Environmental Water Management Plan

Wemen-Liparoo

mallee
catchment management authority

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1	Draft V1 for project team review	M. Cooling	22/03/2016
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3	Draft V2 for Mallee CMA review	E. Healy/ L. Chapman	18/04/2016
4	Environmental watering updated	J. White	02/02/2018
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7	Reviewed and updated to align with DEECA guidelines – Alluvium Consulting Australian	E. Johnston (Mallee CMA)	17/05/2024

Acknowledgement of Country

Mallee Catchment Management Authority (CMA) acknowledges and respects Traditional Owners, Aboriginal communities and organisations. We recognise the diversity of their cultures and the deep connections they have with Victoria's lands and waters. We value partnerships with them for the health of people and Country.

Mallee CMA Board, management and staff pay their respects to Elders past, present and emerging and recognise the primacy of Traditional Owners' obligations, rights and responsibilities to use and care for their traditional lands and waters.

Abbreviations and acronyms

ACHRIS	Aboriginal Cultural Heritage Register and Information System
AHD	Australian Height Datum
AM	Adaptive Management
AVIRA	Aquatic Value Identification and Risk Assessment
BWS	Basin Wide Environmental Watering Strategy
CAMBA	China-Australia Migratory Bird Agreement
CEWH	Commonwealth Environmental Water Holder
CMA	Catchment Management Authority
Ctf	Commence to flow
DCCEEW	Department of Climate Change, Energy, the Environment and Water (C'wth)
DEECA	Department of Energy, Environment and Climate Action (Victorian)
DELWP	Department of Environment, Land, Water and Planning (now DEECA)
EPBC	Environment Protection and Biodiversity Conservation
EVC	Ecological Vegetation Class
EWMP	Environmental Water Management Plan
EWP	Environmental Watering Plan
EWR	Environmental Water Reserve
FFG	Flora and Fauna Guarantee
IAP2	International Association of Public Participation
IWC	Index of Wetland Condition
JAMBA	Japan-Australia Migratory Bird Agreement
MDBA	Murray-Darling Basin Authority
LTWP	Long Term Watering Plan
RAP	Registered Aboriginal Party
ROKAMBA	Republic of Korea – Australia Migratory Bird Agreement
SMART	Specific, Measurable, Achievable, Relevant, Time-bound
SWP	Seasonal Watering Proposal
VBA	Victorian Biodiversity Atlas
VEWH	Victorian Environmental Water Holder
VWMS	Victorian Waterway Management Strategy
WMU	Waterway Management Unit
WRIG	Water Regime Indicator Group

Executive Summary

Environmental Water Management Plans (EWMPs) have been developed for key sites in the Mallee region. The Mallee Waterway Strategy 2014-22 (Mallee CMA, 2014) identified 23 Waterway Management Units (WMU) from 216 targeted waterways in the Mallee. The hydrological interconnectedness and commonality of threats impacting on the waterway values were used to group the WMUs into planning units. This EWMP has been developed for the Wemen-Liparoo WMU sub-unit, hereafter referred to as Wemen-Liparoo. The EWMP will help to guide future environmental watering activities for this area.

Wemen-Liparoo is located within the Happy Valley WMU, located 10km west of Wemen within the Murray-Kulkyne Park. This EWMP addresses the land and water management of this site.

Wemen-Liparoo provides habitat for two listed water dependent fauna species. Additionally, the diverse wetland and floodplain features provide extensive habitat for small-bodied native fish, waterbirds, frogs and turtles. Wemen-Liparoo is located within the Murray-Kulkyne Park and offers good conservation outcomes through land management and implementation of an appropriate environmental water regime.

The management goal for the Wemen-Liparoo EWMP is to provide a water regime for the Wemen-Liparoo target area that will maintain perennial, drought tolerant vegetation, provide seasonal habitat for small-bodied native fish, large waders and waterfowl and maintain an area of Lignum Swampy Woodland as an intermittent waterbird breeding habitat.

The management goal is supported by the following ecological objectives:

WL2: By 2030, maintain representative populations of shallow-water and deep-water feeding guilds of waterbird (F2 and F3, respectively, after Jaensch 2002) at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo by maintaining a mixture of shallow and deep-water habitats.

WL3: By 2030, improve vital habitat at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo, by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.

WL4: By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Liparoo West Billabong – Lignum Swampy Woodland area, Wemen-Liparoo.

WL5: By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Liparoo West Billabong – Lignum Swampy Woodland area, Wemen-Liparoo

The optimal watering regime at Wemen-Liparoo is to fill Liparoo West Billabong and Liparoo East Billabongs to 45.3m AHD every second year in winter and allow natural recession of water levels resulting in a seasonal drying or partial drying of the wetland. In every fourth year, inundate target area to 45.7m AHD in September to flood the Lignum Swampy Woodland area. Top up by pumping to

maintain inundation of Lignum Swampy Woodland for up to six months and then allow natural recession of water levels.

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1 Introduction

1.1 PURPOSE AND SCOPE OF AN EWMP

An EWMP is a management plan for a wetland, wetland complex or river system that sets out the environmental watering goals and objectives, and the water regime required to meet the set objectives. An EWMP describes the:

- consultation undertaken for EWMP preparation and implementation
- asset overview and characteristics
- water-dependent environmental values present
- water-related threats to the environmental values
- management goals for the asset
- environmental objectives, targets and values that environmental watering of the asset will support or improve
- watering requirements needed to meet environmental objectives
- environmental water delivery infrastructure, management and constraints
- risks associated with environmental water delivery
- outcomes intended to be demonstrated through monitoring and assessment, and
- knowledge gaps to address

Further information on the purposes of EWMPs and how they relate to other plans, strategies and policies is provided in Appendix 1.

1.2 POLICY CONTEXT

Management of environmental water in Victoria is a statewide partnership between the Victorian Environmental Water Holder (VEWH), catchment management authorities (including Melbourne Water), DEECA, land managers including Parks Victoria and local councils, water corporations, Traditional Owner groups, and interstate agencies including the Commonwealth Environmental Water Holder (CEWH) and the Murray–Darling Basin Authority (MDBA).

Environmental watering in Victoria has historically been supported by management plans such as EWMPs, that document key information including the watering requirements of an asset, predicted ecological responses and water delivery arrangements. These plans support annual decisions about which sites should receive water and help managers evaluate how well those assets responded to the water they received or what could be done better.

A range of international treaties, conventions and initiatives, as well as National and State Acts, policies and strategies determine management of the target area. Those with particular relevance to Wemen-Liparoo and the management of its environmental values are listed in Table 1**Error! Reference source not found.**.

Table 1. Legislation, conventions, and listings relevant to the target area

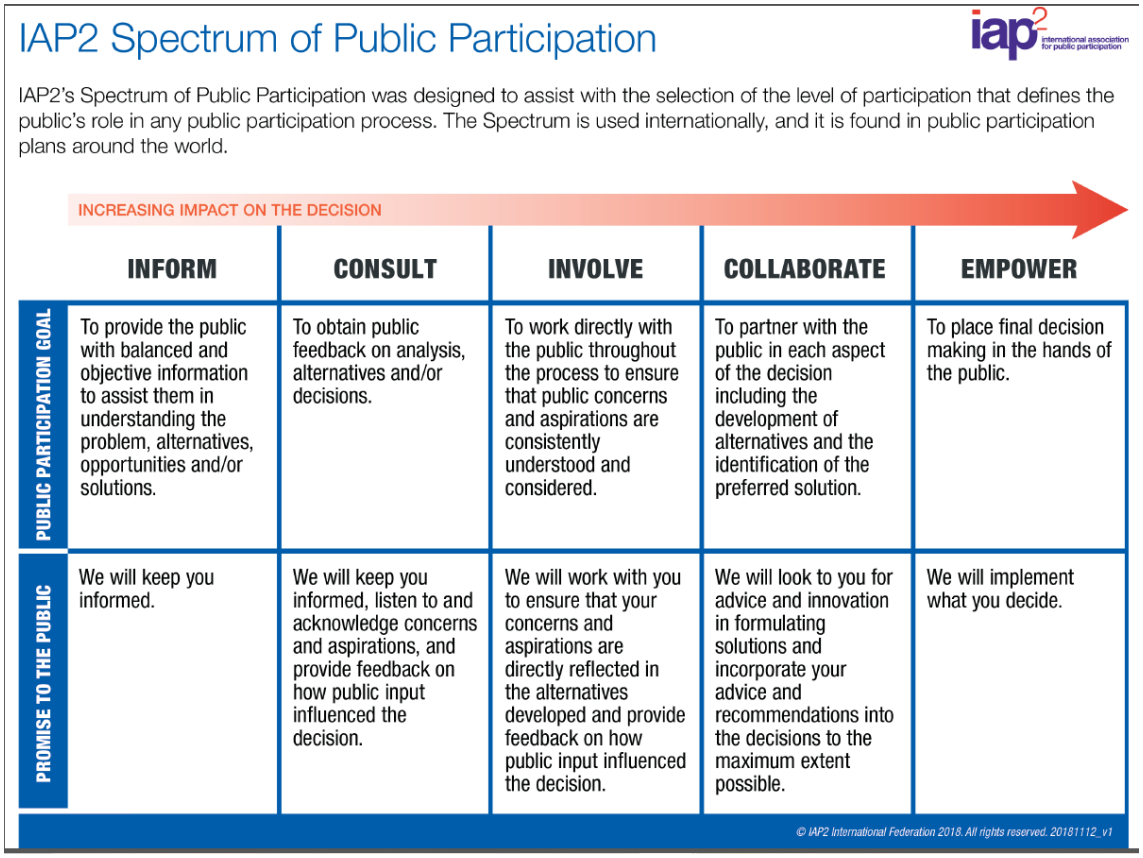
Legislation, Agreement or Convention	Jurisdiction
Environment Protection and Biodiversity Conservation Act 1999	National
Flora and Fauna Guarantee Act 1988	State
Japan-Australia Migratory Bird Agreement (JAMBA)	International
China-Australia Migratory Bird Agreement (CAMBA)	International
Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)	International

2 Partnership and Consultation

2.1 TARGET AUDIENCE

This section identifies the target audience and modes of consultation necessary to manage environmental water delivery, report against stated objectives and targets, and promote adaptive management over the life of the EWMP.

Engagement with different stakeholder groups is based on the International Association of Public Participation (IAP2) spectrum (Figure 1**Error! Reference source not found.**). The spectrum allows for a tailored approach based on stakeholder groups and their needs.



IAP2 Spectrum of Public Participation

iap2 international association for public participation

IAP2's Spectrum of Public Participation was designed to assist with the selection of the level of participation that defines the public's role in any public participation process. The Spectrum is used internationally, and it is found in public participation plans around the world.

INCREASING IMPACT ON THE DECISION

	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
PUBLIC PARTICIPATION GOAL	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.
PROMISE TO THE PUBLIC	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

Figure 1. IAP2 Spectrum (Source: (c) International Association for Public Participation www.iap2.org)

Error! Reference source not found. lists the main stakeholder groups with an i nterest in environmental water based on their needs and interests and level of engagement required. To read more about the role of specific stakeholders in overseeing environmental water at Wemen-Liparoo, refer to Section 3.2.

Mallee CMA develops a communication and engagement plan each year that covers environmental watering events for the entire Mallee CMA region, including Wemen-Liparoo. This ensures that all stakeholders and community members are aware of the Wemen-Liparoo environmental watering operations.

Table 2. Stakeholder groups with an interest in environmental water at Wemen-Liparoo

Stakeholder groups	Stakeholders	Needs and interests	IAP2 level	Consultation modes
Public Land Managers	DEECA, Parks Victoria	Managing impacts from watering such as access, State-level environmental management	Collaborate	Via monthly meetings
River Operators	Goulburn Murray Water	Manage water storage	Collaborate	Via formal meetings.
Local Government	Swan Hill Rural City Council	Access during watering events.	Involve	Meetings, phone calls, correspondence.
Aboriginal Stakeholders	See Section 2.4: Traditional Owners	Ongoing connection to Country and protection of cultural heritage and values. Environmental impacts and benefits. environmental watering regimes and how these may be timed to support/promote cultural values. Provides assistance in planning and implementation of programs.	Involve	Via Mallee CMA's Aboriginal engagement team. Consultation is largely undertaken in-person and, where possible, on Country.
Private landowners and managers	Local landholders	Managing impacts from watering such as access. Provides assistance in planning and implementation of programs.	Collaborate	Directly affected landholders will be informed of watering proposals and asked to provide feedback if relevant.
Community (interest groups)	Trust for Nature	Watering benefits and impacts on local communities such as access to parks and river during watering events. Oversight of the site in accordance with the conditions of the management covenant for Bullock Swamp north.	Consult	Via existing groups such as the Mallee CMA Land and Water Committee. Via Mallee CMA social media and news
Water holders	Victorian Environmental Water Holder	Decision-making around annual environmental water usage.	Collaborate	Via formal meetings.

2.2 DEVELOPING/UPDATING THE EWMP

In the development of this EWMP, Mallee CMA carried out community consultation in the following ways:

- Discussion with the Wemen Progress Association
- On Country meetings with Traditional Owners (see Section 2.4) and landholders
- Online surveys
- In-person engagement at local events such the local markets, local environmental group meetings, and a drop in event at Nangiloc reserve
- Social media platforms
- Meeting with local agencies (Parks Victoria, Lower Murray Water).

2.2.1 Verifying asset values

Asset values at Wemen-Liparoo have been established through environmental assessments and the development of previous versions of this EWMP. Consultation has been a key part of these processes with Traditional Owners, community members and technical specialists. Mallee CMA has continued to engage on asset values throughout the development of the EWMP, particularly with Traditional Owners and private and public landholders.

2.2.2 Informing proposed management objectives, targets and approaches

Mallee CMA has an established working relationship with those who have an extensive knowledge of Wemen-Liparoo and floodplain ecosystems. This work has been central to providing a basis for local knowledge and expertise.

Combined with the Seasonal Watering Proposal, the data and knowledge from the proposed monitoring activities will guide future watering events, as part of the adaptive management approach.

2.2.3 Promoting adaptive management

Mallee CMA and other partners will take an adaptive management approach taking into account both varying seasonal conditions and lessons learned from previous events.

After the annual adaptive management checkpoint, Mallee CMA will adapt the EWMP if needed, which would then go through consultation, giving stakeholders the opportunity to see any updates.

2.3 COMMUNITY ENGAGEMENT

Community stakeholders were engaged during local events such as the local markets, local environmental group meetings, and a drop in event at Nangiloc reserve. This engagement included a 'Pins in Maps' activity, where the community provided information on uses and values at specific locations at the site.

Community stakeholders were also engaged via an online survey, which was hosted on the Mallee CMA website in December 2023 – January 2024. The survey was designed to enable community, landholders, recreational users, environmental groups and other interested parties to provide input to the plans. The survey supplements earlier community engagement about the Wemen-Liparoo EWMPs, and annual community engagement that informs the Seasonal Watering Proposal (SWP). Community consultation occurs at the IAP2 level of CONSULT.

2.4 TRADITIONAL OWNERS

Engagement with Traditional Owners is conducted in an intimate group setting at the INVOLVE level of the IAP2 framework, with the level of interest and involvement self-determined by the group.

Mallee CMA held discussions with Traditional Owners Culpra Milli Aboriginal Corporation, Munatunga Elders, Gilbie Aboriginal Corporation, Latji Latji Mumthelang, Tati Tati Land and Water Indigenous Corporation, Wadi Wadi Land Water Indigenous Corporation, Dadi Dadi Weki Weki Aboriginal Corporation on Country at Liparoo in November 2023. Through this engagement activity, Traditional Owner stakeholders were asked to identify the cultural values/uses at specific sites by placing pins on a map where they occurred. Information from this consultation has informed cultural uses and values incorporated into this EWMP. In-line with EWMP guidelines, consultation with Traditional Owners is ongoing.

3 Asset Overview

The Mallee CMA region is situated in the north-west of Victoria. The area of responsibility is close to 39,000 km2 (3.9 million ha) and has a regional population estimated to be 65,000. Population centres include Mildura, Birchip, Sea Lake, Ouyen, Robinvale, Red Cliffs and Merbein. The boundaries of the Mallee CMA region cover almost one fifth of Victoria, making it the largest area managed by a CMA in the state.

Approximately 40% of the land area within the Mallee CMA boundary is public land, consisting mainly of national parks, reserves, wilderness, and large areas of riverine and dryland forests. The other 60% is predominantly dryland crops, but there is also a significant investment in irrigated horticulture including grapes, citrus, almonds, olives and vegetables along the River Murray corridor. Irrigated crops contribute over 40% of the value of agricultural production for the region.

The site for this plan is the Wemen-Liparoo Water Management Unit (WMU) sub-unit of the Happy Valley WMU, hereby referred to as Wemen-Liparoo in this document. The Happy Valley WMU encompasses the Wemen-Liparoo wetlands, as well as the Gasdens Bend, Carina Bend and Pound Bend wetlands.

