



Recreation Lakes Environmental Values Analysis

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Submitted to:

Dean Lawson, NRM Strategic Planning Officer, Wimmera CMA.

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1 INTRODUCTION

1.1 CONTEXT

Water savings from the Wimmera Mallee Pipeline Project supported the creation of new water entitlements for consumptive, recreational and environmental use in the Wimmera-Glenelg supply system.

The Wimmera and Glenelg rivers' environmental entitlement defines the Victorian Environmental Water Holder's (VEWH) rights to water across both river systems.

Grampians Wimmera Mallee Water (GWMWater) delivers the water allocated to the recreational entitlement to recreation lakes and weir pools via the Wimmera Mallee Pipeline. These lakes and weir pools include Yarriambiack Creek weir pools at Warracknabeal, Brim and Beulah and lakes including Lascelles at Hopetoun; Tchum near Birchip; Marma, Murtoa; Wooroonook, Charlton; Watchem at Watchem; Donald Caravan Park Lake at Donald; Willow Lake annexed to Lascelles at Hopetoun. Donald Weir Pool at Donald also receives a piped recreational allocation via the Wimmera Mallee Pipeline but is not part of this report.

Allocations to the recreation entitlement commence later than allocations to the Wimmera Mallee Pipeline Product (WMPP) entitlements for consumptive and environmental use. Therefore, in dry years, a greater proportion of the environmental entitlement is available for use compared to the recreational entitlement. Ouyen Lake and Green Lake (near Sea Lake) are supplied with allocations from GWMWater's Murray River entitlement.

Periodic low inflows to major water storages have often resulted in low allocation to Wimmera-Glenelg entitlements, including that for the recreation lakes (Figure 1). GWMWater holds surplus water resources in reserve due to unused allocations against unsold growth water and large industrial customers not operating. This has enabled it to make unused water available for recreational use in seasons where allocations to the recreation entitlement are low. For example, since 2011 only 26% of the volume supplied to the recreational lakes has come from allocations to the recreation entitlement, with the remainder being supplied from GWMWater's surplus holdings. GWMWater's 2022 Urban and Rural Water Strategy acknowledges that with the projected increases to demand and the uptake of growth water, GWMWater is less likely to hold surplus allocation to support deliveries to recreational lakes in the future.

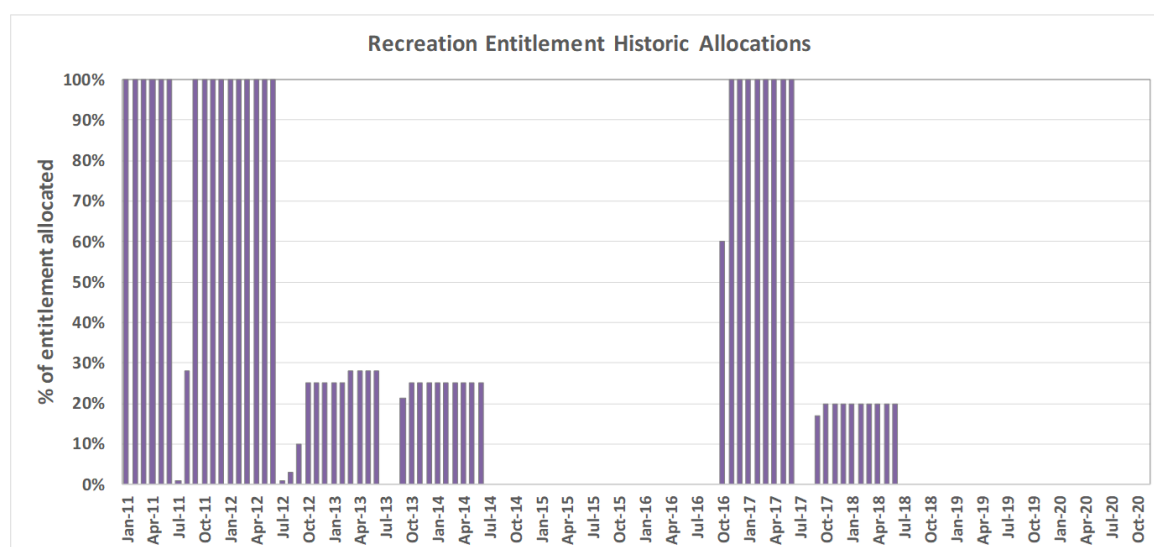


Figure 1. Water allocation to recreation lakes from 2011-2020 (source: GWMWater).

The recreation lakes supported by the pipeline system are valuable to local communities, which have benefited from increased tourism due to the lakes being popular locations for camping and water-based recreational activities. The recreation lakes also contribute socio-economic benefits, including to regional liveability values and general wellbeing. Surface water in a dry landscape can also support regional biodiversity values, with the lakes supporting aquatic species and terrestrial species such as woodland birds, reptiles and other fauna.

While socio-economic and recreation values of Wimmera-Mallee lakes have been well documented in relatively recent studies, an understanding of environmental values of lakes and weir pools supplied with designated recreation water supply is absent from up-to-date information. The previous environmental evaluation of an original list of recreation-supply lakes occurred in 2004 before construction of pipelines. This was during the millennium drought when there was little water in the broader regional landscape.

This 2022 Recreation Lakes Environmental Values Analysis was undertaken at a time when much of the Wimmera-Mallee was experiencing wet conditions and most recreation lakes and weir pools were full, with some having experienced almost a decade of consistent supply. The study was to reconsider the environmental values of these recreation lakes.

Understanding the role of the recreation lakes in contributing to ecosystem function and biodiversity values will be important to inform future management decisions - for example, Regional Waterway Strategies.

This project will contribute to a better understanding of the triple-bottom-line values of these waterbodies and help catchment and water managers meet broad socio-economic demands involving relatively isolated communities especially during a return to times of water scarcity.

It might also guide future decisions relating to water-sharing arrangements. However, changes to bulk and environmental entitlements that impact water-sharing arrangements must be agreed upon by other entitlement holders and can only be amended via statutory processes set out under the *Water Act 1989*. In addition, further data on environmental values would be required to inform that process.

This project has reviewed existing data and information to assess the environmental values of the recreation lakes. The information collected also provided the conceptual basis for assessing the relative environmental benefits for the lakes under various water-delivery regimes, as well as the main threats to environmental condition of each lake. The recreation lakes included in the assessment are (Figure 2):

- Wimmera CMA region:
 - Brim Weir Pool
 - Lake Marma
 - Warracknabeal Weir Pool
 - Watchem Lake
- North Central CMA region:
 - Donald Caravan Park Lake
 - Walkers Lake
 - Wooroonook Lake
- Mallee CMA region:
 - Beulah Weir Pool
 - Green Lake
 - Hopetoun Storage (Willow Lake)
 - Lake Lascelles
 - Ouyen Lake
 - Rainbow Lake
 - Tchum Lake
 - Yaapeet Storage (Turkey Bottom Lake).

2 APPROACH

The synthesis of the environmental values for the lakes includes review of existing reports, datasets, and hydrological information, outputs from site inspections, and listing of the values identified during the community engagement (WCMA unpublished). Each lake has been classified according to a set of attributes used in

classification and typologies for aquatic ecosystems. Conceptual models relating to threatening processes have been developed for each ecosystem type. Combined, this will detail the current condition and environmental values for each lake.

The second phase of the project was to develop and apply a multicriteria assessment (MCA) as a tool to inform future decisions around the supply of water to recreation lakes for environmental outcomes. The environmental values and MCA are based around elements of the program logic of several key documents used in the planning and management of environmental water in Victoria, including:

- Basin Plan Environmental Watering Plan, Chapter 8 objective hierarchy (Sections 8.5, 8.6 and 8.7 in Commonwealth of Australia 2012)
- DELWP Guidelines for Environmental Water Management Plans (DELWP 2022)
- Victorian environmental water management program, including the Seasonal Watering Plan drafted by the Victorian Environmental Water Holder (e.g., VEWH 2022)
- Regional Waterway Strategies and Catchment Strategies.

One of the responsibilities of the Victorian Environmental Water Holder (VEWH) is to work with stakeholders¹, the community and First Nations to coordinate and achieve environmental outcomes from the delivery of all water, including environmental water (VEWH 2022).

At the local scale, Regional Waterway Strategies identify priority waterways and outline integrated waterway management actions and are a sub- strategy of regional catchment strategies.

The third phase of this project considered the adaptive management options available to water managers with regards to making trade-off decisions, applying the appropriate spatial and temporal scales at individual recreation lakes to justify watering needs for environmental outcomes, for example the consideration of environmental water allocations, and recommendations for additional work to improve decision-making, which will include improving the evidence base. This will ultimately lead to a system that establishes an environmental-values ranking for each of the Wimmera-Mallee recreation lakes supplied with piped recreational water. Therefore, there will be greater clarity about which lakes receiving recreation allocations have the highest environmental values and will benefit from intervention aimed at improving their environmental values.

3 ECOSYSTEM CLASSIFICATION AND TYPOLOGY

3.1 AQUATIC ECOSYSTEM CLASSIFICATION SYSTEMS

3.1.1 Terminology

Terminology for aquatic ecosystems is often inconsistently applied. As mentioned above the recreation lakes are not actually all lakes, however these systems are referred to in this way to avoid confusion. Throughout the rest of the text where reference is made to a system the following terms will be used (modified from AETG 2012):

- **Aquatic ecosystem.** Includes any system dependent on flows, or periodic or sustained inundation/waterlogging for their ecological integrity e.g., wetlands, rivers, karst and other groundwater-dependent ecosystems, saltmarshes, estuaries, and areas of marine water the depth of which at low tide does not exceed 6 metres.
- **Recreation lake.** Includes the 15 target systems in this analysis.
- **Lake (Lacustrine systems).** Described by Cowardin et al. (1979) as those aquatic ecosystems situated in a topographic depression or a dammed river channel², having sparse vegetation coverage (less than 30

¹ Includes storage managers, waterway managers and other environmental water holders

² Excludes weir pools which are considered riverine for this project

percent of their coverage area is made up of vegetation such as trees, shrubs, or persistent emergent vegetation), and the total area exceeds 8 hectares.

- **Wetland (Palustrine systems).** Are typically described as swamps, bogs, marshes and meadows, are dominated by trees, shrubs, persistent emergents, emergent mosses, and lichens (greater than 30%). Aquatic ecosystems that lack emergent vegetation might also be palustrine if they are less than 8 hectares, active wave-formed or bedrock shoreline features are lacking, and water depth in the deepest part of the basin is less than 2 metres at low water. As for other inland waters, salinity from ocean-derived salts is less than 0.5‰. Palustrine wetlands may be situated shoreward of lakes, river channels, or estuaries, on river floodplains, in isolated catchments, or on slopes. They may also occur as islands in lakes or rivers (Cowardin et al. 1979).
- **Riverine systems.** Systems contained within a channel and its associated streamside vegetation. This definition refers to both single channel and multi-channel systems. The beds of channels are not typically dominated by emergent vegetation, might be naturally or artificially created, periodically or continuously contain moving water, and might form a connecting link between two bodies of standing water. As for other inland waters, salinity from ocean-derived salts is less than 0.5‰ (Cowardin et al. 1979).

3.1.2 Australian National Aquatic Ecosystem (ANAE) classification

The National aquatic ecosystem classification and typology adopted for use by the Murray-Darling Basin Authority (MDBA) and the Commonwealth Environmental Water Office (CEWO) is the interim Australian National Aquatic Ecosystem (hereafter ANAE) (AETG 2012, Butcher et al. 2012, Brooks 2021). The AETG (2012) distinguish between classification and typology and is adopted here for consistency:

- **Classification.** The process of cataloguing items, in this case aquatic ecosystems, into logical groups based on attributes that have been identified as being relevant to, for example, ecological functioning
- **Typology.** An extension to classification whereby those classified aquatic ecosystems are assembled into groups for a specific purpose i.e., a naming convention.

The ANAE classification is considered a broad-scale, semi-hierarchical, attribute-based, biophysical framework (AETG 2012). It presumes that most classifications will be undertaken in areas with poor and patchy biological data, therefore a broad-scale (top-down) approach is argued as the most feasible way to classify aquatic ecosystems. The AETG (2012) distinguish between top-down and bottom-up approaches as follows (Butcher et al. 2012):

- Bottom-up, point-based classification is possible where there is sufficient biological/ecological data and accompanying environmental information to do a classification based on biodiversity or ecological functioning. This approach is generally the exception rather than the rule.
- Top-down, broad-scale classification is where data is patchy and/or incomplete. By making careful assumptions, surrogate relationships between the physical characteristics (geomorphology, hydrology, chemistry and habitat form) and biodiversity and ecological functioning can be drawn, although caution should be exercised as these relationships are not uniformly strong.

A top-down approach is considered necessary for this project, consistent with the ANAE, as data are known to be limited. As the emphasis of the current project is on classifying recreation lakes for the purpose of environmental water delivery this review predominantly focuses on attributes at the habitat or lower levels of the classifications – the scale of the ecosystem. The recommended, widely accepted, regionalisations suggested for Level 1 and 2 of the ANAE are considered fit for purpose for this project as is the main typology used in Brooks (2021). These have not been reproduced here.

3.1.3 Victorian classification systems

The Victorian wetland classifications including the Corrick type (Corrick and Norman 1980, Corrick 1981, 1982) and the current Victorian classification as per DELWP (2016), along with area (in ha) from MapShare (accessed October

2022) are presented in Table 1. We have included the Corrick type as it provides a historic perspective on ecosystem type. The definitions relating to the hydrological regimes of the Victorian system are presented in Appendix 2.

The ANAE typology (Brooks 2021) was developed at the scale of the Murray-Darling Basin to provide cross-jurisdictional consistency and support for managing aquatic ecosystems with relevance to Commonwealth environmental water management. It is described in more detail below and will be used in this project. One of the most significant differences between the Victorian classification and the ANAE typology is that in Victoria the assignment of wetlands to the Lacustrine or Palustrine category is based solely on the percentage of vegetation cover, regardless of area. In the ANAE, only ecosystems that have less than 30% vegetation cover *and* are greater than 8 hectares are considered Lacustrine systems.

Table 1. Victorian classification data and area of each recreation lake (from MapShare), ANAE data supplied S Brooks, 13.10.2022.

