Environmental Water Management Plan

Photo: Pound Bend

Pound Bend

mallee
catchment management authority

Version Number	Description	Issued To	Issue Date
1.	Environmental Water Management Plan for the Pound Bend Waterway Management Unit – Preliminary Draft	J. White (Mallee CMA)	09/09/2014
2.	Environmental Water Management Plan for the Pound Bend Waterway Management Unit – Final Draft	J. White (Mallee CMA)	29/09/2014
3.	Environmental Water Management Plan for the Pound Bend Waterway Management Unit – FINAL REPORT	J. White (Mallee CMA)	17/11/2014
4.	Internal Review	L. Chapman and L. Murphy (Mallee CMA)	February 2015
5.	External Review – GHD	J. McAmley	25/03/2015
6.	Mallee CMA – Board approval	Mallee CMA Board	22/04/2015
7.	Environmental Water Management Plan for the Pound Bend Waterway Management Unit – Revised FINAL REPORT	S. Watson (DEECA)	30/06/2015
8.	Updated ecological objectives - Water's Edge Consulting	D. Wood (Mallee CMA)	16/12/2020
9.	Whole EWMP review and update to align with latest DEECA Guidelines	Mallee CMA	30/06/2025

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
ANAE	Australian National Aquatic Ecosystem
AWE	Australian Watering Environments
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)
EDBL	Ephemeral Deflation Basin Lake
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
LTWMP	Long-Term Watering Plan
MDBA	Murray-Darling Basin Authority
LTWP	Long Term Watering Plan
RAP	Registered Aboriginal Party
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
WEL	Watering Event Lessons
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 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 Pound Bend a sub-unit of the Happy Valley WMU, hereafter referred to as Pound Bend. The EWMP will help to guide future environmental watering activities for this area.

Pound Bend WMU sub – unit (Pound Bend) is located in the Robinvale Plains bioregion in the Murray River Reserve (river km 1066 to 1081), five kilometres north of Wemen, and covers 1365ha. It encompasses a diverse range of floodplain and terrestrial ecosystems, most of which are in poor condition. The target area for this plan covers 202 ha within Pound Bend and is the area that can potentially be inundated through the proposed environmental watering activities.

Pound Bend is a valuable asset of the region. The site has a high diversity of terrestrial and floodplain landforms and inundation regimes, which support a diverse range of water- dependent flora and fauna species. A number of these species are listed under state, national and international treaties, conventions, Acts and initiatives, including the Regent Parrot (*Polytelis anthopeplus monarchoides*), the Great Egret (Eastern) (*Ardea modesta*) and the Spreading Emu-bush (*Eremophila divaricata ssp. divaricate*). In addition to this, the area could potentially provide habitat for the threatened Carpet Python (*Morelia spilota metcalfie*). The area also contains a number of vulnerable or depleted Ecological Vegetation Classes (EVCs) including Lignum Swamp, Shallow Freshwater Marsh, Riverine Grassy Woodland, Floodway Pond Herbland, Sub-saline Depression Shrubland and Lignum Swampy Woodland.

The site currently receives some natural flooding which promotes vegetation growth. However, the frequency and duration of these flood events are notably less compared to a more natural regime (Gippel 2014). This changed hydrological regime has impacted on River Red Gum condition, with vegetation health degrading with distance from the riverbank (Cunningham et al. 2006).

Recreational impacts at the site are low. While irrigation occurs immediately adjacent to Pound Bend, and while some vegetation health issues may be attributable to the effects of irrigation drainage, the impacts are comparatively modest compared to other floodplain sites in the Mallee region. Assessment of groundwater salinity data suggests that the in-river salinity impacts from any future environmental watering event is likely to be relatively small.

The floodplains and wetlands will continue to receive less than their optimal 'natural' frequency of flooding without intervention. This will lead to a continued reduction in floodplain diversity and vegetation health. The declining floodplain vegetation health, diversity of habitat types, presence of water-dependent endangered species, and low salinity impact characteristics suggest the site would respond well to environmental watering.

The long-term management goal of the Pound Bend EWMP is:

> *To provide a water regime that reflects natural inundation seasonality and duration that will maintain and promote the mosaic of available habitats through the Pound Bend target area.*

To achieve this, ecological and hydrological objectives, have been designed and include two inundation stages. These have been developed to sustain the various ecological components of five targeted wetlands and have been incorporated into minimum, optimal and maximum long-term watering regimes.

The specific ecological objectives for this system are to:

> **PB1**: By 2030, improve vital habitat at Western Wetlands and Tammit Wetlands, Pound Bend by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.
>
> **PB2**: By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Eastern Wetlands, Pound Bend.
>
> **PB3:** By 2030, improve condition and maintain extent from baseline levels of River Red Gum (*Eucalyptus camaldulensis*) to sustain communities and processes reliant on River Red Gum woodlands at the Pound Bend asset
>
> The following minimum, optimal and maximum watering regimes have been developed to sustain and improve the ecological components of Pound Bend.

Minimum watering regime

Inundate Western and Tammit Wetlands five times in 10 years with a maximum 13 months between events once wetland is dry. Allow ponding for three to four months. Inundate Brown Swamp and Eastern Wetlands at least once every 10 years and allow ponding for at least two months, to maintain the health of Lignum present. Preferred timing for watering event is in spring or early summer.

Optimal watering regime

Inundate Western and Tammit Wetlands eight times in 10 years and allow ponding for three to four months. Inundate Brown Swamp and Eastern Wetlands four times in 10 years and allow ponding for up to six months. Preferred timing for watering event is in spring or early summer.

Maximum watering regime

Inundate Western and Tammit Wetlands every year and allow ponding for three to four months. Inundate Brown Swamp and Eastern Wetlands once every two years with a minimum of 12 months between events and allow ponding up to seven months. Preferred timing for watering event is in spring or early summer.

The delivery of environmental water necessary for these water regimes will require the installation of infrastructure, outlined in this plan. The proposed infrastructure requires further investigation and design.

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1 Introduction

This Environmental Water Management Plan (EWMP) has been prepared by the Mallee Catchment Management Authority (CMA) to establish the long-term management goals of Pound Bend.

The Pound Bend EWMP was first developed in 2015 and ecological objectives updated in 2020. This document is a full revision of the EWMP, to update content and to align the EWMP with version 6 of the EWMP Guidelines for rivers and wetlands released by the Department of Energy, Environment and Climate Action (DEECA, formerly DELWP) in 2022 (DELWP 2022).

1.1 PURPOSE AND SCOPE

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 Pound Bend and the management of its environmental values are listed in Table 1.

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

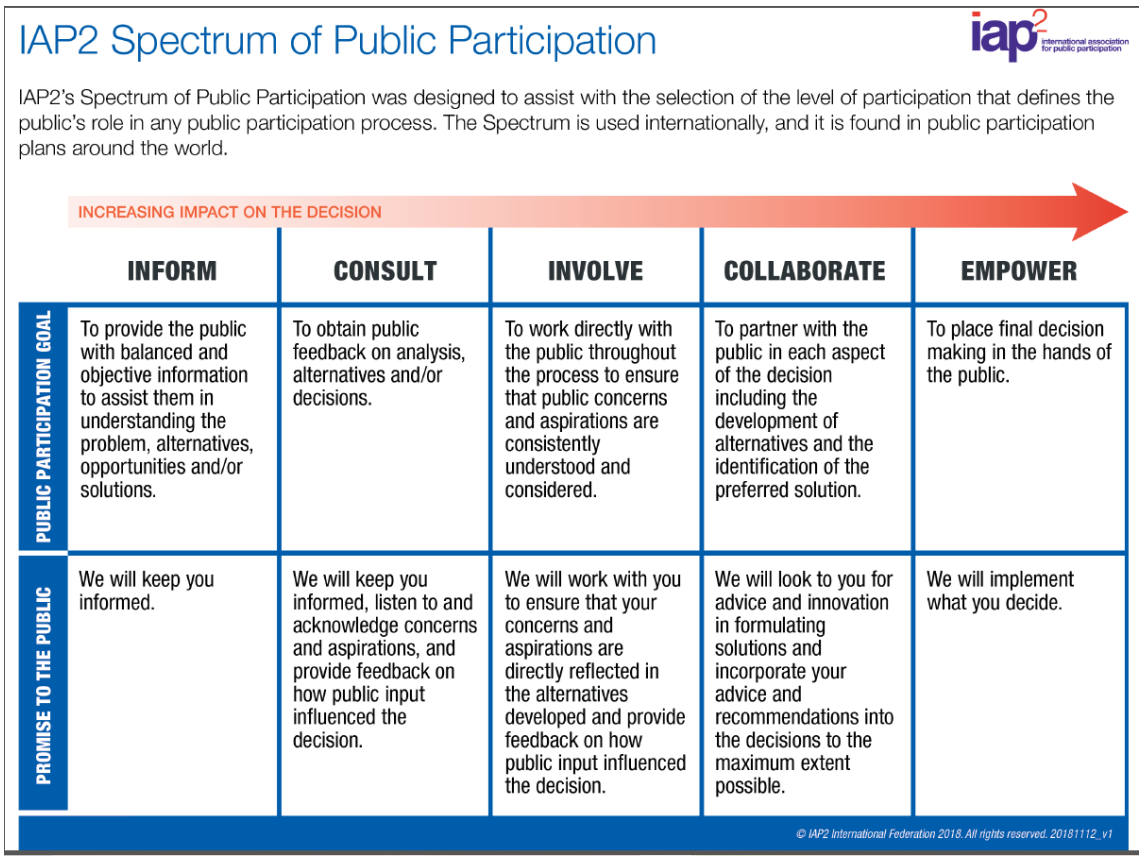
Legislation, Agreement or Convention	Jurisdiction
China-Australia Migratory Bird Agreement (CAMBA)	International agreement administered under the federal *Environment Protection and Biodiversity Conservation Act 1999.*
Japan-Australia Migratory Bird Agreement (JAMBA)	
Environment Protection and Biodiversity Conservation Act (1999) (EPBC)	National
Flora and Fauna Guarantee Act (FFG)	State
Department of Energy, Environment and Climate Action advisory lists (DEECA)	State

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). The spectrum allows for a tailored approach based on stakeholder groups and their needs.



IAP2 Spectrum of 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)

Table 2 lists the main stakeholder groups with an interest in environmental water based on their needs and interests and level of engagement required. To read more about the role of specific stakeholders in environmental water at Pound Bend, refer to Sections 3.2 and 3.4.

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

Table 2. Stakeholder groups with an interest in environmental water at Pound Bend

Stakeholder groups	Stakeholders	Needs and interest	IAP2 level	Consultation modes
Public land/water managers	Parks Victoria	Managing impacts from watering such as access, State-level environmental management	Collaborate	Monthly meetings
	Mallee CMA	N/A	N/A	N/A
	Department of Environment, Energy and Climate Action (DEECA)	State level environmental management planning, land manager, threatened species manager	Collaborate	Monthly meetings
River operator	Goulburn Murray Water	Manage water storage	Collaborate	Formal meetings
Water corporation	Lower Murray Water	Water registers and drainage management	Collaborate	Formal meetings
Local government	Swan Hill Rural City Council	Access during watering events	Involve	Meetings, phone calls, correspondence.
First Nations People	See also 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. Assistance in planning and implementation of programs.	Involve	Ongoing engagement with Mallee CMA's Aboriginal Engagement Team. Engagement is largely undertaken in-person and where possible, on Country.
Environmental Water Holders	Victorian Environmental Water Holder	Decision-making around annual environmental water usage.	Collaborate	Formal meetings
	Commonwealth Environmental Water Holder	Decision-making around annual environmental water usage.	Collaborate	Formal meetings
Private landholders	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 representatives	Recreational users	Watering benefits and impacts on local communities such as access to Parks and river during watering events.	Consult	Existing groups such as the Mallee CMA Land Water Committee. Mallee CMA social media and news.
	General community (Wemen and Robinvale)	Watering benefits and impacts on local communities such as access to Parks and river during watering events.	Consult	Existing groups such as the Mallee CMA Land Water Committee. Mallee CMA social media and news.

2.2 DEVELOPING/UPDATING THE EWMP

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

- Discussions with the Mallee CMA Land and Water Advisory Committee
- Workshops and on-Country engagement with Traditional Owners (see Section 2.4)
- Meetings with agency stakeholders
- Presentation at the Biodiversity-Water Catchment Partnership Committee
- In-person engagement event at local events such as markets and environmental group meetings
- Social media platforms

2.2.1 Verifying asset values

Asset values at Pound Bend 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 Pound Bend and floodplain ecosystems. This work has been central to providing a basis for local knowledge and expertise.

Combined with the Murray Wetlands 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 considering 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

To inform the EWMP update community stakeholders were engaged in-person during local events such as the Red Cliffs Market and local community and environmental group events. This engagement included a 'Pins in Maps' activity, where the community provided information on uses and values at specific locations at the site.

This engagement supplements earlier community engagement about the Karadoc Swamp EWMP, and annual community engagement that informs the Seasonal

Watering Proposal (SWP). Community consultation occurs at the IAPs level of CONSULT. Community engagement activities are summarised in Appendix 2.

2.4 TRADITIONAL OWNERS

Engagement with Traditional Owners was conducted in a 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 Gilbie Group, Dadi Dadi/Weki Weki, Tati Tati Land and Water, Wadi Wadi Land and Water, the Pearce Family and Latji Latji Mumtheland representatives from October to December 2024. Through this engagement activity, Traditional Owner stakeholders were asked to identify the values/uses at specific sites. Information from this consultation has informed cultural site use 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 67,000. 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 Pound Bend subunit of the Happy Valley Waterway Management unit (WMU), hereafter referred to as Pound Bend (Figure 2). Pound Bend is located within the Happy Valley WMU, 5km north of Wemen and directly east of Hattah-Kulkyne National Park (covered by the Hattah Lakes EWMP).

Pound Bend consists largely of public lands, with a small proportion of private land used for agricultural activities. This EWMP focuses on areas that can be inundated through environmental watering, referred to as the target area, not encompassing any private land.

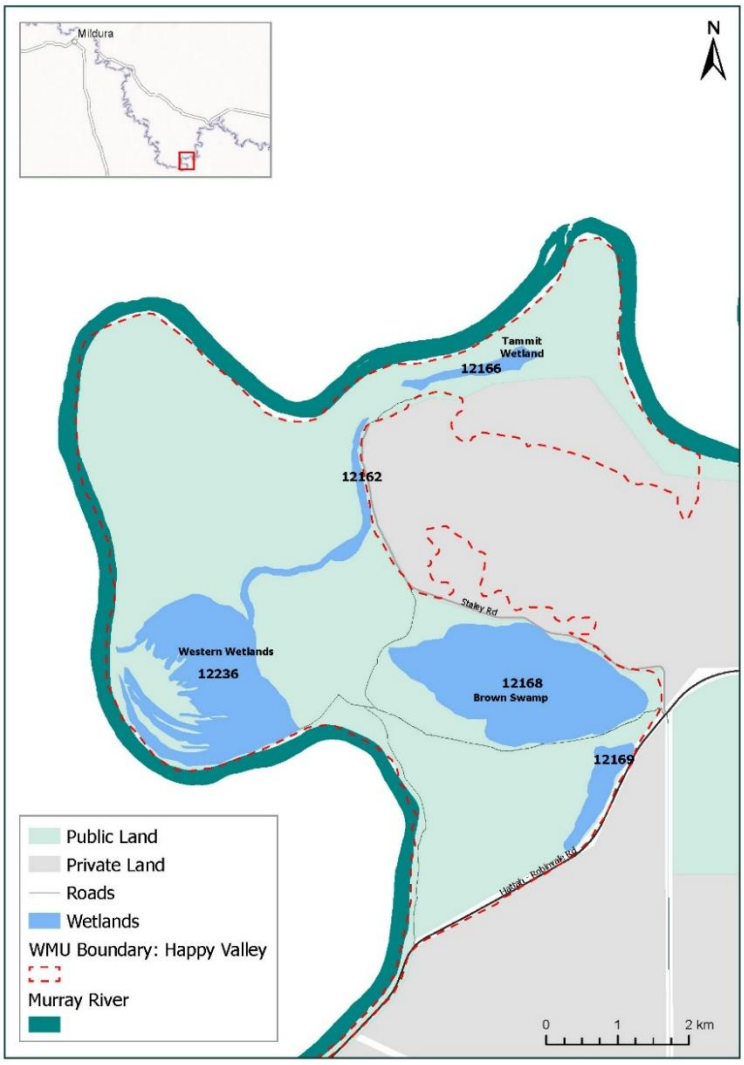


Figure 2. Pound Bend wetlands overview located within the Happy Valley WMU

3.1 CATCHMENT SETTING

Pound Bend is located in the Robinvale Plain bioregion within the Mallee CMA region. The Robinvale Plains bioregion is characterised by a narrow gorge confined by the cliffs along the Murray River, which is entrenched within older up-faulted Cainozoic sedimentary rocks (MCMA 2003). The regional Wemen Fault is inferred to run north-south beneath the western edge of the floodplain, displacing the Tertiary sediments by some 20m, downthrown side to the west. The Wemen Trough lies to the west and the Robinvale Ridge to the East. Much of the native vegetation within the bioregion still remains, mostly as public land in state forest, the Murray River Reserve and the Hattah-Kulkyne National Park (EA 2007).

The floodplain is underlain by sediments of the Coonambidgal Formation, which are generally silty clays at the surface grading to medium to coarse sands at 3-5m depth. The surficial sediments have been modified by previous fluvial (river flow) processes, and, in Pound Bend, a wide range of the prior landforms have expression.

The site is mapped (Figure 7, Cullen et al. 2008) as containing an alluvial (loose sediment) terrace (correlated with the Rufus Formation which is a western correlative of the Shepparton Formation) at the western extent of the floodplain, and beneath and to the east of the irrigated dunes. The terrace clays tend to be slightly to moderately saline.