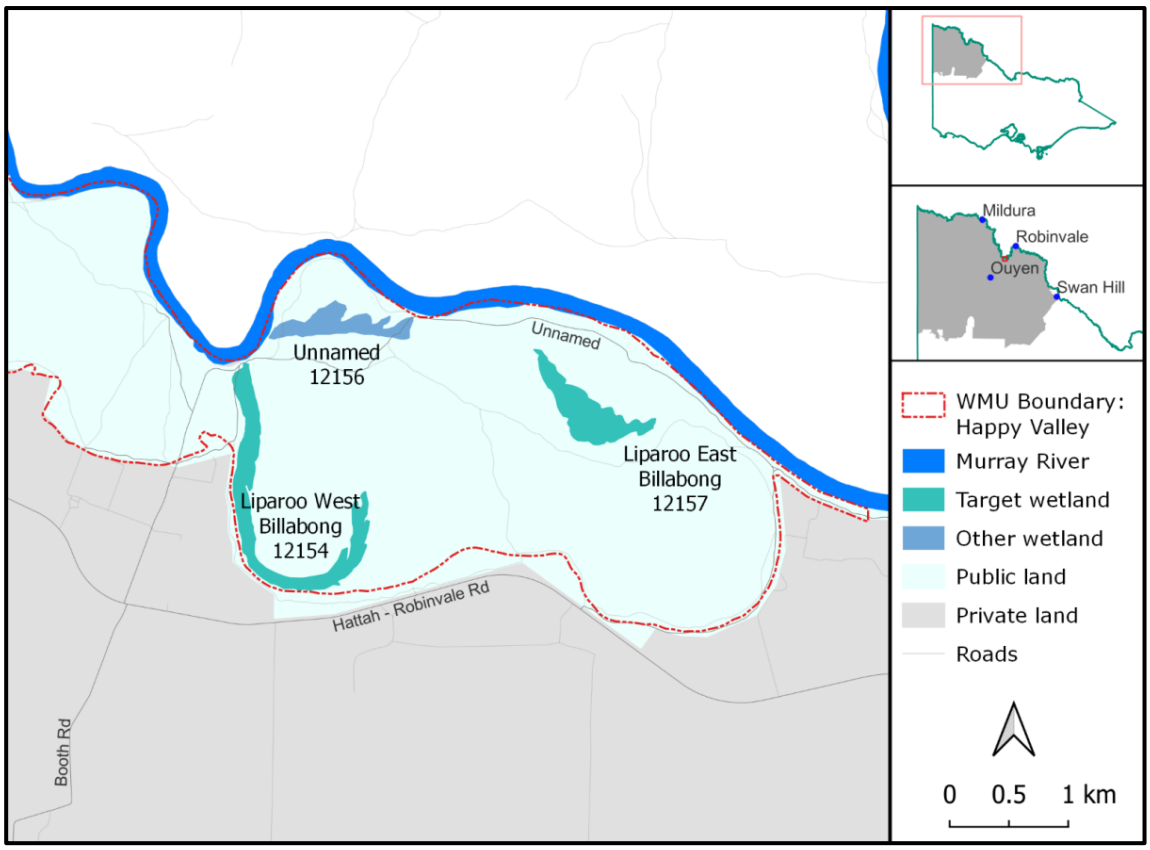


Figure 2. Wemen-Liparoo wetlands.

3.1 CATCHMENT SETTING

The Wemen / Liparoo floodplain management unit is located in the Robinvale Plains bioregion. The Robinvale Plains Bioregion is characterised by a narrow gorge confined by the cliffs along the River Murray, which is entrenched within older up-faulted Cainozoic sedimentary rocks. Alluvium deposits from the Cainozoic period gave rise to the red brown earths, cracking clays and texture contrast soils (Dermosols, Vertosols, Chromosols and Sodosols) which support Riverine Grassy Forest and Riverine Grassy Chenopod Woodland Ecosystems (DEPI, 2015). The Robinvale Plains bioregion contains the floodplain from Boundary Bend in the east to Mildura in the west, and is close to the boundary with the Murray Mallee bioregion which stretches inland.

Wemen-Liparoo is situated on the River Murray floodplain, 10km west of Wemen. The floodplain near the river comprises narrow meander scroll terraces vegetated by River Red Gum communities. Higher ground supports Lignum Shrublands and Black Box woodland. Wemen-Liparoo includes two named wetland Liparoo East Billabong and Liparoo West Billabong and an unnamed wetland. Wemen-Liparoo is located within the Murray-Kulkyne Park.

3.2 LAND STATUS AND MANAGEMENT

Several agencies and individuals are involved in managing the land and water at Wemen-Liparoo (**Error! Reference source not found.**). Wemen-Liparoo is subject t o two land classifications, the Murray-Kulkyne Park and River Murray Reserve, as shown in **Error! Reference source not found.**. Wemen-Liparoo is within the M urray-Kulkyne Park. Parks Victoria is the land manager at Wemen-Liparoo.

Table 3. Land and water managers at Wemen-Liparoo

Organisation	Management Role
Minister for Water (Vic)	• Oversee Victoria's environmental water management policy framework, and its implementation. • Administer the broader water allocation and entitlements framework and the Water Act 1989 (Vic).
Mallee CMA	• The waterway manager that plans and identifies environmental water needs across the Mallee region Water Act 1989 (Vic). • Approves and manages delivery of environmental water and monitoring and reporting of outcomes, in accordance with ecological objectives.
Parks Victoria	• The land manager for the Crown land under the *National Parks Act 1975* (Vic) and *Crown Land (Reserves) Act 1978* (Vic) • Manages pests and specific environmental impacts. • Supports watering on public land and manages any impacts, for example by engaging with site visitors about environmental water-related matters and managing public access during and after an event.
Swan Hill Rural City Council	• Local Government
Victorian Environmental Water Holder	• Manager of Victoria's environmental water entitlements

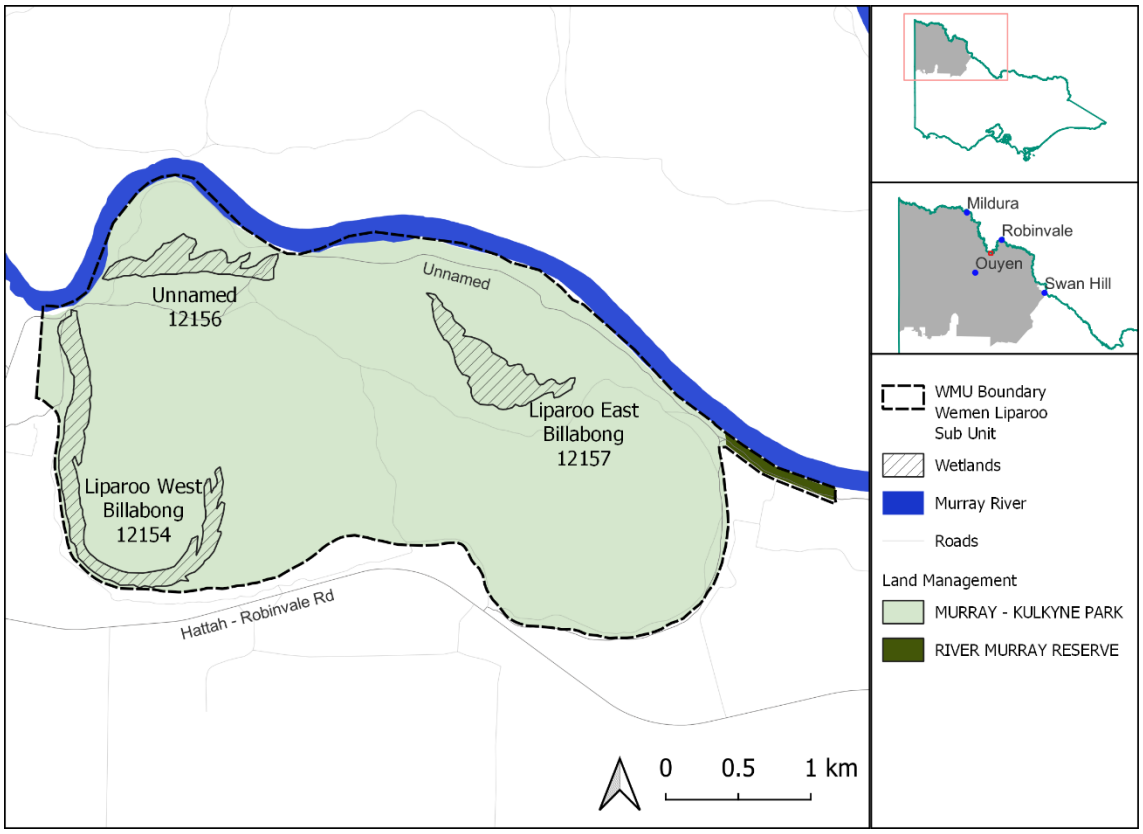


Figure 3. Wemen-Liparoo land management boundaries

3.3 ASSET CHARACTERISTICS

The whole of Wemen-Liparoo has a water requirement as a floodplain complex, but the focus of this plan is restricted to a target area depicted in Figure 2. This target area consists of Liparoo East and Liparoo West Billabongs a connecting floodplain channel and a shallow depression hosting Lignum Swampy Woodland.

Table 4. Wetland characteristics at Wemen-Liparoo

Characteristics	Description
Name	Wemen-Liparoo
Mapping ID (Wetland Current layer)	**Liparoo West Billabong:** 12154 (36.68ha) **Liparoo East Billabong:** 12157 (23.68ha) **Unnamed:** 12156 (16.66ha)
Area of wetlands in target area	60.35 ha (excludes floodplain and channels)
Bioregion	Robinvale Plains
Conservation status	Bioregion conservation status: areas of EVCs listed as Vulnerable, Depleted and Least Concern
Land status	Public Land: Murray-Kulkyne National Park and River Murray Reserve
Land manager	Parks Victoria
Surrounding land use	Dryland cropping, irrigation agriculture (almonds), town of Wemen
Water supply	Natural inflows from the River Murray and local catchment runoff
Wetland category (Corrick classifcation)	The wetlands are currently classified as unknown type, however Corrick previously classified them as: **Liparoo West Billabong:** Deep Freshwater Marsh **Liparoo East Billabong:** Shallow Freshwater Marsh **Unnamed:** 12156: Shallow Freshwater Marsh
Wetland depth at capacity	3–4m at the deepest points

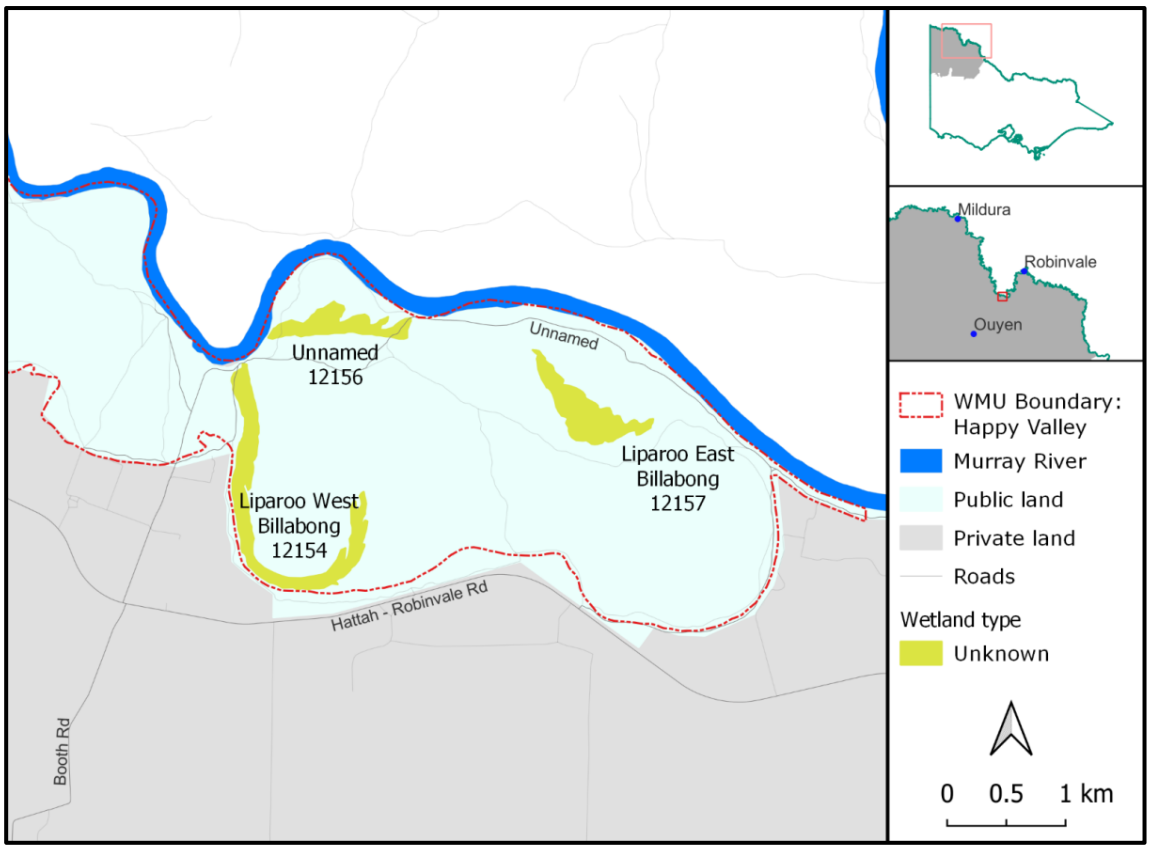


Figure 4. Wemen-Liparoo wetland type.

3.3.1 Conceptualisation of the site

Wemen-Liparoo is represented in a conceptual model presented below. This is a visual representation of the processes and components within the target area that are discussed throughout this EWMP.

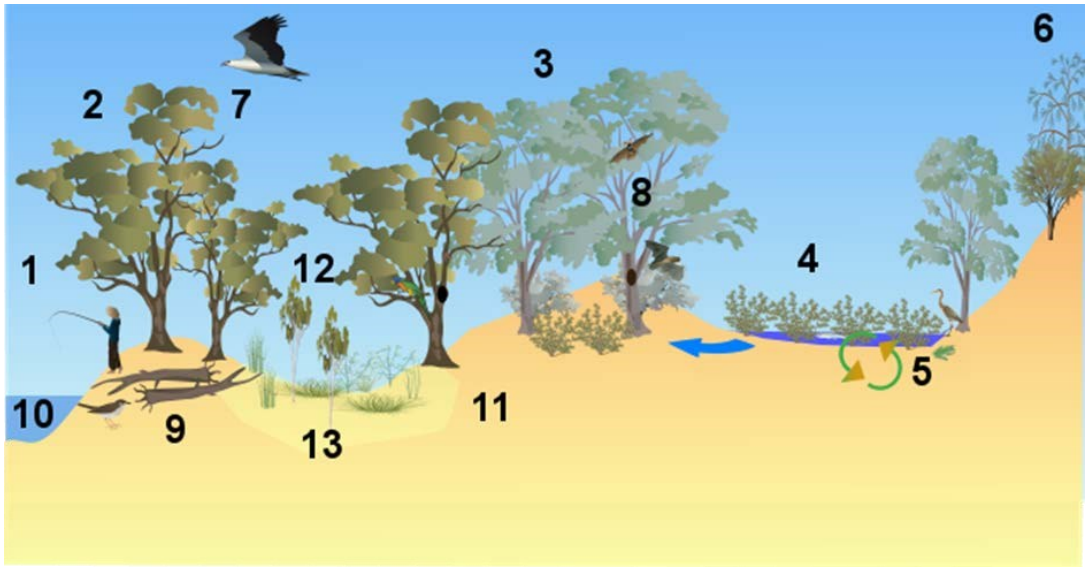


Figure 5. Conceptualisation of Wemen-Liparoo

1. Wemen-Liparoo is located in the Robinvale Plains bioregion, within the Murray-Kulkyne Park, 10km west of Wemen. It is a popular access point for recreational fishing in the River Murray.
2. Adjacent to the River Murray narrow meander scroll terraces support River Red Gum communities.
3. Higher terraces support Lignum shrublands and Black Box woodland. Black Box dominated vegetation communities close to flow paths are healthy and vigorous, having access to water through bank recharge, even if not inundated.
4. A large depression at the eastern end of the site supports an area of infrequently flooded Lignum Swampy Woodland. While the area receives some inundation from local runoff and rainfall, major flooding will encourage Lignum growth and provide roosting and feeding opportunities (such as frogs, small fish) as well as temporary breeding habitat for Ibis and waterfowl and small bodied fish.
5. Inundation of the Lignum Swampy Woodland will also provide habitat for drought-tolerant burrowing frogs and enhance primary productivity and nutrient cycling.
6. Higher areas of land to the south of the site support Semi-arid Woodland and Semi-arid Chenopod Woodland.
7. Large, mature, hollow bearing River Red Gum are plentiful at the site, lining the connecting channels and wetlands. These provide important habitat for including hollows for nesting of Regent Parrot and nesting and perching sites for White-bellied Sea-eagles.
8. A diverse range of bat species are present at Wemen Liparoo. Bats roots in hollows and fissures in mature River Red Gums and Black Box during the day. The increased floodplain productivity that follows inundation of the wetlands and forest understorey will increase insect abundance and hence food supply for bats.
9. Fallen woody debris provide feeding sites for the Brown Tree-creeper and White-browed Treecreeper as they forage for insects from the ground to the canopy. Appropriate inundation frequencies will support tree health and long-term woody debris supply on the ground.
10. River regulation and water extraction have reduced the frequency, extent and duration of inundation at Wemen-Liparoo.
11. Reduced floodplain and wetland inundation has contributed to reductions in the diversity and productivity of riparian vegetation communities and a reduction in habitat availability and structural complexity for aquatic and terrestrial fauna.
12. Improved inundation regimes are expected to increase the health and productivity of the wetland woodland vegetation mosaic and aid in nutrient cycling.
13. Previous environmental watering following prolonged dry conditions has resulted in improved River Red Gum health and recruitment within the wetlands.

