Long-term environmental watering plan for the South Australian River Murray Water Resource Plan Area

Department for Environment and Water
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Government of South Australia
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Acknowledgement of Country

Aboriginal people are the First Peoples and Nations of South Australia. The lands, waters, and sky of the River Murray region have supported diverse and unique Aboriginal cultures since time immemorial.

We acknowledge and respect the Traditional Custodians of these lands and waters, and pay our respects to their Elders past and present. We recognise their deep and ongoing spiritual, cultural, social, and economic connections to Country, and the responsibilities to care for.

Aboriginal peoples continue to practise their lore, maintain cultural heritage, and share their knowledge and languages, which remain of vital importance to the health of Country today.

This plan supports meaningful and equitable engagement with Aboriginal peoples and respects their rights, interests, and obligations in the management of land and water across the River Murray region.

Foreword

Sustainable management of freshwater resources into the future is one of the most critical challenges facing global communities. By international standards, significant progress towards more sustainable management practices has been made in the Murray-Darling Basin with numerous policy and legislative reforms, and roll-out of on-ground river and wetland restoration programs, including infrastructure to aid in environmental water management. Perhaps most significant within the Basin has been the decision under the *Basin Plan (2012)* to commit to returning 2,075 gigalitres (GL) of water to the system under the 'Bridging the Gap' target, in addition to a commitment to returning an additional 450 GL of water to achieve enhanced environmental outcomes. With the passage of the *Water Amendment (Restoring Our River Act) 2023*, the Australian Government has reaffirmed this commitment. This is a key step towards restoring some of the balance between meeting the needs of the environment whilst still providing for productive industries and communities, including water for irrigation and critical human water needs.

Despite the efforts made to date, ongoing and concerted effort will be required to restore a healthy, working Murray-Darling Basin. South Australia, in partnership with other Basin States, the Murray-Darling Basin Authority (MDBA), the Commonwealth Environmental Water Holder (CEWH), local communities and non-government organisations, is progressing well in implementing the Basin Plan, including the environmental water management framework set out in Chapter 8 of that document.

To this end, South Australia is pleased to present this 2025 update of the *Long-term Environmental Watering Plan for the South Australian River Murray Water Resource Plan Area* (SA River Murray LTWP). The first long-term environmental watering plan (LTWP) for this area was developed in 2015 in accordance with the environmental management framework within the Basin Plan, based on the most up-to-date scientific knowledge and understanding of the South Australian River Murray ecosystem that was available at the time. This update provides alignment with the accredited *Water Resource Plan for the South Australian River Murray* (SA River Murray WRP) and enables the inclusion of up-to-date information and knowledge gained through 10 years of implementation. This long-term plan is a critical element of the Basin Plan environmental management framework. It builds on the Basin-wide Environmental Watering Strategy published by the MDBA, as well as work completed in South Australia's annual environmental watering plans and many long-running environmental water management projects.

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Summary

The first *Long-term Environmental Watering Plan for the South Australian River Murray Water Resource Plan Area* (SA River Murray LTWP) was published in 2015. It identified the priority environmental assets (PEAs) of the area and the environmental objectives, targets and environmental water requirements (EWRs) to be achieved for those assets over the longer term. A review and update of the 2015 LTWP was triggered under section 8.22 of the Basin Plan by the accreditation of the *South Australian River Murray Water Resource Plan* (SA River Murray WRP) in 2019 by the Federal Minister for Water. The 2020 LTWP update was focussed on updating the EWRs to incorporate improved understanding of hydro-ecological relationships as well as aligning the LTWP with the accredited WRP. These updates included sections relating to planned environmental water, Aboriginal values and uses, co-operative arrangements within and between water resource areas and strategies to address risks identified to water-dependent ecosystems. In 2025, a review and update of the LTWP has been triggered by the five-yearly review timeframe, corresponding with a review of the Basin-wide Environmental Watering Strategy. This update focusses on the review and updating of the objectives and targets for the PEAs to incorporate new knowledge and understanding of a healthy functioning ecosystem in the LTWP area.

The LTWP is of strategic importance for the management of the South Australian River Murray, its floodplain and wetlands, and the Coorong, Lower Lakes and Murray Mouth (CLLMM). It provides direction for the most efficient and effective use of environmental water. Environmental water holders and managers will use this LTWP to guide environmental water decision making, and to inform the coordination of Basin-wide watering actions in the Southern Connected Basin.

The SA River Murray WRP area includes the River Murray and its floodplain (defined by the 1956 flood extent), from the South Australian/New South Wales/Victorian border (the border) to the Murray Mouth, and includes Lakes Alexandrina and Albert (the Lower Lakes). This LTWP also incorporates the Coorong in recognition of the intrinsic connection between the River Murray and the Coorong. Although considered by the Basin Plan to be part of the SA Murray Region water resource plan area, ecological outcomes in the Coorong are driven by surface water inputs from the River Murray via the Lower Lakes. For this reason, the Coorong, Lower Lakes and Murray Mouth asset needs to be managed as a whole, and this approach is consistently applied by South Australia in annual environmental water planning and implementation, including the development of annual environmental watering priorities under the Basin Plan.

A landscape-scale approach has been used to define the environmental assets, reflecting the ecological importance of the mosaic of habitats, rather than focussing on discrete management units that represent only a small portion of the SA River Murray WRP area. It also ensures that a holistic approach is taken to environmental water planning, delivery and evaluation.

Three PEAs have been identified for the SA River Murray WRP area:

1. the Coorong, Lower Lakes and Murray Mouth Priority Environmental Asset ('the CLLMM PEA') - equivalent to the Lower Lakes, Coorong and Murray Mouth TLM Icon Site and the Coorong, Lakes Alexandrina and Albert Ramsar Wetland of International Importance
2. the South Australian River Murray Channel Priority Environmental Asset ('the Channel PEA') - consists of the area between Wellington, South Australia, and the border and includes the channel component of the Riverland Ramsar site - a total distance of approximately 560 River kilometres. The lateral extent comprises the area inundated at flows up to 40,000 ML/day QSA (i.e. flow measured at the border) under normal River operations
3. the South Australian River Murray Floodplain Priority Environmental Asset ('the Floodplain PEA') - an equivalent longitudinal extent to the Channel PEA, extending from Wellington, South Australia, to the border and includes the floodplain component of the Riverland Ramsar site and the Banrock Station

Ramsar site. It consists of the area that is inundated when flows are between 40,000 ML/day QSA and 80,000 ML/day QSA (under normal River operations).

The outer floodplain (i.e. the area that requires flows above 80,000 ML/day QSA to be inundated) is not included as part of the Floodplain PEA, as the Basin Plan defines a PEA to be an environmental asset that can be managed with environmental water (section 8.49), and MDBA modelling indicates that 80,000 ML/day QSA is the maximum flow rate at which active management of environmental water can occur (subject to the implementation of measures to address flow constraints). The outer floodplain represents approximately 40% of the whole floodplain. Despite not being part of the Floodplain PEA, the outer floodplain is still considered to be an area of high importance to South Australia for many reasons, including supporting a large proportion of the black box woodlands within the water resource plan area (WRP area), and connecting riparian zones with upland habitats. Unregulated flows above 80,000 ML/day QSA support the health of the high elevation floodplain areas that provide critical habitat for a range of species, and it is critical that there is no further reduction in the occurrence of the unregulated flow events that are required to inundate the outer floodplain (Government of South Australia, 2012).

In total, 33 ecological objectives and 132 ecological targets were identified for the 3 PEAs. They represent what is needed to support each of the PEAs in a healthy, functioning state. Each of these objectives and targets were reviewed and updated based on current knowledge. Other objectives and targets were added as the understanding of this system has improved.

13 EWRs were identified for the 3 PEAs. An overall theme of the EWRs is the reinstatement of a more natural flow regime through the delivery of environmental water to the South Australian border, and downstream to the CLLMM. To meet the majority of the EWRs, environmental water will need to be delivered in conjunction with unregulated flows, as the volume of water required is greater than that provided by South Australia's Entitlement alone or that available to the environment through water recovery programs. The availability of water for the environment and ability to make active management decisions on its use is critical for optimising water delivery patterns and achieving the best possible environmental outcomes.

The EWRs describe a desired long-term and variable hydrological regime that enables flexibility and adaptive management in response to climate and ecological condition. The EWRs can be used to contribute to annual planning, together with results from ecological monitoring, to identify vital watering actions for the PEAS, including the need for water and the risks inherent in not watering.

In addition to the ecological information provided, the following management considerations are also explained and fulfil the LTWP content requirements described in the Basin Plan (section 8.19):

- Aboriginal values – consideration of, and where possible alignment with, Aboriginal values in order to maximise the benefits from environmental watering
- Co-operative arrangements – processes to be followed to ensure that watering actions across the WRP area and Southern Connected Basin (SCB) are coordinated
- Operational constraints – whether it is feasible to deliver the proposed watering action in view of operational constraints
- Long-term risks to providing for the EWRs – whether the proposed watering action addresses any of the potential long-term risks.

South Australia recognises the importance of Aboriginal values and uses, and is committed to seeking input and incorporating knowledge into the development of environmental water plans where possible. Within the SA River Murray WRP area, Aboriginal engagement in environmental water planning and delivery has occurred for many years with the Ngarrindjeri Aboriginal Corporation (NAC) the Ngarrindjeri Regional Authority (NRA), the Mannum Aboriginal Community Association Inc (MACAI) and the First Peoples of the River Murray and Mallee Region (FPRMM) through formal agreements with the South Australian Government. More recently, engagement mechanisms with Burrandies Aboriginal Corporation have also been established. Collaboration between the

FPRMM, Murraylands and Riverland Landscape Board (formerly Natural Resources SA Murray-Darling Basin) and DEW has enabled the inclusion of FPRMM's perspectives into the management of the River Murray channel and its wetland and floodplain areas. Crucial to the strong working partnership that has developed between Ngarrindjeri and DEW staff are the Statement of Commitment and the Ngarrindjeri Nation Yarluwar Ruwe Plan (caring for Ngarrindjeri Sea Country and Culture), which has facilitated active Ngarrindjeri participation and involvement in environmental water planning and management for the CLLMM, Channel and Floodplain Assets for a number of years. These relationships have led to an improved LTWP.

Co-operative arrangements within the WRP area are needed to ensure that river operators, environmental asset and site managers, environmental water holders and environmental water managers work toward the common goal for the SA River Murray WRP area of a healthy, functioning and resilient ecosystem. They lead to decisions that are transparent, priorities and trade-offs that are understood, and outcomes at the site-scale that contribute to desired outcomes at the LTWP asset and WRP area scale. The arrangements currently in place for environmental water management within the WRP area have been identified in this LTWP and described in detail in the *Water for the Environment Management Framework, South Australian River Murray* (Department for Environment and Water, 2021).

Co-operative arrangements between upstream WRP areas and the SA River Murray WRP area have progressed significantly in recent years through the operation of the Southern Connected Basin Environmental Watering Committee (SCBEWC). South Australia continues to work closely with the other Basin States, the MDBA and the CEWH to coordinate the management of water for the environment, including an increased focus on coordination for system-scale outcomes.

Physical and operational constraints continue to have a significant impact on the feasibility of delivering environmental water to and within the SA River Murray WRP area, and more broadly throughout the Murray-Darling Basin. The constraints currently having the greatest impact on environmental water management in the SA River Murray WRP area are primarily located upstream of the South Australian border and were identified through the Constraints Management Strategy (CMS). Although some progress has been made towards removing these constraints since the commencement of the Basin Plan, the majority of the upstream flow constraints remain. Basin governments are actively working together to decide on the implementation of constraints relaxation across the Murray-Darling Basin.

Key long-term risks to providing for the EWRs of PEAs and priority ecosystem functions (PEFs) include:

- insufficient water available for SA River Murray WRP area priority assets/functions
- water cannot be delivered to SA River Murray WRP area priority assets/functions
- water quality is unsuitable for use at SA River Murray WRP area priority assets/functions.

Mechanisms for addressing these long-term risks include; effective decision-making frameworks; addressing flow constraints at a Basin scale; and rigorous monitoring and evaluation programs. These key risks align with the risks identified in the SA River Murray WRP (Department for Environment and Water, 2019a).

Effective monitoring, evaluation and reporting will be critical to assessing both the effectiveness of this LTWP and the Basin Plan environmental watering framework more generally. The LTWP represents what is needed to support a healthy, functioning ecosystem and has not been restricted to what is achievable under the Basin Plan or what is likely to be monitored in the future. Work to prioritise monitoring indicators from the LTWP ecological targets and quantify expected outcomes for these indicators has been undertaken as part of the state's reporting requirements under Matter 8, Schedule 12 of the Basin Plan (the achievement of environmental outcomes at an asset scale). This provides a clear line of sight between the LTWP and Matter 8 evaluation and reporting for the SA River Murray WRP area.

Review and update of this LTWP will ensure that it remains relevant and current, and must occur on at least a five yearly basis.

1 Introduction

The first *Long-term Environmental Watering Plan for the South Australian River Murray Water Resource Plan Area* (SA River Murray LTWP) was developed in 2015 in accordance with the environmental management framework within the Basin Plan. It built on many years of annual environmental water planning and brought together information developed through many long-running and successful projects and programs within the region.

In 2019, a review and update of the 2015 LTWP was triggered by the accreditation of the *SA River Murray Water Resource Plan* (SA River Murray WRP) in addition to being five years since the first LTWP for the region was prepared (see Basin Plan section 8.22). The 2020 LTWP update was largely focussed on aligning the LTWP with WRP sections relating to planned environmental water (PEW), Aboriginal values, co-operative arrangements and risks to water-dependent ecosystems.

In response to an update of the Basin-wide Environmental Watering Strategy (BWS) in 2025, the LTWP was reviewed and updated for a second time in 2025. This update focusses on the review and updating of the objectives and targets for the PEAs to incorporate new knowledge and understanding of a healthy functioning ecosystem in the LTWP area.

Projects and programs within the region are focussed on addressing the major impacts arising from a long history of River regulation and development. Extractions for consumptive use and regulation via upstream storages have caused a reduction in the flows needed to generate within-channel pulses and overbank inundation and to provide water to the Lower Lakes, Murray Mouth and the Coorong. In addition, the construction of six weirs along the main channel of the River Murray in South Australia has stabilised water levels and slowed water velocities, creating lentic 'weir pools'. Together, these impacts have resulted in a decline in the ecological condition of the River, and its floodplain, wetlands and estuary.

Aboriginal people within the SA River Murray water resource plan area (SA River Murray WRP area) rely on the interconnectivity between land, waters, spirit and all living things (Ngarrindjeri refer to this as Ruwe/Ruwar), and a decline in the ecological condition of the River system can be understood as a threat to their health and wellbeing.

In addition to being a legislated requirement under Chapter 8 of the Basin Plan, this LTWP provides an opportunity for South Australia to outline the hydrological regimes needed to support a healthy, functioning South Australian River Murray ecosystem. The overall environmental objectives for the water-dependent ecosystems of the SA River Murray WRP area are derived from those identified in the Basin Plan for the Murray-Darling Basin Plan (section 8.04), as follows:

- to protect and restore water-dependent ecosystems of the SA River Murray WRP area
- to protect and restore the ecosystem functions of water-dependent ecosystems
- to ensure that water-dependent ecosystems are resilient to climate change, and other risks and threats.

This LTWP supports these objectives by:

- identifying the PEAs and outlining the hydrological regimes needed to support them in a healthy, functioning state
- identifying priority ecosystem functions that focus on linking the assets and aligning environmental water management across the assets
- consolidating ecological information that will facilitate annual environmental water planning and prioritisation, and inform negotiations with water holders
- identifying constraints to the successful delivery of environmental water to and within the water resource plan area

- outlining the mechanisms in place to assist with coordinating environmental watering throughout the region and the SCB, and ensuring that priorities and trade-offs are transparent
- providing a basis on which to evaluate the success of environmental water management and improve future versions of this LTWP.

The information within this LTWP is presented in the following sections:

Section 2 Context - Explains the spatial and temporal scale of the plan, and the processes and consistencies required under the Basin Plan that were followed when preparing the plan. It also identifies the types and volumes of environmental water potentially available, and the parties responsible for managing the water and environmental assets or sites in the region.

Section 3 Planning Approach - Describes how each PEA was identified and the process used to identify the ecological objectives, targets and EWRs for each asset.

Section 4 Priority Environmental Assets - Describes the PEAs identified within the SA River Murray WRP area. A suite of ecological objectives, targets and EWRs is provided for each. Guidance on the use of the ecological content in annual and real-time planning is also provided.

Section 5 Priority Ecosystem Functions - Describes the priority ecosystem functions identified within the SA River Murray WRP area and the processes used to identify them. A suite of ecological objectives, targets and EWRs is provided for each. Guidance on the use of the ecological content in annual and real-time planning is also provided.

Section 6 Aboriginal Values and Objectives - Provides a summary of the values and objectives in relation to water for First Nation groups in the SA River Murray WRP area.

Section 7 Management considerations - There are many other factors which need to be taken into account during decision-making or which influence the feasibility of delivering water. Some of these critical factors have been described with a particular focus on those requiring description under the Basin Plan environmental water management framework.

Section 8 Reporting - A summary of environmental water reporting requirements is provided, as well as the link between the LTWP and the evaluation and reporting on the achievement of environmental outcomes at an asset scale (Basin Plan Schedule 12, Matter 8).

Section 9 Review of this Plan - Information on the timing for the next review.

2 Context

2.1 Planning area

This LTWP has been developed for the SA River Murray WRP area, which is defined in Chapter 3 of the Basin Plan. The SA River Murray WRP area includes all the surface water resources defined as the prescribed watercourse in the River Murray Water Allocation Plan (Murraylands and Riverland Landscape Board, 2023). The extent includes the River Murray channel and its floodplain defined by the 1956 flood extent, from the South Australian/New South Wales/Victorian border to the Murray Mouth, and includes Lakes Alexandrina and Albert (the Lower Lakes).

This plan also incorporates the Coorong, which is considered by the Basin Plan to be within the SA Murray Region water resource plan area (SA Murray Region WRP area) (Figure 2.1). Ecological outcomes in the Coorong are primarily driven by surface water inputs from the River Murray via the Lower Lakes, with the volume of surface water arriving in the Coorong from the SA Murray Region WRP area being small and the groundwater inputs not well quantified or manageable. The Coorong and Lower Lakes have long been treated as a single environmental asset or site including recognition as a Wetland of International Importance under the Ramsar Convention on Wetlands and as an icon site through The Living Murray Initiative. It is therefore appropriate for the EWRs of the Coorong and the Lower Lakes to be included in the same LTWP.

Murrundi (River Murray), including the Kurangk (Coorong), the Lower Lakes and the Murray Mouth, is an Aboriginal cultural landscape.

The entire Kurangk (Coorong), Lakes and Murray Mouth region lies within the traditional lands and waters of the Ngarrindjeri nation and included in the Ngarrindjeri & Others Native Title Claim (SAD 6027/98). The area includes registered Aboriginal sites such as the 'Meeting of the Waters' (Murray-Darling Basin Authority, 2014f).

In 2017, the First Nations of the South East lodged a native title claim (SAD 211/2017) which overlaps the southern area of the Coorong. The claim has not yet been determined; arrangements between the Nations in this region remain unresolved.

In the upper Murray region, the First Peoples of the River Murray and Mallee Region (FPRMM) hold a native title consent determination (SAD 6026/1998) which applies to Riverland and associated lands and waters.

DEW acknowledges the complexity and evolving nature of Aboriginal native title and cultural rights in the region. As new claims or arrangements are formalised, DEW commits to ongoing engagement with all relevant Nation groups in the planning and management of the water resourcing across the SA River Murray WRP area.

2.2 Planning timeframe

The SA River Murray LTWP (2025 update) has an indicative timeframe of five years, covering the period September 2025 to September 2030, or until a subsequent LTWP is released.

The Basin Plan (section 8.22) outlines certain triggers for the review and updating of a LTWP, including the accreditation, amendment or adoption of the water resource plan for the water resource plan area, published updates to the BWS that materially affect the LTWP, or five years since completion of the previous LTWP. The State may also choose to revise and update the SA River Murray LTWP at any time.

The first LTWP was completed in November 2015 and the water resource plan for the SA River Murray WRP area was accredited in 2019, both triggering a need to undertake a review and update of the SA River Murray LTWP in 2020. This update (2025) is required due to the recent update of the BWS and the time since the last SA River Murray LTWP update. The timing of any subsequent review and update will depend on when the next trigger occurs but will occur no later than 2030.

2.3 Consistency with preparation requirements

The SA River Murray LTWP was developed by the South Australian Department for Environment and Water (DEW) in accordance with Chapter 8 of the Basin Plan. Sections 3 and 4 of this LTWP fulfil the content requirements described in section 8.19 of the Basin Plan. This section describes how DEW met the LTWP preparation requirements that are described in section 8.20 of the Basin Plan and include:

- consultation requirements
- having regard to the Murray-Darling Basin Authority's BWS
- consistency with the 11 principles to be applied in environmental watering
- to not be inconsistent with relevant international agreements.

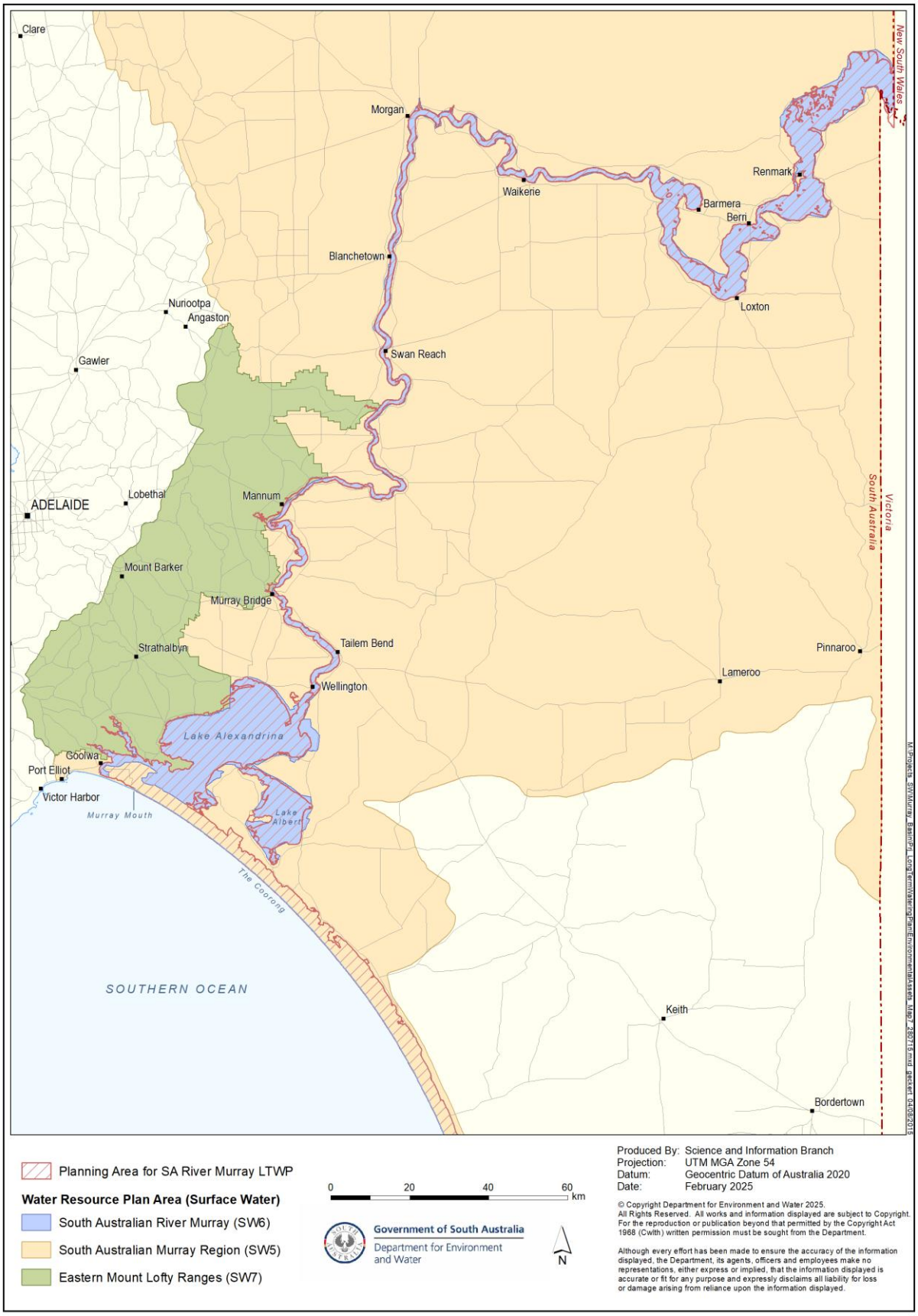

Figure 2.1. Comparison of the planning area of the SA River Murray LTWP to the SA River Murray WRP area

2.3.1 Consultation

Consultation has been undertaken in accordance with the requirements of Chapter 8 of the Basin plan, including:

a) Holders of HEW
b) Managers of PEW
c) River operators
d) Local communities
e) Persons materially affected by the management of e-water.

LTWP preparation in 2015 and 2020

Extensive consultation was undertaken by DEW during the preparation of the first LTWP. This was described in detail in the 2015 LTWP and is summarised below:

- South Australian scientific community, Indigenous representative bodies (Ngarrindjeri Regional Authority and First Peoples of the River Murray and Mallee Region) and regional environmental water practitioners.
- Scientific input from regional experts was provided through their involvement in the development of technical reports that formed the basis of the ecological content of the 2015 LTWP.
- Liaison with the MDBA, environmental water holders and upstream jurisdictions through the Environmental Watering Working Group (EWWG).
- Engagement of key regional stakeholder groups that were involved in environmental water management projects.
- Release of the draft LTWP for review by parties external to DEW, i.e. general public, Aboriginal representative bodies, key regional stakeholder groups, MDBA, CEWH and Basin jurisdictions.

Due to the extensive engagement undertaken on the 2015 LTWP, the targeted nature of the 2020 review and update, and the relatively minor changes, further consultation in relation to the 2020 update was undertaken with key stakeholders. DEW staff continued to engage with the MDBA, CEWH and interstate agencies through the Environmental Water Working Group (EWWG). DEW continue to engage with the River Nations on all aspects of environmental water planning and management.

LTWP update in 2025

Targeted consultation has been undertaken for the 2025 update with key stakeholders including: community members, holders and managers of Environmental Water, River Operators, Local Community members and persons materially affected by the management of environmental water. In addition:

- DEW staff continue to engage with the River Nations on all aspects of environmental water planning and management, including this 2025 LTWP update. An engagement plan was prepared to ensure there was consistent engagement across all 4 Nation groups in the region. Advice and approval was sought from the First Peoples of the River Murray and Mallee Region (FPRMMR) Working Group, River Murray and Mallee Aboriginal Corporation (RMMAC), Ngarrindjeri Aboriginal Corporation (NAC) and the South East Aboriginal Focus Group (SEAFG) and Mannum Aboriginal Community Association Incorporated (MACAI) on the preparation and inclusion of information relating to Aboriginal values and uses.
- Scientific input from experts was provided through their involvement in the development of technical reports that formed the basis of the revised ecological content of the 2025 LTWP.
- Engagement was undertaken with forums that comprise relevant community member participation, e.g. Coorong, Lower Lakes and Murray Mouth Community Advisory Panel, Murraylands and Riverland Landscape Board Water Advisory Committee and Landscape Boards of SA Chairs Forum.

- The draft LTWP was provided for review by parties external to DEW, including Aboriginal representative bodies, key regional stakeholder representatives, community members, Landscape Boards, MDBA, Environmental Water Holders, managers of PEW and Basin jurisdictions.

DEW greatly appreciates the time taken by organisations and individuals in reviewing and providing feedback on the SA River Murray LTWP and associated technical reports, which have contributed to a much-improved final product.

2.3.2 Basin-Wide Environmental Watering Strategy

The BWS was initially published by the MDBA in November 2014 with a second edition released in 2019 and a third in 2025. Its development is a specific requirement of the Basin Plan (section 8.13). The Basin Plan also states that long-term watering plans must be consistent with any particular assets or functions, and their requirements, identified within the BWS. LTWPs must also have regard for the broader principles and content of the BWS.

The purpose of the BWS is to assist environmental water holders and managers to plan and manage environmental watering at the Basin scale. The BWS identifies expected environmental outcomes for four ecological components or 'themes' (river flows and connectivity; native vegetation; waterbirds and fish (Murray-Darling Basin Authority, 2025)) and provides information to support the explanation of those outcomes. Only minor changes have been made to expected outcomes in the 2025 BWS. Assets considered important for supporting vegetation, waterbirds and native fish at the Basin-scale are identified in appendices of the BWS, and a number within the SA River Murray WRP area are listed. The BWS also includes a number of expected outcomes under each theme that are specific to the CLLMM.

Given the spatial scale applied to the identification of assets for this LTWP (see Section 4), the inclusion of vegetation, waterbird and native fish targets for these assets, the focus on connectivity as a priority ecosystem function and broader arrangements identified to align with the BWS, this LTWP is considered to be fully consistent with the BWS. The LTWP incorporates all sites listed as important for supporting Basin Plan outcomes and targets and objectives have been developed for all relevant expected environmental outcomes in each of the 4 ecological themes identified in the BWS. To further illustrate this, Appendix E demonstrates the alignment between the expected environmental outcomes of the 2025 BWS and the ecological objectives and targets identified for each of the PEAs in this LTWP.

2.3.3 International agreements

The Basin Plan requires that a LTWP must not be inconsistent with relevant international agreements (section 8.20 (5)), which includes the Ramsar Convention, the Bonn Convention, Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) and Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA). The methods for identifying environmental assets and their environmental watering requirements (section 8.49) also state that the ecological objectives of an environmental asset should be consistent with the criteria used to identify the asset and provide the example that if the asset is a declared Ramsar wetland, then the objectives must be directed towards maintaining the ecological character of the wetland.

Within the SA River Murray WRP area, there are three wetland and floodplain complexes that are included in the Ramsar List of Wetlands of International Importance (Table 2.1). The inclusion of a site in the Ramsar List involves a commitment to ensure that the ecological character of the site is maintained (where ecological character is the combination of the ecosystem components, processes and benefits/services[1] that characterise the wetland (Ramsar, 2009)). The ecological character of each of the three Ramsar wetlands was taken into account when

[1] The national framework for describing the ecological character of Ramsar wetlands within Australia (Department of the Environment, Water, Heritage and the Arts, 2008) provides the following definition: "benefits and services are defined in accordance with the Millennium Ecosystem Assessment definition of ecosystem services as 'the benefits that people receive from ecosystems' (Ramsar Convention 2005a, Resolution IX.1 Annex A)".

developing the ecological objectives and targets of the PEAs within the SA River Murray WRP area.[2] Consistency was achieved by ensuring that each critical component and process identified within the ecological character description of the three Ramsar wetlands was aligned with at least one ecological objective and target for the relevant PEA. This document does not, however, replace or supersede the work that is being undertaken on these wetlands specifically in association with their Ramsar listing but seeks to support the maintenance of ecological character by informing the management of environmental water.

Migratory bird species

Australia has signed three international bilateral agreements seeking to protect and conserve migratory birds and their important habitats in the East Asian - Australasian Flyway (Commonwealth of Australia, 2013a): JAMBA; CAMBA; ROKAMBA. Australia is also a party to the Bonn Convention (or the Convention on Migratory Species), which aims to conserve terrestrial, aquatic and avian migratory species throughout their range (UNEP/CMS, 2014).

Birds listed under the JAMBA, CAMBA or ROKAMBA and the Bonn Convention must also be placed on the migratory species list of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), which provides a legal framework within Australia to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places (Commonwealth of Australia, 2013a). EPBC-listed species, including migratory birds that have been recorded within the PEAs of the SA River Murray WRP area, are listed in Appendix D. The habitat and breeding requirements of these species have been considered in the development of the ecological objectives and targets of the PEAs.

Table 2.1. Ramsar wetlands in the SA River Murray WRP area

Site	Date of designation	Area	Coordinates [3]
Banrock Station Wetland Complex	21/10/02	1,375 hectares	34°11'S 140°20'E
Riverland	23/09/87	30,640 hectares	34°02'S 140°51'E
The Coorong and Lakes Alexandrina & Albert Wetland	01/11/85	142,530 hectares	35°56'S 139°18'E

2.4 Environmental water availability and management

2.4.1 Definition of environmental water

The environmental water available for use within the SA River Murray WRP Area consists of both 'held' and 'planned' environmental water, where:

- held environmental water (HEW) is water available under a water access right or held on a water licence for the purposes of achieving environmental outcomes (*Water Act 2007* section 4)

[2] At the time of writing, the ecological character description (ECD) for the Coorong Lakes Alexandrina and Albert Wetland was under revision. The ecological objectives and targets in this LTWP will be revised and updated, if required, in the future to reflect the revised ECD. Ngarrindjeri are formally engaged in this ECD revision (see section 4.1). The NRA have advised that this work takes into consideration Ramsar Convention resolutions pertaining to culture (Ramsar Convention 2002 & 2005) and will provide greater alignment of the management of the Ramsar site with other international agreements such as UNDRIP and further support South Australia in the implementation of Basin Plan requirements under Section 10, Part 14.

[3] Notional 'centre point' only

- planned environmental water (PEW) is water that is committed or preserved for achieving environmental outcomes through a plan or legislation, and cannot be used for any other purpose unless required for emergency purposes or specified times and circumstances (*Water Act 2007* section 6).

The full definitions for held and planned environmental water, as per the *Water Act 2007*, are provided in Appendix C.

The SA River Murray Water Resource Plan identifies held and planned environmental water in the South Australian River Murray (Department for Environment and Water, 2019a).

2.4.2 Held environmental water in the SA River Murray

South Australia has published a register of HEW for the SA River Murray WRP area as required under section 10.09 of the Basin Plan.

The *SA River Murray WRP area Held Environmental Water Register* is published on the DEW website and indicates a total HEW volume in the SA River Murray of approximately 254 GL at July 2025 (Department for Environment and Water, 2025d). The HEW register reflects all HEW held in SA and is maintained on an annual basis in accordance with section 5.3.2 of the SA River Murray WRP. However, future updates of the register will not translate into this document and readers should refer to the website for an up-to-date volume of HEW.

2.4.3 Planned environmental water in the SA River Murray

PEW is defined in Section 5.3.2 of the SA River Murray Water Resource Plan (Department for Environment and Water, 2019a). Further information regarding each type of PEW and protection under State water management law can also be found in Section 5.6.3.1 of the SA River Murray WRP.

Consistent with the definition in the Water Act, the following volumes are identified as PEW in the *South Australian River Murray Water Allocation Plan* (Murraylands and Riverland Landscape Board, 2023):

- Dilution and Loss (Principle 4 and 5 of the River Murray Water Allocation Plan (WAP)): PEW volume = the volume available for dilution loss purposes under clause 88(b)-(c) of the Agreement MINUS the volume made available for class 9 water access entitlement shares under the River Murray WAP from this source (Principles 21, 22, 30 and 31 River Murray WAP) MINUS the volume made available for other purposes under clause 88A of the Agreement (Principle 16 River Murray WAP).
- Unallocated Entitlement (Principle 1a.i and Principle 7-46 of the River Murray WAP): PEW volume = the unallocated portion of annual South Australian Entitlement MINUS any volume deferred under clause 91 of the Agreement (Principle 1b) MINUS the volume made available for class 9 water access entitlement shares under the River Murray WAP from this source (Principles 21, 22, 30 and 31 River Murray WAP).
- Unregulated Flow (Principle 6 of the River Murray WAP): PEW volume = unregulated flow to South Australia that cannot be allocated or used for consumptive purposes under the Agreement, unless required under emergency circumstances.
- Additional Dilution Flow (Principle 6 of the River Murray WAP): PEW volume = Additional Dilution Flow determined and delivered by the MDBA.
- Lindsay River Allowance (Principle 6 of the River Murray WAP): PEW volume = Lindsay River Allowance as the volume determined by the MDBA in accordance with River Murray Commission Meeting No 267 Agenda Item 12 (MDBA 2011).
- Eastern Mount Lofty Ranges (EMLR) inflows (Principle 1 of the River Murray WAP): PEW volume = flows received into the River Murray at Lake Alexandrina from the EMLR tributaries.

Principles 1 and 4-46 under the River Murray WAP (Murraylands and Riverland Landscape Board, 2023), which sits under the Landscape Act and operationalises the Basin Plan in South Australia, operate to provide a legislative

obligation that defines the consumptive pool and places an upper limit on the volume that can be allocated, therefore protecting the residual volumes as PEW. Sections 104(1), 104(3) and 104(4) of the Landscape Act also operate to provide a legislative obligation which assists in protecting PEW.

All water delivered to South Australia outside of South Australia's Entitlement (under clause 88 of the Agreement), excluding trade for consumptive purposes, is preserved for environmental purposes within the South Australian River Murray and South Australian Murray Region WRP areas.

2.4.4 South Australia's entitlement

Under the *Murray-Darling Basin Agreement 2008* (*Water Act 2007* (Cwlth) Schedule 1), South Australia is entitled to receive up to 1850 GL/year. The 1850 GL comprises:

- a volume of 58 GL/month (696 GL/year) for dilution and losses (clause 88b), unless the Ministerial Council determines otherwise
- a variable monthly volume of up to 1154 GL/year (clause 88a), unless restricted in a period of special accounting (clause 128). This volume is provided over a water year, in monthly quantities that vary according to the historical consumptive (irrigation) pattern of demand. Lesser volumes are provided in the cooler months (April to September), and peak volumes are delivered in the warmer months (December and January).

South Australia's Entitlement includes both held and planned environmental water. Currently, held environmental water that is part of South Australia's Entitlement is also provided in proportional monthly volumes that vary between months (Figure 2.2). However, this may change in the future if one of the following four mechanisms under the *Murray-Darling Basin Agreement 2008* (MDB Agreement) is implemented:

- Clause 90 Variation to South Australia's Entitlement
- Clause 91 South Australia's Storage Right
- change the timing of the delivery of held environmental water using trade
- permanent change to the pattern of delivery of South Australia's Entitlement (noting that this would require a change to the MDB Agreement).

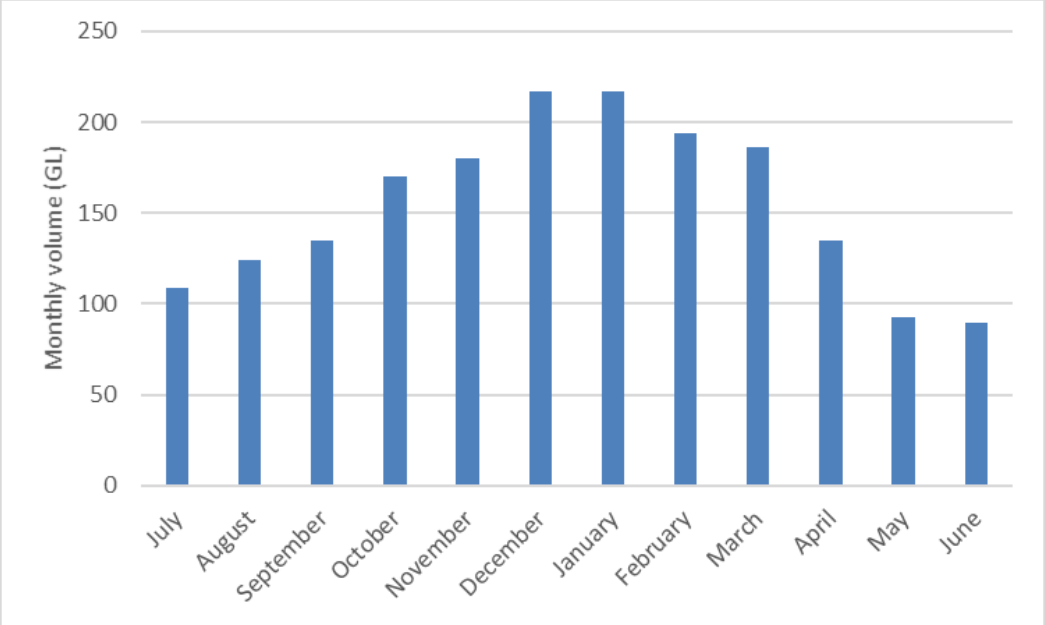

Figure 2.2. South Australian River Murray entitlement annual delivery pattern (at full entitlement)

2.4.5 Flows above South Australia's Entitlement

River Murray flows in addition to Entitlement may be comprised of:

- interstate water trade
- deliveries of deferred water (critical human water needs, private carry over)
- environmental water that is not traded
- Additional Dilution Flow (a volume of 3,000 ML/day that is released once storage volumes in Hume and Dartmouth Reservoirs and Menindee Lakes exceed specified triggers)
- Lindsay River Dilution Flow (the residual of a 250 ML/day 'Lindsay River Dilution Allowance' that is provided down the Lindsay River, via the Mullaroo Offtake, to meet water supply demands (of an acceptable quality) and losses in the Lindsay River. The residual is treated as an unaccounted return flow to South Australia and is additional to the South Australian Dilution and Loss Entitlement. It equates to ~70 GL/year)
- unregulated flow.

Environmental water allocations may be traded to South Australia from elsewhere in the SCB due to the direct allocation of environmental water to an action in the SA River Murray WRP area, or as return flows from an upstream watering action. These allocations are generally sourced from the CEWH portfolio or The Living Murray portfolio. Under some circumstances, the Victorian Environmental Water Holder (VEWH) may also trade environmental water to South Australia. These traded volumes are in addition to held and planned environmental water that is part of South Australia's Entitlement, and result in an increase in the flow to the South Australian border.

Arrangements for trading return flows to South Australia from environmental watering actions undertaken in New South Wales are still evolving as work on the implementation of NSW's pre-requisite policy measures continues (see Section 7.2).

2.4.6 Environmental water holders

There are three major environmental water holders that hold water access rights in the SA River Murray WRP area. The volume held by each is indicated in the HEW Register available on the DEW website (Department for Environment and Water, 2024).

Commonwealth Environmental Water Holder (CEWH)

The Commonwealth Environmental Water Holder (CEWH) manages the Commonwealth's environmental water portfolio, which has been created through water recovery or investment in water-saving infrastructure.

Decisions on the use of Commonwealth environmental water holdings are made by the CEWH. The majority of the South Australian held water is Class 3, therefore it may be traded for use in other SCB reaches and may not be prioritised for use at assets within South Australia. Alternatively, a greater volume than that held in South Australia is typically prioritised for South Australian assets, and this requires additional environmental water to be delivered to South Australia.

The Living Murray Program (TLM)

Advice and recommendations on the use of TLM water are provided through the Southern Connected Basin Environmental Watering Committee (SCBEWC), an inter-jurisdictional forum coordinated by the MDBA, where South Australia is represented by DEW. Similar to Commonwealth environmental water holdings, the water held by TLM in South Australia is not required to be prioritised for assets within South Australia; and a greater volume than that held in South Australia is typically allocated to South Australian assets.

South Australian Minister for Environment and Water

The South Australian Minister for Environment and Water holds water access entitlements that are committed to environmental purposes and form part of South Australia's Entitlement. The majority of the volume held is Class 9 water and is tied to the management of specific wetlands within the SA River Murray WRP area, such that there is limited flexibility in the use of this water. A small volume has been committed for environmental use through the *Implementation Plan for Augmentation of the Adelaide Desalination Plant*, and the location of its use is flexible (within the South Australian portion of the Murray-Darling Basin). Decisions on the allocation and use of this water are made within DEW according to the Policy for Use of the Minister's Reserve.

2.4.7 Managers of planned environmental water

Generally, PEW in South Australia is not actively managed but is delivered to the environment through normal river operations. DEW, SA Water and MDBA work co-operatively to manage water delivery arrangements. Management of unregulated flows is governed by the 'Use of Unregulated Flows Policy and Procedure.'

2.4.8 Environmental site managers

There are a number of environmental site managers within the SA River Murray WRP area, with varying levels of involvement and responsibilities in managing environmental water delivery to and within the assets. Key managers include various projects and programs within DEW as well as external organisations and individuals, including:

- Water, Infrastructure and Operations Branch, DEW – including The Living Murray Program (TLM)
- Murraylands and Riverland Landscape Board (MRLB)
- Ngarrindjeri Aboriginal Corporation (NAC)
- Ngarrindjeri Regional Authority (NRA)
- Mannum Aboriginal Community Association Incorporated (MACAI)
- First Peoples of the River Murray and Mallee Region (FPRMM)
- Australian Landscape Trust (ALT)
- Banrock Station
- Nature Foundation SA (NFSA)
- Renmark Irrigation Trust (RIT)
- Various local wetland community groups and landholders.

3 Planning approach

3.1 Asset scale

The key purpose of defining PEAs and their EWRs is to inform the allocation and delivery of environmental water, and contribute towards a healthy, functioning South Australian River Murray ecosystem. There are multiple means to deliver water for the environment within the SA River Murray WRP area (including flow provisions, infrastructure operations and pumping), all of which influence different areas, making the selection of an appropriate spatial scale for environmental assets challenging.

When selecting the spatial scale for environmental assets within this water resource plan area (WRP area), the following aspects of environmental water management were taken into account:

- planning (the identification of objectives, targets and EWRs)
- delivery (the allocation and delivery of environmental water)
- environmental water accounting (reporting, where possible at an asset-scale, on the volumes of held and planned water delivered)
- reporting on ecological outcomes (monitoring, evaluation and reporting on the response to environmental watering at an asset-scale).

Based on these considerations, a landscape-scale approach was chosen for defining environmental assets, with three assets identified within the SA River Murray WRP area (Figure 3.1):

1. the Coorong, Lower Lakes and Murray Mouth
2. the South Australian River Murray Channel
3. the South Australian River Murray Floodplain.