Cullen et al. (2008) also mapped three distinct floodplain meander belts (i.e. the oldest, intermediate and youngest floodplain meander belts) (Figure 7). The river channel in Pound Bend is located mainly within the youngest floodplain meander belt, flanked by intermediate or older belts. The surface materials on the oldest meander belt are noted as silty clays, while the intermediate and youngest meander belts are noted as being fine to medium sand (Cullen et al. 2008). The meander belt clays are mostly slightly to moderately saline. Loamy sands of relic dunes (Woorinen Formation) overlay the central part of the floodplain on the terrace deposits and form arcuate (bow- shaped) dunes on the oldest floodplain meander belt to the west of the central dunes (Figure 7, and Cullen et al. 2008).

The clays at Pound Bend are generally smectitic (swell and shrink, crack, and sodic (in comparison, clays can form a seal, can swell and are high in sodium). These clays are highly dispersive and form an impermeable seal after minor rain (Cullen et al. 2008).

Alluvium deposits from the Cainozoic period gave rise to the red brown earths, cracking clays and texture contrast soils (Dermosols (structured soils), Vertosols (clay-rich soils), Chromosols (soils with abrupt increase in clay content) and Sodosols (soils high in sodium and with an abrupt increase in clay content) found at Pound Bend today.

Floodplains are dynamic landscapes formed by fluvial processes operating at a range of temporal scales. Floodplains are highly biodiverse ecosystems, as they are the interface between terrestrial and aquatic habitats. Flooding provides for exchange of sediment and nutrients between the floodplain, wetlands and the river. It disperses plant propagules and supports different life stages of fauna species. The composition of species that occur on the floodplain and within the wetland basins vary over time with recent and longer-term inundation history. More complex geomorphology on floodplains, including associated wetland basins and creeks, produces a more variable hydrological regime, creating more diverse habitat niches for plants and animals. Pound Bend is particularly diverse in landform and vegetation communities.

3.2 LAND STATUS AND MANAGAGEMENT

The river frontage at Pound Bend is reserved for public use (MCMA 2003). The areas proposed to be inundated by the watering activities lie within the Murray River Reserve; however, small sections of Pound Bend floodplain are privately owned (Figure 3). These areas of privately owned land are not included in the environmental watering target areas.

Pound Bend is directly or indirectly managed or used by a range of stakeholders (Table 3). The listed stakeholders have been identified as having a vested interest in the site; however, this is not an exhaustive list. For more information on community engagement. Refer to section 5.2.

Table 3. Land and water managers at Pound Bend

Organisation	Management role
Department of Energy, Environment and Climate Action	• State level environmental management • Administer the broader water allocation and entitlements framework and the Water Act 1989 (Vic).
Minister for Water (Victoria)	• 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), where infrastructure will be operated and the wetlands, waterways and floodplain where the environmental water will be delivered. • 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.
Lower Murray Water	• Murray River operations and Irrigation drainage.
Swan Hill Rural City Council	• Local Government
First Nations Peoples	• Traditional Owner representation
Murray Darling Basin Authority	• Management and operation of the Murray River on behalf of the Basin States in accordance with the Water Act 2007 (Cth).
Private Landholders	• Land managers of a significant portion of the Pound Bend WMU sub-unit
Victorian Environmental Water Holder	• Manager of Victoria's environmental water entitlements
Commonwealth Environmental Water Holder	• Manager of Commonwealth environmental water entitlements

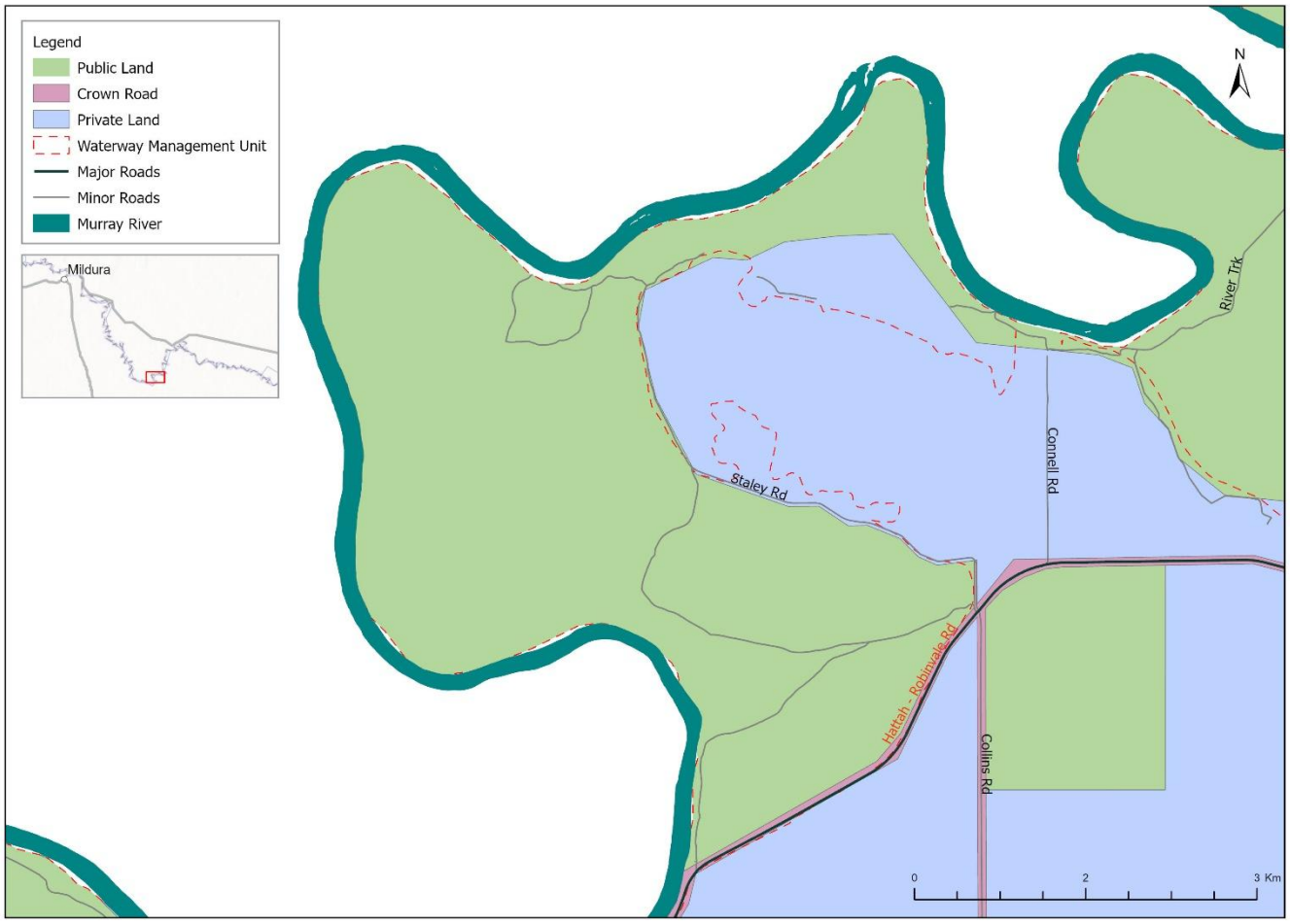


Figure 3. Land management boundaries in Pound Bend

3.3 ASSET CHARACTERISTICS

This EWMP focuses on the area that can be inundated through environmental watering, this is referred to as the target area. The target area is the maximum extent to which environmental water can be managed. Locations of the wetlands within the target area of Pound Bend are presented in Figure 2.

Brown Swamp is classified as a shallow freshwater marsh. It covers an area of 129.25 ha. The mapped EVC for this basin indicates a sub-saline shrubland, though on-ground there was significant Lignum present, indicating a possible error with the modelled EVC classification. There are three other shallow freshwater marsh basins within the target area; Tammit, Smaller Eastern and Western Wetlands).

River Red Gum health is generally good in these areas, but the understorey vegetation is lacking in species diversity. The red gums on these lower elevations are likely to be sustained by a freshwater lens, whereas the understorey is likely affected by reduced flooding.

The Smaller Western Wetland is classified as permanent open freshwater. This wetland supports a Floodway Pond Herbland EVC. This linear water body is maintained as near permanent water by pumping from the river to supply irrigation on the terrace above. It acts as a holding basin from which irrigators can pump. The existing pump is on rails and may need to be raised during the environmental watering event.

There is also a creek that can connect Tammit Wetland to the south-western river flat and the Western Wetlands.

A brief overview of the main characteristics of the wetland system in the target area is given in Table 4.

Table 4. Wetland Characteristics at Pound Bend

Characteristics	Description
Name	Pound Bend
Mapping ID **(Wetland Current layer)**	Tammit Wetland #12166 Western Wetlands #12236 Brown Swamp #12168 Unnamed creek #12162 Unnamed wetland #12169
Area of wetlands in target area	406.24 hectares
Bioregion	Robinvale Plains
Conservation status	EVCs listed as Vulnerable and Depleted (Riverine Grassy Woodland, Floodway Pond Herbland, Sub-saline Depression Shrubland and Lignum Swampy Woodland)
Land status	Murray River Reserve
Land manager	Parks Victoria
Surrounding land use	Agriculture, Industry (the Wemen Mineral Sands Mine), Reserve (Wemen Flora and Fauna Reserve)
Water supply	Natural inflows from Murray River. Some areas used as irrigation channel
Wetland category **(Wetland Current layer)**	Shallow freshwater marsh, freshwater meadow, permanent open freshwater
Wetland depth at capacity	Range between 1 and 2 metres

3.3.1 Conceptualisation of the site

The key ecological, hydrogeological and hydrological processes and components of the Pound Bend sub-unit are presented in the conceptual diagram below, Figure 4. This provides a visual representation of the site's processes and components that are discussed throughout the document.

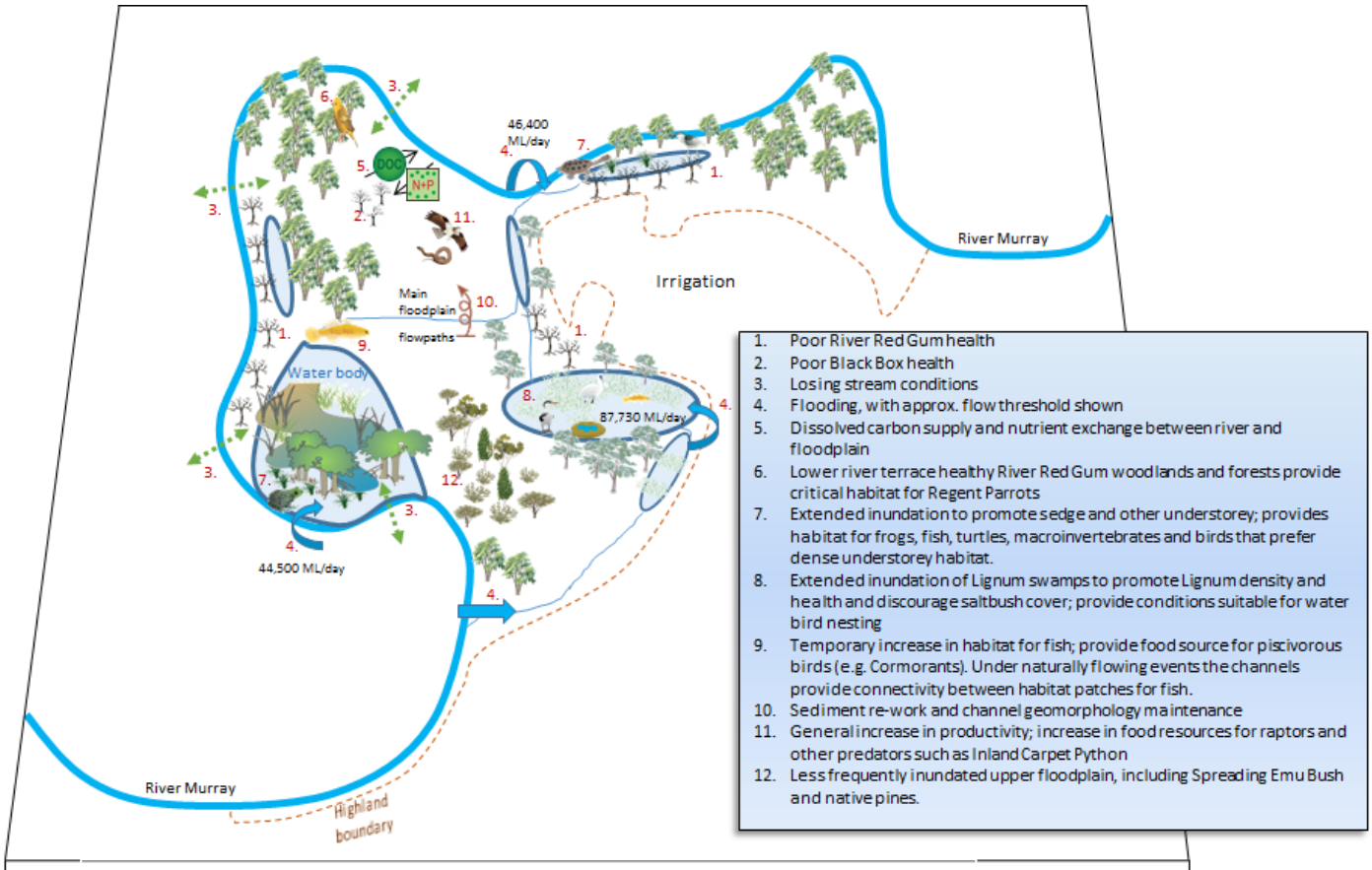


Figure 4. Conceptual model of Pound Bend target areas

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 VEWH is responsible for holding and managing Victoria's environmental water entitlements and sourcing water from the Victorian Murray system for delivery to the target wetlands at Pound Bend Wetland Complex. 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/our-watering-program/our-water-holdings.

4 Current/Historical Hydrological Regime and System Operations

4.1 ENVIRONMENTAL WATERING

Wetland hydrology is the most important determinant in the establishment and maintenance of wetland types and processes. 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. Duration, frequency and seasonality (timing) are the main components of the hydrological regime for wetlands.

The target area within Pound Bend is located on the Victorian floodplain of the River Murray (1066 km to 1081 km) between the river gauges Euston (#414203C) and downstream Mildura (#414216A).

Historical hydrological regime

Under natural conditions, flow is understood to have been strongly seasonal, with median daily discharge highest in spring and lowest in autumn (EA 2007). According to EA (2007), prior to river regulation, floodplain inundation would have occurred more frequently than under currently regulated conditions. In order to inundate low areas of floodplain and many wetlands, the flows would need to be 20,000 to 60,000 ML/d. These flow levels would have occurred more often and with longer duration than under the current baseline conditions (EA 2007). This is supported by the recent spells analysis by Gippel (2014) for natural and baseline flows downstream of Euston (Figure 5).

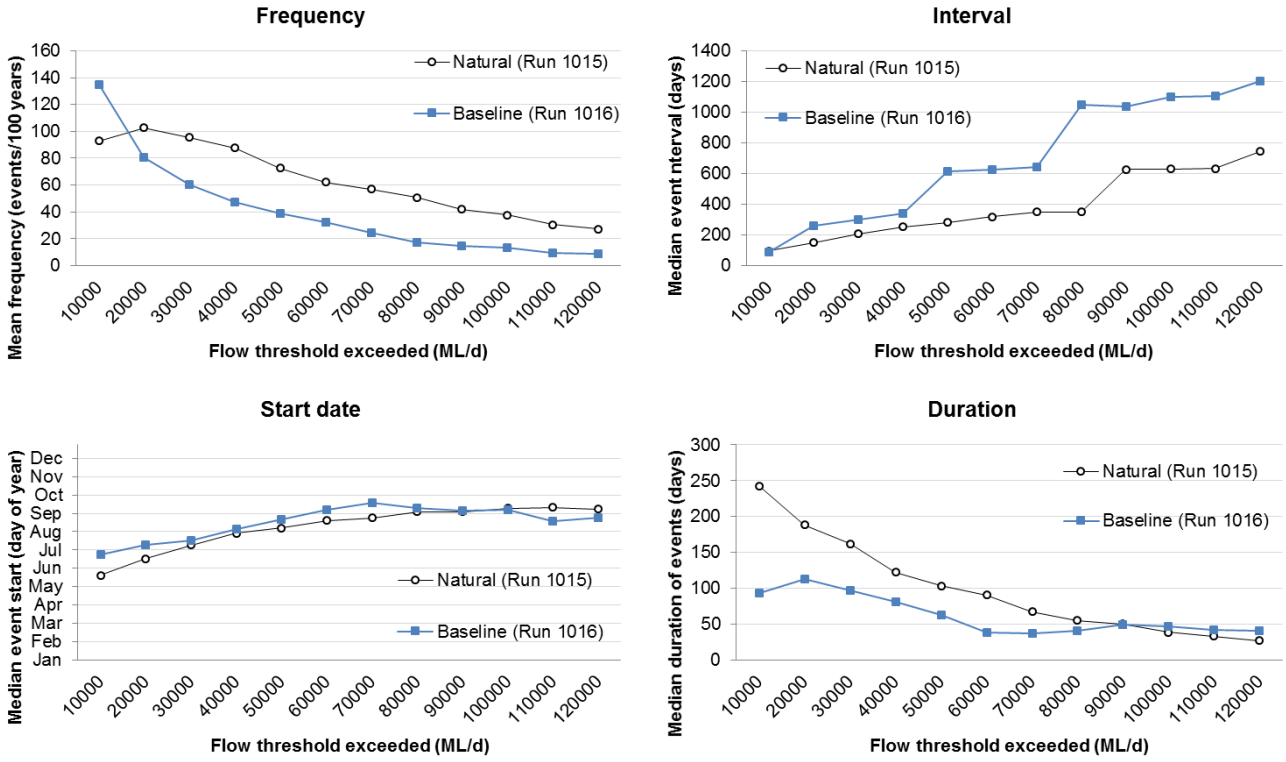


Figure 5. Comparison of Natural (pre-regulation) and Baseline Modelled Flow (post-regulation) scenarios for Euston Downstream (Gippel, 2014)

Current hydrological regime

With the effects of major storages and river regulation on the Murray River, the frequency, duration and magnitude of most flood events have decreased significantly compared to natural conditions. Since 1922, 13 weirs and locks across the Murray River have been constructed. River regulation and increased consumptive water use have reduced overbank flows important for water-dependent flora and fauna (Sunraysia Environmental 2008).