14. The wide wetlands support a mosaic of Shallow Freshwater Marsh and Floodway Pond Herbland EVCs. Floodway Pond Herbland contains a range of ephemeral species whose vegetation communities flourish during and after inundation.
15. The local evaporation rate of approximately 2.2m per year causes a gradual drawdown of water in the wetlands, gradually exposing the banks and mud flats and supporting herb species and a perimeter of drought tolerant macrophytes such as *Cyperus gymocaulos* and *Juncus* species.

Graphics developed using software provided by the Integration and Application Network, University of Maryland Centre for Environmental Science (ian.umces.edu/symbols/).

3.4 ENVIRONMENTAL WATER SOURCES

The Environmental Water Reserve (EWR) is the legally recognised amount of water set aside to meet environmental needs. The Reserve can include minimum river flows, unregulated flows and specific environmental entitlements. Environmental entitlements can be called out of storage when needed and delivered to wetlands or streams to protect their environmental values and health.

The Victorian Minister for Environment, Climate Change and Water appointed Commissioners to Victoria's first independent body for holding and managing environmental water on 1 July 2011. The Victorian Environmental Water Holder (VEWH) is responsible for holding and managing Victoria's environmental water entitlements sourcing water from the Victorian Murray system for delivery to Liparoo sites. This could include water held by the VEWH or CEWH. Details of the VEWH's environmental water entitlements are available at: https://www.vewh.vic.gov.au/watering-program/how-much-water-is-available

4 Current/Historical Hydrological Regime and System Operations

Wetland hydrology is the most important determinant of wetland types and condition. It affects the chemical and physical aspects of the wetland which in turn affects the type of flora and fauna that the wetland supports. A wetland's hydrology is determined by the physical form of the wetland, surface and groundwater inflows and outflows in addition to precipitation and evapotranspiration. The inundation regime is important and the duration, frequency and seasonality (timing) of inflows are the key characteristics that influence wetland responses to inundation.

River Murray hydrology has been altered significantly by regulation and diversion upstream. Storages in Victoria and New South Wales are managed to capture water in winter and spring and to deliver this water at manageable flow rates to consumers (primarily irrigators) during the summer. The impact on river hydrology has been a reduction in large winter and spring flow peaks and higher summer flows.

Liparoo West Billabong is connected to the River Murray at 1056.7 river km at approximately 43.4m AHD. The wetland extends southwards and then curves to the east, where the bed drops to approximately 43m AHD, and the wetland becomes shallower, along the perimeter of the floodplain (Ecological Associates, 2007b). Until 2008, Liparoo West Billabong was regulated as an irrigation supply channel with an earthen bank used to raise the retention level. At elevated river levels, Liparoo West Billabong is the first wetland within the target area to receive inflows.

During very high flows water can enter the floodplain between 1060 and 1062 river km feeding Liparoo East Billabong before spilling into a series of elongated depressions that collectively direct water to the top end of Liparoo West Billabong. The maximum target inundation height for Wemen-Liparoo is 45.7m AHD, making Liparoo Billabong approximately 2.7 metres deep at its maximum depth. The bed of Liparoo East Billabong is at approximately 43.8m AHD, making it approximately 1.9 metres deep at its maximum depth. Unfortunately, there is no elevation data available for the area of Lignum Swampy woodland at the top end of Liparoo West Billabong.

Flows of 20,000 ML/day occur approximately 20 per cent less frequency under current conditions and these events are approximately 30 per cent shorter in duration. Under pre-regulation flows of 70,000 ML/day would have occurred 57 years in 100, with mean event duration of 67 days. Post-regulation conditions have seen a reduction in the inundation threshold being met to 24.6 years in 100, with a reduced mean duration of 37 days.

Table 5. Commence to flow rates for wetlands at Wemen-Liparoo

Wetland	Commence to flow (ctf) with River Murray flows
Liparoo West Billabong	19,300 – 37,900ML/day
Liparoo East Billabong	54,200 ML/day
Lower areas of the floodplain, including unnamed wetland #12156	40,000ML/day

4.1 GROUNDWATER AND SALINITY INTERACTIONS

Groundwater and surface water can be highly connected and need coordinated management (MDBA, 2023a). Groundwater is important to sustain some rivers and river ecosystems during periods of reduced precipitation or flows, and can assist with the provision of adequate water quality to support local ecosystems (MDBA, 2023b). It is important to understand the interactions between surface and groundwater to achieve sustainable management wetlands.

There are groundwater bores at Wemen-Liparoo, and ongoing groundwater monitoring but as of 2024 there has been no surveys or research done. The interaction of groundwater to and the impact of salinity on the wetlands at Wemen-Liparoo remain a knowledge gap.

4.2 ENVIRONMENTAL WATERING

Initial environmental watering, undertaken in 2010 was an 'emergency response' to assist the vegetation during the prolonged dry conditions which had resulted in a decline in River Red Gum health on the River Murray floodplain. The target area for previous watering has been limited to Liparoo East.

Anecdotal evidence suggested that the watering was effective in improving the health of trees (through increased foliage vigour) lining the channels and wetlands in the target area, and had the added benefit of providing drought refuge for waterbirds.

Table 6. A Summary of environmental watering at Wemen-Liparoo

Water year	Waterbody	Time of inflow	Environmental Water Source	Total volume delivered (ML)	Area (ha) inundated
2010	Liparoo West Billabong	Autumn	EWR	329.3	25.78
2010	Liparoo West Billabong	Spring	EWR	130.4	Liparoo West Billabong - 25.78
2010/11	Liparoo East Billabong, Liparoo West Billabong	Spring, Summer and Autumn	Natural flows	Unknown	Unknown
2012/13	Liparoo East Billabong, Liparoo West Billabong	Spring	Natural flows	Unknown	Unknown
2013/14	Liparoo East Billabong	Autumn/winter	EWR	472	49.8
2016/17	Liparoo East Billabong, Liparoo West Billabong	Spring/Summer	Natural flows	Unknown	Unknown
2017/18	Liparoo West Billabong	Spring	EWR	239.66	25.78
2019/20	Liparoo East Billabong, Liparoo West Billabong	Spring	EWR	392.42	Unknown
2019/20	Liparoo East Billabong, Liparoo West Billabong	Spring	EWR	271.50	Unknown
2022/23	Liparoo East Billabong, Liparoo West Billabong		Natural inundation	Unknown	Unknown
2023/24	Liparoo East Billabong, Liparoo West Billabong		Natural inundation	Unknown	Unknown

5 Water Dependent Values

Wetlands and waterways on the floodplain are a vital component of the landscape and support flora and fauna which vary with the type of wetland/waterway system and through time. The habitat provided by vegetation communities around wetlands is essential for maintaining populations of water dependent fauna species. Other ecological functions provided by floodplain complexes include water filtration, slowing surface water flow to reduce soil erosion, flood mitigation and reducing nutrient input into waterways. Protecting the ecological functioning of wetlands ensures these vital services are maintained.

Wemen-Liparoo provides a range of shelter and food resources for indigenous fauna and flora. The types of habitat provided, and consequently the species that utilise the site, change as water fills the wetlands and floodplain and recedes again.

The availability of flora and fauna data for the site is limited. It is recommended that flora and fauna surveys are undertaken at the site to improve knowledge of the site's ecological values.

5.1 ENVIRONMENTAL VALUES

5.1.1 Ecosystem type and function

Section 8.05 of the *Basin Plan 2012* states that an objective is to protect and restore biodiversity that is dependent on water resources, by ensuring that water-dependent ecosystems are protected, and representative populations and communities of native biota are protected and, if necessary, restored. Section 8.06 of the *Basin Plan 2012* outlines objectives relating to the protection and restoration of the ecosystem functions of water-dependent ecosystems.

The conservation significance of Victorian wetland types has been determined by comparing the estimated extent prior to European settlement (Victorian Wetland Inventory - Pre-European) with the current extent (Victorian Wetland Inventory - Current).

Wemen-Liparoo contains three wetlands. They have been classified using the Corrick-Norman wetland classification system as Deep Freshwater Marsh or Shallow Freshwater Marsh. Both Shallow Freshwater Marsh and Deep Freshwater Marsh have declined across the state, (-60% and -70% respectively); within the Mallee CMA (-6% and -45% respectively) and within the Robinvale Plains Bioregion (-4% and -37% respectively)

Based on a comparison of the geospatial wetland layers (1788 and 1994), Deep Freshwater Marshes are the most depleted (-70% change) type of wetland in Victoria, second most (-45% change) in the Mallee CMA region and second most (-37% change) in the Robinvale Plains Bioregion. This makes Liparoo West, which is Deep Freshwater Marsh, significant in the region.

As the wetlands at Wemen-Liparoo are also adjacent to Murray-Kulkyne Park, it is likely that the wetlands at Wemen-Liparoo have a role in supporting or sustaining the values at the National Park.

Table 7. Regional change in area of wetland type at Wemen-Liparoo

Corrick category (Current and Pre - European)	Wetland name	Area (ha)	Percentage change in wetland area from 1788 to 1994		
			Change in Victoria	Change in Mallee CMA	Change in Robinvale Plains Bioregion
Shallow Freshwater Marsh	Liparoo East Unnamed #12156	26.68 16.66	-60%	-6%	-4%
Deep Freshwater Marsh	Liparoo West	36.68	-70%	-45%	-37%

Ecosystem functions

Wetland ecosystems support distinctive communities of plants and animals and support numerous ecosystem functions. Floodplain wetlands perform important functions necessary to maintain the hydrological, physical and ecological health of river systems.

Three key broad ecosystem functions have been identified for the Wemen Liparoo EWMP. Each function is interlinked and must be supported in order for the ecosystem to flourish. The functions are briefly described below.

Connections across floodplains, adjacent wetlands and billabongs (lateral)

Water levels that engage flood channels, wetlands and floodplain surfaces will promote nutrient and carbon cycling and return organic material to the river for further processing (Robertston, Bacon and Heagney, 2001, Zeng et al., 2022).

Waterbird groups also access a variety of habitat types such as mud flats, flooded lignum and shallow aquatic vegetation which only become available following inundation.

Diversity of habitat for feeding, breeding and nursery

Wetland filling and water recession will increase the extent and species diversity of the band of sedges, rushes and semi-aquatic forbs surrounding wetlands and areas of deeper water will support submerged aquatic macrophytes. This inundation cycle will promote high levels of aquatic productivity and increased habitat complexity for frogs, small native fish, and waterbirds.

Seasonal fluctuations in water levels in the wetlands increase the availability of specific habitat niches for feeding, breeding and nursery areas. The permanent and semi-permanent water bodies will provide a source of food, refuge from predators and nesting sites and materials (Kingsford and Norman, 2002).

When flooded, the ephemeral flora component of Lignum Swampy Woodland and Lignum Shrubland will germinate or expand, providing habitat for frogs, aquatic invertebrates and small native fish and the water birds that prey on these species.

The growth and vigour of river red gum and black box within or adjacent to inundated areas will increase, increasing their value as habitat for nesting and perch sites and for the input of leaves and coarse woody debris into the wetlands and floodplain.

Transportation and dilution of nutrients and organic matter and increase in macroinvertebrate and biofilm productivity

Drying of wetlands, particularly during summer and autumn, exposes sediments and facilitates decomposition and processing of organic matter. The microbial decay of plant material is an important route for energy and nutrients to enter the aquatic food chain where it becomes available for consumption by bacteria, algae, macrophytes and macroinvertebrates (Young, 2001, Gawne & Scholz, 2006).

Fluctuations in water levels allow exposure of substrates such as large wood and plant stems through a drying cycle, supporting a mosaic of biofilm species that offer a range of food resources for macroinvertebrates and fish.

5.1.2 Flora and Fauna Values

EVCs

There are 9 EVCs within the target area, as shown in Figure 6. The bioregional conservation status of all water-dependant EVCs in the target area is shown in Table 9. For a full list of EVCs and details on each see Appendix 2.

Table 8. Ecological Vegetation Classes listed as present within the Wemen-Liparoo target area

EVC Number	EVC Name	Bioregional Conservation Status
103	Riverine Chenopod Woodland	Depleted
158	Chenopod Mallee	Vulnerable
200	Shallow Freshwater Marsh	Vulnerable
295	Riverine Grassy Woodland	Depleted
808	Lignum Shrubland	Least concern
810	Floodway Pond Herbland	Depleted
813	Intermittent Swampy Woodland	Depleted
818	Shrubby Riverine Woodland	Least concern
823	Lignum Swampy Woodland	Depleted

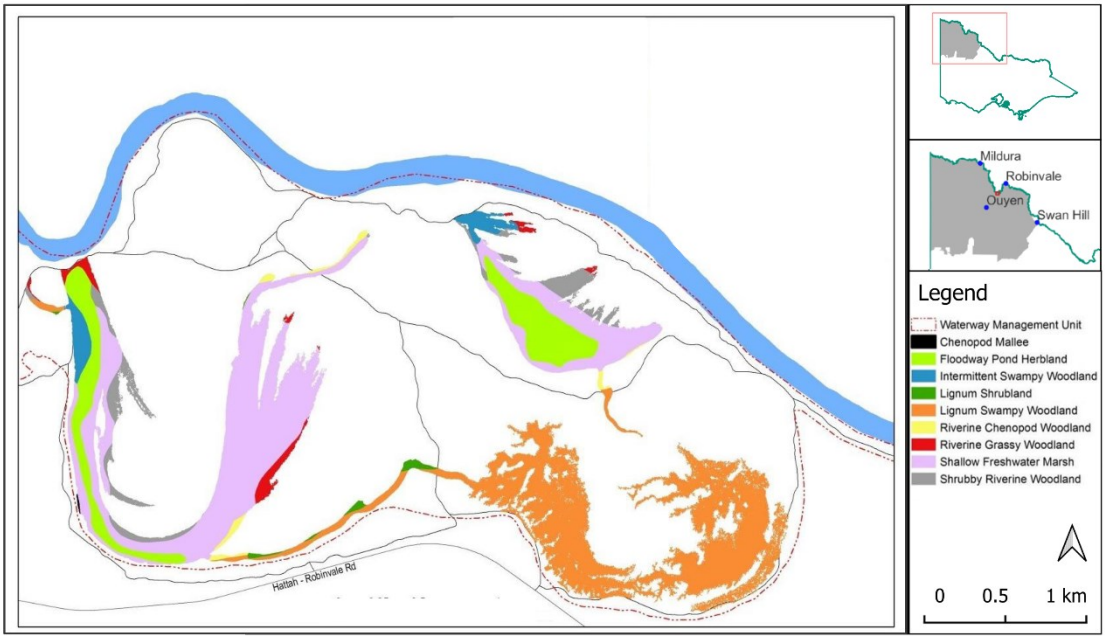


Figure 6. Ecological Vegetation Classes (EVCs) at Wemen-Liparoo

Adjacent to the River Murray low terraces support river red gum dominated communities such as Grassy Riverine Forest (EVC 106). Grassy Riverine Forest is a river red gum forest to 25m tall with an understorey of eumong (*Acacia stenophylla*), Tangled lignum (*Muehlenbeckia florulenta*) and a range of tussock grasses and occasional tall shrubs.

Slightly higher, less frequently inundated terraces support communities dominated by a mix of river red gum and black box such as Intermittent Swampy Woodland (EVC 813), Riverine Grassy Woodland (295), and Shrubby Riverine Woodland (EVC 818). Intermittent Swampy Woodland is comprised of an overstorey of river red gum and black box to roughly 15m tall, with an understorey of eumong, scattered shrubs such as tangled lignum and a range of grasses and sedges. With frequent inundation it is dominated by flood stimulated species in association with inundation-tolerant flora. Shrubby Riverine Woodland is similar, with an understorey of grasses, chenopods and daisies; and Riverine Grassy Woodland has understorey dominated by grasses with scattered chenopod shrubs.

Healthy river red gums provide extensive habitat for a range of fauna, and waterbirds can use these trees for nesting. River red gums also deposit organic woody debris to wetlands which provide structural habitat features for wetland fauna such as perching sites for waterbirds and snags for fish (Roberts and Marston, 2011). Ideal flooding for river red gum recruitment is late spring to early summer (Johns and et al., 2009), while ideal flood timing for river red gum maintenance and survival is winter to spring following the natural flooding pattern (Dalton, 1990).

Higher terraces further away from flow paths support black box woodland dominated EVCs such as Riverine Chenopod Woodland (EVC 103), an EVC with a diverse shrubby and grassy understorey that is subject to only extremely infrequent incidental shallow flooding from major events.