Recreation lake	Size (ha)	Corrick type	Vic wetland type, regime, and origin	ANAE system and type
Wimmera CMA				
Brim Weir Pool	5.8	Shallow freshwater marsh	Type: Unknown- listed as Palustrine or Lacustrine? Water regime: Periodically Inundated - Seasonal Or Episodic Origin: Dam / Storage <8ha	System: Riverine Type: Temporary lowland stream
Lake Marma	18.0	Permanent open water	Type: Unknown - listed as Palustrine or Lacustrine? Water regime: Intermittent Origin: Naturally occurring	System: Palustrine Type: Permanent wetland
Warracknabeal Weir Pool	15.5	-	No data	System: Riverine Type: Temporary lowland stream
Watchem Lake	13.9	Shallow freshwater marsh	Type: Unknown - listed as Palustrine or Lacustrine? Water regime: Periodically Inundated - Seasonal Or Episodic Origin: Naturally occurring	System: Palustrine Type: Temporary black box swamp
North Central CMA				
Donald Caravan Park Lake	3.5	Deep freshwater marsh	Type: Temporary freshwater lake Water regime: Periodically Inundated – Episodic Origin: Naturally occurring	System: Floodplain ³ Type: River red gum woodland riparian floodplain
Walkers Lake	35.0	Permanent open water	Type: Unknown - listed as Palustrine or Lacustrine? Water regime: Periodically Inundated - Seasonal Or Episodic Origin: Naturally occurring	System: Palustrine Type: Freshwater meadow
Wooroonook Lake	36.7	Permanent open water	Type: Unknown - Palustrine Water regime: Periodically Inundated - Seasonal Or Episodic Origin: Naturally occurring	System: Palustrine Type: Freshwater meadow
Mallee CMA				
Beulah Weir Pool	5.0	Permanent open water	Type: Unknown - listed as Palustrine or Lacustrine? Water regime: Periodically Inundated - Seasonal Or Episodic Origin: Dam / Storage =>8ha	Null
Green Lake (Wetland Id 19295)	29.5	Permanent open water	Type: Temporary freshwater lake Water regime: Periodically Inundated - Episodic Origin: Naturally occurring	System: Lacustrine Type: Temporary lake

³ Considered palustrine, marsh, under current conditions

Recreation lake	Size (ha)	Corrick type	Vic wetland type, regime, and origin	ANAE system and type
Hopetoun Storage (Willow Lake) (Wetland Id 19295)	2.2	-	No data	System: Palustrine Type: Permanent wetland
Lake Lascelles (Wetland Id 19295)	21.0	Permanent open water	Type: Unknown - Palustrine or Lacustrine Water regime: Periodically Inundated - Seasonal Or Intermittent Origin: Naturally occurring	System: Palustrine Type: Permanent wetland
Ouyen Lake	13.5	-	No data	System: Lacustrine Type: Permanent lake
Rainbow Lake	1.5	-	No data	Null
Tchum Lake	34.8	Freshwater meadow	Type: Temporary freshwater marshes and meadows Water regime: Periodically Inundated - Episodic Origin: Naturally occurring	System: Palustrine Type: Temporary black box swamp
Yaapeet Storage (Turkey Bottom Lake)	1.3	-	No data	Null

3.2 ECOSYSTEM COMPLEXES

A recreation lake is considered likely to have higher environmental values when part of an ecosystem complex that allows movement of biota, a range of species habitat and variable water regimes. Ecosystem complex is defined as being hydrologically connected and mapped as adjoining or nearby polygons on MapShare (<https://mapshare.vic.gov.au/mapsharevic/>).

Table 2. Wimmera recreation lakes ecosystem type by ecosystem complex description.

Recreation lake	Part of a complex	Ecosystem Description
Wimmera CMA		
Brim Weir Pool	No	Part of Yarriambiack Creek, which only flows during rare occasions of extreme flooding from its source, the Wimmera River near Horsham. Weirs at the north and south end of the pool result in a ponded system. An overflow creek area south of the southern weir supports woody vegetation, which has undergone regeneration post the 2011 flood. Downstream of the weir, the creek runs through a redgum forest. Yarriambiack Creek's natural termination is Lake Coorong next to Lake Lascelles in Hopetoun.
Lake Marma	Yes	Part of a chain of three wetlands, in an urbanised area. The system on the northern side is classified as a temporary freshwater lake (Rabl Park Lake), on the southern side a temporary freshwater swamp (inside the racetrack). Corrick type these two systems is permanent open water, and shallow freshwater marsh respectively.
Warracknabeal Weir Pool	No	A floodplain reserve runs along most of the length of the weir pool which would provide some habitat value, mainly for non-water-dependent species. There are no floodplain or non-floodplain wetlands in close proximity. A part of Yarriambiack Creek, which only flows naturally from its source at the Wimmera River in Horsham during occasions of flooding.
Watchem Lake	Partial	Not directly mapped as hydrologically connected but there are three freshwater meadows to the east in the proximity of Watchem Lake. Mobile biota would be able to move between the systems.
North Central CMA		
Donald Caravan Park Lake	No	No mapped wetlands in the proximity of the recreation lake. The nearest waterway is Richardson River but there is no hydrological connection. The recreation lake has an artificial island which may provide additional environmental value (i.e. potential roosting habitat for waterbirds safe from predation).
Walkers Lake	Yes	Adjoining system is Corrick type freshwater meadow.

Recreation lake	Part of a complex	Ecosystem Description
Wimmera CMA		
Wooroonook Lake	Yes	The recreation lake is separated by a road into Wooroonook Lake Main and Church, both same Corrick type – permanent open water.
Mallee CMA		
Beulah Weir Pool	No	Part of Yarriambiack Creek, which only flows during occasions of flooding from its source, the Wimmera River near Horsham. Weirs at the north and south end of the pool result in a ponded system. An upstream section of the creek periodically receives environmental watering.
Green Lake (at Sea Lake)	Yes	The lake is the prime feature of the Green Lake Regional Park.
Hopetoun Storage (Willow Lake)	Yes	The recreation lake forms part of a complex with Lake Lascelles, Coorong Lake and an unnamed freshwater wetland.
Lake Lascelles	Yes	Hydrologically connected to Hopetoun Storage and Coorong Lake wetland, forming part of the terminal system of Yarriambiack Creek.
Ouyen Lake	No	Created, provided with recreation allocation of water from the Murray River via Northern Mallee Pipeline
Rainbow Lake	No	An isolated former water storage for the town of Rainbow that relies solely on piped water.
Tchum Lake	Yes	The recreation lake features two systems, Tchum Lake south, which is the recreation lake and Tchum Lake north, previously watered from a former channel system and now periodically receiving an environmental water allocation.
Yaapeet Storage (Turkey Bottom Lake)	No	A former water storage for the town of Yaapeet that relies on piped water for supply.

3.3 TYPOLOGY

The Victorian classification and typology is quite similar to the ANAE and is currently being updated to align more closely with the ANAE. For this reason, and as it is the preferred system at the Murray-Darling Basin scale we have adopted the ANAE typology as the basis for this project with some modifications.

The attributes used to classify the recreation lakes for the current study are listed below. Under the ANAE some recreation lakes are classified as riverine, floodplain, and some are palustrine systems (AETG 2012, Brooks 2021). Three of the recreation lakes are weir pools on Yarriambiack Creek and two others are created systems. The remaining recreation lakes are natural basins, but were the subject of modification to varying degrees, mainly their water regime. All recreation lakes are assumed to be freshwater and the water source as being a mixture of run-off from the catchment, rainfall and supply via the Wimmera-Mallee Pipeline system.

Attributes in the typology for the recreation lakes include:

Lacustrine

- **Water regime**
 - Permanent – includes those systems which are identified in the Corrick system as Permanent Open Water
 - Temporary – includes those systems that were previously classified as meadows, marshes, but are now listed as temporary freshwater systems in the Victorian 2016 classification.
- **Origin**
 - Natural – listed as natural origin on MapShare
 - Modified – created system
- **Complex**
 - No – single basin – assumed unless otherwise stated
 - Yes – either hydrologically connected or in close proximity to another aquatic ecosystem

Palustrine

- **Water regime**
 - Permanent

- Temporary
- **Origin**
 - Natural – listed as natural origin on MapShare
 - Modified – created system
- **Complex**
 - No – single basin – assumed unless otherwise stated
 - Yes – either hydrologically connected or in close proximity to another waterbody

Riverine

- **Water regime**
 - Permanent
 - Temporary
- **Origin**
 - Natural – listed as natural origin on MapShare
 - Modified – created system

Table 3. Lacustrine typology for recreation lakes

Type		Description/Justification	Recreation lake
Permanent lake	Permanent lake – natural	Typically, > 2 metres deep when full, with substantial areas of open water – may have fringing vegetation in littoral zone but are defined as having less than 30% emergent vegetation and little submergent vegetation. Often greater than 8 ha in size, but smaller systems are also included if they are greater than 2m deep and support wave action. May or may not have aquatic lakebed vegetation, but less than 30% emergent vegetation.	Lake Marma
Temporary lake	Temporary lake - natural	Tend to be shallower, 1-2 m, and periodically dries (temporary). Under current water management these recreation lakes have their water levels artificially maintained as semi-permanent to permanent (i.e., mostly have water all year round but can vary in area of inundation). May or may not have aquatic lakebed vegetation, but less than 30% emergent vegetation.	Walkers Lake, Wooroonook Lake, Green Lake
	Temporary lake – natural - complex	As for temporary lake – natural, but part of a complex of hydrologically connected wetlands.	Lake Lascelles

Table 4. Palustrine typology for recreation lakes

Type		Description/justification	Recreation lake
Permanent palustrine (wetland)	Permanent marsh – modified - complex	Created and within an urban setting on the downstream end of a wetland complex on the terminal end of Yarriambiack Creek. Area unknown but should be less than 8 ha (compared with Lascelles which is 21ha), therefore in the Palustrine system, not Lacustrine.	Hopetoun Storage
Temporary palustrine (wetland)	Temporary marsh – natural	May be up to 1-2 m in depth: less frequently inundated than seasonally. May have more than 30% vegetation, but also can be dominated by open water. Vegetation if present is dominated by non-woody marsh species (e.g., sedges, rushes) may have some trees, but not dominant. Victorian classification has this system labelled as a temporary freshwater lake with episodic inundation.	Donald Caravan Park Lake

Type		Description/justification	Recreation lake
		Donald Caravan Park Lake is less than 8ha in size, therefore is not Lacustrine. Is classified as floodplain under the ANAE.	
	Temporary marsh – modified	Created system, depth, duration, and frequency of inundation similar to natural systems. Typically characterised by steeper edges than natural basins and less variation in shoreline shape.	Ouyen Lake, Rainbow Lake, Yaapect Storage
	Temporary marsh – natural - complex	As above, but is hydrologically connected to nearby/adjoining aquatic ecosystems	Watchem Lake, Tchum Lake

Table 5. Riverine typology for recreation lakes

Type		Description	Recreation lake
Temporary riverine	Temporary river/stream - modified	Temporary flowing river and or creeks with one or more in channel barriers to connectivity. Systems which rise and fall rapidly, wetting and drying for varying lengths of times, lowland system such as these are only wet periodically.	Brim Weir Pool, Warracknabeal Weir Pool, Beulah Weir Pool

4 CURRENT ENVIRONMENTAL VALUES AND CONDITION

4.1 ENVIRONMENTAL VALUES

The area of each ecosystem type represented by the recreation lakes is presented in Table 6. The most prevalent ecosystem types are temporary lakes (122.2 hectares) and temporary marsh (68.5 hectares), which together account for 81% of the total recreation lake area. Temporary marsh is an important aquatic ecosystem in the Wimmera Regional Waterway Strategy (Wimmera CMA 2014) as it is a wetland type that has declined rapidly in number and quality across the Wimmera catchment.

Table 6. Area of ecosystem type across the recreation lakes

Ecosystem type		Lakes	Total area (hectares)
Lacustrine	Permanent lake	Lake Marma	18.0
	Temporary lake – natural	Walkers Lake, Wooroonook Lake, Green Lake	101.2
	Temporary lake – natural complex	Lake Lascelles	21.0
Palustrine	Permanent marsh – modified - complex	Hopetoun Lake	2.2
	Temporary marsh - natural	Donald Caravan Park Lake	3.5
	Temporary marsh – natural - complex	Watchem Lake, Tchum Lake	48.7
	Temporary marsh – modified	Ouyen Lake, Rainbow Lake, Yaapect Storage	16.3
Riverine	Temporary river/stream - modified	Brim Weir Pool, Warracknabeal Weir Pool, Beulah Weir Pool,	26.3

The environmental values associated with the recreation lakes are presented in Table 8 to Table 11, while a summary of the number of frog, fish, waterbird and vegetation records is presented in Table 7. Species records from the Victorian Biodiversity Atlas (VBA) and Atlas of Living Australia (ALA) and elsewhere from 1 January 2012 to 15 September 2022 were accessed for individual recreation lakes; see Appendix 3 (Table 21 to Table 35). This provides records for the past decade, which post-dates the Millennium Drought and aligns with the general timing of the Wimmera Waterway Strategy 2014-2022 (WCMA 2014).

The number of species recorded in the VBA and ALA varies considerably, with some recreation lakes having expansive species lists while others have relatively few species listed. Care is needed in interpreting such lists, as some lakes will have received more attention than others when it comes to surveying frequency and effort, and upload of survey results. It is expected that additional survey work at each recreation lake would record additional species, particularly for aquatic and riparian vegetation; the number of aquatic and riparian plant species listed is almost certainly an underestimate of the species present over the last 10 years.

Recreation lakes with the largest number of water dependent species (Table 21 to Table 35) include:

- Wooroonook Lake
- Lake Marma
- Walkers Lake
- Lake Lascelles
- Green Lake.

Threatened species (mostly waterbirds and woodland birds) and Ecological Vegetation Classes (EVC) (from Ecology Australia 2004) have been recorded at nearly all the recreation lakes.

Table 7. Summary of water dependent species records (from VBA and ALA).

Taxonomic group	Number of recreation lakes with records	Number of water dependent species or communities
Frogs	5	5
Fish	13 (including stocked lakes)	5
Waterbirds	15	60
Vegetation	14	24 (including EVCs)

Table 8. Summary of environmental values at recreation lakes in the Wimmera CMA region

	Brim Weir Pool	Lake Marma	Warracknabeal Weir Pool	Watchem Lake
Ecosystem type	Temporary riverine - modified	Permanent lake - natural	Temporary riverine - modified	Temporary marsh – natural - complex
Volume at FSL (ML)	120	170	210	259
Environmental values	• 17 records of water dependent species: ○ 2 fish species ○ 12 waterbird species ○ 3 plant species ○ Threatened species include: endangered Freshwater catfish • Stocked with approximately 9,000 Golden perch since 1/07/2018 • EVC 653 – Aquatic Herbland (endangered) – 1% of vegetated area when visited in 2022 • Surrounded by box woodlands? • Wetland area to the south of the weir pool adds to habitat matrix • EVCs listed by Ecology Australia (2004) include: Riverine Chenopod Woodland and Lignum Swampy Woodland	• 47 records of water dependent species: ○ 3 fish species ○ 44 waterbird species ○ Threatened species include: critically endangered Intermediate egret; endangered Freckled duck; vulnerable Hardhead, Musk duck and Eastern great egret • Stocked with approximately 13,000 Golden perch since 1/07/2018 • EVC 653 - Aquatic Herbland (endangered) - 50% of vegetated area when visited in 2022 • Anecdotal evidence of the aquatic plant <i>Vallisneria australis</i>	• 18 records of water dependent species: ○ 1 fish species ○ 2 frog species ○ 14 waterbird species (1 alien) ○ 1 plant species ○ Threatened species include: Australasian shoveler and Musk duck; the critically endangered Black falcon has also been recorded • Stocked with approximately 9,000 Golden perch since 1/07/2018 • Abundant birdlife • EVC 653 - Aquatic Herbland (endangered) - 20% of vegetated area when visited in 2022 • EVCs listed by Ecology Australia (2004) include: Riverine Chenopod Woodland, Lignum Swampy Woodland, Aquatic Herbland • Presence of large river red gums • Anecdotal evidence of the aquatic plant <i>Vallisneria australis</i> • White-striped Freetail-bat (ALA)	• 14 records of water dependent species: ○ 2 fish species ○ 12 waterbird species • Stocked with approximately 15,000 Golden perch and 40,000 Silver perch since 1/07/2018 • EVC 602 - Cane Grass Wetland/Aquatic Herbland Complex - 1% of vegetated area when visited in 2022 • EVCs listed by Ecology Australia (2004) include: Lignum Swampy Woodland
Catchment setting	Located on the western edge of Brim township. Receives urban runoff.	Located within Murtoa township. Receives urban runoff.	Located within Warracknabeal township. Receives urban runoff.	Surrounded by agricultural land.