The hydrology of the Murray River at Euston under natural and current conditions was analysed by Gippel (2014) (Figure 5).

Their analysis shows that the flood events most affected are those generated by flows above approximately 15,000 ML/day, which now occur less (Figure 5; Gippel 2014). Floods generated by flows less than 90,000 ML/day are now also of shorter duration (Figure 5; Gippel 2014).

A comparison of daily discharge by month for the natural and baseline conditions is reproduced from EA (2007) in Figure 6. In addition to river regulation, a decade of drought has put extensive pressure on the system, leading to a decline in river and floodplain health (Sunraysia Environmental 2008). The flooding regime has also been affected by local works such as changes to anabranches and wetland sills, which prevent or reduce inflows to flood-dependent ecosystems (EA 2007).

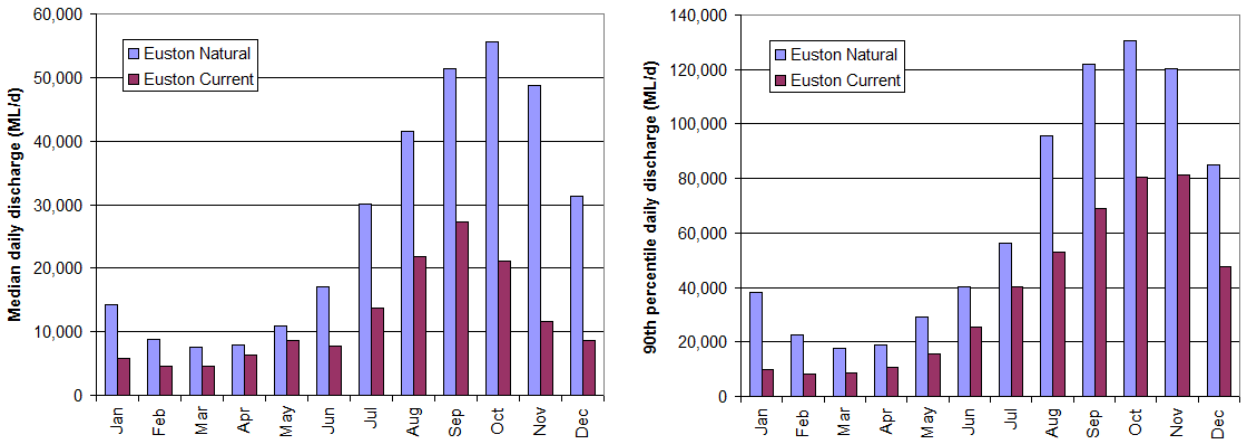


Figure 6. Distribution of median flows and 90th percentile flows for each month in the River Murray through Euston Weir for natural and current (benchmark) conditions. Data derived from MDBC MSM_Bigmod 109-year data (Ecological Associates, 2007b)

Commence to flow elevations were determined using a digital elevation model of the site. Elevations were then related to river stage height to determine flows required to inundate each of the main basins (Table 5).

Table 5. Commence to flow rate for inundation of Pound Bend

Wetland	Chainage from mouth (km)	Elevation threshold (m AHD)	River threshold (ML/day)
Tammit	1075	45.68	46,404
Brown Swamp	1070	47.41	87,731
Western Wetlands	1070	45.21	44,514

Spells analysis undertaken by Gippel (2014) was used to model natural and baseline flows downstream of Euston. Based on the discharge thresholds presented in Table 6; flow thresholds 45,000 ML/d and 90,000 ML/d were selected to be presented in Table 6. The thresholds from natural to baseline flows show a notable reduction in the frequency and duration of flood events for the three wetlands.

Table 6. Modelled natural and baseline flow thresholds of 45,000 and 90,000 ML/d downstream of Euston

Natural (N)/ Baseline (B)	Threshold ML/d	Frequency Mean (/10yrs)	Median Interval (50% of events are less than)	Median Duration (50% of events are shorter than)	Median event start date	Percentage of years with event
N	45,000	8.25	272	105	12th Aug	82%
B	45,000	4.12	572	77	20th Aug	39%
N	90,000	4.21	626	50	9th Sep	38%
B	90,000	1.49	1039	50	11th Sep	12%

4.2 PREVIOUS ENVIRONMENTAL WATERING

In 2024/25, Mallee CMA proposed to pump 850 ML of environmental water, targeting an inundation height of 47 mAHD to Brown Swamp. The water delivery event was unable to proceed due to culturally sensitive sites where temporary works was proposed to take place.

No environmental watering events have been undertaken at the target site; Table 7 below summarises natural inundation events that have occurred at Pound Bend.

Table 7. A summary of environmental watering at Pound Bend

Water year	Waterbody	Time of inflow	Environmental Water Source	Total volume delivered (ML)	Area (ha) inundated
2010-11	Western Wetlands, Tammit Wetlands	Summer	Natural inundation	Unknown	Unknown
2016-17	Brown Swamp, Western Wetlands, Tammit Wetlands	Summer	Natural inundation	Unknown	Unknown
2022-23	Brown Swamp, Western Wetlands, Tammit Wetlands	Spring - Summer	Natural inundation	Unknown	Unknown
2023-24	Western Wetlands, Tammit Wetlands	Spring	Natural inundation	Unknown	Unknown

4.3 GROUNDWATER AND SALINITY INTERACTIONS

The Robinvale Basin is essentially a closed system with little or no opportunity for discharge to the sea, other basins or aquifer systems. The major mechanism of salt discharge is through the Murray River valley, including its floodplain and the river itself. Salt accumulation within the regional aquifers has occurred over thousands of years so that many of the regional aquifers are saline. Saline groundwater inflows are responsible for much of the salt additions to the Murray River (Brown and Stephenson 1991, AWE 2011). Floodplain salinity does not appear to be a major concern at Pound Bend (Figure 8).

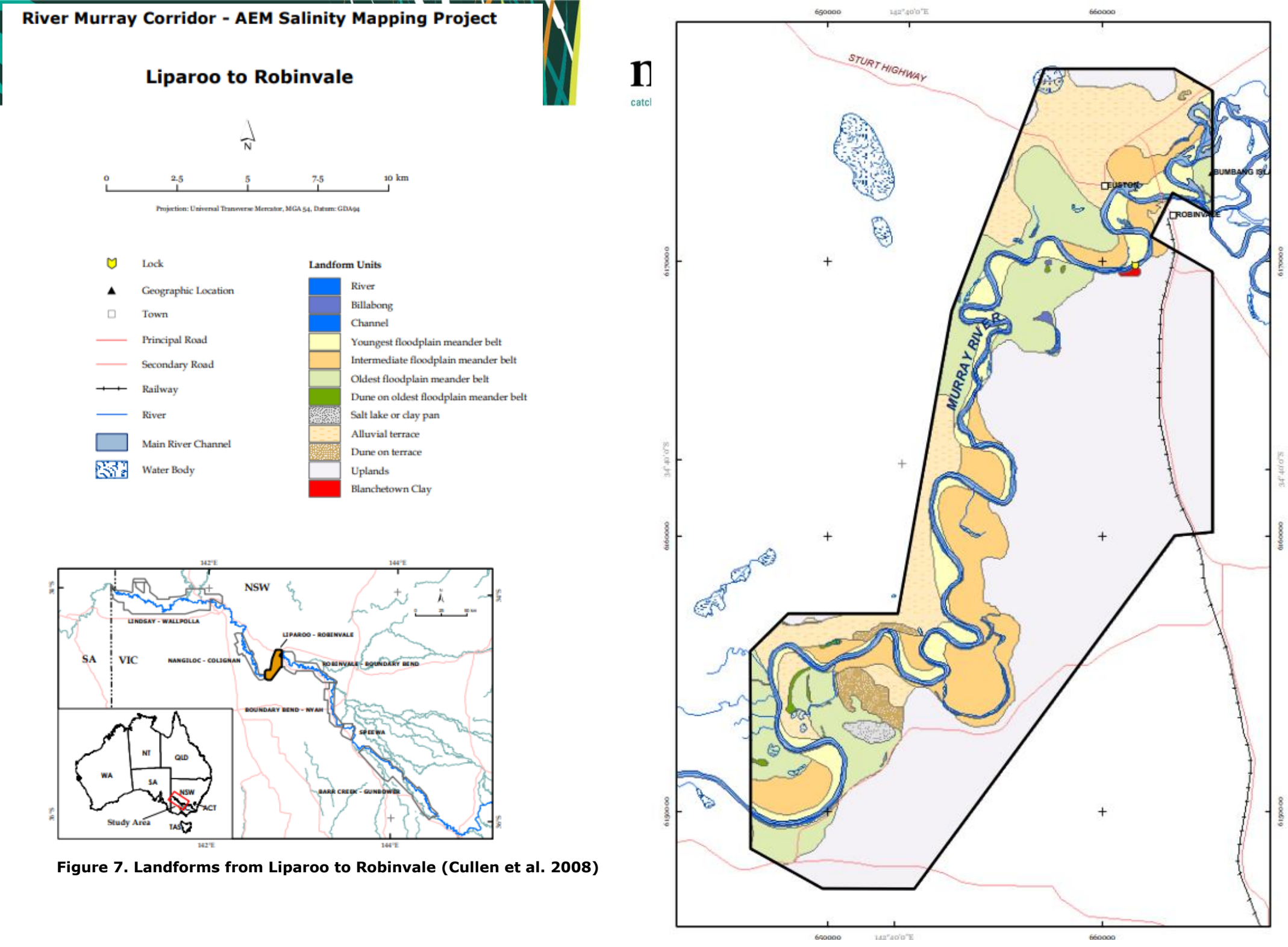


Figure 7. Landforms from Liparoo to Robinvale (Cullen et al. 2008)

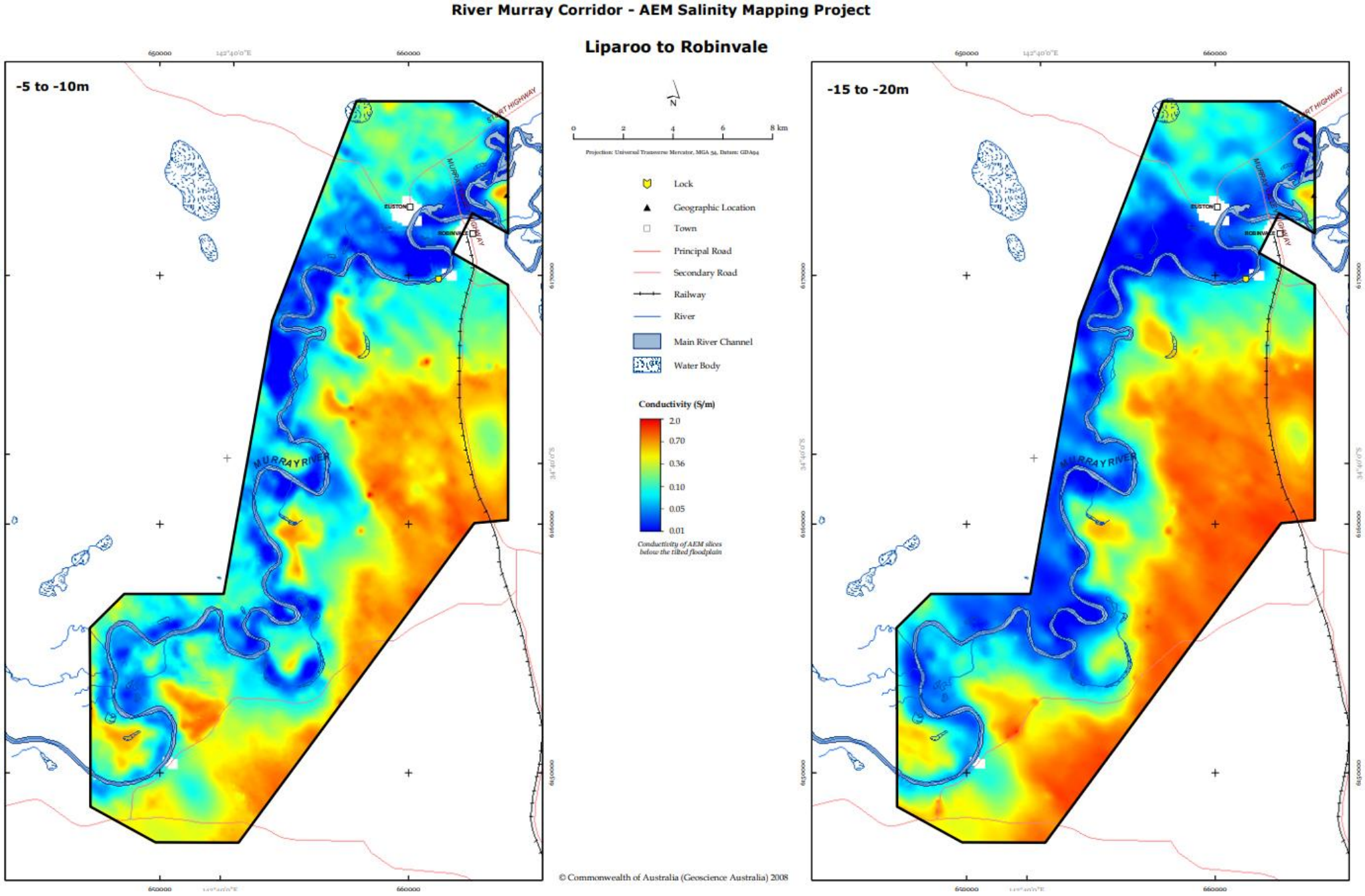


Figure 8. AEM slice below the tilted floodplain from Liparoo to Robinvale (Cullen et al. 2008)

The Aerial Electromagnetic slices (AEM) maps (Figure 8) and vertical profiles from the Robinvale-Liparoo AEM Atlas (Cullen et al. 2008) show a large extent of freshwater underneath the floodplain. These quite extensive freshwater lenses are a feature of the river between Pound Bend and Robinvale. Cartwright et al. (2010) have researched the provenance of these lenses and conclude they are formed by lateral recharge from the river during floods. Vertical infiltration through the floodplain soils being only a minor source of recharge to the lenses.

The AEM data (Figure 7) also shows that the floodplain under the clay-pan and under the oldest floodplain meander belt is relatively conductive. The Cullen et al. (2008) mapping infers the presence of Blanchetown Clay under this area, which could give rise to the conductive AEM signal. However, the Blanchetown Clay interpretation as presented contains some anomalies, so some minor questions remain as to the underlying hydrogeology and the source of the conductive AEM signal (i.e. saline groundwater, or clay, or a combination of both).

The in-river NanoTEM data (Figure 9, Telfer et al. 2006) shows that riverbed resistivity varied within a range of 10-25 Ωm. This suggests that the river circumscribing Pound Bend is a losing stream, in which the river loses freshwater into the floodplain, creating freshwater lenses along the riverbank and further inland.

During an investigative site visit in September 2014, no evidence of saline seepage was evident around the edges of the irrigation district. The clay pan (Yamba Formation) or salt lake (Figure 7) mapped in the south-east of Pound Bend also showed little evidence of high salinity associated with the clay pan/wetland area.

Assessment of groundwater salinity data and the site visit suggests that the in-river salinity impacts of any watering event are likely to be relatively small.

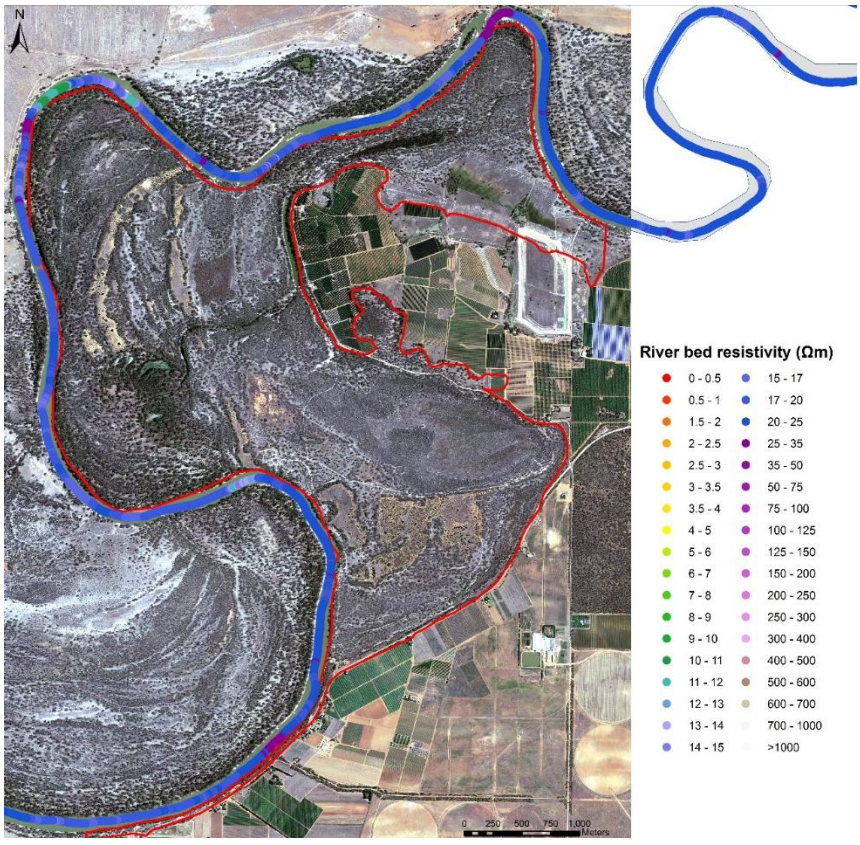


Figure 9. River NanoTEM (Telfer et al. 2006)

5 Water Dependant Values

5.1 ENVIRONMENTAL VALUES

Wetlands and waterways on the floodplain are a vital component of the landscape and support a vast array of flora and fauna species, which may vary greatly according to the type of wetland/waterway system. 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.

5.1.1 Ecosystem type and function

Wetland ecosystems support distinctive communities of plants and animals and provide numerous ecosystem services to the community (DSE 2005). Floodplain wetlands perform important functions necessary to maintain the hydrological, physical and ecological health of river systems. Greater appreciation of the ecological functions of the site will be possible with further intensive surveys.