Black box provides essential habitat and foraging opportunities for a range of species including mammals and reptiles and supports a high proportion of ground foraging and hollow-nesting birds. Black box can tolerate a range of moisture and

salinity conditions (Roberts and Marston, 2011), however recruitment and establishment is linked to the elevated and continued soil moisture associated with flood events. Under extended periods of dry conditions Black box is likely to decline and eventually die (Ecological Associates, 2007a).

The health of Black box dominated vegetation communities is varied, those close to flow paths are healthy and vigorous, having received access to water through their root zones, even if not recently inundated.

Figure 7. Black box and Lignum woodland near the entrance to Liparoo West Billabong. Though there is a diversity of species present, the Lignum is lacking vigour (February 2016)

Figure 8. Lignum Shrubland is present between Liparoo West Billabong and wetland 12156 (February 2016)

Figure 9. The floors of wide flat wetlands such as Liparoo East and Liparoo West Billabongs (shown above) support Floodway Pond Herbland during and after inundation (December 2019)

Figure 10. Mallee on the high escarpment bordering the southern end of Wemen-Liparoo (February 2016)

Fauna

42 fauna species are listed at Wemen-Liparoo (Appendix 3), 41 of which are native. Of special interest are the 2 water dependent fauna species listed in legislation, agreements or conventions.

Wemen-Liparoo supports species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Victoria's *Flora and Fauna Guarantee Act 1988* (FFG Act) (Table 10). These records are drawn from

incidental and targeted surveys; however, it is fair to assume that more listed species are likely to occur due to the availability of habitat and nearby sightings.

Table 9. Listed water dependant fauna at Wemen-Liparoo

Scientific Name	Common Name	FFG Act	EPBC Act Status
Ardea alba modesta	Eastern great egret	Vulnerable	N/A
Polytelis anthopeplus monarchoides	Regent parrot	Vulnerable	Vulnerable

The eastern great egret is considered water-dependent because it forages or nests over water or requires flooding to trigger breeding and fledging. The regent parrot, (*Polytelis anthopeplus monarchoides)* is indirectly dependent on water as it requires riparian trees for nesting habitat.

The eastern great egret (*Ardea modesta*) forage in open water, on exposed banks or flats, particularly in areas with aquatic vegetation rather than emergent vegetation (Marchant and Higgins, 1990). They use overhanging trees for nesting, with river red gum being their preferred tree. Egrets feed mainly on fish but also consume shrimp, crayfish, frogs and insects (Rogers and Ralph, 2011). Draining of wetlands is the main cause of habitat loss for Egrets in Victoria (DSE, 2001).

The eastern great egret prefers permanent water bodies on floodplains such as billabongs, creeks or pools but will also use the shallow edges of deep lakes, moist grasslands and wetlands (Marchant and Higgins, 1990). They forage in water approximately 30cm depth as well as from the surface of deeper waters. Flooding stimulates for breeding (Briggs, 1990) and increases breeding success. The species prefers to nest in live trees over floodwaters, but do not seem to have specific depth requirements. The required flood duration (resulting in water being maintained around nests) for successful breeding is a minimum of six to seven months for the great egret, however peak breeding can occur after twelve months (Rogers and Ralph, 2011). The absence of adequate flooding affects required foraging habitat, increasing the importance of the Wemen-Liparoo wetlands in providing foraging habitat for the eastern great egret during dry periods.

The regent parrot is listed as nationally vulnerable under the EPBC Act, with estimates of only 2,900 birds left in the wild. This species has quite specific habitat requirements. It nests almost exclusively in river red gum (*Eucalyptus camaldulensis*) forest and woodland, typically in large, old and healthy hollow-bearing trees close to water. They require trees that are a minimum of 160 years old (Baker-Gabb and Hurley, 2011). However, regent parrots have also been known to breed in black box (*Eucalyptus largiflorens*). They mostly feed in large blocks of intact Mallee woodlands usually within 510km (maximum 20km) of nest sites, but also consume flower buds of river red gum, black box and buloke (*Allocasuarina leuhmanii*) (Baker-Gabb and Hurley, 2011). Regent parrots are reluctant to fly through open areas and require corridors of vegetation between nesting and foraging sites.

Flora

26 flora species are listed at Wemen-Liparoo (Appendix 4), 16 of which are native. No listed flora species have been identified at Wemen-Liparoo based on a recent naturekit search.

Figure 11. Mature black box trees provide habitat for bats and birds (February 2016)

5.1.3 Current Condition

The condition of the wetlands at Wemen-Liparoo is dependent on an appropriate environmental watering regime. Environmental watering at Wemen-Liparoo has met environmental watering targets for Liparoo West Billabong. This would indicate that Liparoo West Billabong is in good condition and is likely to support the ecological values identified in this EWMP. Environmental watering targets have not been met for Liparoo East Billabong.

Figure 12. Liparoo West showing healthy mature river red gums lining the channel (October 2019)

Figure 13. Liparoo West showing evidence of river red gum recruitment and accumulated leaf litter associated with inundation events (December 2019)

Figure 14. Flow path linking Liparoo West to the area of Lignum Swampy Woodland. River red gum recruitment is evident following earlier inundation, but mature black box and river red gum are in poor health or dead and the understorey is lacking diversity (February 2016).

Figure 15. Lignum and black box in the northern most section of Liparoo Billabong show reduced health and vigour (February 2016)

5.2 SHARED BENEFITS

5.2.1 Traditional Owner Cultural Values

The Mallee has been occupied for thousands of generations by Indigenous people with human activity dated as far back as 23,400 years ago. The region's rich and diverse Indigenous heritage has been formed through the historical and spiritual significance of sites associated with this habitation; together with the strong

connection Traditional Owners continue to have with the natural landscapes of the Mallee.

In Indigenous culture, water is inseparable from the land, air, plants and animals. Caring for, and healing, Country is an inherited cultural obligation that is reliant upon having water in the landscape in the right place, at the right time of year. Water creates and sustains life, and is a living and cultural entity that connects Traditional Owners to Ancestors, Country, cultural practice and identity.

Within the Mallee CMA region, the River Murray and its associated waterways continue to be culturally significant habitation areas for many Aboriginal groups. The high number of Indigenous cultural heritage sites throughout the Murray floodplain is unique in Victoria because of their concentration and diversity. It is typical to find high densities of identified Indigenous cultural heritage sites located around, or close to, freshwater sources. The Aboriginal Heritage Regulations 2018 define "areas of cultural heritage sensitivity" which include land within 200 m of named waterways and land within 50 m of registered Aboriginal cultural heritage places. A review of the Aboriginal Cultural Heritage Register and Information System (ACHRIS) confirms that the wetlands at Wemen-Liparoo are defined as areas of cultural heritage sensitivity.

Within the Mallee CMA region, the River Murray and its associated waterways were important areas for multiple Aboriginal groups, containing many places of spiritual significance. The high number of indigenous cultural heritage sites throughout the Murray floodplain is unique in Victoria, for concentration and diversity. They include large numbers of burial and hunting sites and middens.

In the south of the region, waterways were focal points for the region's traditional owners, with many lakes being the site for large gatherings of several social clan groups that afforded trade and cultural exchanges.

Engagement with Culpra Milli Aboriginal Corporation, Munatunga Elders Aboriginal Corporation, Tati Tati Land & Water Indigenous Corporation, Tati Tai Wadi Wadi Land & Water Indigenous Corporation, Wadi Wadi Nation and Dadi Dadi Weki Weki representatives on Country at Liparoo in November 2023 found that there was ongoing connection to the wetlands at Wemen-Liparoo, with Aboriginal community members invested in the ecological health and sustainable management of water at the site. Participants in the on Country engagement identified that fish breeding, recreational values (uses such as camping & fishing), and water itself were valued.

5.2.2 European Heritage Values

Waterways play a large role in the region's more recent non-indigenous heritage due to the historical infrastructure (e.g. buildings, irrigation and river navigation structures) they often contain. These places provide links to early industries and settlements and play a key part in the region's identity.

5.2.3 Recreational Values

Wemen Liparoo is only a few kilometres from the township of Wemen and is adjacent to the Murray-Kulkyne National Park. Tourists and visitors are encouraged to visit both National Parks together and a series of walking paths and 4WD tracks are provided. Bush camping is allowed and is popular along the River Murray frontage. The minimal tourist facilities contribute to the peaceful and remote atmosphere of the park and attracts those looking for a low-key nature experience. Swimming and canoeing are also popular and Wemen-Liparoo is a popular fishing site for visitors from the inland town of Ouyen.

Survey data collected during the Mallee CMA engagement activities indicates that Wemen-Liparoo is accessed on average every few months, mostly in Spring, and is

used for a range of uses, including walking/running, birdwatching, fishing, socialising, nature appreciation, boating, kayaking, camping, cultural connection and swimming. More information about recent community engagement can be found in Appendix 5.

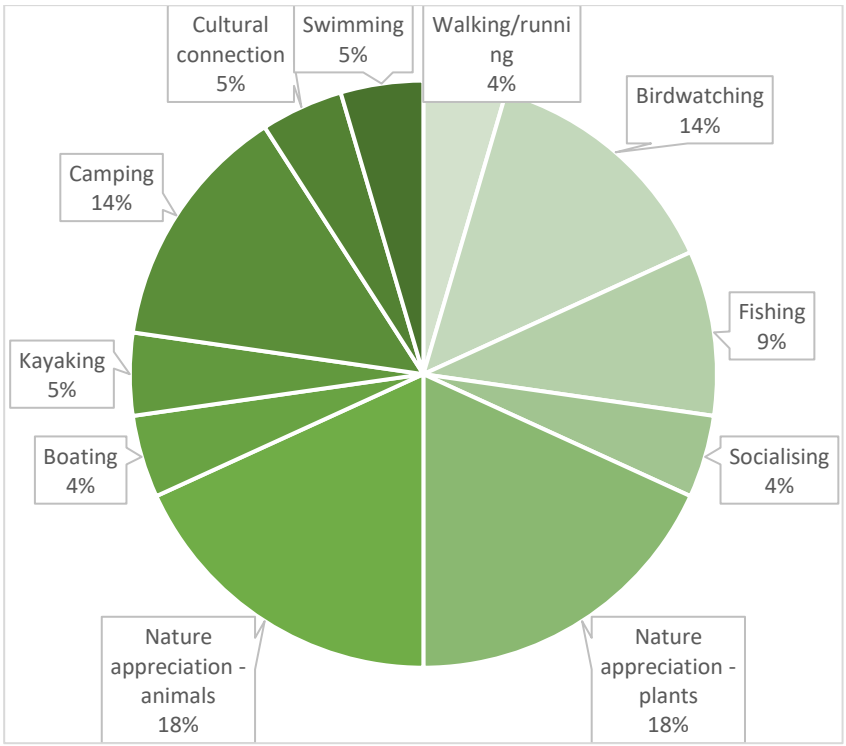


Figure 16. Identified uses at Wemen-Liparoo. Source: Mallee CMA online engagement, 2024.

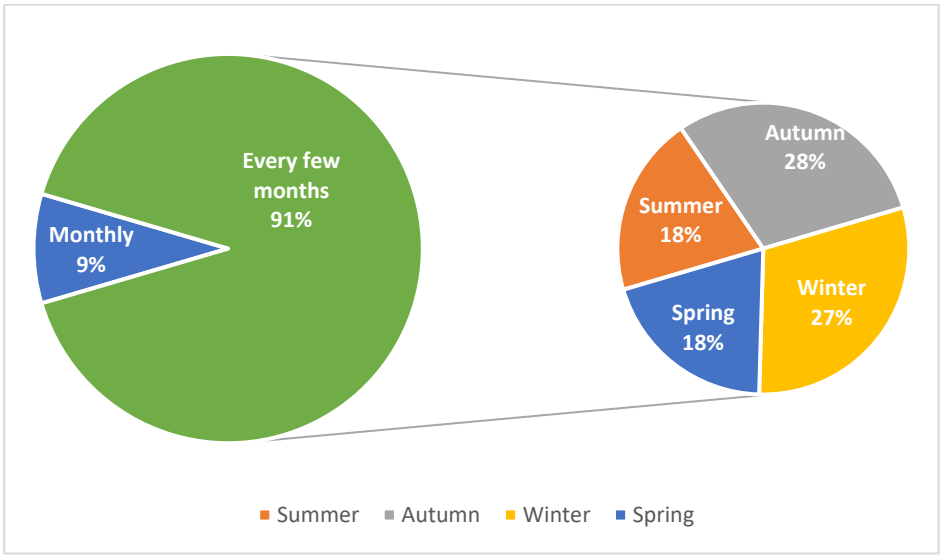


Figure 17. Frequency of visitation to Wemen-Liparoo and visitation season. Source: Mallee CMA online engagement, 2024.

5.2.4 Economic Values

The natural beauty of Wemen Liparoo, the Murray-Kulkyne National Park, as well as the adjacent Hattah-Kulkyne National Park attract both locals and tourists. Surrounding land uses include dryland cropping, irrigated agriculture (almonds), and the town of Wemen.

5.2.5 Educational Values

In consultation undertaken via an online survey in 2024, no educational values were identified at Wemen-Liparoo.

5.3 TRAJECTORY OF CHANGE

Wetlands across the Murray-Darling Basin have been negatively impacted by river regulation and unsustainable management. Reduced flows on the Murray-Darling river system are likely to impact the ecology of the wetlands through:

- reduced productivity;
- reduced connectivity for movement of organic matter and fish;
- reduction of suitable nesting and roosting sites for waterbirds;
- lower capacity to provide nesting sites for hollow-dependent birds and reptiles;
- reduced understorey quality as habitat and shelter for birds and reptiles; and
- limited food sources for all waterbird types, reptiles and amphibians through declines in vegetation condition and reduced terrestrial and aquatic invertebrates

Without improvements to watering frequency and extent, the health of the ecosystems at Wemen-Liparoo is likely to decline.

Figure 18. Photopoints of Liparoo East Billabong, Wemen-Liparoo. Left: photo 30/05/2017, Right: 11/05/2020.

Photopoint monitoring is undertaken at Wemen-Liparoo to monitor wetland condition over time (Figure 18). Photopoints were taken in 2017 and 2020 – during that time, each Spring, Liparoo West (2017/18, 2019/20) or Liparoo East Billabong (2019/20) received flows from the EWR of between 239.66 and 392.42 ML (see Table 7). In 2016/17, Liparoo West Billabong and Liparoo East Billabong were watered by Natural flows in Spring/Summer (see Table 7).

6 Managing Water Related Threats

The Aquatic Value Identification and Risk Assessment (AVIRA) database is an on-line tool used by Victorian waterway managers to store data about the values, threats and risks to waterway health in their region. The database evaluates threats for a range of sub-indices including water regime, invasive fauna and acid sulphate soils (Peters, 2009).

Invasive fauna aquatic

Although no formal observations of Common Carp (*Cyprinus carpio*) have been recorded in Naturekit, wetlands at Wemen-Liparoo are likely to support the invasive species when inundated. Carp have been found to contribute to the loss of aquatic vegetation and increased turbidity, resulting in loss of habitat for waterfowl (Purdey and Loyn, 2008) and native fish species. This species also competes with the native fish for habitat and food, as well as having a detrimental effect on water quality (Mallee CMA, 2003). The presence of Carp can also have a detrimental impact on recruitment for frogs due to predation (Spencer and Wassens, 2009).

Invasive fauna terrestrial

Introduced terrestrial species including Pig (*Sus scrofa*), Red Fox (*Vulpes vulpes*), European Rabbit (*Oryctolagus cuniculus*), Cat (*Felis catus*), House mouse (*Mus musculus*), and Common Starling (*Sturnus vulgaris*) are anticipated to be present at Wemen-Liparoo.

Feral pigs are known to pug and dig wetland soil, destroy macrophyte beds, increase nutrient levels and reduce water clarity. Foxes and Cats predate on native birds and mammals and both are listed as potentially threatening processes under the *Flora and Fauna Guarantee Act 1988* (DSE, 2002, 2004).

High nest predation by foxes is a threat to the Eastern Long-necked Turtle (Kennett et al., 2009). Rabbits can over-browse flora species and reduce survival and recruitment success, cause erosion, compete with native herbivores for food and burrows and support high populations of introduced predators such as foxes and cats (Office of Environment & Heritage, 2015).

Changed water regime

The hydrology of the target area has been greatly impacted by the regulation of the River Murray. The changed water regime is due to the impacts of regulation of the primary water source (River Murray), which impact the seasonality, duration and frequency of the water regime.

Management of water-related threats

Management of water related threats at Wemen-Liparoo is undertaken through maintaining the optimal watering regime. As part of this process, the wetlands will periodically be allowed to dry out, enabling the reduction of invasive aquatic species such as European carp. Drawdown and inundation of wetlands in line with the optimal watering regime will also manage invasive flora species not suited to natural water cycles.

ASSESSING RISKS

Consideration of risk provides a link between recognition of system threats and key management processes, including decade and seasonal planning. Risk assessments are composed of both likelihood and consequence components. In this instance,

likelihood is influenced by the probability that there will be sufficient environmental water to maintain creek flows and water levels.