Table 9. Summary of environmental values at recreation lakes in the North Central CMA region

	Donald Caravan Park	Walkers Lake	Wooroonook Lake
Ecosystem type	Temporary marsh – natural	Temporary lake - natural	Temporary lake - natural
Volume at FSL (ML)	170	120	700
Environmental values	32 records of water dependent species including 2 fish species 1 frog species 26 waterbirds species 3 plant species - Threatened species include: critically endangered Freckled duck, and vulnerable Hardhead - Stocked with approximately 11,000 Golden perch and 27,000 Silver perch since 1/07/2018 - EVC 821 - Tall Marsh - 1% of vegetated area when visited in 2022 - EVCs listed by Ecology Australia (2004) include: Riverine Chenopod Woodland	47 records of water dependent species including 2 fish species 3 frog species 37 waterbird species 5 plant species - Threatened species include: endangered species include White bellied sea eagle and Brolga; vulnerable Australian shoveler, Blue-billed duck, Hardhead and Musk duck. The critically endangered Black falcon has also been recorded at the location - Stocked with approximately 15,000 Golden perch and 18,300 Silver perch since 1/07/2018 - EVC 653 - Aquatic Herbland (endangered) - 100% of vegetated area when visited in 2022	51 records of water dependent species, including 2 fish species 4 frog species 40 waterbird species 5 plant species - Threatened species include: critically endangered Plumed egret, endangered Freckled duck and vulnerable Hardhead, Musk duck and Blue-billed duck. Critically endangered Black falcon have also been recorded at the location - Stocked with approximately 15,000 Golden perch and 40,000 Silver perch since 1/07/2018 - EVC 292 - Red Gum Swamp (vulnerable) - 50% of vegetated area when visited in 2022 - EVC 653 - Aquatic Herbland (endangered) - 50% of vegetated area when visited in 2022 - EVCs listed by Ecology Australia (2004) include: Riverine Chenopod Woodland, Low Rises Woodland, Plains Woodland, Red Gum Wetland, Wetland Formation and Lake-bed Herbfeld
Catchment setting	Located on the north-eastern edge of Donald township, surrounded mainly by recreation reserves.	Located 0.5-1.0 km from two other Avon floodplain lakes; surrounded by agricultural land.	Western lake is part of a wetland complex. Middle and eastern lakes have variable water levels. Complex surrounded by agricultural land.

Table 10. Summary of environmental values at recreation lakes in the Mallee CMA region: Lakes 1-4 of 8 lakes. See Table 11 for environmental values for lakes 4-8.

	Beulah Weir Pool	Green Lake	Hopetoun Storage (Willow Lake)	Lake Lascelles
Ecosystem type	Temporary riverine - modified	Temporary lake - natural	Permanent marsh – modified - complex	Temporary lake – natural - complex
Volume at FSL (ML)	140	480	2	440
Environmental values	• 14 records of water dependent species, including: ○ 1 fish species ○ 1 frog species ○ 12 waterbird species • Stocked with approximately 9,000 Golden perch since 1/07/2018 • Threatened species include the endangered Wood Sandpiper • EVC 653 - Aquatic Herbland (endangered) - 60% of the vegetated area when visited in 2022 • EVCs listed by Ecology Australia (2004) include: Riverine Chenopod Woodland and Lignum Swampy Woodland	• 41 records of water dependent species, including: ○ 1 fish species ○ 33 waterbird species ○ 7 plant species • Stocked with approximately 70,000 Golden perch since 1/07/2018 • Threatened species include the endangered Common greenshank; also present are woodland birds such as the vulnerable Regent parrot and Hooded robin; woodland plants such as the critically endangered Silver cassia, Buloke, Buloke mistletoe and Umbrella wattle • EVC 653 - Aquatic Herbland (endangered) - 100% vegetated area when visited in 2022 • EVCs listed by Ecology Australia (2004) include: Ridged Plains Mallee, Semi-arid Woodland, Woorinen Mallee, Lignum Swampy Woodland, Fringing Sedgeland, Tall Marsh, Lake-bed Herbfield	• No species listed in VBA. The location of the species listed in ALA strongly overlap with the connecting Lake Lascelles, so the 22 waterbird species numbers may be inflated: ○ 2 fish species ○ 1 frog species ○ 22 waterbird species • Stocked with approximately 31,900 Golden perch and 12,500 Silver perch since 1/07/2018 • Threatened species include: vulnerable hardhead • EVC 653 - Aquatic Herbland (endangered) - 10% of the vegetated area when visited in 2022	• 44 records of water dependent species, including: ○ 3 fish species ○ 38 waterbird species ○ 1 reptile ○ 2 plant species • Stocked with approximately 8,000 Murray cod, 25,000 Golden perch and 85,000 Silver perch since 1/07/2018 • Threatened species include: endangered Murray River turtle, Little egret, Gull-billed tern and Freckled duck, vulnerable Australasian shoveler, Blue billed duck, Eastern great egret, Hard head and Musk duck; critically endangered Cane grass; also endangered Bush stone curlew • The vulnerable woodland birds Diamond firetail and Elegant parrot, and critically endangered Umbrella wattle have also been recorded at the site • EVC 653 - Aquatic Herbland (endangered) - 20% of the vegetated area when visited in 2022 • EVCs listed by Ecology Australia (2004) include: Ridged Plains Mallee, Semi-arid Woodland, Lake-bed Herbfield, Lignum Swampy Woodland, Riverine Chenopod

	Beulah Weir Pool	Green Lake	Hopetoun Storage (Willow Lake)	Lake Lascelles
				Woodland, Plains Savannah, Plains Woodland, Woorinen Mallee, Fringing Sedgeland, Tall Marsh See also large bird species list from local birdwatcher Jenny Stephens (unpublished)
Catchment setting	Located at the south western edge of Beulah township. Receives urban runoff. There is community parkland (bushland) above and below the weir pool, along Yarriambiack Creek.	Set within a regional park. Species list is large, reflecting diversity of plants in the bushland reserve.	Located on the eastern margin of Hopetoun township. Receives urban runoff; adjoins Lake Lascelles and Lake Coorong.	Lake Lascelles is on the eastern margin of Hopetoun township. Receives urban runoff; adjoins Hopetoun Storage and Lake Coorong.

Table 11. Summary of environmental values at recreation lakes in the Mallee CMA region: Lakes 4-4 of 8 lakes.

	Ouyen Lake	Rainbow Lake	Tchum Lake	Yaapeet Storage
Ecosystem type	Temporary marsh - modified	Temporary marsh - modified	Temporary marsh – natural - complex	Temporary marsh - modified
Volume at FSL (ML)	450	55	730	40
Environmental values	30 records of water dependent species; 2 fish species 28 waterbird species - Stocked with approximately 45,000 Golden perch and 108,000 Silver perch since 1/07/2018 - Threatened species include: endangered Australian gull-billed tern and vulnerable Hard head - Other threatened birds recorded at the site include the critically endangered Major Mitchell cockatoo and vulnerable Little eagle and Regent parrot - EVC 653 - Aquatic Herbland (endangered) - 100% of the	- No VBA or ALA records; three waterbird species sighted when visited in 2022 - EVC 653 - Aquatic Herbland (endangered) - 1% of the vegetated area when visited in 2022	25 records of water dependent species, including: 2 fish species 19 waterbird species 4 plant species - Stocked with approximately 17,000 Golden perch and 42,500 Silver perch since 1/07/2018 - Threatened species include: vulnerable Australian shoveler, Musk duck - Many scrub and woodland birds have also been recorded, including the vulnerable Diamond firetail, Hooded robin, Little eagle, Mallee fowl, Purple-gaped honeyeater, Inland dotterel, White-throated	7 records of water dependent species; all are waterbird species - The critically endangered Umbrella wattle and endangered Fine-hair spear-grass have also been recorded at the location - EVC 653 - Aquatic Herbland (endangered) - 10% of the vegetated area when visited in 2022

	Ouyen Lake	Rainbow Lake	Tchum Lake	Yaapeet Storage
	vegetated area when visited in 2022		needle tail and Regent parrot. The endangered woodland birds Redthroat and Mallee emu-wren, and critically endangered Major Mitchell cockatoo have also been recorded at the site when visited in 2022 EVC 292 - Red Gum Swamp (vulnerable) - 5% of the vegetated area EVCs listed by Ecology Australia (2004) include: Ridge Plains Mallee, Lignum Swampy Woodland, Plains Savannah and Woorinen Mallee	
Catchment setting	Located on the north-western edge of the Ouyen township. Receives urban runoff. Surrounded by bushland reserve and golf course.	Located on the southern edge of Rainbow township. There is nearby bushland reserve.	Divided from Tchum Lake north (wetland) by a road. Southern unit receives recreation water. Both units surrounded by agricultural land.	Located on the south-east of Yaapeet township. Receives urban runoff; surrounded by bushland reserve and agricultural land.

4.2 CURRENT CONDITION

4.2.1 Environmental condition

The current environmental condition at the recreation lakes was assessed by Wimmera CMA staff in September 2022 using the Index of Wetland Condition (IWC) (DELWP 2020). A summary of IWC indices and components is provided in Table 12; further information on the IWC is provided in Appendix 4, with the raw data held by Wimmera CMA (Wimmera CMA, unpublished).

At the time of assessment, each of the lakes was in good to moderate condition (Table 13). This is despite the generally poor hydrological conditions that prevailed. The reasons for the generally poor hydrology scores are presented in Table 14.

Table 12. Sub-indices, components and measures used in the IWC (DELWP 2020).

IWC sub-index	Key ecological component	Measure	Measure type
Wetland catchment	Wetland catchment	Land-use intensity adjacent to the wetland	Threat
	Wetland buffer	Average width of the buffer	Component
		Percentage of wetland perimeter with a buffer	Component
Physical form	Area of the wetland	Percentage reduction in wetland area	Component
	Wetland form	Percentage of wetland where activities have resulted in a change in bathymetry	Threat
Hydrology	Water regime	Severity of change to the water regime expected from activities identified as altering the water regime	Threat
Water properties	Nutrients	Severity of nutrient enrichment	Threat
	Salinity	Severity of change in salinity	Threat
Soils	Soil physical properties	Severity and extent of wetland soil disturbance	Impact
Biota	Wetland plants	Critical life forms	Component
		Presence of weeds	Impact
		Indicators of altered processes	Impact
		Vegetation structure and health	Component

Table 13. Recreation lakes - Index of wetland condition ranking, September 2022.

Lake	Biota category	Hydrology category	Physical form category	Water properties category	Catchment category	Overall assessment category
Wimmera CMA region						
Brim Weir Pool	Poor	Poor	Moderate	Good	Good	Moderate
Lake Marma	Good	Poor	Excellent	Good	Moderate	Good
Watchem Lake	Poor	Poor	Good	Excellent	Poor	Moderate
Warracknabeal Weir Pool	Good	Poor	Excellent	Good	Poor	Good

Lake	Biota category	Hydrology category	Physical form category	Water properties category	Catchment category	Overall assessment category
North Central CMA region						
Donald Caravan Park Lake	Excellent	Poor	Moderate	Good	Poor	Good
Walkers Lake	Good	Poor	Excellent	Excellent	Good	Good
Wooroonook Lake - Main	Good	Poor	Excellent	Excellent	Good	Good
Mallee CMA region						
Beulah Reservoir	Poor	Poor	Excellent	Good	Good	Moderate
Green Lake	Moderate	Poor	Excellent	Excellent	Excellent	Good
Hopetoun Storage (Willow Lake)	Good	Poor	Moderate	Good	Poor	Good
Lake Lascelles	Good	Moderate	Excellent	Good	Moderate	Good
Ouyen Lake	Poor	Poor	Moderate	Good	Good	Moderate
Rainbow Lake	Excellent	Poor	Moderate	Excellent	Poor	Good
Tchum Lake	Poor	Poor	Excellent	Good	Good	Moderate
Yaapeet Storage (Turkey Bottom Lake)	Excellent	Poor	Moderate	Good	Good	Good

Table 14. Recreation lakes – reasons for poor IWC hydrology scores.

Lake	River regulation	Altered local surface drainage patterns	Artificial drawdown not associated with restoring reference condition	Altered connection between the wetland and its water source	Obstruction or regulation of natural water outlets	Disposal of drainage water not associated with restoring reference condition	Permanently raised water level when full	Altered seasonality of filling and drying
Wimmera CMA region								
Brim Weir Pool					✓		✓	✓
Lake Marma	✓	✓	✓			✓		✓
Watchem Lake					✓		✓	✓
Warracknabeal Weir Pool		✓			✓	✓		✓
North Central CMA region								
Donald Caravan Park Lake		✓			✓	✓	✓	✓
Walkers Lake							✓	✓
Wooroonook Lake - Main		✓			✓			✓
Mallee CMA region								
Beulah Reservoir		✓			✓	✓		✓
Green Lake							✓	✓
Hopetoun Storage (Willow Lake)		✓	✓	✓	✓			✓
Lake Lascelles		✓				✓	✓	
Ouyen Lake		✓	✓					✓
Rainbow Lake							✓	✓
Tchum Lake		✓			✓			✓
Yaapeet Storage (Turkey Bottom Lake)							✓	✓

5 LAKE CONCEPTUALISATION

5.1 CONCEPTUALISATION

The conceptualisations presented below are to be used to inform the possible role these waterbodies may play in supporting environmental values in a regional context across various climate scenarios (droughts/floods).

Inland Australian aquatic ecosystems are naturally adapted to a highly variable climate, both spatially and temporally, resulting in relatively few natural permanent aquatic ecosystems in the landscape in many areas of Australia, including the Wimmera-Mallee. Since European settlement that has changed somewhat, with an emphasis on creating permanent, or near permanent, systems through the alteration and management of the natural hydrology of systems to meet consumptive uses.

In the footprint of the Wimmera-Mallee pipeline, most natural aquatic ecosystems are non-floodplain palustrine systems, with several major riverine systems and some large lakes. Most of palustrine wetlands, the dominant ecosystem type, are temporary in nature and undergo wetting and drying phases. This promotes heterogeneity in the habitat available to support different species and affects alpha diversity (number of species at a site/ecosystem) as well as beta diversity (turnover of species within a system; Butcher 2003).

Temporary aquatic ecosystems can range from those that have water for a few days or months, to seasonal systems that fill and dry annually on a seasonal basis, to those that retain water for most years but will occasionally dry out. Wetting and drying cycles alter the physical and chemical resources for biota and the secondary processes which affect others. Some of the responses of aquatic biota to wetting and drying are shown in Table 15.

The change to supporting more permanent aquatic ecosystem in the landscape has several implications, including the potential for biotic homogenisation to occur. Biotic homogenisation is the potential to increase similarity amongst species and communities or to decrease beta diversity over time (McKinney and Lockwood 1999 cited in Olden et al. 2018). Whilst the concept of homogenisation has been around for several decades, evidence for it occurring is limited, and often restricted to single taxon studies (e.g., Rolls et al. 2021, Rolls et al. 2022). Biotic homogenisation is most likely to occur in ecosystems altered by human activity, mostly via the spread of invasive species and local to regional extinction of native species (Olden 2006; McGill et al. 2015; Nielsen et al. 2019 cited in Rolls et al. 2021). Natural disturbances often increase beta diversity, in part due to the patchy, complex nature and variation in severity (i.e., think wildfire). This can result in increased heterogeneity in landscapes and the fostering of biodiversity as well as biodiversity-dependent ecosystem function (Mori et al. 2018).

Recent and historic patterns of wetting and drying cycles affect community patterns observed, with temporal and spatial variability being key drivers of the observed environmental values evident. Studies into the biodiversity patterns in aquatic ecosystems over longer periods of time are rare and also often limited to single groups of taxa (e.g., Atkinson et al. 2021). In a drying climate, changes at the landscape scale will become more evident, however at this point in time there are few datasets available on which to track changes.

Table 15 Responses of wetland biota to wetting and drying (from Boulton and Brock 1999).