Based on limited survey records and site inspections, the below key ecosystem functions have been identified.

Vital Habitat

Pound Bend supports mature River Red Gums within the core nesting area of Regent Parrots, and opportunities to water the floodplain will support the health, longevity and recruitment of River Red Gums. Inundation of the floodplain and wetland basins will support diversity of important feeding, breeding and nursery sites for native water-dependent biota and lateral connections for off-stream primary production. It will also support general biological productivity, with opportunities for expression of flood responder plant species (which may remain dormant or be present only in the seed bank without any flooding) and increased food resources and habitat to support water-dependent fauna, including their breeding.

Productivity, nutrient and carbon cycling

Wetland inundation transports nutrients and carbon into the water column, which then becomes available for consumption by bacteria, algae and macroinvertebrates. On re-wetting, decomposition accelerates and improves efficiency. Carbon and nutrients are released from the soil and enter the water and are available for aquatic plants and animals. The release of energy and nutrients results in increased productivity, with an increase in bacteria and invertebrates (Ecological Associates, 2013). Inundation of the floodplain and wetland basins will provide for nutrient and sediment exchange with the river.

Connections across floodplains, adjacent wetlands and billabongs

Waterbird groups access a variety of habitat types which only become available following inundation. Many species will nest only in trees or shrubs surrounded by floodwaters. The movement of species of fish, invertebrates and amphibians is driven by floodplain and wetland connectivity. The site may also be important for specific dispersal and connectivity functions or in the life cycle of other water-dependent species that have not yet been recorded on site.

5.1.2 Flora and Fauna Values

Ecological Vegetation Classes (EVCs)

Ecological Vegetation Classes (EVCs) were developed by the state of Victoria in 1994 and have been utilised since for mapping floristic biodiversity. Vegetation communities are grouped based on structural, floristic and ecological features. DEECA has defined all the EVCs within Victoria.

One of the values of the Pound Bend is the high diversity of EVCs present. The key EVCs mapped in association with the wetland water bodies, or in their immediate surrounds are listed in Table 7.

EVC descriptions are provided in Appendix 3, and a map is provided in Figure 10.

Table 7. Ecological Vegetation Classes modelled as present within the Pound Bend target area

EVC Number	EVC name	Structurally dominant species	Bioregional Conservation Status
104	Lignum Swamp	Lignum	Vulnerable
200	Shallow Freshwater Marsh	Sedges, rushes	Vulnerable
295	Riverine Grassy Woodland	Either or both River Red Gum and Black Box (but dominated by River Red Gum at this site)	Depleted
810	Floodway Pond Herbland	Sedges, rushes, grasses and low herbs	Depleted
818	Shrubby Riverine Woodland	Either or both River Red Gum and Black Box	Least Concern
820	Sub-saline Depression* Shrubland	Lignum	Depleted
823	Lignum Swampy Woodland	Lignum	Depleted

Sub-saline Depression Shrubland is characterised by a dominance of chenopods and succulents: however, Lignum was observed to be the dominant species. Further investigation into the EVC at Brown Swamp needs to be conducted.

Other EVCs present, within the target area, are:

- Semi-arid woodland (EVC 97)
- Semi-arid Chenopod woodland (EVC 98)
- Riverine Chenopod woodland (EVC 103)

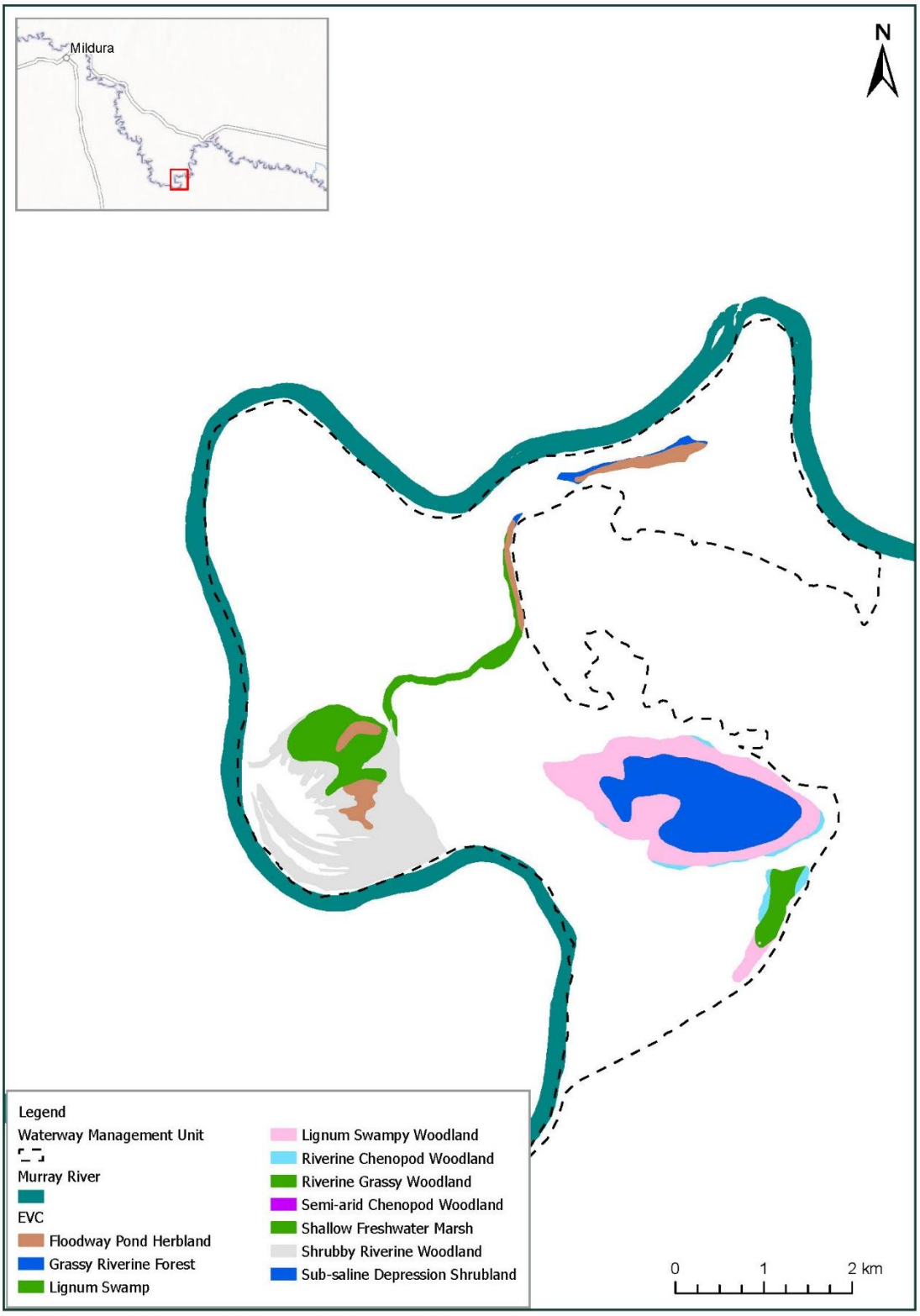


Figure 10. Ecological Vegetation Classes (EVCs) present within the Pound Bend target area

River Red Gum and Lignum communities are both located in areas that would benefit from a more frequent watering regime.

River Red Gums and Lignum are well represented at Pound Bend. EVC Riverine Grassy Woodland is dominated by River Red Gums. EVC Shrubby River Woodland is

also dominated by River Red Gums and some Black Box. Lignum is a dominant species in EVCs Lignum Swamp, and Lignum Swampy Woodland.

Lignum-dominated communities become an extensive aquatic habitat for fish and macro-invertebrates when inundated (Ecological Associates, 2007). Lignum swamps and shrublands are also used as a nesting site by waterbirds, and as a feeding area by raptors, owls, and predatory reptiles (Ecological Associates, 2007).

River Red Gum provides extensive habitat for a range of waterbirds and other fauna such as the listed Regent Parrot, which use these trees for nesting. However, trees in poor condition make little contribution to the function and productivity of the ecosystem and the quality of woodland habitat is greatly reduced (Roberts & Marston 2011). Healthy River Red Gums contribute to the wetland ecosystem by depositing organic material, and submerged fallen trees provide structural habitat features (Roberts & Marston 2011) for wetland fauna such as perching sites for waterbirds, basking sites for turtles and snags for fish (EA 2007b).

River Red Gum communities were observed in the field to range from being in generally good health to degraded. River Red Gums on lower terraces were generally healthier as they are likely to have access to a freshwater lens. The River Red Gums on higher terraces, further away from the river were generally in poorer health (degraded) (Cunningham et al. 2006). These River Red Gums on higher terraces would most likely benefit from a more natural flooding regime.

Black Box also 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 species, such as Carpet Python and the Regent Parrot. Healthy Black Box also provide important vegetative corridors to other areas above the floodplain for a range of transient native fauna. Black Box can tolerate a range of conditions (Roberts & Marston 2011); however, under extended dry periods trees will suffer a decline in health and eventual death (EA 2007a).

The 'natural' flooding regime considered to support the values of these EVCs is as described below in Table 8 (from VEAC 2008).

Table 8. Ideal watering regime for EVCs relevant to the Pound Bend target area

EVC Number	EVC Name	Natural Flood Frequency (yrs)	Critical Interval (yrs)	Minimum Duration (months)
104	Lignum Swamp	1 in 2 - 8	15	2 – 6
200	Shallow Freshwater Marsh	2 – 3 in 3	3	4 – 9
295	Riverine Grassy Woodland	2 – 3 in 10	7	<1
810	Floodway Pond Herbland	6 – 9 in 10	3	4 – 10
818	Shrubby Riverine Woodland	1 – 3 in 5	7	<1
820	Sub-saline Depression Shrubland	1 in 10 – 15	25	2 – 3
823	Lignum Swampy Woodland	1 in 2 – 8	15	2 – 4

These timeframes are estimates and should be modified based on the current condition status of EVCs and the desired trajectory of change or stabilisation, as appropriate, to inform proposed environmental watering.

Wetland depletion and rarity

The conservation significance of Victorian wetland types has been determined by comparing the estimated extent prior to European settlement with the remaining extent.

Victoria's wetlands are mapped and are contained within a state wetland database, using an accepted statewide wetland classification system developed by Corrick and Norman. Mapping was undertaken in 1981 that involved colour aerial photographs, field checking and developed into spatial geographic information systems (GIS) spatial layers. This database is commonly known as the 1994 wetland layer and contains the following information:

- categories (primary) based on water regime
- subcategories based on dominant vegetation

During this mapping, an attempt was made to categorise and map wetland areas present prior to European settlement. This was largely interpretive work and uses only the primary category, based on water regime. This is known as the 1788 layer.

It has therefore been possible to estimate the depletion of wetland types across the state by using the primary category only, based on a comparison of wetland extent between the 1788 and 1994 wetland layers.

Comparison between the wetland layers has demonstrated the impact of European settlement and development on Victorian wetlands. Impacts are severe, with approximately one-third of the state's wetlands being lost since European settlement. Many of those remaining are threatened by continued degradation by salinity, drainage and agricultural practices (ANCA, 1996).

Across the state, the greatest decreases in original wetland area have been in the freshwater meadow (43 per cent decrease), shallow freshwater marsh (60 per cent decrease) and deep freshwater marsh (70 per cent decrease) categories (DNRE, 1997).

Pound Bend contains five wetlands which have been classified using the Corrick-Norman wetland classification system (Table 11). With the exception of the Smaller Western Wetland, classified as Permanent Open Freshwater, all of the other wetlands have been classified as Shallow Freshwater marsh.

While shallow freshwater marshes have undergone a significant area reduction in Victoria (-60%), this is not reflected in the Mallee CMA region or Robinvale Plains Bioregion (Table 10). Permanent open freshwater wetlands have experienced minimal changes in area and increased by 5% in the Mallee CMA region.

A summary of the Corrick classification of the wetlands at Pound Bend, and the change in their distribution at multiple spatial scales is provide below in Table 9.

Table 9. Current area of the site by Corrick classification, and regional historical statistics

Category	No. of wetlands in target area	Total area (ha)	Decrease in wetland area from 1788 to 1994		
			Change in area in Victoria (%)	Change in area in Mallee CMA	Change in area Robinvale Plains Bioregion
Permanent open freshwater	1	4.5	-6	+5	-1

Shallow freshwater marsh	4	273.4	-60	-6	-4

Victoria's wetland classification and inventory was updated in 2024 and replaces the system developed by Corrick and Norman. The updated classification is based on the Australian National Aquatic Ecosystem (ANAE) Classification Framework with data on wetlands and their classification attributes converted in GIS spatial layers.

Fauna

A limited number of biological surveys have been undertaken at Pound Bend. The system potentially provides suitable habitat for a wide range of fauna; however, given the paucity of systematic surveys the full extent of the fauna that may use the site is unknown. Of special interest and responsibility are the six water-dependent species listed in legislation, agreements or conventions, as detailed in Table 10. A full list of all fauna previously recorded at Pound Bend is provided in Appendix 4.

Table 10. Listed water dependent fauna species recorded at Pound Bend

Common name	Scientific name	Type	International agreements	EPBC status	FFG status
Regent Parrot*	*Polytelis anthopeplus monarchoides*	B	-	V	V
Nankeen Night Heron	*Nycticorax caledonicus hillii*	B	-		
Royal Spoonbill	*Platalea regia*	B	-		
Great Egret (Eastern)	*Ardea modesta*	B	CAMBA, JAMBA		V
Pied Cormorant	*Phalacrocorax varius*	B	-		

Lifeform type: Amphibian (A), Bird (B), Fish (F), Reptile (R)
International Agreements: China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA)
EPBC status: Conservation Dependent, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild, Extinct
FFG status: Threatened, Conservation Dependent, Vulnerable, Endangered, Critically Endangered, Extinct
*Indirectly water dependent

The five bird species are considered water-dependent because they forage or nest in or over water or require flooding to trigger breeding and fledging. The list includes the Regent Parrot, (*Polytelis anthopeplus monarchoides)* which is indirectly dependent on water as it requires riparian trees for nesting habitat.

There are numerous records of sightings of Regent Parrots within Pound Bend. The current status of nesting within the system is not known; however, Pound Bend is located within the core breeding area of the species distribution (see Baker-Gabb & Hurley 2011).

Regent Parrots nest in River Red Gum (Eucalyptus camaldulensis) hollows adjacent to the Murray River and use vegetated corridors as flight paths to feeding grounds (Mallee woodlands) up to 20km from nesting sites (Ogyris 2007).

Nest trees are healthy, and average 160 cm diameter at breast height, and 28 meters tall, near water. The age of suitable nest trees is thought to be at least 160 years to allow for suitable hollow development (Baker-Gabb & Hurley 2011). The nesting hollows average 18 meters above ground (Baker-Gabb & Hurley 2011).

Therefore, on-going viability of River Red Gum woodlands is critical to the Regent Parrot population. A wetland watering regime that supports River Red Gum woodlands will help improve habitat for Regent Parrots.

The importance of Pound Bend as habitat for bird species of conservation significance is not well known. Recorded observations indicate the potential for these species to utilise the site, but whether this occurs regularly and whether the site is critical to their populations cannot be deduced from the few observations. A summary of habitat and requirements for wetland inundation for each of the four bird species listed in Victoria (Table 10) is provided below:

- Nankeen Night Herons utilise shallow water for foraging and breed in colonies building stick nests over water (Pizzey and Knight 2007). They are nomadic in response to rainfall and flooding of suitable habitat. Breeding usually occurs from September to February. Nankeen Night Herons have a minimum lag time to breeding of 3 months from flood, and breeding success is significantly enhanced by longer durations of inundation, up to 12 months (Rogers & Ralph, 2011).

- Royal Spoonbills also breed in colonies (including mixed species colonies) and nest on stick platforms over water, built in trees or Lignum (Pizzey & Knight 2007). They prefer freshwater wetlands that are vegetated. Foraging occurs in the areas of wetland edge that are less than 40 cm deep (Rogers & Ralph 2011). Fish are a significant part of the diet, as well as crustacea, molluscs and plant seeds. Breeding occurs between October and March and is stimulated by flood (Rogers & Ralph 2011). The minimum flood duration to support successful breeding is assumed to be four to five months (Rogers & Ralph 2011).

- Great Egrets also breed on a stick platform built over water, usually between November and February (Pizzey & Knight 2007). They prefer permanent water sites, and forage in water up to 30 cm deep (Rogers & Ralph 2011). Fish are a significant part of their diet (Rogers & Ralph 2011). Nests are built in the forks of trees over water, in colonies (which can be of mixed species). Long lag times for breeding have been recorded, though this may vary depending on whether flooding occurs during the optimal breeding season of November to May or whether it occurs outside of the main breeding season (in which case the lag period is longer) (Rogers & Ralph 2011). Minimum flood duration needs to be six to seven months to support breeding (Rogers & Ralph 2011).

- Pied Cormorants are associated with large permanent freshwater bodies inland but are more commonly associated with coastal sites which are their main breeding habitat. They can breed opportunistically at inland sites, are colonial nesters (mixed), exhibit a preference for permanent sites with a stable water level and build nests in trees standing in lakes and swamps (Rogers & Ralph 2011). Their diet is primarily fish and crustacea.

Appropriate watering regimes designed to support good quality vegetation (i.e. Lignum and River Red Gum communities) within the target area and provide appropriate watering events in spring/summer, will support the habitat requirements for the water-dependant bird species listed above (Scott, 1997).

Flora

Limited flora surveys have been carried out at Pound Bend. The only systematic flora survey was conducted in 1986, and covered limited areas of the floodplain, rather than the wetlands. A complete species listing from the VBA for the site is provided in Appendix 4. Of particular interest are wetland species such as aquatic and semi-aquatic flood-responder species. They provide valuable food, shelter and

spawning habitat for many wetland-dependent species such as frogs. A flooding regime that supports these species will protect and enhance biodiversity in the floodplain.

The only species of conservation significance to be recorded at Pound Bend is the Spreading Emu-bush (Table 11). Spreading Emu-bush is a floodplain species not considered to be tolerant of regular or long duration of flooding, although it may recruit following inundation.

