural or artificial);

k. The nature of any soil moisture monitoring devices used on the relevant land;

l. Area of non-irrigated vegetation on relevant land; and

m. Any other information required by the Minister.

**Salinity Modelled Areas**

The following principles set out conditions that apply to site use approvals in the Chowilla, Border to Lock 3, Lock 3 to Morgan, Waikerie to Morgan, and Morgan to Wellington salinity modelled areas. The principles require specified data that can be used to calculate targeted root zone drainage for the salinity modelled areas.

106. If required by way of notice in writing from the Minister, a person who has the benefit of a site use approval in the Chowilla, Border to Lock 3, Lock 3 to Morgan, Waikerie to Morgan, and Morgan to Wellington salinity modelled areas must provide to the Department water use data once every five years.

107. The data required to be provided to the Department by Principle 106 must include:

a. Number of irrigations and application rates;

b. Crop details (e.g. type, location, area, plant spacing);

c. Groundwater level and salinity monitoring, where measured; and

d. Any other information required by the Minister.
Upper Pike River Extraction Management Zone

The issues identified for the upper Pike River anabranch are explained in Section 2.3.3. It is important to measure the flows and extraction by consumptive use to ensure critical water quantity and quality outcomes are achieved.

The following condition will apply to water resource works approvals where water is taken from the Upper Pike River Extraction Management zone. The information required by Principle 108 will be particularly relevant during critical flow requirement periods.

108. If required by notice in writing from the Minister, a person who has the benefit of a water resource works approval in the Upper Pike River Extraction Management Zone must provide meter readings to the Department.

9.2.2 Resource Condition Indicator for the Upper Pike River

There have been significant investigations focused on improving the floodplain inundation and associated ecological condition of the Pike anabranch complex. Infrastructure upgrades are underway to introduce additional water into the anabranch complex in order to reinstate a more natural flow regime. While flows will increase into the upper Pike River as a result of these works, it is recognised that unlimited extraction for consumptive use is likely to decrease the intended environmental and water quality benefits associated with the additional water. To ensure existing water users have a secure supply as well as improving ecological health, a resource condition indicator has been established as an early warning of potential adverse trends in resource condition. If the resource condition indicator is reached, this will trigger investigative actions as described in Principle 109.

Extraction – Resource Condition Indicator

Negative environmental impacts are likely to occur when combined extraction rates from the upper Pike River within the Upper Pike River Extraction Management Zone exceed 77 ML/day.

109. If the resource condition indicator of 77 ML/day is exceeded, the Minister will use best endeavors to:

a. Determine the cause of the resource condition breach;

b. Determine the impacts on the upper Pike River anabranch and floodplain health and other dependent water users;

c. Identify options to mitigate the breach of the resource condition indicator; and

d. Implement the appropriate cause of action to reduce further negative impact on the upper Pike River anabranch and floodplain, and other dependent water users.
10 CONNECTION WITH OTHER LEGISLATION

In preparing this Plan, the South Australian Murray-Darling Basin NRM Board has had regard to, and is consistent with requirements of the:

- *Natural Resource Management Act 2004*;
- *Native Vegetation Act 1991*;
- *South Australia’s Strategic Plan 2007*;
- *Environment Protection Act 1993*;
- *State Natural Resources Management Plan South Australia 2012-2017*;
- *Intergovernmental Agreement on a National Water Initiative 2004*;
- *Natural Resources Management Plan for the South Australian Murray-Darling Basin Natural Resources Management Region*;
- *Murray-Darling Basin Agreement 2008*;
- *Water Act 2007 (Cth)*;
- Relevant development plans under the *Development Act 1993*; and
- Relevant plans of management under the *National Parks and Wildlife Act 1972*.

By 2019, the *Water Allocation Plan for the River Murray Prescribed Watercourse* is required to be accredited by the Murray-Darling Basin Authority, to ensure compliance with the Murray-Darling Basin Plan. This version of the Plan is not Basin Plan compliant, but consideration has been given to Basin Plan requirements throughout its development.
11 GLOSSARY AND ABBREVIATIONS

11.1 Glossary

**Act, the** – in this document, refers to the *Natural Resources Management Act 2004*, which replaced the repealed *Water Resources Act 1997*. Also referred to as the NRM Act.