Biotic component	On flooding	While damp	On drying
Soil	Pulse of nutrients, siltation		Nutrients locked up, deflation
Micro-organisms	Process nutrients and organic matter		Change from anaerobic to aerobic bacteria, resistant stages
Cyanobacteria	Photosynthesise, reproduce, bloom	Fix nitrogen	Propagule bank of resistant sexual and asexual spores
Aquatic plants: submerged	Germinate, grow and reproduce in water	Seed bank	Seed bank

Biotic component	On flooding	While damp	On drying
Aquatic plants: amphibious	Aquatic form or seed bank	Tolerate or respond to water fluctuation	Seed bank
Aquatic plants: semi-terrestrial	Seed bank	May tolerate damp	Grow in damp areas
Zooplankton	Feed and breed		Propagule bank of resistant eggs
Benthic invertebrates	Many larval stages of aerial adults; others, aquatic larvae and adults		Terrestrial adults, resistant eggs
Frogs	Eggs in or near water; tadpoles grow, mature, in water; many adults leave, return to lay	Tolerate or use damp areas to move between wet and dry	Adults lay briefly resistant eggs in edge vegetation; some adults aestivate
Turtles	Lay and hatch out of wetland; grow, feed and mature in water; move between wetlands	Move between dry and wet wetlands	Eggs in terrestrial surrounds; some adults aestivate in cover; others leave to find wet refuges
Waterbirds	Feed, nest when habitat available		Disperse to other wetlands

5.2 ECOSYSTEM TYPE CONCEPTUAL MODELS

There are a range of conceptual models that have been developed to illustrate the key ecological attributes of the different ecosystem types, along with a series of stressor models that show the potential threatening processes associated with each ecosystem type (see Section 5.2.1). The models presented below represent simple schematics of the main ecosystem types found represented by the recreation lakes. They are not comprehensive as the models would need to be developed for each lake as the local conditions will dictate the values supported at each waterbody.

The term “value” is anthropocentric; hence assigning values to different natural processes or ecological components of an ecosystem usually reflects human perceptions and needs rather than intrinsic ecological processes. Aquatic ecosystems are multiple value systems. For example, a temporary freshwater marsh is perhaps better habitat for herbivorous waterbirds and plants than a permanent lake, but a lake is potentially a better fish habitat and piscivorous waterbirds – which is of more value?

Depth and duration of inundation are drivers of aquatic vegetation. Variability in water levels tend to promote diversity in conditions which in turn support a wider range of vegetation than in permanent stable systems in which water levels are artificially maintained (Figure 3 and Figure 4).

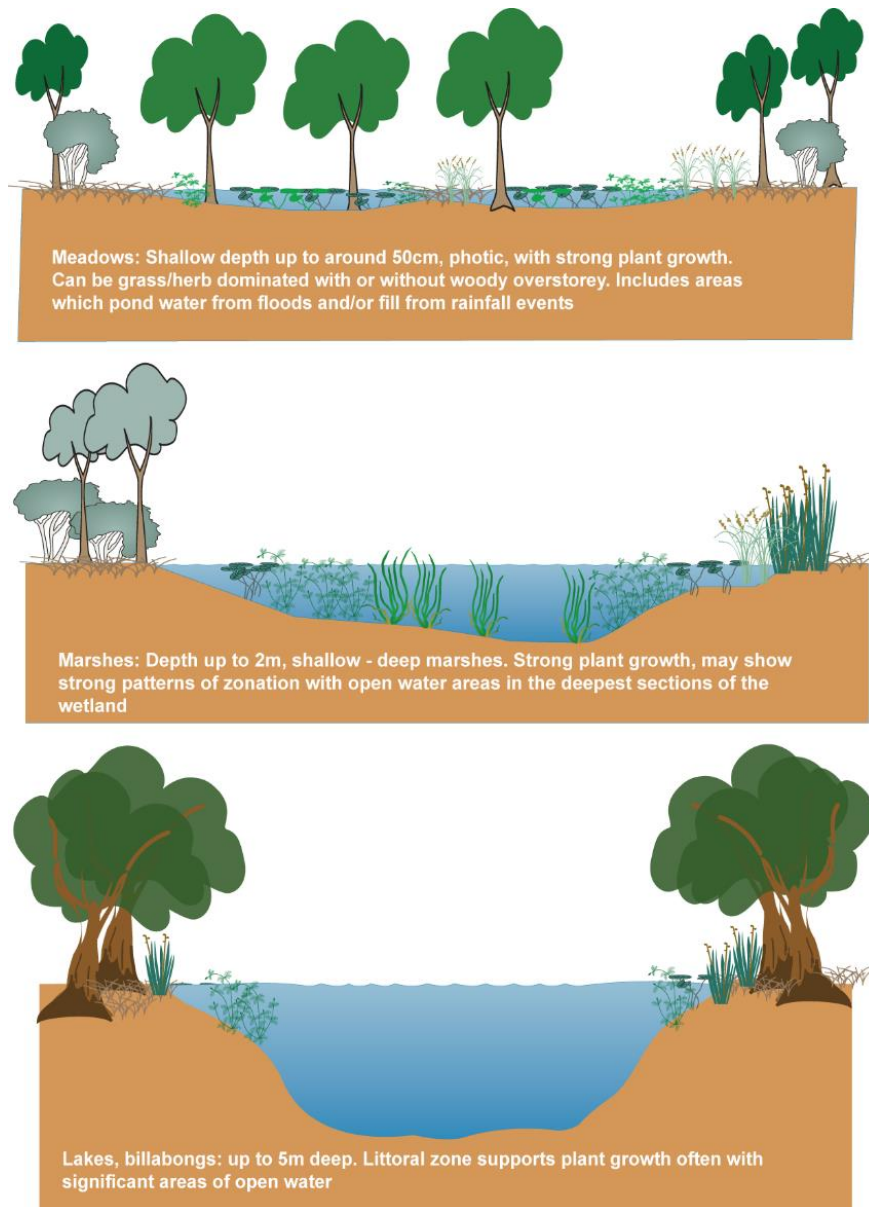


Figure 3. Schematic of key attributes of broad palustrine ecosystem types (meadows and marshes) and lacustrine (lakes) showing how depth affects presence of aquatic plants (modified from Butcher 2008).

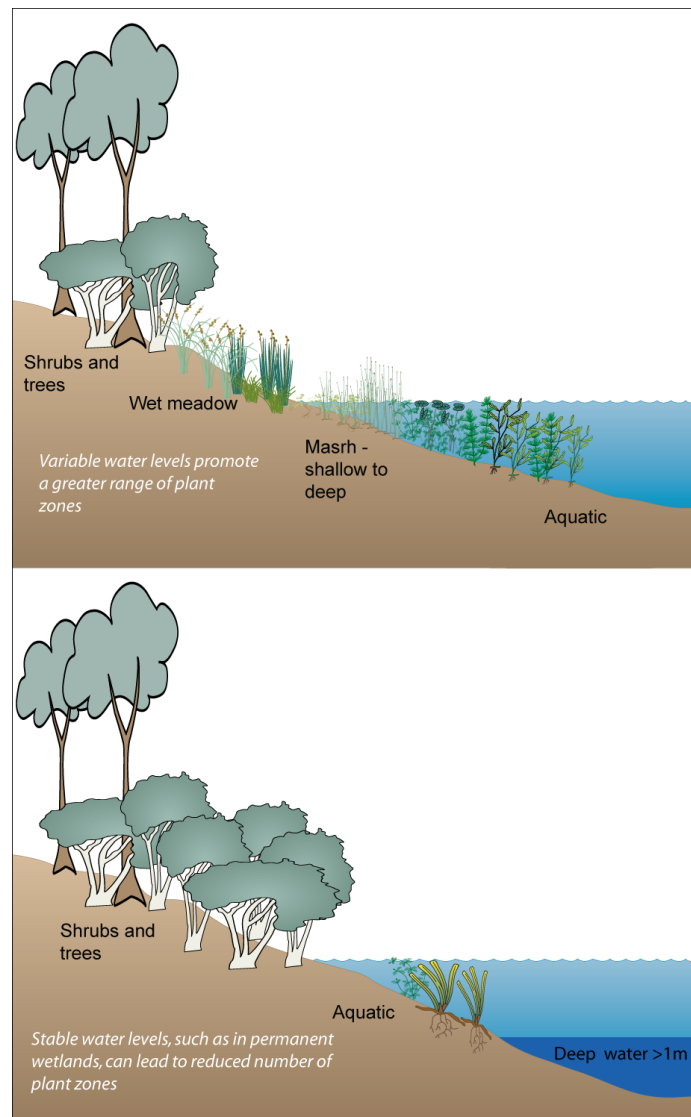


Figure 4. Schematic of how a variable water level promotes aquatic macrophyte diversity and structural habitat for fish, birds and invertebrates (from Butcher 2008).

The riverine ecosystems are atypical in that the weir pools are predominantly lacking in flow except during floods. This influences the chemistry and biota of the sites with values like those seen in the lentic lacustrine, and in some instances palustrine, systems likely to dominate (Figure 5). In general, the deeper riverine and lacustrine systems will support submerged vegetation to the depth which light penetrates (Figure 6 and Figure 7) and in many cases primary productivity will be algal driven as opposed to macrophyte driven, although this will be site specific and is yet to be determined for the recreation lakes. The relative importance of the recreation lakes to waterbirds is a knowledge gap, however a range of species typical of the regional fauna are listed as being present. There are no data on waterbird breeding, although there have been anecdotal reports of breeding (e.g., by black swan and swamp hen at Lake Marma).

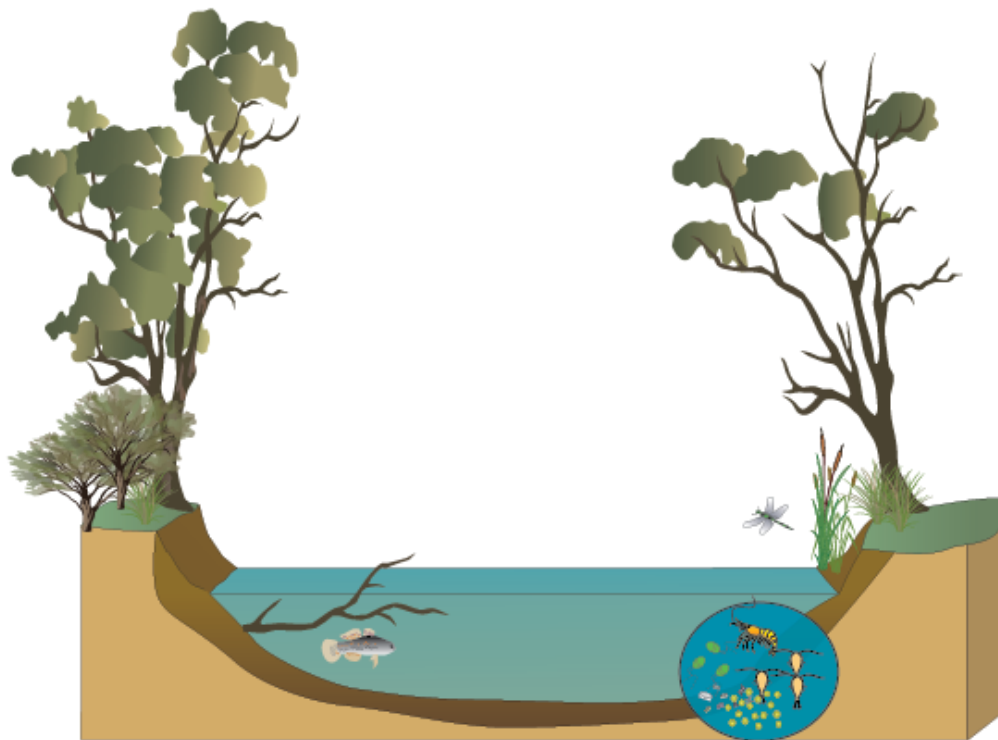


Figure 5. Schematic cross section of a riverine/weir pool channel. Predominantly non-flowing, with organic debris from the riparian zone.

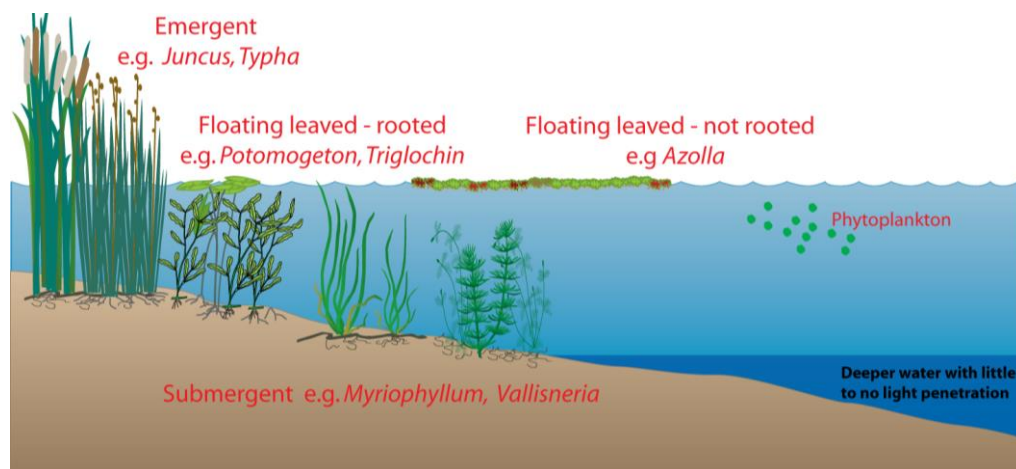


Figure 6 Vegetation zonation seen in palustrine systems and potentially in littoral zone of lacustrine systems – will be site specific regarding species diversity.

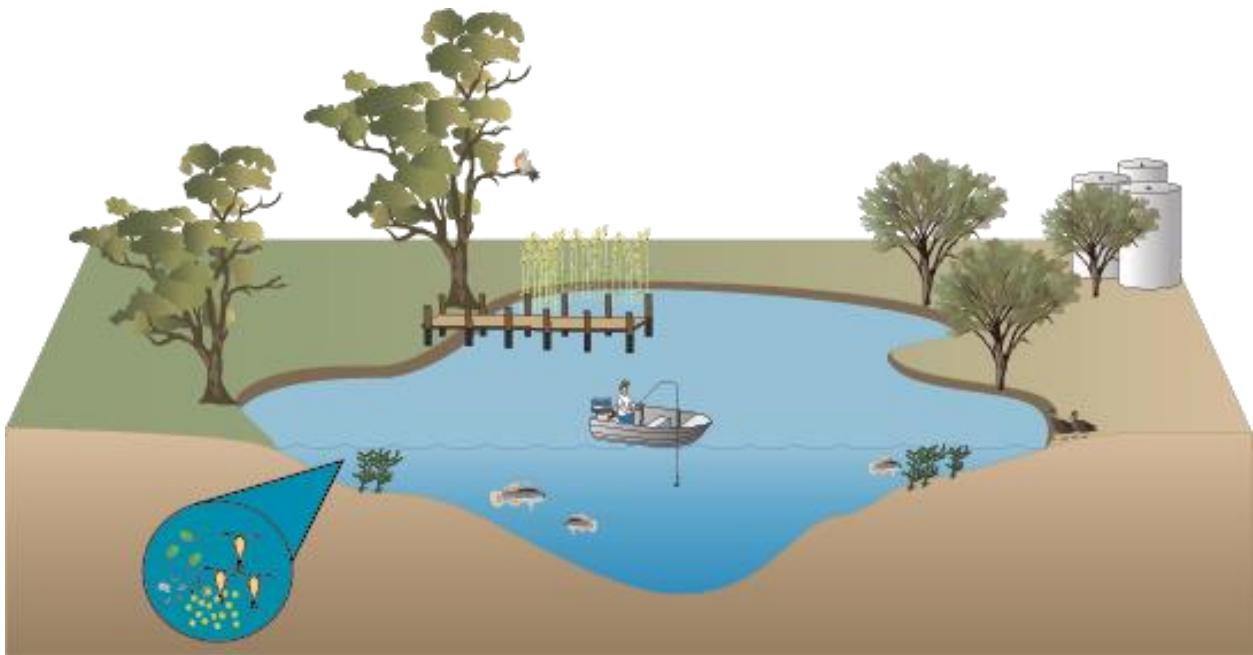


Figure 7 Schematic cross section of a lacustrine ecosystem. Fish and waterbirds will be present, primary productivity is likely to be algal driven with submergent macrophytes present in the photic zone. Emergent vegetation is limited, and littoral zone structural habitat complexity limited.