Table 11. Listed water dependent flora species recorded at Pound Bend

Common name	Scientific name	EPBC status	FFG status	EVC Listing species
Spreading Emu-bush	*Eremophila divaricata ssp. divaricata*		V	103
EPBC status: Conservation Dependent, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild, Extinct FFG status: Threatened, Conservation Dependent, Vulnerable, Endangered, Critically Endangered, Extinct				

5.1.3 Current Condition

Index of Wetland Condition assessments have not been undertaken for wetlands within the target area. The condition assessment described below is based on brief field observations taken by Australian Watering Environments (AWE) during September 2014 and limited existing literature. It should be considered high priority to undertake a more up to date condition assessment.

AWE described the floodplain trees to be generally in moderate to good health, judged from canopy cover, with reductions of health in large old Red Gums along the north-eastern margins of the southern wetland and the southern margin of the northern wetland. It was noted that the northern wetland contains two areas where the regeneration of Red Gum appears, with some death of an older regeneration (Figure 14). Reductions in younger Red Gum health were also observed at the inland extremity of Red Gum extent in a mixed Red Gum/Black Box cohort along the river at the western edge of Pound Bend (Photo 13). Black Box was generally in good health except for what appears to be competition-based natural selection in dense black-box communities on the oldest and clayey soils of the north-western alluvial terrace. The southern wetland, which is described in the EVC map (Figure 10) as Sub-Saline Depression Shrubland, reveals that it is mostly lignum swamp with an understorey of Atriplex lindleyi ssp. inflata and other herbs (Figure 14). It was also noted that there were potentially some impacts to understorey along the river frontage, where camping occurs.

While there was no obvious evidence of irrigation-induced decline in health, the mature River Red Gums in poor to dead condition occur between the irrigated area and the wetland/channel features.

To fully understand the current ecological condition of the wetland would require a flora assessment of the floodplain.

Along the Murray River, surveys of River Red Gum forest have shown a substantial decline in tree condition over the past twenty years. For example, in the late 1980s the health of tree canopies declined dramatically below the Wakool Junction in the Mallee. Survey of River Red Gum condition in 2006 indicated 70% of these forests across the Victorian Murray River floodplain were in a stressed condition (Cunningham et al. 2006). Stressed trees are usually found away from the banks of

the Murray River and permanently inundated anabranches on the floodplain (Cunningham et al. 2006).

Cunningham et al. (2006) indicates that the condition of River Red Gum stands at Pound Bend is generally degraded or declining, with most trees in the area in poor condition (Figure 11). River Red Gum condition gradually degrades as distance from the riverbank increases. Patterns of decline may be related to competition pressure among the younger River Red Gums in some locations, and possible senescence among the older River Red Gums, although lack of flooding during the millennium drought (1997-2010) may have exacerbated declines in health.

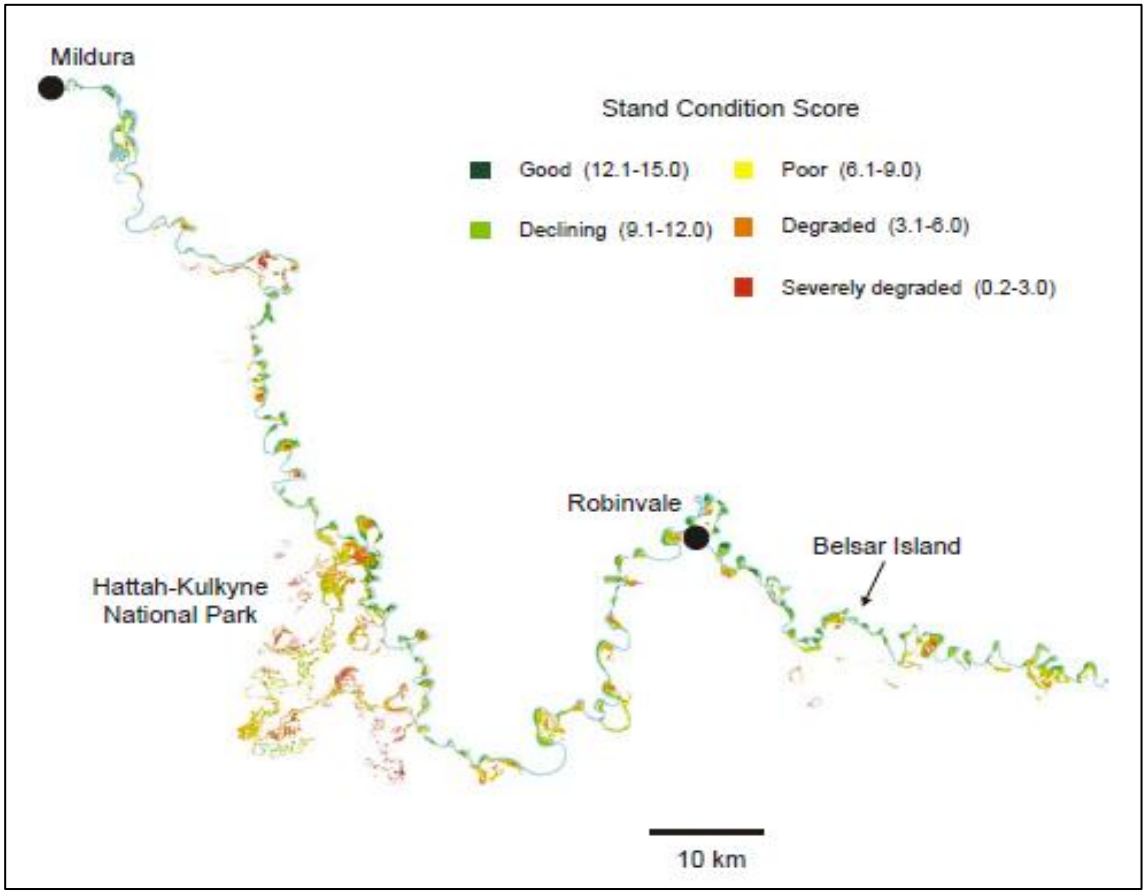


Figure 11: Condition of River Red Gum stands predicted by the PVL model (r2 = 0.78) from remotely sensed data for the Murray Scroll Belt (Cunningham et al. 2006).

Site inspection of the Brown Swamp which is described in the EVC map (Figure 10) as Sub-Saline Depression Shrubland, found that it is mostly Lignum swamp with an understorey of Atriplex lindleyi ssp. inflata and other herbs. (Figure 12). Figure 12 to 14 below show the general health of sites at Pound Bend.

Figure 12. Vegetation in Brown Swamp (AWE, Sept 2014)

Figure 13. Poor health and mortality of River Red Gum at inner margin of Red Gum extent at western margin of floodplain (AWE, Sept 2014)

Figure 14. Dieback of young River Red Gums in Tammit Wetland. Note new River Red Gum regeneration (red circle). Regent Parrot pair sighted here (AWE, Sept 2014)

Field surveys conducted at Brown Swamp by ARI over 2024-25 observed the main body of the wetland dominated by dense Lignum (*Duma florulenta)* and Native liquorice (*Glycyrrhiza acanthocarpa).* The wetland margin was dominated by Black box (*Eucalyptus largiflorens*) and with the understorey consisting of a mix of wetland species such as Common nardoo (*Marsilea drummondii*) and Lesser joyweed (*Alternanthera denticulata*), mostly drying and senescing following the Spring 2022 flood. Four threatened species were recorded at the site: Blue burr-daisy (*Calotis cunefolia*), Purple love-grass (*Eragrostis lacunaria*), Goat head (*Malacocera tricornis*) and Hoary scurf-pea (*Cullen cinereum*).

Figure 15. New stems of *Duma florulenta* emerging from the ground (ARI, 2025)

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 Mallee's natural landscapes.

Given the semi-arid climate of the region, ready access to more permanent water has been a major determinant of human habitation, and, as such, the highest density of identified Indigenous cultural heritage sites are located around or close to areas of fresh water sources.

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

Traditional Owner groups have highlighted the importance of understanding the different flora and fauna species known at Pound Bend, particularly birdlife and vegetation. Groups also value knowledge sharing and passing on culturally significant information onto the younger generation.

5.2.2 Recreational Values

Pound Bend is a popular area for recreational activities such as camping, fishing, swimming, bush walking, canoeing and kayaking. It also has a boat ramp facility to launch small boats.

5.2.3 Economic Values

Adjacent irrigators have pump and channel infrastructure located on the floodplain. Watering events should not impact irrigator pumping requirements.

5.2.4 Significance

The Pound Bend floodplain is significant for its provision of vital habitat to the nationally vulnerable Regent Parrot.

Further, the floodplain has high potential habitat value for a diverse range of species, due to its underlying diversity of landform and hydrology. The fact that the key structural overstorey species of the component EVCs are in moderate health, and that the wetlands receive some 'natural' flows (discussed above in Environmental Watering Section), mean that Pound Bend is a prime target for protection of biodiversity values through supplementary flows. It has great capacity for biodiversity enhancement in understorey composition, through modest intervention to provide top-up flows.

5.3 CONDITION TRAJECTORY

EVCs

A comparison of the characterisation of current flood regime (Table 12) with the ideal watering regime for the component EVCs (provided earlier in Table 8) shows that there is a reasonable approximation of frequency of event to suit River Red Gum woodland with a terrestrial understorey (e.g. EVCs 818 Shrubby Riverine Woodland and 295 Riverine Grassy Woodland) which occur on the lower terraces and the fringe of the Western Wetlands and Tammit Wetlands. The River Red Gum Community is made up of drought tolerant and flood responsive species. It is not sufficient to have a watering regime that will only benefit the drought tolerant species.

The flood responsive part of the community may not always be present (should be in the seed bank) but will still require flooding. The duration of flooding is not sufficient to maintain aquatic and semi-aquatic vegetation at the lower elevations of the basins (e.g. 810 Floodway Pond Herbland and 200 Shallow Freshwater Marsh).

A loss of biodiversity would be expected over time, where the viability of seed and tubers of aquatic and semi-aquatic plant species is lost over extended dry periods. These species do not then regenerate in response to the next flood, and are lost from the vegetation community, unless they re-establish by colonising from other sites. Aquatic macrophytes in particular are highly valuable habitat for fish and frogs, and some waterbirds, such as crakes and rails.

Similarly, it appears that the frequency of inundation of the two Lignum basins (Eastern Wetlands) meets the upper bounds of the ideal watering regime for Lignum EVCs (823 Lignum Swampy Woodland, 104 Lignum Swamp). However, again, the duration of inundation is not met, leading to the basins tending towards

EVC 820 Sub-saline Depression Shrubland, with higher cover of terrestrial species, such as Atriplex lindleyi ssp. inflata. Table 12 summarises the comparison for the two largest wetlands; Western Wetlanda and Brown Swamp.

Table 12: Comparison of ideal EVC watering regime and approximate current conditions at Western Wetlands and Brown Swamp

Dominant wetland EVCs	Natural Flood Frequency (yrs) to support EVC values	Minimum Duration (months) to support EVC values	Approximate current frequency wetland is inundated* (yrs)	Median duration of flow event that inundates wetland** (days)
Western Wetlands, lower river terrace				
200 Shallow Freshwater Marsh	2 – 3 in 3	4 – 9	1 in 2 – 3	77
810 Floodway Pond Herbland	6 – 9 in 10	4 – 10		
295 Riverine Grassy Woodland	2 – 3 in 10	<1		
818 Shrubby Riverine Woodland	1 – 3 in 5	<1		
Brown Swamp				
823 Lignum Swampy Woodland	1 in 2 – 8	2 – 4	1 in 6-7	50
104 Lignum Swamp	1 in 2 - 8	2 – 6		
820 Sub-saline Depression Shrubland	1 in 10 – 15	2 – 3		

**These are based on commence to flow values and do not represent each wetland filling to their full extent, which would occur less frequently (Gippel 2014).*
***This figure derived from the Spells analysis, Gippel (2014), describes the duration of a flood event where flows are sustained at the level that inundates each wetland. Particularly the wetlands underlain by clay may obviously hold ponded water for a longer period once flow ceases.*

An appropriate watering regime could enhance species diversity, improve floodplain productivity and ensure the long-term viability of floodplain species. The watering regime outlined in this EWMP is designed to achieve this. Without an improved hydrological regime, floodplain health will continue to decline with an expected loss of species diversity, change of EVC present and reduced floodplain productivity.

Fauna

Seven additional water-dependant species of conservation significance have been selected as potentially inhabiting Pound Bend (Table 13). These species have not been recorded on site; however, it was considered worth noting the potential for these species to benefit from environmental watering activities at Pound Bend. The listed species (Table 13) were selected because Pound Bend supports suitable habitat for them to utilise and/or the species have been recorded at sites close to Pound Bend.

Table 13. Listed water-dependent species potentially found at Pound Bend

Common name	Scientific name	Type	International agreements	EPBC status	FFG Status	Advisory List
Australasian Bittern	*Botaurus poiciloptilus*	B		E	L	EN

Australian Painted Snipe	*Rostratula australis*	B		E	L	CR
Carpet Python	Morelia spilota metcalfei	R			L	EN
Growling Grass Frog	Litoria ranformis	A		VU	L	EN
Silver Perch	*Bidyanus bidyanus*	F		CR	L	VU
South-eastern Long-eared Bat	*Nyctophilus corbeni*	M		VU	L	EN
White-bellied Sea Eagle	*Haliaeetus leucogaster*	B	CAMBA	VU	L	VU

Lifeform type: Amphibian (A), Bird (B), Fish (F), Reptile (R)
International Agreements: China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA)
EPBC status: Conservation Dependent, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild, Extinct
FFG status: Threatened, Conservation Dependent, Vulnerable, Endangered, Critically Endangered, Extinct

A hydrological regime designed to support good quality vegetation, enhance floodplain biodiversity, and improve floodplain productivity will benefit the species listed in Table 13. The floodplain vegetation (e.g. Lignum) and shallow freshwater marsh wetlands, (e.g. Brown Swamp), present on Pound Bend could provide valuable habitat for water-dependent species such as the Painted Snipe, Australasian Bitterns and Growling Grass Frog. The River Red Gum and Black Box communities present on Pound Bend could also provide valuable habitat for the Carpet Python, South-eastern Long-eared Bat and White-bellied Sea Eagle. The species in Table 13 rely on suitable habitat which may be protected or improved through this EWMP. Brief notes on the habitat preferences of these species are provided below.

- Australian Painted Snipe prefer habitat in shallow and well-vegetated wetland edges and disperse to areas with suitable habitat.
- Australasian Bitterns require complex and well-vegetated wetland habitat.
- The Growling Grass Frog is usually found amongst well vegetated permanent or ephemeral waterbodies, and these habitats are found in Pound Bend. Breeding is triggered by flooding or a significant rise in water levels in late winter/ spring (SKM, 2009). It is likely that Pound Bend could support Growling Grass Frog populations.
- The Carpet Python rely on habitat provided by River Red Gum forests and Black Box woodlands along major watercourses. Hollow-bearing trees and logs, or large rock outcrops, plus thick litter or shrub cover, are essential to the existence of Inland Carpet Pythons (DSE, 2003).
- Forests lining waterways in the Murray Darling Basin are one of a number of different habitat types favoured by South-eastern Long-eared Bats. If present, an environmental watering regime that supports River Red Gum stands and contributes to general wetland productivity (including insect productivity) would support this, and other bat species.
- White-bellied Sea Eagles nest in tall, live trees near water, and take prey from the water's surface. A watering regime that supports the longevity of large trees such as River Red Gum, will provide nesting sites into the future.
- Silver Perch spawns in response to rising floodwaters and can utilise inundated floodplains for breeding (but are not limited to floodplain habitat for recruitment), with the main spawning season being November to January

(Rogers & Ralph 2011). They require high water quality and coarse substrate (Rogers & Ralph 2011).

- Water quality, levels (and rate of change in water level) and temperature interact to produce breeding cues for fish of the Murray Darling Basin. Inundation of complex habitat, which includes large woody debris, substrate variation, macrophytes, and variable flow velocities across floodplains are important factors that support recruitment of both threatened and other non-threatened fish species. Watering events that pump water onto Pound Bend won't provide opportunities for fish breeding. Watering events that do not return water to the river provide for local breeding of small-bodied fish as part of a local increase in wetland productivity.

To provide breeding opportunities for many fauna species, habitat elements within Pound Bend, such as temporary wetlands and River Red Gum and Black Box communities, must be maintained in good condition. The benefits associated with environmental watering, such as improved vegetation, River Red Gum recruitment and floodplain health, will facilitate listed and many other species to utilise the floodplain, improving its value in the wider landscape.

6 Managing Water Related Threats

As discussed in the hydrology section of this EWMP, the hydrology of the target area has been greatly impacted by the regulation of the River Murray. The proposed water regime (refer Section 8) takes into account the impacts of regulation of the primary water source of the wetland (River Murray), and other activities which may impact the wetland water regimes and proposes a watering regime that will support the achievement of the environmental objectives and goals of the site.

The target areas of Pound Bend have been identified in The Mallee Waterway Strategy 2014-2022 as low priority reaches.

Changed water regime

The floodplains and wetlands will continue to receive less than their optimal pre regulation frequency of flooding without intervention. This will lead to a continued reduction in floodplain diversity and vegetation health.

Invasive species

Watering may provide opportunities for pest fish breeding, and for colonising weed species to expand their distribution on the floodplain. Environmental water delivery undertaken by the Mallee CMA has recently been implemented at Hattah Lakes to address pest problems and proven to be a success through monitoring.

Agricultural and other weeds are an ongoing threat and management issue along the Murray River floodplain. These may pose a threat when water is applied as increased water availability can cause weeds to thrive and displace native vegetation. A list of exotic flora species identified at Pound Bend is given in Appendix 4. The majority of these weeds are described as having high invasive potential and high impact in the EVC descriptions for the Robinvale Plains area (DEECA, 2024). The following species are of note:

- Prickly Lettuce (*Lactuca serriola*) and Mediterranean Turnip (*Brassica tournefortii)* are particularly liable to reproduce prolifically on drying wetland beds, providing serious competition to native species that recruit in this environment following flood recession.
- Horehound (*Marrubium vulgare*) is a declared noxious weed in Victoria.
- Prickly pear species (*Opuntia spp*. other than *O. ficus-indica*) have been actively controlled in the past at Pound Bend (MCMA & Parks Victoria 2009).