This spatial scale was chosen primarily because it reflects the ecological importance of the mosaic of habitats that comprise the South Australian River Murray ecosystem, rather than focussing on discrete management units that represent only a relatively small portion of the WRP area. It also ensures that a holistic approach is taken to environmental water planning, delivery and evaluation, enabling the contribution of outcomes at smaller scales to be considered towards the achievement of outcomes at the larger scale.

Each of the three environmental assets meets all five of the criteria for identifying an environmental asset provided in Schedule 8 of the Basin Plan.[4] The Basin Plan further defines a ***priority*** environmental asset as an environmental asset that can be managed with environmental water (section 8.49). The full extent of two of the three environmental assets within the SA River Murray WRP area can be managed with environmental water (in conjunction with unregulated flows): the South Australian River Murray Channel Asset and the CLLMM Asset. Therefore, for both of these, the PEA is equivalent to the environmental asset.

The South Australian River Murray Floodplain Asset extends to the 1956 flood level, requiring flows in excess of 100,000 ML/day QSA to be fully inundated. MDBA modelling indicates that 80,000 ML/day QSA is the maximum flow rate at which active management of environmental water can occur, either through releases of held environmental water from storages or changes in dam storage operations (subject to the implementation of the Constraint Management Strategy), although releases of environmental water under higher flow conditions from Lake Victoria or Menindee may be possible. In addition, delivery through the operation of infrastructure is highly

[4] Evidence that the assets meets the Basin Plan Schedule 8 Criteria for Identifying an Environmental Asset is provided throughout this document where the individual assets are described in more detail, as well as in key references.

unlikely under flows of greater than 80,000 ML/day, with weirs along the River Murray in South Australia ceasing operation once flows exceed between 55,000 and 70,000 ML/day (depending on the lock). For these reasons, the South Australian River Murray Floodplain PEA is considered to be the portion of the Floodplain Asset that is inundated by flows up to and including 80,000 ML/day QSA, which is approximately 60% of the total floodplain (compare Figure 3.1 and Figure 3.2). This threshold is based on modelled data and may be altered in the future.

The three PEAs of the SA River Murray WRP area are:

1. the Coorong, Lower Lakes and Murray Mouth Priority Environmental Asset ('the CLLMM PEA')
2. the South Australian River Murray Channel Priority Environmental Asset ('the Channel PEA')
3. the South Australian River Murray Floodplain Priority Environmental Asset ('the Floodplain PEA').

It should be noted that the term 'priority' is used throughout this document in accordance with the Basin Plan definition and is based on the operational feasibility of delivering environmental water. Despite not being part of the 'priority' asset, the outer floodplain (i.e. the area that requires flows greater than 80,000 ML/day QSA to be inundated) is still considered to be an area of high importance to South Australia for many reasons, including supporting a large proportion of the black box woodlands within the WRP area, and connecting riparian zones with upland habitats. The close association of these two habitat types is important for many species including such as the Regent Parrot (a nationally and state-listed threatened species) which nests in floodplain trees but feeds in mallee vegetation (Ecological Associates, 2010). The Riverland Ramsar site also contains a significant area of floodplain that requires flows of greater than 80,000 ML/day.

Unregulated flows of greater than 80,000 ML/day QSA support the health of high elevation floodplain areas and it is critical that there is no further reduction in the occurrence of unregulated flow events that are required to inundate the outer floodplain (Government of South Australia, 2012). Further research is needed to better understand the condition of the outer floodplain and the role that it plays in the South Australian River Murray ecosystem, including the importance of providing connectivity to the adjacent uplands.

The following sections of the LTWP provide further information for each of the PEAs, including:

- Location and geographic extent
- Conservation significance
- Ecological attributes
- Ecological objectives, targets and EWRs.

3.2 Identifying ecological objectives, targets and EWRs for the priority environmental assets

The ecological objectives, targets and EWRs within this LTWP represent what is needed in order to support each of the PEAs in a healthy, functioning state. They were initially identified through three sub-projects that consolidated many years of knowledge and experience from projects and programs such as The Living Murray Initiative and Murray Futures. A full description of the original ecological objectives, targets and original EWRs, and the methods and detailed background information (including conceptual models and hydrological modelling) used in their development, is presented in four separate background reports:

- Ecological objectives, targets and environmental water requirements for the South Australian River Murray Floodplain environmental asset (Kilsby, et al., 2015)
- Ecological objectives, targets and environmental water requirements for the Coorong, Lower Lakes and Murray Mouth (O'Connor, et al., 2015)

- River Murray Channel environmental water requirements: Ecological objectives and targets (Wallace, et al., 2014a)
- River Murray Channel environmental water requirements: Hydrodynamic modelling results and conceptual models (Wallace, et al., 2014b).

Given the increase in knowledge and lessons leaned over the preceding 10 years, a project was instigated to review and update the ecological objectives and targets for the priority ecological assets. The approach to the update was to engage subject matter experts to review the initial objectives and targets and provide advice as to whether they should change along with a rationale. For a full description of the method, updated objectives, targets and expected contribution of the EWRs to the achieve of the targets, refer to 2 separate reports:

- Review and update of the ecological objectives and targets for the channel and floodplain priority ecological assets (Department for Environment and Water, 2025)
- Review and update of the ecological objectives and targets for the Coorong, Lower Lakes and Murray Mouth priority ecological asset (Department for Environment and Water, 2025a).

Updated EWRs and the methods used to revise them are presented in the following report prepared for DEW:

- Revision of South Australia's in-channel, floodplain and Coorong, Lower Lakes and Murray Mouth environmental water requirements (Gehrig, et al., 2020).

A consistent approach was taken when identifying ecological objectives, ecological targets and EWRs for all three of the PEAs:

- Each of the ecological objectives provides 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 focussed on a key biotic group or ecological process; however, the inter-dependencies between the objectives should not be overlooked.
- 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', i.e. specific, measurable, achievable, realistic and time bound. This format informs monitoring and provides a means of assessing the change in condition and progress towards achieving the objectives. This assessment should not be undertaken as a pass or fail on an annual basis but rather as a consideration of trajectory over longer timeframes (see pp 26-27 in Wallace, et al., 2014a).
- The EWRs are descriptions of the water regimes needed to sustain the ecological values of the PEAs at a low level of risk (Department of Environment, Water and Natural Resources, 2014a). They represent a hydrological regime in the appropriate metrics for the given environmental asset. The EWRs are based on hydrological, hydraulic and hydrodynamic modelling outputs together with an understanding of the needs of different biota and processes. The feasibility of meeting the EWRs under various Basin Plan water recovery and constraint management scenarios has not been tested.

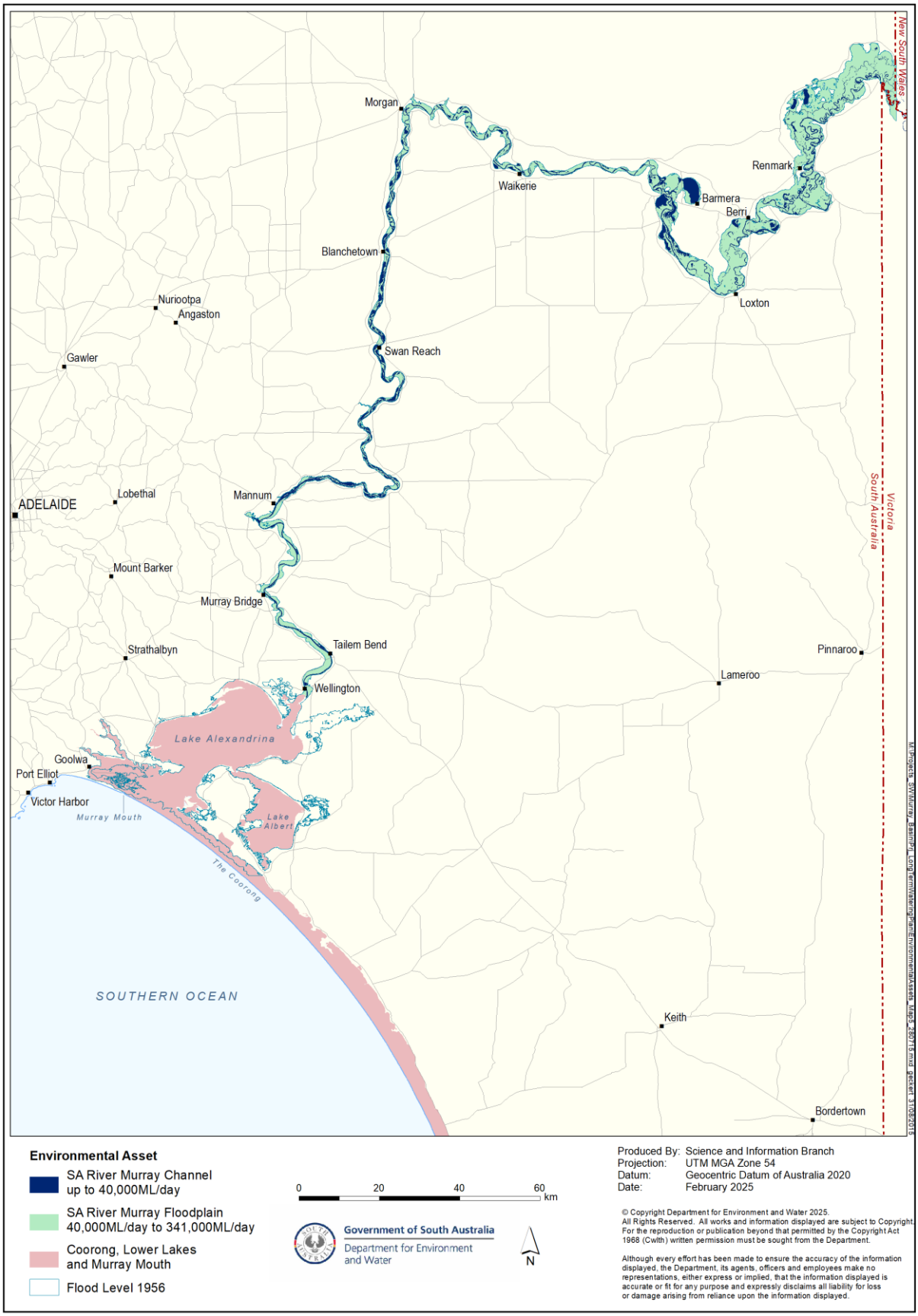

Figure 3.1. Map of the three environmental assets within the SA River Murray WRP area

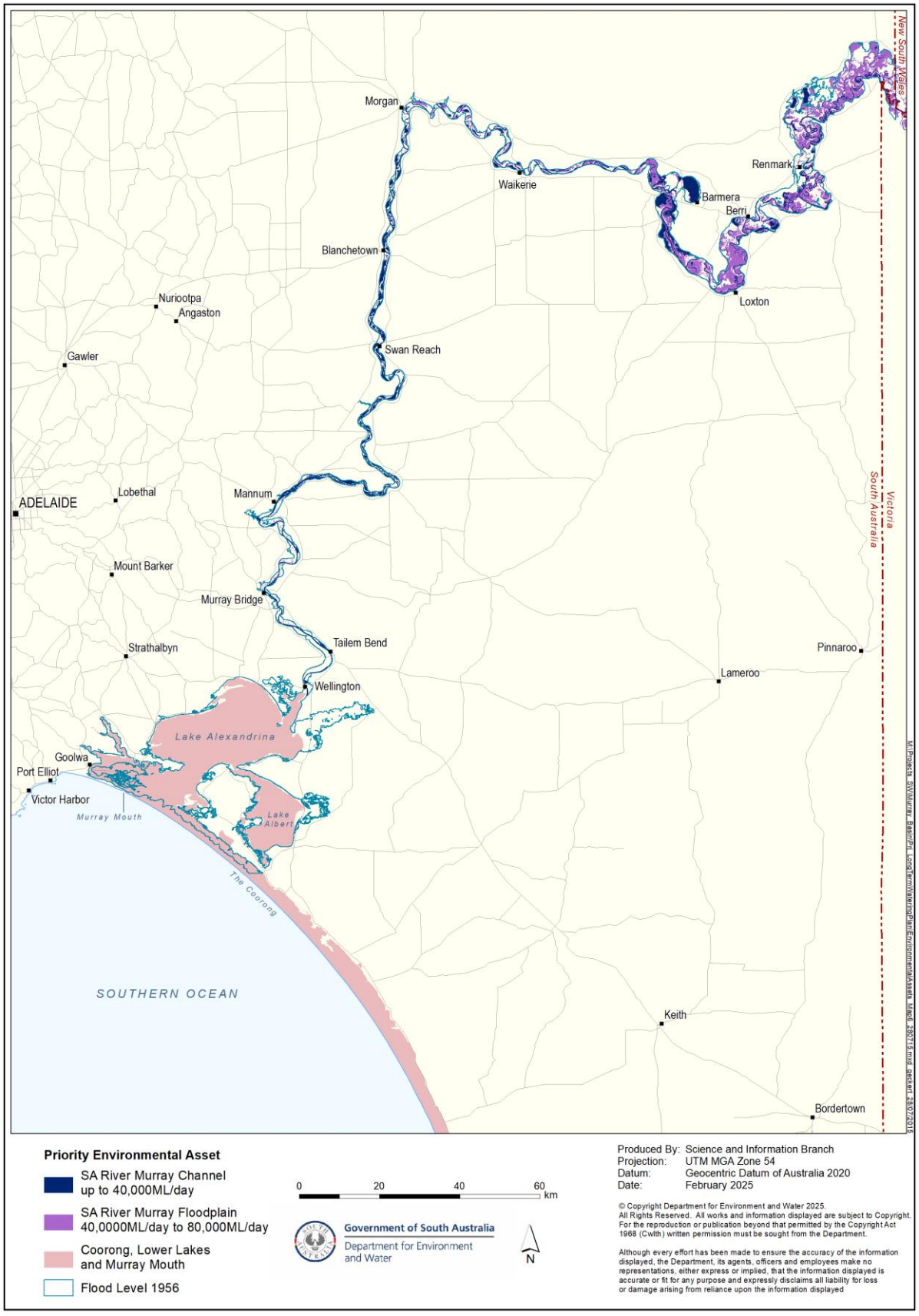

Figure 3.2. Map of the three PEAs within the SA River Murray WRP area

3.3 Having regard for groundwater

Consideration was given to groundwater during the development of the EWRs. While no groundwater metrics are expressed in the EWRs, consideration was given to groundwater during the development of the EWRs. Regional groundwater is highly saline and groundwater-derived base flows do not contribute to meeting the EWRs of the Channel and Floodplain assets. Ecological targets relating to groundwater have been expressed for the Channel and the Floodplain (refer to Table 4.1).

There is very little known about groundwater flows to or from the CLLMM. With Lakes Alexandrina and Albert being such large bodies of surface water, groundwater levels in the surrounding shallow aquifers are strongly influenced by water levels in the Lakes; however, there is insufficient data to quantify this relationship. Freshwater soaks along the edge of the Coorong are important ecologically, but are primarily rainfall-fed. There are indications that groundwater discharge is widespread in the Coorong South Lagoon; however, no estimate of volume is currently available (Haese, et al., 2008).

4 Priority environmental assets

4.1 The SA River Murray channel priority environmental asset

4.1.1 Location and geographic extent

The South Australian River Murray Channel Priority Environmental Asset ('the Channel PEA') covers an area of approximately 28,800 hectares (Figure 4.1 and Figure 4.2). The longitudinal extent is from Wellington, South Australia, to the South Australian border - a total distance of approximately 560 River kilometres. The lateral extent consists of the area that is inundated at flows up to 40,000 ML/day QSA (under normal River operations), which is considered to be the discharge at which overbank flows commence and water starts to spread more broadly across the floodplain. The Channel PEA incorporates ephemeral habitats as well as areas of permanent water, including the main River channel, and permanently inundated wetlands and anabranches (where anabranches are distinguished as flowing habitats).

4.1.2 Conservation significance

The Channel PEA intersects two Ramsar-listed Wetlands of International Importance - the Riverland Ramsar Site and Banrock Station Wetland Complex.

The Riverland Ramsar site is described in (Newell, Lloyd, Gell, & K, 2009). The site extends from Renmark, South Australia, to the New South Wales/Victoria/South Australian border (approximately 80 River kilometres). It encompasses the floodplain on both sides of the River, covering a total area of 30,615 hectares. The permanent waterbodies and the areas that are inundated by flows up to 40,000 ML/day QSA (approximately 3,840 hectares) fall within the Channel PEA.

The Banrock Station Wetland Complex Ramsar site is described in (Butcher, Hale, Muller, & and Kobryn, 2009). It is located approximately 430 River kilometres from the Murray Mouth and covers a total area of 1,375 hectares, which includes 1,068 hectares of floodplain and 307 hectares of mallee uplands. The part of the floodplain that is inundated by flows up to 40,000 ML/day QSA (approximately 190 hectares) falls within the Channel PEA.

The Living Murray Initiative (TLM) recognises 8 icon sites for their high ecological and cultural values (Murray-Darling Basin Authority, 2024), including the River Murray Channel TLM icon site. The icon site extends for over 2,000 River kilometres from Hume Dam near Albury, New South Wales, to Wellington, South Australia (Murray-Darling Basin Authority, 2024). The icon site is separated into five reaches, two of which occur in South Australia. The vision for the River Murray Channel icon site is 'a healthy and productive River Murray' (Commonwealth of Australia, 2015a). There is consistency between the vision and extent of the South Australian reaches of the icon site and the Channel PEA. The Channel PEA also intersects the Chowilla Floodplain TLM icon site, namely the section of the Chowilla Floodplain that is within the SA River Murray WRP area and is inundated by up to 40,000 ML/day QSA.

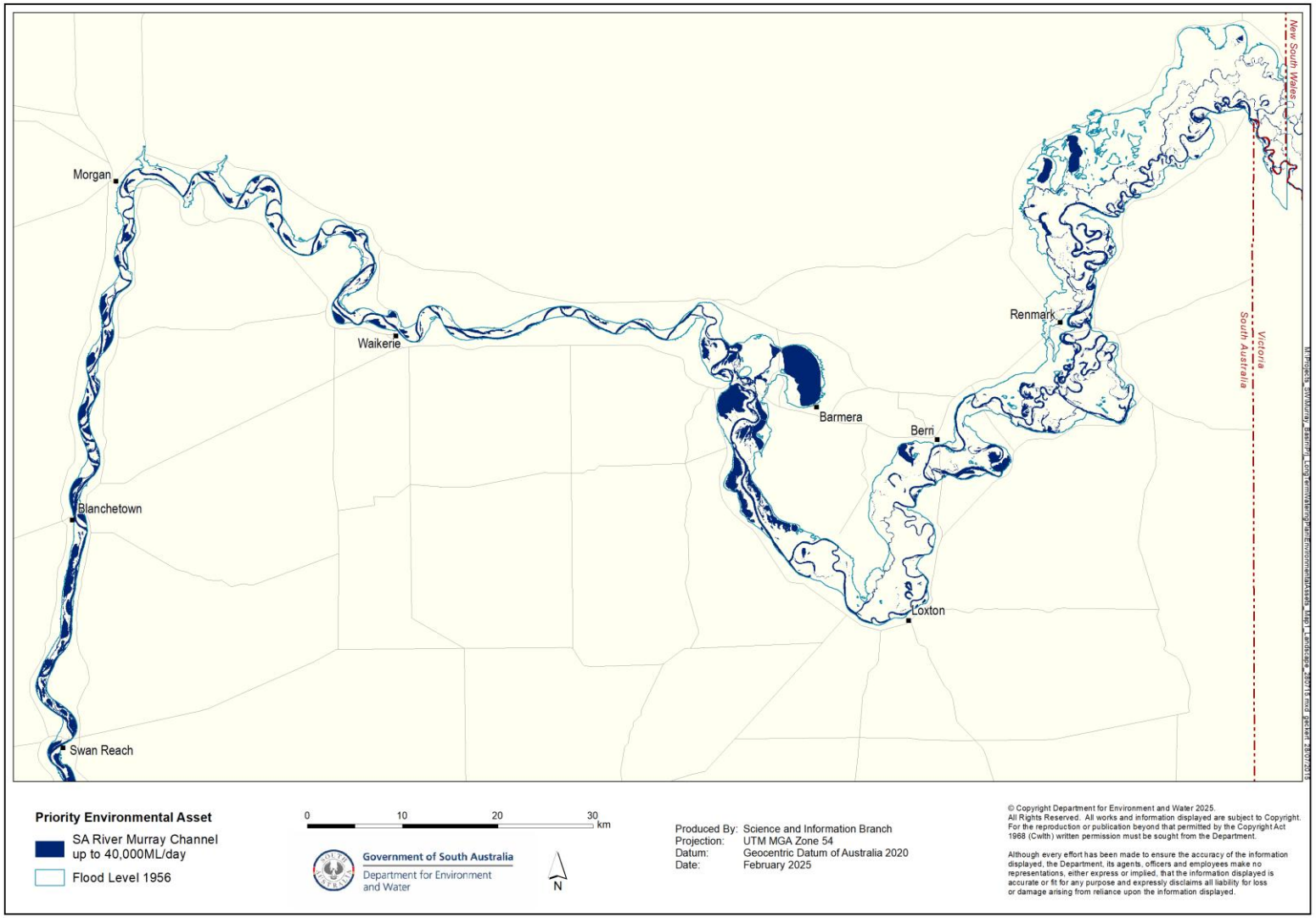

Figure 4.1. Spatial extent of the Channel PEA between the border and Swan Reach

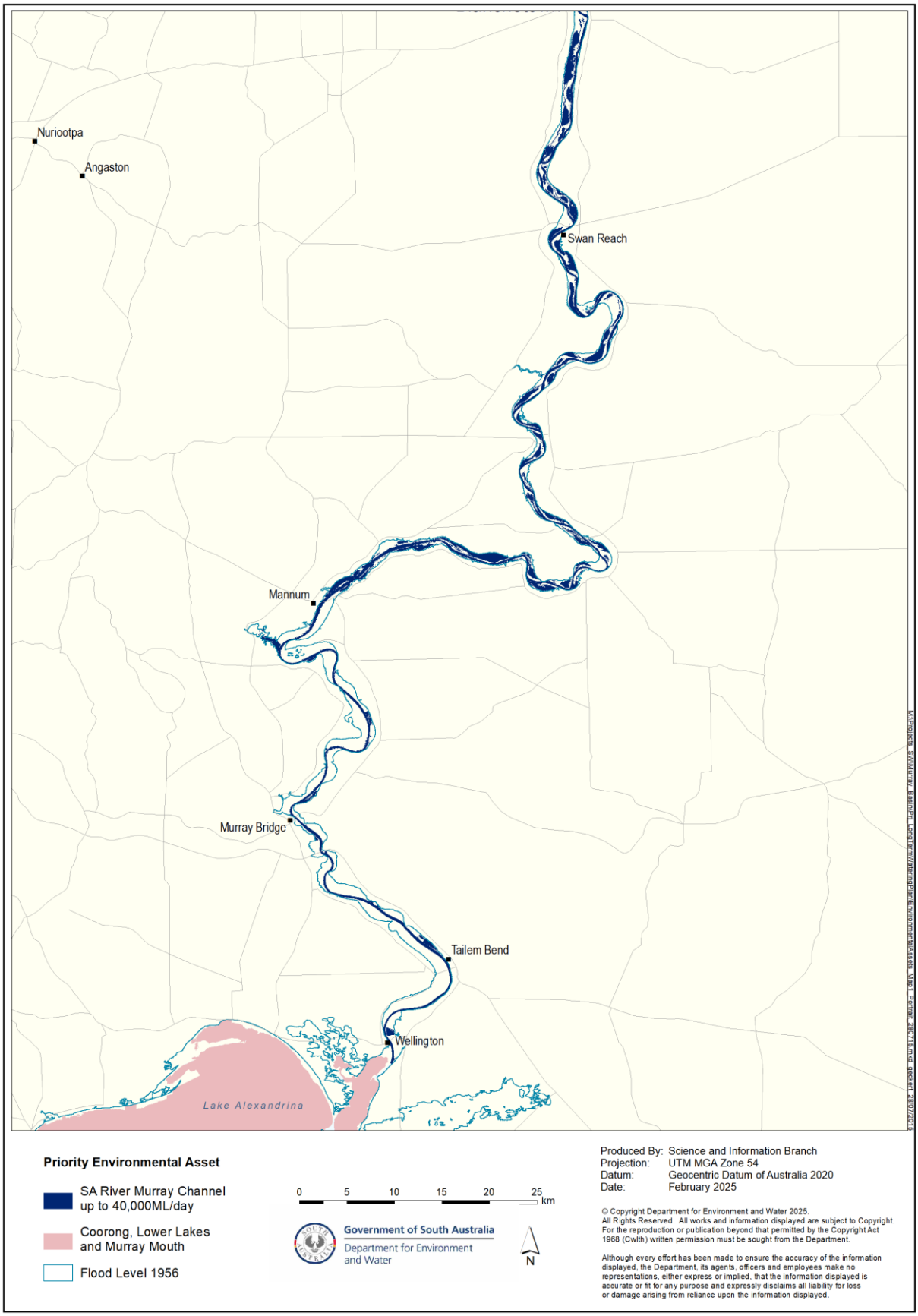

Figure 4.2. Spatial extent of the Channel PEA between Swan Reach and Wellington

Data from the DEW's biological database indicates that within the Channel PEA the following species of conservation significance have been recorded at least once[5]:

- 51 plant taxa (Table listed as Endangered, Vulnerable or Rare under the South Australian *National Parks and Wildlife Act 1972* ('state-listed') and/or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- 67 protected fauna taxa (Appendix D), of which 56 are state-listed and 18 are listed as nationally threatened under the EPBC Act
- 16 migratory birds that are listed under international agreements (Appendix D).

4.1.3 Ecological attributes

In 2014, a project was undertaken through the Goyder Institute for Water Research to identify ecological objectives and targets for in-channel habitats and processes, as well as the EWRs needed to meet those targets (Wallace, et al., 2014a). In doing so, a series of conceptual models describing the hydro-ecological relationships for key components of the Channel asset were developed (Wallace, et al., 2014b). Building on this work, conceptual models from Bice et. al. (2014), Wallace et al. (2021) and unpublished DEW (2016) were also considered. Ecological attributes include:

- Woodland dependant fauna – terrestrial birds, reptiles and mammals
- Wetland dependent fauna – waterbirds, frogs and turtles
- Lateral and longitudinal connectivity – basal food resources, invertebrate food resources, water column stratification, hydraulic conditions, River channel and wetland connectivity and salt export
- Water quality – phytoplankton blooms, dissolved oxygen, in-stream salinity, in-steam pH
- Native fish – Murray cod, Golden perch, Silver perch and freshwater catfish
- Floodplain trees – River redgum, River cooba
- Shrublands – lignum shrublands
- Non-woody vegetation – permanently inundated areas, frequently inundated temporary wetlands and shedding floodplain
- Groundwater – groundwater depth
- Soil condition – soil water potential and soil salinity.

The revised attributes acknowledge the hydrological continuity between the channel and floodplain PEAs, rather than treating the 40,000 ML/day flow band as a strict boundary. It also acknowledges that biotic and ecological responses do not stop and start at the PEA boundary (Department for Environment and Water, 2025). Hence the attributes identified above for the channel PEA largely apply to the floodplain PEA (see section 4.2.3).

4.1.4 Ecological objectives, targets and environmental water requirements

A total of 15 ecological objectives and 63 nested ecological targets have been identified for the Channel PEA. 20 ecological targets are unique to the Channel PEA, while 43 of the targets are shared with the floodplain PEA.

[5] Presence/absence records from DEW's biological database have been provided as an indication of the number of threatened species that have been found within each PEA only. Currently there are very few fish records and no invertebrate records entered into the dataset. This is not a comprehensive list and does not reflect species records that have not been provided to DEW for input to the database.

Table 4.1 taken from (Department for Environment and Water, 2025), these objectives and targets focus on both biotic and abiotic processes.

Gehrig, et al., 2020 identified four EWRs with target discharges ranging from 10,000 to 40,000 ML/day QSA for the Channel PEA. Together the EWRs describe the desired variable flow regime to meet the ecological objectives and targets. The metrics for the Channel PEA EWRs include:

- target discharge - measured as ML/day QSA, the EWR specifies a value that the discharge should be equal to or greater than
- duration - the number of days that the discharge needs to remain at or above a specified value
- timing - the timing during which the EWR event needs to occur
- frequency - how often the EWR event needs to occur within a specified period; the frequency metric is expressed in 3 formats to aid interpretation and represent variability (not a regular pattern)
- maximum rates of rise and fall - represented as the change in water level over time (metres per day) and change in discharge over time or ML/day; in the lower Murray, the rate of change is influenced by a change in discharge and weir operations
- critical maximum interval - the maximum number of years between events that meet the EWR metrics

Table 4.1. Ecological objectives and targets for the SA River Murray Channel PEA

Table taken from DEW (2025).

Attribute	Group	Ecological objective	Channel Ecological Target
Lateral and longitudinal connectivity	Basal food resources	Restore lateral and longitudinal connectivity to support basal and secondary productivity, and flow dependent processes including salt export	Dissolved organic carbon concentration increases from baseflow values (3-4 mg/L) to ≥6 mg/L during the rising limb of hydrographs.
	Invertebrate food resources		Mean microinvertebrate abundance in the main channel is ≥1,000 individuals/L during late spring/early summer
			Peak microinvertebrate abundance in the main channel is ≥2,000 individuals/L during late spring/early summer
			During late spring/early summer, at least 25% of the microinvertebrate assemblage in the main channel is comprised of individuals from the littoral functional groups (e.g. littoral rotifers, cyclopoid copepods and cladocerans)
			During late spring/early summer the density of cyclopoid copepods and cladocerans is 100–1000 individuals/L within 3 weeks of inundation of shedding and retaining habitats on the floodplain
	Water column stratification		Maintain passing flows at the downstream side of the locks above 4,000 ML/day to ensure at least one mixing event per day
			Maintain passing flows at the downstream side of the locks above 10,000 ML/day to provide sufficient turbulence intensity to support downstream drift
	Hydraulic conditions		Maintain contiguous flowing habitat with velocity ≥0.2 ms-1 from the junction of the Murray and Darling Rivers to Wellington during late spring-early summer to facilitate downstream transport/dispersal of drift dependent biota

Attribute	Group	Ecological objective	Channel Ecological Target
			Maintain contiguous flowing habitat with velocity ≥0.3 ms-1 from the junction of the Murray and Darling Rivers to Wellington during late spring-early summer to restore high value hydraulic habitat
	River channel-wetland connectivity		≥75% of ephemeral wetland area is inundated with lateral connectivity to the river/creek for a minimum of 20 continuous days at least once every 3 years
	Salt export		Salt export, averaged over the preceding 3 years, is ≥2 million tonnes per year
Water quality	Phytoplankton blooms	Maintain water quality conducive to supporting biota, and have regard to consumptive and recreational use of river water	Algal cell counts and toxin concentrations for cyanobacteria remain within the parameters used by SA Water for managing risks related to algal blooms
	Dissolved oxygen		Dissolved Oxygen remains above 6 mgO2/L (or 90% saturation) in the main channel and connected anabranch creeks at all times
	In-stream salinity		Salinity remains below 1,000 mg/L (EC = 1,800 µScm-1) 100% of the time in the main channel and connected anabranch creeks
			Increase in in-stream salinity facilitated by environmental watering actions does not exceed >200 EC for more than two weeks
	In-stream pH		Water column pH in the main channel and connected anabranch creeks remains within 6.5-9.0 100% of the time
Native fish	Murray cod	Restore resilient populations of Murray cod *(Maccullochella peelii)*	Population age structure of Murray cod includes recent recruits, subadults and adults in 9 years in 10
			Abundance (measured as CPUE) of Murray cod exhibits a positive trajectory and increases by ≥50% over a 10-year period
	Golden Perch	Restore resilient populations of golden perch *(Macquaria ambigua)*	Population age structure of golden perch indicates a large recruitment event 2 years in 5, demonstrated by separate cohorts that combined, represent >30% of the population.

Attribute	Group	Ecological objective	Channel Ecological Target
			Abundance (measured as CPUE) of golden perch exhibits a positive trajectory and increases by ≥30% over a 5-year period
			Cohorts of golden perch originate from multiple spatial recruitment sources including the lower Murray
	Silver Perch	Restore resilient populations of silver perch *(Bidyanus bidyanus)*	Population age structure of silver perch indicates recruitment 4 years in 5, indicated by presence of year classes
			Abundance (measured as CPUE) of silver perch exhibits a positive trajectory and increases by ≥30% over a 5-year period
			Cohorts of silver perch originate from multiple spatial recruitment sources including the lower Murray
	Freshwater catfish	Restore resilient populations of freshwater catfish *(Tandanus tandanus)*	Population age structure of freshwater catfish includes recent recruits, subadults and adults in 9 years in 10
			Abundance (measured as CPUE) of freshwater catfish exhibits a positive trajectory and increases by ≥50% over a 10-year period
Floodplain trees	River Red Gum	Maintain spatial extent and restore ecologically functional River Red Gum woodlands	In standardised transects spanning the elevation gradient, ≥90% of viable River Red Gum will have a Tree Condition Index Score ≥10
			Effective regeneration of River Red Gum woodlands at least 1 in 10 years, as evidenced by >85 % of assessment areas containing saplings and/or sub-adult trees (DBH <10cm) comprising >30% of the population
			The rate of loss (die back to a TCI = 0) of mature River Red Gums will not exceed 0.15% per year
	River Cooba	Maintain spatial extent and restore ecologically functional River Cooba woodlands	In standardised transects spanning the elevation gradient, ≥90% of viable River Cooba will have a Tree Condition Index Score ≥10

Attribute	Group	Ecological objective	Channel Ecological Target
Shrublands	Lignum shrublands	Maintain spatial extent and restore ecologically functional lignum shrublands	30% of lignum sites receive condition values indicative of good condition at least once every 2 years
			60% of lignum sites receive condition values indicative of good condition at least once every 3 years
			80% of lignum sites receive condition values indicative of good condition at least once every 4 years
			Percentage of dead (non-viable plants) within assessment areas decreases
Non-woody vegetation	Permanently inundated areas	Establish ecologically functional native understorey vegetation community in permanently inundated habitats	In permanently inundated channels and pool connected wetlands, a minimum of 90% of survey cells located on the bed, bank toe, slope and crest are either inundated or contain native flood-dependent and/or amphibious taxa at least once every 2 years
			In permanently inundated channels and pool connected wetlands, survey cells will have species richness of native flood-dependent, amphibious and aquatic plants ≥ 60 at least once every 2 years
	Frequently inundated temporary wetlands and shedding floodplain	Establish ecologically functional native understorey vegetation community in frequently inundated habitats	In temporary wetlands inundated at flows ≤40,000 MLday-1, a minimum of 70% of survey cells located on the bed, bank toe, slope and crest are either inundated or contain native flood-dependent and/or amphibious taxa at least once every 2 years
			In temporary wetlands inundated at flows ≤40,000 MLday-1, survey cells will have species richness of native flood-dependent, amphibious and aquatic plants ≥ 80 at least once every 2 years
			The shedding floodplain inundated at flows ≤40,000 MLday-1 has a minimum of 70% of survey cells either inundated or containing native flood-dependent and/or amphibious taxa at least once every 2 years

Attribute	Group	Ecological objective	Channel Ecological Target
			The shedding floodplain inundated at flows ≤40,000 MLday-1 survey cells will have species richness of native flood-dependent, amphibious and aquatic plants ≥ 80 at least once every 2 years
Groundwater	Groundwater depth	Establish and maintain groundwater conditions conducive to supporting diverse ecologically functional native vegetation	Where the watertable resides within the active rooting depth, groundwater salinity in the top one metre of the saturated zone is within the range utilisable as a water source for river red gum (≤ 5,000 µScm-1)
			Where groundwater salinity in the top 1 metre of the saturated zone exceeds the range utilisable as a water source for trees, depth to groundwater returns to pre-watering baseline values during inter-flood periods
Soil condition	Soil water potential	Establish soil conditions conducive to supporting diverse ecologically functional non-woody native vegetation	In River Red Gum woodlands, at least one depth interval between 0.2 m and the water table has soil water potential ≥ -1.0 MPa
			In lignum shrublands, at least one depth interval between 0.2 m and the water table has soil water potential ≥ -2.0 MPa
	Soil salinity		Soil salinity (EC 1:5) is <2,700 µScm-1 in the 0.2-0.5 m depth interval
			Soil salinity (EC 1:5) is <1,300 µScm-1 (non-moderately saline) in the 0.2-0.5 m depth interval at least once every 2 years in the Channel PEA
Woodland dependent fauna	Terrestrial birds	Restore resilient populations of native semi-aquatic and terrestrial reptiles, mammals and birds	Across all sites, independent of habitat type, terrestrial bird species richness measured across all four seasons within one year is maintained at or above 78 species
			Across all sites, independent of habitat type, terrestrial bird species richness measured over a rolling four-year period is maintained at or above 110 species

Attribute	Group	Ecological objective	Channel Ecological Target
	Reptiles and mammals		Each of the terrestrial reptile species that use the littoral and/or floodplain zones are recorded across ≥50% of sites within their known distribution at least once every two years
			Each of the terrestrial mammal species that use the littoral and/or floodplain zones for are recorded across ≥50% of sites within their known distribution at least once every two years
			Each of the 15 bat species known to occur within the asset will be detected across ≥ 75% of sites within their known distribution at least once every two years
Wetland dependent fauna	Waterbirds	Restore resilient populations of waterbirds, frogs and turtles	Increase the spatial extent of productive foraging zones (inundated mud flats, shallow water) by 50% above that occurring under entitlement flow and normal weir pool conditions to support adult waterbirds and survival of juveniles/sub-adults during spring-summer for ≥30 days
			Maintain the water depth and duration of inundation of emergent vegetation required to support waterbird breeding through to completion (egg laying, fledging and post fledging care) at least 3 years in 10 with a maximum return interval of 5 years.
			Annual species richness of waterbirds is maintained at ≥ 55 species
			Over a three-year period, species richness is maintained at ≥ 60 species, and includes small-bodied migratory waders
	Frogs		Each of the 10 frog species known to occur within the asset will be detected at least once every two years at 75% of surveyed sites within their known distribution within the channel PEA
			Tadpoles from each of the 10 frog species known to occur within the asset will be recorded in achieve later stages of metamorphosis

Attribute	Group	Ecological objective	Channel Ecological Target
			(Gosner stage >36), 3 years in 10 with a maximum 3 year return interval
			Maintain the existing distribution of the nationally listed Southern Bell Frog (Litoria raniformis) as evidenced by detection of adults 3 years in 5 within their known distribution
	Turtles		Population age structure of turtles indicates an effective recruitment event 1 year in 5 (max 7 years), demonstrated by separate cohorts of juveniles/sub-adults and adults of each species
			Abundance (measured as CPUE) of juvenile/sub-adult turtles of each species exhibits a positive trajectory and increases by ≥30% over a 5-year period
			Abundance (measured as CPUE) of adult turtles of each species exhibits a positive trajectory and increases by ≥30% over a 10-year period
			All three species are recorded annually in 90% of sampling sites within permanent mesohabitats along length of PEA
			Long neck turtles are recorded annually in 90% of sampling sites within inundated temporary wetlands along the length of the PEA

Table 4.2. Environmental water requirements for the SA River Murray channel PEA

Table taken from Gehrig et.al (2020).

EWR #	Target discharge (ML/day QSA)	Duration (days)	Timing (months)	Frequency* (# flows-per-ARI; [% of years]; {#yr in 10-yr})	Critical Maximum Interval^ (years)	Rate of water level rise# (m/day or [ML/day])	Rate of water level fall (m/day or [ML/day])
EF^^	≥3,000	365	All year	1-in-1 [100%] {10 yr in 10}	0	N/A	N/A
IC1	≥10,000	≥60	Sep–Mar	1-in-1.05 [95%] {9–10 yr in 10}	2	0.05 [465]	0.025 [232.50]
IC2	≥20,000	≥60	Oct–Dec	1-in-1.33 [75%] {6–7 yr in 10}	3	0.05 [465]	0.025 [232.50]
IC3	≥30,000	≥60	Oct–Dec	1-in-1.54 [65%] {5–6 yr in 10}	4	0.05 [465]	0.025 [232.50]
IC4	≥40,000	≥60	Oct–Dec	1-in-2.22 [45%] {4–5 yr in 10}	5	0.05 [465]	0.025 [232.50]

*Frequency is expressed as: 1) number of flows per Average Return Interval (ARI), 2) percentage of years and 3) the number of years that the EWR should occur within a 10-yr period.
^represents the critical maximum interval (years) between EWRs before a significant decline in IC condition is likely to occur. This period should not be exceeded wherever possible.
#rate of rise and fall presented as m/day or ML/day.
^^EF = Entitlement Flow and is not an EWR.

4.2 The SA River Murray floodplain priority environmental asset

4.2.1 Location and geographic extent

The South Australian River Murray Floodplain Priority Environmental Asset ('the Floodplain PEA') covers an area of approximately 54,300 hectares (Figure 4.3 and Figure 4.4). The longitudinal extent is equivalent to the Channel PEA, extending from Wellington, South Australia, to the South Australian border - a total distance of approximately 560 River kilometres. The Floodplain PEA consists of the area that is inundated when flows are between 40,000 and 80,000 ML/day QSA (under normal River operations). It runs immediately adjacent to the Channel PEA, and at any given cross-section the Channel PEA must be fully inundated before inundation of the Floodplain PEA commences. The outer floodplain, which requires flow of greater than 80,000 ML/day QSA to be inundated, is also ecologically important. However, it is unable to be managed with environmental water and so does not meet the Basin Plan definition of a PEA.

The Floodplain PEA consists of a mosaic of ephemeral habitats. A key factor is the influence of landform on water retention capacity as high flows recede, with some areas shedding water ('shedding floodplain') and others retaining water in depressions or basins ('temporary wetlands'). The Floodplain PEA does not contain any areas of permanent water and the distance to the main River channel differs along the length of the floodplain. Above Overland Corner is the Valley geomorphic zone where the floodplain is up to 10 kilometres wide, while below Overland Corner is the Gorge geomorphic zone which is constrained to approximately 2 - 3 kilometres (Walker

and Thoms 1993). The area between Mannum and Wellington is dominated by reclaimed swamps and very little floodplain habitat remains.

4.2.2 Conservation significance

The Floodplain PEA intersects two Ramsar-listed Wetlands of International Importance - the Riverland Ramsar Site and Banrock Station Wetland Complex (see Section 4.1.2 for brief descriptions). The areas of these Ramsar sites that are inundated by flows between 40,000 and 80,000 ML/day QSA (approximately 13,250 hectares and 710 hectares, respectively) fall within the Floodplain PEA.

The Floodplain PEA intersects the portion of the Chowilla Floodplain (an Icon Site under TLM) that is within the SA River Murray WRP area and comprises a large part of the Riverland Ramsar Site, which is inundated by flows between 40,000 and 80,000 ML/day QSA.

Data from DEW's biological database indicates that within the Floodplain PEA the following species of conservation significance have been recorded at least once[6]:

- 46 plant species (Appendix D) listed as Critically Endangered, Endangered, Vulnerable or Rare under the South Australian *National Parks and Wildlife Act 1972* ('state-listed') *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- 57 protected fauna species (Appendix D) of which 48 are state-listed species and 14 species are listed as nationally threatened under the EPBC Act
- 11 migratory bird species that are listed under international agreements (Appendix D).

[6] Presence/absence records from DEW's biological database have been provided as an indication of the number of threatened species that have been found within each PEA only. Currently there are very few fish records and no invertebrate records entered into the dataset. This is not a comprehensive list and does not reflect species records that have not been provided to DEW for input to the database.