5.2.1 Threats to environmental condition

Wetlands can be subject to a range of water-related threats to their environmental values and condition. These threats can limit the achievement of environmental objectives targeted by environmental watering (DELWP 2022). Generally, they are direct threats from proximate human activities or processes that have impacted, are impacting, or may impact the wetland or broader environment and can be past (historical, unlikely to return or historical, likely to return), ongoing, and/or likely to occur in the future (IUCN 2012).

In the context of managing environmental values of recreation lakes threats can be related to factors that constrain the achievement of environmental objectives for these lakes, as well as inadvertent outcomes associated with the delivery of environmental water to them.

Victoria's guidelines for developing environmental water plans recommend the adoption of the threat classification scheme of the IUCN Red List (DELWP 2022) and hence this is the typology followed here (<https://www.iucnredlist.org/resources/threat-classification-scheme>). It is noted that the IUCN typology is broadly consistent with other threat classifications (Salafsky et al. 2008).

In the context of this project the following types of threats may be of relevance to the wetlands under consideration (note the tiered nature of the IUCN threat classification scheme):

Residential & commercial development

- **Tourism & recreation:** these are threats tied to a defined and relatively compact area. In the context of the recreation lakes in this project can include campgrounds associated with the lakes or other tourist accommodation and associated facilities.

Agriculture & aquaculture

- **Freshwater aquaculture:** examples in the IUCN classification scheme includes "hatchery fish allowed to roam in the wild". Given that several the recreation lakes are specifically stocked for recreational purposes, this threat is applicable in the context of this project.

- Grazing: stocking of domestic animals in the mid catchment of the Yarriambiack Creek, whilst not a direct threat to the three weir pools, the water quality of inflows could be compromised due to the free access to this section of the creek system and its associated floodplain (Alluvium 2018).

Biological resource use

- Fishing & harvesting aquatic resources: this includes harvesting of aquatic wild animals or plants for commercial, recreation, subsistence, research, or cultural purposes and includes accidental mortality and bycatch. Given that fishing is a key recreational activity of the lakes considered in this project, this threat category is of relevance here.

Human intrusions & disturbance

- Recreational activities: this includes threats from human activities that can alter, destroy and disturb habitats and species associated with non-consumptive uses of biological resources. In this context this can include motorboats, jet-skis, birdwatchers, pets brought into recreation areas and temporary campsites.

Natural system modifications

The IUCN threat classification includes three levels within this category that are all associated with threats from actions that convert or degrade habitat in service of managing natural or semi-natural systems, such as the recreation lakes, often to improve human welfare:

- Fire & fire suppression: this category focuses on the human activities that lead to either not enough fire or too much fire in the surroundings of the wetlands under consideration. It can also include damaging natural fires in systems that have lost their natural resilience. Given the nature of the recreation lakes it can include escaped campfires and fire suppression to protect caravan parks and associated tourist facilities surrounding these lakes.
- Dams & water management/use: this includes changing the frequency, magnitude, duration of water regimes to patterns outside of their natural range of variation. This includes changing the hydrology of wetlands from temporary to permanent systems and the creation of artificial lakes.
- Other ecosystem modifications: this includes actions that convert or degrade habitat in service of managing natural systems to improve human welfare. Within the context of the recreation lakes examples could include the construction of boat ramps, removal of aquatic vegetation and creation of artificial islands to introduce safe refuges for waterbirds.

Invasive & other problematic species, genes & diseases

The IUCN Classification of direct threats (IUCN 2012) restricts the use of the term “invasive species” non-native species. Other problematic species, genes and diseases can also include native plants, animals, pathogens or microbes or genetic material that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance. For northern Victoria there are a number of water-dependent vectors (e. g. mosquitoes) for viral diseases that affect humans that can be included in this threat category, as well as diseases of aquatic animals, such as frogs and fish.

Identifications of this threat category should also include the source of the invasive species and/or conditions that exacerbate their effect, for example, transporting boats contaminated by invasive algae or diseased aquatic animals between recreational water bodies.

Pollution

- Domestic & urban wastewater: given the recreational nature of these lakes both sewage from adjacent caravan park or other recreational facilities (e. g., toilets associated with picnic areas or boating facilities) and run-off from surrounding roads, residential areas and recreational areas can represent a threat to the environmental conditions of these lakes. Furthermore, human contamination from in-water activities can also represent a threat in these systems.

- **Pollutants:** spills or leakages from fuel tanks from motorboats or jet skis can also constitute a threat to recreation lakes given the increased intensity of human recreational activities in and around these lakes.
- **Garbage and solid waste:** represent a problem as it can entangle wildlife and/or can result in flotsam and jetsam from recreational boats that interferes with aquatic ecological processes and functions.

Climate change & severe weather

Finally, while strictly speaking climatic variability may be part of natural disturbances, it is now well recognised that climate change caused by human activities has resulted in changed rainfall and temperature regimes that are outside of the natural range of variation historically experienced by species or ecological communities. Specific threats in this category include droughts, temperature extremes and changed frequency and intensity of storms and flooding.

Conceptual models

Several conceptual models were developed to illustrate threats specific to the recreation lakes of this project within each IUCN threat category described above, the stressor and its impact on the environmental values in each of four types of systems:

- Weir pools – these are viewed as modified riverine systems (Figure 8),
- Lacustrine (lake) systems (Figure 9).
- Palustrine (marsh) systems (Figure 10), and
- Aquatic ecosystem complexes (Figure 11).

For each system the conceptual model describes the likely e-values associated with each type, and current/potential threats. This will inform potential 'improvement outcomes' associated with different water management scenarios.

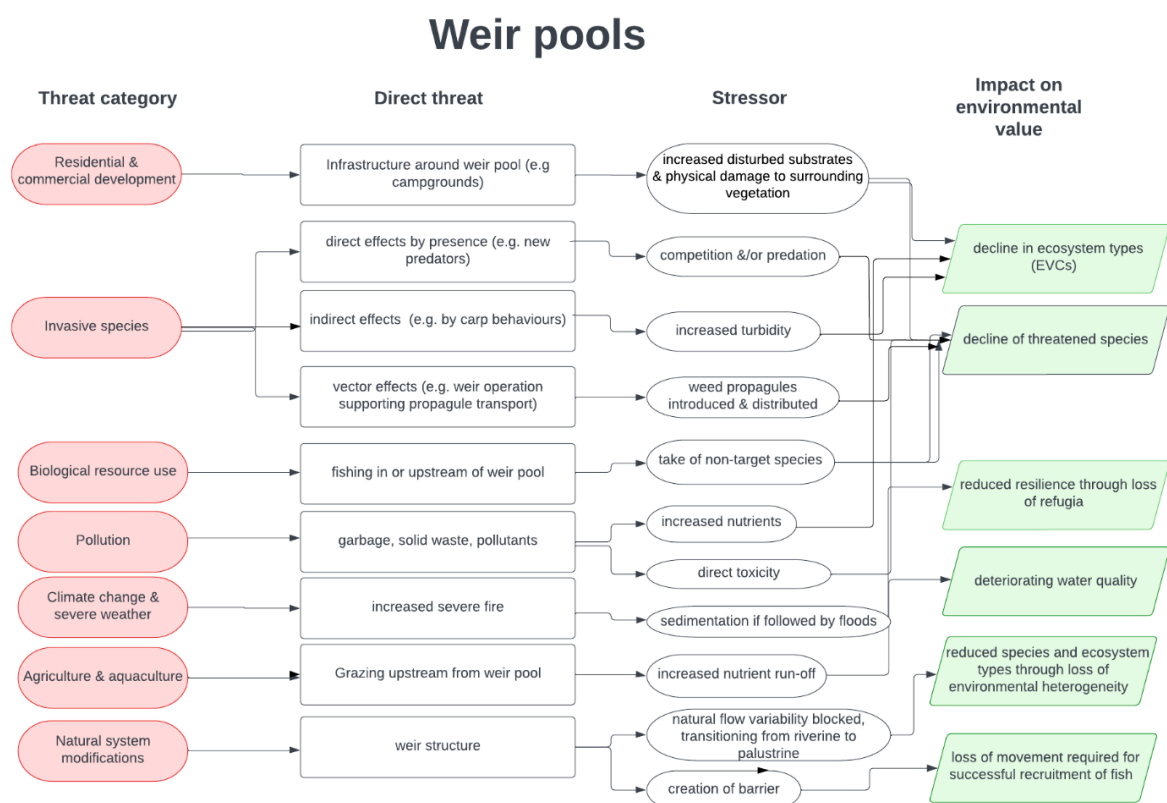


Figure 8. Conceptual model illustrating the impacts of stressors associated with direct threats in each of the IUCN threat category discussed on weir pools.

Palustrine systems

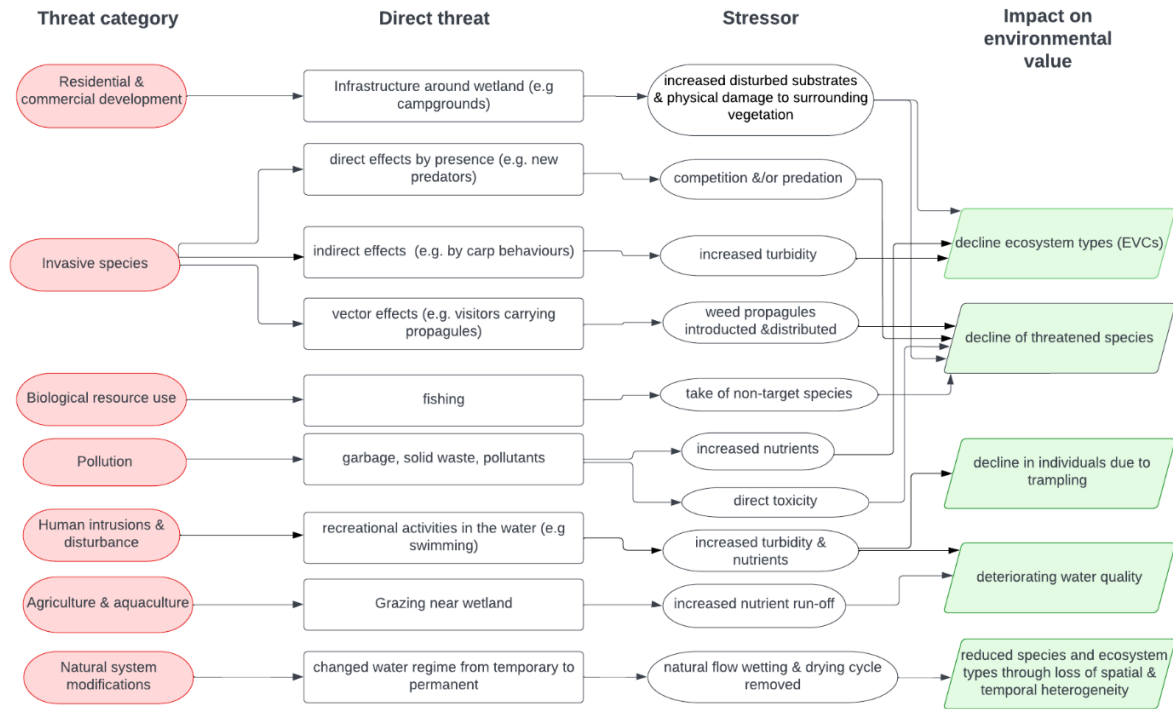


Figure 9. Conceptual model illustrating the impacts of stressors associated with direct threats in each of the IUCN threat category discussed on lacustrine systems.

Lacustrine systems

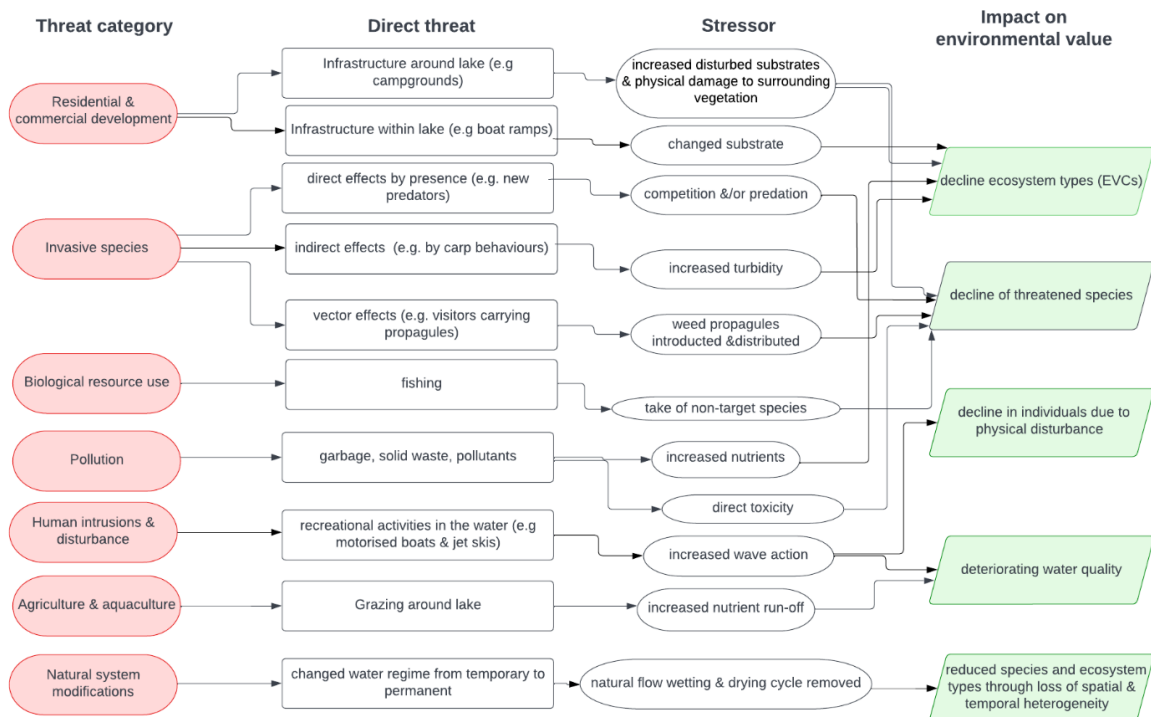


Figure 10. Conceptual model illustrating the impacts of stressors associated with direct threats in each of the IUCN threat category discussed on palustrine systems.