Poor water quality

There is no evidence of existing problems, such as evaporative concentration or stagnation; water pumped up onto the floodplain does not stand for long periods of time due to losing floodplain conditions.

ASSESSING RISK

Risk assessments identify and prioritise system threats and support development of risk management strategies, that may be implemented over seasonal or decadal time frames. 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 consequence. While consequence for an individual wetland can be determined, environmental water allocations require consideration of the

consequences at larger scales. The Mallee CMA considers consequences at the scale of their region, for the VEWH it is Victoria-wide and the CEWH it is the scale of 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 5.

7 Management Goals, Objectives and Targets

7.1 MANAGEMENT GOAL

The management goals for Pound Bend are to:

- protect and maintain the health of good quality floodplain vegetation;
- enhance floodplain biodiversity by re-instating a hydrological regime which supports a wider range of flora and fauna species; and
- provide for general floodplain productivity.

These are supported by specific ecological objectives outlined in Section 7.2.

Pound Bend has been recognised as a priority site for habitat for Regent Parrots. River Red Gums along the lower terraces, that provide critical habitat for Regent Parrots are (from general observation) in relatively good health probably sustained by significant freshwater lenses. They are, however, susceptible to decline under low flow conditions brought on by drought. Promoting the expansion of the more drought tolerant sedges (such as Cyperus gymnocaulos and Eleocharis spp.) would provide significant habitat enhancement for frogs and fish, when they gain access to floodplain basins.

Aquatic and semi-aquatic flood-responder plant species remain dormant during dry periods, with seeds stored in the seedbank or tubers or turions surviving dormant in the substrate. These species are at risk from dying out from the vegetation community if long dry periods are experienced, leading to the viability of stored seed and other propagules being lost between floods. Maintaining a flooding regime that promotes the expression of these flood responding species in the understorey protects and enhances biodiversity of the floodplain.

There is evidence from site visits, and from the vegetation mapping discrepancies over time, that the Lignum basins of the Eastern wetlands (Brown Swamp, Smaller Eastern Wetland) have developed a significant cover of low, saline-tolerant, terrestrial shrubs and herbs. The management objective for these wetlands is to increase flooding frequency and duration to favour Lignum over terrestrial species. Lignum has high habitat value, and the development of a high cover of terrestrial species means that the wetland is under higher risk of experiencing poor water quality when it is inundated, as a result of rotting terrestrial vegetation.

Additionally, achieving a longer duration of inundation, up to six months, at least several times over a ten-year planning cycle, has the potential to support waterbird breeding.

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 outlines 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 Pound Bend can be found in Section 5.22 of Butcher et al. (2020).

While every attempt has been made to make the following objectives and targets as complete as possible, there still remains gaps in critical information. As such, baselines are not able to be set at this time. In the interests of moving forward, the objectives and target 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 14. Environmental objectives and targets for Pound Bend

EWMP Objective	Target
PB1: By 2030, improve vital habitat at Western Wetlands and Tammit Wetlands, Pound Bend by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.	Target not able to be set adequately as no baseline data for Pound Bend vegetation By 2030, increase diversity of native of macrophytes at Western Wetlands and Tammit Wetlands, Pound Bend with ≥2 species from each of the following Water Regime Indicator Groups present in 80% of years: • Aquatic (small floating) (Asf) (no species recorded) • Aquatic (obligate submerged) (Aos) (no species recorded) • Aquatic (submerged to partially emergent) (Ase) (no species recorded) • Aquatic graminoids (persistent) (Agp) (no species recorded) • Aquatic to semi-aquatic (persistent) (Asp) (no species recorded) • Seasonally immersed – low growing (Slg) (no species recorded) • Seasonally inundated – emergent non woody (Sen) (Spiny Flat-sedge *Cyperus gymnocaulos*) • Seasonally inundated – emergent woody (Sew) (no species recorded) Mud herbs (Muh) (no species recorded)
PB2: By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Eastern Wetlands, Pound Bend.	By 2030, condition in standardised transects that span the floodplain elevation gradient and existing spatial distribution at Eastern Wetlands, Pound Bend ≥70% of Lignum plants in good condition with a Lignum Condition Score (LCI) ≥4.
PB3: By 2030, improve condition and maintain extent from baseline levels of River Red Gum (*Eucalyptus camaldulensis*) to sustain communities and processes reliant on River Red Gum woodlands at the Pound Bend asset	By 2030, a positive trend in the condition score of River Red Gum dominated EVC benchmarks at 80% of sites over the 10-year period. OR By 2030, at stressed sites (see Wallace et al. 2020): in standardised transects that span the floodplain elevation gradient and existing spatial distribution, ≥70% of viable trees will have a Tree Condition Index Score (TCI) ≥ 10. Baseline condition of River Red Gum trees at the Pound Bend to be established.

7.3 REGIONAL SIGNIFICANCE

Pound Bend supports a range of environmental values with local, regional and Murray-Darling Basin significance. These values are linked to the management goals and environmental objectives and targets described in Section 7.1. Details of the links between the environmental objectives and environmental outcomes at a regional/Basin scale are provided in Appendix 6.

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 Lake Pound Bend as a low priority wetland complex within the Happy Valley WMU.

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. 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 (LTWMP), the Basin-wide Environmental Watering Strategy (BWS) and annual Basin environmental watering priorities.

Details on the alignment of the updated Pound Bend EWMP environmental objectives to the Basin Plan are provided in Table 15. The mapping of objectives to Schedule 7 targets, the BWS and LTWMP are provided by Butcher et al., 2020 in Appendix 6.

Table 15. Mapping updated Pound Bend EWMP objectives to Basin Plan

EWMP Objective	Alignment with Basin Plan		
	8.05 Ecosystem and biodiversity	**8.06** Ecosystem function	**8.07** Ecosystem resilience
PB1: By 2030, improve vital habitat at Western Wetlands and Tammit Wetlands, Pound Bend 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
PB2: By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Eastern Wetlands, Pound Bend.	8.05, 3(b)	n/a	n/a
PB3: By 2030, improve condition and maintain extent from baseline levels of River Red Gum (*Eucalyptus camaldulensis*) to sustain communities and processes reliant on River Red Gum woodlands at the Pound Bend asset	8.05, 3(b)	8.06(b)	n/a

8 Environmental Water Requirements and Intended Water Regime

The wetland watering regime has been derived from the ecological and hydrological objectives. To allow for adaptive and integrated management, the watering regime is 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 and minimum watering regimes are 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.

8.1 WATERING REQUIREMENTS AND INTENDED WATERING REGIMES

Hydrological objectives describe the components of the water regime required to achieve the ecological objectives at Pound Bend. The hydrological requirements to achieve each of these objectives are presented in Table 16. They are based not only on recommended watering regimes for particular EVCs but also considers a desired trajectory of change as described in the ecological objectives and their justifications (i.e. reduce build-up on terrestrial vegetation in the Lignumwetlands on the higher terrace, promote aquatic and semi-aquatic understorey in the lower Red Gum terraces). The recommended timings are therefore based on the current mix of dominant species and their flooding and drying tolerances, as well as requirements to promote health and increase cover of other suites of understorey plants. The sources of information used are Roberts & Marsten (2011), Rogers and Ralph (2011) and VEAC (2008).

The first two rows of Table 16, below, describe watering options for the wetlands; the first being those wetlands that would be expected to support some aquatic and semi-aquatic herbs and macrophytes, the second being those wetlands for which Lignum is the key species to be promoted. The third row relates to the objective to inundate the fringing Red Gum woodlands of the Western Wetlands, (and to a lesser extent, Brown Swamp on a less frequent basis, which would be achieved by surcharging the wetland above the levels at the observation points, resulting in shallow flows across lower floodplain areas.

In addition to the guidelines presented below, there are adaptive management principles that should be applied in response to 'natural' floods and that should be considered in the context of mid-range timeframes (i.e. longer than annual planning cycles). Indications are that each wetland receives 'natural' flows, though these are likely to be less frequent than in the past and almost certainly of less duration. Therefore, the objectives set out below can potentially be facilitated by delivering piggyback late spring and summer flows into wetlands that have received a winter/spring flow, to extend the duration of the event and/or to achieve a surcharge of the wetlands to achieve shallow inundation of surrounding woodland vegetation communities.

Additionally, in recognition of the high value of Red Gum woodlands in this area to Regent Parrots, Pound Bend should be prioritised to receive at least minimum flow requirements in the lower Western Wetlands in drought conditions, to ensure that Red Gums do not decline to an irreversible condition. Ideally in drought conditions a refuge would be provided by ensuring there is a watering event at least one wetland within Pound Bend.

Table 16. Hydrological objectives for Pound Bend

Ecological Objectives	Water management area(s)	Hydrological Objectives											
		Recommended number of events in 10 years			Tolerable interval between events once wetland is dry (months)			Duration of ponding (months)			Preferred timing of inflows	Volume to fill to target supply level (ML)	Depth (mm)
		Min	Opt	Max	Min	Opt	Max	Min	Opt	Max			
PB1. By 2030, improve vital habitat at Western Wetlands and Tammit Wetlands, Pound Bend by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.	Western Wetlands, & Tammit Wetland	5	8	10	2	4	13	4	8	10	Spring – early Summer	1,200	600-1000
PB2. By 2030, improve condition and maintain extent from baseline levels of Lignum (Duma florulenta) to sustain communities and processes reliant on Lignum communities at Eastern Wetlands and Brown Swamp, Pound Bend.	Eastern Wetlands and Brown Swamp	2	4 – 5	5	4	6	42	12	6*	18	Spring – early Summer	450	1000
PB3. By 2030, improve condition and maintain extent from baseline levels of River Red Gum (Eucalyptus camaldulensis) to sustain communities and processes reliant on River Red Gum woodlands at the Pound Bend asset	Riparian and low floodplain fringing woodland of Western Wetlands and Brown Swamp	2	4	7	6	30	66	0	2	3	Spring – early Summer	1,200	50 – 500
*Duration is set to allow breeding cycle of waterbirds to complete; meeting an inundation duration of this length would be desirable in at least some years, as shorter periods can result in abandonment of nests.													

Watering regime

The wetland watering regime has been derived from the ecological and hydrological objectives. To allow for adaptive and integrated management, the watering regime is 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.

Minimum watering regime

Inundate Western and Tammit Wetlands five times in 10 years with a maximum 13 months between events once wetland is dry. Allow ponding for three to four months. Inundate Brown Swamp and Eastern Wetlands at least twice every 10 years and allow ponding for at least two months, to maintain the health of Lignum present. Preferred timing for watering event is in spring or early summer.

Optimal watering regime

Inundate Western and Tammit Wetlands eight times in 10 years and allow ponding for eight months. Inundate Brown Swamp and Eastern Wetlands four times in 10 years and allow ponding for up to six months. Preferred timing for watering event is in spring or early summer.

Maximum watering regime

Inundate Western and Tammit Wetlands every year and allow ponding for three to four months. Inundate Brown Swamp and Eastern Wetlands once every two years with a minimum of 12 months between events and allow ponding up to seven months. Preferred timing for watering event is in spring or early summer.

8.2 EXPECTED WATERING EFFECTS

This section aims to explicitly outline potential watering actions to achieve the state environmental objectives and expected watering effects.

Table 16. Expected watering effects and potential watering action required to achieve environmental objectives

Objective code	Environmental Objective	Potential Watering Action	Expected Watering Effect
PB1	By 2030, improve vital habitat at Western Wetlands and Tammit Wetlands, Pound Bend by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.	Facilitate flooding of 1,200 ML every 8 in 10 years during spring/early summer, with ponding for 8 months.	Suitable habitat (food, refuge) is provided in flooded wetland vegetation in spring and summer.
PB2	By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Eastern Wetlands, Pound Bend.	Facilitate flooding of 450 ML every 4-5 in 10 years during spring/early summer, with ponding for 6* months.	Maintain appropriate seasonal variation in water levels to improve condition and extent of Lignum.
PB3	By 2030, improve condition and maintain extent from baseline levels of River Red Gum (*Eucalyptus camaldulensis*) to sustain communities and processes reliant on River Red Gum woodlands at the Pound Bend asset	Facilitate flooding of 1,200 ML every 4 in 10 years during spring/early summer, with ponding for 2 months.	Maintain appropriate seasonal variation in water levels to improve condition and extent of River Red Gum.

*Duration is set to allow breeding cycle of waterbirds to complete; meeting an inundation duration of this length would be desirable in at least some years, as shorter periods can result in abandonment of nests.

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 (refer to Table 16). The planning scenarios under different seasonal conditions for Pound Bend are described in Figure 15. The example watering actions presented in Figure 15 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.

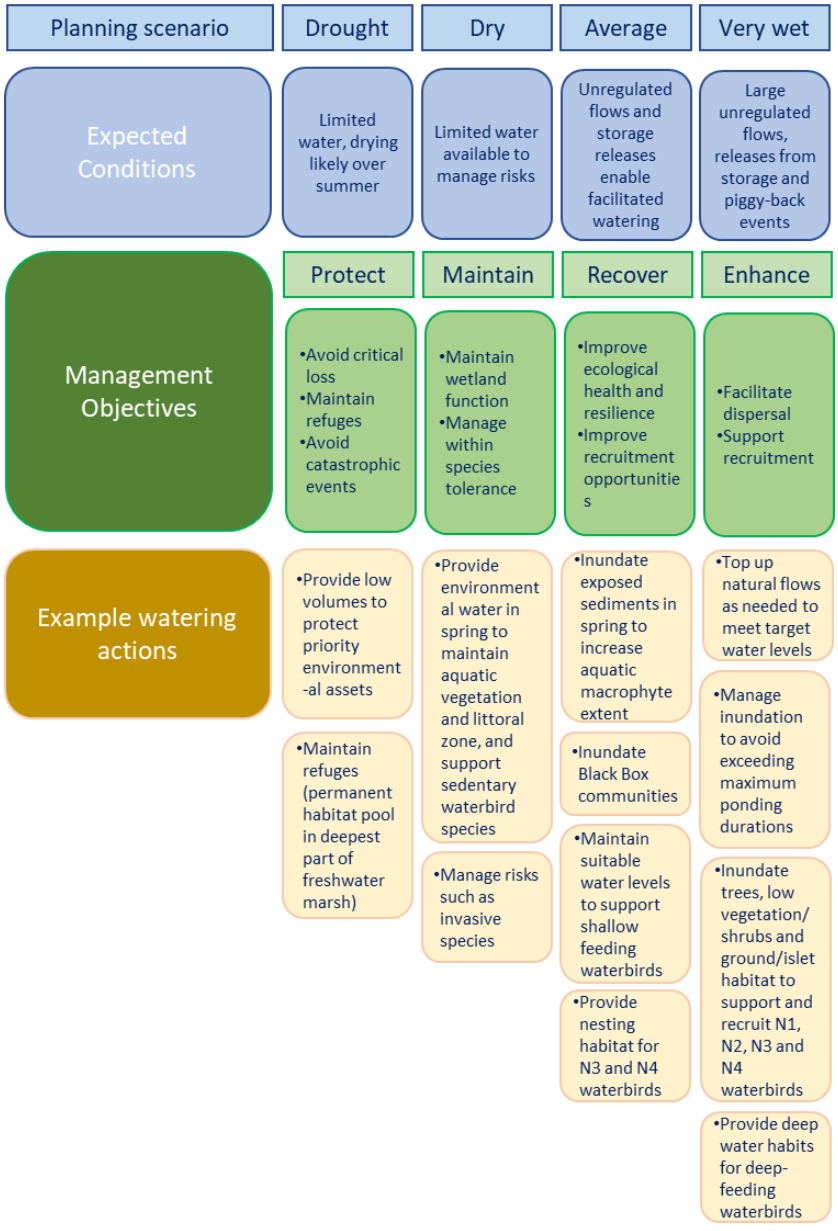


Figure 15. Indicative seasonally adaptive approach

9 Environmental Water Delivery Infrastructure

9.1 WATER DELIVERY INFRASTRUCTURE

There is currently no infrastructure installed for environmental watering purposes at Pound Bend. Temporary works are required to facilitate environmental water delivery.

9.2 CONSTRAINTS

The Smaller Western Wetland is currently used as a holding basin for irrigators to pump from. Any watering activities should not interfere with irrigator pumping requirements.

10 Demonstrating Outcomes

10.1 ENVIRONMETNAL MONITORING

The following monitoring activities have been proposed for the Pound Bend target area (Table 17). These activities 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. The link between stated objectives and monitoring priorities are described in Table 17.

Table 17. Environmental monitoring proposed for Pound Bend

Objective	Monitoring Focus	Monitoring Question	Method	When
Overarching management goal	Wetland condition	Has there been an overall improvement in the condition of the target area by 2030?	Undertake IWC method assessment	Every 5 years
Water regime	Volume	How much water has been delivered and retained in the Pound Bend wetland complex?	Lower Murray Water	Annually
	Inundation extent	Which components of the Pound Bend wetland complex were inundated?	Sentinel 2	Annually
	Maximum depth (AHD & depth classes)	When filled, to what height (AHD) and what area of key depth classes?	CSIRO, MDBA inundation products	Annually
	Minimum depth (AHD & depth classes)	What was the minimum depth of the residual pool and what was its extent?	Sentinel 2	Annually
PB1	Diversity of aquatic macrophytes from across a range of Water Regime Indicators groups	What is the baseline diversity of aquatic macrophytes? By 2030 Are ≥2 species from each of the Water Regime Indicator groups present in 80% of years?	Undertake surveys of aquatic macrophytes at Pound Bend (including species ID and extent). Compare results against benchmark of initial survey	Based on existing and antecedent conditions, monitor against expected community
PB2	Condition and extent of Lignum	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	Every 3 years

PB3	Condition and extent of River Red Gum	Is the condition of River red gum improving? What is the extent compared to the baseline? Are new trees being recruited into the forest and woodland populations?	TSC tool, field assessments Evaluate survival of seedlings over a 15-year period, transect survey and Tree Condition Index (TCI) score assessments, photo point monitoring, remote sensing	Annually

10.2 MONITORING PRIORITIES 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 Pound Bend are the monitoring questions that most strongly influence watering decisions and the evaluation of watering effectiveness. The monitoring priorities at Pound Bend are shown in Table 18.