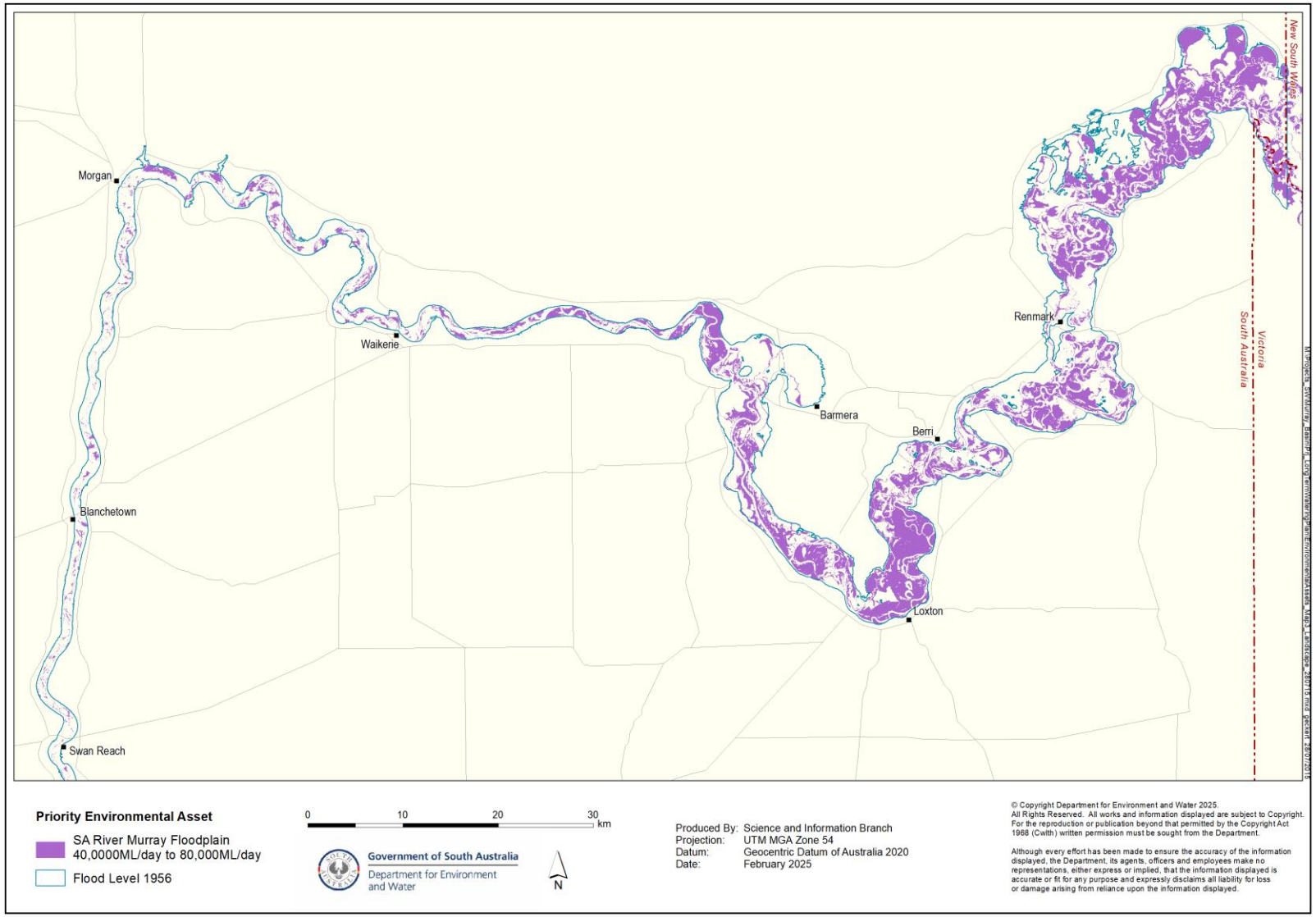

Figure 4.3. Spatial extent of the Floodplain PEA between the border and Swan Reach

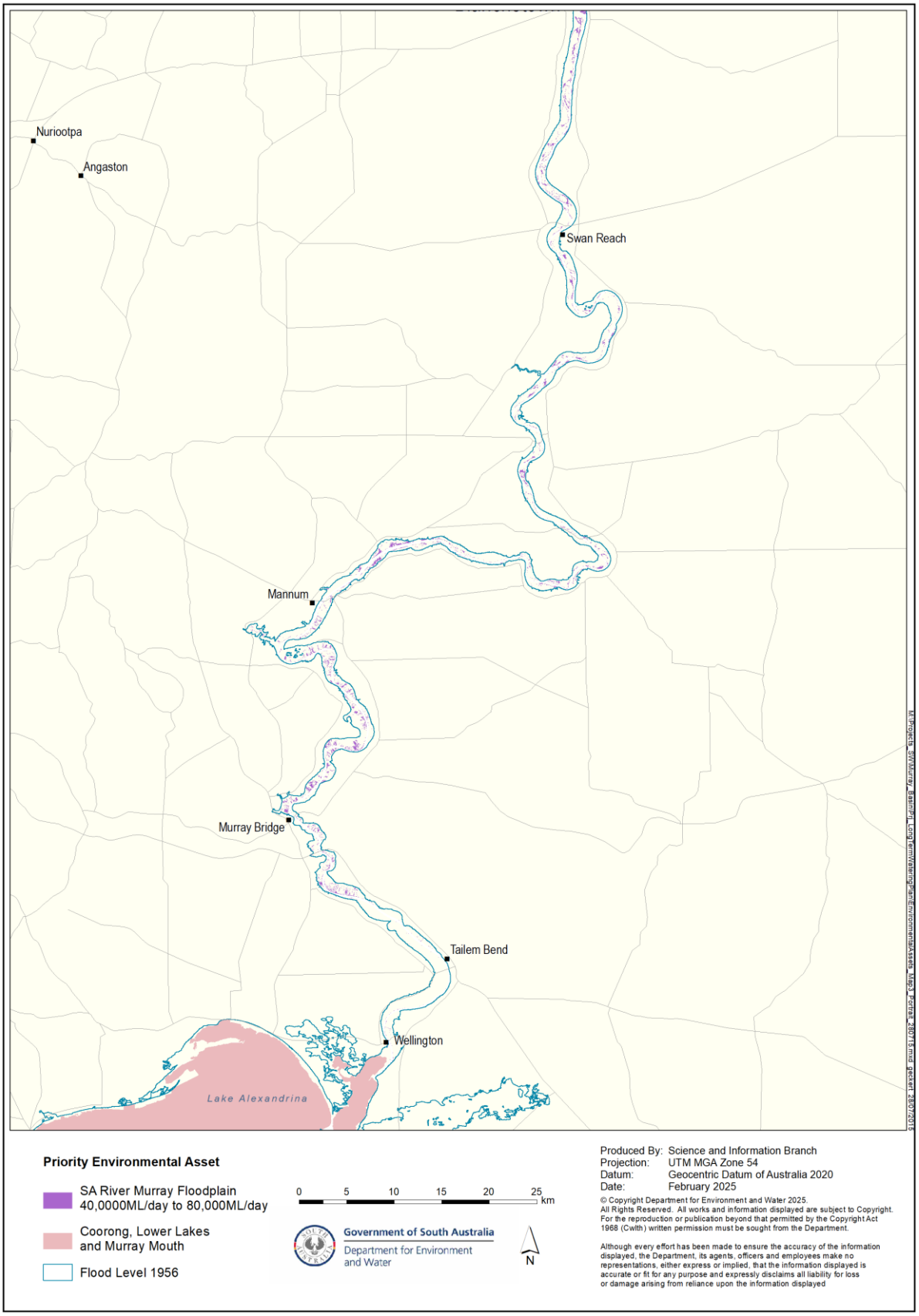

Figure 4.4. Spatial extent of the Floodplain PEA between Swan Reach and Wellington

4.2.3 Ecological attributes

The development of the ecological objectives and targets for the Floodplain PEA (Kilsby, et al., 2015) largely drew on a synthesis of the likely response of key ecological components of the floodplain ecosystem to changes in flow (see Bice, et al., 2014). The ecological components of the Floodplain PEA overlap considerably with those of the Channel PEA as these two assets are adjacent and continuous with each other. The main difference between the two is the effect that changes in geomorphology (i.e. elevation) have on hydrology. The Floodplain PEA consists of ephemeral areas that sit at higher elevations and are inundated later, and hence less frequently and for shorter durations, than the Channel PEA.

Bice, et al. (2014) presents hydro-ecological conceptual models for three flow bands relevant to the Floodplain PEA: 40,000 ML/day QSA - the threshold between the Channel and Floodplain PEAs; 60,000 ML/day QSA - a small overbank flow; and 80,000 ML/day QSA - a large overbank flow. Based on this report and unpublished DEW (2016) and Wallace et al. (2021), ecological attributes include:

- Woodland dependant fauna – terrestrial birds, reptiles and mammals
- Wetland dependent fauna – waterbirds, frogs and turtles
- Lateral and longitudinal connectivity – basal food resources, invertebrate food resources, water column stratification, hydraulic conditions, River channel and wetland connectivity and salt export
- Water quality – phytoplankton blooms, dissolved oxygen, in-stream salinity, in-steam pH
- Native fish – Murray cod, Golden perch, Silver perch and freshwater catfish
- Floodplain trees – River redgum, Black box, River cooba
- Shrublands – lignum shrublands
- Non-woody vegetation – infrequently inundated temporary wetlands and infrequently inundated shedding floodplain
- Groundwater – groundwater depth
- Soil condition – soil water potential and soil salinity.

4.2.4 Ecological objectives, targets and environmental water requirements

Fifteen ecological objectives and 60 nested ecological targets have been identified for the Floodplain PEA. 17 of the targets are unique to the Floodplain PEA, while 43 of the targets are shared with the Channel PEA (refer Table 4.3 taken from DEW, 2015). These objectives and targets are based on the key components (identified above) derived through expert elicitation and incorporating information from Wallace, et al., (2014a), Wallace, et al., (2014), Wallace, Denny, & Bice (2017), Bice et. al. (2014), Wallace et al. (2021) and unpublished DEW (2016) were also considered.

Gehrig, et al., 2020 identified five EWRs for the Floodplain PEA with target discharges ranging from 50,000 to 80,000 ML/day QSA. Together the EWRs describe the desired variable flow regime to meet the ecological objectives and targets. The metrics of the Floodplain PEA EWRs are:

- target discharge - measured as ML/day QSA, the EWR specifies both a value that the discharge should be equal to or greater than
- duration - the number of days that the discharge needs to remain at or above a specified value
- timing - the timing during which the EWR event needs to occur
- frequency - how often the EWR event needs to occur; the frequency metric is expressed in 3 formats to aid interpretation and represent variability (not a regular pattern)

- critical maximum interval - the maximum number of years between events that meet the EWR metrics
- maximum rates of rise and fall - represented as the change in water level over time (metres per day) and change in discharge over time or ML/day; in the lower Murray, the rate of change is influenced by a change in discharge and weir operations.

Table 4.3. Ecological objectives and targets for the SA River Murray floodplain PEA

Table taken from DEW (2025).

Attribute	Group	Ecological objective	Floodplain Ecological Target
Lateral and longitudinal connectivity	Basal food resources	Restore lateral and longitudinal connectivity to support basal and secondary productivity, and flow dependent processes including salt export	Dissolved organic carbon concentration increases from baseflow values (3-4 mg/L) to ≥6 mg/L during the rising limb of hydrographs.
			During late spring/early summer the density of cyclopoid copepods and cladocerans is 100–1000 individuals/L within 3 weeks of inundation of shedding and retaining habitats on the floodplain
	River channel-wetland connectivity		≥75% of ephemeral wetland area is inundated with lateral connectivity to the river/creek for a minimum of 20 continuous days at least once every 3 years
	Salt export		Salt export, averaged over the preceding 3 years, is ≥2 million tonnes per year[7]
Native fish	Murray cod	Restore resilient populations of Murray cod (Maccullochella peelii)	Population age structure of Murray cod includes recent recruits, subadults and adults in 9 years in 10
			Abundance (measured as CPUE) of Murray cod exhibits a positive trajectory and increases by ≥50% over a 10-year period
	Golden Perch	Restore resilient populations of golden perch (Macquaria ambigua)	Population age structure of golden perch indicates a large recruitment event 2 years in 5, demonstrated by separate cohorts that, combined, represent >30% of the population.
			Abundance (measured as CPUE) of golden perch exhibits a positive trajectory and increases by ≥30% over a 5-year period
			Cohorts of golden perch originate from multiple spatial recruitment sources including the lower Murray

[7] Target is applicable at the Basin scale

Attribute	Group	Ecological objective	Floodplain Ecological Target
	Silver Perch	Restore resilient populations of silver perch (Bidyanus bidyanus)	Population age structure of silver perch indicates recruitment 4 years in 5, indicated by presence of year classes
			Abundance (measured as CPUE) of silver perch exhibits a positive trajectory and increases by ≥30% over a 5-year period
			Cohorts of silver perch originate from multiple spatial recruitment sources including the lower Murray
	Freshwater catfish	Restore resilient populations of freshwater catfish (Tandanus tandanus)	Population age structure of freshwater catfish includes recent recruits, subadults and adults in 9 years in 10
			Abundance (measured as CPUE) of freshwater catfish exhibits a positive trajectory and increases by ≥50% over a 10-year period
Floodplain trees	River Red Gum	Maintain spatial extent and restore ecologically functional River Red Gum woodlands	In standardised transects spanning the elevation gradient, ≥90% of viable River Red Gum will have a Tree Condition Index Score ≥10
			Effective regeneration of River Red Gum woodlands at least 1 in 10 years, as evidenced by >85 % of assessment areas containing saplings and/or sub-adult trees (DBH <10cm) comprising >30% of the population
			The rate of loss (die back to a TCI = 0) of mature River Red Gums will not exceed 0.15% per year
	Black Box	Maintain spatial extent and restore ecologically functional Black Box woodlands	In standardised transects spanning the elevation gradient, ≥90% of viable Black Box will have a Tree Condition Index Score ≥10
			Effective regeneration of Black Box woodlands at least 1 in 20 years, as evidenced by >75 % of assessment areas containing saplings (size) and/or sub-adult trees (DBH <10cm) comprising >30% of the population
			The rate of loss (die back to a TCI = 0) of mature Black Box will not exceed will not exceed 0.15% per year

Attribute	Group	Ecological objective	Floodplain Ecological Target
	River Cooba	Maintain spatial extent and restore ecologically functional River Cooba woodlands	In standardised transects spanning the elevation gradient, ≥90% of viable River Cooba will have a Tree Condition Index Score ≥10
Shrublands	Lignum shrublands	Maintain spatial extent and restore ecologically functional lignum shrublands	30% of lignum sites receive condition values indicative of good condition at least once every 2 years
			60% of lignum sites receive condition values indicative of good condition at least once every 3 years
			80% of lignum sites receive condition values indicative of good condition at least once every 4 years
			Percentage of dead (non-viable plants) within assessment areas decreases
Non-woody vegetation	Infrequently inundated temporary wetlands	Establish ecologically functional native understorey vegetation community in infrequently inundated temporary wetlands	In temporary wetlands inundated at flows >40,000 MLday-1, a minimum of 40% of survey cells located on the bed, bank toe, slope and crest are either inundated or contain native flood-dependent and/or amphibious taxa once every 2 years on average with maximum interval ≤4 years.
			In temporary wetlands inundated at flows >40,000 MLday-1, survey cells located on the bed, bank toe, slope and crest will have species richness of native flood-dependent, amphibious and aquatic plants ≥40 once every 2 years on average with maximum interval ≤ 4 years.
			In temporary wetlands inundated at flows >40,000 MLday-1, a minimum of 80% of survey cells located on the bed, bank toe, slope and crest are either inundated or contain native flood-dependent and/or amphibious taxa once every 4 years on average with maximum interval ≤ 6 years.
			In temporary wetlands inundated at flows >40,000 MLday-1, survey cells located on the bed, bank toe, slope and crest will have species richness of native flood-dependent, amphibious and aquatic plants

Attribute	Group	Ecological objective	Floodplain Ecological Target
			≥60 once every four years on average with maximum interval ≤ 6 years.
	Infrequently inundated shedding floodplain	Establish ecologically functional native understorey vegetation community on infrequently inundated shedding floodplain areas	The shedding floodplain inundated at flows >40,000 MLday-1 has a minimum of 20% of survey cells that are either inundated or contain native flood-dependent and/or amphibious taxa once every 3 years on average with maximum interval ≤5 years.
			On the shedding floodplain inundated at flows >40,000 MLday-1, survey cells will have species richness of native flood-dependent, amphibious and aquatic plants ≥ 50 once every 3 years on average with maximum interval ≤ 5 years.
			The shedding floodplain inundated at flows >40,000 MLday-1 has a minimum of 40% of survey cells that are either inundated or contain native flood-dependent and/or amphibious taxa once every 5 years on average with maximum interval ≤7 years.
			On the shedding floodplain inundated at flows >40,000 MLday-1, survey cells will have species richness of native flood-dependent, amphibious and aquatic plants ≥ 75 once every 5 years on average with maximum interval ≤ 7 years.
			The shedding floodplain inundated at flows >40,000 MLday-1 has a minimum of 70% of survey cells that are either inundated or contain native flood-dependent and/or amphibious taxa once every 7 years on average with maximum interval ≤10 years.
			On the shedding floodplain inundated at flows >40,000 MLday-1, survey cells will have species richness of native flood-dependent, amphibious and aquatic plants ≥ 100 once every 7 years on average with maximum interval ≤ 10 years.

Attribute	Group	Ecological objective	Floodplain Ecological Target
Groundwater	Groundwater depth	Establish and maintain groundwater conditions conducive to supporting diverse ecologically functional native vegetation	Where the watertable resides within the active rooting depth, groundwater salinity in the top one metre of the saturated zone is within the range utilisable as a water source for river red gum (≤ 5,000 µScm-1)
			Where the watertable resides within the active rooting depth, groundwater salinity in the top one metre of the saturated zone is within the range utilisable as a water source for black box (≤ 8,000 µScm-1)
			Where groundwater salinity in the top 1 metre of the saturated zone exceeds the range utilisable as a water source for trees, depth to groundwater returns to pre-watering baseline values during inter-flood periods
Soil condition	Soil water potential	Establish soil conditions conducive to supporting diverse ecologically functional non-woody native vegetation	In River Red Gum woodlands, at least one depth interval between 0.2 m and the water table has soil water potential ≥ -1.0 MPa
			In Black Box woodlands, at least one depth interval between 0.2 m and the water table has soil water potential ≥ -2.0 MPa
			In lignum shrublands, at least one depth interval between 0.2 m and the water table has soil water potential ≥ -2.0 MPa
	Soil salinity		Soil salinity (EC 1:5) is <2,700 µScm-1 in the 0.2-0.5 m depth interval
			Soil salinity (EC 1:5) is <1,300 µScm-1 (non-moderately saline) in the 0.2-0.5 m depth interval at least once every 5 years in the Floodplain PEA
Woodland dependent fauna	Terrestrial birds	Restore resilient populations of native semi-aquatic and	Across all sites, independent of habitat type, terrestrial bird species richness measured across all four seasons within one year is maintained at or above 78 species

Attribute	Group	Ecological objective	Floodplain Ecological Target
		terrestrial reptiles, mammals and birds	Across all sites, independent of habitat type, terrestrial bird species richness measured over a rolling four-year period is maintained at or above 110 species
	Reptiles and mammals		Each of the terrestrial reptile species that use the littoral and/or floodplain zones are recorded across ≥50% of sites within their known distribution at least once every two years
			Each of the terrestrial mammal species that use the littoral and/or floodplain zones for are recorded across ≥50% of sites within their known distribution at least once every two years
			Each of the 15 bat species known to occur within the asset will be detected across ≥ 75% of sites within their known distribution at least once every two years
Wetland dependent fauna	Waterbirds	Restore resilient populations of waterbirds, frogs and turtles	Increase the spatial extent of productive foraging zones (inundated mud flats, shallow water) by 50% above that occurring under entitlement flow and normal weir pool conditions to support adult waterbirds and survival of juveniles/sub-adults during spring-summer for ≥30 days
			Maintain the water depth and duration of inundation of emergent vegetation required to support waterbird breeding through to completion (egg laying, fledging and post fledging care) at least 3 years in 10 with a maximum return interval of 5 years.
			Annual species richness of waterbirds is maintained at ≥ 55 species
			Over a three-year period, species richness is maintained at ≥ 60 species, and includes small-bodied migratory waders

Attribute	Group	Ecological objective	Floodplain Ecological Target
	Frogs		Each of the 10 frog species known to occur within the asset will be detected at least once every two years at 60% of surveyed sites within their known distribution within the floodplain PEA
			Tadpoles from each of the 10 frog species known to occur within the asset will be recorded in achieve later stages of metamorphosis (Gosner stage >36) 3 years in 10 with a maximum 3 year return interval
			Maintain the existing distribution of the nationally listed Southern Bell Frog (Litoria raniformis) as evidenced by detection of adults 3 years in 5 within their known distribution
	Turtles		Population age structure of turtles indicates an effective recruitment event 1 year in 5 (max 7 years), demonstrated by separate cohorts of juveniles/sub-adults and adults of each species
			Abundance (measured as CPUE) of juvenile/sub-adult turtles of each species exhibits a positive trajectory and increases by ≥30% over a 5-year period
			Abundance (measured as CPUE) of adult turtles of each species exhibits a positive trajectory and increases by ≥30% over a 10-year period
			All three species are recorded annually in 90% of sampling sites within permanent mesohabitats along length of PEA
			Long neck turtles are recorded annually in 90% of sampling sites within inundated temporary wetlands along the length of the PEA

Table 4.4. Environmental water requirements for the SA River Murray floodplain PEA

Table taken from Gehrig et.al (2020).

EWR #	Target discharge (ML/day QSA)	Duration (days)	Timing (months)	Frequency* (# flows-per-ARI; [% of years]; {#yr in 10-yr})	Critical Maximum Interval^ (years)	Rate of water level rise# (m/day or [ML/day])	Rate of water level fall (m/day or [ML/day])
FP1	≥50,000	≥40	Sep–Dec	1-in-1.67 [60%] {5-7 yr in 10}	4	0.05 [465]	0.025 [232.50]
FP2	≥60,000	≥20	Sep–Dec	1-in-2.25 [45%] {4–5 yr in 10}	5	0.05 [465]	0.025 [232.50]
FP3	≥70,000	≥20	Sep–Dec	1-in-2.86 [35%] {3–4 yr in 10}	5	0.05 [465]	0.025 [232.50]
FP4	≥80,000	≥10	Sep–Dec	1-in-4.0 [25%] {2–3 yr in 10}	5	0.05 [465]	0.025 [232.50]
FP5	≥80,000	≥30	Sep–Dec	1-in-6.67 [15%] {1–2 yr in 10}	8.5	0.05 [465]	0.025 [232.50]

*Frequency is expressed as: 1) number of flows per Average Return Interval (ARI), 2) percentage of years and 3) the number of years that the EWR should occur within a 10-yr period.
^represents the critical maximum interval (years) between EWRs before a significant decline in FP condition is likely to occur. This period should not be exceeded wherever possible.
#rate of rise and fall presented as m/day or ML/day.

4.3 The Coorong, Lower Lakes and Murray Mouth priority environmental asset

4.3.1 Location and geographic extent

The Coorong, Lower Lakes and Murray Mouth Priority Environmental Asset (the 'CLLMM PEA') is equivalent to:

- the Lower Lakes, Coorong and Murray Mouth TLM Icon Site (LLCMM Icon Site)
- the Coorong, Lakes Alexandrina and Albert Ramsar Wetland of International Importance (Coorong and Lakes Ramsar Site).

The geomorphology, hydrology and water quality of the CLLMM PEA is extremely complex. The site is already well described in a number of documents, particularly the Lower Lakes, Coorong and Murray Mouth Environmental Water Management Plan (Murray-Darling Basin Authority, 2014f), Natural History of the Coorong, Lower Lakes, and Murray Mouth region (Yarluwar-Ruwe) (Royal society of South Australia, 2019) and the Ecological Character Description of the Coorong, Lakes Alexandrina and Albert Wetland of International Importance (Phillips, et al., 2006), with a synopsis provided in (O'Connor, et al., 2015). The following summary has been adapted from text provided in these documents.

The CLLMM PEA covers a total approximate area of 142,530 hectares (Figure 4.5) and consists of four sub-regions. For this update these sub-regions were updated to:

1. **Lower Lakes and wetlands** (Wellington to the Barrages) – comprises Lake Alexandrina (c. 65,000 hectares) and Lake Albert (c. 23,000 hectares), the wetlands downstream of the confluence of the River Murray and Lake Alexandrina (near Wellington) that fringe the lakes and those located in the lower

reaches of the Eastern Mount Lofty Ranges tributaries, noting that there is a separate long-term watering plan for the Eastern Mount Lofty Ranges PEA (DEW 2020).

2. **Murray Mouth and Barrages** (Goolwa Barrage, the most northerly barrage, to Pelican Point) – represents high energy areas with direct impacts of River Murray flows through the five barrages mixing with sea water coming in through an open Murray Mouth (five barrages from north to south: Goolwa, Mundoo, Boundary Creek, Ewe Island and Tauwitchere Barrages).
3. **Coorong North Lagoon** (south of Pelican Point to north of Parnka Point) – refers to the hydrological North Lagoon of the Coorong, the flow through which constricts at Parnka Point before entering the South Lagoon, noting that the ecological processes and habitats do not entirely align with this hydrological unit spatially.
4. **Coorong South Lagoon** (Parnka Point to southern most extremity of South Lagoon) – refers to the hydrological South Lagoon of the Coorong, including the connected water bodies south of Parnka Point to the southern extent of the Coorong lagoon water body and the confluence with Salt Creek.

These 4 subregions are more closely aligned to the gross geomorphological features and hydrology used for management purposes than the subregions in the 2020 LTWP. From an ecological perspective, however, there are different habitat or population boundaries and different dispersal attributes of different taxa that provide eco-hydrological connections within and between these subregions. Some of the updated objectives and targets refer specifically to one or more of the four subregions and others operate across the whole of the CLLMM PEA.

Flows from upstream areas of the Murray-Darling Basin arrive via the Channel PEA and pass into Lake Alexandrina (approximately 5 km south of Wellington) and out to the Southern Ocean via the Murray Mouth Estuary. Lake Alexandrina also connects to the terminal Lake Albert through the Narrung Narrows on the eastern side. The Lower Lakes are physically separated from the Murray Mouth and Coorong via a complex series of islands, channels and five barrages. The barrages were constructed in the 1930s to prevent ingress of saline water to the Lower Lakes and to regulate lake water levels. Fishways have since been incorporated into the barrages to allow fish movement between freshwater and saline environments.

At times, small volumes of freshwater pass into Lake Alexandrina from the EMLR tributaries, which are fed by unconfined aquifers and regional rainfall. When conditions are dry in the EMLR and there is no flow in the tributaries, freshwater from Lake Alexandrina helps to maintain inundation of the wetlands in the lower reaches of the EMLR tributaries, providing important habitat for birds, frogs and fish.

The salinity and morphology of the Murray Mouth estuary varies depending on freshwater flows and coastal conditions and processes. Freshwater outflows are required to keep the Murray Mouth open. Due to the impacts of regulation and extraction, constriction and closure of the Murray Mouth has occurred in recent history. Dredging operations to maintain an open Murray Mouth recommenced on 9 January 2015 and at 1 January 2025 had removed over 10,000,000 cubic metres of sand (Department for Environment and Water, 2025).

The Coorong receives inflows at the northern end from Lake Alexandrina and the Southern Ocean, and at times to the southern end via Salt Creek. It is a 'reverse estuary' (i.e. salinity increases with distance from the Mouth), with salinities ranging from fresh to brackish in parts of the Murray Mouth estuary to hyper-saline in areas of the South Lagoon. This gradient varies temporally depending on inflows from the Lower Lakes, Southern Ocean and Salt Creek.

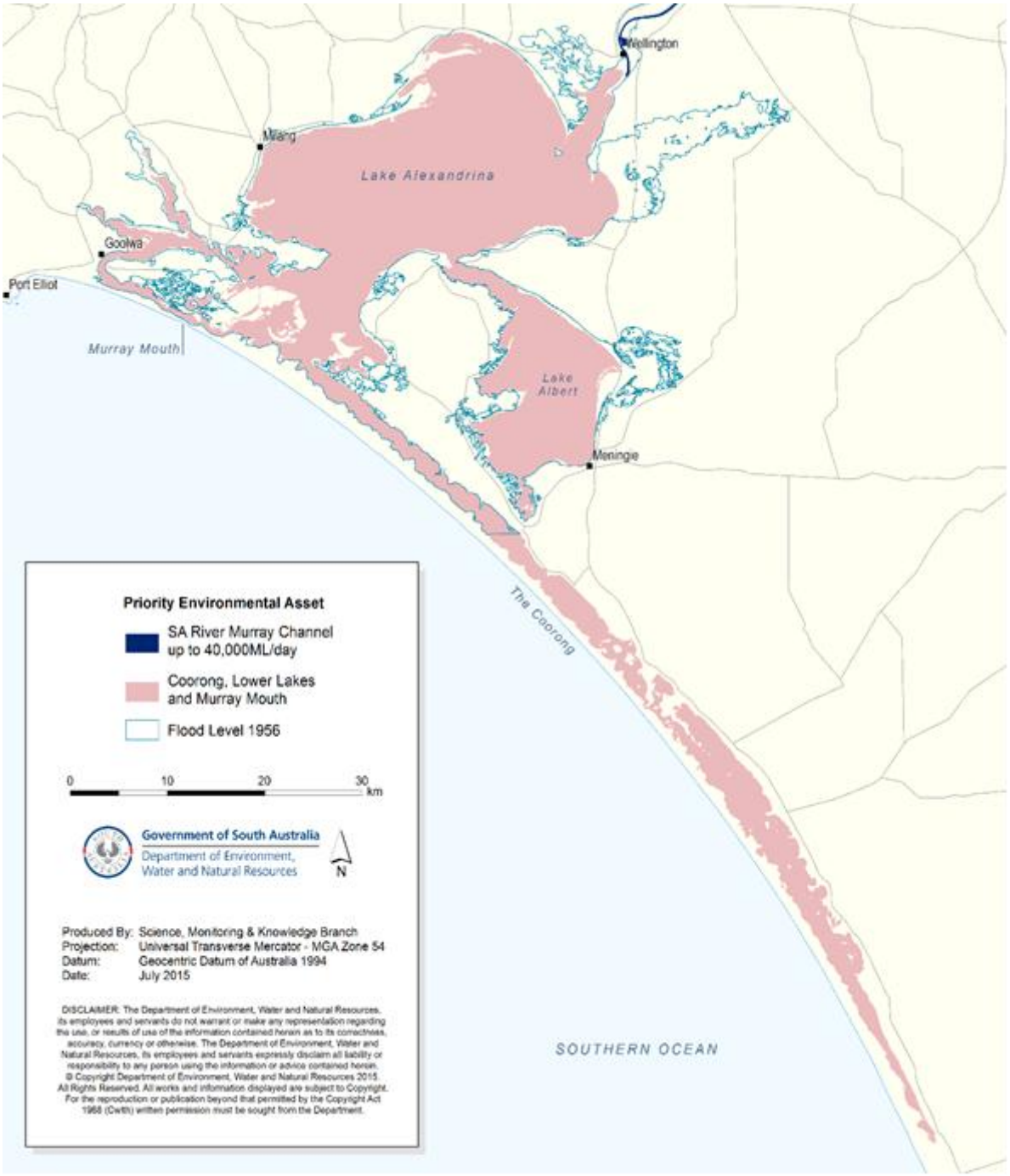

Figure 4.5. Spatial extent of the Coorong, Lower Lakes and Murray Mouth PEA

4.3.2 Conservation significance

The CLLMM PEA is recognised as a site of high ecological and cultural value through The Living Murray Initiative and as a Wetland of International Importance under the Ramsar Convention. As the only estuary of the Murray-Darling Basin, the CLLMM is also a unique geomorphological feature of the Basin.

Detailed descriptions of the conservation values of the CLLMM are provided in the Lower Lakes, Coorong and Murray Mouth Environmental Water Management Plan (Murray-Darling Basin Authority, 2014f) and the Ecological Character Description of the Coorong and Lakes Alexandrina and Albert Wetland of International Importance (Phillips, et al., 2006). O'Connor, et al. (2015) provided the following summary of some of the key values of the asset:

- waterbirds: regularly supports >200,000 waterbirds during summer (Paton, 2010), significant numbers of colonial-nesting and beach-nesting waterbirds (O'Connor, Rogers, & Pisanu, 2013) and a number of threatened waterbird species (Department of Environment, Water and Natural Resources, 2013b)
- fish: plays an important role for 49 native fish species, including diadromous, endangered and commercially caught species (Phillips, et al., 2006; Ye, et al., 2014)
- vegetation: characterised by a range of ecologically significant submerged, emergent and fringing vegetation species and communities including, *Gahnia* sedgelands, Fleurieu Peninsula swamps and *Ruppia* community (Phillips, et al., 2006).

Data from the DEW's biological database indicates that within the CLLMM PEA the following species of conservation significance have been recorded at least once[8]:

- 63 plant species (Appendix D) listed as Endangered, Vulnerable or Rare under the South Australian *National Parks and Wildlife Act 1972* ('state-listed')
- 130 protected fauna species (Appendix D), of which 95 are state-listed species, five are listed as nationally threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and 30 are both state and nationally listed
- 29 migratory bird species that are listed under international agreements (Appendix D).

Error! Reference source not found. The significance of the CLLMM PEA is further underscored by the inclusion of three overall environmental objectives within the Basin Plan that specifically relate to this asset, as follows:

> Section 8.06 (3) An objective is to protect and restore connectivity within and between water-dependent ecosystems by ensuring that:
>
> > (c) the Murray Mouth remains open at frequencies, for durations, and with passing flows, sufficient to enable the conveyance of salt, nutrients and sediment from the Murray-Darling Basin to the ocean; and
> >
> > (d) the Murray Mouth remains open at frequencies, and for durations, sufficient to ensure that the tidal exchanges maintain the Coorong's water quality (in particular salinity levels) within the tolerance of the Coorong ecosystem's resilience; and
> >
> > *Note: This is to ensure that water quality is maintained at a level that does not compromise the ecosystem and that hydrologic connectivity is restored and maintained.*
> >
> > (e) the levels of the Lower Lakes are managed to ensure sufficient discharge to the Coorong and Murray Mouth and help prevent river bank collapse and acidification of wetlands below Lock 1, and to avoid acidification and allow connection between Lakes Alexandrina and Albert, by:
> >
> > > (i) maintaining levels above 0.4 metres Australian Height Datum for 95% of the time, as far as practicable; and
> > >
> > > (ii) maintaining levels above 0.0 metres Australian Height Datum all of the time.

The CLLMM PEA also includes a significant 'Sacred Site' – the Meeting of the Waters' (registered Aboriginal heritage site under the SA *Heritage Act 1988*). This includes the waters and the bed of the lakes, river and estuary. Its spiritual and cultural significance is essential to the wellbeing and productivity of the Ngarrindjeri nation, Ngarrindjeri lands and waters, and all living things (Ngarrindjeri Nation 2006).

[8] Presence/absence records from DEW's biological database have been provided as an indication of the number of threatened species that have been found within each PEA only. Currently there are very few fish records and no invertebrate records entered into the dataset. This is not a comprehensive list and does not reflect species records that have not been provided to DEW for input to the database.

4.3.3 Ecological attributes

A project was undertaken by DEWNR (O'Connor, et al., 2015) that reviewed information from the following key sources:

- the existing objectives and targets for the CLLMM TLM icon site (Maunsell Australia Pty Ltd, 2009); (Murray-Darling Basin Commission, 2006a) and a recent TLM condition monitoring refinement project (Robinson, 2014)
- the critical components, processes and services (CPS), and limits of acceptable change (LAC) from the draft, updated ecological character description (ECD) for the Coorong and Lakes Alexandrina and Albert Ramsar site Coorong (Department for Environment and Water, in prep (a))
- outputs from the MDBA's quantitative environmental outcomes workshops for shorebirds, general waterbirds, Coorong fish and *Ruppia tuberosa*, and subsequent content in the BWS (Murray-Darling Basin Authority, 2014a); (Murray-Darling Basin Authority, 2014e).

This project highlighted the following as key ecological attributes for the CLLMM PEA:

- ecosystem processes and physio-chemical conditions - hydrology, connectivity, salinity gradients, diversity and extent of wetland types, Murray Mouth openness
- vegetation - freshwater submergent and emergent communities, submergent and emergent halophytes, *Ruppia* community
- macroinvertebrates - taxonomic richness, distribution, biomass and sediment conditions
- fish - diversity, diadromous species, endangered species, estuarine species, small-mouthed hardyhead
- waterbirds - diversity, abundance, breeding, state and nationally threatened species, species listed under international treaties and migratory agreements, >1% total flyway population size.

High-level conceptual models of the Lower Lakes and of the Coorong are provided in (Maunsell Australia Pty Ltd, 2009). Hydro-ecological conceptual models of the likely response of vegetation, macroinvertebrates, fish and waterbirds in the CLLMM under six discharges ranging from Entitlement to 80,000 ML/day QSA are provided in Bice, et al. (2014).

4.3.4 Ecological objectives, targets and environmental water requirements

In total, 15 ecological objectives and 50 nested ecological targets have been identified for the CLLMM PEA (Table from (Department for Environment and Water, 2024). The detailed methods for developing these objectives and targets are described in Department for Environment and Water, 2024. This review builds on the extensive work undertaken to date by many scientists and managers over decades and has been presented in a manner that seeks to be transparent, collaborative and technically sound, as well as providing a base for continual improvement. It has been informed by other work undertaken for the Ramsar Management Plan: the Coorong and Lakes Alexandrina and Albert Wetland (RMP, Department for Environment and Water 2025b) and The Living Murray – Lower Lakes, Coorong and Murray Mouth Icon Site Condition Monitoring Plan (CMP, DEWNR 2017). The Objectives and Resource Condition Targets (RCTs) for the RMP were largely developed in 2018-2021 and, where possible, adopted the TLM CMP objectives and targets, with some minor amendments to wording based on consultation with relevant scientific experts. The RMP includes objectives and RCTs in addition to those within the TLM CMP (e.g. various waterbird targets) as they were relevant to Ramsar listing criteria but less relevant to hydrological management. Since the time the RMP content was developed many investigations into the Coorong have been undertaken. New information from this research and monitoring has been incorporated into this review of the CLLMM PEA through the involvement of subject matter experts, ensuring the 2025 update of the SA River Murray LTWP is based on the most up-to-date science.

(Gehrig, et al., 2020) identified four EWRs for the CLLMM PEA, which considered the EWRs described in (O'Connor, et al., 2015) (Lester, Fairweather, & Higham, 2011) and (Heneker, 2010) needed to maintain salinities of < 700 µS/cm and < 1000 µS/cm in Lake Alexandrina, but incorporated additional metrics to further describe the desired hydrological regime for the site (O'Connor, et al., 2015).

The Coorong South Lagoon metrics were developed in 2015 (O'Connor, et al. 2015) and revised in 2020 (Gehrig, et al., 2020) based on expert advice. The metric represents target water levels and shows an incremental increase when moving through the EWRs, with the water level for the lowest EWR (EWR-CLLMM1) indicating

target levels under low flow conditions[9]. Under these conditions, strong *Ruppia* community recruitment events are unlikely, however, the target water level range will support existing adult populations of *Ruppia tuberosa* within the deeper channel and is important for general mudflat health to support waterbird populations, including migratory waders.

This water level metric provides guidance for environmental water planning but should not preclude targeting higher levels in real-time event planning should the opportunity arise for improved outcomes.

In total there are ten metrics for each of the EWRs, as follows:

1. Annual barrage flow - the total volume (gigalitres per year) released from the barrages (all gates) over the course of a water-year.
2. Total barrage flow over rolling 3-year period - total volume released from the barrages (all gates) over a 3-year period.
3. Frequency - the desired average frequency that the minimum annual volume is released. The frequency metric is expressed in 3 formats and does not seek to describe a regular pattern.
4. Critical maximum interval - the maximum number of years between events that meet the EWR metrics.
5. Barrage outflow annual pattern – barrage releases should occur over the entire water-year but the EWRs seek to vary the monthly outflow volume with peak outflows in late spring/early summer in order to support seasonal ecological processes. This variation is also described in Figure 4.6.
6. Lake water level range - the range that Lake water levels should remain within throughout the year (in mAHD); water level values should be calculated as the average across the Lower Lakes rather than a minimum or maximum at any given location.
7. Lake water level peak and/or minimum timing - describes the months when maximum and minimum water levels should occur.
8. Coorong South Lagoon peak water level - the range that maximum water levels (in mAHD) should remain within at the indicated time. This should be based on the average daily water level at Parnka Point, Woods Well and Snipe Island.
9. Coorong South Lagoon peak water level timing - the months when South Lagoon water levels need to remain within the specified range.
10. Coorong South Lagoon peak water level duration - the number of days that South Lagoon water levels need to remain within the specified range.

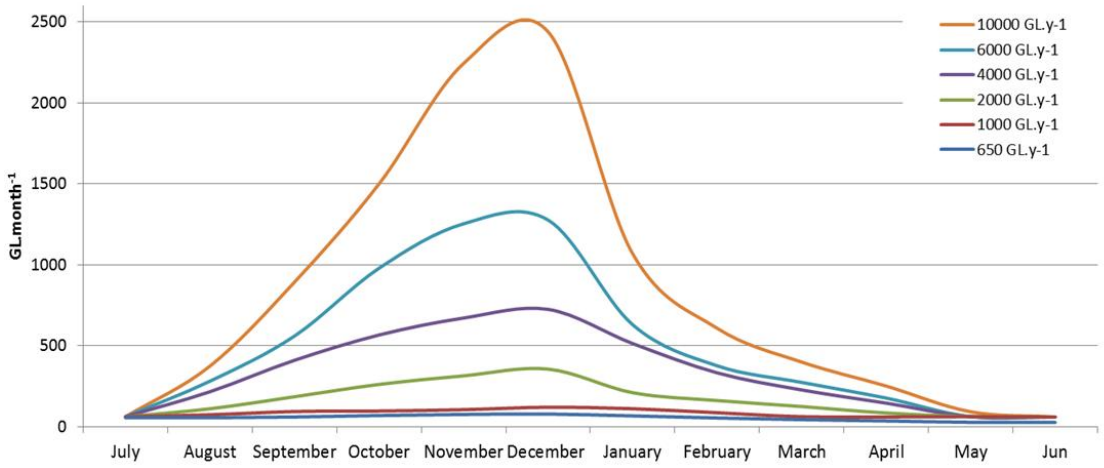

Figure 4.6. Hypothetical optimal timing of barrage releases for various annual flow scenarios

[9] Although (Gehrig, et al., 2020) recommended the lowest water level of 0.5 mAHD (for EWR-CLLMM1), to be consistent with the Basin Plan 2012 this has been modified to 0.4 mAHD.

Table 4.5 Ecological objectives and targets for the Coorong, Lower Lakes and Murray Mouth PEA

Targets taken from DEW (2024). Note: not all targets have been transferred into this long term plan

Attribute	Ecological objective	Ecological targets
Waterbirds	Maintain or improve waterbird populations.	Exceed the long-term (2000–2015) median value for abundance of each of 40 selected waterbird species in the Coorong in two of the last three years.
		Exceed the 75% threshold for the long-term (2000–2015) area of occupation (AOO) for each of 40 selected waterbird species in the Coorong.
		Exceed the 75% threshold for the long-term (2000–2015) extent of occurrence (EOO) for each of 40 selected waterbird species in the Coorong.
		Exceed the recent (2013–2015) median value for abundance of each of 25 selected waterbird species in the Lower Lakes in two of the last three years.
		Exceed the 75% threshold for the recent (2013–2015) AOO for each of 25 selected waterbird species in the Lower Lakes and fringing wetlands.
		Exceed the 75% threshold for the recent (2013–2015) EOO for each of 25 selected waterbird species in the Lower Lakes and fringing wetlands.
		Maintain annual breeding of waterbird species that are known to breed at the site annually.
		Increase the number of threatened waterbirds of breeding age compared to 2000 – 2015.

Attribute	Ecological objective	Ecological targets
Fish	Maintain a spatio-temporally diverse and resilient fish community.	A spatio-temporally diverse native fish community present across the whole site, including all 17 fish families, with annual observations of both common and threatened species.
	Successful migration and recruitment of diadromous fish.	The annual abundance of upstream migrating YOY congolli (*Pseudaphritis urvillii*) is ≥ the mean recruitment reference value (i.e. 44.5 YOY/hr).
		The annual abundance of upstream migrating YOY common galaxias (*Galaxias maculatus*) is ≥ the mean recruitment reference value (i.e. 6.1 YOY/hr).
		Pouched lamprey (*Geotria australis*) are sampled from ≥60% of large vertical-slot fishway sites10 when barrage discharge is <30,000 ML/d across the winter sampling season and present when discharge is > 30,000 ML/d and all years.
		Short-headed lamprey (*Mordacia mordax)* present in all years[11].
Fish	Restore resilient populations of estuarine fish	WOISS equal to 4 (maximum value) for Black bream (*Acanthopagrus butcheri*) on an annual basis.
		WOISS equal to 4 (maximum value) for Greenback flounder (*Rhombosolea tapirina*) on an annual basis.

[10] Large fishways include Mundoo, Goolwa, Ewe Island, Trapezoidal and large Vertical slot fishway at Tauwitchere and exclude Boundary Creek and the small fishways at Tauwitchere, Goolwa and Hunters Creek.

[11] presence in a year includes detection in any fishway, at Lock 1 or any other part of the River Murray system.

		Detect juvenile Mulloway in at least 50% of the Coorong and Murray Mouth and Barrages subregions.
	Maintain abundant, resilient populations of small-bodied fish in the Coorong and Murray Mouth and Barrages, including Small-mouthed hardyhead and Sandy sprat.	Small-mouthed hardyhead (*Atherinosoma microstoma*) populations achieve a WOISS of ≥4 on an annual basis.
		Maintain annual population abundance (Catch Per Unit Effort – CPUE) of Sandy sprat (*Hyperlophus vittatus*) throughout the Coorong and Murray Mouth and Barrages subregions.
	Increase distribution and recruitment success of threatened fishes in the Lower Lakes and wetlands to enhance resilience of existing, and establish new, self-sustaining populations.	Murray hardyhead (*Craterocephalus fluviatilis*) WOISS >0.5 in autumn of low to moderate flow years and detected in years of moderate to high river flows.[12]
		Yarra pygmy perch (*Nannoperca obscura*) WOISS >0.5 on an annual basis with wild recruits detected in autumn sampling and maintenance of populations at release sites.
		Southern pygmy perch (*Nannoperca australis*) WOISS >0.5 on an annual basis with wild recruits detected in autumn sampling and maintenance of populations at release sites.
	Restore resilient populations of Golden perch (*Macquaria ambigua*).	Population age structure[13] Golden perch has at least one strong (>20%) cohort in the first 5 years, two or more moderate (>15%) cohorts and >10% fish >10 years of age.
		Cohorts of Golden perch originate from multiple spatial recruitment sources including the lower Murray and Lower Lakes.

[12] If Murray hardyhead are detected in March then likely to be YOY because adults will have been lost from the populations after breeding in spring.

[13] Based on commercial fishery catch by large mesh gill net in the Lower Lakes.