From a seasonal watering perspective, prioritisation of watering actions will be based on expected outcomes. While consequence for an individual wetland can be determined, environmental water allocations require consideration of the consequences at larger scales. For the Mallee CMA it is their region, for the VEWH it is Victoria and the CEWH it is the Murray Darling Basin.

Not all consequences can be identified as readily and so we have provided a process that can be followed in Appendix 6.

7 Management Goals, Objectives and Targets

7.1 MANAGEMENT GOAL

The overall management goal proposed for the Wemen-Liparoo target area has been developed through consultation with various experts and stakeholders including DEECA, Parks Victoria, and local residents. The goal considers the values the wetland supports and the potential threats that need to be managed. This includes consideration of the values the wetland has historically supported and the likely values it could support into the future.

The management goal for Wemen-Liparoo is:

"To provide a water regime for the Wemen-Liparoo target area that will maintain perennial, drought tolerant vegetation, provide seasonal habitat for, large waders and waterfowl and maintain an area of Lignum Swampy Woodland as an intermittent waterbird breeding habitat."

This is strongly linked to the goals of the Mallee Waterway Strategy 2014-22 (Mallee CMA 2014):

- To maintain or improve habitat within waterways and on surrounding riparian land;
- To manage all land tenures for water quality benefits and respond appropriately to threatening events (both natural and pollution based);
- To restore appropriate water regimes and improve connectivity;
- To protect the extent and condition of Cultural Heritage (Indigenous and non-Indigenous) sites associated with waterways; and
- To increase community capacity for, awareness of and participation in waterway management.

7.2 ENVIRONMENTAL OBJECTIVES AND TARGETS

Environmental objectives represent the desired environmental outcomes of the site based on the management goal, above, as well as the key values outlined in the Water Dependent Values section. It is intended that EWMP objectives will be described in terms of the primary environmental outcomes, in most cases ecological attributes. The focus of the objectives should be on the final ecological outcomes and not the drivers per se.

During 2020, the environmental objectives (formally ecological objectives) undertook a refinement process with the intent of improving the specificity and measurability of the objectives through the development of targets, and to improve line of sight to the Basin Plan. While the process attempted to maintain the intent and integrity of the original objectives, it provided an opportunity to reassess the suitability of these objectives for the asset. The rationalisation, assessment of SMARTness, mapping to Basin Plan and update of each objective for Wemen-Liparoo can be found in Section 5.25.1 of Butcher et al. (2020).

The outcome of the refinement process in 2020 resulted in the consolidation of the original five objectives into four concise objectives. Updated objective numbering is consistent with Butcher et al (2020). Updated objective numbering is consistent with Butcher et al (2020).

While every attempt has been made to make the following objectives and targets as complete as possible, there still remain gaps as critical information is not currently available. As such, baselines are not able to be set at this time. In the

interests of moving forward, the objectives and targets have been written in a way (i.e. red highlighted text) that allows this information to be included at a later stage as this information becomes available.

Table 10. Updated Environmental Objectives and Targets for Wemen-Liparoo

EWMP Objective	Target
WL2: By 2030, maintain representative populations of shallow-water and deep-water feeding guilds of waterbird (F2 and F3, respectively, after Jaensch 2002) at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo by maintaining a mixture of shallow and deep-water habitats	By 2030, 80% of representative F2 and F3 species recorded at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo in 8 out of any 10-year period where conditions are suitable. • Representative F2 species include: Australasian Grebe (*Tachybaptus novaehollandiae*), Pacific Black Duck (*Anas superciliosa*), White-necked Heron (*Ardea pacifica*), Australian White Ibis (*Threskiornis molucca*), Masked Lapwing (*Vanellus miles*) • Representative F3 species include: Australian Pelican (*Pelecanus conspicillatus*), Great Cormorant (*Phalacrocorax carbo*), Little Black Cormorant (*Phalacrocorax sulcirostris*), Australian Darter () • Feeding habitat defined as a mixture of deep feeding areas (water >1 m) and shallow feeding areas (<0.5 m depth and or drying mud) with intermittent inundation of densely vegetated shrublands.
WL3: By 2030, improve vital habitat at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo, by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.	By 2030, increase diversity of native of macrophytes at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo with ≥2 species from each of the following Water Regime Indicator Groups present in 80% of years: • Aquatic to semi-aquatic (persistent) (Asp) (Short-fruit Nardoo *Marsilea hirsute*) • Seasonally immersed – low growing (Slg) (Common Woodruff *Asperula conferta*, Twin-leaf Bedstraw *Asperula gemelli*, Common Spike-sedge *Eleocharis acuta*, Poison Pratia *Lobelia concolor*, Tall Fireweed *Senecio runcinifolius*, Blue Rod *Stemodia florulenta*, River Bluebell *Wahlenbergia fluminalis*) • Seasonally inundated – emergent non woody (Sen) (Spiny Flat-sedge *Cyperus gymnocaulos*, Warrego Summer-grass *Paspalidium jubiflorum*) • Mud herbs (Muh) (Spreading Sneezeweed *Centipeda minima s.l.*, Mousetail *Myosurus australis*, Starry Goosefoot *Scleroblitum atriplicinum*, Sweet Fenugreek *Trigonella suavissima*) Only a subset of WRIGs applied due to 'drought tolerant' in the original objective. Can add other WRIGs as needed.
WL4: By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Liparoo West Billabong – Lignum Swampy Woodland area, Wemen-Liparoo	By 2030, condition in standardised transects that span the floodplain elevation gradient and existing spatial distribution at Liparoo West Billabong –Lignum Swampy Woodland area Wemen-Liparoo ≥70% of Lignum plants in good condition with a Lignum Condition Score (LCI) ≥4.
WL5: By 2030, maintain nesting and recruitment of colonial waterbirds (N7, after Jaensch 2002) at Liparoo West Billabong – Lignum Swampy Woodland area, Wemen-Liparoo by maintaining a mixture of tree, low vegetation/shrubs, and ground/islet nesting habitat.	There is a lack of data on species that breed at the site. The expectation is that the list of species commonly nesting at Wemen-Liparoo will be confirmed over time. By 2030, at least two of the following species to be recorded as nesting and/or breeding at Liparoo West Billabong – Lignum Swampy Woodland area, Wemen-Liparoo 50% years in which nesting/breeding conditions are suitable over the 10 year period: • Representative N7 species include: Australian White Ibis (*Threskiornis molucca*), Straw-necked Ibis (*Threskiornis spinicollis*), Royal Spoonbill (*Platalea regia*)

7.3 REGIONAL SIGNIFICANCE

Wemen-Liparoo supports a range of environmental values of local, regional and Basin significance as described in Section 5. These values are linked to the management goals and environmental objectives and targets described in Section 7. Details of the links between the environmental objectives and environmental outcomes at a regional/Basin scale are provided in Appendix 7.

The management goals and environmental objectives and targets are aligned with the goals of the Mallee Waterway Strategy as described in Section 7.1. The Mallee Waterway Strategy identifies Liparoo West Billabong and Liparoo East Billabong as medium priority wetlands.

As demonstrated in table 8, Deep Freshwater Marsh and Shallow Freshwater Marsh wetlands have declined across the state, the catchment area and the region, indicating that these wetlands are significant as they are increasingly rare in the landscape.

7.4 ALIGNMENT TO BASIN PLAN

The primary environmental outcome of the Basin Plan is the protection and restoration of water-dependent ecosystems and ecosystem functions in the Murray-Darling Basin, with strengthened resilience to a changing climate. Section 8.05 of the *Basin Plan 2012* states that an objective is to protect and restore biodiversity that is dependent on water resources, by ensuring that water-dependent ecosystems are protected, and representative populations and communities of native biota are protected and, if necessary, restored. Section 8.06 of the *Basin Plan 2012* outlines objectives relating to the protection and restoration of the ecosystem functions of water-dependent ecosystems.

The MDBA is required to measure progress towards achieving the objectives of the Basin Plan Environmental Watering Plan (EWP) (Chapter 8 of the Basin Plan) by using the targets in Schedule 7 and having regard to the long-term average sustainable diversion limits, ecological objectives and ecological targets. These are set out in Long-Term Watering Plan's (LTWP), the Basin-wide Environmental Watering Strategy (BWS) and annual Basin environmental watering priorities. Details on the alignment of the updated Wemen-Liparoo EWMP environmental objectives to the Basin Plan are provided in Table 13 and Appendix 7.

Table 11. Mapping updated Wemen-Liparoo EWMP objectives to Basin Plan

EWMP Objective	Alignment with Basin Plan		
	8.05 Ecosystem and biodiversity	8.06 Ecosystem function	8.07 Ecosystem resilience
WL2: By 2030, maintain representative populations of shallow-water and deep-water feeding guilds of waterbird (F2 and F3, respectively, after Jaensch 2002) at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo by maintaining a mixture of shallow and deep-water habitats	8.05,3(b)	N/A	N/A
WL3: By 2030, improve vital habitat at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo, by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.	8.05,3(b)	8.06,6(b)	N/A
WL4: By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Liparoo West Billabong – Lignum Swampy Woodland area, Wemen-Liparoo	8.05,3(b)	N/A	N/A
WL5: By 2030, maintain nesting and recruitment of colonial waterbirds (N7, after Jaensch 2002) at Liparoo West Billabong – Lignum Swampy Woodland area, Wemen-Liparoo by maintaining a mixture of tree, low vegetation/shrubs, and ground/islet nesting habitat.	8.05,3(b)	8.06,6(b)	N/A

8 Environmental Water Requirements and Intended Water Regime

8.1 WATERING REQUIREMENTS AND INTENDED WATERING REGIME

The wetland watering regime has been derived from the ecological and hydrological objectives. To allow for adaptive and integrated management, the hydrological objectives have been framed using the seasonally adaptive approach. This means that a watering regime is identified for optimal conditions, as well as the maximum and minimum tolerable watering scenarios. The minimum watering regime is likely to be provided in drought or dry years, the optimum watering regime in average conditions and the maximum watering regime in wet or flood years.

Table 12. Intended watering regime for Wemen-Liparoo target area (Liparoo East and Liparoo West Billabongs)

Level (m AHD)	Zone	Timing	Frequency (years in 10)	Duration (months)
44.5	Aquatic habitat	Winter/ spring	5	Up to 12 months
45.3	Emergent macrophyte/ Littoral zone	Late winter/ early summer	5	4-6 months
45.7	Lignum Swampy Woodland	Early spring/ summer	2.5	3-7 months

8.2 EXPECTED WATERING EFFECTS

This section aims to explicitly outline the potential watering actions and expected watering effects needed to achieve the stated environmental objective.

The wetland watering regime has been derived from the ecological and hydrological objectives. To allow for adaptive and integrated management, the hydrological objectives have been framed using the seasonally adaptive approach. This means that a watering regime is identified for optimal conditions, as well as the maximum and minimum tolerable watering scenarios. The minimum watering regime is likely to be provided in drought or dry years, the optimum watering regime in average conditions and the maximum watering regime in wet or flood years.

The optimal watering regime is described below. Due to the inter-annual variability of these estimates (particularly the climatic conditions), determination of the predicted volume requirements in any given year will need to be undertaken by the environmental water manager when watering is planned. The watering regime has been derived following review of the pre-regulation hydrology data.

Optimal watering regime

Fill Liparoo West Billabong and Liparoo East Billabongs to 45.3m AHD every second year in winter and allow natural recession of water levels resulting in a seasonal drying or partial drying of the wetland. In every fourth year, inundate target area to 45.7m AHD in September to flood the Lignum Swampy Woodland area. Top up by pumping to maintain inundation of Lignum Swampy Woodland for up to six months and then allow natural recession of water levels.

Minimum watering regime

Fill Liparoo West Billabong and Liparoo East Billabongs to 45.3m AHD every second year in winter and allow natural recession of water levels resulting in a seasonal drying or partial drying of the wetland.

Maximum watering regime

Fill Liparoo West Billabong and Liparoo East Billabongs to 45.3m AHD every year in winter and allow natural recession of water levels resulting in a seasonal drying or partial drying of the wetland. In every fourth year inundate target area to 45.7m AHD in September to flood the Lignum Swampy Woodland area. Top up by pumping to maintain inundation of Lignum Swampy Woodland for six months and

then allow natural recession of water levels.

Table 13. Expected watering effects and potential watering action required to achieve environmental objectives.

Objective code	Environmental Objective	Potential Watering Action	Expected Watering Effect
WL2	By 2030, maintain representative populations of shallow-water and deep-water feeding guilds of waterbird (F2 and F3, respectively, after Jaensch 2002) at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo by maintaining a mixture of shallow and deep-water habitats.	• Facilitate seasonally variable watering to support natural wetting and drying cycles of the wetlands. • Time inflows preferably in late Winter/Spring, allow water levels to recede over Summer/Autumn.	Maintain appropriate seasonal variation in water levels to maintain a mixture of shallow- and deep-water habitats for waterbirds.
WL3	By 2030, improve vital habitat at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo, by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.	• Maintain regular flooding to 45.3mAHD every second year. • Inundate areas of exposed sediments in Winter/Spring.	Maintain appropriate seasonal variation in water levels to increase aquatic macrophyte extent.
WL4	By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Liparoo West Billabong – Lignum Swampy Woodland area, Wemen-Liparoo.	• Maintain regular flooding every 4 years to 45.7mAHD, with ponding of 3-7 months duration. • Allow waters to recede over Autumn/Winter.	Maintain appropriate seasonal variation in water levels to improve condition and extent of Lignum.
WL5	By 2030, maintain nesting and recruitment of colonial waterbirds (N7, after Jaensch 2002) at Liparoo West Billabong – Lignum Swampy Woodland area, Wemen-Liparoo by maintaining a mixture of tree, low vegetation/shrubs, and ground/islet nesting habitat.	• Facilitate seasonally variable watering to support natural wetting and drying cycles of the wetlands. • Time inflows preferably in late Winter/Spring, allow water levels to recede over Summer/Autumn.	Maintain appropriate seasonal variation in water levels to maintain appropriate nesting habitat to support colonial waterbirds.

8.3 SEASONALLY ADAPTIVE APPROACH

To allow for adaptive and integrated management, the watering requirements have been framed using an adaptive approach which identifies priorities for environmental watering under different seasonal conditions. This means that a watering regime is identified for optimal conditions, as well as the maximum and minimum tolerable watering scenarios. The planning scenarios under different seasonal conditions for Wemen-Liparoo are described in Figure 19. The example watering actions presented in Figure 19 are indicative of the actions that may be delivered under the various planning scenarios. Other factors such as the condition of the site, recent watering history and forecast water availability will also influence the watering actions that are delivered.

Figure 19. Indicative seasonally adaptive approach

9 Environmental Water Delivery Infrastructure

9.1 WATER DELIVERY INFRASTRUCTURE

Current infrastructure at Wemen-Liparoo required for environmental water delivery consists of:

- A temporary pump and 16m delivery line at the northern edge of Liparoo West, connecting Liparoo West to the River Murray.
- A temporary pump and 300m long delivery line at the north-western edge of Liparoo East, connecting Liparoo East to the River Murray.

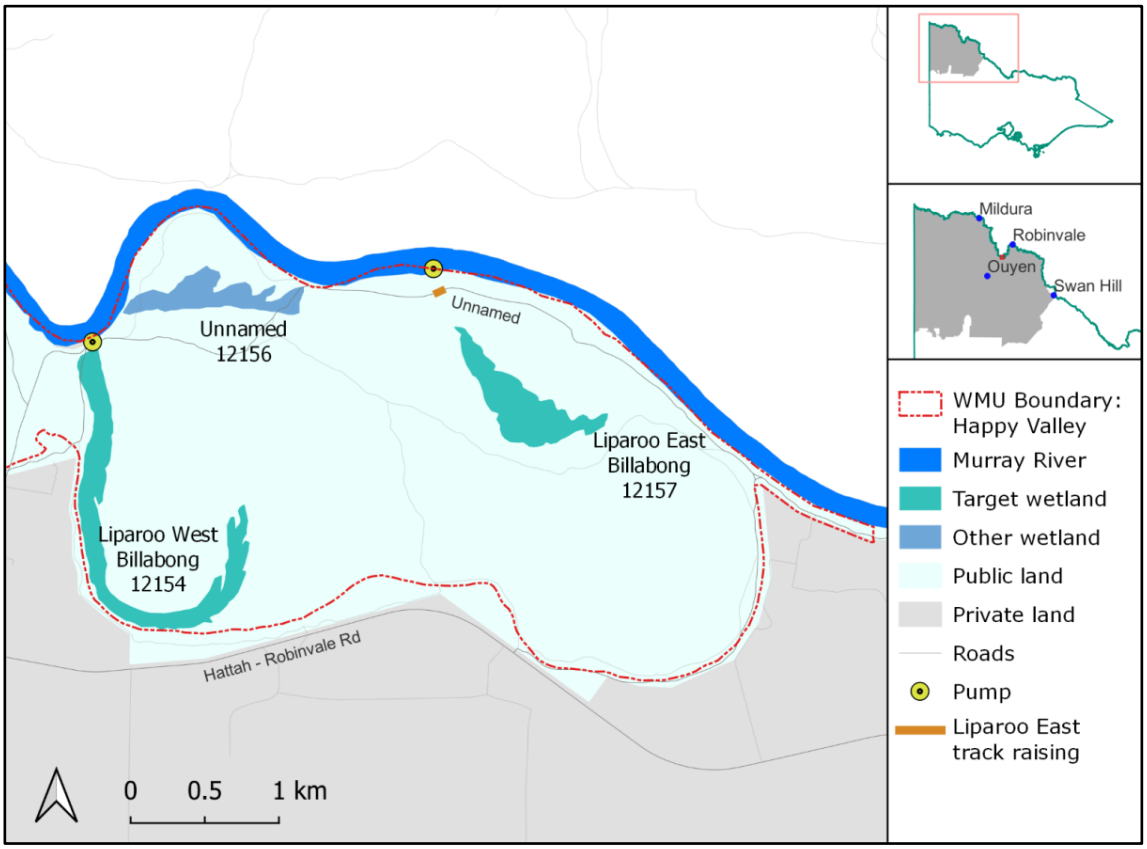


Figure 20. Location of current infrastructure required at Wemen-Liparoo.