**Adaptive management** – a natural resource management approach where you identify actions, implement changes, monitor the outcomes, investigate the assumptions, and regularly evaluate and review the required actions. Consideration must be given to the temporal and spatial scale of monitoring and the evaluation processes appropriate to the natural resource being managed.

**Agreement, the** – see *Murray-Darling Basin Agreement 2008*.

**Allotment** – as defined in the *Real Property Act 1886*.

**Anabranch** – a branch of the prescribed watercourse which leaves the watercourse and either enters it again or dries up.

**Aquatic ecosystem** – the stream channel, lake or estuary bed, water, and/or biotic communities, and the habitat features that occur therein.

**Aquifer** – an underground layer of rock or sediment that holds water and allows water to percolate through.

**Australian Height Datum (AHD)** – the datum adopted for vertical control, measured in metres. Zero metres AHD is approximately mean sea level.

**Backwater** – a temporary or permanent body of water that fills from the main river channel but excludes the Coorong, Lake Alexandrina and Lake Albert.

**Baseflow** – the water in a stream that results from underground water discharge to the stream. It often maintains flows during seasonal dry periods and has important ecological functions.

**Biodiversity** – as defined in the NRM Act – the variety of life forms represented by plants, animals and other organisms and micro-organisms, the genes that they contain, and the ecosystems and ecosystem processes of which they form a part.

**Biota** – all the organisms at a particular locality.

**Building** – a structure with a roof and walls, or a portion of such a structure, whether temporary or permanent, moveable or immovable, including but not limited to, a boat or pontoon permanently moored or fixed to land, or a caravan permanently fixed to land, a shed, and a pump station.

**Carryover** – the portion of a water allocation made available for use under a water access entitlement that is not taken in a water-use year that may be taken in a subsequent water-use year pursuant to a water allocation plan, or if allowed by the Minister.
**Catchment** – the catchment of a particular point is all of the land, determined by natural topographic features, from which runoff has potential to naturally drain to that point.

**Consumptive pool** – as defined in the NRM Act – the water that will from time to time be taken to constitute the resource within a particular part of a prescribed water resource for the purpose of Chapter 7 of the NRM Act, as determined:

- by or under a water allocation plan for that water resource; or
- in prescribed circumstances, by the Minister.

**Consumptive use** – as defined in the *Water Act 2007* (Cth) – the use of water for private benefit consumptive purposes including irrigation, industry, urban, and stock and domestic use.

**Country towns** – Renmark, Cooltong, Berri, Glossop, Monash, Barmera, Moorook, Kingston, Loxton, Waikerie, Woolpunda (Moorook Country Lands), Cadell, Blanchetown, Cowirra, Jervois, Milang, Morgan No.1 Pump Station, Myopolonga, Pompoota, Swan Reach Water District, Tailem Bend No.1 Pump Station and Wall.

**Critical Human Water Needs (CHWN)** – as defined under section 86A(2) of the *Water Act 2007* (Cth) – the minimum amount of water, that can only reasonably be provided from Basin water resources, required to meet: a) core human consumption requirements in urban and rural areas; and b) those non-human consumption requirements that a failure to meet would cause prohibitively high social, economic or national security costs.

**Deferred water** –

- any part of the South Australian Entitlement under clause 88 of the Agreement that South Australia stores under clause 91 of the Agreement; and
- any allocations that South Australia may have acquired for use in South Australia from within an upstream state, the delivery of which has been deferred in accordance with Schedule G of the Agreement.

**Department, the or DEWNR** – the Department of Environment, Water and Natural Resources (Government of South Australia), or any subsequent South Australian Government agency administering the relevant sections of the NRM Act.

**Domestic purpose** – in relation to the taking of water, as defined in the NRM Act, and does not include:

- taking water for the purpose of watering or irrigating land, other than land used solely in connection with a dwelling; or
- without limiting the above point – taking water for the purpose of watering or irrigating more than 0.4 of a hectare of land; or
- taking water to be used in carrying on a business (except for the personal use of persons employed in the business).