Attribute	Ecological objective	Ecological targets
Macroinvertebrates	Improve and maintain diverse macroinvertebrate communities.	Macroinvertebrate species richness and community composition remains within or exceeds the long-term (2004-2023) reference for the Coorong and Murray Mouth and Barrages subregions.
		The index of occurrence of macroinvertebrate species remains within or exceeds their long-term (2004-2023) species-specific reference level.
		Abundance of macroinvertebrate species are at or above reference levels for the Coorong and Murray Mouth and Barrages subregions.
		The proportional distribution and abundance of bioturbating Nereididae (*Simplisetia aequisetis*, *Australonereis ehlersi*) for the Coorong and Murray Mouth and Barrages subregions is ≥50%.
		Macroinvertebrate biomass is at or above reference levels for the Coorong and Murray Mouth and Barrages subregions.
		Macroinvertebrate communities are similar to those occurring under intermediate continuous flows.
		Populations of larger-bodied bivalves (*Spisula trigonella*, *Hiatula alba*) are maintained in the Coorong and/or Murray Mouth and Barrages subregions.
		Lokeri (Floodplain mussel, *Velesunio ambiguus*) population comprises all size classes, including small individuals (<4 years old), in both Lakes Alexandrina and Albert.
		Kaltuwari (yabby, *Cherax destructor*) populations have at least 50% of individuals with <15 mm occipital carapace length (OCL) in November

		and at least 70% of individuals with >30 mm OCL in March with increasing total abundance and distribution.
	Improve sediment conditions in the Coorong and Murray Mouth and Barrages subregions to support diverse and abundant macroinvertebrate and macrophyte communities.	Median grain size of sediments in the Coorong and Murray Mouth will remain between 125 – 500 µm (Dittman, 2014)
		Sediment organic matter content between 1 and 3.5 % dry weight in the Coorong and Murray Mouth (Dittman, 2014)
Turtles	Improve recruitment of Thukabi (Eastern long-necked turtle, *Chelodina longicollis* and Murray short-necked turtle, *Emydura macquarii*) in Lakes Alexandrina and Albert.	Carapace length frequency distribution demonstrates presence of juvenile *Thukabi* by 2030, and regular, successful recruitment detected at three or more Ngarrindjeri *Thukabi* monitoring sites.
Frogs	Restore resilient populations of frogs in Lower Lakes, especially in the fringing wetlands.	Each of the six frog species known to occur in Lower Lakes and wetlands will be detected at least once every two years at 75% of surveyed sites.
		Maintain and/or improve habitat suitable for the nationally listed Southern bell frog (*Litoria raniformis*) at wetlands where they are known to have previously occurred.
Vegetation	Maintain or improve the extent and diversity of aquatic and littoral vegetation in the Lower Lakes and wetlands.	Lower Lakes aquatic and littoral vegetation achieves a WOISS >=0.6 on an annual basis (both autumn and spring) as quantified using the LLCMM TLM vegetation indices.
		Expand the distribution of littoral vegetation at 0 mAHD across the site compared to 2012 baseline.
	Restore and maintain submerged macrophyte communities in the Coorong.	Vigorous submerged macrophyte populations at the regional scale have: ○ Extent of occurrence (EOO) - macrophyte beds containing *Ruppia tuberosa* occur for at least 43 km along the Coorong.

	○ Area of occupation (AOO) - 80% of sites within the sampled distribution have a submerged macrophyte community containing *Ruppia tuberosa* present in winter. ○ Vigour - 50% of sites exceed the local (site) vigour levels. ○ Resilience (RES) - 50% of sites should exceed 2,000 seeds/m2.
	Vigorous submerged macrophyte populations at the local scale have: ○ At least 30% of cores (75 mm diam.) contain aquatic plants in winter and in summer. ○ At least 10 shoots per core (75 mm diam.) in winter. ○ At least 50 flower-heads/m2 for 50% of the area sampled at a site during spring/early summer flowering. ○ At least 50% of surface sediment cores (75 mm diam. x 40 mm deep) with seeds in summer. ○ At least 50% of cores (75 mm diam) taken across area sampled at a site in late summer contain turions.
	Submerged macrophyte communities detected at >50% of sites with suitable habitats between Pelican Point and The Needles (North Lagoon).
	By 2029: 10,000 seeds/m^2 at one or more sampling zones at 50% of sites (≥40 seeds per 75 mm diam. × 40 mm deep core).

Water quality	Maintain salinities within a range suitable for freshwater flora and fauna communities that characterise the Lower Lakes and suitable dissolved oxygen levels across a seasonally fluctuating salinity gradient in the Coorong and Murray Mouth and Barrages subregions.	Salinity in Lake Alexandrina is maintained at the long-term (1975-2000) annual average of 700 EC, below 1000 EC 95 % of years and below 1500 EC all of the time.
		Salinity gradient in the Coorong is present, with Murray estuary average monthly salinities <35 ppt, North Lagoon average monthly salinities <45 ppt, South Lagoon average monthly salinities over winter <60 ppt and daily salinities year-round <100 ppt 95% of the time.[14]
Ecosystem processes	Maintain a permanently open Murray Mouth through freshwater outflows to maximise fish passage and connectivity between the Murray Mouth and Barrages, the Coorong and the sea and improve water quality across the whole site.	Murray Mouth is open at all times maintained by freshwater releases from the barrages.
		All barrage fishways are open every day.
		Attractant flows, via the operation of barrage bays adjacent to fishways, are provided every day.
		Maximise number of barrage gates open at all times of year and especially between June to September to facilitate greater fish movement and connectivity (based on water availability and lake level management).

[14] Salinity targets sourced from RMP RCT for Salinity in the Murray Estuary, Coorong North and Coorong South lagoons (DEW 2025b).

Table 4.6. Environmental water requirements for the Coorong, Lower Lakes and Murray Mouth PEA

Table adapted from Gehrig, et al. (2020). '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).

EWR #	Average annual barrage flow (GL/yr)	Total barrage flow over rolling 3-yr period (GL)	Barrage outflow annual pattern^	Frequency# (# flows-per-ARI; [% of years]; {#yr in 10-yr})	Critical maximum interval& (years)	Lakes water level (m AHD)	Lakes water level peak and/or minimum timing (months)	Coorong South Lagoon peak water level (m AHD)	Coorong South Lagoon peak water level timing (months)	Coorong South Lagoon peak water level duration (days)
CLLMM1	≥2,000	≥6,000*	Total volume released in Sep–Dec > Total volume released in Jan–Aug	1-in-1 [100%] {10 yr in 10}	0	0.4*** to ≥0.75	Peak: Sep–Dec Min: Mar–May	0.0 to 0.1	Sep–Dec	≥90
CLLMM2	≥4,000	≥12,000**	Total volume released in Sep–Dec > Total volume released in Jan–Aug	1-in-2 [50%] {5 yr in 10}	3	0.5 to ≥0.83		0.2 to 0.45	Sep–Jan	≥150
CLLMM3	≥6,000	N/A	Total volume released in Sep–Jan >Total volume released in Feb–Aug	1-in-3 [33.3%] {3–4 yr in 10}	5	0.6 to ≥0.83		0.2 to 0.45	Sep–Feb	≥180
CLLMM4	≥10,000	N/A	Total volume released in Sep–Jan >Total volume released in Feb–Aug	1-in-7 [14%] {1–2 yr in 10}	17	0.6 to ≥0.9		N/A	N/A	N/A

* CLLMM1 = no less than 650 GL in a single year, and no less than 6,000 GL over 3 years

** CLLMM2 = no less than 3150 GL in a single year, and no less than 12,000 over 3 years

^ see Figure 4.6 for hypothetical representation of annual barrage release pattern

#Frequency is expressed as: 1) number of flows per Average Return Interval (ARI), 2) percentage of years and 3) the number of years that the EWR should occur within a 10-yr period.

&represents the critical maximum interval (years) between EWRs before a significant decline in CLLMM condition is likely to occur. This period Application of the environmental water requirements

*** Although (Gehrig, et al., 2020) recommended the lowest water level of 0.5 mAHD (for EWR-CLLMM1), for consistency with the Basin Plan 2012 this has been modified to 0.4 mAHD.

4.4 Application of the environmental water requirements

4.4.1 EWRs contribution to targets

The methods used to develop the EWRs for this LTWP do not provide a single EWR per objective or target; rather, the suite of EWRs for each PEA describes a variable flow regime which is required to achieve the ecological targets. To assist with annual planning and environmental watering decisions, such as potential benefits or trade-offs under different flow scenarios, a matrix was developed that assessed the likely contribution of each EWR in isolation towards achieving each of the ecological targets. The assessment uses a coarse ranking system and so a result of no change in ranking does not necessarily mean there is no improvement in contribution, and outcomes will be dependent on antecedent flows and prevailing ecosystem condition (Department for Environment and Water, 2025). The matrices were populated based on the flow-ecology conceptual models (see PEA descriptions above) and expert opinion. The results are presented in the two tables below:

- Table 4.7. Assessment of contribution of SA River Murray Channel and Floodplain PEA EWRs towards ecological targets
- Table 4.8. Assessment of contribution of the Coorong, Lower Lakes and Murray Mouth PEA EWRs towards ecological targets.

The matrices developed for the Floodplain PEA and the CLLMM PEA show the importance of flows of 70,000 ML/day QSA or greater in achieving ecological outcomes, with the higher EWRs likely to result in a 'large positive contribution' to the greatest number of targets. However, the need for a long-term variable flow regime consisting of baseflows, in-channel freshes and overbank flows (as represented by the suite of EWRs for each asset) should not be overlooked.

4.4.2 EWRs and annual planning

The EWRs for the PEAs are not presented in the form of prescriptive five-year hydrographs because the feasibility of delivery will be highly dependent on climatic conditions. In order to meet the majority of the EWRs, environmental water will need to be delivered in conjunction with unregulated flows, as the volume of water required is greater than that provided by South Australia's Entitlement or available to the environment through water recovery programs. The need to deliver an EWR in any given year will also depend on antecedent climate conditions and the condition of the different ecological components of the asset. Therefore, the EWRs describe a desired long-term and variable hydrological regime in a way that enables flexibility and adaptive management in response to climate and ecological condition.

In recent years, South Australia has used a scenario-based approach to plan and prioritise environmental watering actions each year. The process is described in the Annual Environmental Watering Plans for the South Australian River Murray, which are published on the DEW website. The EWRs can be used to inform annual planning by:

- comparing desired return frequency (i.e. the average return frequency metric of EWR) to actual return frequency (i.e. how often the EWR has been met based on surface water data) over a 20-year period, where an EWR is considered to be met within any given water-year when the volume/discharge, duration, timing, water level and rate of change metrics have all been satisfied. A 20-year timeframe is preferred as it captures the longest 'maximum interval' specified by any of the EWRs (i.e. 17 years for EWR - CLLMM4) and ensures results are based on long-term watering histories
- assessing the number of years since the EWR was met and comparing to the maximum interval metric of the EWR.

These assessments are hydrological and assume the flow-ecology relationship is well understood. Decisions should also be informed by results from ecological monitoring that indicate current condition, need for water and risk of not watering. Once accurate forecasts of climatic conditions are available, the assessment should be

revisited and watering actions refined based on what is feasible to deliver. As required by Principle 1 of the Basin Plan (*principles to be applied in environmental watering*), regard must be given to the Basin annual environmental watering priorities in determining the appropriateness of environmental watering actions.

In addition to the ecological information, management considerations within Section 7 should also be taken into account during planning and decision-making, including:

- Aboriginal values – consideration of, and where possible alignment with, Aboriginal values in order to maximise the benefits from environmental watering
- co-operative arrangements – processes to be followed to ensure that watering actions across the WRP area and SCB are coordinated, and potential risks to water quality are considered
- operational constraints – whether it is feasible to deliver the proposed watering action in view of operational constraints
- long-term risks to providing environmental water – whether the proposed watering action addresses any of the potential long-term risks.

4.4.3 EWRs and management levers

The description of landscape-scale environmental assets for the SA River Murray LTWP and their EWRs encourages the reinstatement of a more natural flow regime through the delivery of environmental water to the South Australian border, and subsequently downstream to the CLLMM. Achieving most EWRs will require an unregulated flow event to occur, with environmental water used to boost the magnitude or duration of the event. However, the PEAs incorporate many smaller scale management units that offer alternative opportunities for delivering environmental water and meeting some of the EWR metrics in discrete locations.

In particular, environmental regulators on Chowilla, Pike and Katarapko anabranches can be operated and the main channel weirs can be raised to increase the extent of inundation of parts of the Channel and Floodplain PEAs, while pumps can be used to deliver water to discrete temporary wetland basins in any of the three PEAs. Each of these management units have their own management plans and site-specific objectives and targets, but these types of actions will also contribute to partially meeting the ecological targets of the PEAs. The mechanism for evaluating the contribution of localised environmental water delivery to the PEA ecological targets is addressed through Matter 8 evaluation and reporting (see Section 8.1.1), and the information used to inform adaptive management of both the site and the PEA.

By modelling the flow rate at which temporary wetlands are inundated (commence-to-flow), sites that are likely to receive water as a result of enhancing flows at the South Australian border can be identified. Cross-referencing these commence-to-flow values and the discharge metrics of the EWRs for the Channel PEA and the Floodplain PEA provides an indication of the wetlands that will be influenced by the delivery of different flow events, noting that this relationship will change in lock reaches when weir manipulations or operation of large environmental regulators are undertaken.

Fringing temporary wetlands of the CLLMM PEA are influenced by water levels in the Lower Lakes (which are largely influenced by barrage operations) and the effects of wind seiching, and their desired hydrological regime is provided by the variable Lake levels specified in the CLLMM PEA EWRs. Pumping water to these wetlands may be required at times, depending on climatic conditions and the ability to maintain the appropriate seasonal Lake level pattern.

The Channel PEA also includes a large number of pool-connected wetlands (i.e. wetlands that are permanently inundated due to the stable water levels created by the weirs). At some of these wetlands, wetting and drying regimes have been reinstated through the installation of infrastructure that enables them to be disconnected from the River. These managed pool-connected wetlands have their own management plans that describe site-specific objectives and targets. The unmanaged and the managed pool-connected wetlands use planned environmental water and held environmental water, respectively. It may be difficult to determine the direct contribution that

pool-connected wetlands make to the Channel PEAs ecological targets, which focus largely on outcomes from the delivery of additional water to South Australia. However, increased flows and the re-establishment of lotic habitats in the main channel will increase the value of the lentic conditions provided by off-channel habitats.

Table 4.7. Assessment of contribution of SA River Murray Channel and Floodplain PEA EWRs towards ecological targets

Table taken from DEW (2025).

Assessment based on the following ranking system:

Score	Description
0	No contribution expected / contribution unlikely
1	very minor contribution may occur, difficult to detect without intense and targeted survey effort
2	minor contribution, may only be detectable in some locations
3	moderate contribution towards achieving target expected
4	major contribution towards achieving target expected

Ecological Targets Flows measured in megalitres per day at SA Border	**EF**	**IC1**	**IC2**	**IC3**	**IC4**	**FP1**	**FP2**	**FP3**	**FP4**	**FP5**
	≥3,000	**≥10000**	**≥20000**	**≥30000**	**≥40000**	**50,000**	**≥60000**	**≥70000**	**≥80000**	**≥80000**
	all year	**≥60**	**≥60**	**≥60**	**≥60**	**≥40**	**≥20**	**≥20**	**≥10**	**≥30**
1. Across all sites, independent of habitat type, terrestrial bird species richness measured across all four seasons within one year, is maintained at or above 78 species	0	0	0	0	0	1	2	3	4	4
2. Across all sites, independent of habitat type, terrestrial bird species richness measured over a rolling four-year period, is maintained at or above 110 species	0	0	0	0	0	1	2	3	4	4
3. Each of the terrestrial reptile species that use the littoral and/or floodplain zones are recorded across ≥50% of sites within their known distribution at least once every two years	0	0	2	2	4	4	4	4	4	4
4. Each of the terrestrial mammal species that use the littoral and/or floodplain zones for are recorded across ≥50% of sites within their known distribution at least once every two years	0	0	2	2	4	4	4	4	4	4
5. Each of the 15 bat species known to occur within the asset will be detected across ≥ 75% of sites within their known distribution at least once every two years	0	2	2	2	2	2	2	2	2	2

Ecological Targets Flows measured in megalitres per day at SA Border	**EF**	**IC1**	**IC2**	**IC3**	**IC4**	**FP1**	**FP2**	**FP3**	**FP4**	**FP5**
	≥3,000	**≥10000**	**≥20000**	**≥30000**	**≥40000**	**50,000**	**≥60000**	**≥70000**	**≥80000**	**≥80000**
	all year	**≥60**	**≥60**	**≥60**	**≥60**	**≥40**	**≥20**	**≥20**	**≥10**	**≥30**
6. Each of the 10 frog species known to occur within the asset will be detected at least once every two years at 75% of surveyed sites within their known distribution within the channel PEA	0	1	2	2	4	4	4	4	4	4
7. Each of the 10 frog species known to occur within the asset will be detected at least once every two years at 60% of surveyed sites within their known distribution within the floodplain PEA	0	0	0	0	0	1	2	3	3	4
8. Tadpoles from each of the 10 frog species known to occur within the asset will be recorded in achieve later stages of metamorphosis (Gosner stage >36), 3 years in 10 with a maximum 3 year return interval	0	0	2	3	4	3	3	3	3	3
9. Maintain the existing distribution of the nationally listed Southern Bell Frog (*Litoria raniformis*) as evidenced by detection of adults 3 years in 5 within their known distribution	0	0	2	2	4	4	4	4	4	4
10. Increase the spatial extent of productive foraging zones (inundated mud flats, shallow water) by 50% above that occurring under entitlement flow and normal weir pool conditions to support adult waterbirds and survival of juveniles/sub-adults, during spring-summer for ≥30 days	0	0	1	2	3	4	4	4	4	4
11. Maintain the water depth and duration of inundation of emergent vegetation required to support waterbird breeding through to completion (egg laying, fledging and post fledging care) at least 3 years in 10 with a maximum return interval of 5 years.	0	0	0	1	2	3	4	4	4	4
12. Annual species richness of waterbirds is maintained at ≥ 55 species	0	0	0	1	2	3	4	4	4	4
13. Over a three-year period, species richness is maintained at ≥ 60 species, and includes small-bodied migratory waders	0	0	0	0	2	2	3	4	4	4
14. Population age structure of turtles indicates an effective recruitment event 1 year in 5 (max 7 years), demonstrated by separate cohorts of juveniles/sub-adults and adults of each species	0	0	0	0	0	1	1	1	1	1
15. Abundance (measured as CPUE) of juvenile/sub-adult turtles of each species exhibits a positive trajectory and increases by ≥30% over a 5-year period	0	0	0	0	0	1	1	1	1	1

Ecological Targets Flows measured in megalitres per day at SA Border	EF	IC1	IC2	IC3	IC4	FP1	FP2	FP3	FP4	FP5
	≥3,000	≥10000	≥20000	≥30000	≥40000	50,000	≥60000	≥70000	≥80000	≥80000
	all year	≥60	≥60	≥60	≥60	≥40	≥20	≥20	≥10	≥30
16. Abundance (measured as CPUE) of adult turtles of each species exhibits a positive trajectory and increases by ≥30% over a 10-year period	0	0	0	0	0	1	1	1	1	1
17. All three species are recorded annually in 90% of sampling sites within permanent mesohabitats along length of PEA	0	1	1	1	1	2	2	2	2	2
18. Long neck turtles are recorded annually in 90% of sampling sites within inundated temporary wetlands along the length of the PEA	0	0	0	0	0	1	1	2	2	2
19. Dissolved organic carbon concentration increases from baseflow values (3-4 mg/L) to ≥6 mg/L during the rising limb of hydrographs.	0	0	2	3	4	4	4	4	4	4
20. Mean microinvertebrate abundance in the main channel is ≥1,000 individuals/L during late spring/early summer	0	0	1	2	3	3	3	4	4	4
21. Peak microinvertebrate abundance in the main channel is ≥2,000 individuals/L during late spring/early summer	0	0	1	2	3	3	3	4	4	4
22. During late spring/early summer, at least 25% of the microinvertebrate assemblage in the main channel is comprised of individuals from the littoral functional groups (e.g. littoral rotifers, cyclopoid copepods and cladocerans)	0	0	1	2	3	3	3	4	4	4
23. During late spring/early summer the density of cyclopoid copepods and cladocerans is 100–1000 individuals/L within 3 weeks of inundation of shedding and retaining habitats on the floodplain	0	0	0	0	1	2	3	4	4	4
24. Maintain passing flows at the downstream side of the locks above 4,000 ML/day to ensure at least one mixing event per day	1	4	4	4	4	4	4	4	4	4
25. Maintain passing flows at the downstream side of the locks above 10,000 ML/day to provide sufficient turbulence intensity to support downstream drift	1	4	4	4	4	4	4	4	4	4
26. Maintain contiguous flowing habitat with velocity ≥0.2 ms^{-1} from the junction of the Murray and Darling Rivers to Wellington during late spring-early summer to facilitate downstream transport/dispersal of drift dependent biota	0	0	3	4	4	4	4	4	4	4
27. Maintain contiguous flowing habitat with velocity ≥0.3 ms^{-1} from the junction of the Murray and Darling Rivers to Wellington	0	0	1	3	4	4	4	4	4	4

Ecological Targets Flows measured in megalitres per day at SA Border	EF	IC1	IC2	IC3	IC4	FP1	FP2	FP3	FP4	FP5
	≥3,000	≥10000	≥20000	≥30000	≥40000	50,000	≥60000	≥70000	≥80000	≥80000
	all year	≥60	≥60	≥60	≥60	≥40	≥20	≥20	≥10	≥30
during late spring-early summer to restore high value hydraulic habitat										
28. ≥75% of ephemeral wetland area is inundated with lateral connectivity to the river/creek for a minimum of 20 continuous days at least once every 3 years	0	0	0	0	1	2	2	3	4	4
29. Salt export, averaged over the preceding 3 years, is ≥2 million tonnes per year	1	1	2	3	3	4	4	4	4	4
30. Algal cell counts and toxin concentrations for cyanobacteria remain within the parameters used by SA Water for managing risks related to algal blooms	1	3	4	4	4	4	4	4	4	4
31. Dissolved Oxygen remains above 6 mgO_2/L (or 90% saturation) in the main channel and connected anabranch creeks at all times	3	4	4	4	4	4	4	4	4	4
32. Salinity remains below 1,000 mg/L (EC = 1,800 μScm^{-1}) 100% of the time in the main channel and connected anabranch creeks	2	3	4	4	4	4	4	4	4	4
33. Increase in in-stream salinity facilitated by environmental watering actions does not exceed >200 EC for more than two weeks	2	3	4	4	4	4	4	4	4	4
34. Water column pH in the main channel and connected anabranch creeks remains within 6.5-9.0 100% of the time	4	4	4	4	4	4	4	4	4	4
35. Population age structure of Murray cod includes recent recruits, subadults and adults in 9 years in 10	0	1	2	3	4	4	4	4	4	4
36. Abundance (measured as CPUE) of Murray cod exhibits a positive trajectory and increases by ≥50% over a 10-year period	0	1	2	3	4	4	4	4	4	4
37. Population age structure of golden perch indicates a large recruitment event 2 years in 5, demonstrated by separate cohorts that combined, represent >30% of the population.	0	0	2	3	3	3	4	4	4	4
38. Abundance (measured as CPUE) of golden perch exhibits a positive trajectory and increases by ≥30% over a 5-year period	0	0	2	3	3	3	4	4	4	4
39. Cohorts of golden perch originate from multiple spatial recruitment sources including the lower Murray	0	0	2	3	3	3	4	4	4	4
40. Population age structure of silver perch indicates recruitment 4 years in 5, indicated by presence of year classes	0	1	3	3	3	3	3	3	3	3
41. Abundance (measured as CPUE) of silver perch exhibits a positive trajectory and increases by ≥30% over a 5-year period	0	1	2	3	3	3	4	4	4	4

Ecological Targets Flows measured in megalitres per day at SA Border	EF	IC1	IC2	IC3	IC4	FP1	FP2	FP3	FP4	FP5
	≥3,000	≥10000	≥20000	≥30000	≥40000	50,000	≥60000	≥70000	≥80000	≥80000
	all year	≥60	≥60	≥60	≥60	≥40	≥20	≥20	≥10	≥30
42. Cohorts of silver perch originate from multiple spatial recruitment sources including the lower Murray	0	0	2	3	3	3	4	4	4	4
43. Population age structure of freshwater catfish includes recent recruits, subadults and adults in 9 years in 10	0	1	1	1	1	2	2	2	2	2
44. Abundance (measured as CPUE) of freshwater catfish exhibits a positive trajectory and increases by ≥50% over a 10-year period	0	1	1	1	1	2	2	2	2	2
45. In standardised transects spanning the elevation gradient, ≥90% of viable River Red Gum will have a Tree Condition Index Score ≥10	0	0	1	1	2	2	3	3	3	4
46. Effective regeneration of River Red Gum woodlands at least 1 in 10 years, as evidenced by >85 % of assessment areas containing saplings and/or sub-adult trees (DBH <10cm) comprising >30% of the population	0	0	1	1	2	2	3	3	3	4
47. The rate of loss (die back to a TCI = 0) of mature River Red Gums will not exceed 0.15% per year	0	0	1	1	2	2	3	3	3	4
48. In standardised transects spanning the elevation gradient, ≥90% of viable Black Box will have a Tree Condition Index Score ≥10	0	0	0	0	0	1	2	3	3	4
49. Effective regeneration of Black Box woodlands at least 1 in 20 years, as evidenced by >75 % of assessment areas containing saplings (size) and/or sub-adult trees (DBH <10cm) comprising >30% of the population	0	0	0	0	0	1	2	3	3	4
50. The rate of loss (die back to a TCI = 0) of mature Black Box will not exceed will not exceed 0.15% per year	0	0	0	0	0	1	2	3	3	4
51. In standardised transects spanning the elevation gradient, ≥90% of viable River Cooba will have a Tree Condition Index Score ≥10	0	0	2	3	4	4	4	4	4	4
52. 30% of lignum sites receive condition values indicative of good condition at least once every 2 years	0	0	0	1	2	3	4	4	4	4
53. 60% of lignum sites receive condition values indicative of good condition at least once every 3 years	0	0	0	2	3	3	3	4	4	4
54. 80% of lignum sites receive condition values indicative of good condition at least once every 4 years	0	0	0	2	3	3	3	3	3	4
55. Percentage of dead (non-viable plants) within assessment areas decreases	0	0	0	1	2	3	4	4	4	4
56. In permanently inundated channels and pool connected wetlands, a minimum of 90% of survey cells located on the bed,	1	2	3	4	4	4	4	4	4	4

Ecological Targets Flows measured in megalitres per day at SA Border	EF	IC1	IC2	IC3	IC4	FP1	FP2	FP3	FP4	FP5
	≥3,000	≥10000	≥20000	≥30000	≥40000	50,000	≥60000	≥70000	≥80000	≥80000
	all year	≥60	≥60	≥60	≥60	≥40	≥20	≥20	≥10	≥30
bank toe, slope and crest are either inundated or contain native flood-dependent and/or amphibious taxa at least once every 2 years										
57. In permanently inundated channels and pool connected wetlands, survey cells will have species richness of native flood-dependent, amphibious and aquatic plants ≥ 60 at least once every 2 years	1	2	3	4	4	4	4	4	4	4
58. In temporary wetlands inundated at flows ≤40,000 MLday^{-1}, a minimum of 70% of survey cells located on the bed, bank toe, slope and crest are either inundated or contain native flood-dependent and/or amphibious taxa at least once every 2 years	0	1	2	3	4	4	4	4	4	4
59. In temporary wetlands inundated at flows ≤40,000 MLday^{-1}, survey cells will have species richness of native flood-dependent, amphibious and aquatic plants ≥ 80 at least once every 2 years	0	1	2	3	4	4	4	4	4	4
60. The shedding floodplain inundated at flows ≤40,000 MLday^{-1} has a minimum of 70% of survey cells either inundated or containing native flood-dependent and/or amphibious taxa at least once every 2 years	0	1	1	2	4	4	4	4	4	4
61. The shedding floodplain inundated at flows ≤40,000 MLday^{-1} survey cells will have species richness of native flood-dependent, amphibious and aquatic plants ≥ 80 at least once every 2 years	0	1	1	2	4	4	4	4	4	4
62. In temporary wetlands inundated at flows >40,000 MLday^{-1}, a minimum of 40% of survey cells located on the bed, bank toe, slope and crest are either inundated or contain native flood-dependent and/or amphibious taxa once every 2 years on average with maximum interval ≤4 years.	0	0	0	0	1	2	2	3	3	4
63. In temporary wetlands inundated at flows >40,000 MLday^{-1}, survey cells located on the bed, bank toe, slope and crest will have species richness of native flood-dependent, amphibious and aquatic plants ≥40 once every 2 years on average with maximum interval ≤ 4 years.	0	0	0	0	1	2	2	3	3	4
64. In temporary wetlands inundated at flows >40,000 MLday^{-1}, a minimum of 80% of survey cells located on the bed, bank toe, slope and crest are either inundated or contain native flood-	0	0	0	0	0	0	2	3	3	4

Ecological Targets Flows measured in megalitres per day at SA Border	**EF**	**IC1**	**IC2**	**IC3**	**IC4**	**FP1**	**FP2**	**FP3**	**FP4**	**FP5**
	≥3,000	**≥10000**	**≥20000**	**≥30000**	**≥40000**	**50,000**	**≥60000**	**≥70000**	**≥80000**	**≥80000**
	all year	**≥60**	**≥60**	**≥60**	**≥60**	**≥40**	**≥20**	**≥20**	**≥10**	**≥30**
dependent and/or amphibious taxa once every 4 years on average with maximum interval ≤ 6 years.										
65. In temporary wetlands inundated at flows >40,000 MLday^{-1}, survey cells located on the bed, bank toe, slope and crest will have species richness of native flood-dependent, amphibious and aquatic plants ≥60 once every four years on average with maximum interval ≤ 6 years.	0	0	0	0	0	0	2	3	3	4
66. The shedding floodplain inundated at flows >40,000 MLday^{-1} has a minimum of 20% of survey cells that are either inundated or contain native flood-dependent and/or amphibious taxa once every 3 years on average with maximum interval ≤5 years.	0	0	0	0	0	1	2	3	3	4
67. On the shedding floodplain inundated at flows >40,000 MLday^{-1}, survey cells will have species richness of native flood-dependent, amphibious and aquatic plants ≥ 50 once every 3 years on average with maximum interval ≤ 5 years.	0	0	0	0	0	1	2	3	3	4
68. The shedding floodplain inundated at flows >40,000 MLday^{-1} has a minimum of 40% of survey cells that are either inundated or contain native flood-dependent and/or amphibious taxa once every 5 years on average with maximum interval ≤7 years.	0	0	0	0	0	1	2	3	3	4
69. On the shedding floodplain inundated at flows >40,000 MLday^{-1}, survey cells will have species richness of native flood-dependent, amphibious and aquatic plants ≥ 75 once every 5 years on average with maximum interval ≤ 7 years.	0	0	0	0	0	1	2	3	3	4
70. The shedding floodplain inundated at flows >40,000 MLday^{-1} has a minimum of 70% of survey cells that are either inundated or contain native flood-dependent and/or amphibious taxa once every 7 years on average with maximum interval ≤10 years.	0	0	0	0	0	1	2	3	3	4
71. On the shedding floodplain inundated at flows >40,000 MLday^{-1}, survey cells will have species richness of native flood-dependent, amphibious and aquatic plants ≥ 100 once every 7 years on average with maximum interval ≤ 10 years.	0	0	0	0	0	1	2	3	3	4
72. Where the watertable resides within the active rooting depth, groundwater salinity in the top one metre of the saturated zone is within the range utilisable as a water source for river red gum (≤ 5,000 µScm^{-1})	0	0	2	3	3	4	4	4	4	4

Ecological Targets Flows measured in megalitres per day at SA Border	**EF**	**IC1**	**IC2**	**IC3**	**IC4**	**FP1**	**FP2**	**FP3**	**FP4**	**FP5**
	≥3,000	**≥10000**	**≥20000**	**≥30000**	**≥40000**	**50,000**	**≥60000**	**≥70000**	**≥80000**	**≥80000**
	all year	**≥60**	**≥60**	**≥60**	**≥60**	**≥40**	**≥20**	**≥20**	**≥10**	**≥30**
73. Where the watertable resides within the active rooting depth, groundwater salinity in the top one metre of the saturated zone is within the range utilisable as a water source for black box (≤ 8,000 µScm^{-1})	0	0	1	2	3	4	4	4	4	4
74. In River Red Gum woodlands, at least one depth interval between 0.2 m and the water table has soil water potential ≥ -1.0 MPa	0	0	1	2	2	3	3	4	4	4
75. In Black Box woodlands, at least one depth interval between 0.2 m and the water table has soil water potential ≥ -2.0 MPa	0	0	0	0	1	1	2	3	3	4
76. In lignum shrublands, at least one depth interval between 0.2 m and the water table has soil water potential ≥ -2.0 MPa	0	0	0	2	3	3	3	3	3	4
77. Soil salinity (EC 1:5) is <2,700 µScm^{-1} in the 0.2-0.5 m depth interval	0	0	0	0	1	1	2	3	3	4
78. Soil salinity (EC 1:5) is <1,300 µScm^{-1} (non-moderately saline) in the 0.2-0.5 m depth interval at least once every 2 years in the Channel PEA	0	0	0	0	0	1	1	2	3	3
79. Soil salinity (EC 1:5) is <1,300 µScm^{-1} (non-moderately saline) in the 0.2-0.5 m depth interval at least once every 5 years in the Floodplain PEA	0	0	0	0	0	1	1	2	3	3

Table 4.8. Assessment of contribution of the Coorong, Lower Lakes and Murray Mouth PEA EWRs towards ecological targets

Table taken from DEW (2025)

Assessment based on the ranking system displayed under Table 4.5

Ecological Targets Flows measured in megalitres per day at SA border	**CLLMM1** ≥2000	**CLLMM2** ≥4000	**CLLMM3** ≥6000	**CLLMM4** ≥10000
1. Exceed the long-term (2000–2015) median value for abundance of each of 40 selected waterbird species in the Coorong in two of the last three years.	2	4	4	3
2. Exceed the 75% threshold for the long-term (2000–2015) area of occupation (AOO) for each of 40 selected waterbird species in the Coorong.	2	4	4	3
3. Exceed the 75% threshold for the long-term (2000–2015) extent of occurrence (EOO) for each of 40 selected waterbird species in the Coorong.	2	4	4	3
4. Exceed the recent (2013–2015) median value for abundance of each of 25 selected waterbird species in the Lower Lakes in two of the last three years.	2	4	4	3
5. Exceed the 75% threshold for the recent (2013–2015) AOO for each of 25 selected waterbird species in the Lower Lakes and fringing wetlands.	2	4	4	3
6. Exceed the 75% threshold for the recent (2013–2015) EOO for each of 25 selected waterbird species in the Lower Lakes and fringing wetlands.	2	4	4	3
7. Maintain annual breeding of waterbird species that are known to breed at the site annually.	2	4	4	3
8. Increase the number of threatened waterbirds of breeding age compared to 2000 – 2015.	2	4	4	3
9. Provide functional mudflat habitats to sustain shorebirds, especially during September to April.	3	4	4	3
10. A spatio-temporally diverse native fish community present across the whole site, including all 17 fish families, with annual observations of both common and threatened species.	3	4	4	4
11. The annual abundance of upstream migrating YOY congolli (*Pseudaphritis urvillii*) is ≥ the mean recruitment reference value (i.e. 44.5 YOY/hr).	3	4	4	4
12. The annual abundance of upstream migrating YOY common galaxias (*Galaxias maculatus*) is ≥ the mean recruitment reference value (i.e. 6.1 YOY/hr).	3	4	4	4
13. Pouched lamprey (*Geotria australis*) are sampled from ≥60% of large vertical-slot fishway sites[15] when barrage discharge is <30,000 ML/d across the winter sampling season and present when discharge is ≥ 30,000 ML/d and all years.	2	4	4	4
14. Short-headed lamprey (*Mordacia mordax*) present in all years[16].	2	4	4	4
15. WOISS equal to 4 (maximum value) for Black Bream (*Acanthopagrus butcheri*) on an annual basis.	3	4	4	2
16. WOISS equal to 4 (maximum value) for Greenback Flounder (*Rhombosolea tapirina*) on an annual basis.	3	4	4	4
17. Detect juvenile Mulloway (*Argyrosomus japonicus*) in at least 50% of the Coorong and Murray Mouth and Barrages subregions.	1	2	3	4

[15] Large fish ways include Mundoo, Goolwa, Ewe Island, trap and the large Vertical slot fishway at Tauwitchere and exclude Boundary Creek and the small fishways at Tauwitchere, Goolwa and Hunters Creek.

[16] presence in a year includes detection in any fishway, at Lock 1 or any other part of the River Murray system.

Ecological Targets Flows measured in megalitres per day at SA border	**CLLMM1** **≥2000**	**CLLMM2** **≥4000**	**CLLMM3** **≥6000**	**CLLMM4** **≥10000**
18. Small-mouthed hardyhead (*Atherinosoma microstoma*) populations achieve a WOISS of ≥4 on an annual basis.	3	4	4	4
19. Maintain annual population abundance (Catch Per Unit Effort – CPUE) of Sandy sprat (*Hyperlophus vittatus*) throughout the Coorong and Murray Mouth and Barrages subregions.	3	4	4	4
20. Murray hardyhead (*Craterocephalus fluviatilis*) WOISS >0.5 in autumn of low to moderate flow years and detected in years of moderate to high river flows.	3	2	1	1
21. Yarra pygmy perch (*Nannoperca obscura*) WOISS >0.5 on an annual basis with wild recruits detected in autumn sampling and maintenance of populations at release sites.	2	3	4	4
22. Southern pygmy perch (*Nannoperca australis*) WOISS >0.5 on an annual basis with wild recruits detected in autumn sampling and maintenance of populations at release sites.	2	3	4	4
23. Population age structure[a] of golden perch has at least one strong (>20%) cohort in the first 5 years, two or more moderate (>15%) cohorts and >10% fish >10 years of age. [a] Based on commercial fishery catch by large mesh gill net in the Lower Lakes.	2	3	4	4
24. Cohorts of golden perch originate from multiple spatial recruitment sources including the lower Murray and Lower Lakes.	2	3	4	4
25. Macroinvertebrate species richness and community composition remains within or exceeds the long-term (2004-2023) reference for the Coorong and Murray Mouth and Barrages subregions.	3	3	4	4
26. The index of occurrence of macroinvertebrate species remains within or exceeds the long-term (2004-2023) species-specific reference level.	3	3	4	4
27. Abundance of macroinvertebrate species are at or above reference levels for the Coorong and Murray Mouth and Barrages subregions.	3	4	4	3
28. The proportional distribution and abundance of bioturbating Nereididae (*Simplisetia aequisetis*, *Australonereis ehlersi*) for the Coorong and Murray Mouth and Barrages subregions is ≥50%.	3	3	4	3
29. Macroinvertebrate biomass is at or above reference levels for the Coorong and Murray Mouth and Barrages subregions.	3	4	4	4
30. Macroinvertebrate communities are similar to those occurring under intermediate continuous flows.	3	4	4	4
31. Populations of larger-bodied bivalves (*Spisula trigonella*, *Hiatula alba*) are maintained in the Coorong and/or Murray Mouth and Barrages subregions.	2	2	4	4
32. *Lokeri* (Floodplain mussel, *Velesunio ambiguus*) population comprises all size classes, including small individuals (<4 years old), in both Lakes Alexandrina and Albert.	3	4	4	3
33. *Kaltuwari* (yabby, *Cherax destructor*) populations have at least 50% of individuals with <15 mm occipital carapace length (OCL) in November and at least 70% of individuals with >30 mm OCL in March with increasing total abundance and distribution.	2	3	3	4
34. Median grain size of sediments in the Coorong and Murray Mouth and Barrages will remain between 125 – 500 µm.	3	4	4	3
35. Sediment organic matter content between 1 and 3.5 % dry weight in the Coorong and Murray Mouth and Barrages.	3	4	4	3
36. Carapace length frequency distribution demonstrates presence of juvenile *Thukabi* by 2030, and regular, successful recruitment at three or more Ngarrindjeri *Thukabi* monitoring sites.	4	4	4	4
37. Each of the six frog species known to occur in the Lower Lakes and wetlands will be detected at least once every two years at 75% of surveyed sites.	2	3	4	4

Ecological Targets Flows measured in megalitres per day at SA border	**CLLMM1** **≥2000**	**CLLMM2** **≥4000**	**CLLMM3** **≥6000**	**CLLMM4** **≥10000**
38. Maintain and/or improve habitat suitable for the nationally listed Southern bell frog (*Litoria raniformis*) at wetlands where they are known to have previously occurred.	2	3	4	4
39. Lower Lakes aquatic and littoral vegetation achieves a WOISS ≥ 0.6 on an annual basis as quantified using the LLCMM TLM vegetation indices.	4	4	4	4
40. Expand the distribution of littoral vegetation at 0 mAHD across the site compared to the 2024 baseline.	4	4	4	4
41. Extent of occurrence (EOO) - macrophyte beds containing *Ruppia tuberosa* occur for at least 43 km along the Coorong.	2	3	4	4
42. Area of occupation (AOO) – 80% of sites within the sampled distribution have a submerged macrophyte community containing *Ruppia tuberosa* present in winter.	2	3	3	4
43. Regional Vigour - 50% of sites exceed the local (site) vigour levels.	1	2	3	4
44. Local Vigour - At least 30% of cores (75 mm diam.) contain aquatic plants in winter and in summer.	2	3	3	4
45. Local Vigour - At least 10 shoots per core (75 mm diam.) in winter.	2	3	3	4
46. Local Vigour - At least 50 flower-heads/m^2 for 50% of the area sampled at a site during spring/early summer flowering.	2	3	3	4
47. Local Vigour - At least 50% of surface sediment cores (75 mm diam. x 40 mm deep) with seeds in summer.	2	3	3	4
48. Local Vigour - At least 50% of cores (75 mm diam) taken across area sampled at a site in late summer contain turions.	2	3	3	4
49. Resilience – 50% of sites should exceed 2,000 seeds/m^2.	2	3	3	4
50. Colonisation - Submerged macrophyte communities detected at >50% of sites with suitable habitats between Pelican Point and The Needles (North Lagoon).	2	3	3	4
51. Recruitment - By 2029: 10,000 *Ruppia* sp. seeds/m^2 in multiple samples from >50% of sites (e.g. ≥40 seeds per 75 mm diam. × 40 mm deep core).	2	3	3	4
52. Salinity in Lake Alexandrina at a long-term annual average of 700 EC, below 1,000 EC 95% of years, and below 1,500 EC all of the time[17] (DEW, in prep)	3	4	4	4
53. Murray estuary, Coorong North Lagoon, Coorong South Lagoon: Salinity gradient in the Coorong is present, with Murray estuary average monthly salinities <35 ppt, North Lagoon average monthly salinities <45 ppt, South Lagoon average monthly salinities over winter <60 ppt and daily salinities year-round <100 ppt 95% of the time[18]. (DEW, 2025b).	4	4	4	4
54. Murray Mouth is open at all times maintained by freshwater releases from the barrages.	3	3	4	4
55. All barrage fishways are open every day.	4	4	4	4
56. Attractant flows, via the operation of barrage bays adjacent to fishways, are provided every day.	4	4	4	4
57. Maximise number of barrage gates open at all times of year and especially between June and September to facilitate greater fish movement and connectivity.	3	4	4	4

[17] No target has been proposed for Lake Albert, the narrow connection between Lake Alexandrina and Lake Albert means it is not practical to manage salinity levels within Lake Albert independently of Lake Alexandrina (DEW in prep).

[18] Abundance and diversity of macroinvertebrate, plant and fish communities are expected to increase at salinity ranges lower than <60ppt (DEW in prep).

5 Priority ecosystem functions (PEFs)

5.1 Ecological objectives, targets and environmental water requirements

The Basin Plan (Schedule 9) provides the following criteria for identifying ecosystem functions:

- supports the creation and maintenance of vital habitats and populations
- supports the transportation and dilution of nutrients, organic matter and sediment
- provides connections along a watercourse (longitudinal connectivity)
- provides connections across floodplains, adjacent wetlands and billabongs (lateral connections).

Processes or functions consistent with these criteria have been identified as key ecological attributes for each of the PEAs within the SA River Murray WRP area (the Channel, the Floodplain and the CLLMM), and so ecological objectives relating to ecosystem functions have been included for each asset.

The identification of PEFs for the SA River Murray WRP area as a whole was undertaken through a DEWNR project described in Bonafacio (2015) and the following information has been extracted from this report. PEFs are considered to be those that occur within two or more of the PEAs and rely on connectivity between the PEAs. By aligning the ecological objectives of the PEAs with ecosystem functions identified in the scientific literature, 10 PEFs have been identified. An associated ecological objective has been developed for each PEF. A unique suite of ecological targets and EWRs for the PEFs has not been developed because the targets and EWRs of the PEAs capture those of the PEFs. This is justified on the basis that the approach aligned the objectives of the PEAs and these already have associated EWRs and targets. Table demonstrates the ecological objectives for the PEFs, and provides an example of a PEA objective or target for each that is relevant to the PEF ecological objective.

Connectivity throughout the WRP area is implicit to the achievement of the asset EWRs, with the primary mechanism for delivery being the provision of environmental water to the SA border, which then flows onto the CLLMM. This reflects a continuing shift towards more integrated management of the SA River Murray WRP area as a whole. For example, in recent years, proposed multi-site watering actions for the SA River Murray WRP area have been developed (Department of Environment and Water, 2025c) that seek to align the desired water delivery pattern for the CLLMM with that of the Channel or Floodplain. This was further investigated through hydrological modeling of the alignment of the asset EWRs (see section **Error! Reference source not found.** below).