Table 18. Monitoring priorities at Pound Bend

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
Groundwater monitoring	A small groundwater-monitoring program could also be implemented focusing on bores located around the perimeter of target wetlands within Pound Bend. The collection of groundwater level and salinity data will help assess the groundwater response to watering and the level of connection between the waterbodies and the floodplain aquifer
Soil sampling	Soil sampling is recommended at the conclusion of an environmental wearing event, to help to evaluate the success of watering relative to leaching salts from the upper soil profile.
River Red Gum, Lignum and Black box 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.
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.

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 16 shows an illustration of the adaptive management cycle for environmental water delivery.

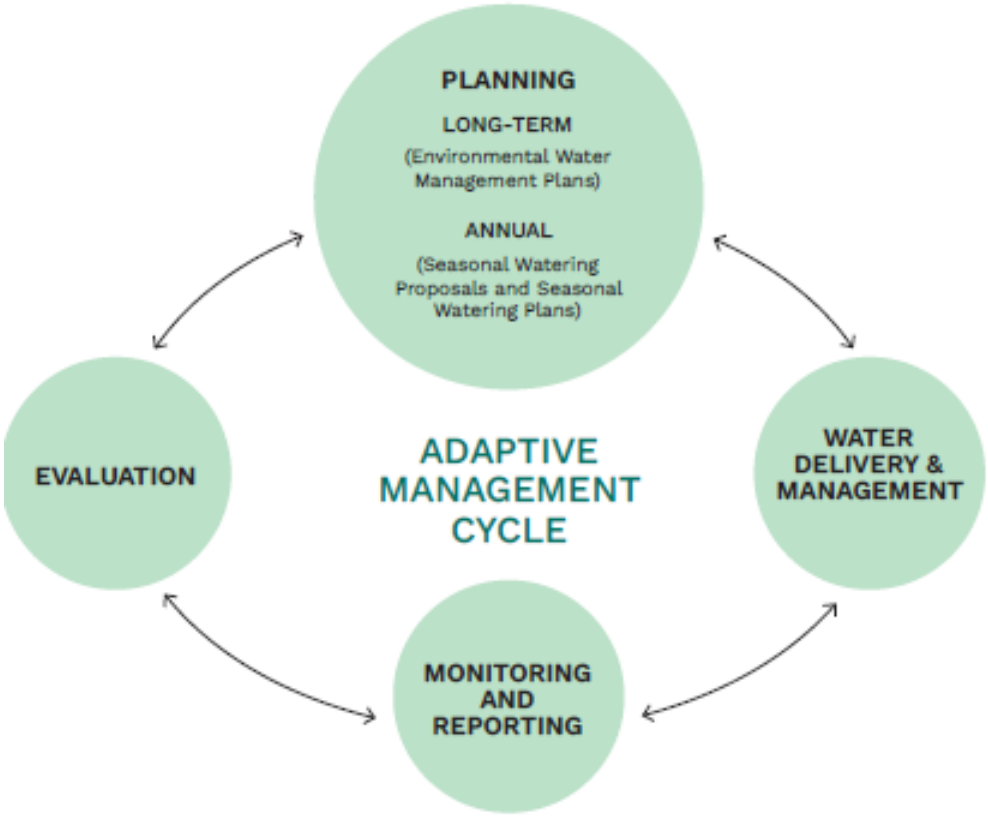


Figure 16. The adaptive management cycle for environmental water delivery and management

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.

In 2022, Mallee CMA further refined its adaptive management approach, implementing the Environmental Watering Adaptive Management Framework (Mallee CMA 2022)

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.

Mallee CMA's 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. In this way, we iteratively improve 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.

11.1 ADAPTIVE MANAGEMENT COMPONENTS

Environmental Watering Database

Mallee CMA uses an Environmental Watering Database for storage of watering information. It stores hydrological, environmental, and ecological watering event details, including data for informing adaptive management decisions.

Annual adaptive management checkpoint

An annual adaptive management checkpoint (AM Checkpoint) for each of Mallee CMA's Seasonal Watering Proposals provides a structured and formalised forum for evaluation and review.

The outcomes from each AM Checkpoint:

- informs the annual reporting to relevant stakeholders, including VEWH and DEECA
- identifies the key lessons from environmental water delivery events throughout the year, to be documented into the Watering Event Lessons (WEL) Record (below)
- informs Mallee CMA environment water annual planning for subsequent years.

Watering Event Lessons (WEL) record

Key decisions and justifications, new knowledge and lessons learned are documented in a 'live', site-specific, centralised, document called a Watering Event Lessons (WEL) Record. The WEL Record provides an opportunity for planning and delivery information to be systematically recorded and retained for subsequent evaluation at the AM Checkpoint (see above).

The WEL Record is also used to capture outcomes and knowledge generated from lesson review at the AM Checkpoint.

WEL Records are updated at the end of each watering event providing an accessible library of lessons ready to be uploaded into the CMA's organisational knowledge base via the EWMP update process.

Seasonal watering proposal presentation adaptive management section

The annual seasonal watering proposals presentation to Mallee CMA Chief Executive Officer and Executive Management includes a section on adaptive management.

This section explicitly focuses on outcomes and observations from previous events and any subsequent changes being made as a response within that years' Seasonal Watering Proposal. This promotes for the broader dissemination of findings and outcomes within Mallee CMA.

Monitoring Consultants' findings summary

Monitoring consultants are required to synthesise their results and describe the implications of results for ongoing environmental watering programs. This promotes the transfer and uptake of knowledge from monitoring and other investigations into Mallee CMA water planning and management.

Figure 16 shows how adaptive management processes are integrated with Mallee CMA's environmental watering program.

12 Knowledge gaps and recommendations

Limited flora and fauna survey work has been carried out at Pound Bend, leading to a lack of knowledge of the full range of ecological values that may be present. The influence of the adjacent irrigation area, and the underlying hydrogeology, are poorly known. The following recommendations are made to assist to fill knowledge gaps (Table 19).

Table 19. Knowledge and gaps and recommendations for Pound Bend

Knowledge and data gap	Action recommended	Responsibility
Wetland condition	Pound Bend should be incorporated into the five-yearly Index of Wetland Condition assessments	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.
Mechanism to achieve optimal pumping into the target wetlands at Pound Bend	Explore mechanisms to achieve maximum inundation of the target area, such as infrastructure or the relaxation of constraints. A concept design report is required to scope the infrastructure requirements at Pound Bend	
Best options for watering of target wetlands at Pound Bend	Scoping of requirements and detailed design of options for watering wetlands within Pound Bend wetland complex	
Condition and extent of black box and aquatic macrophytes	Undertake methods identified in Table 18	
Impacts of nearby irrigation on wetland health	Investigation of surface water, groundwater and irrigation water interaction	
Tree health and soil salinity impacts	Investigation of tree condition and correlation with soil salinity and potential causes of decline	
Sub-saline depression shrubland classification in Brown Swamp	Conduct revision and ground truthing of EVC classification	
Flora and fauna presence	Conduct flora and fauna surveys to provide more understanding of site values	
Understanding of aquifer/aquiclude systems underlying Pound Bend	Review of bore hole data to provide information about the presence or absence of Blanchtown clay under the southern part of Pound Bend. This will assist to determine processes of accumulation and export of salt, and will also inform investigations on mixed tree health across the floodplain	

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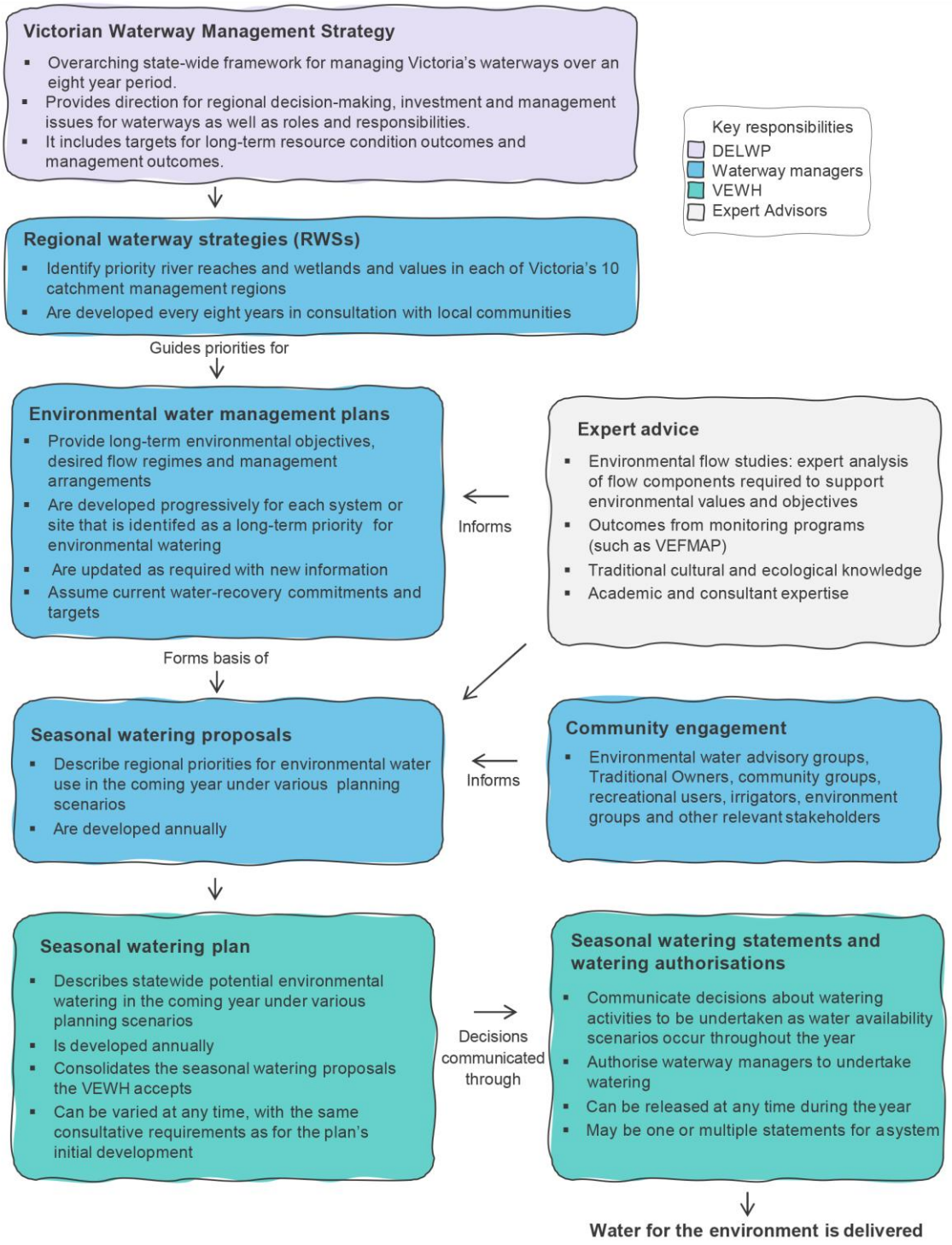
APPENDIX 1.

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 Pound Bend 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 Pound Bend 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 Pound Bend.

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.



EWMP Policy Context

APPENDIX 2.

COMMUNITY AND AGENCY ENGAGEMENT 2025

Community stakeholders were engaged on the update of this and other EWMPs in-person at local events, including local markets (Red Cliffs Market), local environmental group outings to the site (Mildura Birdlife) and onsite community group events (general community). In-person engagements were designed to enable community input to the plans, and included a 'Pins in Maps' exercise, where stakeholders identified locations of water-dependent values at the sites within the Bottle Bend and other WMU subunits. Community consultation occurs at the IAP2 level of CONSULT.

In-person community engagement:

Community stakeholders provided information about Pound Bend at in-person meetings with Mildura Birdlife, and in general community events and markets. These stakeholders had specific interests in birds, recreational activities and water values at the site.

Traditional Owner engagement on Country:

Traditional Owner representatives were engaged on the Pound Bend EWMP at an in-person meeting at Mallee CMA offices in October 2024. Representatives from FPMMAC attended the meeting. A 'pins in maps' exercise was also completed at this meeting. Traditional Owners identified water-dependent values, flora and fauna values (birdlife and native vegetation), recreational values (camping), and other cultural values across Pound Bend. The true extent of cultural heritage at Pound Bend is unknown.

Agency Engagement:

Mallee CMA engaged with representatives from agency stakeholders Parks Victoria, Lower Murray Water, Mildura Rural City Council and Goulburn Murray Water in June 2025 via email and presentation seeking site specific input regarding changes to site condition, site and surrounding land use, known flora and fauna and infrastructure (drainage, bores etc) at the site.

APPENDIX 3.

ECOLOGICAL VEGETATION CLASSES

EVC no.	EVC name	Bioregional Conservation Status	Description
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 semisucculent understorey shrubs.
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.
106	Grassy Riverine Forest	Depleted	Occurs on the floodplain of major rivers, in a slightly elevated position where floods are infrequent, on deposited silts and sands, forming fertile alluvial soils. River Red Gum forest to 25 m tall with a ground layer dominated by tussock-forming graminoids. Occasional tall shrubs present.
808	Lignum Shrubland	Least concerned	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 the open and even distribution of relatively small Lignum shrubs. Occupies heavy soil plains along Murray River, low-lying areas on higher-level (but still potentially flood-prone) terraces.
104	Lignum Swamp	Vulnerable	Typically treeless shrubland to 4 m tall, with robust (but sometimes patchy) growth of lignum. Widespread wetland vegetation type in low rainfall areas on heavy soils, subject to infrequent inundation resulting from overbank flows from rivers or local runoff.
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.
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 ground layer

EVC no.	EVC name	Bioregional Conservation Status	Description
			dominated by graminoids and sometimes lightly shrubby or with chenopod shrubs.
98	Semi-arid Chenopod Woodland	Vulnerable	Sparse, low non-eucalypt woodland to 12 m tall of the arid zone with a tall open chenopod shrub-dominated understorey or a treeless, tall chenopod shrubland to 3 m tall. This EVC may occur as either a woodland (typically with a very open structure but tree cover >10%) or a shrubland (tree cover <10%) with trees as an occasional emergent.
828	Semi-arid Parilla Woodland	Vulnerable	A shrubby, non-eucalypt woodland or open forest to 15 m tall of low rainfall areas associated with topographic highs created by weathered Parilla sandstone ridges and dominated by Belah Casuarina pauper. This EVC represents a distinctive floristic segregate of Semi-arid Woodland – comprising relatively undisturbed remnants of this broader vegetation descriptor with little or no groundwater influence.
97	Semi-arid Woodland	Vulnerable	Non-eucalypt woodland or open forest to 12 m tall, of low rainfall areas. Occurs in a range of somewhat elevated positions not subject to flooding or inundation. The surface soils are typically light textured loamy sands or sandy loams.
818	Shrubby Riverine Woodland	Least concerned	Eucalypt woodland to open forest to 15 m tall of less flood-prone (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.
820	Sub-saline Depression Shrubland	Depleted	A low open shrubland/herbland dominated by chenopods and succulents and occurring on the highest terraces of the former (i.e. pre1750) Murray River floodplain in far North-West Victoria. It occupies semi-saline treeless pans in low-lying areas within Riverine Chenopod Woodland on very heavy and mildly saline clay soils.
86	Woorinen Sands Mallee	Depleted	Mallee shrubland to 7 m tall, typically supporting a hummock grass (Triodia spp.) dominated understorey. This EVC could be considered intermediate between the heavier soil mallee woodlands and the lighter sandy soil mallee vegetation predominant on Lowan (siliceous) sand.

APPENDIX 4.