**Ecological processes** – all biological, physical or chemical processes that maintain an ecosystem.

**Ecosystem** – as defined in the NRM Act – a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.
**Effluent** – as defined in the NRM Act – domestic or industrial wastewater.

**Environmental asset** – a permanent pool or red gum swamp. The locations of environmental assets used for the purposes of this Plan will be identified in a database.

**Environmental land management** – in the context of this Plan, the use of water in the Lower Murray Reclaimed Irrigation Areas to minimise the historical effects of high saline groundwater levels and minimise the production of acid sulfate soils, thereby minimising impacts of irrigation activity on the river. Pursuant to Schedule E of the *Water Act 2007*, 22.2 GL is reserved for environmental land management purposes within the Lower Murray Reclaimed Irrigation Areas.

**Environmental water provisions** – those parts of environmental water requirements that can be met at any given time.

**Environmental water requirements** – as defined in the NRM Act – those water requirements that must be met in order to sustain the ecological values of ecosystems that depend on the water resource, including their processes and biodiversity, at a low level of risk.

**Environmental water use** – water for non-profit environmental purposes including, but not limited to, the maintenance or rehabilitation of aquatic or riparian ecosystems.

**Floodplain** – as defined in the NRM Act – any area of land adjacent to a watercourse, lake or estuary that is periodically inundated with water and includes any other area designated as a floodplain:

- in an NRM plan; or
- in a development plan under the *Development Act 1993*.

**Flow path** – the natural preferential path or direction of surface water flow, including a drainage path.

**Flow regime** – the character of the timing and amount of flow in a stream.

**Gazette** – the *South Australian Government Gazette*.

**Gigalitre (GL)** – equal to one thousand million litres (1,000,000,000).

**Groundwater** – see *underground water*.

**High conservation value ecosystem** – an identified and categorised value, based on an accepted or approved set of criteria for aquatic ecosystems, which may include rivers, wetlands, floodplains, lakes, inland saline ecosystems, groundwater-dependent ecosystems and estuaries but not the marine environment.

**Hydrogeology** – the study of underground water, which includes its occurrence, recharge and discharge processes, and the properties of aquifers; see also ‘hydrology’.
**Hydrologic connections and water supply considerations** – as defined in section 12.18 of the Basin Plan – in relation to a water access right, any of the following:

- the amount of transmission loss that may be incurred through evaporation, seepage, or other means;
- the potential impact, as a result of the trade of a water access right, on water availability in relation to a water access right held by a third party (other than an impact arising solely because of an increase in use of the traded water access right);
- the ability to:
  - deliver water from the same storage from which it is currently delivered; or
  - adjust valley and state transfer accounts to facilitate trade, for example by way of a back trade.

**Note 1:** See clause 3 of Schedule D to the Agreement for the meaning of *valley account*.

**Note 2:** See clause 5 of the Murray-Darling Basin Agreement (adjusting Valley Accounts and State Transfer Accounts) Protocol 2010 for the meaning of *state transfer account*.

**Hydrology** – the study of the characteristics, occurrence, movement and utilisation of water on and below the Earth’s surface and within its atmosphere; see also ‘hydrogeology’.

**HYDSTRA** – a time series data management system that stores continuously recorded water related data such as water level, rainfall, evaporation, salinity and temperature. It provides a powerful data analysis, modelling and simulation system, and contains details of site locations, setup and other supporting information.

**Industrial water use** – water for an industrial purpose or purposes including, but not limited to, processing, manufacturing, construction, fabrication, mining, quarrying, smelting, bulk handling, slaughtering, commercial, business, aquaculture or intensive farming.

**Infrastructure** – as defined in the NRM Act – artificial lakes; dams or reservoirs; embankments, walls, channels or other works or earthworks; buildings or structures; roads; pipes, machinery or other equipment; any device; any item or thing used in connection with:

- testing, monitoring, protecting, enhancing or re-establishing any natural resource, or any aspect of a natural resource; and
- any other program or initiative associated with the management of a natural resource.

**Intensive farming** – as defined in the NRM Act – a method of keeping animals in the course of carrying on the business of primary production in which the animals are confined to a small space or area and are usually fed by hand or mechanical means.