Aquatic ecosystem complexes

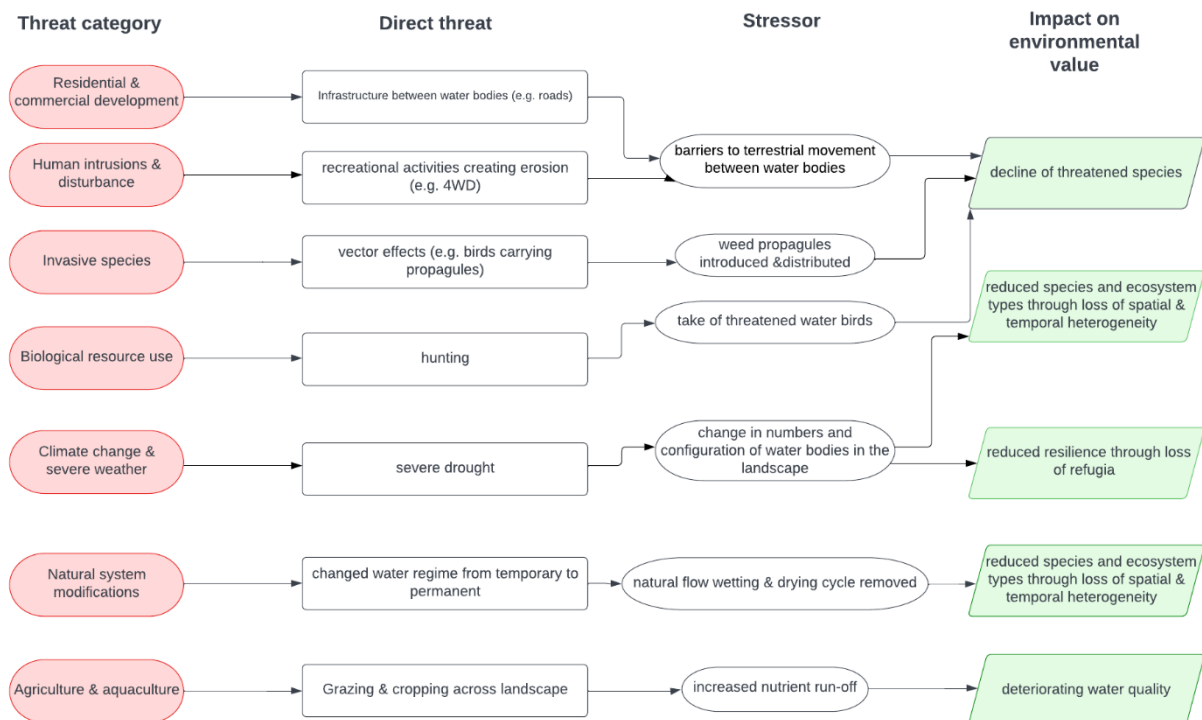


Figure 11. Conceptual model illustrating the impacts of stressors associated with direct threats in each of the IUCN threat category discussed on aquatic ecosystem complexes.

5.3 LAKE WATERING SCENARIOS

5.3.1 Scenarios

Potential future environmental watering scenarios at the recreation lakes are likely to follow the pattern outlined in the seasonal watering approach used by the VEWH (2022) (Figure 12).

During drought and dry climatic conditions, management objectives will be to protect or maintain the environmental values of the lakes to the extent possible given the potential for water scarcity and the need to prioritise environmental water to the lakes whose environmental values will be most at risk. Thus, the potential for water scarcity will likely necessitate the prioritisation of which lakes receive water (see Chapter 6).

During average and wet climatic conditions, management objectives will be to promote recovery, and where possible increase environmental values at the lakes receiving water.

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	No or negligible contributions from unregulated flows; waterways may stop flowing at times, more likely in summer & autumn	Minor contributions from unregulated reaches and tributaries, more likely in winter & spring	Unregulated flows provide extended low flows and multiple freshes, more likely in winter & spring; minor storage spills may occur	Extended, unregulated high flows, multiple large storage spills and overbank flooding, more likely in winter & spring but possible any time of the year
Management objectives	Protect - Avoid critical loss - Maintain refuges - Avoid catastrophic events	Maintain - Maintain river functioning with reduced reproductive capacity - Maintain key functions of high-priority wetlands - Manage within dry-spell tolerances	Recover - Improve ecological health and resilience - Improve recruitment opportunities for key plant and animal species	Enhance - Restore key floodplain wetland linkages - Maximise recruitment opportunities for key animal and plant species
Example watering actions to support management objectives	Provide low flows and trigger-based freshes to maintain water quality in deep refuge pools	Provide summer & autumn low flows to manage water quality and maintain connectivity	Provide year-round low flows to maintain habitat connectivity to support fish movement	Maintain year-round low flows and seasonal freshes to improve the quality of in-stream and bank vegetation and trigger the spawning and movement of native fish
		Extend the duration and/or magnitude of flow peaks to freshen water quality in deep refuge pools	Extend the duration and/or magnitude of peaks to provide spawning cues for fish	Maintain connectivity and the exchange of nutrients between the river and floodplain
			Provide seasonal freshes to support the establishment and maintenance of bank vegetation	Slow the recession of natural peaks to avoid bank slumping and erosion
				Top up natural flows if needed, to meet targets for winter low flows and spring peaks

Figure 12. Planning scenarios under a range of climatic conditions (VEWH 2022).

6 MCA APPROACH

A multi-criterion analysis (MCA) and ranking matrix was developed to rank the recreation lakes by environmental values. The purpose of the MCA is to rank the recreational lakes against each other based on environmental values that would be supported or improved with water delivery. This report does not compare the recreation lakes with other wetland and lake assets in the Wimmera and Glenelg catchments that receive environmental water from the Wimmera and Glenelg Rivers Environmental Entitlement. The use of environmental water for new assets would require confirmation of environmental values and clear environmental watering objectives and targets, which would be included in Environmental Water Management Plans and seasonal watering proposals, as per the established environmental water management framework of the VEWH (e.g., VEWH 2022). As such this report addresses the first two steps of the MCA approach, with further work required to address data gaps.

The VEWH lists the following factors that potentially influence decisions for environmental water management via their Seasonal Water Plan (VEWH 2022):

- Seasonal conditions, weather forecasts and catchment conditions
- River and system operations (such as unregulated flows, catchment inflows, storage levels, other water users' needs and potential delivery constraints)
- Ecological or biological factors and triggers (such as plant and animal responses to natural flows or temperature)
- Water availability
- Risks or costs associated with an action to deliver water for the environment
- The opportunity to deliver shared benefits (for example, for Traditional Owners' and recreational values).

It is important there is the flexibility to respond to these different factors, as they can significantly influence the environmental outcomes and shared benefits that can be achieved. Currently, the VEWH undertakes a prioritisation process in collaboration with stakeholders, which has mainly been undertaken at the asset scale. However, the VEWH is moving to consider outcomes for ecological processes that *underpin waterway health* at a landscape scale; thus, the environmental water allocation process is evolving to consider the combination of watering actions that are needed across multiple waterways in a region to achieve the *best environmental outcomes* (VEWH 2022). The current, asset based, prioritisation criteria used by the VEWH are shown in Figure 13. Details on what landscape scale ecological processes are considered to *underpin waterway health* have not been documented, nor what would be considered as the *best environmental outcome*.

Ultimately, the ranking of the recreation lakes will be a four-step process:

1. Determine the environmental values of each lake and identify key knowledge gaps
2. Rank the recreation lakes based on the current understanding of their environmental values
3. Rank the recreation lakes based on type/threat/likelihood of measurable improvement achieved with environmental water management (relates to VEWH extent and significance of environmental benefit)
 - a. Based on likely improvement in key environmental values (i.e., those that would respond to watering and ability to mitigate threats)
4. Weight by judgement of *if receiving water*, which lakes would get the best outcome
 - a. Feasibility of water level variability
 - b. Likelihood of benefits – triple bottom line

This current ranking focuses on the first two steps, above, as further investigations of environmental values, threats and ecological responses to watering is required to inform the latter two steps.

Prioritisation criteria	Types of factors considered
Extent and significance of environmental benefit	← Size of the area being watered ← Expected ecological outcomes ← Expected scale of response ← Conservation status of the species or community that will benefit ← Expected contribution to regional environmental objectives
Likelihood of success	← Evidence that the desired outcomes are likely to be achieved ← External threats that may affect getting the desired results
Longer-term benefits	← Value added to previous watering undertaken at the site ← Longer-term environmental benefits expected ← Ability to sustain these values into the future
Urgency of watering needs	← History of watering at the site ← Potential for irreversible damage if the watering does not occur ← Risks associated with not delivering the water
Feasibility of the action	← Capacity of infrastructure to meet the delivery requirements ← System or operational constraints ← Flexibility in the timing of delivery ← Likelihood that planned management actions will mitigate external threats
Environmental or third-party risks	← Adverse environmental outcomes that may arise ← Third-party risks associated with the event ← Effectiveness of mitigation to manage third-party and environmental risks
Cost effectiveness of the watering action	← Likely environmental benefit compared against: • costs to deliver and manage water • costs of interventions to manage external threats and risks
Efficiency of water use	← Volume of water needed to achieve the desired outcomes ← Volume and timing of return flows that may be used at downstream sites (see section 1.4.2) ← Alternative supply options such as use of consumptive water en route or augmenting natural flows ← Risks of spills from storages in the upcoming water year and any carryover water (see section 1.4.2) that may be available
After consideration of above criteria	
Cultural, economic, social and Traditional Owner benefits	← Traditional Owner values and aspirations ← Recreation, community events and activities ← Economic benefits

Figure 13. Criteria for prioritising actions to deliver water for the environment used in Seasonal Water Planning by the VEWH (from VEWH 2022).

6.1 CRITERIA

The selection of MCA criteria has been guided by environmental objectives included in Chapters 5 and 8 of the Basin Plan, as well as factors included in the VEWH Seasonal Water Plan (VEWH 2022, Figure 13). The environmental outcomes expected with achieving Basin Plan objectives are:

- To protect and restore water-dependent ecosystems of the Murray-Darling Basin and the biota that depend on them; and

- To protect and restore the ecosystem functions of water-dependent ecosystems (and the biodiversity that is dependent on them); and
- To ensure that water-dependent ecosystems are resilient to climate change and other risks and threats.

Thus, the criteria based on Basin Plan logic relate the aquatic ecosystem types present, ecosystem processes (e.g., fish breeding, waterbird breeding) and the relative risk posed by threats to environmental values and thus resilience.

Relevant criteria and factors from the VEWL prioritisation approach include:

- Extent and significance of the environmental benefit
 - Size of area being watered
 - Conservation status of the species or community that will benefit
- Urgency of watering needs
 - History of watering at the site
 - Risks associated with not delivering water
- Cost effectiveness of the watering action
 - Costs to deliver and manage water
 - Costs of interventions to manage external threats and risk
- Efficiency of water use
 - Volume of water needed to achieve the desired outcome

Many criteria and factors included in the VEWL prioritisation have been omitted as they apply equally to the recreation lakes (e.g. feasibility of the action - all delivery is via pipeline, third party risks associated with the watering event), there is insufficient information available from which to differentiate between each lake (e.g., longer term benefits), or there is redundancy when considering criteria related to Basin Plan objectives (e.g., the number of water dependent species present generally increases with the size of the lake (Figure 14).

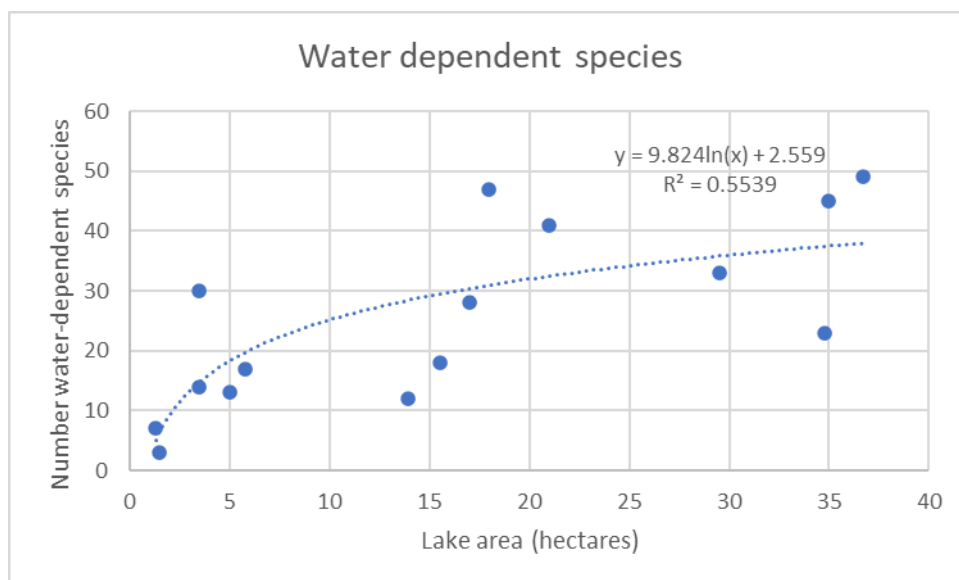


Figure 14. Relationship between lake area and number of water dependent species.

6.1.1 Scoring

A scoring (Table 16) and weighting system has been adopted that helps identify preferred options from less preferred options. It assigns a score of 1-3, where 1 is low and 3 is high, to each criterion and then sums the scores

to identify the relevant importance of each recreation lake (i.e., highest to lowest score; maximum score is 18). The exception is for scoring the criterion for refugia, which has scores of 3 (can be a refugia) or 1 (not likely to be a refugia) based on whether a lake has a permanent typology (see Section 3.3). Weighting of criterion scores (e.g., using numerical multipliers) can be used to better separate the relative importance of each criterion, if required.

Table 16. MCA criteria and scoring system for prioritising recreation lakes based on environmental values

Criterion	Criterion score
Ecosystem type	3: Lake is a single asset inclusive of multiple ecosystem types, and/or, part of a complex 2: Lake is a single ecosystem type but is part of a wetland complex 1: Lake is a single asset and single ecosystem type and is isolated from other aquatic ecosystems
Supports biodiversity	3: Lake supports 31 or more water dependent species 2: Lake supports between 16 and 30 water dependent species 1: Lake supports less than 15 water dependent species
Supports threatened water dependent species listed under the EPBC or FFG Acts	3: Lake supports 5 or more threatened species or communities 2: Lake supports between 3 and 4 threatened species or communities 1: Lake supports less than 2 threatened species or communities
Supports threatened ecological communities at state or regional level (not under legislation – e.g. EVCs)	3: Lake supports 5 or more threatened species or communities 2: Lake supports between 3 and 4 threatened species or communities 1: Lake supports less than 2 threatened species or communities
Refugia for flora and fauna	3: Lake can be a refugia for flora and fauna (waterbirds, frogs and plants) at the landscape level in years of sustained drought 1: System is not likely to provide refugial habitat for flora and fauna in years of sustained drought
Surrounding landuse	3: Lake is within a reserve and/or remnant native vegetation 2: Lake partially abuts landscape that contains remnant native vegetation reserve 1: Lake is in an altered landscape – either urban or agricultural

6.2 RANKING OF LAKES

6.2.1 MCA results

The MCA criteria described in Section 6.1 were assigned scores based on the environmental values information presented in Section 4.1. To reduce operator bias in assigning a final high, medium, and low ranking, K-mean analysis (Past statistical package, Hammer 2011) was applied to the scores to separate the three groups statistically (Table 17). The break in scores for each group were:

- >10 received a high ranking
- 8-10 received a medium ranking
- 6-7 received a low ranking.

Based on existing information and the criteria applied as at November 2022, Lake Marma, Wooroonook Lake, Green Lake, Lake Lascelles and Tchum Lake ranked highest in terms of priority for receiving water. Brim Weir Pool, Warracknabeal Weir Pool, Donald Caravan Park Lake, Walkers Lake, Beulah Weir Pool, Hopetoun Storage (Willow Lake) and Ouyen Lake had a medium ranking for receiving water, while the remaining lakes ranked as low.

As noted in Section 4.1., the information on environmental values at each recreation lake is patchy, and likely influenced by which lakes have been surveyed and data made available in the VBA, ALA and technical reports. It is possible that further surveys at each of the lakes could change the relative ranking of individual lakes in the future.

Table 17. MCA results for the recreation lakes. Green shading indicates a high ranking for receiving water, orange indicates medium ranking and red indicates a low ranking.