Table 5.1. Priority ecosystem functions and associated ecological objectives for the SA River Murray WRP area

Priority ecosystem functions	PEF Ecological objectives	Example **PEA** target
Flow variability	Improve flow variability throughout the SA River Murray	Maintain contiguous flowing habitat with velocity ≥0.3 ms-1 from the junction of the Murray and Darling Rivers to Wellington during late spring-early summer to restore high value hydraulic habitat
Lateral hydrological connectivity	Improve the lateral hydrological connectivity between the Channel and Floodplain	≥75% of ephemeral wetland area is inundated with lateral connectivity to the river/creek for a minimum of 20 continuous days at least once every 3 years
Longitudinal hydrological connectivity	Improve the longitudinal hydrological connectivity	Maintain contiguous flowing habitat with velocity ≥0.3 ms-1 from the junction of the Murray and Darling Rivers to Wellington

	between the Channel and CLLMM	during late spring-early summer to restore high value hydraulic habitat
Mobilisation and transport of salt	Increase the mobilisation, transport and export of salt through the SA River Murray	Salt export, averaged over the preceding 3 years, is ≥2 million tonnes per year
Mobilisation and transport of carbon and nutrients	Increase the mobilisation, transport and export of nutrients and carbon through the SA River Murray	Dissolved organic carbon concentration increases from baseflow values (3-4 mg/L) to ≥6 mg/L during the rising limb of hydrographs.
Primary productivity	Enhance primary productivity due to increased lateral and longitudinal connectivity	Maintain contiguous flowing habitat with velocity ≥0.2 ms-1 from the junction of the Murray and Darling Rivers to Wellington during late spring-early summer to facilitate downstream transport/dispersal of drift dependent biota
Transport of plant propagules	Facilitate the transport of plant propagules throughout the SA River Murray due to increased lateral and longitudinal connectivity	Maintain contiguous flowing habitat with velocity ≥0.2 ms-1 from the junction of the Murray and Darling Rivers to Wellington during late spring-early summer to facilitate downstream transport/dispersal of drift dependent biota
Dispersal of faunal larvae and juveniles	Facilitate the dispersal of faunal larvae throughout the SA River Murray due to increased lateral and longitudinal connectivity	Maintain contiguous flowing habitat with velocity ≥0.2 ms-1 from the junction of the Murray and Darling Rivers to Wellington during late spring-early summer to facilitate downstream transport/dispersal of drift dependent biota
Faunal recruitment	Enhance the recruitment into faunal populations due to increased lateral and longitudinal connectivity	Population age structure of turtles indicates an effective recruitment event 1 year in 5 (max 7 years), demonstrated by separate cohorts of juveniles/sub-adults and adults of each species
Secondary productivity	Increase secondary productivity due to increased lateral and longitudinal connectivity	Maintain contiguous flowing habitat with velocity ≥0.2 ms-1 from the junction of the Murray and Darling Rivers to Wellington during late spring-early summer to facilitate downstream transport/dispersal of drift dependent biota

5.2 Alignment of environmental water requirements

In order to improve the understanding of the hydrological connectivity between the three assets, to promote integrated management across the SA River Murray WRP area, and to inform the development of future regional multi-site watering actions, a modeling exercise was undertaken that assessed the alignment of the EWRs of the Channel and Floodplain with the EWRs for the CLLMM in terms of volume, timing and frequency. The modeling inputs were hypothetical hydrographs of flows at the border that met the discharge, duration, timing, rate of rise

and rate of fall metrics of the Channel and the Floodplain EWRs and assumed that, outside of the EWR delivery period, flows were equivalent to SA Entitlement. The methods, assumptions and outputs are described in Gehrig, et al., (2020).

In general, aligning the revised IC and FP EWRs with the revised CLLMM EWRs presents some challenges. This modelled outcome is strongly influenced by the key assumption in the modelling exercise that, outside the delivery period for the channel/floodplain EWRs, flows returned to low baseflows equivalent to SA Entitlement only. This appears to have a profound influence on meeting certain CLLMM metrics and may not reflect likely actual water delivery.

Some key findings include:

- The timing of the revised IC and FP EWRs align well with the preferred timing of peak barrage outflows, however outside of these months, as a result of the return to Entitlement (i.e. low base flows), barrage outflows are significantly reduced, which impacts total annual outflow volumes
- A revised IC3 EWR (>30,000 ML/day QSA) is required to meet the target average annual barrage volume requirement for CLLMM 1; however, IC3 would need to occur more frequently than currently specified (i.e. 65% of years) to meet the target frequency for the revised CLLMM1 EWR (i.e. 100% of years)
- A revised FP5 EWR (≥80,000 ML/day QSA) with a longer target duration (i.e. ≥30 days) is required to meet the target average annual barrage outflow volume for CLLMM4
- The Coorong Hydrodynamic Model (CHM) outputs indicate that the target values for peak Coorong South Lagoon water levels are either not achieved, or only somewhat achieved, for most of the modelled scenarios of the revised IC, FP and CLLMM EWRs
- The CHM outputs also indicate that estuarine conditions within the Coorong North Lagoon may cease for short periods under the modelled scenarios for the revised IC and FP EWRs if there are sustained periods of low base flows outside of the EWR flow peaks.

This information will assist with planning for coordinated watering actions within the SA River Murray WRP area by providing an understanding of the nature of the flow events required to achieve the CLLMM EWRs as well as meeting the Channel and Floodplain hydrological requirements. These types of watering actions will assist in achieving the objectives for the PEFs.

6 Aboriginal values and objectives

The River Murray, along with its floodplains and wetlands, holds deep cultural, spiritual, and practical significance for Aboriginal Nation groups across the South Australian River Murray WRP area.

Murrundi (the South Australian River Murray) meanders from the South Australia/Victoria border, through the traditional lands of the First Peoples of the River Murray and Mallee, Peramangk and Ngarrindjeri peoples, before 'Meeting of the Waters' of the Murray Mouth (Department for Environment and Water, 2019a). The traditional lands of the Ngarrindjeri also extend along the length of the Kurangk (Coorong) while the First Nations of the South East have traditional ties to the South East region which includes the Coorong South Lagoon (Department for Environment and Water, 2018).

The River Nations along *Murrundi* are represented by the River Murray Mallee Aboriginal Corporation (RMMAC), the Mannum Aboriginal Community Association Incorporated (MACAI) and the Ngarrindjeri Aboriginal Corporation (NAC) / Ngarrindjeri Regional Authority (NRA). The First Nations of the South East (FNSE) are engaged in water resource planning through the South East Aboriginal Focus Group (SEAFG) (Department for Environment and Water, 2018).

Aboriginal representation in water resource planning and management includes several key bodies:

- First Peoples River Murray Mallee engaged through River Murray Mallee Aboriginal Corporation (RMMAC)
- Mannum Aboriginal Community Association Incorporated (MACAI)
- Ngarrindjeri Nation engaged through Ngarrindjeri Aboriginal Corporation (NAC) and Ngarrindjeri Regional Authority (NRA)
- First Nations of the South East (FNSE), engaged through the South East Aboriginal Focus Group (SEAFG) and Burrandies Aboriginal Corporation (BAC)

These groups reflect the diverse cultural, family and historical connections between Aboriginal people from across the SA MDB region (Hemming, et al., 2000).

The strong association between Aboriginal people and the environment is reflected in their Creation stories, which pass on important knowledge, cultural values and beliefs and reflect the relationships between land, water, animals and people (Australian Government, 2015; Ngarrindjeri Nation, 2006).

Through the development of the water resource plans, Aboriginal Nations were engaged to articulate objectives and desired outcomes for the water resources in the regions based on Nations' values and uses (refer Part 14 of the SA River Murray WRP and Part 14 of the SA Murray Region WRP). The values expressed below are consistent with those outlined in the water resource plans.

The ongoing sustainability of the River Murray and its ecosystems is critical to maintaining Aboriginal culture, knowledge and identity. Ensuring Aboriginal Knowledge is incorporated in environmental water planning, alongside opportunities for cross-cultural learning, will strengthen both cultural understanding and environmental outcomes. The stories, knowledge and culture embedded in the River are vital not only for Aboriginal communities but for the broader recognition of South Australia's living culture.

6.1 First peoples of the River Murray and Mallee region

6.1.1 Background

The First Peoples of the River Murray and Mallee (FPRMM) have maintained a long association with the River Murray and see it as a living body (Murray-Darling Basin Authority, 2012). They are the Native Title Holders of

approximately 260 km^2 of land and waters in the Riverland, South Australia, including areas of the River Murray around Renmark, Berri, Barmera, Waikerie and Morgan (Native Title Research Unit - Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSI). The Native Title consent determination was handed down in November 2011. The South Australian Government and the FPRMM have entered into The River Murray and Crown Lands Indigenous Land Use Agreements (ILUA), which commenced on the same day as the Native Title consent determination was made. The ILUA recognises FPRMM's non-exclusive rights to access, hunt, fish, camp, gather and use the natural resources, undertake cultural activities, conduct ceremonies and meetings, and protect places of cultural and religious significance (AIATSIS, 2024).

The River Murray and Mallee Aboriginal Corporation (RMMAC) is the Registered Native Title Prescribed Body Corporate for the native title consent determination and administers land on behalf of the FPRMM (AIATSIS, 2024). RMMAC has an established Board of Directors with seven elected First Peoples which includes a Chairperson and Vice Chairperson. RMMAC's projects in relation to water-related matters are governed through the First Peoples Working Group (FPWG) which consists of elected members from the RMMAC Board of Directors, their nominated FPRMM community member and various Department for Environment and Water (DEW) and Murraylands and Riverland Landscape Board (MRLB) staff. The FPWG does not have the authority to make decisions but can make recommendations to the RMMAC Board and allows for direct community input.

RMMAC have prepared a River Murray and Mallee Country Plan, a Strategic Plan by the First Peoples of the River Murray and Mallee (2019-2024), which sets out strategies and objectives for working with government agencies and other stakeholders (River Murray and Mallee Aboriginal Corporation, 2019).

First Peoples of the River Murray and Mallee's Vision is:

'Our living culture is healing our people and Country. Walking together as one, carrying the strength of our ancestors forward for the next generations and strengthening connection to Country – land and water. Our intellectual and cultural knowledge and practices are alive and active on Country and in the community for the Country and people to share a sustainable future. Healthy Country, Healthy Community, Healthy People' (River Murray and Mallee Aboriginal Corporation, 2019).

6.1.2 Involvement in the management of water for the environment

For the FPRMM, looking after Country is guided by their cultural connections and obligations, passed down through Elders and encapsulated in their values (River Murray and Mallee Aboriginal Corporation, 2019).

For many years the FPRMM were using weirs and fish traps to manipulate the flow of water and the movement of fish in the River Murray and surrounding floodplains and wetlands. There are sites that show weirs that have been constructed to hold water in small lagoon areas after flooding, as well as weirs that have been built to force fish to move into a small area to allow for easier fishing (Westell, Roberts, McCullough, & River Murray and Mallee Aboriginal Corporation, 2023).

Today RMMAC are engaged in a range of programs and partnerships, many of which are directly related to the management of water for the environment:

- Research with institutions, government and non-government agencies
- Cultural heritage monitoring
- Murray Darling Basin regional planning and policy
- Government partnerships (Berri Barmera Council, DEW & MRLB)
- Partnership with the Renmark Irrigation Trust
- Natural resource management plans and investment strategies, South Australian Murray Darling Basin (MDB) Natural Resource Management Regional Plan, River Murray and Mallee Aboriginal water interests)
- Barmerara Meru Committee co-management of Lake Bonney

- Agreements with developers and land users
- Mining agreements and power network suppliers
- Aboriginal Waterways Assessment (AWA) Program, to consistently measure and prioritise river and wetland health to support Traditional Owners in water planning and management across the Basin.
- The RMMAC Ranger Program has also recently been established in March 2022, so country and cultural heritage is protected & healed – land and waters, animals and air.

Collaboration between the FPRMM, DEW and MRLB has seen the inclusion of FPRMM's perspectives into the management of the Riverland's three major floodplains, Chowilla, Pike and Katarapko, as well as other wetland and floodplain areas within the RMMAC ILUA. Engagement is formalised by the FPWG, which meets bi-monthly to coordinate First People's engagement in DEW & MRLB projects. The First Peoples Project Officer has been employed by RMMAC to coordinate the FPWG and support the engagement of the FPRMM in a range of water for the environment programs and projects, including input into wetland and floodplain management plans and the coordination of the AWA Program.

The FPWG and the AWA program enables the FPRMM community to:

- *'Build relationships to restore access to River Murray and Mallee Country, including pastoral leases, private land, Government and private conservation reserves, to look after country (such as burial sites and other culturally important places) and for our native title rights (such as camping, fishing and hunting).*
- *Continue working constructively with DEW to re-establish cultural flows and connectivity of wetlands.*
- *Continue to engage and support our rights, interest and values in water planning, including fisheries management frameworks (see RMMAC Aboriginal Water Interests).*
- *Create programs and opportunities (such as Country camps, events, 'bush schools' etc.) for First Peoples to connect with Country and pass on our Traditional Knowledge.*
- *Manage natural ecosystems to protect and sustainably use culturally important values, such as bush tucker and bush medicine.'* (River Murray and Mallee Aboriginal Corporation, 2019): pp48)

These programs also assist with achieving the following health-related outcome:

- *'First Peoples connecting with Country to improve well-being (physical, spiritual and mental health).'* (River Murray and Mallee Aboriginal Corporation, 2019): pp50)

The RMMAC Ranger Program employs part time and casual FPRMM community members as male, female, senior and junior rangers to support DEW, MRLB and RMMAC programs and projects. The RMMAC Ranger program provides training, ranger exchanges and capacity building by participating in two-way knowledge sharing with DEW ecologists and local school students. This provides an opportunity for the rangers to share traditional cultural and environmental knowledge, and for the broader, diverse Riverland community to understand FPRMM cultural values and roles and responsibilities, while maintaining and strengthening partnerships to ensure long term success. This work includes:

- Understanding, recording and monitoring the health of Country, including waterways and aquatic ecosystems
- Protection of heritage sites through appropriate approaches
- Compliance work to manage access to, and use of, culturally significant areas.

The Rangers have also undertaken cultural burning to assist in the management of the country. Cultural burning is cooler than back burning or bush fires and allows for weeds to be removed and the native understory to regenerate quickly.

6.1.3 Cultural environmental values and objectives

The RMMAC Strategic Plan (River Murray and Mallee Aboriginal Corporation, 2019): pp21) identifies four strategic values of the FPRMM:

- *'Culture is part of our past, present and future - like our culture we are unique and resilient*
- *Our culture, traditions, views and priorities should have the respect of all in the community*
- *The First Peoples of the River Murray and Mallee Region conduct their business with integrity*
- *The land, animals and plants are vital to the First Peoples and ensuring ecological sustainability is a priority'*.

The 'Freshwater River Systems' section of the RMMAC Country Plan provides good insight into the places, plants and animals that hold cultural significance and can be supported through the management of water for the environment. The following is an extract from *River Murray and Mallee Country Plan, A Strategic Plan by the First Peoples of the River Murray and Mallee (2019-2024)* (River Murray and Mallee Aboriginal Corporation, 2019):

> *The river was a central aspect of people's survival with rich resources - plants and animals providing food, fibre, tools and shelter - to sustain people all year round. There was an abundance of fish, birds and eggs, mammals, fruits, vegetables and shellfish. The river was a living landscape of water that rose and retreated depending on the season and other environmental factors. People adapted to the flooding and drying and knew the indicators for the seasons and the variations in the environment.*
>
> *River Red Gum forests and woodlands are particularly important places where our people lived, gathering resources and food: fishing, hunting turtles, waterbirds and gathering bait, crustaceans, fruits, vegetables and starchy tubers and a wealth of medicinal plants. Wetland plants provide food, fibre for string or nets, tools, weapons and medicine, and trees and bark were used to construct winter huts and cooking shelter. Redgum is an important timber used to make canoes, tools and weapons and for shelter and fuel. Many scar trees along the river and wetlands show this history of our highly skilled and mobile people.*
>
> *The main food staples include fish such as* Pondi*, Murray Cod,* Thukeri*, Bony Herring,* Pilarki*, Golden Perch, possums, waterbirds and their eggs and* Thukubi*, Long necked or Macquarie Tortoise. Animal skins provided important cloaks and clothing and many animals are important* ngartji *or totem species. Fire remains an important tool to manage Country by opening up the reed beds in spring enabling people to move through and flush out waterbirds and other game, and at the same time encouraging new growth.*
>
> *All parts of Country hold meaning. Some culturally important river and wetland places are now within protected areas such as Chowilla Floodplain and Katarapko within the Murray River National Park. These continue to be important places for us to maintain our cultural and spiritual connection to Country, teach our younger generations traditional knowledge and management and practice our culture.*
>
> *The Murray River is one of the major water bird breeding areas in south eastern Australia. The River Red Gum forests are prime places for birds to nest, and to hunt. Many birds and their eggs continue to be an important part of our diet.* Kunggari*, Black Swan,* Nakari*, Pacific Black Duck and* Toori *Coot eggs were collected and eaten.*

Members of the FPWG have indicated support for the environmental water and wetland management programs, and their objectives, for their role in protecting and maintaining Aboriginal cultural and heritage values.

Some of the plants and animals of cultural significance to the FPRMM and related ecological objectives for the SA River Murray Channel and Floodplain environmental assets, which will help inform the management of water for the environment to support cultural values, are included in Table 6.1 and Table 6.2.

Table 6.1. Examples of culturally significant plant species found on the SA River Murray floodplain and along the River channel for the First Peoples of the River Murray and Mallee

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the SA River Murray channel and floodplain
Bulrush	*Typha* spp	Manangkeri, Kongi	Rhizomes formed staple of the diet (Clarke 1985); **Invalid source specified.** Fibre from rhizomes used to make string, nets etc (Clarke 1985); **Invalid source specified.**	Establish ecologically functional native understorey vegetation community in permanently inundated habitats
Common Reed	*Phragmites australis*	Pangki	Rhizomes eaten (Clarke 1985); **Invalid source specified.**; **Invalid source specified.** Shoots eaten **Invalid source specified.**; **Invalid source specified.** Flowers eaten **Invalid source specified.** Spear making **Invalid source specified.**; **Invalid source specified.** Medicinal (Clarke 1987) Necklace making **Invalid source specified.** Trade **Invalid source specified.**	Establish ecologically functional native understorey vegetation community in permanently inundated habitats Establish ecologically functional native understorey vegetation community in frequently inundated habitats
Nardoo	*Marsilea* spp		Eaten (Clarke, 1985)	Establish ecologically functional native understorey vegetation community in frequently inundated habitats Establish ecologically functional native understorey vegetation community in infrequently inundated temporary wetlands Establish ecologically functional native understorey vegetation community in

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the SA River Murray channel and floodplain
				infrequently inundated shedding floodplain areas
River Box	*Eucalyptus largiflorens*		Boomerang making (Hutchinson 2012) Favoured tree species for carving due to having two colours within timber **Invalid source specified.** Other implements**Invalid source specified.** Witchetty Grubs collected from the soil under this species of tree**Invalid source specified.**	Maintain spatial extent and restore ecologically functional Black Box woodlands
River Cooba	*Acacia stenophylla*	'Patcheda' (Turner 2013) 'Patcheroo' (Mooney & Tan 2010)	Spear making **Invalid source specified.** Carving **Invalid source specified.**	Maintain spatial extent and restore ecologically functional River Cooba woodlands
River Red Gum	*Eucalyptus camaldulensis camaldulensis*	Wuri Karrarru (Ngaiawang) (Clarke 2009)	Canoe making **Invalid source specified.**. Tool / implement making **Invalid source specified.** Weapon making **Invalid source specified.**. Scar trees from the above uses are significant heritage sites **Invalid source specified.**. Ring trees **Invalid source specified.** Medicinal **Invalid source specified.** Shelter / storage **Invalid source specified.** Lerp sugar (likely) (Clarke 1986).	Maintain spatial extent and restore ecologically functional River Red Gum woodlands

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the SA River Murray channel and floodplain
Spiny Flat-sedge	*Cyperus gymnocaulous*	Yalkari	Weaving baskets, mats etc (Hemming 1989; **Invalid source specified.**; **Invalid source specified.** which in post-European contact times were also sold to passing paddle steamers (Koolmatrie 2013). Used to grill fish on **Invalid source specified.** Fuel for smoking fish**Invalid source specified.** Bedding material **Invalid source specified.** Trade **Invalid source specified.**	Establish ecologically functional native understorey vegetation community in frequently inundated habitats Establish ecologically functional native understorey vegetation community in infrequently inundated temporary wetlands
Tobacco tree	*Solanum mauritianum*		Wurlies and shelter **Invalid source specified.**	Establish ecologically functional native understorey vegetation community

Table 6.2. Examples of culturally significant fauna species found on the SA River Murray floodplain and along the River channel for the First Peoples of the River Murray and Mallee

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the SA River Murray channel and floodplain
Birds / Mrayi				
Australian Pelican	*Pelecanus conspicillatus*	No:ri	Feathers used to make feather flowers (Turner 2013b). Food **Invalid source specified.** Ngartji (totem)**Invalid source specified.** Messenger**Invalid source specified.**	Restore resilient populations of waterbirds, frogs and turtles

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the SA River Murray channel and floodplain
Black Swan	*Cygnus atratus*	Kungari	Food **Invalid source specified.** Swan eggs collected and eaten **Invalid source specified.** Ngartji (totem)**Invalid source specified.**	Restore resilient populations of waterbirds, frogs and turtles
Pacific Black Duck	*Anas superciliosa*	Nakari	Food**Invalid source specified.** Duck eggs collected for food**Invalid source specified.** Ngartji (totem) **Invalid source specified.**	Restore resilient populations of waterbirds, frogs and turtles
Purple Swamp Hen	*Porphyrio porphyria melanotus*	Bald coot	Eaten**Invalid source specified.** Eggs collected for food**Invalid source specified.**	Restore resilient populations of waterbirds, frogs and turtles
Eurasian Coot / Black tailed Native Hen	*Fulica atra/Tribonyx ventralis*	Toori (Grace 2013)	Eaten**Invalid source specified.** Eggs collected for food**Invalid source specified.**	Restore resilient populations of waterbirds, frogs and turtles
Willie Wagtail	*Rhipidura leucophrys*	Ritjaruki UPPER MURRAY (Turner 2013) Tjerri Tjerri RIVERLAND (Grace 2013)	Messenger bird**Invalid source specified.** Ngartji (totem)**Invalid source specified.**; **Invalid source specified.**	Restore resilient populations of native semi-aquatic and terrestrial reptiles, mammals and birds
Tawny Frogmouth	*Podargus strigoides*	*Minka* bird	Important messenger birds or indicator for environmental occurrence seasons ((River Murray and Mallee Aboriginal Corporation, 2019))	Restore resilient populations of native semi-aquatic and terrestrial reptiles, mammals and birds

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the SA River Murray channel and floodplain
Regent Parrot	*Polytelis anthopeplus monarchoides*		Species of conservation significance ((River Murray and Mallee Aboriginal Corporation, 2019)	Restore resilient populations of native semi-aquatic and terrestrial reptiles, mammals and birds
Fish / Ma:mi				
Bony Herring	*Nematalosa erebi*	Thukeri	Food **Invalid source specified.** Ngartji (totem)**Invalid source specified.**	
Golden Perch	*Macquaria ambigua ambigua*	Pilarki	Food **Invalid source specified.**; **Invalid source specified.**; (MACAI, 2012)	Restore resilient populations of golden perch (*Macquaria ambigua*)
Murray Cod	*Maccullochella peelii*	*Pondi*	A significant food resource and still highly prized today	Restore resilient populations of Murray cod (*Maccullochella peelii*)
Reptiles				
Turtles	*Chelodina longicollis, Emydura macquarii, Chelodina expansa*	Thukubi	Food**Invalid source specified.**; **Invalid source specified.** Shells used as bowls **Invalid source specified.** Trade **Invalid source specified.** Ngartji (totem)**Invalid source specified.**) Post-European contact Aboriginal people collected and sold baby tortoises for pets **Invalid source specified.**.	Restore resilient populations of waterbirds, frogs and turtles
Mammals				
Water Rat			Post-European contact Aboriginal people trapped the species to sell furs up until the 1950's-60's **Invalid source specified.**.	Restore resilient populations of native semi-aquatic and terrestrial reptiles, mammals and birds

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the SA River Murray channel and floodplain
Possums	*Trichosurus vulpecula*		A main food staple, skins provided important cloaks and clothing	Restore resilient populations of native semi-aquatic and terrestrial reptiles, mammals and birds
Invertebrates				
Yabbie	*Cherax destructor*	Kaltuwarri Morrokun (Jensen & Turner, 2002) Warbku (when soft) Grace, 2013)	Food **Invalid source specified. Invalid source specified.** Ngartji (totem)**Invalid source specified.**	Restore lateral and longitudinal connectivity to support basal and secondary productivity, and flow dependent processes including salt export
Amphibians				
Southern Bell frog	*Littoria raniformis*		Species of conservation significance (River Murray and Mallee Aboriginal Corporation, 2019)	Restore resilient populations of waterbirds, frogs and turtles

6.1.4 Threats and risks

The FPRMM have expressed concern for the future sustainability of the River, wetlands and floodplains and it is their hope that they are restored to a sustainable ecosystem for future generations. Water flowing down the river and connecting the floodplains is important. It is recognised that trying to mimic the natural flow regime is an important part of maintaining the River and its floodplains as healthy ecosystems. The health of these region is of cultural, spiritual, social and economic significance to the Aboriginal members.

The FPRMM have seen a number of changes in recent years, including:

- the changes in the health of callop and catfish with both losing their colour
- the lower numbers of freshwater crayfish (yabbies) which now tend to be black and soft instead of blue and hard
- the increasing difficulty in finding *Pondi*.

Water flowing down the river and connecting the floodplains is considered important to culturally important species and the continuation of cultural practices. The southern bell frog, regent parrot and *Pondi* are three species in particular that are seen as requiring more water.

Working together with the FPRMM will help maintain this area as a healthy functioning ecosystem that will benefit future generations through strengthening and revitalising the foundation of Aboriginal knowledge.

6.2 Ngarrindjeri

6.2.1 Background

The Ngarrindjeri have occupied, enjoyed, managed and used their inherited lands and waters of the River Murray, Lakes and *Kurangk* (Coorong) since time immemorial. The River Murray, Lower Lakes, Coorong and Murray Mouth area are central to Ngarrindjeri cultural and spiritual beliefs. This association is expressed through *Kaldowinyeri* stories (cultural and spiritual histories) about *Yarluwar-Ruwe* (Sea Country) which reveals the significance of the relationship between the country and the people, both practically and spiritually. The Ngarrindjeri have always depended on their *Yarluwar-Ruwe* and its resources. Old People's living places (e.g. middens, burial grounds and other sacred places) are evidence of thousands of years of Ngarrindjeri sustainable use of their lands and waters since creation.

Ngarrindjeri consists of 18 clan groups or *Laklinyerar* who occupied, and still inhabit, the Lower Murray, Coorong and Lakes area of South Australia: *Ramindjeri, Tanganarin, Kondarlindjeri, Lungundi, Turarorn, Pakindjeri, Kanmererorn, Kaikalabindjeri, Mungulindjeri, Rangulindjeri, Karatinderi, Piltindjeri, Korowalie, Punguratpular, Welindjeri, Luthindjeri, Wunyakulde,* and *Ngrangatari*. Each of these clans had their own dialect, plus their own tract of land and *Ngartji* (totem) (Mobile Language Team, 2024).

The Native Title rights and interests of the Ngarrindjeri peoples were recognised in Ngarrindjeri and Others Native Title Claim over the area from Murray Bridge southwest to Cape Jervis and southeast almost to Tintinara in December 2017. The determination granted the Ngarrindjeri peoples non-exclusive rights including the right to access and move around the Native Title land, hunt, fish and gather, share and exchange, use natural water resources, cook and light fires for ceremonial purposes, engage in cultural activities and protect cultural sites (South Australian Native Title Services Ltd (SANTS), 2024).

The Ngarrindjeri Aboriginal Corporation (NAC) is the Registered Native Title Body Corporate (RNTBC) that represents the Native Title rights and interests of the Ngarrindjeri peoples and is the primary contact for all engagement in relation to Ngarrindjeri lands and waters (South Australian Native Title Services Ltd (SANTS), 2024). NAC has an established Board of Directors with an elected Chairperson and six elected Ngarrindjeri community

members. The NAC Board is the governing body and it performs its duties with the support of staff in line with its members' wishes, its constitution, and in partnership with stakeholders.

The Ngarrindjeri Nation have produced the *Ngarrindjeri Nation Yarluwar-Ruwe Plan. Caring for Ngarrindjeri Sea Country and Culture* which was prepared to help government agencies, natural resource managers, researchers, industry and the wider Australian community to better understand and recognise their rights and responsibilities to the *Yarluwar-Ruwe* (Sea Country), including the lower Murray River, Lakes, Coorong and adjacent marine and land areas (Ngarrindjeri Tendi; Ngarrindjeri Heritage Committee; Ngarrindjeri Native Title Management Committee, 2006).

The Ngarrindjeri's vision for Country is:

> *Our Lands, Our Waters, Our People, All Living Things are connected. We implore people to respect our* Ruwe *(Country) as it was created in the* Kaldowinyeri *(the Creation). We long for sparkling, clean waters, healthy land and people and all living things. We long for the* Yarluwar-Ruwe *(Sea Country) of our ancestors. Our vision is all people Caring, Sharing, Knowing and Respecting the lands, the waters and all living things*. (Ngarrindjeri Tendi; Ngarrindjeri Heritage Committee; Ngarrindjeri Native Title Management Committee, 2006).

6.2.2 Involvement in the management of water for the environment

For the Ngarrindjeri People looking after Country is guided by their cultural connections and beliefs passed down through Elders. The waters of the seas, the waters of the *Kurangk* (Coorong), the waters of the rivers and the lakes are all spiritual waters (Ngarrindjeri Tendi; Ngarrindjeri Heritage Committee; Ngarrindjeri Native Title Management Committee, 2006). The Creation ancestors taught them how to respect and understand the connections between the lands, the waters and the sky. The place where the fresh and salt waters mix is a place of creation where their *Ngarjtis* breed.

NAC have ongoing relationships with government departments such as Department for Environment and Water (DEW), the Murray-Darling Basin Authority and the Commonwealth Environmental Water Holder, as well as the Murraylands and Riverland Landscape Board (MRLB) on water and environmental related matters. NAC have had long standing involvement in environmental water management, natural resource management (NRM) decision making and involvement in academic research, education, and cultural heritage on their Country.

Collaboration between the Ngarrindjeri, DEW and MRLB has seen the inclusion of Ngarrindjeri's perspectives into the management of the Coorong, Lower Lakes and Murray Mouth as well as specific wetland areas within the Native Title area. Through The Living Murray Indigenous Partnerships Program, a *Yarluwar-Ruwe* Project Coordinator has been employed by NAC to support their meaningful involvement in the adaptive management of water for the environment for the Lower Lakes, Coorong, Murray Mouth icon site. Members of the Ngarrindjeri community have also been involved in a number of working groups and forums including the Ngarrindjeri Ramsar Working Group, Ngarrindjeri (Healthy Coorong, Healthy Basin) Working Group and the Coorong, Lower Lakes and Murray Mouth Community Advisory Panel. Some of the key activities undertaken include:

- Providing cultural input to the development of the SA River Murray annual water for the environment plan
- Assistance with ecological and cultural monitoring programs to track the health of important *Ngartjis* such as *Thukab*i (turtles) and *Kultuwarri* (yabbies)
- Development of tools for cultural health assessments under the Healthy Coorong, Healthy Basin (HCHB) Program
- Ngarrindjeri *Yarluwar-Ruwe* assessments undertaken at a range of priority sites to measure and monitor cultural values and health, and inform on-ground works including revegetation, the re-establishment of aquatic vegetation, maintenance of wetland flow paths, pest plant and animal control, and erosion control

- The identification, development and delivery of priority on-ground restoration works to improve the environmental and cultural resilience of the *Yarluwar-Ruwe*.

6.2.3 Cultural environmental values and objectives

For Ngarrindjeri people to be healthy, their *Yarluwar-Ruwe* must be healthy and spiritually alive. Ngarrindjeri require connectivity, flow and mixing to occur between all living things and the lands, the waters and the spirit world. Ngarrindjeri Nation use the term *Ruwe/Ruwar* to encapsulate the concept of interconnection between country, body and spirit, with this interconnection being fundamental to wellbeing (Aspect Studios Pty Ltd, 2018). *Ruwe/Ruwar* requires connectivity and flow to occur between all living things and the lands, waters and the spirit world. Flows come together and produce life as fish breed in the Lakes and *Kurrangk* (Coorong) where the freshwater and salt water mix; birds breed in the places where life is produced; and the complexity and interrelatedness of the processes concerned are recognised in Ngarrindjeri philosophy.

Ngarrindjeri regard all living creatures as equal and do not prioritise one species over another. The focus should be on the overall ecosystem health – a healthy *Ruwe* (country) relates to healthy plants and animals, and healthy Ngarrindjeri people. Ngarrindjeri recognise the importance of ensuring that *Ngartjis* are cared for and flourishing. This is best reflected in the following extract from the Ngarrindjeri Nation *Yarluwar-Ruwe* Plan:

> *Ngarrindjeri people hold cultural and spiritual connections to particular places, to particular species of animals and plants, and all elements of the environment are part of our kinship system. Particular animal and plant species are the* Ngartji *(totem or special friend) of Ngarrindjeri people, who have special responsibility to care for their* Ngartji*. To care for* Ngartji *is to care for country.*
>
> *The waters of the seas, the waters of the* Kurangk *(Coorong), the waters of the rivers and the lakes are all spiritual waters. The Creation ancestors taught us how to respect and understand the connections between the lands, the waters and the sky. The place where the fresh and salt waters mix is a place of creation where our* Ngarjtis *breed. Our women fought to protect these spiritual waters by objecting to the building of the bridge to* Kumarangk *(Hindmarsh Island). Any future plans affecting these waters must respect our cultural traditions and beliefs. We implore non-Indigenous people to respect the Yarluwar-Ruwe as it was created in the* Kaldowinyeri *(the Creation).*
>
> *Our Old People have rejoiced the return to Ngarrindjeri* Yarluwar-Ruwe *of* Kondoli *our whale ancestors. Some of our* Ngartjis *have not returned to our lands and waters. We mourn the loss of our closest friends. We fear for the animals, fish, birds and all living things in our seas and waterways. We hope that the growing awareness of non-Indigenous people will not be too late. We know that many of our* Ngartjis *travel to other countries during certain times of the year and therefore we have a cultural responsibility to care for each other's* Ngartji*, and to care for each other's lands and waters. We have always recognised our responsibilities and connections to other parts of Australia and to distant lands. In recent times we have learned that our* Ngartjis *travel to places such as Great Turtle Island (North America) and various other countries.*
>
> *The land and waters is a living body. We the Ngarrindjeri people are a part of its existence. The land and waters must be healthy for the Ngarrindjeri people to be healthy. We say that if* Yarluwar-Ruwe *dies, the waters die, our* Ngartjis *die, then the Ngarrindjeri will surely die.*

The Ngarrindjeri Nation *Yarluwar-Ruwe* Plan identifies five goals:

- *For our people, children and descendants to be healthy and to enjoy our healthy lands and waters.*
- *To see our lands and waters healthy and spiritually alive.*
- *For all our people to benefit from our equity in our lands and waters.*
- *To see our closest friends - our Ngartjis (special animals) - healthy and spiritually alive. For our people to continue to occupy and benefit from our lands and waters.*

- *To see all people respecting our laws and living in harmony with our lands and waters.*

Ngarrindjeri cultural values and aspirations in relation to protecting specific *Ngartjis* closely align with ecological objectives relative to enhancing or protecting waterbird and fish populations by supporting their feeding, breeding and migration opportunities. There are also ecological objectives for *Thukab*i (turtles), *Kultuwarri* (yabbies) and *Korbili (frogs)* and ensuring that the freshwater habitat in Lake Alexandrina and *Kurilpang* (Lake Albert) remains in good quality with plenty of food and optimal habitat and water levels to ensure their survival and breeding (Department for Environment and Water 2023). Some of the plants and animals of cultural significance to the Ngarrindjeri Nation and related ecological objectives for the SA River Murray CLLMM environmental asset, which will help inform the management of water for the environment to support cultural values, are included in Table 6.3 and Table 6.4.

Table 6.3. Examples of Ngarrindjeri culturally significant plant species found in the Coorong, Lower Lakes and Murray Mouth environmental asset

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the Coorong, Lower Lakes and Murray Mouth
Tea tree		Narangali	Used to make artefacts and canoes from particular trees A healthy tree population provides habitat for a variety of *Ngartjis*	Maintain or improve the extent and diversity of aquatic and littoral vegetation in the Lower Lakes and wetlands
Rushes (Department for Environment and Water 2022)	*Cyperus gymnocaulos*	Pilbili	Required for providing healthy habitat and sustaining cultural practice Weaving is a cultural activity that not only produced an item that is useful but also an opportunity to sit and tell culturally important stories	Maintain or improve the extent and diversity of aquatic and littoral vegetation in the Lower Lakes and wetlands
Freshwater reeds		*Pranggar*		Maintain or improve the extent and diversity of aquatic and littoral vegetation in the Lower Lakes and wetlands
Bulrush	*Typha* spp	*Manangkeri* (Ngarrindjeri Tendi, et al. 2006)	Making nets (Ngarrindjeri Tendi, et al. 2006i Tendi, et al. 2006)	Maintain or improve the extent and diversity of aquatic and littoral vegetation in the Lower Lakes and wetlands
Yam	*Microseris lanceolata*	*Murrnong (Ngarrindjeri Workshop 10 April 2024)*	Important food source *(Ngarrindjeri Workshop 10 April 2024)*	Maintain or improve the extent and diversity of aquatic and littoral vegetation in the Lower Lakes and wetlands
Wattle Gum		*Wirulde/Tangari*	*Ramindjeri Ngartji*	Maintain or improve the extent and diversity of aquatic and littoral

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the Coorong, Lower Lakes and Murray Mouth
				vegetation in the Lower Lakes and wetlands
Sweet Apple Berry		*Kundawie*		
Coastal Wattle		*Karla*		

Table 6.4. Examples of Ngarrindjeri culturally significant animal species found in the Coorong, Lower Lakes and Murray Mouth environmental asset

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the Coorong, Lower Lakes and Murray Mouth
Murray Cod	*Maccullochella peelii*	*Pondi* (Ngarrindjeri Tendi, et al. 2006)	Key to the Ngarrindjeri creation story and for the creation of all fish	Restore resilient populations of Murray cod (*Maccullochella peelii*)*
Catfish	*Tandanus tandanus*	*Pomeri* (Ngarrindjeri Tendi, et al. 2006)		Restore resilient populations of freshwater catfish (*Tandanus tandanus*)*
Callop/Golden Perch	*Macquaria ambigua ambigua*	*Pilarki* (Ngarrindjeri Tendi, et al. 2006)	A food source	Restore resilient populations of Golden perch (*Macquaria ambigua*)*
Coorong Mullet	*Aldrichetta forsteri*	*Kanmeri* (Department for Environment and Water 2022)	*Kanmerarorn Ngartji* *Food source*	Restore resilient populations of estuarine fish
Flounder	*Rhombosolea tapirina*	*Mamikalt* (Department for Environment and Water 2022)		Restore resilient populations of estuarine fish

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the Coorong, Lower Lakes and Murray Mouth
Mulloway/ Butterfish	*Argyrosomus japonicus*	*Maliwi* (Department for Environment and Water 2022)	*Pakindjeri Ngartji*	Restore resilient populations of estuarine fish
Black Bream	*Acanthopagrus butcheri*	*Tulari* (Department for Environment and Water 2022)		Restore resilient populations of estuarine fish
Bony Bream	*Nematolosa erebi*	*Thukeri* (Ngarrindjeri Tendi, et al. 2006)	Story in the Ngarrindjeri Nation Sea Country Plan Food source	Restore resilient populations of estuarine fish
Australian Salmon	*Arripis truttaceus*	*Kuratji* (Department for Environment and Water 2022)		Restore resilient populations of estuarine fish
Congolli	*Pseudaphritis urvillii*	*Kungguldhi* (Department for Environment and Water 2022)		Successful migration and recruitment of diadromous fish
Black Swan	*Cygnus atratus*	*Kungari* (Department for Environment and Water 2022)	a *Ngartji* eggs are a food source for people, and a significant part of cultural practice	Maintain or improve waterbird populations
Pelican	*Pelecanus conspicillatus*	*Ngori* (Ngarrindjeri Tendi, et al. 2006)	a *Ngartji* indicator species	Maintain or improve waterbird populations
Tern	*Sternula nereis*	*Wituwit* ***Invalid source specified.***	*Lungundi Ngartji*	Maintain or improve waterbird populations
Coot	*Fulica atra*	*Turi* ***Invalid source specified.***	*Turarorn Ngartji*	Maintain or improve waterbird populations

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the Coorong, Lower Lakes and Murray Mouth
Australian shelduck	*Tadorna tadornoides*	*Wanyi* ***Invalid source specified.***	*Mungulindjeri Ngartji*	Maintain or improve waterbird populations
Musk duck	*Biziura lobata*	*Peldi* ***Invalid source specified.***	*Punguratpular Ngartji*	Maintain or improve waterbird populations
Black duck	*Anas superciliosa*	*Nakare* ***Invalid source specified.***	*Welindjeri Ngartji* *Wunyakulde Ngartji*	Maintain or improve waterbird populations
Teal	*Anas crecca*		*Luthindjeri Ngartji*	Maintain or improve waterbird populations
Egret		*Rangaraltie*		Maintain or improve waterbird populations
Blue crane		*Krawli*		Maintain or improve waterbird populations
Silver gull		*Throkuri*		Maintain or improve waterbird populations
Frogs			*Korbili*	Restore resilient populations of frogs in Lower Lakes, especially in the fringing wetlands
Yabbie	*Cherax destructor*	*Kaltuwarri* (Department for Environment and Water 2022)	A healthy population of turtles, frogs and yabbies are required for Ngarrindjeri to continue their cultural practices	Improve and maintain diverse macroinvertebrate communities
Turtles	*Chelodina longicollis, Emydura macquarii,*	*Thukabi*	An important *Ngartji* Also apart of Ngarrindjeri creation stories. These stories need to be shared to future generations	Improve recruitment of Thukabi (Eastern long-necked turtle, *Chelodina longicollis* and Murray short-necked

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the Coorong, Lower Lakes and Murray Mouth
				turtle, *Emydura macquarii*) in Lakes Alexandrina and Albert
Cockles / pipi	*Plebidonax deltoides*	*Kuti*	A staple food for Ngarrindjeri people for thousands of years	Improve and maintain diverse macroinvertebrate communities

*Ecological objective listed is for the SA River Murray Channel PEA

6.2.4 Threats and risks

The Ngarrindjeri have expressed concern for the future sustainability of the Lower Lakes and Coorong and it is their hope that they are restored to a sustainable ecosystem for future generations. Water flowing down the river and into the Lower Lakes and Coorong is important. The health of these regions is of cultural, spiritual, social and economic significance to the Ngarrindjeri people.

On 12 April 2024, a workshop to discuss this long-term environmental watering plan and the values and concerns of the Ngarrindjeri people was held. At this gathering, a number of changes observed over recent years were described, including:

- Lower numbers of migratory birds
- *Kungguldhi (congolli)* numbers have decreased
- Many food sources have decreased including *Murnong (yam)*
- There is reduced duck life and swans around the wetland
- The movement patterns of *Nori (pelicans),* which are considered a strong indicator of health of Country, have changed
- A decline in water quality which is recognised as being important for a healthy ecosystem.

6.3 First Nations of the South East

6.3.1 Background

The First Nations of the South East are made up of a number of language groups and have traditional ties to the wider South East region of South Australia, including the Coorong South Lagoon and the associated ephemeral lakes and wetlands (Limestone Coast Landscape Board, 2024).

Historically, freshwater flowed through the watercourses and wetlands of the South East and eventually into the Coorong South Lagoon. This source of freshwater has been reduced by drainage works in the South East over the past 150 years, groundwater extraction and a reduction in rainfall. Salinity levels of the Coorong South Lagoon are determined by flows from the River Murray through the barrages, the ocean through the river mouth, water from the South East, mainly via Tilley Swamp, and groundwater flows, generally from the east (Watson, 2017).

The South East Aboriginal Focus Group (SEAFG) was established in 2004 and is a First Nations advisory committee made up of First Nations people of the South East who hold subject matter expertise on environmental planning and policy. The SEAFG meets regularly to apply their cultural knowledge to various environmental issues and champion support for First Nations managed lands (Limestone Coast Landscape Board, 2024).

In 2011, the SEAFG developed the Lartara-Wirkeri Cultural Governance framework to guide their inclusion with environmental planning and on ground actions. In 2015, Burrandies Aboriginal Corporation entered into a cultural governance agreement with the SEAFG. The Lartara-Wirkeri framework is an agreement that maps out a working relationship where the SEAFG provide the cultural knowledge in decision making for their projects and BAC provide the business delivery mechanism to undertake fee for service works and program delivery (Limestone Coast Landscape Board, 2024).

The SA River Murray Long-Term Environmental Watering Plan focuses on the management of water for the environment along the length of the River Murray within South Australia and incorporates the Coorong as the ecological outcomes are largely driven by surface water inputs via the Lower Lakes. The lands and waters of the First Nations of the South East that fall outside of the Coorong South Lagoon area are not covered by this long-term environmental watering plan. However, the First Nations of the South East recognise the importance of the areas.

6.3.2 Involvement in the management of water for the environment

For more than 60,000 years First Nations people have managed their Country in an ecologically sustainable way. At the time of colonisation, the region supported a wetland estate that covered approximately 50% of the region. Now only 1.5%-2.5% of this former wetland area remains in the south east region. Drainage of land began in the 1860s and has continued into present times. Drainage has dramatically altered the landscape, and we now experience a drier South East which is more susceptible to the effects of climate variability.

Although the effects of colonisation have had a deep and long-lasting impact on the transmission of cultural knowledges and languages, the SEAFG, BAC and the First Nations of the South East are committed to reconnecting with this knowledge and passing it on to future generations. Their connection to their Country and the water that has always been part of it has not ceased and their opinions about the management required for healthy Country need to be heard.