**Interstate Water Entitlements Transfer Scheme** or **IWETS** – as defined in the NRM Act –

- a scheme for the transfer of entitlements between two or more states under the Murray-Darling Basin Agreement; or
- an agreement between South Australia and one or more states or a territory entered into under Chapter 7 Part 3 Division 6 of the NRM Act.

**Irrigation water use** – water for primary production and/or for watering a crop or crops.
Irrigation season – the period in which major irrigation diversions occur, usually starting in August–September and ending in April–May.

Kilolitre (kL) – equal to one thousand litres (1,000).

Lake – as defined in the NRM Act – a natural lake, pond, lagoon, wetland or spring (whether modified or not) and includes:

- part of a lake; or
- a body of water designated as a lake –
  - in an NRM Plan; or
  - in a development plan under the Development Act 1993.

Land – as defined in the NRM Act – according to the context, and including any building or structure fixed to land:

- land as a physical entity, including land under water; or
- any legal estate or interest in, or right in respect of, land.

Licensee – a person who holds a water licence.

Megalitre (ML) – equal to one million litres (1,000,000).

Minister, the – South Australian Minister for Sustainability, Environment and Conservation, unless otherwise specified.

Murray-Darling Basin – as defined in the Water Act 2007 (Cth) – the area falling within the Murray-Darling Basin drainage division as specified in the dataset held by the Commonwealth, dated 28 May 2007 and with a scale of 1:250,000, which is derived from the Australian Drainage Divisions defined by the Australian Water Resources Management Commission in 1997.

Murray-Darling Basin Agreement 2008 (the Agreement) – the agreement between the Commonwealth of Australia, New South Wales, Victoria, Queensland, South Australia and the Australian Capital Territory, as set out in Schedule 1 of the Water Act 2007 (Cth).

Murray-Darling Basin Authority (MDBA) – a body established under the Water Act 2007 (Cth).


NRM Act, the – see the Act.

Occupier of land – as defined in the NRM Act – a person who has, or is entitled to, possession or control of the land (other than a mortgagee in possession unless the mortgagee has assumed active management of the land), or who is entitled to use the land as the holder of native title in the land.
Owner of land – as defined in the NRM Act –

- if the land is unalienated from the Crown – the Crown; or
- if the land is alienated from the Crown by grant in fee simple – the owner (at law or in equity) of the estate in fee simple; or
- if the land is held from the Crown by lease or licence – the lessee or licensee, or a person who has entered into an agreement to acquire the interest of the lessee or licensee; or
- if the land is held from the Crown under an agreement to purchase – the person who has the right to purchase; or
- a person who holds native title in the land; or
- a person who has arrogated to himself or herself (lawfully or unlawfully) the rights of an owner of the land;

and includes an occupier of the land and any other person of a prescribed class included within the ambit of this definition by the regulations.

Percentile – a way of describing sets of data by ranking the dataset and establishing the value for each percentage of the total number of data records. For example, the 90th percentile of the distribution is the value such that 90 percent of the observations fall at or below it.

Plant – as defined in the NRM Act – vegetation of any species, including the seeds and any part of any such vegetation, or any other form of plant material, but does not include any vegetation or material excluded from the ambit of this definition by the regulations.

Prescribed area – an area or watercourse, lake or well declared by the Governor to be prescribed, in accordance with section 125 of the NRM Act. May include, but is not limited to, a prescribed water resources area, surface water prescribed area, prescribed watercourse, or prescribed wells area.

Prescribed watercourse – a watercourse declared to be a prescribed watercourse under section 125 of the NRM Act.

Prescribed water resource – a surface water prescribed area, or a prescribed watercourse, lake or well.

Prescribed well – a well declared to be a prescribed well under section 125 of the NRM Act.

Private carryover – see carryover.

Proponent – the person or persons (who may be a body corporate) seeking approval to take water from a prescribed water resource.

Property – an allotment or contiguous allotments owned or occupied by the same person, persons or body and operated as a single unit. Allotments will be considered to be contiguous if they abut at any point, or are separated only by a road, street, lane, footway, court, alley, railway, thoroughfare, easement, right-of-way, watercourse, channel or a reserve or similar open space.
**Ramsar Convention** – an international treaty on wetlands titled *The Convention on Wetlands of International Importance Especially as Waterfowl Habitat*. It is administered by the International Union for Conservation of Nature and Natural Resources. It was signed in the town of Ramsar, Iran in 1971, hence its common name. The convention includes a list of wetlands of international importance and protocols regarding the management of these wetlands. Australia became a signatory in 1974.