9.2 CONSTRAINTS

As the target area is within the Murray-Kulkyne Park, there are no constraints to implementing the recommended water regime.

10 Demonstrating Outcomes

10.1 ENVIRONMENTAL MONITORING

The foci for monitoring identified for the Wemen-Liparoo target area are presented in Table 16. The monitoring methods in Table 16 will enable environmental water managers to assess progress against targets and assist in the adaptive management of the target area to achieve the stated environmental objectives and outcomes.

Table 14. Links between objectives, monitoring foci, questions and methods.

Objective	Monitoring Focus	Monitoring Question	Method	When
Overarching management objective	Wetland Condition	Has there been an overall rehabilitation in the condition of the target area by 2030?	Undertake IWC method assessment	Every five years
WL2	Waterbird populations	Are 80% of representative shallow- and deep-water feeding waterbirds recorded at Wemen-Liparoo is 8 out of any 10-year period where conditions are stable?	Undertake waterbird surveys.	Annually
WL3	Aquatic macrophyte diversity	What is the baseline diversity of Water Regime Indicators groups species? By 2030 has there been an increase in diversity of aquatic macrophytes? What species are present 80% of years?	Undertake surveys of aquatic macrophytes (including species ID and extent). Compare results against benchmark of initial survey.	Every three years
WL4	Condition and extent of lignum	What is the baseline extent of lignum? Has the extent of lignum changed with environmental watering? Has the condition of lignum improved with environmental watering? By 2030, are ≥70% of Lignum plants in good condition with a Lignum Condition Score (LCI) ≥4?	Undertake Lignum population monitoring using standardised transects that span the floodplain elevation gradient and existing spatial distribution. Photo point monitoring. Compare results against benchmark of initial survey.	Every three years
WL5	Waterbird populations	What species breed at Wemen-Liparoo? Are at least two of the representative N7 species identified in the WL5 target recorded as nesting and/or breeding at Wemen-Liparoo in 50% of years in which nesting/breeding conditions are suitable over the 10-year period?	Undertake waterbird surveys.	Annually
WL5	Waterbird nesting habitat	Is the condition of waterbird nesting habitat (mixture of tree, low vegetation/shrubs, and ground/islet nesting habitat improving with environmental watering?	Transect surveys	Annually

10.2 MONITORING PRORITIES AT THE ASSET

Ecological monitoring is required to demonstrate the effectiveness of environmental watering in achieving environmental objectives, to help manage environmental risks and to identify opportunities to improve the efficiency and effectiveness of the program.

The highest priorities for monitoring at Wemen-Liparoo are the monitoring questions that most strongly influence watering decisions and the evaluation of watering effectiveness. The monitoring priorities at Wemen-Liparoo are shown in Table 17.

Table 15. Monitoring priorities at Wemen-Liparoo.

Monitoring Priority	Reason for Priority
Water delivery	Adaptive management: water is managed to meet EWMP objectives.
Index of wetland condition assessments	These provide information on changes in hydrology and water quality that impact on flora and fauna
Waterbird population data	To develop baselines to assist condition assessments. Key for assessing progress against objectives of the Basin Plan Environmental Watering Plan (EWP), Basin Plan Schedule 7 targets, Basin wide Environmental Watering strategy (BWS) and Victorian Murray Long Term Watering Plan.
Diversity of aquatic macrophytes	To develop baselines to assist condition assessments. Key for assessing progress against objectives of the Basin Plan Environmental Watering Plan (EWP), Basin Plan Schedule 7 targets, Basin wide Environmental Watering strategy (BWS) and Victorian Murray Long Term Watering Plan.
Lignum condition and extent	To develop baselines to assist condition assessments. Key for assessing progress against objectives of the Basin Plan Environmental Watering Plan (EWP), Basin Plan Schedule 7 targets, Basin wide Environmental Watering strategy (BWS) and Victorian Murray Long Term Watering Plan.
Waterbird nesting habitat condition	To develop understanding of the potential for the site to provide habitat for waterbird nesting, and to provide a baseline of waterbird habitat condition, against which the achievement of ecological objectives can be assessed.
Monitor extent and length of inundation of Intermittent Swampy Woodland area to ensure that there is enough time for target large wading bird species to recruit.	To determine the suitability of the target area to provide habitat for waterbird breeding.
Telemetry on depth gauges should be used to continuously monitor depth through the wetting and drying phases of the water regime.	To better understand the hydrology of the system and contribute towards adaptive management of the site.
Photo point monitoring of tree health within the woodlands should be undertaken.	To develop baselines to assist condition assessments.

11 Adaptive Management

Mallee CMA uses an adaptive management approach in planning and managing environmental watering actions.

Adaptive management is the process of incorporating new scientific and operational information into the implementation of a project or plan to ensure that management actions are appropriate, effective and contribute to goals efficiently. It is a standard and well-established practice for environmental water management, recognising the inherent uncertainties and risks associated with the complex relationships between changes to hydrology and ecological responses, and the potential for a watering event to provide both positive and adverse outcomes. Figure 21 shows an illustration of the adaptive management cycle for environmental water delivery.

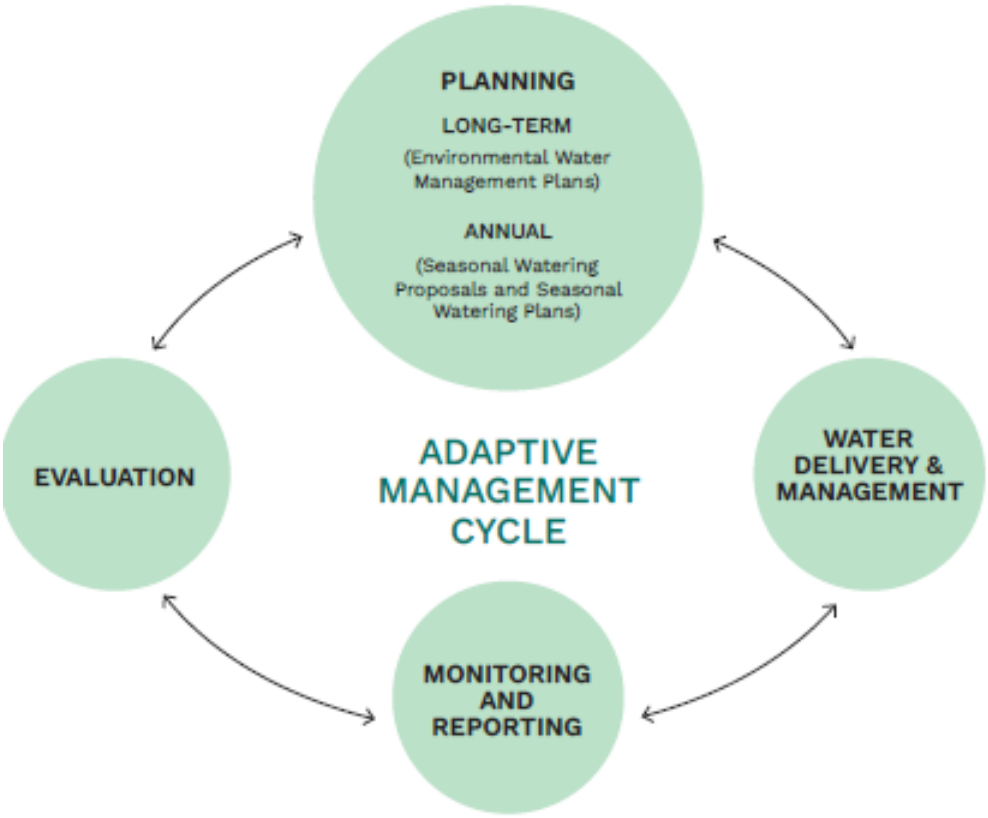


Figure 21. The adaptive management cycle for environmental water delivery and management

Mallee CMA uses three main pathways to identify inputs to the adaptive management process (also referred to as lessons):

- monitoring to detect differences between what was planned and the outcomes at the environmental watering site
- incidental observations by managers, operators or other observers that identify opportunities to reduce risk or improve outcomes
- research or investigations into hydraulic or ecological management practices that could improve the conceptual models on which operations are based.

Mallee CMA formally documents lessons to strengthen organisational memory and provide transparency in continual improvement measures. Recording of lessons is crucial for both annual environmental watering actions and long-term planning. Demonstrating continual improvement provides the justification for monitoring programs and confirms that assets are being managed responsibly.

An adaptive management framework has several components that work together to build lessons learned from environmental watering actions and program partners into the environmental water program. This produces iterative improvements in the way environmental watering is undertaken using the best available evidence.

The EWMP will be constantly refined to incorporate learnings from ecological monitoring as well as feedback from community consultation.

Land managers and river operators are included in the operational planning cycle which include adaptive management processes to incorporate learnings and risk management.

12 Knowledge gaps and recommendations

This plan is based on best information at the time of writing. In some cases, information is scarce or outdated. Further investigation and information collection will continue and the results of this further work will continue to build a better picture of the site and add rigor to future planning. Some areas where further knowledge would be beneficial are outlined in Table 16. Any future monitoring plan could include a number of these recommendations.

Table 16. Knowledge gaps and recommendations for the target area

Knowledge and data gaps	Action recommended	Responsibility
Index of Wetland Condition/ Index of Stream Condition Assessments	IWC/ISC assessments undertaken to establish baseline condition and as the basis for ongoing monitoring of improvement over time	Implementation of any of these recommendations would be dependent on investment from Victorian and Australian Government funding sources as projects managed through the Mallee CMA
Full extent of cultural Heritage values	Cultural heritage assessment and mapping of values within target area	
Impact of watering program on native vegetation	Continue to investigate and understand the range of species at the site, including surveys of vegetation, including aquatic macrophytes.	
Condition Lignum and aquatic macrophytes. The range of species at the site, including surveys of vegetation, including aquatic macrophytes.	Undertake methods identified in Table 16**Error! Reference source not found.**.	
Range of waterbird species that breed at the site, and the condition of suitable nesting habitat.	Undertake methods identified in The foci for monitoring identified for the Wemen-Liparoo target area are presented in Table 16. The monitoring methods in Table 16 will enable environmental water managers	

	to assess progress against targets and assist in the adaptive management of the target area to achieve the stated environmental objectives and outcomes. Table 14**Error! Reference source not found.**.	
Groundwater and salinity interactions at the site.	Analysis of groundwater information collected through groundwater bore monitoring.	

13 References

Baker-Gabb, D. and Hurley, V.., 2011. National Recovery Plan for the Regent Parrot (eastern subspecies). East Melbourne, Victoria: Department of Sustainability and Environment.

Briggs, S.V., 1990. Waterbirds. In: The Murray. Canberra, ACT: Murray-Darling Basin Commission, pp.337–344.

Butcher, R., Cottingham, P. and Fenton, A. (2020) Briefing paper: Update of Mallee EWMP objectives, Report prepared by Water's Edge Consulting for Mallee Catchment management Authority, Mooroolbark, Victoria.

DELWP, 2015. Long-term Watering Plan- Victorian Murray, Victoria Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DEPI, 2015. EVC benchmarks. [text] EVC benchmarks. Available at: <http://www.depi.vic.gov.au/environment-andwildlife/biodiversity/evc-benchmarks> [Accessed 28 Oct. 2015].

DSE, 2001. Action Statement; Great Egret Ardea alba, Intermediate Egret Ardea intermedia, Little Egret Egretta garzetta. East Melbourne, Victoria: Department of Sustainability and Environment.

DSE, 2002. Action Statement: Predation of native wildlife by the introduced Red Fox (Vulpes vulpes). East Melbourne, Victoria: Department of Sustainability and Environment.

DSE, 2004. Action Statement: Predation of Native Wildlife by the Cat (Felis catus). East Melbourne, Victoria: Department of Sustainability & Environment.

Ecological Associates, 2006. Investigation of Water Management Options for the Murray River - Nyah to Robinvale: Final Report. Mildura, Victoria: Report prepared for Mallee Catchment Management Authority.

Ecological Associates, 2007. Final Report - Investigation of water management options for the River Murray - Robinvale to Walpolla Island. Mildura, Victoria: Report prepared for Mallee CMA.

Gawne, B. and Scholz, O. 2006. Synthesis of a new conceptual model to facilitate management of ephemeral deflation basin lakes. Lakes and reservoirs, 11(3), 117-188.

Kennett, R., Roe, R., Hodges, K. and Georges, A., 2009. Chelodina longicollis - Eastern Long-necked Turtle, Common Longnecked Turtle, Common Snake-necked Turtle. Chelonian Research Foundation.

Kingsford, R.T. and Norman, F.I., 2002. Australian waterbirds - products of the continent's ecology. Emu, (102), pp.47–69.

Mallee CMA, 2003. Murray River Frontage Action Plan: Robinvale to Merbein Common. Mildura, Victoria: Mallee CMA.

Mallee CMA, 2006. Mallee Wetland Strategy. Mildura, Victoria: Mallee CMA.

Mallee CMA, 2014. Mallee Waterway Strategy 2014-22. Mildura, Victoria.

Mallee CMA, 2022. Environmental Watering Adaptive Management Framework, Mallee CMA, Mildura, Victoria.

Marchant, S. and Higgins, P., 1990. Handbook of Australian, New Zealand & Antarctic birds. Melbourne: Oxford University Press.

Murray-Darling Basin Authority (2019) Basin-wide environmental watering strategy, Murray–Darling Basin Authority Canberra, ACT.

Murray-Darling Basin Authority 2023a. Groundwater. Available at: https://www.mdba.gov.au/water-management/groundwater

Murray-Darling Basin Authority 2023b. Groundwater management. Available at: https://www.mdba.gov.au/water-management/groundwater/groundwater-management

Peters, G., 2009. Aquatic Value Identification and Risk Assessment (AVIRA). Environmental, Social and Economic Values and Threats. Belmont, Victoria: Riverness Pty Ltd.

Purdey, D. and Loyn, R., 2008. Wetland use by Blue-billed Ducks Oxyura australis during Summer Waterfowl Counts in NorthWest Victoria, 1984-2008. Heidelberg, Victoria: Arthur Rylah Institute for Environmental Research.

Robertston, A.I., Bacon, P. and Heagney, G., 2001. The responses of floodplain primary production to flood frequency and timing. Journal of Applied Ecology, (38), pp.126–136.

Rogers, K. and Ralph, T.J., 2011. Floodplain wetland biota: in the Murray-Darling basin; water and habitat requirements. Collingwood: CSIRO Publishing.

Spencer, J. and Wassens, S., 2009. Responses of waterbirds, fish and frogs to environmental flows in the Lowbidgee wetlands in 2008-09. Sydney.

Young, W.J., 2001. Rivers as ecological systems: the Murray-Darling Basin. Canberra, ACT: Murray-Darling Basin Commision.

Zeng, L., McGowan, S., Swann, G. E. A., Leng, M. J., Chen, X. 2022. Eutrophication has a greater influence on floodplain lake carbon cycling than dam installation across the middle Yangtze region. Journal of Hydrology, 614(a).

APPENDIX 1. ENVIRONMENTAL WATER MANAGEMENT PLAN CONTEXT

Environmental water in Victoria is managed as an integral part of the Victorian Waterway Management Program. The state-level Victorian Waterway Management Strategy (VWMS) provides the overarching framework for environmental water management (see accompanying figure). The Mallee Waterway Strategy (2014-22) drives implementation of the VWMS at the regional level. Information from the Mallee Waterway Strategy is a key input to environmental water planning arrangements, including the selection of eligible assets to receive environmental water. Environmental water management plans are site-specific plans developed for a wetland or wetland complex deemed a priority to receive environmental water through the Mallee Waterway Strategy development process. This document is the Environmental Water Management Plan (EWMP) for Wemen-Liparoo in the Mallee Catchment Management region.

Environmental watering in the Mallee Region has historically been supported by management plans such as this one, that document key information including the watering requirements of an asset, predicted ecological responses and water delivery arrangements. These plans support annual decisions about which sites should receive water and assist managers to evaluate how well those assets respond to the water they receive or what could be done better. Environmental water management at Wemen-Liparoo is further underpinned by the Murray-Darling Basin Plan 2012 (Commonwealth) and the associated Basin-wide environmental watering strategy. In accordance with Basin Plan requirements, Victoria has also developed the Victorian Murray Water Resource Plan and Victorian Murray Long-Term Watering Plan, which apply at Wemen-Liparoo.