SEAFG works closely with organisations such as the Department for Environment and Water (DEW), South Eastern Water Conservation and Drainage Board and the Limestone Coast Landscape Board (LCLB) to initiate programs and other environmental related initiatives, and are closely involved with water-planning, rehabilitation and wetland projects many of which are directly related to the management of water but are outside the area of this long-term environmental watering plan including:

- Input into the Tatiara Water Allocation Plan (WAP) review
- Cultural valuation of wetlands in the Lower Limestone Coast WAP
- Installing fences and planting native sedges to protect the lake shorelines
- Monitoring acid sulphate soils and water quality.

To-date, First Nations of the South East involvement in the management of water for the environment has been primarily in the management of water outside of the River Murray system. However, increased involvement is being actively sought particularly through The Living Murray program. First Nations of the South East have also had significant involvement in the *Healthy Coorong, Healthy Basin* Program and other environmental initiatives relating to the Coorong, including:

- Contribution to the Ramsar Management Plan for the Coorong, Lakes Alexandrina and Albert (Australian Government and Department for Environment and Water, 2024a)
- South East Flows Restoration Project (SEFRP) through the delivery of Aboriginal heritage surveys, and the design and the associated monitoring of on-ground works and in the development of an Operation Plan for the South East drainage network and its flows into the Coorong (Department for Environment and Water, 2018)
- Providing cultural knowledge into plans, strategies and policies to ensure cultural knowledge is incorporated into the restoration of the Coorong and surrounding lands and waters as part of *Healthy Coorong, Healthy Basin* (Australian Government and Department for Environment and Water, 2024a)
- Partnered with Ngarrindjeri to identify priority species and wetlands for restoration under *Healthy Coorong, Healthy Basin* (Australian Government and Department for Environment and Water, 2024a)
- Cultural Rangers in the Coorong National Park working with scientific researchers (Australian Government and Department for Environment and Water, 2024a)
- Representation of the Coorong Partnership provided a community insight, ideas and perspectives into the development, implementation, and performance of Project Coorong initiatives, including the *Healthy Coorong, Healthy Basin* program.

The SEAFG see it as essential that First Nations of the South East representatives be involved in research, planning, implementation and long-term management of the southern Coorong in accordance with their cultural

connection to the lands and waters. They would also like to see the importance of water in the wetlands of their Country as a standalone priority, rather than as an add-on to other water management plans.

6.3.3 Cultural environmental values and objectives

The health of the Coorong and its connected lands and waters are central to the culture and beliefs of the First Nations of the South East and intrinsically linked to their health. Wetlands and water sources are precious areas for First Nations peoples. They are part of their Country and provide the basis for the livelihoods of their families and communities. They are also fundamental elements of their cultures since the lands and waters are a living body, and they are part of its existence. The Coorong and its connected waters are spiritual waters since many of those places are sacred and have high spiritual significance (Australian Government and Department for Environment and Water, 2024a).

The First Nations of the South East have cultures based on an interconnectedness with Country, including its wetlands and water. Their ways of life, cultural expressions and value systems are deeply connected to those ecosystems (Australian Government and Department for Environment and Water, 2024a).

It is important that First Nations' rights, interests, and cultural knowledge are valued, recognised, and reflected in collaborative management partnerships, agreements and strategies and integrated into all aspects of decision-making. It is also important that connections to Country are prioritised and supported in restoration projects (Australian Government and Department for Environment and Water, 2024b) (Australian Government and Department for Environment and Water, 2024a).

The Vision of the First Nations of the South East is (Australian Government and Department for Environment and Water, 2024a):

> *In the spirit of our ancestors, with the wisdom of our Elders, and for the future of our children, our vision is for the preservation of Country and effective management of our natural resources.*
>
> *First Nations of the South East will maintain and respect the natural resources of* Mambuwang *(Great Ancestral Spirit) and protect our* Burt *(*boort- *totem) and surrounding waters to establish sustainable resources for everyone.*

Many species are considered important for a healthy Coorong ecosystem. Fauna species of importance include the diverse waterbird populations, fish such as small-mouthed hardy head, yellow-eyed mullet, congolli and greenback flounder, as well as a diverse abundance of macroinvertebrates across the salinity gradient (Australian Government and Department for Environment and Water, 2024b).

Important plant species include many sedges, rushes, and aquatic plants. For example, submerged *Ruppia* is critically important for black swans, fish and invertebrates that require a specific salinity and water level regime across the seasons. *Phragmites*, the common reed, is an indicator of freshwater and provides breeding habitat for many ducks and other waterbird species, and related birds including the reed warbler. Rushes such as *Juncus spp*., are indicators of freshwater seeps, found where freshwater lies on top of salt.

Some of the plants and animals of cultural significance to the First Nations of the South East and related ecological objectives for the SA River Murray CLLMM environmental assets, which will help inform the management of water for the environment to support cultural values, are included in Table 6.5 and Table 6.6.

Table 6.5. Examples of culturally significant plant species found in the Coorong, Lower Lakes and Murray Mouth environmental asset for the First Nations of the South East

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the Coorong, Lower Lakes and Murray Mouth
Ruppia	*Ruppia spp.*		Critical for Black swans, fish and invertebrates	Restore and maintain submerged macrophyte communities in the Coorong
Common Reed	*Phragmites spp*	*thirr*	Breeding habitat for ducks and the reed warbler Traditionally used for weaving	Maintain or improve the extent and diversity of aquatic and littoral vegetation in the Lower Lakes and wetlands
Rushes	*Juncus spp*		Indicator for freshwater Some species traditionally used for weaving	Maintain or improve the extent and diversity of aquatic and littoral vegetation in the Lower Lakes and wetlands
Sedges	*Carex spp.*	*yayiyal*	Some species traditionally used for weaving	Maintain or improve the extent and diversity of aquatic and littoral vegetation in the Lower Lakes and wetlands
Tea tree		*wiriyu*	Provides shelter, holds water and soil, protects against erosion	Maintain or improve the extent and diversity of aquatic and littoral vegetation in the Lower Lakes and wetlands
Stringy bark	*Eucalyptus arenacea*	*Mra-murn*	*burt*	
She oaks	*Allocasuarina verticillata*	*Ngirr / kiriwu*	*burt*	

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the Coorong, Lower Lakes and Murray Mouth
Red gums	*Eucalyptus camaldulensis*	*Tarrpina*	*burt*	Maintain spatial extent and restore ecologically functional River Red Gum woodlands*

*Ecological objective listed is for the SA River Murray Channel PEA

Table 6.6. Examples of culturally significant animal species found in the Coorong, Lower Lakes and Murray Mouth environmental asset for the First Nations of the South East

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the Coorong, Lower Lakes and Murray Mouth
Black Swan	*Cygnus atratus*	*Kunawara*	Eggs as a food source Totem animal	Maintain or improve waterbird populations
Reed Warbler	*Acrocephalus australis*		Messenger Bird	Maintain or improve waterbird populations
Ducks		*Parna (general term)*	Food source	Maintain or improve waterbird populations
Australasian Bittern	*Botaurus poiciloptilus*	*Pulan*	Part of Craitbul creation story, warns him and family of evil spirit	Maintain or improve waterbird populations
White faced Heron	*Egretta novaehollandiae*	*Ngarapyne*	*Burt*	Maintain or improve waterbird populations
Sea Eagle	*Haliaeteus leucogaster*	*Mingar*	*Burt*	Maintain or improve waterbird populations
Willie wagtails	*Rhipidura leucophrys*	*Teriteritj*	*Burt*, messenger bird	Restore resilient populations of native semi-aquatic and terrestrial reptiles, mammals and birds*

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the Coorong, Lower Lakes and Murray Mouth
Emu	*Dromaius novaehollandiae*	*Kabir*	Eggs as food source	Restore resilient populations of native semi-aquatic and terrestrial reptiles, mammals and birds*
Black Bream	*Acanthopagrus butcheri*	*Ngaraingk*	Food source	Restore resilient populations of estuarine fish
Congolli	*Pseudaphritis urvilli*		Food source	Successful migration and recruitment of diadromous fish
Mud fish (black slimy fish)	*Gadopsis marmoratus*		Food source	Maintain a spatio-temporally diverse and resilient fish community
Eel	*Anguilla australis australis*	*Kuya*	Food source	Successful migration and recruitment of diadromous fish
SE Cray's (red rock lobster)	*Jasus edwardsii*	*Kela*	Food source	Improve and maintain diverse macroinvertebrate communities
Freshwater Crayfish	*Euastacus armatus*	*Konkro*	Food source	Improve and maintain diverse macroinvertebrate communities
Yabbies	*Cherax destructor*		Food source	Improve and maintain diverse macroinvertebrate communities
Cockles	*Plebidonax deltoides*	*Kuri*	Food source/ assisted food collection of other species	Improve and maintain diverse macroinvertebrate communities
Brine shrimp			Food source	Improve and maintain diverse macroinvertebrate communities
Freshwater lobster		*Pranggut*	Food source	Improve and maintain diverse macroinvertebrate communities
Mussels	*Velesunio ambiguus*	*Wataru*	Food source/ shell used for tools	Improve and maintain diverse macroinvertebrate communities

Common name	Scientific name	Aboriginal name/s	Examples of cultural significance	Relevant ecological objectives for the Coorong, Lower Lakes and Murray Mouth
Turtles	*Chelodina longicollis, Emydura macquarii*	*Turanggal*	Animal and eggs food source	Improve recruitment of Thukabi (Eastern long-necked turtle, *Chelodina longicollis* and Murray short-necked turtle, *Emydura macquarii*) in Lakes Alexandrina and Albert

*Ecological objective listed is for the SA River Murray Channel PEA

6.3.4 Threats and risks

First Nations of the South East are deeply concerned for the future sustainability of the Coorong and the greater South East region given the potential climate change impacts. First Nations of the South East's vision and aspiration are for both regions to be revitalised and restored as sustainable ecosystems for future generations. The health and revitalisation of these regions hold significant cultural, spiritual, social and economic importance to the Aboriginal communities.

There has been a reduced ability for First Nations of the South East to care for *Burt* (Australian Government and Department for Environment and Water, 2024b). The First Nations of the South East have expressed concerns for the species that have declined across the South East. It has been noted in recent times that over 50% of routinely monitored waterbird species are reduced in abundance and distribution (Australian Government and Department for Environment and Water, 2024b).

The reinstatement of saline or freshwater flows is deemed crucial, particularly tailored to the needs of key species such as for *Ruppia* and swans, ducks, and duckweed. Altering water quality and quantity must carefully consider the regime required by these target species.

It was emphasised that the preservation of all wetlands of the South East and their resident species is critical. A healthy wetland system plays a critical role in ensuring the delivery of 'healthy water' to the southern lagoon. There is a responsibility to ensure that the management and diversion of water is carefully considered for the risk and impact that such diversion may have upon other wetlands of the South East. The impacts of environmental changes to First Nations of the South East includes reduced access and connection to Country, as well as barriers to the transmission of cultural knowledge, oral histories, and traditional practices within their communities and across generations.

6.4 Integrating Aboriginal values

The Government of South Australia recognises the importance of Aboriginal culture and values and is committed to seeking and incorporating these in the development of environmental water planning and delivery wherever possible.

This commitment is clearly reflected in the LTWP where a strong alignment has been identified between ecological objectives and the cultural values of Aboriginal Nation Groups. For many of these Groups, a range of objectives and targets outlined in this plan for restoring the freshwater flows required to sustain healthy functioning 'ecosystems' are deeply intertwined with cultural objectives in maintaining interconnectivity of the River and Land and people across the River Murray, the Coorong, the Lower Lakes and Murray Mouth. Further consideration of Aboriginal values will continue to occur at smaller spatial and temporal scales (e.g. during annual environmental water planning for the region).

The *Water Act 2007* includes as an objective, ensuring that the use and management of Basin water resources takes into account spiritual, cultural, environmental, social and economic matters relevant to Indigenous people, including in relation to their knowledge, values, uses, traditions and customs.

The consideration of the values, aspirations and views of Aboriginal Nation Groups in decision-making through their participation in the development of water resource and environmental water plans is also prescribed under the Basin Plan (2012).

The Environmental Watering Plan of the Basin Plan requires that environmental watering is undertaken in a way that maximises its benefits and effectiveness by having regard to Indigenous values (section 8.35), with these values being integrated through engagement with relevant Indigenous organisations when identifying the objectives of Indigenous people during water resource planning (section 10.52).

The LTWP aligns with BWS objectives to strengthen First Nations involvement and agency in water for the environment by creating a planning framework that recognises the importance of Aboriginal values and uses, and is committed to seeking involvement, input and incorporation of knowledge into the development of environmental water plans where possible.

Further to the engagement that has occurred during the preparation of this plan, ongoing engagement with Aboriginal Nation Groups is undertaken by environmental water managers during the development of watering proposals and preparation of Annual Priorities. Through workshops on Country, Aboriginal Nation Groups provide significant input to the development of environmental water priorities. Nation groups are engaged in the development of Annual Plans and will continue to be engaged on environmental water management to incorporate their cultural interests, visions, and aspirational goals. These goals include maintaining connectivity through the Murray-Darling Basin, as well as the protection of culturally significant places and Ngatjis (totems).

First Nations are also funded to assist with engagement between DEW and Aboriginal Nations Groups and to support monitoring of the outcomes of environmental water management. Where possible, engagement with groups is undertaken in collaboration with the CEWH and MDBA staff to ensure both site-based and system-scale planning and priorities are addressed.

Table 6.1 to Table 6.6 in the LTWP detail key ecological species of importance to Aboriginal groups and highlight how specific watering objectives align with those cultural priorities. The LTWP reflects many of the key outcomes outlined in the Southern Basin First Nations' input to the BWS (MLDRIN, 2025). It is acknowledged that First Nations involvement in environmental water management continues to evolve, and this planning work represents an important step toward a more inclusive, respectful, and culturally aware water management framework, that sees Aboriginal Nation Groups as vital partners in caring for Country and shaping a sustainable environmental future for South Australia.

7 Management considerations

7.1 Co-operative arrangements

7.1.1 Co-operative arrangements within the SA River Murray water resource plan area

Environmental water management within the SA River Murray WRP area continues to evolve and, as such, the information provided in this section is correct at the time of publication but may be subject to further change. There is a growing number of environmental managers responsible for managing environmental sites, including multiple areas within the LTWP PEAs, and a variety of mechanisms for delivering environmental water. Asset and site (intra-asset) managers are described in Section 2.4.8.

Co-operative arrangements are important to ensure all environmental asset and site managers, environmental water holders and environmental water managers are working towards the common goal of a healthy, functioning and resilient SA River Murray ecosystem. These arrangements ensure that decisions are transparent, priorities and trade-offs are understood, and outcomes at the site-scale contribute to desired outcomes at the LTWP asset and WRP area scale. With a finite volume of environmental water available, it is not always possible to deliver all desired actions; however, the benefits of environmental water management can be maximised if a single allocation of environmental water is used efficiently and effectively to achieve multiple outcomes at multiple sites.

For the purposes of the SA River Murray LTWP, co-operative arrangements refer to the policies, processes and forums that should be observed by all relevant parties (DEW staff and external to DEW) involved in managing environmental water and sites within the WRP area. These are further described in section 5.6.1 and 5.6.1.1 of the SA River Murray WRP (Department for Environment and Water, 2019a).

Co-operative arrangements within South Australia may be formal or informal, and participation of stakeholders may be both direct and in-direct. For example, community groups undertaking environmental site management may be indirectly involved in forums through staff from the Murraylands and Riverland Landscape Board representing their interests or directly through participation in workshops (refer Figure 7 in the SA River Murray WRP). Interactions between Government and Ngarrindjeri may take place through working together on monitoring and caring for country, leader to leader meetings or with the NAC. FPRMM interactions with Government are occurring through the First Peoples NRM Working Group, which was established by the River Murray and Mallee Aboriginal Corporation (RMMAC) and DEW and the MRLB to facilitate greater involvement of First Peoples in the department's projects.

There are additional site-specific planning and management mechanisms (e.g. site-specific advisory groups). These are still relevant and are not replaced by the arrangements described within this document. However, their decisions and activities with respect to environmental water management should be consistent with state policies and plans, and feed through to the policy and operational areas of DEW to ensure there is strategic oversight of environmental water management across the WRP area.

Generally, planned environmental water (PEW) is not actively managed and therefore these co-operative arrangements are not directly relevant, unless South Australia is receiving less than Entitlement or water allocations are less than 100%. Under these circumstances, river managers and managers of sites that rely on PEW will need to participate in any additional co-operative arrangements that apply to the WRP area and across the Southern Connected Basin under dry conditions, e.g. Dry Allocation Framework in the Water Allocation Plan for the River Murray Prescribed Watercourse or arrangements agreed through Southern Connected Basin Environmental Watering Committee (SCBEWC).

There are five key phases in the management of environmental water, each of which can be undertaken at multiple spatial scales (WRP area, LTWP asset or intra-asset 'site'):

1. Planning and prioritisation

2. Collaboration and allocation
3. Delivery
4. Monitoring
5. Evaluation and reporting.

Table 7.1 below indicates the existing co-operative arrangements for each phase of environmental water management. The co-operative arrangements listed are those that apply to the management of environmental water within the SA River Murray WRP area only and apply across all assets and sites. The table does not include the arrangements that operate at a smaller scale – i.e. planning, management and monitoring mechanisms that are relevant to a single asset or site (e.g. the Barrage Operations Advisory Group or TLM Icon Site monitoring); nor those that operate at a broader scale (e.g. activities overseen by the SCBEWC). The 'co-operative mechanism' column provides the title of the arrangement currently in place; further detail is generally documented through internal DEW policies, procedures and Terms of Reference and is available from the administrator. The 'administrator' column indicates the party responsible for overseeing the policy, procedure or forum; it does not list all groups or individuals that should participate in implementation as all parties involved in environmental water management within the SA River Murray WRP area are expected to participate.

Environmental site and water managers must also have regard to the flow management targets for a number of key water quality factors (including dissolved oxygen, cyanobacteria or biovolume and salinity) as outlined in Chapter 9 of the Basin Plan. In particular, the asset and water managers should consider potential water quality impacts during annual and real-time planning (including potential cumulative impacts from multi-site actions), manage any risks that may emerge once water is being delivered in real time, and report annually on how they have had regard for flow management targets as part of their obligations under Schedule 12, Matter 14.

The co-operative arrangements currently in place are expected to be expanded over time to improve coordination, minimise risk and optimise the outcomes of environmental watering in the SA River Murray WRP area. Current arrangements are described in detail in the *Water for the Environment Management Framework, South Australian River Murray* (Department for Environment and Water, 2021).

Table 7.1. Co-operative arrangements for environmental water management within the SA River Murray WRP area

Environmental water management phase	Co-operative mechanism	Description	Administrator
Planning and prioritisation			
State annual planning for the WRP area	Standard Operating Procedure: Develop Annual Watering Plan	Describes process for developing an annual environmental watering plan for the WRP area for the upcoming water year.	DEW E-Water[19]
	Watering Proposal Template	To be completed by each asset/site manager (including a risk assessment) - key input to annual plan and prioritisation. The template used for the SA River Murray WRP area is generally based on the template developed by SCBEWC, with minor changes to improve relevance to the region.	DEW E-Water; MRL Wetlands[20]
State annual priorities for the WRP area	Annual Prioritisation	Method currently being further refined. Process/outcome documented in the Annual Environmental Watering Priorities, which are submitted to the MDBA by 31 May each year, and the Annual Environmental Watering Plan for the South Australian River Murray, which is published on the DEW website each year.	DEW E-Water
Multi-site planning for the WRP area	Watering Proposal Template	Undertaken as a component of annual planning to develop a potential delivery pattern for outcomes at multiple assets/sites.	DEW E-Water
Collaboration and allocation			
Collaborate on water allocation	Process yet to be formalised, however, negotiations should be consistent with the Annual Environmental Watering Plan for the WRP area	Collaboration is via SCBEWC for TLM water or undertaken directly between asset/site managers, river operators and the CEWH.	n/a

[19] DEW E-water refers to the Environmental Water Team within the Water Infrastructure and Operations Branch of DEW.

[20] MRL Wetlands refers to the Wetland and Floodplain Team in the Murraylands and Riverland Landscape Board.

Environmental water management phase	Co-operative mechanism	Description	Administrator
Notify allocation approval	Schedule (CEWH) Instructions (TLM)	CEWH develop a watering schedule, which specifies the agreed watering action and accounting methodologies. TLM inform the relevant asset/site managers via email.	DEW E-Water; DEW Water Delivery[21]
Trade environmental water	Standard Operating Procedure: Trade Environmental Water	Environmental water held interstate is generally traded onto a South Australian licence held by the Minister for Environment and Water. Some external site managers have their own licence for environmental watering so will not trade onto the Minister's licence.	DEW Finance[22]
Report trade activity	Process yet to be formalised	Advice is provided by DEW Licensing upon receipt of trades to DEW Finance who then advise DEW E-Water who keep a record of all environmental water trades and their purpose.	DEW E-Water
Delivery			
Real-time planning	E-flows Reference Group	DEW asset/site managers participate in regular meetings when planning the delivery of environmental water (including unregulated flows) to the WRP area. Each asset/site manager will have their own arrangements in place for operational planning at a site scale but this information should be fed through to the E-flows Reference Group and River Murray Operations Working Group (RMOWG).	DEW E-Water
Assessment of potential water quality impacts	Guidelines for Having Regard to Targets for Managing Water Flows	Potential cumulative impacts in the context of current conditions are assessed through the RMOWG as per the Guidelines. Assessments consider current and forecast operational conditions to identify and mitigate risk.	DEW Water Delivery
Advise on extraction/use from River	River Murray Action Request Form	To be completed by asset/site managers and submitted to DEW Water Delivery, where an assessment will be undertaken and referred to the RMOWG as necessary	DEW Water Delivery

[21] DEW Water Delivery refers to the Water Delivery Team within the Water Infrastructure and Operations Branch of DEW

[22] DEW Finance refers to the Finance Branch of DEW, who complete the trades of environmental water under Chinese wall arrangements as per Basin Plan section 12.52

Environmental water management phase	Co-operative mechanism	Description	Administrator
Deliver water to SA border	Water order to MDBA and liaison with SA Water	Requires knowledge of all environmental water allocations and trades, and ensures water is available for environmental watering actions at the appropriate time.	DEW Water Delivery
Deliver water to asset/site	Standard Operating Procedure: Deliver Environmental Water	The mechanism for delivering water varies widely and each asset/site manager will have their own arrangements in place for water delivery. Water delivery must be undertaken consistent with the approved action.	Asset/site manager
Report watering activity	Standard Operating Procedure: Record Environmental Use Spreadsheet template for environmental water accounting	Asset/site managers should provide regular updates to DEW E-Water and DEW Water Delivery to ensure there is oversight of all watering activities underway.	Asset/site manager
Monitoring and evaluation			
Measure site-specific water use	The mechanism for measuring the volume of water used will depend on the type of watering action as follows: • Pumping/drip irrigation - metered[23] • Gravity fed wetland basins - modelled • Large scale actions - modelled using DEW-approved models, and measurements to	Asset/site managers are responsible for ensuring that water use complies with the allocated/approved volume.	Asset/site manager

[23] Refer South Australian Licensed Water Use Metering Policy

Environmental water management phase	Co-operative mechanism	Description	Administrator
	calculate discharge over structures and area inundated		
Report water use	Standard Operating Procedure: Record Environmental Water Use	Describes process for site managers to report volumes of water use to DEW E-Water. This data is needed to enable the State to meet legislated reporting requirements under the Basin Plan (Matter 9 - Identification of environmental water and the monitoring of its use).	DEW E-Water
	Spreadsheet template for environmental water accounting	Standard template to be used by asset and site managers to report volumes as per procedure.	DEW E-Water; DEW Water Delivery
	Standard Operating Procedure: Produce Annual Report on Environmental Watering	Each year a report is published summarising environmental water use and key ecological outcomes.	DEW E-Water
Reconcile environmental water licenses (water volumes and cost)	Standard Operating Procedure: Reconcile Environmental Water Accounts	For licenses held by the Minister, reconciliation is completed by DEW E-Water. If an externally-held licence is used for environmental watering, then the environmental water manager is responsible for providing a reconciliation to DEW Licensing.	DEW E-Water; external site managers; DEW Licensing[24]
Monitor ecological outcomes Evaluate and report ecological outcomes	Site-specific outcomes recorded through various existing programs (e.g. TLM icon site monitoring, wetland monitoring through MRL Wetlands and monitoring associated with weir manipulations, and Pike and Katarapko floodplain management) and used for continued adaptive management of these sites. Intervention monitoring of the SA River Murray Channel asset is undertaken by CEWH. Collation and evaluation of information from these programs will enable the State to meet legislated reporting requirements under the Basin Plan (Matter 8 - the achievement of outcomes at an asset scale).		

[24] DEW Licensing refers to the Water Licensing Branch of DEW

7.1.2 Co-operative arrangements with upstream water resource plan areas

The SA River Murray WRP area is strongly influenced by environmental watering activities that take place in upstream water resource plan areas, particularly the Victorian Murray WRP area, the Northern Victoria WRP area, the New South Wales Murray and Lower Darling WRP area, and the Murrumbidgee WRP area (refer sections 5.2.4; 5.2.4.1; 5.6.2: 5.6.2.1 of the SA River Murray WRP). Collectively these four interstate water resource plan areas, together with the SA River Murray WRP area, represent the Southern Connected Basin of the Murray-Darling Basin. There are mechanisms in place to maintain and improve co-operative arrangements for the planning and delivery of environmental water in the Southern Connected Basin.

Operating within a broader governance framework, there are a number of cross-jurisdictional committees to facilitate the management of environmental water and in which South Australian representatives participate including:

- Southern Connected Basin Environmental Watering Committee (SCBEWC), which coordinates the planning and delivery of environmental water to maximise ecological outcomes each year through co-operative watering regimes. SCBEWC also considers management of potential water quality risks associated with multi-site watering such as black water events and cumulative salinity impacts. Membership includes holders of environmental water as well as managers of held and planned water, managers of environmental assets, planners and operators responsible for environmental water delivery
- the Environmental Water Committee (EWC) provides formal advice, strategic guidance and problem resolution for matters relating to joint government and Basin Plan business to enable improved integration of environmental water delivery and river operations to achieve outcomes under the relevant intergovernmental agreements and the Basin Plan
- the Water Liaison Working Group (WLWG), which assesses the deliverability of environmental water, implications for the Barmah Choke and overall River Murray system operations and coordination
- the Environmental Water Improvement Group (EWIG), which supports the development of processes and procedures relating to the delivery and accounting of environmental water and implementation of Prerequisite Policy Measures (PPMs).

In addition to these cross-jurisdictional arrangements, representatives from South Australia participate in regular bi-lateral teleconferences with the CEWH.

7.1.3 Co-operative arrangements between water resource plan areas in SA

There are two other water resource plan areas in South Australia – the Eastern Mount Lofty Ranges (EMLR) WRP area and the SA Murray Region WRP area. There are some co-operative environmental watering arrangements with both of these areas.

Eastern Mount Lofty Ranges water resource plan area

There is no active management of water for the environment within Eastern Mount Lofty Ranges (EMLR) WRP area and, as such, long-term cooperative arrangements have been established through policies within the relevant water planning documents (i.e. WAPs). The EMLR WRP area has two prescribed water resource areas within its boundary: EMLR and Marne Saunders.

Flows from the EMLR tributaries (average 78 GL per year) are received into the River Murray (Department for Environment and Water, 2019a). The Water Allocation Plan (WAP) development process for the EMLR assessed whether taking or using water from the prescribed resource of the EMLR has an impact on adjacent water resource areas. It was concluded that the EMLR contributes small volumes to the lower River Murray and Lake Alexandrina and ultimately to Lake Albert, the Murray Mouth and the Coorong. The consumptive use limits for the EMLR have been set to provide water to the local environment (Section 2.4 of the EMLR WAP), including the terminal wetlands where the EMLR streams meet the River Murray and Lake Alexandrina (Natural Resources SA Murray-

Darling Basin, 2013). Protecting low flows has been identified as a key tool for providing part of the EWRs in the Eastern Mount Lofty Ranges (Natural Resources SA Murray-Darling Basin, 2019) and is being addressed through the Flows for the Future Program. The monitoring and reporting arrangements for WAP policies are described in Section 8 of the EMLR WAP.

The EMLR WAP notes that conditions in the River Murray and Lake Alexandrina can also directly affect the environmental condition of the lower reaches of the EMLR streams as occurred during the Millennium Drought. To minimise this impact, the Water Allocation Plan for the River Murray Prescribed Watercourse (River Murray WAP) incorporates principles that prevent increased extractions from the tributaries of Lake Alexandrina (Natural Resources SA Murray-Darling Basin, 2020).

There are two additional mechanisms that will assist with minimising the impacts of low water levels in Lake Alexandrina on the lower reaches of the EMLR streams. The first mechanism is the inclusion of a particular objective in the Basin Plan (section 8.06) to maintain water levels in the Lower Lakes above 0.4 m AHD for 95% of the time and above 0.0 m AHD all of the time. The second mechanism is a documented decision-making process for the management of the Lower Lakes during extreme drought (Murray-Darling Basin Authority, 2014c).

The Marne River and Saunders Creek begin in the high rainfall hills zone, flowing east down the hills, through gorges and then out onto the low rainfall plains zone to eventually meet the River Murray. Flow from the Upper Marne River to its mouth at the River Murray is now uncommon, with most outflows from the hills zone recharging the groundwater on the plains zone in most years. Flow from the Upper Saunders to its mouth is even more uncommon given the smaller discharge volumes from this area; it is unknown when this last occurred (Department for Environment and Water, 2019a). The WAP for the Marne Saunders PWRA includes policies to protect the spring flow for the Marne Mouth Wetland, which is located at the junction of the Marne River with the River Murray.

SA Murray Region water resource plan area

Potential inflows from the south-east into the CLLMM PEA are low (median 42 GL per year) when compared to the flows from the River Murray (average 5,685 GL per year) (Department for Environment and Water, 2019a). The South Lagoon of the Coorong has been historically impacted by the redirection of water (both floodwater and saline groundwater) into the South East drainage system and out to sea rather than into the Coorong (Department for Environment and Water, 2019a). The DEW South East Flows Restoration Project was established to manage water release from Morella Basin via Salt Creek, improve outcomes for en-route South East wetlands and increase flows to the Coorong when required for salinity management. The pattern of releases at Morella Basin and Salt Creek can be altered in consideration of potential outcomes and impacts within the South Lagoon of the Coorong, including salinity, nutrients and biotic responses (particularly *Ruppia tuberosa*).

Decisions on the release volume, flow rate and timing of releases are made each year by the South Eastern Water Conservation and Drainage Board (SEWCDB) following the objectives, procedures and governance structures outlined in the *South East Flows Restoration Project Operations Manual* (Department for Environment and Water, 2019) and advice from DEW and SEWCDB staff. The Board will receive a recommendation on proposed operations via the Director, Water Infrastructure and Operations, DEW, who is accountable for decisions regarding Morella and Salt Creek releases to the Coorong. The SEWCDB consists of an eight member statutory body established under the *South Eastern Water Conservation and Drainage Act 1992*. The SEWCDB staff use a digital elevation model and seasonal weather conditions to provide advice to the Director, Water Infrastructure and Operations and the Board. DEW staff seek advice from the Lower Lakes, Coorong and Murray Mouth Scientific Advisory Group and Community Advisory Panel on the potential risks and benefits to the Coorong of the proposed release patterns and provide advice to the Barrage Operations Advisory Group on Morella and Salt Creek operations. The revision of an operating plan to guide decisions on the release of water from the South East into the Coorong is underway.

7.2 Operational constraints

Constraints have a significant impact on the feasibility of delivering environmental water to and within the SA River Murray WRP area. It is important for environmental asset and site managers in this area to have a good understanding of these constraints so that they can be factored into their annual and real-time planning for environmental water delivery.

The Basin Plan (section 8.19 (6)) requires that a long-term watering plan identify any ***operational constraints*** in relation to environmental watering in the water resource plan area. Operational constraints relate to the effective management of water resources through a range of operating protocols (for instance, the requirement to maximise reliability of supply for consumptive use, or to protect infrastructure and private property from inundation) (Murray-Darling Basin Authority, 2013c). For example, due to the risk of exceeding a flow threshold at which point water inundates private land (a physical constraint), river operating rules may set maximum flow rates for a given location in-line with the physical constraint (an operational constraint).

7.2.1 Constraints relaxation in the Southern Connected Basin

In November 2013, the MDBA published the Constraints Management Strategy: 2013-2024 (CMS). The CMS sought to maximise the environmental benefits of returned water to the river system while ensuring no adverse impact to the community. The CMS identified priority constraints to water delivery to achieve better outcomes from the use of environmental water (Murray-Darling Basin Authority, 2013a).

Basin States agreed to a final package of constraints measures for seven key focus areas, six of which are located upstream of South Australia.

The key focus areas identified as part of the CMS have been subject to several delays. Although work has commenced in the upstream states these projects are far from being able to deliver the CMS target flows. Only the SA River Murray project will have made significant progress by the current legislated deadline of 2026. Although SA is in a position to receive enhanced overbank flows in excess of 80,000 ML/day at the SA border, these flows cannot be 'manufactured' in South Australia and the achievement of actual delivery of water above this threshold will be limited based on the flows that are achievable upstream. Upstream states are making slow progress towards delivering on the CMS flow targets. As at July 2025, it remains unclear if and when the full anticipated outcomes can be achieved. Whilst there will be some progress by the 2026 deadline, this will fall short of the anticipated CMS targets.

Section 7.08A in the 2023 Basin Plan amendments required the Murray-Darling Basin Authority to prepare a *Constraints Relaxation Implementation Roadmap* by 31 December 2024 (Roadmap). The purpose of the Roadmap as set out in section 7.08A is to assist the Australian Government and Basin States to identify measures to relax constraints, and develop and implement them in a way that:

- maximises the benefits of the constraint measures to deliver environmental outcomes, including but not limited to enhanced environmental outcomes and outcomes identified by the Constraints Management Strategy, and
- provides, as far as practicable, a common approach across river systems and jurisdictions including, but not limited to, in relation to:
    - reporting, transparency and public accountability
    - program implementation and governance including regulatory approvals
    - supporting the acceleration of constraint measures by 31 December 2026, and
    - managing impacts on third parties.

The Roadmap focuses on what can be delivered by 2026 and it also has line of sight for implementation up to 2036. The Roadmap contains a number of findings that reflect MDBA views, while recognising that it is up to

Basin States and the Commonwealth to make decisions moving forward to relax constraints (Murray-Darling Basin Authority, 2024).

Finding 7 of the Roadmap proposes no longer pursuing 80,000 ML/day as an operational target for the Murray at the South Australian border (Murray-Darling Basin Authority, 2024). This would have significant consequences for the SA River Murray Floodplain PEA and CLLMM PEA as flow rates of this magnitude are identified as EWRs and are expected to make major contributions to meeting multiple ecological targets (refer to Section 4 Table 4.5 for further information). Until such time as the target thresholds of constraints relaxation for each of the Key Focus Areas are known, it is not possible to determine the full impact of achieving 80,000 ML/day at the SA border.

7.2.2 River Murray in South Australia key focus area

The River Murray in South Australia Constraints Measure (SA Constraints Measure) is focused on removing physical constraints to flow from the River Murray channel to its wetlands and floodplains. Overbank flows and floodplain inundation are natural occurrences that were experienced at a much greater frequency in the past. These high flows are essential for supporting floodplain and in-channel health, and providing water to the Coorong, Lower Lakes and Murray Mouth. In order to better replicate the natural hydrological regime, the addition of environmental water or operational changes will be used to enhance flow events. As part of ensuring the practical delivery of enhanced flows, the SA Constraints Measure also considers mitigation measures for potential impacts to private property owners (e.g. shacks), councils and infrastructure operators (e.g. operators of boat ramps or roads along the floodplain).

7.2.3 Constraints Management Strategy operational and management constraints

The CMS identified nine broad operational and management constraints (expressed as outcomes) that require action by Basin States (primarily) and the MDBA (to the extent that it is responsible for river operations). Of the nine constraints, the following four have been identified as priorities (Murray-Darling Basin Authority, 2014b):

1. protection of environmental flows from extraction and re-regulation

2. delivery of water on top of other in-stream flows

3. environmental water to be used throughout the length of a river

4. channel capacity sharing.

The first three of these priority operational and management constraints coincide with the pre-requisite policy measures (PPMs) (s7.15 of the Basin Plan) that have been assessed as implemented by the MDBA as of June 2019. Basin States have implemented the PPMs in each valley within their jurisdictions and will continue to improve PPM implementation in accordance with the recommendations from the MDBA (Murray-Darling Basin Authority, 2019). The MDBA will work with Basin States to undertake further scoping and analysis of the other operational and management constraints impacting the deliverability of environmental water.

A summary is provided in Table 7.2 of the constraints that are currently being addressed through the CMS and PPMs that are considered to be having the greatest impact on environmental water management in the SA River Murray WRP area. Addressing these predominately upstream constraints is critical to achieving many environmental outcomes along the Lower River Murray – particularly the Floodplain and CLLMM where significant volumes are required to achieve inundation and flow requirements.

Table 7.2. Key flow constraints for the SA River Murray WRP area being addressed through the CMS and PPMs

Constraint Implication for environmental watering in the SA	River Murray WRP area constraint	River Murray WRP area Constraint management
Public and private infrastructure, and access routes affected during higher flows	Potential reluctance to allocate or deliver environmental water that may contribute to a total flow to South Australia in excess of 40,000 ML/day QSA without addressing known impacts to infrastructure and private property, including, but not limited to, dwellings, shacks and council infrastructure located close to the river's edge.	Being addressed as part of the CMS project in South Australia.
Protection of environmental flows from extraction and reregulation; Environmental water to be used throughout the length of a river	The protection of environmental flows from extraction and re-regulation once they pass the point of extraction relies on trading/delivery mechanisms and the implementation of PPMs by State governments. This is critical for South Australia to receive adequate volumes of return flows from environmental water used at upstream locations.	Ongoing refinement of PPM Implementation. Within SA environmental flows are protected from extraction and reregulation through the Water Allocation Plan for the River Murray Prescribed Watercourse.
Delivery of water on top of other in-stream flows	While improvements have been made in recent years, past river operating and accounting rules have not been conducive for environmental water holders to release water on top of unregulated flows. This reduces the ability to increase flow peaks and their duration through the use of environmental water.	Ongoing refinement of PPM Implementation.
Physical constraints in upstream locations	Low managed delivery flow thresholds in many upstream locations limit the timing and volume of environmental water that can be released from storages for delivery at the South Australian border. This limits the ability to boost flow peaks.	Focus of CMS business cases for upstream locations – e.g. Hume Dam to Yarrawonga Weir, Yarrawonga Weir to Wakool Junction, Murrumbidgee River, Goulburn River and the Lower Darling.

7.2.4 Other constraints and management strategies

In addition to the constraints being addressed through the CMS or the SDL Adjustment Mechanism, there are many challenges to environmental water delivery to and/or in the SA River Murray WRP area. Some of these are not constraints *per se* but challenges to the ability to achieve a certain flow delivery pattern or water level at specific times of the year. For instance, flow to South Australia consists of water sourced from storages in multiple

valleys (e.g. Murray River, Goulburn River, Darling River, Murrumbidgee River) and the coordination of water provisions from these multiple sources to achieve a particular flow event at the South Australian border can be logistically difficult. The associated large distances and long travel times for water delivery also make it difficult to respond to rapid changes in flow conditions. This is compounded by uncertainty around travel times for water releases, as well as natural flow peaks, due to differences between events as a result of the influence of antecedent conditions. Knowledge and experience in the coordination of environmental watering actions across multiple catchments is growing and mechanisms such as the establishment of the SCBEWC have been important in managing water in consideration of these challenges.

In giving consideration to the delivery of water for the environment at South Australian and Southern Connected Basin scales, South Australia aims to apply Principles 10 (river management and operation practices should be reviewed and/or altered to ensure that rivers can be managed to achieve multiple objectives) and 11 (management of water for consumptive use should be undertaken in a way that is consistent with the objectives in Part 2) of the Basin Plan principles to be applied in environmental watering (Chapter 8). The constraints and the current understanding of the implications for environmental watering in the SA River Murray WRP area are provided in Table 7.3. This list is not limited to constraints that occur within the SA River Murray WRP area but also includes those that occur upstream of the WRP area and have a major impact on environmental water delivery to the South Australian border. For each flow constraint identified, Table 7.3 indicates how the constraint is currently being managed or may be managed. The constraints and management strategies may change in the future as managers and River operators gain greater experience in managing environmental water.

One of the major flow constraints that can significantly impact on the delivery of environmental water to South Australia at critical times (particularly summer and autumn) is the Barmah Choke channel capacity constraint. The Barmah Choke has the lowest capacity of any stretch of the River Murray (Murray-Darling Basin Authority, 2013a) due to a naturally occurring narrow stretch of river that passes through the Barmah-Millewa Forest. Once channel capacity is exceeded, overbank flows into the Forest occur. At certain times of the year it is not desirable to flood the Forest as it may result in negative environmental outcomes and high water losses; therefore flows downstream of Yarrawonga Weir are kept below approximately 9,200 ML/day (Murray-Darling Basin Authority, 2013a) during this period. This timing coincides with high irrigation demands over summer and the necessity to transfer water to Lake Victoria to provide South Australia's Entitlement flow (including SA HEW and PEW), which occupy most of the available channel capacity, and therefore limits the volume of environmental water that can be passed downstream of Hume Dam.

Historically it has not been desirable to inundate the Forest from mid-December through to the end of April (Murray- Darling Basin Authority, 2013a). Travel time from Yarrawonga to the CLLMM is approximately five to six weeks; therefore this constraint may impact on environmental water delivery to the CLLMM from January to May. Environmental water delivery to the CLLMM in addition to that provided within South Australia's Entitlement is critical in summer and autumn in order to prevent the likelihood of low water levels in the Lower Lakes, which are also critical in order to maintain barrage outflows for Murray Mouth maintenance and prevent Coorong South Lagoon salinity thresholds from being exceeded. The Barmah Choke channel capacity constraint poses a significant long-term risk to the delivery of the EWRs for the CLLMM PEA.

The capacity of the Barmah Choke has declined approximately 20 percent since the 1980s. Research released by the MDBA (2021) found that a massive 'slug' of sand, believed to be mobilised by gold-mining and land clearing upstream in the 19th and early 20th centuries, has been slowly moving downstream and accumulating in the naturally narrow Barmah Choke. Prior to the 2022-23 floods around 9,200 ML/day could be released from Yarrawonga. After the floods it had declined to around 8,600 ML/day. In recent times releases of around 8,900 ML/day from Yarrawonga have been possible without exceeding 2.6 m at Picnic Point (MDBA, Milne T, pers. comm 2025). In 2018, the Murray-Darling Basin Ministerial Council established the cross-jurisdictional Capacity Policy Working Group to investigate options that would manage the decline of channel capacity and mitigate shortfall risk for all water users (Doolan, et al., 2019). This work is underway and is investigating options, including policy and infrastructure solutions. Implementation of the CMS is anticipated to alleviate some of risk related to capacity to deliver water for the environment, by providing upstream environmental water holders with improved flexibility to deliver environmental water at higher flows across the Southern Connected Basin.

Table 7.3. Flow constraints that influence environmental water delivery to South Australia

Constraint	Implication for environmental watering in the SA River Murray WRP area	Constraint management
Physical capacity to release water from storages during high flows limits quantity of water that can be delivered to South Australia.	The current understanding is that flows to South Australia can only be boosted by approximately 10,000 ML/day, depending on flow conditions at the time (Murray-Darling Basin Authority, 2014d). This limits the flow rates that can be achieved through enhancing unregulated flows.	This constraint is factored into environmental water planning. The learnings gained over time will provide a more accurate understanding of the volume of environmental water that can be added including under certain unregulated flow conditions.
Social constraints on releases that would impact flows or river levels based on potential impacts to social and recreational activities.	Limits the volume of environmental water that can be delivered during periods when competing demands are high. As a result, there is a risk that at times insufficient water can be delivered to South Australia or that timing of delivery may not be optimal to achieve environmental outcomes.	This constraint is factored into environmental water planning. Coordination between operators and environmental planning will enhance input into the timing of environmental flows such that they are less likely to be impacted by competing uses.
Channel capacity through the Barmah Choke and operational/policy decisions to minimise summer inundation of the Barmah-Millewa Forest to avoid potential adverse environmental impacts.	Limits the volume of environmental water that can be delivered below the Barmah Choke in summer, particularly during periods of low flow when competing demands are high. As a result, there is a risk that at times insufficient water can be delivered to South Australia to maintain water levels in the Lower Lakes and provide for barrage releases.	In 2018 the Murray-Darling Basin Ministerial Council established the cross jurisdictional Capacity Policy Working Group to investigate policy and infrastructure solutions. This work is on-going.
Various factors may constrain the use of Lake Victoria in managing environmental water delivery, including: ○ operating rules (Lake Victoria Operating Strategy) ○ specific objective and outcome for improving water quality using Lake Victoria (Murray- Darling Basin Authority, 2015)	These constraints can limit the potential to operate Lake Victoria to: ○ provide a source of environmental water ○ store environmental water for release at an alternative time ○ be bypassed and allow longitudinal connectivity and ensure flow peaks move into South Australia.	There has been increased flexibility in the operation of Lake Victoria to facilitate environmental watering actions, including a pre-release of environmental water to prevent a short-term drop in flow rates at the South Australian border and delivery to CLLMM PEA over summer. Opportunities to trial further flexibility in operations should continue to be explored.