**Recreational water use** – water taken and/or used for recreational purposes including, but not limited to, the watering of land commonly used for playing sports or games, or the use of a body of water for recreational purposes including swimming, boating and recreational fishing.

**Resilience** – the capacity to recover quickly from difficulties.

**Restriction or restrict** – as defined in the Basin Plan – in relation to trade, includes refuse, prevent, deter, delay or impose a condition or a barrier on.

**Reticulated water** – water supplied through a piped distribution system.

**Riparian zone** – that part of the landscape adjacent to a water body that influences and is influenced by watercourse processes. This can include landform, hydrological or vegetation definitions. It is commonly used to include the in-stream habitats, bed, banks and sometimes floodplains of watercourses.

**SA Water** – South Australian Water Corporation (Government of South Australia).

**South Australian Entitlement or Entitlement** – the monthly quantities of River Murray water South Australia is entitled to receive, as determined by the Murray-Darling Basin Agreement 2008.

**Stock purposes** – water that is taken for drinking water for stock not subject to intensive farming (as defined in the NRM Act).

**Site use approval** – an authorisation under the NRM Act to use water at a particular site in a particular manner.

**South Australian Murray-Darling Basin Natural Resources Management Region** – the region established by proclamation on 2 September 2004 as varied by proclamation on 9 October 2008, which is defined in GRO Plan 27/.

**Specified environment improvement program** - a program established pursuant to the NRM Act, that outlines requirements of site use or water resource works approval holders to undertake specific actions to support the objectives of the Plan.

**Structure** – something built or constructed, including, but not limited to, a ford, causeway, culvert, fence, jetty, boat mooring, weir or retaining wall.
Surface water – as defined in the NRM Act –

- water flowing over land (except in a watercourse),
  - after having fallen as rain or hail or having precipitated in any another manner,
  - or after rising to the surface naturally from underground;
- water of the kind referred to in the first point that has been collected in a dam or reservoir;
- water of the kind referred to in the first point that is contained in any stormwater infrastructure;
- water in a watercourse if the watercourse, or a particular part of a watercourse, is declared by proclamation under subsection (13) to constitute surface water for the purposes of the NRM Act.

Tagged Water Access Entitlement – as defined in section 12.23(5) of the Basin Plan – a Water Access Entitlement:

- which is registered on a water register in relation to one place; and
- under which the water allocation is extracted in a different place (which is tagged on the register);

pursuant to an arrangement for Water Access Entitlement tagging.

Tagged trade – an arrangement under which every allocation made under an entitlement in a state of origin is made available for use in a state of destination either permanently or for a fixed term.

To take water from a water resource – as defined in the NRM Act – includes:

- to take water by pumping or syphoning the water;
- to stop, impede or divert the flow of water over land (whether in a watercourse or not) for the purpose of collecting the water;
- to stop, impede or direct the flow of water in any stormwater infrastructure for the purpose of collecting the water, or to extract any water from stormwater infrastructure;
- to divert the flow of water in a watercourse from the watercourse;
- to release water from a lake;
- to permit water to flow under natural pressure from a well;
- to permit stock to drink from a watercourse, a natural or artificial lake, a dam or reservoir; and
- to cause, permit or suffer any activity referred to in a preceding paragraph.

Total Dissolved Solids (TDS) – a measure of water salinity, measured in milligrams per litre (mg/L).

Tributary – a river or creek that flows into a larger river.

Underground water or groundwater – as defined in the NRM Act –

- water occurring naturally below ground level; and
- water pumped, diverted or released into a well for storage underground.
Unregulated flows – a river flow that does not result from a controlled release made to service an allocation, or flows declared to be unregulated by the appropriate authority.

Unused water allocation – the volume held in a water account that relates to a South Australian Water Access Entitlement that may comprise water allocated against the Water Access Entitlement, volumes of private carryover determined by the Minister and/or water traded to the water account from intrastate or interstate.