Mallee Catchment Management Authority (MCMA), the Victorian Department of Energy, Environment and Climate Action (DEECA), the Victorian Environmental Water Holder (VEWH) and Traditional Owner groups have worked together to develop several EWMPs for watered assets throughout the Mallee region. These plans are continually updated through an adaptive management process. A primary purpose of EWMPs is to provide a consistent set of documents that support seasonal watering proposals to be submitted by asset managers to the VEWH annually.

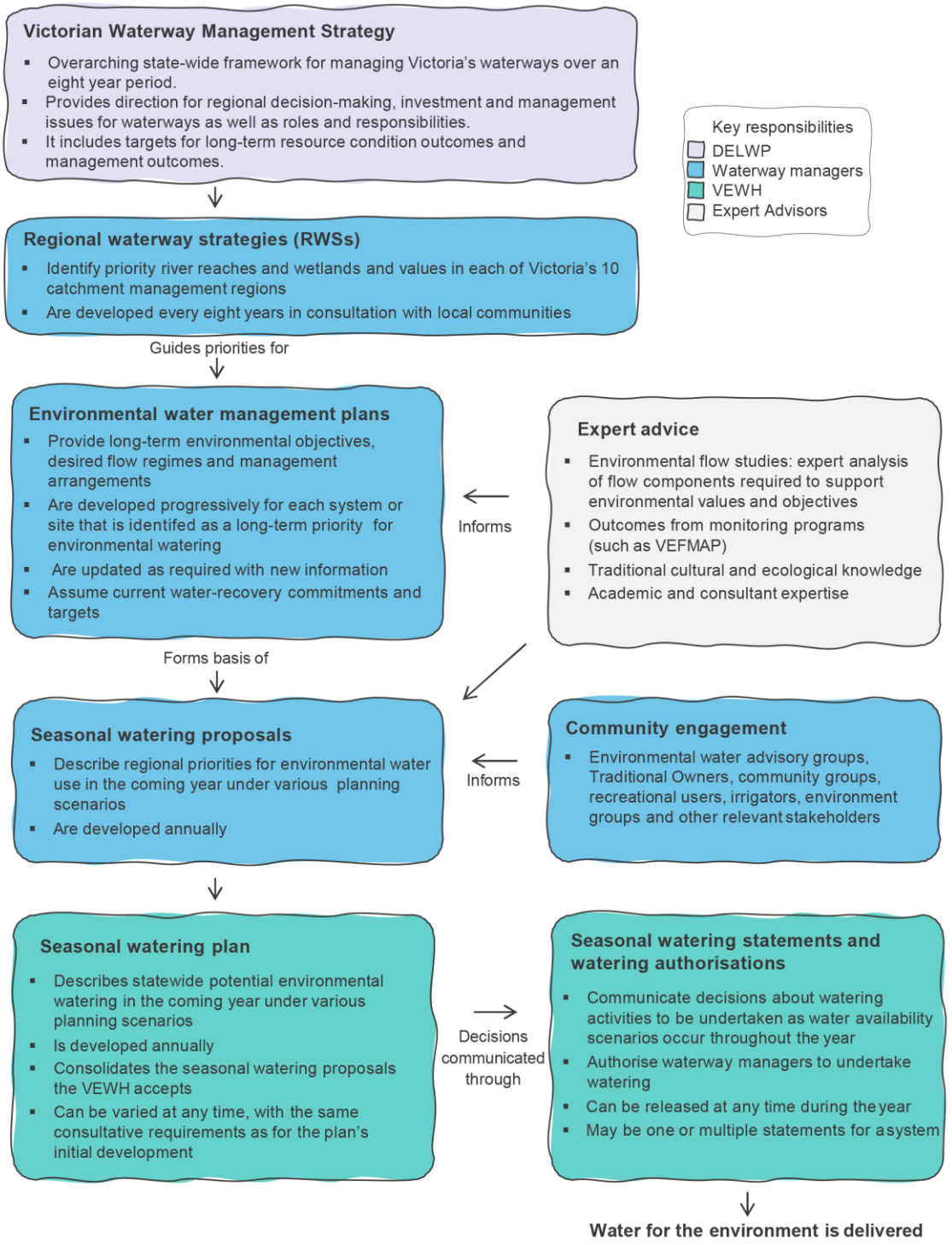


Figure 22. EWMP Policy Context

APPENDIX 2. ECOLOGICAL VEGETATION CLASSES

Table 17. EVCs at Wemen-Liparoo

EVC no.	EVC name	Bioregional conservation status	Description
103	Riverine Chenopod Woodland	Depleted	Eucalypt woodland to 15 m tall with a diverse shrubby and grassy understorey occurring on most elevated riverine terraces. Confined to heavy clay soils on higher level terraces within or on the margins of riverine floodplains (or former floodplains), naturally subject to only extremely infrequent incidental shallow flooding from major events if at all flooded.
158	Chenopod Mallee	Vulnerable	Open to very open mallee woodland to 12 m tall (almost invariably dominated by Eucalyptus gracilis) supported by thin Woorinen deposits typically overlying gypsiferous and sodic clays. Characterised by the dominance of saltbushes and semi- succulent understorey shrubs.
200	Shallow Freshwater Marsh	Vulnerable	Generally, shallow freshwater marshes are no more than half a metre deep and usually dry out in summer. They are usually formed in volcanic flow beds. Large stands of River Red Gum or Lignum are often found around shallow freshwater marshes, with reeds, rushes and Cane Grass, or low-growing herbs and sedges, dominating the vegetation.
295	Riverine Grassy Woodland	Depleted	Occurs on the floodplain of major rivers, in a slightly elevated position where floods are rare, on deposited silts and sands, forming fertile alluvial soils. River Red Gum woodland to 20 m tall with a groundlayer dominated by graminoids and sometimes lightly shrubby or with chenopod shrubs.
808	Lignum Shrubland	Least concern	Relatively open shrubland of species of divaricate growth form. The ground-layer is typically herbaceous or a turf grassland, rich in annual/ephemeral herbs and small chenopods. Characterised by the open and even distribution of relatively small Lignum shrubs. Occupies heavy soil plains along River Murray, low-lying areas on higher-level (but still potentially flood-prone) terraces.
810	Floodway Pond Herbland	Depleted	Low herbland to < 0.3 m tall with occasional emergent life forms, usually with a high content of ephemeral species. Floors of ponds associated with floodway systems. Typically heavy deeply cracking clay soils. Characteristically smaller wetlands with a more regular flooding and drying cycle in comparison to sites supporting Lake Bed Herbland.
813	Intermittent Swampy Woodland	Depleted	Eucalypt woodland to 15 m tall with a variously shrubby and rhizomatous sedgy - turf grass understorey, at best development dominated by flood stimulated species in association with flora tolerant of inundation. Flooding is unreliable but extensive when it happens. Occupies low elevation areas on river terraces (mostly at the rear of pointbar deposits or adjacent to major floodways) and lacustrine verges (where sometimes localised to narrow transitional bands). Soils often have a shallow sand layer over heavy and frequently slightly brackish soils.
818	Shrubby Riverine Woodland	Least concern	Eucalypt woodland to open forest to 15 m tall of less floodprone (riverine) watercourse fringes, principally on levees and higher sections of point-bar deposits. The understorey includes a range of species shared with drier floodplain habitats with a sparse shrub component, ground-layer patchily dominated by various life-forms. A range of large dicot herbs (mostly herbaceous perennial, several with a growth-form approaching that of small shrub) are often conspicuous.
823	Lignum Swampy Woodland	Depleted	Understorey dominated by Lignum, typically of robust character and relatively dense (at least in patches), in association with a low Eucalypt and/or Acacia woodland to 15 m tall. The ground layer includes a component of obligate wetland flora that is able to persist even if

			dormant over dry periods.
103	Riverine Chenopod Woodland	Depleted	Eucalypt woodland to 15 m tall with a diverse shrubby and grassy understorey occurring on most elevated riverine terraces. Confined to heavy clay soils on higher level terraces within or on the margins of riverine floodplains (or former floodplains), naturally subject to only extremely infrequent incidental shallow flooding from major events if at all flooded.

APPENDIX 3. FAUNA SPECIES LIST

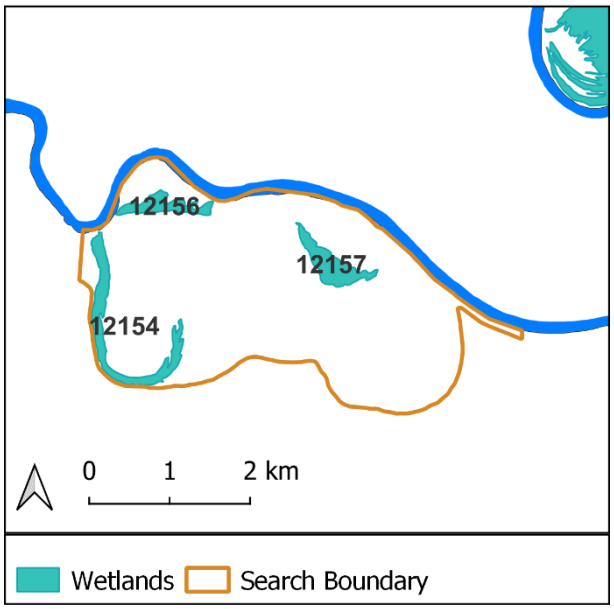


Table 18. Fauna Species list for Wemen-Liparoo

Scientific Name	Common Name	FFG Act Status	EPBC Act Status
Gymnorhina tibicen	Australian magpie	-	-
Pelecanus conspicillatus	Australian pelican	-	-
Anthus australis	Australian pipit	-	-
Corvus coronoides	Australian raven	-	-
Barnardius zonarius	Australian ringneck	-	-
Chenonetta jubata	Australian wood duck	-	-
Northiella haematogaster	Blue bonnet	-	-
Cincloramphus cruralis	Brown songlark	-	-
Pomatostomus ruficeps	Chestnut-crowned babbler	-	-
Acanthiza uropygialis	Chestnut-rumped thornbill	-	-
Platycercus elegans	Crimson rosella	-	-
Felis catus	Domestic cat (feral)*	-	-
Ardea alba modesta	Eastern great egret	Vulnerable	-
Fulica atra	Eurasian coot	-	-
Eolophus roseicapilla	Galah	-	-
Colluricincla harmonica	Grey shrike-thrush	-	-
Dacelo novaeguineae	Laughing kookaburra	-	-
Cacatua sanguinea	Little corella	-	-
Philemon citreogularis	Little friarbird	-	-
Microcarbo melanoleucos	Little pied cormorant	-	-
Nycticorax caledonicus	Nankeen night-heron	-	-
Manorina melanocephala	Noisy miner	-	-

Scientific Name	Common Name	FFG Act Status	EPBC Act Status
Anas superciliosa	Pacific black duck	-	-
Geopelia placida	Peaceful dove	-	-
Malurus assimilis	Purple-backed fairywren	-	-
Corvus spp.	Ravens and crows	-	-
Petroica goodenovii	Red-capped robin	-	-
Psephotus haematonotus	Red-rumped parrot	-	-
Polytelis anthopeplus monarchoides	Regent parrot	Vulnerable	Vulnerable
Pachycephala rufiventris	Rufous whistler	-	-
Todiramphus sanctus	Sacred kingfisher	-	-
Gavicalis virescens	Singing honeyeater	-	-
Malurus splendens	Splendid fairy-wren	-	-
Pardalotus striatus	Striated pardalote	-	-
Cacatua galerita	Sulphur-crested cockatoo	-	-
Petrochelidon nigricans	Tree martin	-	-
Gerygone fusca	Western gerygone	-	-
Egretta novaehollandiae	White-faced heron	-	-
Ptilotula penicillata	White-plumed honeyeater	-	-
Rhipidura leucophrys	Willie wagtail	-	-
Acanthiza nana	Yellow thornbill	-	-
Acanthiza chrysorrhoa	Yellow-rumped thornbill	-	-

* indicates introduced

Source: Naturekit search 2023, and personal observations by Mallee CMA field staff.

APPENDIX 4. FLORA SPECIES LIST

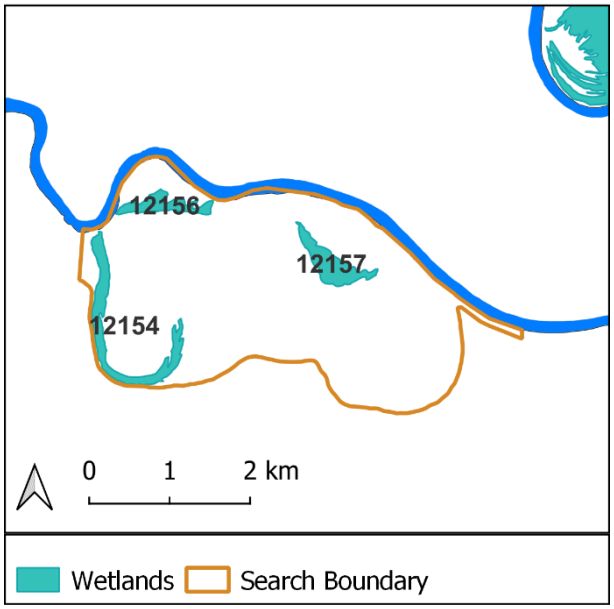


Table 19. Flora Species List for Wemen-Liparoo

Scientific Name	Common Name	FFG Act Status	EPBC Act Status
Eucalyptus largiflorens	Black box	-	-
Solanum nigrum s.l.	Black nightshade*	-	-
Ranunculus spp.	Buttercup	-	-
Centipeda cunninghamii	Common sneezeweed	-	-
Sonchus oleraceus	Common sow-thistle*	-	-
Cynodon dactylon	Couch^	-	-
Lolium temulentum	Darnel*	-	-
Vittadinia dissecta s.l.	Dissected New Holland daisy	-	-
Geococcus pusillus	Earth cress	-	-
Euphorbia drummondii s.l.	Flat spurge^	-	-
Laphangium luteoalbum	Jersey cudweed	-	-
Silene nocturna	Mediterranean catchfly*	-	-
Einadia nutans	Nodding saltbush	-	-
Hordeum glaucum	Northern barley-grass*	-	-
Plantago spp.	Plantain	-	-
Lactuca serriola	Prickly lettuce*	-	-
Bromus rubens	Red brome*	-	-
Wahlenbergia fluminalis	River bluebell	-	-
Eucalyptus camaldulensis	River red-gum	-	-
Sonchus asper s.l.	Rough sow-thistle*	-	-
Cardamine tenuifolia	Slender bitter-cress	-	-
Rumex brownii	Slender dock	-	-
Hypochaeris glabra	Smooth cat's-ear*	-	-

Cirsium vulgare	Spear thistle*	-	-
Centipeda minima s.l.	Spreading sneezeweed	-	-
Paspalidium jubiflorum	Warrego summer-grass^	-	-

* indicates introduced
^ indicates native, but some stands may be alien

Source: Naturekit search 2023, and personal observations by Mallee CMA field staff.

APPENDIX 5. COMMUNITY AND AGENCY ENGAGEMENT 2024 SUMMARY

Community Engagement

Mallee CMA conducted in-person community engagement in December 2023. From that engagement, one participant identified Wemen-Liparoo as a site they value, and 'camping' as the key value/use of this site.

Community stakeholders were engaged via an online survey, which was hosted on the Mallee CMA website in December 2023 – January 2024. The survey was designed to enable community, landholders, recreational users, environmental groups and other interested parties to provide input to the plans. Community stakeholders were also engaged during local events such as the local markets and local environmental group meetings, though only one community member engaged at in-person events provided information on Wemen-Liparoo wetlands – this was at the Swan Hill Market in December 2023. This community member identified 'Camping' values at 'Wemen'. The survey supplements earlier community engagement about the Wemen-Liparoo EWMPs, and annual community engagement that informs the Seasonal Watering Proposal (SWP). Community consultation occurs at the IAP2 level of CONSULT.

Four participants completed who the online survey (residents, recreational users, business operators and a member of the VMRG community group) identified Wemen-Liparoo as a site that they visit; Liparoo East Billabong and Liparoo West Billabong are accessed monthly or every few months, year-round, for a range of uses. These uses were ranked in priority order, as follows:

Table 20. Uses of target wetlands at Wemen-Liparoo, ranked in priority order. Source: Mallee CMA online engagement, 2024.

Priority	Use
1	Camping
2	Boating
3	Nature appreciation - animals
4	Nature appreciation – plants
5	Walking/running
6	Birdwatching
7	Socialising
8	Fishing
9	Kayaking
10	Swimming
N/A	Cultural connection

In response to the question 'Both wetting and drying cycles are important for wetland health. Since river regulation, our wetlands often don't get the inundation they need because when floods do occur, they are shorter and less frequent. How would you feel about natural watering cycles returning to this area?', 3 out of 4 participants responded 'strongly agree'.

Agency Engagement

Mallee CMA consulted with Parks Victoria and Lower Murray Water about the Wemen-Liparoo EWMP in February 2024. During this session, Parks Victoria and Lower Murray Water discussed infrastructure at Wemen-Liparoo.