FAUNA SPECIES LIST – COMBINED NATUREKIT, BIRD OBSERVATIONS AND PROTECTED MATTERS SEARCHES

Scientific Name	Australian Magpie	FFG Act Status	EPBC Act Status
Gymnorhina tibicen	Australian Pelican		
Pelecanus conspicillatus	Australian Raven		
Corvus coronoides	Australian White Ibis		
Threskiornis molucca	Australian Wood Duck		
Chenonetta jubata	Barking Marsh Frog		
Limnodynastes fletcheri	Black-faced Cuckoo-shrike		
Coracina novaehollandiae	Black-fronted Dotterel		
Elseyornis melanops	Blue-faced Honeyeater		
Entomyzon cyanotis	Boulenger's Skink		
Morethia boulengeri	Brown Goshawk		
Accipiter fasciatus	Brown Treecreeper (south-eastern ssp.)		
Climacteris picumnus victoriae	Buff-rumped Thornbill		
Carassisus auratus*	Goldfish		
Acanthiza reguloides	Carnaby's Wall Skink		
Cryptoblepharus pannosus	Central Bearded Dragon		
Turdus merula*	Common Blackbird		
Pogona vitticeps	Common Bronzewing		
Cyprinus carpio*	Common Carp		
Sturnus vulgaris*	Common Starling		
Phaps chalcoptera	Crested Pigeon		
Ocyphaps lophotes	Crimson Rosella		
Platycercus elegans	Dusky Woodswallow		
Artamus cyanopterus	Eastern Great Egret	Vulnerable	
Ardea modesta	Fairy Martin		
Petrochelidon ariel	Galah		
Gambusia holbrooki*	Gambusia		
Eolophus roseicapilla	Great Cormorant		
Phalacrocorax carbo	Grey Butcherbird		
Cracticus torquatus	Grey Fantail		
Rhipidura albiscarpa	Grey Shrike-thrush		
Colluricincla harmonica	Grey Teal		
Anas gracilis	Inland Thornbill		
Acanthiza apicalis	Laughing Kookaburra		
Dacelo novaeguineae	Little Black Cormorant		
Phalacrocorax sulcirostris	Little Corella		

Scientific Name	Australian Magpie	FFG Act Status	EPBC Act Status
Cacatua sanguinea	Little Friarbird		
Philemon citreogularis	Little Pied Cormorant		
Microcarbo melanoleucos	Magpie-lark		
Grallina cyanoleuca	Mallee Ringneck		
Barnardius zonarius barnardi	Mallee Spadefoot Toad		
Neobatrachus pictus	Marbled Gecko		
Christinus marmoratus	Masked Lapwing		
Vanellus miles	Nankeen Night Heron		
Nycticorax caledonicus hillii	Noisy Miner		
Manorina melanocephala	Pacific Black Duck		
Anas superciliosa	Pallid Cuckoo		
Cuculus pallidus	Peaceful Dove		
Geopelia striata	Peregrine Falcon		
Falco peregrinus	Pied Cormorant		
Phalacrocorax varius	Pink-eared Duck		
Malacorhynchus membranaceus	Rainbow Bee-eater		
Vulpes vulpes*	Red Fox		
Merops ornatus	Red Wattlebird		
Anthochaera carunculata	Red-rumped Parrot		
Psephotus haematonotus	Regent Parrot	Vulnerable	Vulnerable
Polytelis anthopeplus monarchoides	Restless Flycatcher		
Myiagra inquieta	Royal Spoonbill		
Platalea regia	Rufous Songlark		
Cincloramphus mathewsi	Rufous Whistler		
Pachycephala rufiventris	Sacred Kingfisher		
Todiramphus sanctus	Splendid Fairy-wren		
Malurus splendens	Spotted Burrowing Skink		
Lerista punctatovittata	Spotted Marsh Frog (race unknown)		
Limnodynastes tasmaniensis	Straw-necked Ibis		
Threskiornis spinicollis	Striated Pardalote		
Pardalotus striatus	Stumpy-tailed Lizard		
Tiliqua rugosa	Sulphur-crested Cockatoo		
Cacatua galerita	Tessellated Gecko		
Diplodactylus tessellatus	Tree Dtella		
Gehyra variegata	Tree Martin		
Petrochelidon nigricans	Weebill		
Smicrornis brevirostris	Welcome Swallow		
Petrochelidon neoxena	Western Grey Kangaroo		
Macropus fuliginosus	Whistling Kite		

Scientific Name	Australian Magpie	FFG Act Status	EPBC Act Status
Haliastur sphenurus	White-browed Babbler		
Pomatostomus superciliosus	White-faced Heron		
Egretta novaehollandiae	White-necked Heron		
Ardea pacifica	White-plumed Honeyeater		
Lichenostomus penicillatus	White-winged Chough		
Corcorax melanorhamphos	Willie Wagtail		
Rhipidura leucophrys	Yellow Rosella		
Platycercus elegans flaveolus	Yellow Thornbill		
Acanthiza nana	Yellow-billed Spoonbill		
Platalea flavipes	Yellow-rumped Thornbill		
Acanthiza chrysorrhoa	Australian Magpie		
DEECA 2025, DCCEEW 2024 *Indicates introduced species			

FLORA SPECIES LIST - COMBINED NATUREKIT, VICTORIAN BIODIVERSITY ALTAS WITH RESULTS OF A WETMAP FLORA SURVEY (WETMAP 2024)

Scientific Name	Common Name	FFG Act Status	EPBC Act Status
Acacia stenophylla	Eumong		
Acacia oswaldii	Umbrella Wattle		
Alternanthera denticulata	Lesser Joyweed		
Arctotheca calendula*	Cape weed		
Asphodelus fistulosus*	Onion Weed		
Aster subulatus*	Aster-weed		
Atriplex leptocarpa	Slender-fruit Saltbush		
Atriplex lindleyi	Flat-top Saltbush		
Atriplex prostrata*	Hastate Orache		
Atriplex semibaccata	Berry Saltbush		
Avena fatua*	Wild Oat		
Austrostipa scabra/nitida/nodosa spp. agg.	Variable Spear-grass		
Brachyscome lineariloba	Hard-head Daisy		
Bromus diandrus*	Great Brome		
Bromus rubens*	Red Brome		
Calotis cunefolia	Blue Burr-daisy	Endangered	
Casuarina pauper	Belah		
Centaurea melitensis*	Malta Thistle		
Cirsium vulgare*	Spear Thistle		
Cotula bipinnata*	Ferny Cotula		
Cucumis myriocarpus subsp. Leptodermis*	Paddy Melon		
Cullen cinereum	Hoary Scurf-pea	Endangered	
Cyperus hamulosus*	Curry Flat-sedge		
Dittrichia graveolens*	Stinkwort		
Duma florulenta	Tangled Lignum		
Einadia nutans	Nodding Saltbush		
Emex australis*	Spiny Emex		
Enchylaena tomentosa var. tomentosa	Ruby Saltbush		
Eragrostis lacunaria	Purple Love-grass	Endangered	
Eremophila divaricata subsp. divaricata	Spreading Emu-bush	Vulnerable	
Eucalyptus largiflorens	Black Box		
Eucalyptus camaldulensis	River Red Gum		
Euchiton sphaericus	Annual Cudweed		
Euphorbia terracina*	Terracina Spurge		
Glycyrrhiza acanthocarpa	Native liquorice		
Hordeum leporinum*	Barley-grass		
Hypochaeris glabra*	Smooth Cat's-ear		
Hypochaeris radicata*	Flatweed		
Juncus acutus subsp. Acutus*	Spiny Rush		
Lactuca saligna*	Willow-leaf Lettuce		
Lactuca serriola*	Prickly Lettuce		
Lepidium africanum*	Common Peppercress		
Lycium ferocissimum*	African Box-thorn		
Maireana brevifolia	Short-leaf Bluebush		
Maireana pentagona	Hairy Bluebush		

Scientific Name	Common Name	FFG Act Status	EPBC Act Status
Malacocera tricornis	Goat Head	Vulnerable	
Marsilea drummondii	Common Nardoo		
Medicago minima*	Little Medic		
Medicago sativa subsp. sativa*	Lucerne		
Melilotus indicus*	Sweet Melilot		
Mesembryanthemum crystallinum*	Common Ice-plant		
Mesembryanthemum nodiflorum*	Small Ice-plant		
Monoculus monstrosus*	Tripteris		
Parapholis incurve*	Coast Barb-grass		
Paspalum dilatatum*	Paspalum		
Paspalum distichum*	Water Couch		
Pentameris airoides subsp. Airoides*	False Hair-grass		
Phyla canescens*	Fog-fruit		
Plantago cunninghamii	Clay Plantain		
Plantago lanceolata*	Ribwort		
Pogonolepis muelleriana	Stiff Cup-flower		
Polycalymma stuartii	Poached-eggs Daisy		
Polygonum aviculare s.l.*	Prostrate Knotweed		
Psilocaulon granulicaule*	Wiry Noon-flower		
Reichardia tingitana*	False Sow-thistle		
Rytidosperma caespitosum	Common Wallaby-grass		
Salsola tragus subsp. tragus	Prickly Saltwort		
Salvia verbenaca*	Wild Sage		
Schismus barbatus*	Arabian Grass		
Sclerochlamys brachyptera	Short-wing Saltbush		
Sclerolaena muricata	Black Roly-poly		
Sclerolaena tricuspis	Streaked Copperburr		
Sida corrugata	Variable Sida		
Sida spp.	Sida		
Sisymbrium erysimoides*	Smooth Mustard		
Sisymbrium irio*	London Rocket		
Sisymbrium orientale*	Indian Hedge-mustard		
Solanum esuriale	Quena		
Sonchus asper s.l.*	Rough Sow-thistle		
Sonchus oleraceus*	Common Sow-thistle		
Spergularia diandra*	Lesser Sand-spurrey		
Spergularia rubra s.l.*	Red Sand-spurrey		
Stelligera endecaspinis	Star Bluebush		
Teucrium racemosum s.l.	Grey Germander		
Vittadinia dissecta s.l.	Dissected New Holland Daisy		
Vulpia myuros*	Rat's-tail Fescue		
Wahlenbergia gracilenta s.l.	Annual Bluebell		
Xanthium strumarium spp. agg.*	Noogoora Burr spp. agg.		
Xanthium spinosum*	Bathurst Burr		
DEECA 2025, DCCEEW 2024 * Indicates introduced species			

APPENDIX 5.

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 A2
			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	

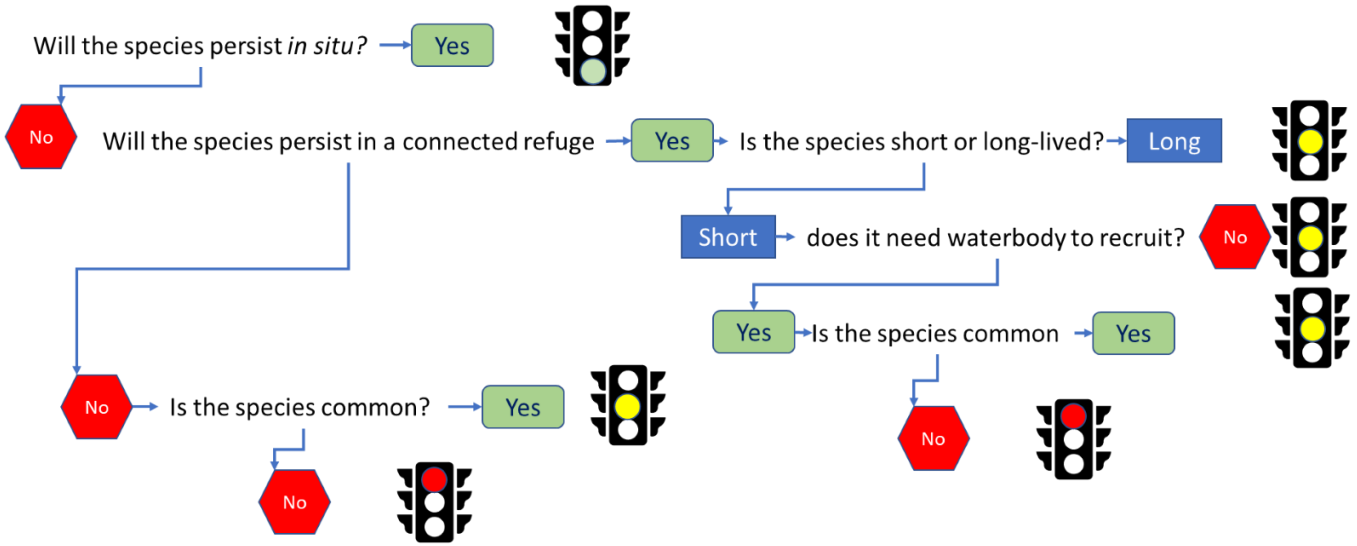


Figure A1 – Decision tree for assessing risk

APPENDIX 6.

EWMP UPDATED ENVIRONMENTAL OBJECTIVES, FURTHER INFORMATION 9FROM BUTCHER ET AL. 2020)

5.22 Pound Bend

5.22.1 SMARTness and rationalisation

Site-specific environmental objectives for the Pound Bend EWMP (Mallee CMA 2015e).

EWMP objectives
PB1: Protect and improve the diversity of native wetland flora species consistent with Shallow Freshwater Marsh, Floodway Pond Herbland, and Shrubby Riverine Woodland, by increasing the understory species diversity in Un-named 1 and Tammit Wetlands.
PB2: Protect and improve the diversity of native wetland flora species consistent with Lignum Swampy Woodland and Lignum Swamps, by increasing density of Lignum in Eastern Wetlands.
PB3: Maintain the health of fringing River Red Gums and facilitate longevity of River Red Gum population, as evidenced by canopy health and germination and recruitment rates.

Assessment of SMARTness of current Pound Bend 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
PB1	0	0.5	1	1	1	0.5	1	1	1	0	0

PB2	0	0.5	1	1	1	0.5	1	1	1	0	0
PB3	0	0	1	1	1	0.5	1	1	1	0	0

Rationalised environmental objectives for the Pound Bend EWMP (Mallee CMA 2015e).

Objective	Issue	Outcome
PB1	No issue with objective other than its not fully SMART and no baseline data.	Objective updated to align with Basin Plan language. River Red Gum aspect (Shrubby Riverine Woodland) is captured in PB3, this focuses on aquatic macrophytes. Mud WRIG is kept for this objective.
PB2	Objective has multiple outcomes – consider simplifying.	Rationalised to align with LTWP objectives – change to be about lignum condition. Consolidate aquatic vegetation diversity aspect of this objective with PB1.
PB3	No issue with objectives other than its not fully SMART and no baseline data.	Objective updated to align with Basin Plan language

5.22.2 Mapping to Basin Plan

Basin Plan Schedule 8 and 9 criteria.

Schedule 8 criteria met	Schedule 9 criteria met
From DELWP (2015a)	
1: JAMBA, CAMBA **3:** The movement of species of fish, invertebrates and amphibians is driven by floodplain and wetland connectivity. The site is important for specific dispersal and connectivity functions. **4:** EPBC Act, FFG Act, DSE Listed **5:** High fauna biodiversity	**1:** Supports the creation and maintenance of vital habitats and populations **2:** water quality - ecosystem processes support 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(b): Prevents declines in native biota	**1(e):** Vital habitat - preventing decline of native biota

Mapping Pound Bend 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
PB1: Protect and improve the diversity of native wetland flora species consistent with Shallow Freshwater Marsh, Floodway Pond Herbland, and Shrubby Riverine Woodland, by increasing the understory species diversity in Un-named 1 and Tammit Wetlands.	8.05,3(b) 8.06,6(b)	Diversity of native water dependent Vegetation Condition of priority asset - prevention of decline in native biota Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species	B2.11	LTWPVM2 LTWPVM4 LTWPVM5
PB2: Protect and improve the diversity of native wetland flora species consistent with Lignum Swampy Woodland and Lignum Swamps, by increasing density of Lignum in Eastern Wetlands.	8.05,3(b) 8.06,6(b)	Diversity of native water dependent vegetation Condition of priority asset - prevention of decline in native biota Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species	B2.10	LTWPVM8
PB3: Maintain the health of fringing River Red Gums and facilitate longevity of River Red Gum population, as evidenced by canopy health and germination and recruitment rates.	8.06,6(b)	Recruitment and populations of native water-dependent vegetation Condition of native water dependent vegetation Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species	B2.9	LTWPVM5

5.22.3 Updated objectives for Pound Bend

Current objective	PB1: Protect and improve the diversity of native wetland flora species consistent with Shallow Freshwater Marsh, Floodway Pond Herbland, and Shrubby Riverine Woodland, by increasing the understorey species diversity in Un-named 1 and Tammit Wetlands.

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. River Red Gum aspect (Shrubby Riverine Woodland) is captured in PB3
EWP objective(s)	8.05,3(b) 8.06,6(b)
Schedule 7 targets	Diversity of native water dependent vegetation Condition of priority asset - prevention of decline in native biota 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	B2.11 To maintain the current extent of non-woody vegetation
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 Un-named 1 and Tammit Wetlands, Pound Bend by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.
2020 Targets:	Target no able to be set adequately as no baseline data for Pound Bend vegetation By 2030, increase diversity of native of macrophytes at Un-named 1 and Tammit Wetlands, Pound Bend with ≥2 species from each of the following Water Regime Indicator Groups present in 80% of years: • Aquatic (small floating) (Asf) (no species recorded) • Aquatic (obligate submerged) (Aos) (no species recorded) • Aquatic (submerged to partially emergent) (Ase) (no species recorded) • Aquatic graminoids (persistent) (Agp) (no species recorded) • Aquatic to semi-aquatic (persistent) (Asp) (no species recorded) • Seasonally immersed – low growing (Slg) (no species recorded) • Seasonally inundated – emergent non woody (Sen) (Spiny Flat-sedge *Cyperus gymnocaulos*) • Seasonally inundated – emergent woody (Sew) (no species recorded) • Mud herbs (Muh) (no species recorded)

Current objective	**PB2: Protect and improve the diversity of native wetland flora species consistent with Lignum Swampy Woodland and Lignum Swamps, by increasing density of Lignum in Eastern Wetlands.**
Comments	Rationalised to align with LTWP objectives – change to be about lignum condition.

EWP objective(s)	8.05,3(b)
Schedule 7 targets	Condition of priority asset - prevention of decline in native biota 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 Eastern Wetlands, Pound Bend.
2020 Targets:	By 2030, condition in standardised transects that span the floodplain elevation gradient and existing spatial distribution at Eastern Wetlands, Pound Bend ≥70% of Lignum plants in good condition with a Lignum Condition Score (LCI) ≥4.

Current objective	**PB3: Maintain the health of fringing River Red Gums and facilitate longevity of River Red Gum population, as evidenced by canopy health and germination and recruitment rates.**
Comments	Focus of the objective is the condition of mature RRG
EWP objective(s)	8.05,3(b) 8.06,6(b)
Schedule 7 targets	Condition of priority asset - prevention of decline in native biota Condition of native water dependent vegetation Recruitment and populations of native water-dependent vegetation Extent and contiguousness of native water dependent vegetation
PEA/PEF criteria met	PEA 3(b) Prevents declines in native biota PEF 1(e) Vital habitat - preventing decline of native biota
BEWS QEEO	B2.9 By 2024 improve recruitment of trees within River Red Gum and Black Box communities
LTWP objective	LTWPVM5 Improve the condition of River Red Gum dominated EVCs
LTWP target	A positive trend in the condition score of River red gums dominated Ecological Vegetation Class (EVC) benchmarks at 80% of sites over the 10-year period to 2025
2020 Objective:	By 2030, improve condition and maintain extent from baseline levels of River Red Gum (*Eucalyptus camaldulensis*) to sustain communities and processes reliant on River Red Gum woodlands at the Pound Bend asset

2020 Targets:	By 2030, a positive trend in the condition score of River Red Gum dominated EVC benchmarks at 80% of sites over the 10-year period. OR By 2030, at stressed sites (see Wallace et al. 2020): in standardised transects that span the floodplain elevation gradient and existing spatial distribution, ≥70% of viable trees will have a Tree Condition Index Score (TCI) ≥ 10. Baseline condition of River Red Gum trees at the Pound Bend to be established.

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