	Supports ecosystem types	Supports biodiversity	Supports threatened species	Supports EVCs	Refugia for flora and fauna	Surrounding landuse	Total score
Brim Weir Pool	1	2	1	2	1	1	8
Lake Marma	1	3	3	1	3	1	12
Warracknabeal Weir Pool	1	2	1	2	1	1	8
Watchem Lake	2	1	1	1	1	1	7
Donald Caravan Park Lake	1	3	1	1	1	1	8
Walkers Lake	1	3	3	1	1	1	10
Wooroonook Lake	1	3	2	3	1	2	12
Beulah Weir Pool	1	1	1	2	1	2	8
Green Lake	1	3	2	2	1	3	12
Hopetoun Storage (Willow Lake)	1	1	2	1	3	1	9
Lake Lascelles	3	3	3	3	1	2	15
Ouyen Lake	1	2	1	1	1	2	8
Rainbow Lake	1	1	1	1	1	1	6
Tchum Lake	2	2	1	3	1	2	11
Yaapeet Storage (Turkey Bottom Lake)	1	1	1	1	1	2	7

6.2.2 Sensitivity analysis

A sensitivity analysis was undertaken by doubling the score for each criterion, in turn, whilst maintaining the original scores for the remaining criteria (Appendix 5). This weighting of individual criteria generally had a relatively minor effect on the overall ranking. All the high-ranking lakes retained their high ranking. In addition:

- Walkers Lake had a high ranking for receiving water when any of the criteria were weighted.
- Hopetoun Storage (Willow Lake) had a high ranking when the 'supports threatened species' and 'refugia for flora and fauna' criteria were weighted
- Donald Caravan Park Lake had a high ranking when the 'supports biodiversity' criterion was weighted.

7 SUMMARY

This project was to investigate the environmental values of 15 recreation lakes in the Wimmera-Mallee which are currently supplied with designated recreation water supply and provide an environmental ranking. The findings are considered preliminary in that there are very limited data available on the environmental values for these sites.

The findings suggest that five of the recreation lakes ranked highly from an environmental perspective. These include Lake Marma, Wooreoonook Lake, Green Lake, Lake Lascelles and Tchum Lake. The addition of Walkers Lake to this group could also be considered, given it received a high ranking if any of the assessment criteria were weighted. Lake Tchum is a temporary marsh, Lake Marma a permanent lake and the rest are temporary lakes. This finding matches the judgement of on ground managers, that these lakes would be likely to support environmental values in addition to recreation and social values.

To increase the confidence in the ranking of environmental value of the sites, further environmental data is required across all 15 recreation lakes. If these assets were to be managed for environmental outcomes, it is likely that a variation in water levels and or a wetting and drying regime would need to be considered. Potential benefits from managing the six high environmental value recreation lakes (Marma, Wooreoonook, Green, Walkers, Lascelles and Tchum), for environmental outcomes could include:

- Increased alpha diversity in water-dependent plant species and or communities (i.e., EVCs)
- Improved condition in water-dependent woody and non-woody vegetation
- Provision of refuge habitat in drought conditions
- Improved water quality via promotion of macrophyte dominated primary production and increased filtration of run off by enhancing riparian vegetation cover

The other nine lakes could improve their ranking if they had their environmental values improved via the mitigation of threats, for example by:

- Reintroduction of hydrological regimes typical of historic conditions (i.e., introduce varied lake levels)
- Control of non-native species, and / or
- Planting of native riparian plant species to provide habitat for fauna and also to filter overland run-off.

7.1 KNOWLEDGE GAPS

- Two lakes, Rainbow Lake and Hopetoun Storage, do not have any species listed in the VBA. Surveys are recommended to put these lakes on the same basis as other lakes.
- Biotic surveys across all sites at a comparable level to existing sites that receive environmental water within the Wimmera-Mallee pipeline footprint. In particular the following need to be addressed:
 - Vegetation data is extremely limited, both fringing, riparian and in-system
 - Waterbird data is extremely limited and there are only anecdotal data for breeding
- Confirm salinity status at Green Lake as *Ruppia* has been identified as being present.

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9 APPENDIX 1: SUMMARY OF SOCIAL AND ECONOMIC VALUES

The social and economic values associated with the recreation lakes are summarised in the following sections. Social values are based on interviews with representatives for each recreation lake, as well as economic analyses based on visitor numbers and associated economic and health benefits (Street Ryan 2022 and 2022a).

9.1 SOCIAL VALUES

The social values associated with the recreation lakes is summarised in Table 19. Each lake is valued for opportunities for fishing, camping, caravanning, birdwatching, walking and other passive activities. Many are also highly valued for activities such as fishing, boating (power boats as well as canoeing and kayaking) and swimming. All of these values contributed to the social values and lifestyles of nearby regional, town and local communities. This was reflected in visitor number information (Table 18) collected for many of the lakes as part of a wider study on the socio-economic value of recreation lakes in the Wimmera-Southern Mallee (Street Ryan 2022). Community satisfaction, pride, reduced social isolation and volunteering were all reported to be improved by having functional lakes and weirs.

Table 18. Summary of visitor numbers at recreation lakes 2020/21 (from Street Ryan 2022a)

	Overnight visitors	Visit nights	Active day participants	Passive day participants	Total water participants 2021
Wimmera CMA Region					
Brim Weir Pool	1,178	3,937	3,643	NA	4,822
Lake Marma	1,007	3,596	732	9,250	10,989
Warracknabeal Weir Pool	1,840	8,983	2,464	13,983	18,287
Watchem Lake	847	5,953	581	NA	1,429
North Central CMA region					
Donald Caravan Park Lake	933	3,835	1,081	2,995	5,009
Walkers Lake	1,067	5,134	1,342	NA	2,409
Wooroonook Lake	1,004	4,345	794	NA	1798
Mallee CMA region					
Beulah Weir Pool	717	2,308	955	NA	1,672
Green Lake	493	3,939	3,120	NA	3,613
Hopetoun Storage (Willow Lake)	NA	NA	NA	NA	NA
Lake Lascelles	1,374	7,348	6,383	4,233	11,990
Ouyen Lake	200	544	7,500	5,000	12,700
Rainbow lake	NA	NA	NA	NA	NA
Tchum Lake	898	4,899	2,050	1,320	4,268
Yaapeet storage (Turkey Bottom Lake)	NA	NA	NA	NA	NA

Table 19. Summary of social values at recreation lakes.

Lake	Fishing	Boating/ Water skiing	Kayaking/ canoeing	Swimming	Camping/ caravanning	Birdwatching	BBQ/ picnicking	Walking/ other passive
Brim Weir Pool	✓✓✓	✓✓✓	✓	✓✓	✓✓✓	✓✓	✓✓✓	✓✓
Lake Marma	✓✓✓	✓✓✓	✓✓	✓	✓✓✓	✓	✓✓✓	✓✓✓
Watchem Lake	✓✓✓	✓✓✓	✓✓	✓✓	✓✓✓	✓	✓✓✓	✓
Warracknabeal Weir Pool	✓✓✓	✓✓✓	✓✓	✓	✓✓✓	✓	✓✓✓	✓✓✓
Donald Caravan Park Lake	✓✓✓		✓✓✓	✓	✓✓✓	✓	✓✓✓	✓✓✓
Walkers Lake	✓✓✓	✓✓	✓	✓✓	✓	✓✓✓	✓✓✓	✓
Wooroonook Lake	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓
Beulah Weir Pool	✓✓✓	✓✓✓	✓	✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓
Green Lake	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓
Hopetoun Storage (Willow Lake)	✓✓		✓	✓	✓✓	✓	✓✓✓	✓
Lake Lascelles	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓
Ouyen Lake	✓✓✓	✓✓✓	✓✓	✓✓✓	✓	✓✓	✓✓✓	✓✓
Rainbow Lake	✓✓✓		✓	✓✓✓		✓	✓✓✓	✓✓
Tchum Lake	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓
Yaapeet Storage (Turkey Bottom Lake)	✓✓✓		✓	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓✓

9.2 ECONOMIC VALUES

An investigation of the economic value of activities at 31 lakes and waterways across the Wimmera-Southern Mallee region between 2016/17-2019/20 (Street Ryan 2022) confirmed the lakes in this study as valuable recreational assets. The economic contribution associated with the 31 lakes varies between \$33.7 million during 2018-19 to \$28.5 million in 2019/2020, the latter period being affected by threats of fire, low or poor quality water at several waterbodies, and restrictions imposed during the COVID-19 pandemic.

Street Ryan (2022) also estimated the value of health benefits to be approximately \$1.5 million per annum for Wimmera-South Mallee resident who visited the recreation lakes, and between \$2.5 million and \$4 million per annum for all regional Victorian residents.

As tourism assets, the recreation lakes were considered underdeveloped in this investigation (Street Ryan 2022). Additional investment in infrastructure, facilities and promotion, particularly around events and festivals at individual lakes (e.g. water skiing, fishing events) were suggested as possibilities to increase the economic return from the lakes.

10 APPENDIX 2: TERMINOLOGY USED IN CLASSIFICATION

Table 20. Victorian wetland water regime descriptions (from DELWP 2016)

Water regime	Water regime description	Water regime subcategory	Frequency of inundation	Duration of inundation
Permanent	Inundated constantly, rarely drying completely	-	Constant, annual or less frequently but usually before system dries	Never dries or dries rarely (i.e. holds water at least 8 years in 10), but levels may fluctuate within or between years
Periodically inundated	Inundated annually to infrequently, holding water for at least 1 month to more than 1 year before drying	Seasonal	Annual or near annual inundation (i.e. holds water at least 8 years in 10)	Holds water 1-8 months, then dries
		Intermittent	Infrequent – holds water on average 3-8 in every 10	Holds water >1 month to >1 years, then dries
		Episodic	Infrequent – holds water on average less than 3 years in every 10	Holds water >1 month to >1 years, then dries

11 APPENDIX 3: SPECIES LISTS FOR INDIVIDUAL LAKES

The following species lists have been compiled from the Victorian Biodiversity Atlas (VBA, accessed 27 September 2022) and Atlas of Living Australia (ALA, accessed 20 October 2022). THE VBA provides species lists for all records within a user-defined polygon. This allowed access to records for each recreation lake and its immediate surrounds. The ALA provides a species list for all records within a 1 km radius of a centroid. For this project, the centroid was placed in order to isolate as much as possible records at the recreation lakes and their fringe from other features in the landscape, such as other wetlands and parks. Thus, the ALA lists were used to complement the VBA lists for water dependent species only.

The Victorian Flora and Fauna Guarantee (FFG) and EPBC codes for all tables are: VU = vulnerable, EN = endangered, CR = critically endangered.

11.1 WIMMERA CMA REGION

11.1.1 Brim Weir Pool

Table 21. Species recorded in the VBA and ALA for Brim Weir Pool: January 2012 – September 2022. Water-dependent native species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Bidyanus bidyanus</i>	Silver perch (stocked)	EN	CR
<i>Carassius auratus</i>	Goldfish*		
<i>Cyprinus carpio</i>	European Carp*		
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
<i>Perca fluviatilis</i>	Redfin*		
<i>Tandanus tandanus</i>	Freshwater Catfish	EN	
Waterbirds			
<i>Anas (Nettion) gracilis</i>	Grey Teal		
<i>Anas superciliosa</i>	Pacific Black Duck		
<i>Anhinga novaehollandiae</i>	Australasian Darter		
<i>Chenonetta jubata</i>	Australian Wood Duck		
<i>Egretta novaehollandiae</i>	White-faced Heron		
<i>Elseya melanops</i>	Black-fronted Dotterel		
<i>Gallinula tenebrosa</i>	Dusky Moorhen		
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant		
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant**		
<i>Tachybaptus novaehollandiae</i>	Australian Little Grebe		
<i>Tadorna tadornoides</i>	Australian Shelduck		
<i>Vanellus miles</i>	Masked Lapwing		
Woodland birds			
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar		
<i>Anthochaera carunculata</i>	Red Wattlebird		
<i>Artamus personatus</i>	Masked Woodswallow		
<i>Artamus superciliosus</i>	White-browed Woodswallow		
<i>Cacatua tenuirostris</i>	Long-billed Corella		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Climacteris picumnus</i>	Brown Treecreeper		
<i>Columba livia</i>	Domestic Pigeon*		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		
<i>Corcorax melanorhamphos</i>	White-winged Chough		
<i>Corvus coronoides</i>	Australian Raven		
<i>Cracticus nigrogularis</i>	Pied Butcherbird		
<i>Dacelo novaeguineae</i>	Laughing Kookaburra		
<i>Elanus axillaris</i>	Black-shouldered Kite		
<i>Eolophus roseicapilla</i>	Galah		
<i>Falco berigora</i>	Brown Falcon		
<i>Falco cenchroides</i>	Nankeen Kestrel		
<i>Falco longipennis</i>	Australian Hobby		
<i>Falco peregrinus</i>	Peregrine Falcon		
<i>Glossopsitta concinna</i>	Musk Lorikeet		
<i>Grallina cyanoleuca</i>	Magpie-lark		
<i>Gymnorhina tibicen</i>	Australian Magpie		
<i>Haliastur sphenurus</i>	Whistling Kite		
<i>Hirundo neoxena</i>	Welcome Swallow		
<i>Malurus cyaneus</i>	Superb Fairy-wren		
<i>Manorina melanocephala</i>	Noisy Miner		
<i>Milvus migrans</i>	Black Kite		
<i>Ocyphaps lophotes</i>	Crested Pigeon		
<i>Pardalotus punctatus</i>	Spotted Pardalote		
<i>Pardalotus striatus</i>	Striated Pardalote		
<i>Passer domesticus</i>	House Sparrow*		
<i>Petrochelidon ariel</i>	Fairy Martin		
<i>Phaps chalcoptera</i>	Common Bronzewing		
<i>Platycercus eximius</i>	Eastern Rosella		
<i>Psephotus haematonotus</i>	Red-rumped Parrot		
<i>Ptilotula penicillata</i>	White-plumed Honeyeater		
<i>Rhipidura leucophrys</i>	Willie Wagtail		
<i>Sturnus vulgaris</i>	Common Starling*		
<i>Sugomel nigrum</i>	Black Honeyeater		
<i>Turdus merula</i>	Common Blackbird*		
Vegetation			
<i>Duma florulenta</i>	Tangled Lignum		
<i>Eucalyptus camaldulensis</i>	River Red-gum**		
<i>Eucalyptus largiflorens</i>	Black Box**		