Constraint	Implication for environmental watering in the SA River Murray WRP area	Constraint management
○ channel capacity constraints at both the inlet and outlet. ○ reduced ability to release water when flow rates are high in the Murray.		
Weir pools are generally managed within a given narrow operating range to advantage extraction for consumptive use, recreation and other riparian uses.	Weir manipulations are constrained due to operational limitations, which restricts the flexibility of operation and achievement of ecological outcomes through the raising and lowering of weir pools.	A transition to establishing variable weir pool levels is underway but will need to be implemented over time. This may continue to be addressed through future revisions in the *Water Allocation Plan for the River Murray Prescribed Watercourse* and refinement and publication of operating procedures for weir pool level manipulation. Updated assessment of structural stability is underway which may result in further limitations placed on the capacity to raise or lower weirpools.
Weir manipulation, the operation of environmental regulators and boosting unregulated flows will affect certain private and public infrastructure and access.	Operating infrastructure and augmenting flows needs to consider known likely impacts.	Trial weir pool raising and lowering have been undertaken to test communication protocols and approval processes. Small incremental increases in the scale of manipulation events have occurred and will continue across most reaches. CMS projects are investigating impacts and considering options to mitigate potential impacts.
Works and construction activity on the floodplain, including environmental works.	Reluctance to enhance flow peaks through the addition of environmental water if it may impact on construction works and incur additional expenses. Flow peaks may also be managed, where required, to avoid impacting on construction activity.	Contractual arrangements with constructing bodies should consider potential impacts of peaks in flow, including through the addition of environmental water, so as to limit financial penalties where possible. Watering decisions should also consider the likely benefit of

Constraint	Implication for environmental watering in the SA River Murray WRP area	Constraint management
		watering and the impact on construction, including the delay in future site operation for environmental outcomes.
Distance to permanent water limits the feasibility of pumping to some temporary wetland and floodplain habitats.	Physical limitations of pumping infrastructure and the costs of delivery limit the wetlands/ floodplain areas that can be actively watered through pumping.	In some circumstances, alternative watering techniques, such as reservoir-fed drip irrigation, may provide a more efficient or cost-effective method of delivering water to priority areas in need. There have been some trials into alternative watering techniques and these should continue to be explored in the future.
Logistics of barrage operations.	Physical operation of barrages is time consuming and can limit opportunities to rapidly open or close gates, particularly under low lake level conditions where there is an increased risk of saltwater ingress.	Investigate options for installing additional automated gates on Goolwa barrage.

7.3 Long-term risks to providing environmental water

7.3.1 Identification of risks

The risks to the condition and availability of Basin water resources identified in the Basin Plan (section 4.02) are:

a) insufficient water available for the environment

b) water being of a quality unsuitable for use

c) poor health of water dependent ecosystems.

A risk assessment was undertaken as part of the SA River Murray WRP development in accordance with Part 9, Chapter 10 of the Basin Plan. A water resource plan must be prepared having regard for the risks to the condition and availability of Basin water resources identified by the Basin Plan (section 4.02) and in accordance with the AS/NZS ISO 31000:2009 *Risk Management – Principles and Guidelines* (4.04(3)) (Department for Environment and Water, 2019b). This risk assessment determined that the management of connected water resources upstream of the South Australia border remains a source of medium risk for the River Murray with resulting impacts on water-dependent ecosystems. Six of the ten medium risks identified relate to upstream connected water resources (section 5.2.4 of the SA River Murray WRP) that affect water quality, quantity or regime, which in turn cause impacts on water-dependant ecosystems. The remaining four risks relate to the impact of climate extremes on water dependent ecosystems.

The risks identified cannot be fully addressed by the South Australia alone as the strategies to address these risks include the successful implementation of the Basin Plan in full, which includes full implementation of Prerequisite

Policy Measures, Constraints Management Strategy, the additional 450 GL to be recovered and no reduction of planned environmental water across the Basin. This will require implementation of all WRPs for the Southern Connected Basin in the Murray-Darling Basin including the associated long-term environmental watering plans. Anything less will compromise the ecological character of the Ramsar sites and impact on the PEAs and PEFs identified in the SA River Murray WRP area.

7.3.2 Potential risk management strategies

The strategies identified within the SA River Murray WRP (section 5.9.11) need to be maintained for the level of risk to remain the same. In addition, the following needs to occur: 1) effective decision-making frameworks; 2) addressing flow constraints; and 3) rigorous monitoring and evaluation programs.

Effective decision-making frameworks

The co-operative arrangements section of this LTWP describes the processes in place within the WRP area to facilitate the coordination of environmental water management and guide decision-making across the region. In addition, DEW will continue to participate in arrangements to coordinate environmental watering across the Southern Connected Basin (SCB) (see Section 7.1).

Addressing flow constraints

Flow constraints pose a major risk to providing the EWRs of the PEAs of the SA River Murray WRP area and modelling indicates that relaxation of constraints can improve the delivery of environmental watering events (Gibbs, et al., 2012). Further details of the constraints that influence environmental water delivery to and within the SA River Murray WRP area are provided in the Operational Constraints section of this LTWP (Section 7.2).

Rigorous monitoring and evaluation programs

Monitoring and evaluation will be undertaken to enable the assessment of ecological outcomes at the PEAs within the SA River Murray WRP area (see Section 8). The information gathered through the implementation of this monitoring and evaluation will be critical for ongoing management and to support the recognition of the environmental assets within the SA River Murray WRP area as priorities for the Basin.

The River Murray WAP recognises the need for monitoring and evaluation of water demand and water availability to inform adaptive management for climate change (Natural Resources SA Murray-Darling Basin, 2020). The impacts of climate change remain an ongoing significant issue for the future health and productivity of the Murray-Darling Basin.

Further research and monitoring are needed to better quantify the impacts (forecast and actual) of climate change on water availability and water demand and the resulting impacts on water-dependent ecosystems. This information will assist with the identification of specific mitigation strategies which may include altering water resource plans to manage resources differently (section 10.51) and a review of the Basin Plan (section 6.06).

7.4 Social and economic values

The BWS recommends considering opportunities for complementary social and economic outcomes when planning and delivering environmental water.

All environmental watering events provide a social and economic benefit by having a healthier environment, improving recreation activities, supporting local tourism, and improving well-being (Murray-Darling Basin Authority, 2025).

The River Murray Water Resource area is part of a Murraylands and Riverland region that is home to approximately 73,000 people (Regional Development Australia, 2023). The region supports high-value ecological communities and provides water for around 1.5 million South Australians, supporting industries, urban use, and social and cultural needs.

The primary economic use of the River Murray water resources is primary production, including broadacre agriculture, livestock and horticulture (fruit, nuts and wine grapes). Tourism is also a major economic driver in the region. The region's Gross Regional Product (GRP) was $4.23 billion in the year ending June 2021, representing 3.63% of South Australia's GSP (Gross State Product). The Agriculture, Forestry and Fishing industry generated $1,155 million value added in 2020-21, and the total tourism output in the region was $237.3 million (RDA 2023). Both of these sectors are heavily reliant on a healthy, functioning River Murray.

Water for the environment is critical for supporting resilient ecosystems that underpin the social, economic, and cultural fabric of the region. Environmental water delivery significantly enhances the social and economic values of the SA River Murray Water Resource Area and can also contribute to related social and economic outcomes.

7.4.1 Social and economic benefits of environmental water

Healthy rivers, floodplains and wetlands provide a range of social and economic benefits. Some of the benefits of environmental water delivery in the region include but are not limited to:

Enhanced recreational fishing / yabbying – Native fish are recognised as having significant social and economic value. Recreational fishing is a popular pastime that provides social and health benefits, with almost half a million recreational anglers in the Murray–Darling Basin contributing around $403 million annually to Australia's GDP (Basin Plan Evaluation 2020). The ongoing benefits of recreational fishing depend on healthy native fish populations and functional ecosystems. Native fish are also highly valued by Aboriginal people for their cultural significance and serve as a source of food, trade, commerce, recreation, spirituality, and traditional customs (Noble et al. 2016).

Commercial fishing – Environmental watering also contributes to the commercial fishing particularly in the CLLMM region. The Lakes and Coorong Fishery has been commercially fished since 1846, with a number of generational fishing families still conducting activities in the region. The fishery contributes to the socio-economic well-being of regional communities through commercial and recreational activity and harbours significant cultural, spiritual and livelihood significance for the Ngarrindjeri people. In 2018/19, total Lakes and Coorong fishing industry related contribution to GSP in South Australia was $21.6 million, and the total catch in 2018/19 was 1,861 tonnes (PIRSA, 2022).

Enhanced tourism opportunities - Tourism is a major industry in the region. Environmental watering contributes to a range of passive and active nature-based recreational activities such as swimming, camping, boating, kayaking, water skiing, birdwatching and bushwalking. These activities are supported by environmental watering and provide important health, enjoyment and recuperation benefits. These activities draw many visitors to the region and provide significant economic benefits. Tourism has traditionally provided an important source of revenue to the region. In 2020/21, tourism constituted around 6% of regional workforce and 10% of regional businesses (Regional Development Australia, 2023).

Reduced salinity - Increased river flows from environmental water delivery dilutes salinity in the Murray River system which in turn reduces the need to invest in public salinity management measures such as salt-interception schemes (Natural Capital Economics, 2019).

Reduced blackwater and blue green algal bloom risks - Environmental watering plays a vital role in mitigating blackwater and blue-green algae events and associated impacts on livestock production. Increased flows, particularly during warmer months, reduces the likelihood of stratification in the water column and the risk of blooms forming. Importantly, this avoids potential health issues and can reduce the costs associated with water treatment.

Improved river navigation and enhanced boating access - Environmental water delivery in the region provides improved river navigation through increase flows and greater depth in the river channel.

Enhanced pollination - Environmental watering provides substantial benefits in terms of keeping healthy Eucalyptus forests (particularly river red gum forests), which help support commercial pollination services particularly to almond production (NCE 2019).

7.4.2 Planning environmental water delivery

Whilst operating under existing rules that generally reflect social and economic priorities, when planning environmental water delivery in South Australia, environmental water managers have regard to social and economic outcomes and consider a range of potential social and economic issues including the following:

- Access to water for irrigation and other purposes
- Salinity and water quality
- Blackwater and algal bloom risks
- Navigation risks
- Mitigation of any risks associated with access to recreational areas, public land use, property and assets/infrastructure.

Whilst the primary purpose of water for the environment will always be the achievement of environmental outcomes, water for the environment also achieves a range of social and economic outcomes. Water planners also give consideration to the achievement of social and economic outcomes resulting from the use of water for the environment, where environmental outcomes are not likely to be compromised.

7.5 Complementary Management Actions

Although achieving environmental water requirements is fundamental to achieving ecological objectives and targets, ecological benefits may also be enhanced through a range of complementary management actions.

While no substitute for water recovery, South Australia recognises complementary management actions may have an important role in supporting the achievement of the ecological objectives and targets for the River Murray channel, floodplain, and CLLMM PEAs. As part of the recent PEA objectives and targets review, a number of complementary management actions were identified for each PEA that may contribute to achieving the objectives and targets. These are listed in Table 7.4.

"As outlined by CSIRO (2018), complementary management actions: are non-flow-based actions or measures such as infrastructure works, vegetation management and pest control. Although flow restoration and environmental watering are necessary, they will not be sufficient to achieve the environmental outcomes sought by the Basin Plan alone, particularly where other factors limit the ecosystem response to hydrological change" (MDBA, 2025a).

The Basin-wide Environmental Watering Strategy (BWS) comprises two documents: the Basin-wide Environmental Watering Strategy and a detailed supporting information document. The supporting information document provides additional technical detail on various aspects of the strategy, including details on the complementary management actions (MDBA, 2025a) .

Complementary management actions can support the ecological improvements that environmental water aims to achieve including (CSIRO, 2018):

- Increasing the abundance of waterbirds
- Enhancing the diversity and distribution of native fish
- Improving the condition and extent of native vegetation
- Enhancing river connectivity in strategic locations.

Table 7.4. Complementary management actions – River Murray channel, floodplain and CLLMM PEA

Sr. No.	Complementary Action	Priority Environmental Asset (PEA)	Theme	Responsible organisation
1	Predator control – through various control methods including baiting. Particularly important to control foxes on Younghusband Peninsula for Fairy terns, Hooded plovers and Pied oyster catchers. Turtles and their eggs are highly vulnerable to predation by foxes and cats. Pest animal control is an important action, particularly around known nesting areas.	CLLMM Channel and Floodplain	Waterbirds Turtles	Landscape Board / DEW-NPWS / Landowners
2	Recreation / tourism management – hooded plovers breed on ocean beaches in summer and are vulnerable to 4WDs and other recreational activities. Fencing and signage for beach nesting species (hooded plovers and fairy terns) in areas where recreation occurs.	CLLMM	Waterbirds	DEW–NPWS
3	Disease management – it is likely that the risk of disease is always present; however, it can be affected by water regime and provision of food resources (e.g. areas where birds congregate will be likely to have higher transmission rates). Risk can be reduced by providing a mosaic of wetland habitats across the site with healthy and functional food webs and variable water levels.	CLLMM	Waterbirds	PIRSA
4	Hunting controls across NP and Game Reserves – for example, at Tolderol Game Reserve, which includes the adjacent shores of Lake Alexandrina, DEW administers hunting permits and has provided a guide for responsible and sustainable hunting.	CLLMM	Waterbirds	DEW-NPWS
5	Dredging - operation of a dredge to keep the Murray Mouth open for fish, particularly if freshwater discharges are inadequate. This may also influence grain sizes in the Murray Mouth region	CLLMM	Fish / Macroinvertebrate and sediment	SA Water / MDBA
6	Further stocking of Southern pygmy perch and Yarra pygmy perch into new locations, targeting sites with *Ceratophyllum demersum* and *Typha sp*. to provide shady, complex habitats with healthy invertebrate communities.	CLLMM	Fish	Landscape Board / Relevant NGOs
7	Commercial fishing management – i.e. Black bream no take periods during spawning season.	CLLMM	Fish	PIRSA

Sr. No.	Complementary Action	Priority Environmental Asset (PEA)	Theme	Responsible organisation
8	Salt Creek management – provides connectivity and refuge habitat when environmental condition deteriorates in the South Lagoon (e.g. salinity increases to unfavourable levels).	CLLMM	Fish	SEWC and Drainage Board/ DEW
9	Coorong - Filamentous algae mat removal or reduction through on-ground works.	CLLMM	Macroinvertebrate and sediment	DEW
10	Lower Lakes - Fisheries management –manage the take of yabbies.	CLLMM	Macroinvertebrate and sediment	PIRSA
11	Coorong - on-ground works being considered as part of the Healthy Coorong, Healthy Basin program, i.e. large-scale pumping programs to dilute nutrients and salt in the South Lagoon, and dredging in the Parnka Point region.	CLLMM	Macroinvertebrate and sediment	DEW
12	Catchment management – sediment health in the CLLMM PEA is also a function of total catchment management of nutrient and sediment loads entering the CLLMM PEA.	CLLMM	Macroinvertebrate and sediment	MDBA
13	Predator control – turtles and their eggs are highly vulnerable to predation by foxes and cats. Pest animal control is an important action, particularly around known nesting areas.	CLLMM Channel and Floodplain	Turtles	Landscape Board / DEW-NPWS
14	Nest protection and turtle fencing – fencing materials can be used in various ways to support turtles, including the installation of wire or plastic mesh over nests to protect eggs from being dug up by foxes and turtle fences around the cleared lake edges to create areas where they can penetrate the dense reeds around the lakes and find suitable nesting sites.	CLLMM	Turtles	Landscape Board / DEW-NPWS
15	Littoral vegetation - Re-establish vast beds of littoral vegetation - beds of Vallisneria sp. (ribbon weed) are an important habitat for Murray short-necked turtles. Key areas are the littoral zones of the Lower Lakes and fringing wetlands, particularly near known nesting sites of Murray short-necked turtle.	CLLMM	Turtles	Landscape Boards / Local councils

Sr. No.	Complementary Action	Priority Environmental Asset (PEA)	Theme	Responsible organisation
16	Revegetation - Wave action is main factor limiting establishment of vegetation. Planting *Schoenoplectus tabernaemontani* can reduce wave action and facilitate other plants to establish.	CLLMM	Vegetation	Landscape Boards / Local councils
17	Fencing and grazing management – lakeshore graziers work with local NGOs to fence off the lakeshore and protect the littoral vegetation from grazing, trampling, pugging and eutrophication associated with cattle grazing.	CLLMM	Vegetation	Landscape Boards / Landholders
18	Sites scale seed dispersal or habitat modifications – such as dredging to improve connectivity between the Coorong lagoons.	CLLMM	Vegetation	DEW
19	Limiting the cumulative impact of grazers on survival of germinants and seedlings may be a key component of increasing the success of recruitment events.	Channel and Floodplain	Floodplain trees – River Red Gum and Black Box	DEW / Landscape Board
20	Managing total (domestic, feral and native) grazing pressure, combined with weed management to influence ability to achieve metrics and provide functional habitat.	Channel and Floodplain	Non-woody vegetation – Frequently and infrequently inundated temporary wetlands and shedding floodplain	Landscape Boards / DEW-NPWS
21	Salt interception schemes - action for groundwater and salt management.	Channel and Floodplain	Groundwater Water quality	
22	Removal of weirs at high flows, and provision of fishways.	Channel and Floodplain	Native fish – Lamprey	SA Water / MDBA

Sr. No.	Complementary Action	Priority Environmental Asset (PEA)	Theme	Responsible organisation
23	Wetland habitat management actions including restocking.	Channel and Floodplain	Native fish - Wetland/floodplain specialists	DEW/ Landscape Board
24	Carp control activities.	Channel and Floodplain	Non-native fish	
25	Limiting cutting down of old trees for firewood - Legislation that limits any tree removal without approval.	Channel and Floodplain	Floodplain trees	DEW
26	Wetland habitat management actions - Removing barriers to flow. Captive breeding for threatened species during drought.	Channel and Floodplain	Native fish - Wetland/floodplain specialists	DEW/ Landscape Board

7.5.1 Landscape boards' contributions in managing and implementing complementary management actions

Some of the complementary management actions listed above are supported through a framework provided under the *Landscape South Australia (LSA) Act 2019*. Eight regional landscape boards are established under the *LSA Act 2019*, which work with partners to deliver practical, on-ground programs to manage South Australia's landscapes. These landscape boards invest landscape levies into regional priority issues as well as leverage Australian Government funding towards managing and protecting State's productive and natural landscapes.

Regional landscape boards run numerous programs, which directly or indirectly support measures that are complementary to achieving LTWP objectives and targets. These programs are in line with the seven priority areas of work identified in the State Landscape Strategy 2021 (Landscape_SA, 2021). The seven statewide priorities are:

1. Sustainable primary production
2. Soils
3. Water
4. Pest plant and animal management
5. Impact causing native species
6. Nature conservation and biodiversity
7. Fire, flood and drought recovery.

8 Reporting

This section presents a brief summary of the main reporting requirements associated specifically with environmental watering activity in the SA River Murray WRP area. There are many other broader natural resource management reports produced that incorporate information relating to the condition of the SA River Murray and environmental watering, but these have not been included here (e.g. state and regional Landscape reporting). Additional requirements may also include reporting to funding bodies that have supported investigations and works for environmental outcomes such as the installation of flow regulators, and reporting requirements for Ramsar-listed wetlands.

8.1 Basin plan reporting requirements

Schedule 12 of the Basin Plan lists four 'Matters' that relate to reporting against the implementation of the Environmental Watering Plan (Basin Plan Chapter 8), three of which South Australia is required to report on (Table 8.1). The MDBA and CEWH are responsible for reporting against the fourth Matter (Matter 7 - the achievement of environmental outcomes at a Basin-scale) and information provided by the Basin States will contribute to Matter 7 reporting.

Annual reporting against Matters 9 and 10 commenced for the 2013-14 water year and the first report was submitted to the MDBA before 31 October 2014. Since then, SA has completed Matter 9 and 10 reporting annually as required. The first round of reporting against Matter 8 was submitted in by 31 October 2020, and assessed environmental outcomes up to 30 June 2019. The second round of reporting against Matter 8 Reports were submitted by 31 October 2024, and assessed environmental outcomes up to 30 June 2023. Matter 8 reporting will be completed every five years.

Table 8.1. Reporting requirements for Basin States relating to Basin Plan Chapter 8 Environmental Watering Plan

Item	Matter	Reporting frequency	Due
8	The achievement of environmental outcomes at an asset scale	Five-yearly	First report was due 31 October 2020 then five-yearly every five years following
9	The identification of environmental water and the monitoring of its use	Annual	31 October each year
10	The implementation of the environmental management framework (Part 4 of Chapter 8)	Annual	31 October each year
12	The progress towards water quality and salinity targets	Five-yearly	First report was due 31 October 2020 then five-yearly every five years following

8.1.1 Environmental Evaluation and Reporting

The purpose of the MDBA's 2025 Basin Plan evaluation (Murray-Darling Basin Authority, 2022) is to:

- Inform the 10-yearly Basin Plan Review in 2026;
- Contribute to ongoing Basin Plan implementation by Basin government water management agencies;

- Communicate the effectiveness, appropriateness and impacts of the Basin Plan to the intended audience.

South Australia's evaluation of the environmental outcomes of the Basin Plan is underpinned by the 5-yearly Matter 8 reporting, along with a contribution from Matter 12 reporting. The purpose of South Australia's evaluation of environmental outcomes includes:

- Meet Basin Plan reporting requirements (Schedule 12, Basin Plan)
- Inform South Australia's, the Australian Government's and other States' environmental water delivery decision making and adaptive management capacity
- Make a meaningful contribution to the Authority's evaluation of the effectiveness of the Basin Plan and its review in 2026
- Communicate outcomes to stakeholders, including the wider community.

South Australia's evaluation approach has been developed to directly align with the Authority's Evaluation Framework, including key evaluation questions that will ensure a meaningful contribution to the Authority's evaluation of the effectiveness of the Basin Plan (see South Australian evaluation of environmental outcomes under the Basin Plan: 2024 Approach and Summary (Department for Environment and Water 2024); Figure 8.1 *Overarching evaluation framework for South Australia's 5-yearly reporting obligations*).

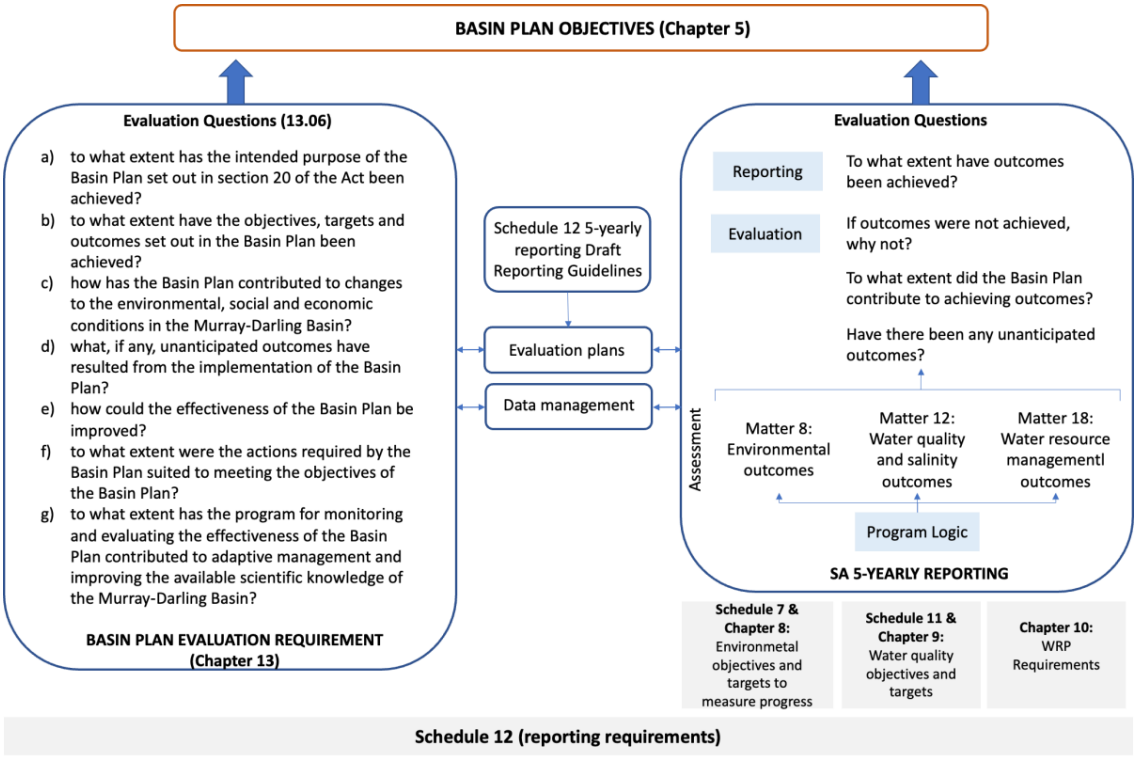

Figure 8.1: Overarching evaluation framework for South Australia's 5-yearly reporting obligations .

South Australia's approach for the SA River Murray WRP Area is underpinned by the development of expected environmental outcomes for a selection of SA River Murray LTWP targets (note: SA 2024 Matter 8 outcomes based on prioritised targets from the 2015 SA River Murray LTWP targets). The development of quantitative expected environmental outcomes provides a more nuanced approach to the environmental outcome evaluation and reporting, as it enables tracking of the trajectory towards outcomes and demonstrates progress towards LTWP targets. Expected environmental outcomes document our expected progress towards the LTWP targets over three time points post-Basin Plan adoption (2019, 2029 and 2042).

South Australia's environmental outcome evaluation includes an assessment and evaluation of the expected environmental outcomes across key themes, including flow and ecosystem function, vegetation, fish and birds.

8.2 Other reporting requirements

Additional reporting of environmental watering activity within the SA River Murray WRP area is summarised below.

8.2.1 Water use reporting

Reconciliation of use against environmental water licences and accounts is reported to DEW Licensing and is due quarterly in line with the conditions for use associated with the water accounts.

8.2.2 Ecological and operational reporting to water holders

Reporting of environmental water use to environmental water holders (CEWH and TLM) takes place on both event and routine bases, and is agreed with the holders and varies depending on the site and watering action.

For TLM, long-term environmental monitoring programs are in place at Chowilla and the LLCMM Icon Sites, including intervention and condition monitoring. Information generated through these programs is used to report on responses to environmental watering, and the environmental condition of the sites.

For CEWH, reporting requirements vary depending on the site and watering action, and is agreed between the CEWH and the site manager prior to water delivery. Ecological outcomes arising from the delivery of Commonwealth environmental water to the Channel PEA and areas of the Floodplain PEA that are inundated by flows of less than 60,000 ML/day QSA (excluding Chowilla) will be monitored and evaluated through the CEWH's Long-Term Intervention Monitoring Project (LTIM Project).

For the South Australian Minister for Environment and Water, reporting requirements are met through information gathered in the preparation of DEW's annual environmental watering report (see below).

8.2.3 Public reporting of environmental watering activity

An annual environmental watering report is produced by DEW at the end of each water year. This report summarises the volumes and timing of environmental water delivered within the SA River Murray WRP area, provides an evaluation of actual against planned actions and highlights some of the key environmental outcomes achieved through environmental water delivery. The report is published on DEW's website and meets the South Australian Government's commitment to the Council of Australian Governments (COAG) to provide transparency and accountability for public information sharing of River Murray environmental water use in South Australia (Council of Australian Governments, 2010).

9 Review of this plan

The triggers and timeframes for reviewing and updating this LTWP are provided in Section 2.2. Information generated through the implementation of site-specific monitoring programs, together with annual and five-yearly reporting (and associated plans), will be instrumental in updating and improving future versions of the LTWP.

10 Appendices

A. Regional landscape boundaries under the *Landscape South Australia Act 2019*

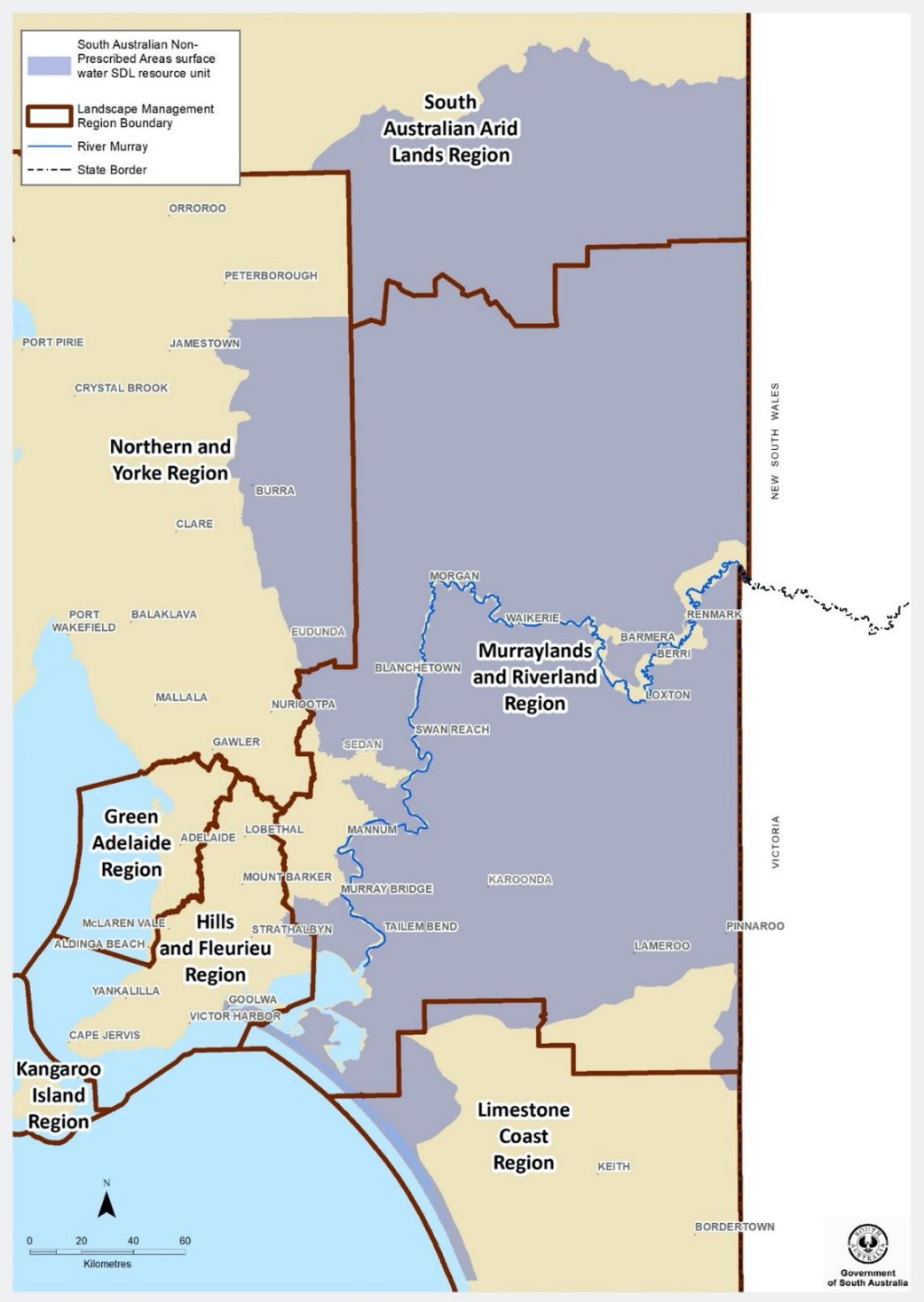

Figure 10.1. Landscape SA boundaries within the Basin Plan's South Australian Murray Region water resource plan area

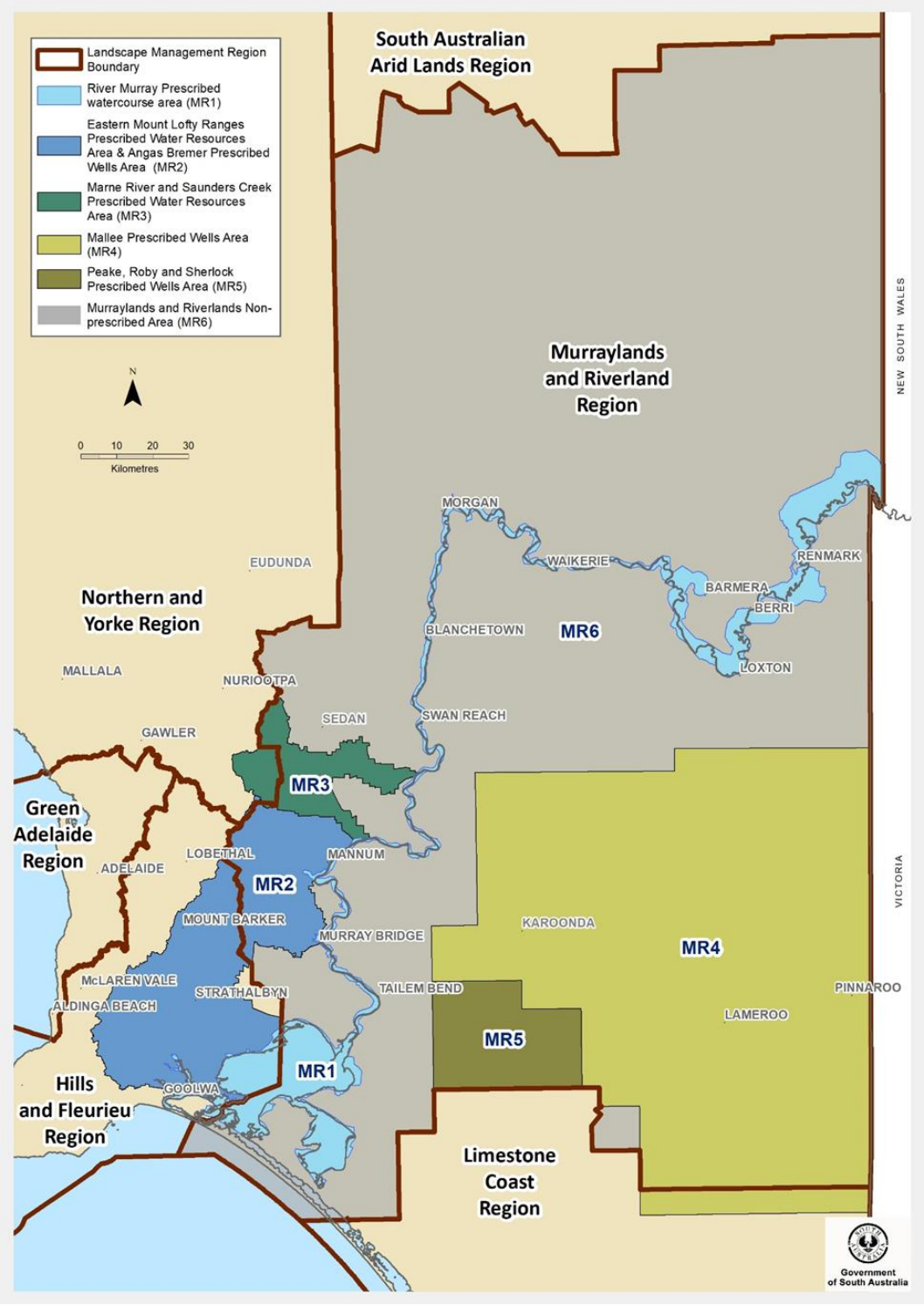

Figure 10.2. Water planning zones within the Murraylands and Riverland landscape management region

B. State planning in the SA River Murray WRP area

Landscape Regions	Resource Area Type	Relevant Legislation /Plans / Reports
All Regions		*Landscape South Australia Act 2019* *Water Act 2007* (Commonwealth)
Hills and Fleurieu (HF)	Non-prescribed water area	HF Water Affecting Activities Control Policy
	Prescribed water areas	Eastern Mount Lofty Ranges WAP Marne-Saunders WAP
Murraylands and Riverland (MR)	River Murray Prescribed Watercourse	River Murray WAP
	North East Mt Lofty Ranges sub-catchments	MR Water Affecting Activities Control Policy
	Non-prescribed water area	MR Water Affecting Activities Control Policy
Limestone Coast (LC)	Non-prescribed water area	LC Water Affecting Activities Control Policy *South Eastern Water Conservation and Drainage Act 1992 (*SA)

C. Definitions of held and planned environmental water

The following definitions of held and planned environmental water are taken from Sections 4 and 6 of the *Water Act 2007*.

Held environmental water means water available under:

(a) a water access right; or

(b) a water delivery right; or

(c) an irrigation right;

for the purposes of achieving environmental outcomes (including water that is specified in a water access right to be for environmental use).

Planned environmental water

(1) For the purposes of this Act, planned environmental water is water that:

(a) is committed by:

(i) the Basin Plan or a water resource plan for a water resource plan area; or

(ii) a plan made under a State water management law; or

(iii) any other instrument made under a law of a State;

to either or both of the following purposes:

(iv) achieving environmental outcomes

(v) other environmental purposes that are specified in the plan or the instrument; and

(b) cannot, to the extent to which it is committed by that instrument to that purpose or those purposes, be taken or used for any other purpose.

(2) For the purposes of this Act, **planned environmental water** is water that:

(a) is preserved, by a law of a State or an instrument made under a law of a State, for the purposes of achieving environmental outcomes by any other means (for example, by means of the setting of water flow or pressure targets or establishing zones within which water may not be taken from a water resource); and

(b) cannot, to the extent to which it is preserved by that instrument for that purpose or those purposes, be taken or used for any other purpose.

(3) The water may be committed to, or preserved for, the purpose or purposes referred to in paragraph (1)(a) or (2)(a) either generally or only at specified times or in specified circumstances.

(4) Without limiting paragraph (1)(b) or (2)(b), the requirements of paragraph (1)(b) or (2)(b) are taken to have been met even if the water is taken or used for another purpose in emergency circumstances in accordance with:

(a) the instrument referred to in that paragraph; or

(b) the law under which the instrument is made; or

(c) another law.

D. Species of conservation significance recorded within SA River Murray WRP area Priority Environmental Assets

Table 10.1. Threatened plant species[25]

CR: Critically Endangered; EN: Endangered; VU: Vulnerable; R: Rare

sp: species listed as ; ssp: subspecies listed

Scientific Name	Common Name	EPBC Status	State Status	Priority Environmental Asset			No. of assets recorded in
				Channel	Floodplain	CLLMM	
Acacia dodonaeifolia	Hop-bush Wattle	n/a	R			Y	1
Acacia lineata	Streaked Wattle	n/a	R	Y	Y		2
Acacia menzelii	Menzel's Wattle	VU	VU		Y		1
Acacia montana	Mallee Wattle	n/a	R		Y		1
Acacia pinguifolia	Fat-leaf Wattle	EN	EN			Y	1
Acacia rhetinocarpa	Resin Wattle	VU	VU			Y	1
Acanthocladium dockeri	Spiny Everlasting	CR	EN		Y		1
Adiantum capillus-veneris	Dainty Maiden-hair	n/a	VU	Y			1
Atriplex australasica	n/a	n/a	R			Y	1
Atriplex morrisii	n/a	n/a	VU	Y			1
Austrostipa echinata	Spiny Spear-grass	n/a	R			Y	1
Austrostipa tenuifolia	n/a	n/a	R			Y	1
Billardiera scandens var. scandens	Eastern Apple-berry	n/a	R			Y	1
Bothriochloa macra	Red-leg Grass	n/a	R	Y			1
Brachyscome graminea	Grass Daisy	n/a	R	Y	Y		2
Brachyscome melanocarpa ssp. melanocarpa	Black-fruit Daisy	n/a	VU		Y		1

[25] Presence/absence records from DEW's biological database have been provided as an indication of the number of threatened species that have been found within each PEA only. This is not a comprehensive list and does not reflect species records that have not been provided to DEW for input to the database.

Scientific Name	Common Name	EPBC Status	State Status	Priority Environmental Asset			No. of assets recorded in
				Channel	Floodplain	CLLMM	
Brachyscome paludicola	Swamp Daisy	n/a	R	Y	Y	Y	3
Brachyscome parvula	Coast Daisy	n/a	R		Y		1
Caladenia colorata	Coloured Spider-orchid	EN	EN			Y	1
Caladenia flaccida	Drooping Spider-orchid	n/a	VU			Y	1
Caladenia fragrantissima	Scented Spider-orchid	n/a	VU			Y	1
Caladenia ornata	Ornate Pink Fingers	VU	EN			Y	1
Caladenia reticulata	Veined Spider-orchid	n/a	R			Y	1
Caladenia richardsiorum	Little Dip Spider-orchid	EN	EN			Y	1
Caladenia tensa	Inland Green-comb Spider-orchid	EN	n/a			Y	1
Caladenia valida	Robust Spider-orchid	n/a	EN			Y	1
Callistemon brachyandrus	Prickly Bottlebrush	n/a	R	Y	Y		2
Callitriche sonderi	Matted Water Starwort	n/a	R	Y	Y		2
Callitriche umbonata	Water Starwort	n/a	VU	Y	Y		2
Calocephalus sonderi	Pale Beauty-heads	n/a	R	Y	Y		2
Calotis scapigera	Tufted Burr-daisy	n/a	R	Y	Y		2
Centrolepis cephaloformis ssp. cephaloformis	Cushion Centrolepis	n/a	R			Y	1
Ceratophyllum demersum	Hornwort	n/a	R	Y		Y	2
Christella dentata	Soft Shield-fern	n/a	R	Y		Y	2
Cladium procerum	Leafy Twig-rush	n/a	R			Y	1
Correa aemula	Hairy Correa	n/a	R	Y			1
Correa alba var. pannosa	White Correa	n/a	R			Y	1
Corybas expansus	Dune Helmet-orchid	n/a	VU			Y	1
Corynotheca licrota	Sand Lily	n/a	R	Y			1
Crassula peduncularis	Purple Crassula	n/a	R		Y		1
Cyperus bifax	Downs Flat-sedge	n/a	R		Y		1
Cyperus flaccidus	Flaccid Flat-sedge	n/a	R		Y		1

Scientific Name	Common Name	EPBC Status	State Status	Priority Environmental Asset			No. of assets recorded in
				Channel	Floodplain	CLLMM	
Cyperus nervulosus	n/a	n/a	R		Y		1
Cyperus sphaeroideus	n/a	n/a	R			Y	1
Dianella porracea	Pale Flax-lily	n/a	VU		Y		1
Diuris behrii	Behr's Cowslip Orchid	n/a	VU			Y	1
Dodonaea subglandulifera	Peep Hill Hop-bush	EN	EN	Y	Y		2
Duma horrida ssp. horrida	Spiny Lignum	n/a	R	Y	Y		2
Elatine gratioloides	Waterwort	n/a	R	Y	Y	Y	3
Eragrostis infecunda	Barren Cane-grass	n/a	R	Y	Y		2
Eragrostis lacunaria	Purple Love-grass	n/a	R	Y	Y		2
Eremophila gibbifolia	Coccid Emubush	n/a	R	Y			1
Eremophila polyclada	Twiggy Emubush	n/a	R	Y			1
Eucalyptus fasciculosa	Pink Gum	n/a	R			Y	1
Eucalyptus leucoxylon ssp. megalocarpa	Large-fruit Blue Gum	n/a	R			Y	1
Euphrasia collina ssp. osbornii	Osborn's Eyebright	EN	EN			Y	1
Exocarpos strictus	Pale-fruit Cherry	n/a	R	Y	Y		2
Fimbristylis aestivalis	Summer Fringe-rush	n/a	R			Y	1
Geijera parviflora	Wilga	n/a	R	Y			1
Goodenia gracilis	Grampians Goodenia	n/a	VU	Y	Y		2
Goodenia heteromera	Spreading Goodenia	n/a	R	Y	Y		2
Gratiola pedunculata	Stalked Brooklime	n/a	R	Y	Y		2
Gratiola pumilo	Dwarf Brooklime	n/a	R	Y	Y		2
Haegiela tatei	Small Nut-heads	n/a	R			Y	1
Hakea tephrosperma	Hooked Needlewood	n/a	R	Y			1
Hydrilla verticillata	Waterthyme	n/a	R	Y			1
Hypolepis rugosula	Ruddy Ground-fern	n/a	R			Y	1
Isolepis producta	Nutty Club-rush	n/a	VU			Y	1
Juncus prismatocarpus	Branching Rush	n/a	EN	Y			1

Scientific Name	Common Name	EPBC Status	State Status	Priority Environmental Asset			No. of assets recorded in
				Channel	Floodplain	CLLMM	
Lachnagrostis robusta	Tall Blown-grass	n/a	R	Y		Y	2
Lawrencia berthae	Showy Lawrencia	n/a	R	Y			1
Leionema microphyllum	Limestone Phebalium	n/a	R			Y	1
Lepidium pseudotasmanicum	Shade Peppercress	n/a	VU	Y	Y		2
Lobelia concolor	Poison Pratia	n/a	R	Y	Y	Y	3
Lycopodiella serpentina	Bog Clubmoss	n/a	EN			Y	1
Lythrum salicaria	Purple Loosestrife	n/a	R	Y	Y	Y	3
Machaerina acuta (as *Baumea acuta*)	Pale Twig-rush	n/a	R			Y	1
Maireana decalvans	Black Cotton-bush	n/a	EN		Y		1
Maireana pentagona	Slender Fissure-plant	n/a	R	Y	Y		2
Maireana rohrlachii	Rohrlach's Bluebush	n/a	R		Y		1
Melaleuca squamea	Swamp Honey-myrtle	n/a	R			Y	1
Mentha diemenica	Slender Mint	n/a	R	Y			1
Micromyrtus ciliata	Fringed Heath-myrtle	n/a	R			Y	1
Montia australasica	White Purslane	n/a	R		Y	Y	2
Myoporum parvifolium	Creeping Boobialla	n/a	R	Y	Y	Y	3
Myriophyllum crispatum	Upright Milfoil	n/a	VU		Y		1
Myriophyllum papillosum	Robust Milfoil	n/a	R	Y	Y		2
Najas tenuifolia	Water Nymph	n/a	EN	Y			1
Nymphoides crenata	Wavy Marshwort	n/a	R	Y	Y		2
Olearia pannosa ssp. cardiophylla	Velvet Daisy-bush	n/a	R			Y	1
Olearia pannosa ssp. pannosa	Silver Daisy-bush	VU	VU			Y	1
Olearia passerinoides ssp. glutescens	Sticky Daisy-bush	n/a	R			Y	1
Orobanche cernua var. australiana	Australian Broomrape	n/a	R	Y	Y		2
Ottelia ovalifolia ssp. ovalifolia	Swamp Lily	n/a	R		Y		1
Philotheca angustifolia ssp. angustifolia	Narrow-leaf Wax-flower	n/a	R	Y		Y	2

Scientific Name	Common Name	EPBC Status	State Status	Priority Environmental Asset			No. of assets recorded in
				Channel	Floodplain	CLLMM	
Picris squarrosa	Squat Picris	n/a	R	Y	Y	Y	3
Poa fax	Scaly Poa	n/a	R			Y	1
Podolepis jaceoides	Showy Copper-wire Daisy	n/a	R			Y	1
Pomaderris halmaturina ssp. halmaturina	Kangaroo Island Pomaderris	VU	VU			Y	1
Prasophyllum constrictum	Tawny Leek-orchid	n/a	R				0
Prostanthera eurybioides	Monarto Mintbush	EN	EN		Y		1
Pteris tremula	Tender Brake	n/a	R	Y			1
Pterostylis arenicola	Sandhill Greenhood	VU	VU			Y	1
Pterostylis curta	Blunt Greenhood	n/a	R			Y	1
Ranunculus inundatus	River Buttercup	n/a	R			Y	1
Ranunculus papulentus	Large River Buttercup	n/a	VU			Y	1
Rorippa laciniata	Jagged Bitter-cress	n/a	R	Y			1
Scaevola calendulacea	Dune Fanflower	n/a	VU			Y	1
Schizaea fistulosa	Narrow Comb-fern	n/a	VU			Y	1
Sclerolaena muricata var. villosa	Five-spine Bindyi	n/a	R	Y			1
Scutellaria humilis	Dwarf Skullcap	n/a	R				1
Spiranthes australis	Austral Lady's Tresses	n/a	R			Y	1
Spyridium fontis-woodii	Woods Well Spyridium	CR	EN			Y	1
Stellaria angustifolia var. tenella	Swamp Starwort	n/a	R	Y			1
Stellaria multiflora ssp. collaris	Rayless Starwort	n/a	sp R		Y		1
Swainsona behriana	Behr's Swainson-pea	n/a	VU		Y		1
Thelymitra epipactoides	Metallic Sun-orchid	EN	EN			Y	1
Veronica decorosa	Showy Speedwell	n/a	R	Y			1
Viminaria juncea	Native Broom	n/a	R			Y	1
Wurmbea latifolia ssp. vanessae	Broad-leaf Nancy	n/a	R			Y	1
Zannichellia palustris	n/a	n/a	R	Y	Y		2

Scientific Name	Common Name	EPBC Status	State Status	Priority Environmental Asset			No. of assets recorded in
				Channel	Floodplain	CLLMM	
Zoysia macrantha ssp. walshii	Manila Grass	n/a	R			Y	1
Total number of threatened species recorded in each Priority Environmental Asset				**51**	**46**	**62**	

Table 10.2. Threatened fauna species[26]

'Migratory status' indicates the international agreement the species is listed under where Bonn = Bonn Convention, CAM = CAMBA, JAM = JAMBA and ROK = ROKAMBA

'Marine' EPBC Status indicates species listed on Declaration under section 248 of the Environment Protection and Biodiversity Conservation Act 1999 - List of Marine Species

(Y) indicates a migratory bird species has been recorded in the asset, however it is not a state or nationally listed threatened species

CR: Critically Endangered; EN: Endangered; VU: Vulnerable; R: Rare

sp: species listed as ; ssp: subspecies listed

Scientific Name	Common Name	EPBC Status	State Status	Migratory Status	Priority Environmental Asset			No. of assets recorded in
					Channel	Floodplain	CLLMM	
Acrobates pygmaeus	Feathertail Glider	n/a	EN	n/a	Y			1
Actitis hypoleucos	Common Sandpiper	Marine Migratory	R	CAM/JAM/ROK	Y	Y	Y	3
Anhinga novaehollandiae novaehollandiae	Australasian Darter	n/a	R	n/a	Y	Y	Y	3
Anseranas semipalmata	Magpie Goose	Marine	EN	n/a		Y	Y	2
Aphelocephala leucopsis leucopsis	Southern Whiteface	sp VU	n/a	n/a	Y	Y	Y	3

[26] Presence/absence records from DEW's biological database have been provided as an indication of the number of threatened species that have been found within each PEA only. Currently there are very few fish records and no invertebrate records entered into the dataset. This is not a comprehensive list and does not reflect species records that have not been provided to DEW for input to the database.