Watercourse – as defined in the NRM Act – a river, creek or other natural watercourse (whether modified or not) in which water is contained or flows whether permanently or from time to time and includes:
- a dam or reservoir that collects water flowing in a watercourse;
- a lake through which water flows;
- a channel (but not a channel declared by regulation to be excluded from the ambit of this definition) into which the water of a watercourse has been diverted;
- part of a watercourse;
- an estuary through which water flows;
- any other natural resource, or class of natural resource, designated as a watercourse for the purposes of the NRM Act by an NRM plan.

Waterlogging – the permanent or temporary saturation of the soil profile so as to impede plant growth.

Water Access Entitlement – in respect of a water licence, an entitlement to gain access to a share of the Consumptive Pool to which a licence relates.

Water affecting activities – activities referred to in section 127 of the NRM Act.

Water allocation – as defined in the NRM Act –
- in respect of a water licence, an allocation of water under the terms of the licence in accordance with Chapter 7 Part 3 Division 2 of the NRM Act and includes, if the context so requires, a component or part of such an allocation, or the water available in connection with the entitlement.
- in respect of an Interstate Water Entitlements Transfer Scheme, an allocation of water under the terms of that scheme and the provisions of Chapter 7 Part 3 Division 2 of the NRM Act and includes, if the context so requires, a component or part of such an allocation, or the water available in connection with the entitlement.
- in respect of water taken pursuant to an authorisation under section 128, the maximum quantity of water that can be taken and used pursuant to the authorisation.

Water allocation plan – as defined in the NRM Act – a water allocation plan prepared by a regional NRM Board under Chapter 4 Part 2 of the NRM Act.

Water licence – as defined in the NRM Act – a licence granted by the Minister under section 146 of that Act.
Water Management Authorisation – as defined in the NRM Act –

- a water licence; or
- a water allocation; or
- a site use approval; or
- a water resource works approval; or
- a delivery capacity entitlement.

Water resource – as defined in the NRM Act – a watercourse or lake, surface water, underground water, stormwater and effluent.

Water resource works approval – a water management authorisation granted under the NRM Act to construct, maintain or operate any works for the purpose of taking water.

Water-use year – the period between 1 July in any given calendar year and 30 June the following calendar year.

Water-dependent ecosystems – those parts of the environment, the species composition and natural ecological processes, that are determined by the permanent or temporary presence of flowing or standing water, above or below ground; the in-stream areas of rivers, riparian vegetation, springs, wetlands, floodplains, estuaries and lakes are all water-dependent ecosystems.

Well – as defined in the NRM Act –

- an opening in the ground excavated for the purpose of obtaining access to underground water;
- an opening in the ground excavated for some other purpose but that gives access to underground water; and
- a natural opening in the ground that gives access to underground water.

Wetland or wetlands – as defined in the NRM Act – an area that comprises land that is permanently or periodically inundated with water (whether through a natural or artificial process) where the water may be static or flowing and may range from fresh water to saline water and where the inundation with water influences the biota or ecological processes (whether permanently or from time to time) and includes any other area designated as a wetland:

- by an NRM plan; or
- by a development plan under the Development Act 1993;

But does not include:

- a dam or reservoir that has been constructed by a person wholly or predominantly for the provision of water for primary production or human consumption;
- an area within an estuary or within any part of the sea; or
- an area excluded from the ambit of this definition by the regulations.
This definition encompasses a number of concepts that are more specifically described in the definition used in the Ramsar Convention on Wetlands of International Importance. This describes wetlands as areas of permanent or periodic to intermittent inundation, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tides does not exceed six metres. For the purposes of the River Murray PWC, this does not include the principal channel of the River Murray, any marina, or any land inundated for the purpose of primary production (whether such inundation occurs directly or indirectly, and whether or not such inundation is incidental or ancillary to the purpose of primary production).