APPENDIX 6. ASSESSING RISKS

Assessing Risk - Consequence

Prioritising wetland watering is often difficult because there is no framework by which the fate of different species can be compared. To support prioritization, this guide seeks to put each wetland and its associated species within a regional context. The process can also be used when communicating the rationale behind decisions or support engagement by providing a framework for discussion.

The process is presented in Figure A1, with a more detailed explanation provided in Tables A1 and A2.

Table A1.

Row	Question	Rationale	Response	Risk	Go To
1	Will the species persist *in situ*?	If the species will survive without intervention, It becomes a lower priority	Yes	Low	
			No		Row 2
2	Will the species persist in a connected refuge?	If the species has the capacity (its own capability and appropriate connectivity) to survive, it becomes a lower priority	Yes		Table 2
			No		Row 3
3	Is the species common?	If a species is common then there may be other populations that are more likely or easier to protect than the ones in the wetland.	Yes	Med	
			No	High	

Table A2

Row	Question	Rationale	Response	Risk	Go To
1	Is the species short or long lived?	Long-lived species often have greater capacity to endure periods of hardship, whereas short lived species are programmed to die.	Long	Med	
			Short		Row 2
2	Does the species need the wetland to recruit?	If the species requires the wetland to recruit then sustaining will require protection of wetland condition.	No	Med	
			Yes		Row 3
3	Is the species common?	If a species is common then there may be other populations that are more likely or easier to protect than the ones in the wetland.	Yes	Mod	
			No	High	

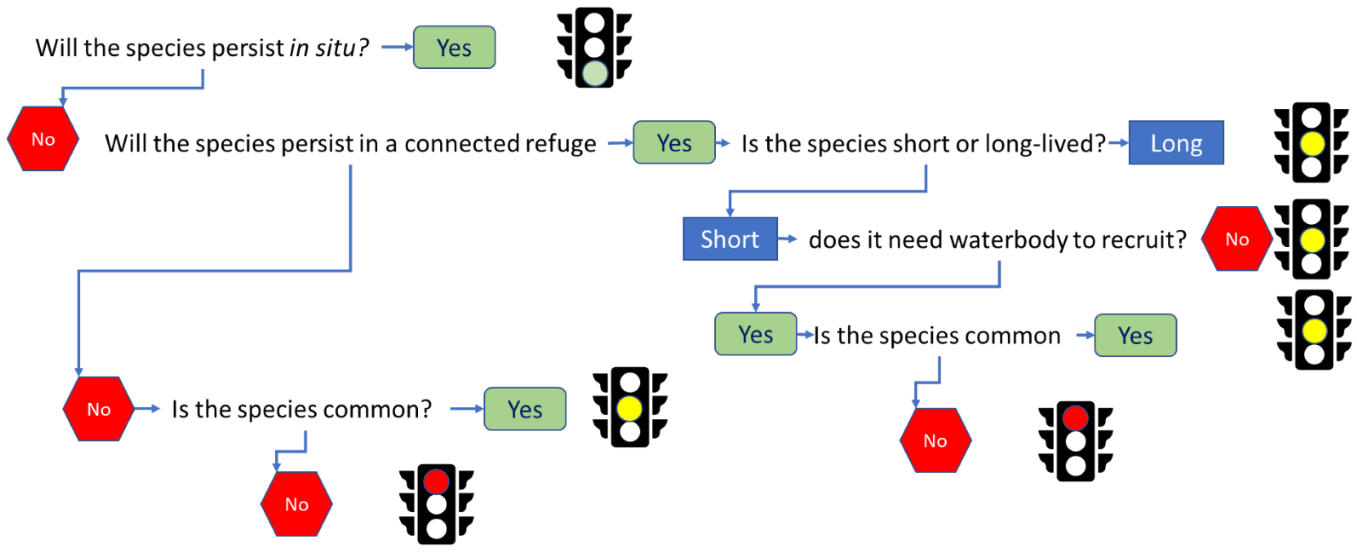


Figure A1 – Decision tree for assessing risk

APPENDIX 7. WEMEN-LIPAROO EWMP UPDATED ENVIRONMENTAL OBJECTIVES, FURTHER INFORMATION (FROM BUTCHER ET AL. 2020)

Information describing rationale behind updated environmental objectives and targets for Wemen-Liparoo EMWP (from Butcher at al. 2020).

SMARTness and rationalisation

Site-specific environmental objectives for the Wemen-Liparoo EWMP (Mallee CMA 2016d).

EWMP objectives
WL1: Support seasonal habitat for small native fish – (Wetland area: Liparoo and Liparoo East Billabongs)
WL2: Provide seasonal feeding habitat for large waders and waterfowl – (Wetland area: Liparoo and Liparoo East Billabongs)
WL3: Maintain a community of drought-tolerant emergent aquatic macrophytes at the wetland edge – (Wetland area: Liparoo and Liparoo East Billabongs)
WL4: Healthy and productive Lignum Swampy Woodland community that supports frogs and small native fish when flooded – (Wetland area: Liparoo Billabong – Lignum Swampy Woodland area)
WL5: Maintain Lignum Shrubland and provide occasional breeding events by platform building waterbirds including Ibis and Spoonbill – (Wetland area: Liparoo Billabong – Lignum Swampy Woodland area)

Assessment of SMARTness of current Wemen-Liparoo EWMP objectives. Scoring: 1 is criterion met, 0 is criterion not met, and 0.5 is partially met

	Specific		Measurable			Achievable		Relevant		Timely	
Objective	Magnitude clearly specified	Location and scale detailed	Indicators available or easily developed	Can be analysed using accepted statistical practices	Capacity to collect data exists	Under river operating constraints and current climate variability	Considered feasible by knowledgeable stakeholders	Matters driven by environmental watering and/or works and measures	Linked to BP objectives	Absolute date or time period specified	Considers likely lags in response
WL1	0	0.5	1	1	1	0.5	1	1	1	0	0
WL2	0	0.5	1	1	1	0.5	1	1	1	0	0
WL3	0	0.5	1	1	1	0.5	1	1	1	0	0
WL4	0	0.5	1	1	1	0.5	1	1	0	0	0
WL5	0	0.5	1	1	1	0.5	1	1	1	0	0

Rationalised environmental objectives for the Spence's Bend EWMP (Mallee CMA 2016d)

Objective	Issue	Outcome
WL1	Not considered viable by the MCMA as e-water can only be delivered by pumps to wetlands. Following water delivery, hydrological regime has them drying frequently thus not primary habitat for small bodied fish.	Deleted
WL2	No issue with objective other than its not fully SMART and no baseline data.	Objective updated to align with Basin Plan language
WL3	No issue with objective other than its not fully SMART and no baseline data.	Objective updated to align with Basin Plan language
WL4	On advice from the MCMA the frog and fish are not to be included in this objective.	Objective simplified to focus on Lignum vegetation
WL5	No issue with objective other than its not fully SMART and no baseline data.	Objective updated to align with Basin Plan language – need species that are recorded as breeding at the site.

Basin Plan Schedule 8 criteria for which the site is identified as a PEA in the Victorian Murray LTWP (DELWP 2015).

Schedule 8 criteria met	Schedule 9 criteria met
From DELWP (2015a)	
3: Contains a floodplain wetland complex of four wetlands which are categorised as deep freshwater marsh, shallow freshwater marsh and permanent open freshwater. **4:** EPBC Act, FFG Act, DSE Listed **5:** A high level of ecological communities exist within the site (9 EVCs) ^	**1:** Supports the creation and maintenance of vital habitats and populations **2:** water quality - ecosystem processes supports the transportation and dilution of nutrients, organic matter and sediment; supports the dilution of carbon and nutrients from the floodplain to the river system **4:** lateral connectivity - (between floodplains, anabranches and wetlands)
Updated assessment	
3(a)iii: Vital habitat - feeding, breeding, nursery sites **3(b):** Prevents declines in native biota	**1(c):** Vital habitat - feeding, breeding, nursery sites **1(e):** Vital habitat - preventing decline of native biota

^ Mapping PEA criteria 5 to EVC is not appropriate

Mapping Wemen-Liparoo EWMP objectives to Basin Plan EWP objectives, Schedule 7 targets, BWS QEEO, and LTWP Vic Murray objective.

EWMP objectives	Relevant Basin Plan EWP objective	Relevant Schedule 7 target	Relevant BWS QEEO	LTWP objective
WL1: Support seasonal habitat for small native fish – (Wetland area: Liparoo and Liparoo East Billabongs)	8.05,3(b)	Condition of priority asset - prevention of decline in native biota	B4.5	LTWPVM15 LTWPVM17 LTWPVM18
WL2: Provide seasonal feeding habitat for large waders and waterfowl – (Wetland area: Liparoo and Liparoo East Billabongs)	8.05,3(b)	Condition of priority asset - Vital habitat - feeding, breeding, nursery	B3.1	LTWPVM12 LTWPVM13
WL3: Maintain a community of drought-tolerant emergent aquatic macrophytes at the wetland edge – (Wetland area: Liparoo and Liparoo East Billabongs)	8.05,3(b) 8.06,6(b)	Condition of priority asset - prevention of decline in native biota Diversity of native water dependent vegetation Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species	B2.11	LTWPVM2
WL4: Healthy and productive Lignum Swampy Woodland community that supports frogs and small native fish when flooded – (Wetland area: Liparoo Billabong – Lignum Swampy Woodland area)	8.05,3(b)	Condition of priority asset - prevention of decline in native biota	B2.10	LTWPVM6
WL5: Maintain Lignum Shrubland and provide occasional breeding events by platform building waterbirds including Ibis and Spoonbill – (Wetland area: Liparoo Billabong – Lignum Swampy Woodland area)	8.05,3(b) 8.06,6(b)	Condition of priority asset - prevention of decline in native biota Recruitment and populations of native water-dependent birds	B3.3	LTWPVM10

Updated objectives for Wemen-Liparoo

Current objective	**WL1: Support seasonal habitat for small native fish** – (Wetland area: Liparoo West and Liparoo East Billabongs)
Comments	Deleted

Current objective	**WL2: Provide seasonal feeding habitat for large waders and waterfowl** – (Wetland area: Liparoo West and Liparoo East Billabongs)
Comments	
EWP objective(s)	8.05,3(b)
Schedule 7 targets	Condition of priority asset - Vital habitat - feeding, breeding, nursery
PEA/PEF criteria met	PEA 3(a) iii Vital habitat - feeding, breeding, nursery sites PEF 1 (c) Vital habitat - feeding, breeding, nursery sites
BWS QEEO	B3.1 That the number and type of water bird species present in the Basin will not fall below current observations
LTWP objective	LTWPVM12: That the number and type of water bird species present in the Basin will not fall below current observations LTWPVM13: Improve feeding areas for waterbirds
LTWP target	Appropriate water regime to support feeding and habitat areas for guilds of waterbirds delivered at 50% of sites, 8 years in 10
2020 Objective:	By 2030, maintain representative populations of shallow-water and deep-water feeding guilds of waterbird (F2 and F3, respectively, after Jaensch 2002) at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo by maintaining a mixture of shallow and deep-water habitats.
2020 Targets:	By 2030, 80% of representative F2 and F3 species recorded at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo in 8 out of any 10-year period where conditions are suitable. • Representative F2 species include: Australasian Grebe (*Tachybaptus novaehollandiae*), Pacific Black Duck (*Anas superciliosa*), White-necked Heron (*Ardea pacifica*), Australian White Ibis (*Threskiornis molucca*), Masked Lapwing (*Vanellus miles*) • Representative F3 species include: Australian Pelican (*Pelecanus conspicillatus*), Great Cormorant (*Phalacrocorax carbo*), Little Black Cormorant (*Phalacrocorax sulcirostris*), Australian Darter () • Feeding habitat defined as a mixture of deep feeding areas (water >1 m) and shallow feeding areas (<0.5 m depth and or drying mud) with intermittent inundation of densely vegetated shrublands.

Current objective	**WL3: Maintain a community of drought-tolerant emergent aquatic macrophytes at the wetland edge** – (Wetland area: Liparoo West and Liparoo East Billabongs)
Comments	Adopted WRIGs developed by DELWP. Some species need to be identified as currently not all aquatic WRIGs represented in the flora lists in the EWMP.
EWP objective(s)	8.05,3(b) 8.06,6(b)
Schedule 7 targets	Condition of priority asset - prevention of decline in native biota Diversity of native water dependent vegetation Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species
PEA/PEF criteria met	PEA 3(b) Prevents declines in native biota PEF 1(e) Vital habitat - preventing decline of native biota
BEWS QEEO	None specified
LTWP objective	LTWPVM2 Improve the species richness of aquatic vegetation in wetlands
LTWP target	None specified for non-woody vegetation
2020 Objective:	By 2030, improve vital habitat at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo, by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.
2020 Targets:	By 2030, increase diversity of native of macrophytes at Liparoo West and Liparoo East Billabongs, Wemen-Liparoo with ≥2 species from each of the following Water Regime Indicator Groups present in 80% of years: • Aquatic to semi-aquatic (persistent) (Asp) (Short-fruit Nardoo *Marsilea hirsute*) • Seasonally immersed – low growing (Slg) (Common Woodruff *Asperula conferta*, Twin-leaf Bedstraw *Asperula gemelli*, Common Spike-sedge *Eleocharis acuta*, Poison Pratia *Lobelia concolor*, Tall Fireweed *Senecio runcinifolius*, Blue Rod *Stemodia florulenta*, River Bluebell *Wahlenbergia fluminalis*) • Seasonally inundated – emergent non woody (Sen) (Spiny Flat-sedge *Cyperus gymnocaulos*, Warrego Summer-grass *Paspalidium jubiflorum*) • Mud herbs (Muh) (Spreading Sneezeweed *Centipeda minima s.l.*, Mousetail *Myosurus australis*, Starry Goosefoot *Scleroblitum atriplicinum*, Sweet Fenugreek *Trigonella suavissima*) Only a subset of WRIGs applied due to 'drought tolerant' in the original objective. Can add other WRIGs as needed.

Current objective	**WL4: Healthy and productive Lignum Swampy Woodland community that supports frogs and small native fish when flooded** – (Wetland area: Liparoo West Billabong – Lignum Swampy Woodland area)
Comments	Objective simplified to focus on Lignum vegetation
EWP objective(s)	8.05,3(b)
Schedule 7 targets	Condition of water-dependent vegetation
PEA/PEF criteria met	PEA criteria: 3(b) Prevents declines in native biota
BWS QEEO	B2.10 Maintain extent of Lignum along the Murray River from the junction with the Wakool River to downstream of Lock 3, including Chowilla and Hattah Lakes
LTWP objective	LTWPVM8: Improve the condition of shrub and lignum dominated EVCs
LTWP target	A positive trend in the condition score of Shrub and Lignum dominated EVC benchmarks at 50% of sites over the 10 year period to 2025
2020 Objective:	By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Liparoo West Billabong – Lignum Swampy Woodland area, Wemen-Liparoo
2020 Targets:	By 2030, condition in standardised transects that span the floodplain elevation gradient and existing spatial distribution at Liparoo West Billabong – Lignum Swampy Woodland area Wemen-Liparoo ≥70% of Lignum plants in good condition with a Lignum Condition Score (LCI) ≥4.

Current objective	**WL5: Maintain Lignum Shrubland and provide occasional breeding events by platform building waterbirds including Ibis and Spoonbill** – (Wetland area: Liparoo West Billabong – Lignum Swampy Woodland area)
Comments	Breeding species need to be determined
EWP objective(s)	8.05,3(b) 8.06,6(b)
Schedule 7 targets	Condition of priority asset - Vital habitat - feeding, breeding, nursery Recruitment and populations of native water-dependent birds
PEA/PEF criteria met	PEA 3(a) iii Vital habitat - feeding, breeding, nursery sites PEF 1 (c) Vital habitat - feeding, breeding, nursery sites
BEWS QEEO	B3.3 Breeding events (the opportunities to breed rather than the magnitude of breeding per se) of colonial nesting waterbirds to increase by up to 50% compared to the baseline scenario
LTWP objective	LTWPVM10: Improve breeding opportunities for colonial-nesting waterbirds
LTWP target	Water required for successful colonial waterbird breeding delivered in at least 2 years in 10 by 2025
2020 Objective:	By 2030, maintain nesting and recruitment of colonial waterbirds (N7, after Jaensch 2002) at Liparoo West Billabong – Lignum Swampy Woodland area, Wemen-Liparoo by maintaining a mixture of tree, low vegetation/shrubs, and ground/islet nesting habitat.
2020 Targets:	There is a lack of data on species that breed at the site. The expectation is that the list of species commonly nesting at Wemen-Liparoo will be confirmed over time. By 2030, at least two of the following species to be recorded as nesting and/or breeding at Liparoo West Billabong – Lignum Swampy Woodland area, Wemen-Liparoo 50% years in which nesting/breeding conditions are suitable over the 10 year period: • Representative N7 species include: Australian White Ibis (*Threskiornis molucca*), Straw-necked Ibis (*Threskiornis spinicollis*), Royal Spoonbill (*Platalea regia*)

mallee
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