Scientific Name	Common Name	EPBC Status	State Status	Migratory Status	Priority Environmental Asset			No. of assets recorded in
					Channel	Floodplain	CLLMM	
Arctocephalus pusillus	Australian Fur Seal (Brown Fur Seal)	Marine	R	n/a			Y	1
Arctocephalus tropicalis	Subantarctic Fur Seal	EN Marine	EN	n/a			Y	1
Ardea intermedia plumifera	Plumed Egret	sp Marine	R	n/a	Y	Y	Y	3
Ardenna carneipes	Flesh-footed Shearwater	Marine Migratory	R	JAM/ROK			Y	1
Ardeotis australis	Australian Bustard	n/a	VU	n/a	Y		Y	2
Arenaria interpres interpres	Ruddy Turnstone	sp VU Marine Migratory	R	CAM/JAM/ROK		Y	Y	2
Bidyanus bidyanus	Silver Perch	CR	n/a	n/a	Y	Y		2
Biziura lobata menziesi	Musk Duck	sp Marine	R	n/a	Y	Y	Y	3
Botaurus poiciloptilus	Australasian Bittern	EN	EN	n/a	Y		Y	2
Bubulcus ibis coromandus	Eastern Cattle Egret	sp Marine	R	n/a	Y		Y	2
Burhinus grallarius	Bush Stonecurlew	n/a	R	n/a	Y	Y	Y	3
Calidris acuminata	Sharp-tailed Sandpiper	VU Marine Migratory	n/a	Bonn/CAM/JAM/ROK	Y	Y	Y	3
Calidris alba alba	Sanderling	sp Marine Migratory	R	CAM/JAM/ROK			Y	1
Calidris canutus rogersi	Red Knot	sp VU Marine Migratory	EN	CAM/JAM/ROK			Y	1
Calidris ferruginea	Curlew Sandpiper	CR Marine Migratory	EN	Bonn/CAM/JAM/ROK	Y		Y	2
Calidris melanotos	Pectoral Sandpiper	Marine Migratory	R	JAM/ROK	Y		Y	2

Scientific Name	Common Name	EPBC Status	State Status	Migratory Status	Priority Environmental Asset			No. of assets recorded in
					Channel	Floodplain	CLLMM	
Calidris pugnax	Ruff	Marine Migratory	R	Bonn/CAM/JAM/ROK			Y	1
Calidris subminuta	Long-toed Stint	Marine Migratory	R	CAM/JAM/ROK	Y		Y	2
Calidris tenuirostris	Great Knot	VU Marine Migratory	EN	Bonn/CAM/JAM/ROK			Y	1
Caperea marginata	Pygmy Right Whale	Cetacean Migratory	R	Bonn			Y	1
Cereopsis novaehollandiae novaehollandiae	Cape Barren Goose	sp Marine	R	n/a	Y	Y	Y	3
Charadrius bicinctus bicinctus	Double-banded Plover	sp Marine Migratory	n/a	Bonn	(Y)	(Y)	(Y)	3
Charadrius leschenaultii leschenaultii	Greater Sand Plover	sp VU Marine Migratory	R	JAM/CAM/ROK	Y		Y	2
Charadrius mongolus mongolus	Lesser Sand Plover	sp EN Marine Migratory	EN	JAM/CAM/ROK			Y	1
Charadrius veredus	Oriental Plover	Marine Migratory	n/a	JAM/CAM/ROK	(Y)		(Y)	2
Chelodina expansa	Broadshelled Turtle	n/a	VU	n/a	Y	Y		2
Chlidonias leucopterus	White-winged Tern	Marine Migratory	n/a	CAM/JAM/ROK			(Y)	1
Cladorhynchus leucocephalus	Banded Stilt	n/a	VU	n/a	Y	Y	Y	3
Climacteris affinis	White-browed Treecreeper	n/a	R	n/a	Y			1
Coracina papuensis robusta	White-bellied Cuckooshrike	sp Marine	R	n/a	Y	Y	Y	3
Corcorax melanorhamphos melanorhamphos	White-winged Chough	n/a	sp R	n/a	Y	Y		2
Coturnix ypsilophora australis	Brown Quail	n/a	VU	n/a	Y	Y	Y	3

Scientific Name	Common Name	EPBC Status	State Status	Migratory Status	Priority Environmental Asset			No. of assets recorded in
					Channel	Floodplain	CLLMM	
Craterocephalus fluviatilis	Murray Hardyhead	EN	n/a	n/a	Y	Y	Y	3
Dasyornis broadbenti broadbenti	Rufous Bristlebird	n/a	R	n/a			Y	1
Dasyurus viverrinus	Eastern Quoll	EN	EN	n/a				
Diomedea exulans complex	Wandering Albatross	sp VU Marine Migratory	sp VU	Bonn			Y	1
Echiopsis curta	Bardick	n/a	R	n/a			Y	1
Egretta garzetta nigripes	Little Egret	sp Marine	R	n/a	Y	Y	Y	3
Egretta sacra sacra	Pacific Reef Heron	sp Marine	R	n/a			Y	1
Elanus scriptus	Letter-winged Kite	n/a	VU	n/a			Y	1
Emydura macquarii	Macquarie River Turtle	n/a	VU	n/a	Y	Y	Y	3
Entomyzon cyanotis cyanotis	Blue-faced Honeyeater	n/a	R	n/a	Y	Y		2
Epthianura crocea crocea	Yellow Chat	n/a	EN	n/a			Y	1
Euastacus armatus	Murray Crayfish	VU	n/a	n/a	Y			1
Eubalaena australis	Southern Right Whale	EN Cetacean Migratory	VU	Bonn			Y	1
Eulamprus heatwolei	Yellow-bellied Water Skink	n/a	VU	n/a			Y	1
Falco hypoleucos	Grey Falcon	VU	R	n/a			Y	1
Falco peregrinus macropus	Peregrine Falcon	n/a	R	n/a	Y	Y	Y	3
Falco subniger	Black Falcon	n/a	R	n/a	Y		Y	2
Falcunculus frontatus frontatus	Eastern Shriketit	n/a	R	n/a	Y			1
Gallinago hardwickii	Latham's Snipe	VU Marine Migratory	R	Bonn/JAM/ROK	Y	Y	Y	3
Gerygone fusca	Western Gerygone	n/a	R	n/a		Y		1
Globicephala macrorhynchus	Short-finned Pilot Whale	Cetacean	R	n/a			Y	1
Haematopus fuliginosus fuliginosus	Sooty Oystercatcher	n/a	R	n/a			Y	1

Scientific Name	Common Name	EPBC Status	State Status	Migratory Status	Priority Environmental Asset			No. of assets recorded in
					Channel	Floodplain	CLLMM	
Haematopus longirostris	Pied Oystercatcher	n/a	R	n/a			Y	1
Haliaeetus leucogaster	White-bellied Sea Eagle	Marine	EN	n/a	Y	Y	Y	3
Halobaena caerulea	Blue Petrel	VU Marine	n/a	n/a			Y	1
Hieraaetus morphnoides	Little Eagle	n/a	VU	n/a	Y	Y	Y	3
Hydrurga leptonyx	Leopard Seal	Marine	R	n/a			Y	1
Hylacola cauta cauta	Shy Heathwren	n/a	R	n/a			Y	1
Ixobrychus dubius	Black-backed Bittern (Australian Little Bittern)	n/a	EN	n/a		Y	Y	2
Kogia breviceps	Pygmy Sperm Whale	Cetacean	R	n/a			Y	1
Larus dominicanus dominicanus	Kelp Gull	sp Marine	R	n/a			Y	1
Leipoa ocellata	Malleefowl	VU	VU	n/a			Y	1
Lewinia pectoralis pectoralis	Lewin's Rail	n/a	VU	n/a			Y	1
Lichenostomus cratitius occidentalis	Purple-gaped Honeyeater	n/a	R	n/a			Y	1
Limosa lapponica	Bar-tailed Godwit	Marine Migratory	ssp	Bonn/CAM/JAM/ROK			(Y)	1
Limosa lapponica baueri	Bar-tailed Godwit	EN	R				Y	1
Limosa limosa melanuroides	Black-tailed Godwit	sp EN Marine Migratory	R	Bonn/CAM/JAM/ROK	Y	Y	Y	3
Litoria raniformis	Southern Bell Frog	VU	VU	n/a	Y	Y	Y	3
Lophochroa leadbeateri leadbeateri	Major Mitchell's Cockatoo (LNE, MM)	n/a	sp R	n/a		Y		1
Maccullochella peelii	Murray Cod	VU	n/a	n/a	Y			1
Macronectes giganteus	Southern Giant Petrel	EN Marine Migratory	VU	Bonn			Y	1

Scientific Name	Common Name	EPBC Status	State Status	Migratory Status	Priority Environmental Asset			No. of assets recorded in
					Channel	Floodplain	CLLMM	
Melanodryas cucullata cucullata	Hooded Robin	EN	R	n/a	Y	Y	Y	3
Melithreptus gularis	Black-chinned Honeyeater	n/a	ssp	n/a	Y		Y	2
Mesoplodon bowdoini	Andrews' Beaked Whale	Cetacean	R	n/a			Y	1
Mesoplodon grayi	Gray's Beaked Whale (Scamperdown Whale)	Cetacean	R	n/a			Y	1
Microeca fascinans	Jacky Winter	n/a	ssp	n/a		Y	Y	2
Mirounga leonina	Southern Elephant Seal	VU Marine	R	n/a			Y	1
Morelia spilota	Carpet Python	n/a	R	n/a	Y	Y		2
Myiagra cyanoleuca	Satin Flycatcher	Marine	n/a	n/a			Y	1
Myiagra inquieta	Restless Flycatcher	n/a	R	n/a	Y	Y	Y	3
Myotis macropus	Large-footed Myotis	n/a	EN	n/a	Y			1
Nannoperca australis Murray-Darling Basin lineage	Southern Pygmy Perch	VU	n/a	n/a			Y	1
Nannoperca obscura	Yarra Pygmy Perch	VU	n/a	n/a			Y	1
Neophema chrysogaster	Orange-bellied Parrot	CR Marine	EN	n/a			Y	1
Neophema chrysostoma	Blue-winged Parrot	VU Marine	VU	n/a		Y	Y	2
Neophema elegans elegans	Elegant Parrot	n/a	R	n/a	Y	Y	Y	3
Neophema petrophila zietzi	Rock Parrot	sp Marine	R	n/a			Y	1
Neophema splendida	Scarlet-chested Parrot	n/a	R	n/a		Y		1
Numenius madagascariensis	Far Eastern Curlew	CR Marine Migratory	EN	Bonn/CAM/JAM/ROK			Y	1
Numenius phaeopus variegatus	Whimbrel	sp Marine Migratory	R	CAM/JAM/ROK			Y	1

Scientific Name	Common Name	EPBC Status	State Status	Migratory Status	Priority Environmental Asset			No. of assets recorded in
					Channel	Floodplain	CLLMM	
Oriolus sagittatus sagittatus	Olive-backed Oriole	n/a	R	n/a	Y	Y		2
Ornithorhynchus anatinus	Platypus	n/a	EN	n/a	Y			1
Oxyura australis	Blue-billed Duck	n/a	R	n/a	Y	Y	Y	3
Pachycephala inornata	Gilbert's Whistler	n/a	R	n/a	Y	Y		2
Pachycephala rufogularis	Red-lored Whistler	VU	R	n/a			Y	1
Pandion haliaetus cristatus	Eastern Osprey	sp Marine Migratory	EN	Bonn	Y		Y	2
Parvipsitta pusilla	Little Lorikeet	n/a	EN	n/a			Y	1
Petroica boodang boodang	Scarlet Robin	n/a	R	n/a			Y	1
Petroica phoenicea	Flame Robin	Marine	VU	n/a			Y	1
Pezoporus wallicus wallicus	Eastern Ground Parrot	n/a	EN	n/a			Y	1
Philemon citreogularis citreogularis	Little Friarbird	n/a	R	n/a	Y	Y		2
Physeter macrocephalus	Sperm Whale	Cetacean Migratory	R	Bonn			Y	1
Plectorhyncha lanceolata	Striped Honeyeater	n/a	R	n/a	Y	Y	Y	3
Plegadis falcinellus	Glossy Ibis	Marine Migratory	R	Bonn	Y	Y	Y	3
Pluvialis fulva	Pacific Golden Plover	Marine Migratory	R	CAM/JAM/ROK	Y	Y	Y	3
Pluvialis squatarola squatarola	Grey Plover	sp VU Marine Migratory	n/a	CAM/JAM/ROK			Y	1
Podiceps cristatus australis	Great Crested Grebe	n/a	R	n/a	Y	Y	Y	3
Polytelis anthopeplus monarchoides	Regent Parrot	VU	VU	n/a	Y	Y		2
Pseudophryne bibronii	Brown Toadlet	n/a	R	n/a	Y		Y	2
Pseudophryne semimarmorata	Marbled Toadlet	n/a	VU	n/a			Y	1
Pterodroma mollis	Soft-plumaged Petrel	VU Marine	n/a	n/a			Y	1
Pteropus poliocephalus	Grey-headed Flying-fox	VU	R	n/a		Y	Y	2

Scientific Name	Common Name	EPBC Status	State Status	Migratory Status	Priority Environmental Asset			No. of assets recorded in
					Channel	Floodplain	CLLMM	
Rattus lutreolus	Swamp Rat	n/a	R	n/a		Y	Y	2
Rhipidura rufifrons rufifrons	Rufous Faintail	Marine	n/a	n/a			Y	1
Rostratula australis	Australian Painted-snipe	EN Marine	EN	n/a	Y		Y	2
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat	n/a	R	n/a			Y	1
Spatula rhynchotis	Australasian Shoveler	n/a	R	n/a	Y	Y	Y	3
Stagonopleura bella	Beautiful Firetail	n/a	R	n/a			Y	1
Stagonopleura bella interposita	Beautiful Firetail	n/a	sp R	n/a			Y	1
Stagonopleura bella samueli	Beautiful Firetail	EN	sp R	n/a			Y	1
Stagonopleura guttata	Diamond Firetail	VU	VU	n/a			Y	1
Sterna hirundo longipennis	Common Tern	sp Marine Migratory	R	CAM/JAM/ROK			Y	1
Sterna paradisaea	Arctic Tern	Marine Migratory	n/a	Bonn			(Y)	1
Sternula albifrons sinensis	Little Tern	sp VU Marine Migratory	EN	Bonn/CAM/JAM/ROK	Y		Y	2
Sternula nereis nereis	Fairy Tern	VU	EN	n/a	Y		Y	2
Stictonetta naevosa	Freckled Duck	n/a	VU	n/a	Y	Y	Y	3
Stipiturus malachurus intermedius	Southern Emuwren	EN	EN	n/a			Y	1
Stipiturus malachurus polionotum	Southern Emuwren	n/a	R	n/a			Y	1
Thalassarche carteri	Indian Yellow-nosed Albatross	VU Marine Migratory	EN	Bonn			Y	1
Thalassarche cauta cauta	Shy Albatross	sp EN Marine Migratory	VU	Bonn			Y	1

Scientific Name	Common Name	EPBC Status	State Status	Migratory Status	Priority Environmental Asset			No. of assets recorded in
					Channel	Floodplain	CLLMM	
Thalassarche chrysostoma	Grey-headed Albatross	EN Marine Migratory	VU	Bonn			Y	1
Thalassarche melanophris	Black-browed Albatross	VU Marine Migratory	n/a	Bonn			Y	1
Thinornis cucullatus cucullatus	Hooded Plover	VU Marine	VU	n/a		Y	Y	2
Trichosurus vulpecula	Common Brushtail Possum	n/a	R	n/a	Y	Y		2
Tringa brevipes	Grey-tailed Tattler	Marine Migratory	R	Bonn/CAM/JAM/ROK			Y	1
Tringa glareola	Wood Sandpiper	Marine Migratory	R	CAM/JAM/ROK	Y	Y	Y	2
Tringa nebularia	Common Greenshank	EN Marine Migratory	n/a	CAM/JAM/ROK	Y	Y	Y	3
Tringa stagnatilis	Marsh Sandpiper	Marine Migratory	n/a	CAM/JAM/ROK		(Y)		1
Turnix varius varius	Painted Buttonquail	n/a	R	n/a			Y	1
Varanus rosenbergi	Heath Goanna	n/a	VU	n/a			Y	1
Varanus varius	Lace Monitor	n/a	R	n/a	Y	Y		2
Vombatus ursinus	Common Wombat	n/a	R	n/a			Y	1
Xenus cinereus	Terek Sandpiper	VU Marine Migratory	R	CAM/JAM/ROK			Y	1
Zanda funerea whiteae	Yellow-tailed Black Cockatoo	n/a	VU	n/a			Y	1
Zapornia tabuensis	Spotless Crake	Marine	ssp	n/a	Y	Y	Y	3
Total number of threatened species (state/national) per PEA					**67**	**57**	**129**	
Total number of migratory species per PEA					**16**	**11**	**41**	

E. Alignment of BWS expected outcomes with ecological objectives of the SA River Murray WRP area priority environmental assets

Theme	BWEWS Expected Environmental Outcome	Scale	BWEWS Code	Channel and Floodplain PEA Objective	CLLMM PEA Objective
Longitudinal connectivity	To keep base flows at least 60% of the natural level (note: this will be especially important during dry years).	Basin-wide	FC_1	Restore lateral and longitudinal connectivity to support basal and secondary productivity, and flow dependent processes including salt export. Maintain water quality conducive to supporting biota, and have regard to consumptive and recreational use of river water.	
	A 30% overall increase in flows. From increased tributary contributions from the Murrumbidgee, Goulburn, Campaspe, Loddon and Lower Darling catchments collectively.	River Murray tributaries	FC_3	Restore lateral and longitudinal connectivity to support basal and secondary productivity, and flow dependent processes including salt export. Maintain water quality conducive to supporting biota, and have regard to consumptive and recreational use of river water.	
	A 30 to 40% increase in flows to the Murray mouth.	Lower Lakes, Coorong & Murray Mouth	FC_4	Restore lateral and longitudinal connectivity to support basal and secondary productivity, and flow dependent processes including salt export	Maintain a permanently open Murray Mouth through freshwater outflows to maximise fish passage and connectivity between the Murray Mouth and Barrages, the Coorong and the sea and improve water quality across the whole site.

Lateral connectivity	A 30 to 60% increase in the frequency of freshes, bank-full and lowland floodplain flows.	Murray, Murrumbidge, Goulburn–Broken and Condamine–Balonne	FC_5	Restore lateral and longitudinal connectivity to support basal and secondary productivity, and flow dependent processes. Establish and maintain groundwater conditions conducive to supporting diverse ecologically functional native vegetation. Changes in depth to groundwater do not increase the rate of salt accumulation in soils. Establish soil conditions conducive to supporting diverse ecologically functional native vegetation.	
End-of-Basin flows	The barrage flows are greater than 2,000 GL/yr on a 3-year rolling average basis for 95% of the time, with a two-year minimum of 600GL at any time.	Lower Lakes, Coorong & Murray Mouth	FC8		EWR CLLMM1[27] - no less than 650 GL in a single year, and no less than 6,000 GL over 3 years. All barrage fishways are open every day. Attractant flows, via the operation of barrage bays adjacent to fishways, are provided every day.
	The water levels in the Lower Lakes are maintained above: a) Sea level 0m AHD) b) 0.4 meters AHD, for 95% of the time, as far as	Lower Lakes, Coorong & Murray Mouth	FC9		EWR CLLMM1 – Minimum water level 0.4m AHD. All barrage fishways are open every day.

[27] EEO FC8 is addressed by EWR CLLMM1 rather than a specific objective.

	practicable, to allow for barrage releases			Attractant flows, via the operation of barrage bays adjacent to fishways, are provided every day.
	Salinity in the Coorong and Lower Lakes remains below critical thresholds for key flora and fauna including: a) salinity in Lake Alexandrina is lower than 1,000 EC 95% of the time and less than 1,500 EC all the time b) salinity in the Coorong's south lagoon is less than 100 grams per litre 95% of the time c) c) the Murray Mouth is open 90% of the time to an average annual depth of one metre.	Lower Lakes, Coorong & Murray Mouth	FC10	Maintain a permanently open Murray Mouth through freshwater outflows to maximise fish passage and connectivity between the Murray Mouth and Barrages, the Coorong and the sea and improve water quality across the whole site. Maintain salinities within a range suitable for freshwater flora and fauna communities that characterise the Lower Lakes and suitable dissolved oxygen levels across a seasonally fluctuating salinity gradient in the Coorong and Murray Mouth and Barrages subregions.

Theme	BWEWS Expected Environmental Outcome	Scale	BWEWS Code	Channel and Floodplain PEA Objective	CLLMM PEA Objective
Native vegetation - Forests and woodlands	To maintain the extent of forest and woodland vegetation including approximately: a) 360,000 ha of river red gum b) 409,000 ha of black box c) 310,000 ha of coolabah	Basin-wide	V1	Maintain spatial extent and restore ecologically functional River Red Gum. Maintain spatial extent and restore ecologically functional Black Box woodlands. Establish ecologically functional native understorey vegetation community in permanently inundated habitats. Establish ecologically functional native understorey vegetation community in frequently inundated habitats.	
	Improved age class structure of river red gum, black box and coolabah communities to support viable population demographics.	Basin-wide	V2	Maintain spatial extent and restore ecologically functional River Red Gum. Maintain spatial extent and restore ecologically functional Black Box woodlands.	
	No decline in the condition of river red gum, black box and coolibah across the Basin.	Basin-wide	V3	Maintain spatial extent and restore ecologically functional River Red Gum. Maintain spatial extent and restore ecologically functional Black Box woodlands.	
	Improved condition of river red gum in the Lachlan, Murrumbidgee, Lower Darling, Murray, Goulburn-Broken and Wimmera-Avoca.	Regional	V4	Maintain spatial extent and restore ecologically functional River Red Gum.	

Theme	BWEWS Expected Environmental Outcome	Scale	BWEWS Code	Channel and Floodplain PEA Objective	CLLMM PEA Objective
Native vegetation - Shrublands	To maintain the extent of the large areas of lignum shrublands within the Basin.	Basin-wide	V5	Maintain spatial extent and restore ecologically functional Lignum shrublands.	
	Improvement in the condition of lignum shrublands.	Basin-wide	V6	Maintain spatial extent and restore ecologically functional Lignum shrublands.	
Native vegetation - non-woody	To maintain the extent of non-woody vegetation.	Basin-wide	V7	Establish ecologically functional native understorey vegetation community in permanently inundated habitats. Establish ecologically functional native understorey vegetation community in frequently inundated habitats. Establish ecologically functional native understorey vegetation community in infrequently inundated temporary wetlands. Establish ecologically functional native understorey vegetation community in infrequently inundated shedding floodplain areas.	Maintain or improve the extent and diversity of aquatic and littoral vegetation in the Lower Lakes and wetlands. Restore and maintain submerged macrophyte communities in the Coorong.
	Increased periods of growth for communities th closely fringe or occur within the main river corridors.	Basin-wide	V8	Establish ecologically functional native understorey vegetation community in permanently inundated habitats. Establish ecologically functional native understorey vegetation community in frequently inundated habitats.	

				Establish ecologically functional native understorey vegetation community in infrequently inundated temporary wetlands. Establish ecologically functional native understorey vegetation community on infrequently inundated shedding floodplain areas.	
A sustained and adequate population of *Ruppia tuberosa* in the south lagoon of the Coorong, including: a) *Ruppia tuberosa* to occur in at least 80% of sites across at least a 43 km extent b) By 2029, the seed bank to be sufficient for the population to be resilient to major disturbances	Lower Lakes, Coorong & Murray Mouth	V10			Restore and maintain submerged macrophyte communities in the Coorong.

Theme	BWEWS Expected Environmental Outcome	Scale	BWEWS Code[28]	Channel and Floodplain PEA Objective	CLLMM PEA Objective
Waterbirds	The number and type of waterbird species present in the Basin will not fall below current observations.	Basin-wide	B1	Restore resilient populations of waterbirds, frogs and turtles.	Maintain or improve waterbird populations.
	A significant improvement in waterbird populations in the order of 20-25% over the baseline scenario*[29], with increases in all waterbird functional groups.	Basin-wide	B2	Restore resilient populations of waterbirds, frogs and turtles.	Maintain or improve waterbird populations.
	Breeding events (the opportunities to breed rather than the magnitude of breeding per se) of group-nesting waterbirds to increase by up to 50% compared to the baseline scenario*.	Basin-wide	B3	Restore resilient populations of waterbirds, frogs and turtles	Maintain or improve waterbird populations.
	Breeding abundance (nests and broods) for all of the other functional groups to increase by 30–40% compared to the baseline scenario*, especially locations where the Basin Plan improves over-bank flows.	Basin-wide	B4	Restore resilient populations of waterbirds, frogs and turtles	Maintain or improve waterbird populations.
	At a minimum, maintain populations of the following 4 key species: curlew sandpiper, greenshank, red-necked stint and sharp-tailed sandpiper, at levels recorded between 2000 and 2014.	Lower Lakes, Coorong & Murray Mouth	B5		Maintain or improve waterbird populations.

[29]* Represents the Basin with the consumptive use and the rules and sharing arrangements as at June 2009

Theme	BWEWS Expected Environmental Outcome	Scale	BWEWS Code	Channel and Floodplain PEA Objective	CLLMM PEA Objective
Native fish - All native species	No loss of native fish species currently present within the Basin.	Basin-wide	F1	Restore resilient populations of Murray cod (*Maccullochella peelii*) Restore resilient populations of golden perch (*Macquaria ambigua*) Restore resilient populations of silver perch (*Bidyanus bidyanus*) Restore resilient populations of freshwater catfish (*Tandanus tandanus*)	
	Improved population structure of key fish species through regular recruitment.	Basin-wide	F2	Restore resilient populations of Murray cod (*Maccullochella peelii*) Restore resilient populations of golden perch (*Macquaria ambigua*) Restore resilient populations of silver perch (*Bidyanus bidyanus*) Restore resilient populations of freshwater catfish (*Tandanus tandanus*)	Maintain a spatio-temporally diverse and resilient fish community.
	Increased movement of key fish species.	Basin-wide	F3	Restore resilient populations of Murray cod (*Maccullochella peelii*) Restore resilient populations of golden perch (*Macquaria ambigua*) Restore resilient populations of silver perch (*Bidyanus bidyanus*)	Maintain a spatio-temporally diverse and resilient fish community.
	Expanded distribution of key fish species and populations in	Basin-wide	F4	Restore resilient populations of Murray cod (*Maccullochella peelii*)	

	the northern and southern Basin.			Restore resilient populations of golden perch (*Macquaria ambigua*) Restore resilient populations of silver perch (*Bidyanus bidyanus*) Restore resilient populations of freshwater catfish (*Tandanus tandanus*)	
	Improved community structure of key native fish species.	Basin-wide	F5	Restore resilient populations of Murray cod (*Maccullochella peelii*) Restore resilient populations of golden perch (*Macquaria ambigua*) Restore resilient populations of silver perch (*Bidyanus bidyanus*) Restore resilient populations of freshwater catfish (*Tandanus tandanus*)	Maintain a spatio-temporally diverse and resilient fish community.
Native fish - Short-lived species[30]	Restored distribution and abundance to levels recorded pre-2007 (prior to major losses caused by extreme drought). This will require annual or biennial recruitment events depending on the species.	Basin-wide	F6		Maintain a spatio-temporally diverse and resilient fish community.
Native fish - Moderate to long-lived species	Improved population structure (i.e. a range of size/age classes for all species and stable sex ratios where relevant) in key sites. This will require annual recruitment events in at least 8 out of 10 years at 80% of key sites, with at least 4 of these	Basin-wide	F7	Restore resilient populations of Murray cod (*Maccullochella peelii*). Restore resilient populations of golden perch (*Macquaria ambigua*). Restore resilient populations of silver perch (*Bidyanus bidyanus*).	Restore resilient populations of Golden perch (*Macquaria ambigua*).

[30] Based on Appendix 6 of the BWEWS short-lived species relevant to the SA River Murray WRP area = Murray hardyhead, southern pygmy perch, Yarra pygmy perch, southern purple-spotted gudgeon

being 'strong' recruitment events.			Restore resilient populations of freshwater catfish (*Tandanus tandanus*).	
A 10–15% increase of mature fish (of legal take size) for recreational target species (Murray cod and golden perch) in key populations.	Basin-wide	F8	Restore resilient populations of Murray cod (*Maccullochella peelii*). Restore resilient populations of golden perch (*Macquaria ambigua*).	Restore resilient populations of Golden perch (*Macquaria ambigua*).
Annual detection of species and life stages representative of the whole fish community through key fish passages; with an increase in passage of Murray cod, trout cod, golden perch, silver perch, Hyrtl's tandan, congolli, short-headed lamprey and pouched lamprey through key fish passages to be detected in 2019–2027; compared to passage rates detected in 2014–2019.	Basin-wide	F9	Restore resilient populations of Murray cod (*Maccullochella peelii*). Restore resilient populations of golden perch (*Macquaria ambigua*). Restore resilient populations of silver perch (*Bidyanus bidyanus*).	Maintain a spatio-temporally diverse and resilient fish community. Restore resilient populations of Golden perch (*Macquaria ambigua*). Successful migration and recruitment of diadromous fish. Restore resilient populations of estuarine fish. Maintain abundant, resilient populations of small-bodied fish in the Coorong and Murray Mouth and Barrages, including Small-mouthed hardyhead and Sandy sprat.

Native fish - Estuarine species[31]	Detection of all estuarine-dependent fish families throughout 2014–2027.	Lower Lakes, Coorong & Murray Mouth	F10	Maintain a spatio-temporally diverse and resilient fish community. Restore resilient populations of estuarine fish. Maintain abundant, resilient populations of small-bodied fish in the Coorong and Murray Mouth and Barrages, including Small-mouthed hardyhead and Sandy sprat.
	Maintenance of annual population abundance (Catch Per Unit Effort – CPUE) of key estuarine prey species (sandy sprat and small-mouthed hardyhead) throughout the Coorong.	Lower Lakes, Coorong & Murray Mouth	F11	Maintain abundant, resilient populations of small-bodied fish in the Coorong and Murray Mouth and Barrages, including Small-mouthed hardyhead and Sandy sprat.
	Detection of a broad spatial distribution of black bream and greenback flounder; with adult black bream and all life stages of greenback flounder present across >50% of the Coorong in 8 out of 10 years.	Lower Lakes, Coorong & Murray Mouth	F12	Restore resilient populations of estuarine fish.
	Detection in 9 out of 10 years of bi-directional seasonal movements of diadromous species through the barrages and fishways between the Lower Lakes and Coorong.	Lower Lakes, Coorong & Murray Mouth	F13	Successful migration and recruitment of diadromous fish.
	Increased rates of native fish passage in 2019–2027 compared to 2014–2019.	Lower Lakes, Coorong & Murray Mouth	F14	Successful migration and recruitment of diadromous fish. Restore resilient populations of estuarine fish.

[31] Based on Appendix 6 of the BWEWS estuarine species = mulloway, black bream, greenback flounder, sandy sprat, small-mouthed hardyhead; and four diadromous species (congolli, common galaxias, short-headed lamprey, pouched lamprey)

					Maintain abundant, resilient populations of small-bodied fish in the Coorong and Murray Mouth and Barrages, including Small-mouthed hardyhead and Sandy sprat.
	Improved population structure of mulloway, including spawning aggregations at the Murray Mouth in 6 out of 10 years and recruitment in at least 5 out of 10 years.	Lower Lakes, Coorong & Murray Mouth	F15		Restore resilient populations of estuarine fish.
Native fish – distribution of key fish species [32]	Significant increases in the distributions of key species in the southern Basin.	Southern Basin	F17	Restore resilient populations of Murray cod (*Maccullochella peelii*) Restore resilient populations of golden perch (*Macquaria ambigua*) Restore resilient populations of silver perch (*Bidyanus bidyanus*) Restore resilient populations of freshwater catfish (*Tandanus tandanus*)	Maintain a spatio-temporally diverse and resilient fish community. Successful migration and recruitment of diadromous fish. Increase distribution and recruitment success of threatened fishes in the Lower Lakes and wetlands to enhance resilience of existing, and establish new, self-sustaining populations.

[32] Based on Appendix 6 of the BWEWS key species relevant to the SA River Murray WRP area = southern pygmy perch, southern purple-spotted gudgeon, Yarra pygmy perch, Murray hardyhead, diadromous species (Congolli, short-headed and pouched lamprey).

11 Glossary

ALT — Australian Landscape Trust

ARI — Average Return Interval

AWA — Aboriginal Waterways Assessment

Basin State — Defined in the *Water Act 2007* to mean (a) New South Wales; (b) Victoria; (c) Queensland; (d) South Australia; (e) the Australian Capital Territory.

Bonn Convention — The Convention on the Conservation of Migratory Species of Wild Animals - an environmental treaty aimed at conserving terrestrial, aquatic and avian migratory species throughout their range.

BWS — Basin-Wide Environmental Watering Strategy – published by the Murray-Darling Basin Authority, a legislative requirement under Chapter 8 of the Basin Plan.

CAMBA — China-Australia Migratory Bird Agreement – a bilateral agreement to protect and conserve migratory birds and their habitat.

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.

CEWH — Commonwealth Environmental Water Holder.

CLLMM — Coorong, Lower Lakes and Murray Mouth

CMS — Constraints Management Strategy

COAG — Council of Australian Governments

CPUE — Catch Per Unit Effort – a unit use to measure fish and turtle abundance

CSIRO — Commonwealth Scientific and Industrial Research Organisation

DBH – Diameter at breast height

Deferred water – Per the Water Allocation Plan for the River Murray Prescribed Watercourse:

- any part of the 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.

DEW — South Australian Department for Environment and Water.

DEWNR — South Australian Department of Environment, Water and Natural Resources (superseded).

Discharge — The volumetric flow rate of water i.e. volume of streamflow over a given time. In South Australia, this is often represented as ML/day.

EC — Electric Conductivity

EMLR — Eastern Mount Lofty Ranges

EPBC Act — *Environment Protection and Biodiversity and Conservation Act 1999*.

EWR — Environmental Water Requirement - the water regime needed to sustain the ecological values of aquatic ecosystems and biological diversity at a low level of risk.

EWC — Environmental Watering Committee

EWIG — Environmental Watering Improvement Group

EWWG — Environmental Watering Working Group

FNSE — First Nations of the South East

FPWG — First People Working Group

FPRMM — First People of the River Murray and Mallee

GL — Gigalitres

GRP — Gross Regional Product

GSP — Gross State Product

GDE — Groundwater dependent ecosystem.

HCHB — Healthy Coorong Healthy Basin

HEW — Held Environmental Water – defined in Section 4 of the *Water Act 2007*.

HF — Hills and Fleurieu.

ILUA — Indigenous Land Use Agreement.

JAMBA — Japan-Australia Migratory Bird Agreement – a bilateral agreement to protect and conserve migratory birds and their habitat.

Landscape Act — *Landscape South Australia Act 2019*.

LCLB — Limestone Coast Landscape Board.

Lower Lakes — Lakes Alexandrina and Albert.

LTWP — Long-Term Environmental Watering Plan – a legislative requirement under Chapter 8 of the Basin Plan.

MACAI — Mannum Aboriginal Community Association Incorporated

mAHD — Meters above the Australian Height Datum

MDBA — Murray-Darling Basin Authority.

ML/day — Megalitres per day – a measure of flow or discharge, where a megalitre equals 1,000,000 litres.

MRLB — Murraylands and Riverland Landscape Board.

NAC — Ngarrindjeri Aboriginal Cooperation.

NFSA — Nature Foundation of South Australia.

NRA — Ngarrindjeri Regional Authority

NRM — Natural resource management.

NYR — Ngarrindjeri Yarluwar Ruwe

PEA — Priority Environmental Asset – defined in s8.49 of the Basin Plan as an environmental asset that can be managed with environmental water.

PEF — Priority Environmental Function - defined in s8.50 of the Basin Plan as an ecosystem functions that can be managed with environmental water.

PEW — Planned Environmental Water – defined in Section 6 of the *Water Act 2007*.

PIRSA — Department of Primary Industries and Regions of South Australia.

PPMs — Prerequisite Policy Measures.

PWA — Prescribed wells areas.

QSA — Flow measured at the South Australian boarder.

RDA — Rural Development Australia.

RIT — Renmark Irrigation Trust

RMMAC — River Murray and Mallee Aboriginal Cooperation.

RNTBC — Registered Native Title Body Corporate

ROKAMBA — Republic of Korea-Australia Migratory Bird Agreement – a bilateral agreement to protect and conserve migratory birds and their habitat.

SA — South Australia.

SAAL — South Australian Arid Lands.

SANTS — South Australian Native Title Services Ltd.

SA River Murray LTWP — The Long-Term Environmental Watering Plan for the South Australian River Murray Water Resource Plan Area.

SA River Murray WRP Area (also SARM) — South Australian River Murray Water Resource Plan Area – defined in Chapter 3 of the Basin Plan.

SCB — Southern Connected Basin.

SCBEWC — Southern Connected Basin Environmental Watering Committee.

SDL — Sustainable Diversion Limit – defined in the Basin Plan as the long-term average sustainable diversion limit.

SEAFG — South East Aboriginal Focus Group.

SIS — Salt interception scheme.

TCI – Tree Condition Index

TLM — The Living Murray Program.

UNEP — United Nations Environment Program.

VEWH — Victorian Environmental Water Holder.

WAACP — Water affecting activity control policy - means a water affecting activities control policy prepared by a regional landscape board under section 102 of the Landscape Act.

WAP — Water allocation plan.

WLWG — Water Liaison Working Group.

WRP Area — Water Resource Plan Area – water planning units identified for the purpose of implementing the Basin Plan. The water resource plan areas are listed in Chapter 3 of the Basin Plan.

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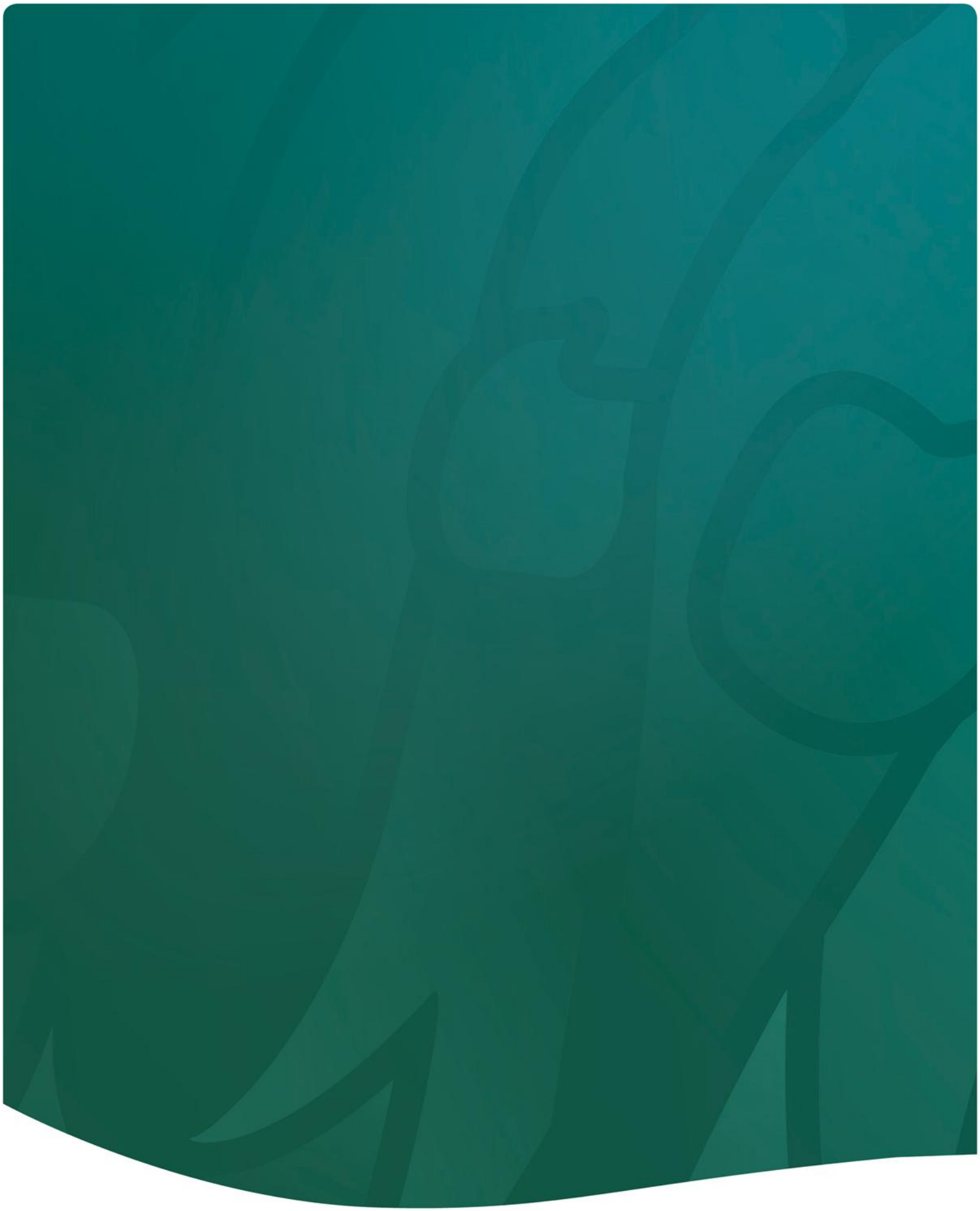

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