### 11.2 Abbreviations

**ABS** – Australian Bureau of Statistics  
**AHD** – Australia Height Datum  
**BOM** – Bureau of Meteorology  
**CEWH** – Commonwealth Environmental Water Holder, as defined by the *Water Act 2007*  
**CHWN** – Critical Human Water Needs  
**CLLMM** – Coorong, Lower Lakes and Murray Mouth  
**Cth** – Commonwealth of Australia  
**DEWNR** – The Department of Environment, Water and Natural Resources (Government of South Australia)  
**EC** — Electrical conductivity, 1 EC unit = 1 micro-Siemen per centimetre (μS/cm) measured at 25°C, commonly used to measure water salinity as it is quicker and easier to measure than TDS  
**ELMA** – Environmental Land Management Allocation  
**EPA** — Environment Protection Authority (Government of South Australia)  
**EWPs** – Environmental Water Provisions  
**EWRs** – Environmental Water Requirements  
**GL** – Gigalitre, equal to one thousand million litres (1,000,000,000)  
**GRO** – General Registry Office, location for registered maps or plan and held at the Land Titles Office  
**KL** – Kilolitre, equal to one thousand litres (1,000)  
**LWMP** – Land and Water Management Plan  
**LMRIA** – Lower Murray Reclaimed Irrigation Area
MDBA – Murray-Darling Basin Authority

MDBC – Murray-Darling Basin Commission

ML – Megalitre, equal to one million litres (1,000,000)

NRM – Natural Resources Management

PWA — Prescribed Wells Area

PWC — Prescribed Watercourse

PWRA — Prescribed Water Resources Area

QSA – flow at the South Australian border

RBLAP – Renmark to Border Local Action Planning Association

River Murray PWC – River Murray Prescribed Watercourse, as per Figure 1

RRP – Riverine Recovery Project

SIS – Salt Interception Scheme

TDS – Total Dissolved Solids, a measure of water salinity, measured in milligrams per litre (mg/L)

TLM – The Living Murray program

WAP — Water Allocation Plan, a plan prepared by a NRM Board and adopted by the Minister in accordance with the NRM Act

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APPENDIX A

Reasonable Irrigation Requirements

For the purpose of Principles 70.b.iii.c. and 71.a., ‘reasonable irrigation requirement’ means the amount of water required by a reasonably efficient irrigator to deliver crop production, excluding effective precipitation.

Reasonable irrigation requirements can be calculated for a range of crops grown in the South Australian Murray-Darling Basin region using average regional monthly evaporation and effective precipitation (Table 17 and Table 18), FAO 56 Crop Factors (Table 19) and a field application efficiency of 85 percent.42

If it can be demonstrated that the calculated reasonable irrigation requirement is insufficient to meet crop needs, or if crop factors are not included in Table 19 for the proposed crop, professional advice or literature may be considered when determining reasonable irrigation requirements.

How to Calculate Reasonable Irrigation Requirements

Step 1 – Identify monthly long-term average evaporation rates (Table 17) and effective precipitation (Table 18) for the station nearest to the land upon which water is to be used.

Step 2 – For each calendar month, calculate the crop water requirements by multiplying evaporation (Table 18) by the corresponding crop factor (Table 19) and subtracting effective precipitation (Table 18). A negative number indicates no moisture deficit and can be disregarded for the purposes of step 3.

Step 3 – Calculate the annual crop water requirement by summing the individual monthly crop water requirements.

Step 4 – Divide the annual crop water requirement by 0.85 to provide for delivery losses and leaching.

\[
\text{Reasonable Irrigation Requirement} = \frac{(\text{Evaporation} – \text{Effective Precipitation}) \times \text{Crop Factor}}{0.85 \text{ Field Application Efficiency}}
\]

42 Tables are taken direct from the 2002 Plan
Table 17: Monthly average evaporation (epan) in millimetres (mm)

<table>
<thead>
<tr>
<th>Name</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barmera</td>
<td>52</td>
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**Note:** Values in the above table have been determined by multiplying average monthly precipitation by 0.6 where monthly precipitation <75mm or 0.8 where precipitation >75mm
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<tr>
<td>Stonefruit^</td>
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<td>0.57</td>
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</table>

* Pomefruit includes apple, cherry and pear (FAO 56)
^ Stonefruit includes apricots, peach, pecan and plum (FAO 56)
# Vegetable crop factors are shown in a typical season, but planting time and harvest are variable. The 0.2 crop factor outside of the growing season for vegetable crops allows for water requirement of groundcover for (sandy) soil stabilisation.