*Alien species, **seen during IWC 2022 assessment

11.1.2 Lake Marma

Table 22. Species recorded in the VBA and ALA for Lake Marma: January 2012 – September 2022. Water-dependent native species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Bidyanus bidyanus</i>	Silver Perch (stocked)	EN	CR
<i>Carassius auratus</i>	Goldfish*		
<i>Cyprinus carpio</i>	European Carp*		
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
<i>Perca fluviatilis</i>	Redfin*		
<i>Philypnodon grandiceps</i>	Flatheaded Gudgeon		
<i>Tandanus tandanus</i>	Freshwater Catfish	EN	
<i>Tinca tinca</i>	Tench*		
Waterbirds			
<i>Acrocephalus australis</i>	Reed-Warbler		
<i>Anas castanea</i>	Chestnut Teal		
<i>Anas gracilis</i>	Grey Teal**		
<i>Anas rhynchotis</i>	Australasian Shoveler		
<i>Anas superciliosa</i>	Pacific Black Duck**		
<i>Anhinga novaehollandiae</i>	Australasian Darter		
<i>Ardea alba</i>	Eastern Great Egret		
<i>Ardea intermedia</i>	Intermediate Egret	CR	
<i>Ardea pacifica</i>	White-necked Heron		
<i>Aythya australis</i>	Hardhead	VU	
<i>Biziura lobata</i>	Musk Duck	VU	
<i>Bubulcus ibis</i>	Cattle Egret		
<i>Casmerodius modesta</i>	Eastern Great Egret	VU	
<i>Chenonetta jubata</i>	Australian Wood Duck**		
<i>Chlidonias hybrida</i>	Whiskered Tern		
<i>Chroicocephalus novaehollandiae</i>	Silver Gull**		
<i>Cladorhynchus leucocephalus</i>	Banded Stilt		
<i>Cygnus atratus</i>	Black Swan		
<i>Egretta novaehollandiae</i>	White-faced Heron		
<i>Elseya melanops</i>	Black-fronted Dotterel		
<i>Erythronyx cinctus</i>	Red-kneed Dotterel		
<i>Fulica atra</i>	Eurasian Coot**		
<i>Gallinula tenebrosa</i>	Dusky Moorhen		
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck		
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant**		
<i>Nycticorax caledonicus</i>	Nankeen Night Heron		
<i>Pelecanus conspicillatus</i>	Australian Pelican		
<i>Phalacrocorax carbo</i>	Great Cormorant		
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant**		
<i>Phalacrocorax (Phalacrocorax) varius</i>	Pied Cormorant		
<i>Podiceps cristatus</i>	Great Crested Grebe		
<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Porphyrio melanotus</i>	Australasian Swamphen		
<i>Porzana (Porzana) fluminea</i>	Spotted Crake		
<i>Porzana pusilla</i>	Baillon's Crake		
<i>Recurvirostra novaehollandiae</i>	Australian Red-necked Avocet		
<i>Spatula rhynchotis</i>	Australasian Shoveler		
<i>Stictonetta naevosa</i>	Freckled Duck	EN	
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe		
<i>Tadorna (Casarca) tadornoides</i>	Chestnut Sheldrake		
<i>Threskiornis moluccus</i>	Black-necked Ibis		
<i>Tribonyx ventralis</i>	Black-tailed Native Hen		
<i>Vanellus miles</i>	Masked Lapwing		
<i>Vanellus (Lobivanellus) tricolor</i>	Banded Lapwing		
Woodland birds			
<i>Accipiter fasciatus</i>	Brown Goshawk		
<i>Anthochaera carunculata</i>	Red Wattlebird		
<i>Artamus cyanopterus</i>	Dusky Woodswallow		
<i>Artamus superciliosus</i>	White-browed Woodswallow		
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo		
<i>Cacatua sanguinea</i>	Little Corella		
<i>Cacatua tenuirostris</i>	Long-billed Corella		
<i>Columba livia</i>	Domestic Pigeon*		
<i>Carduelis carduelis</i>	European Goldfinch*		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		
<i>Corvus mellori</i>	Little Raven		
<i>Dacelo novaeguineae</i>	Laughing Kookaburra		
<i>Eolophus roseicapilla</i>	Galah		
<i>Falco peregrinus</i>	Peregrine Falcon		
<i>Geopelia placida</i>	Peaceful Dove		
<i>Glossopsitta concinna</i>	Musk Lorikeet		
<i>Grallina cyanoleuca</i>	Magpie-lark		
<i>Gymnorhina tibicen</i>	Australian Magpie		
<i>Haliastur sphenurus</i>	Whistling Kite		
<i>Hirundo neoxena</i>	Welcome Swallow		
<i>Milvus migrans</i>	Black Kite		
<i>Ocyphaps lophotes</i>	Crested Pigeon		
<i>Parvipsitta porphyrocephala</i>	Purple-crowned Lorikeet		
<i>Passer domesticus</i>	House Sparrow*		
<i>Petrochelidon ariel</i>	Fairy Martin		
<i>Petrochelidon nigricans</i>	Tree Martin		
<i>Phaps chalcoptera</i>	Common Bronzewing		
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater		
<i>Platycercus eximius</i>	Eastern Rosella		
<i>Poodytes gramineus</i>	Little Grassbird		
<i>Psephotus haematonotus</i>	Red-rumped Parrot		
<i>Ptilotula penicillata</i>	White-plumed Honeyeater		
<i>Rhipidura leucophrys</i>	Willie Wagtail		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Sturnus vulgaris</i>	Common Starling*		
<i>Tribonyx ventralis</i>	Black-tailed Native-hen		
<i>Trichoglossus molucannus</i>	Rainbow Lorikeet		
<i>Turdus merula</i>	Common Blackbird*		

*Alien species, **seen during IWC 2022 assessment

11.1.3 Warracknabeal Weir Pool

Table 23. Species recorded in the VBA and ALA for Warracknabeal Weir Pool: January 2012 – September 2022. Water-dependent native species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Bidyanus bidyanus</i>	Silver Perch (stocked)	EN	CR
<i>Carassius auratus</i>	Goldfish*		
<i>Cyprinus carpio</i>	European Carp*		
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
<i>Perca fluviatilis</i>	Redfin*		
Frogs			
<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog		
<i>Litoria peronii</i>	Peron's Tree Frog		
Waterbirds			
<i>Anas gracilis</i>	Grey Teal		
<i>Anas superciliosa</i>	Pacific Black Duck		
<i>Anas superciliosa</i> X <i>Anas platyrhynchos</i>	Pacific Black Duck/Mallard Hybrid*		
<i>Ardea pacifica</i>	White-necked Heron		
<i>Biziura lobata</i>	Musk Duck	VU	
<i>Chenonetta jubata</i>	Australian Wood Duck		
<i>Egretta novaehollandiae</i>	White-faced Heron		
<i>Gallinula tenebrosa</i>	Dusky Moorhen		
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant**		
<i>Pelecanus conspicillatus</i>	Australian Pelican		
<i>Phalacrocorax carbo</i>	Great Cormorant		
<i>Spatula rhynchotis</i>	Australasian Shoveler	VU	
<i>Tribonyx ventralis</i>	Black-tailed Native-hen		
<i>Todiramphus sanctus</i>	Sacred Kingfisher		
<i>Vanellus miles</i>	Masked Lapwing		
Woodland birds			
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill		
<i>Anthochaera carunculata</i>	Red Wattlebird		
<i>Artamus superciliosus</i>	White-browed Woodswallow		
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo		
<i>Cacatua sanguinea</i>	Little Corella		
<i>Cacatua tenuirostris</i>	Long-billed Corella		
<i>Caligavis chrysops</i>	Yellow-faced Honeyeater		
<i>Climacteris picumnus</i>	Brown Treecreeper		
<i>Columba livia</i>	Domestic Pigeon*		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		
<i>Corcorax melanorhamphos</i>	White-winged Chough		
<i>Corvus mellori</i>	Little Raven		
<i>Cracticus nigrogularis</i>	Pied Butcherbird		
<i>Dacelo novaeguineae</i>	Laughing Kookaburra		
<i>Eolophus roseicapilla</i>	Galah		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Glossopsitta concinna</i>	Musk Lorikeet		
<i>Grallina cyanoleuca</i>	Magpie-lark**		
<i>Gymnorhina tibicen</i>	Australian Magpie		
<i>Hirundo neoxena</i>	Welcome Swallow		
<i>Lalage tricolor</i>	White-winged Triller		
<i>Manorina melanocephala</i>	Noisy Miner**		
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater		
<i>Merops ornatus</i>	Rainbow Bee-eater		
<i>Milvus migrans</i>	Black Kite		
<i>Ocyphaps lophotes</i>	Crested Pigeon		
<i>Pachycephala rufiventris</i>	Rufous Whistler		
<i>Pardalotus striatus</i>	Striated Pardalote		
<i>Parvipsitta porphyrocephala</i>	Purple-crowned Lorikeet		
<i>Passer domesticus</i>	House Sparrow*		
<i>Phaps chalcoptera</i>	Common Bronzewing		
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater		
<i>Platycercus eximius</i>	Eastern Rosella		
<i>Psephotus haematonotus</i>	Red-rumped Parrot		
<i>Ptilotula penicillata</i>	White-plumed Honeyeater		
<i>Rhipidura albiscapa</i>	Grey Fantail		
<i>Rhipidura leucophrys</i>	Willie Wagtail		
<i>Smicrornis brevirostris</i>	Weebill		
<i>Sturnus vulgaris</i>	Common Starling*		
<i>Turdus merula</i>	Common Blackbird*		
<i>Zosterops lateralis</i>	Silvereye		
Vegetation			
<i>Eucalyptus camaldulensis</i>	River Red-gum**		

*Alien species, **seen during IWC 2022 assessment

11.1.4 Watchem Lake

Table 24. Species recorded in the VBA and ALA for Watchem Lake: January 2012 – September 2022. Water-dependent species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Bidyanus bidyanus</i>	Silver Perch (stocked)	EN	CR
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
Waterbirds			
<i>Anas gracilis</i>	Grey Teal		
<i>Anas superciliosa</i>	Pacific Black Duck**		
<i>Chenonetta jubata</i>	Australian Wood Duck		
<i>Elsemyornis melanops</i>	Black-fronted Dotterel		
<i>Fulica atra</i>	Eurasian Coot		
<i>Phalacrocorax carbo</i>	Great Cormorant		
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant**		
<i>Phalacrocorax varius</i>	Pied Cormorant**		
<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe		
<i>Tachybaptus novaehollandiae</i>	Australian Little Grebe		
<i>Tribonyx ventralis</i>	Black-tailed Native Hen		
<i>Vanellus miles</i>	Masked Lapwing**		
Woodland birds			
<i>Grallina cyanoleuca</i>	Magpie-lark		
<i>Gymnorhina tibicen</i>	Australian Magpie		
<i>Hirundo neoxena</i>	Welcome Swallow**		
<i>Manorina melanocephala</i>	Noisy Miner		
<i>Milvus migrans</i>	Black Kite		
<i>Pardalotus striatus</i>	Striated Pardalote		
<i>Petrochelidon ariel</i>	Fairy Martin		
<i>Psephotus haematonotus</i>	Red-rumped Parrot		
<i>Sturnus vulgaris</i>	Common Starling*		

*Alien species, **seen during IWC 2022 assessment

11.2 NORTH CENTRAL CMA REGION

11.2.1 Donald Caravan Park Lake

Table 25. Species recorded in the VBA and ALA for Donald Caravan Park Lake: January 2012 – September 2022. Water-dependent species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Bidyanus bidyanus</i>	Silver Perch (stocked)	EN	CR
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
<i>Perca fluviatilis</i>	Redfin		
Waterbirds			
<i>Acrocephalus australis</i>	Reed-Warbler		
<i>Anas (Nettion) gracilis</i>	Grey Teal		
<i>Anas superciliosa</i>	Pacific Black Duck**		
<i>Anhinga novaehollandiae</i>	Australasian Darter		
<i>Aythya (Nyroca) australis</i>	Hardhead	VU	
<i>Chenonetta jubata</i>	Australian Wood Duck		
<i>Chroicocephalus novaehollandiae</i>	Silver Gull		
<i>Egretta novaehollandiae</i>	White Faced heron		
<i>Elseyornis melanops</i>	Black-fronted Dotterel		
<i>Fulica atra</i>	Eurasian Coot**		
<i>Gallinula tenebrosa</i>	Dusky Moorhen**		
<i>Himantopus himantopus</i>	Pied Stilt		
<i>Microcarbo melanoleucos</i>	Little Cormorant		
<i>Nycticorax caledonicus</i>	Nankeen Night Heron		
<i>Pelecanus conspicillatus</i>	Australian Pelican		
<i>Phalacrocorax carbo</i>	Great Cormorant**		
<i>Phalacrocorax (Phalacrocorax) sulcirostris</i>	Little Black Cormorant		
<i>Phalacrocorax (Phalacrocorax) varius</i>	Pied Cormorant		
<i>Platalea (Platalea) regia</i>	Royal Spoonbill		
<i>Platalea (Platibis) flavipes</i>	Yellow-legged Spoonbill		
<i>Poliocephalus poliocephalus</i>	Hoary-headed Dabchick		
<i>Stictonetta naevosa</i>	Freckled Duck	EN	
<i>Tachybaptus novaehollandiae</i>	Australian Little Grebe		
<i>Todiramphus (Todiramphus) sanctus</i>	Sacred Kingfisher		
<i>Tribonyx ventralis</i>	Black-tailed Native-hen		
<i>Vanellus miles</i>	Masked Lapwing		
Woodland birds			
<i>Anthochaera carunculata</i>	Red Wattlebird		
<i>Artamus cyanopterus</i>	Dusky Woodswallow		
<i>Artamus superciliosus</i>	White-browed Woodswallow		
<i>Cacatua tenuirostris</i>	Long-billed Corella		
<i>Columba livia</i>	Domestic Pigeon*		
<i>Corcorax melanorhamphos</i>	White-winged Chough		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Corvus mellori</i>	Little Raven		
<i>Eolophus roseicapilla</i>	Galah		
<i>Glossopsitta concinna</i>	Musk Lorikeet		
<i>Grallina cyanoleuca</i>	Magpie-lark**		
<i>Gymnorhina tibicen</i>	Australian Magpie		
<i>Hirundo neoxena</i>	Welcome Swallow		
<i>Manorina melanocephala</i>	Noisy Miner**		
<i>Milvus migrans</i>	Black Kite		
<i>Ocyphaps lophotes</i>	Crested Pigeon		
<i>Petrochelidon nigricans</i>	Tree Martin		
<i>Psephotus haematonotus</i>	Red-rumped Parrot		
<i>Ptilotula penicillata</i>	White-plumed Honeyeater		
<i>Rhipidura leucophrys</i>	Willie Wagtail		
<i>Sturnus vulgaris</i>	Common Starling*		
<i>Turdus merula</i>	Common Blackbird*		
Vegetation			
<i>Eucalyptus camaldulensis</i>	River Red Gum**		
<i>Eucalyptus largiflorens</i>	Black Box**		
<i>Typha domingensis</i>	Narrowleaf Cumbungi**		
<i>Vallisneria australis</i>	Eel Grass**		

*Alien species, **seen during IWC 2022 assessment

11.2.2 Walkers Lake

Table 26. Species recorded in the VBA and ALA for Walkers Lake: January 2012 – September 2022. Water-dependent native species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Bidyanus bidyanus</i>	Silver Perch (stocked)	EN	CR
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
Frogs			
<i>Crinia parinsignifera</i>	Eastern Sign-bearing Froglet		
<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog		
<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog (race unknown)		
Waterbirds			
<i>Anas castanea</i>	Chestnut Teal		
<i>Anas gracilis</i>	Grey Teal**		
<i>Anas superciliosa</i>	Pacific Black Duck**		
<i>Anhinga novaehollandiae</i>	Australasian Darter		
<i>Ardea alba</i>	Great Egret		
<i>Ardea pacifica</i>	White-necked Heron		
<i>Aythya australis</i>	Hardhead	VU	
<i>Biziura lobata</i>	Musk Duck	VU	
<i>Charadriidae spp.</i>	Plovers, Dotterels and Lapwings		
<i>Chenonetta jubata</i>	Australian Wood Duck		
<i>Chlidonias hybrida</i>	Whiskered Tern		
<i>Chroicocephalus novaehollandiae</i>	Silver Gull		
<i>Cygnus atratus</i>	Black Swan		
<i>Egretta novaehollandiae</i>	White-faced Heron		
<i>Elseya melanops</i>	Black-fronted Dotterel		
<i>Erythronyx cinctus</i>	Red-kneed Dotterel		
<i>Fulica atra</i>	Eurasian Coot**		
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	EN	
<i>Himantopus leucocephalus</i>	Pied Stilt		
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck		
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant**		
<i>Pelecanus conspicillatus</i>	Australian Pelican		
<i>Phalacrocorax carbo</i>	Great Cormorant**		
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant		
<i>Phalacrocorax varius</i>	Pied Cormorant		
<i>Platalea flavipes</i>	Yellow-billed Spoonbill		
<i>Podicipedidae spp.</i>	Grebes		
<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe		
<i>Porphyrio melanotus</i>	Australasian Swamphen		
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet		
<i>Spatula rhynchotis</i>	Australasian Shoveler	VU	
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Tadorna tadornoides</i>	Australian Shelduck		
<i>Threskiornis spinicollis</i>	Straw-necked Ibis		
<i>Todiramphus sanctus</i>	Sacred Kingfisher		
<i>Tribonyx ventralis</i>	Black-tailed Native-hen		
<i>Vanellus miles</i>	Masked Lapwing**		
Woodland birds			
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar		
<i>Anthochaera carunculata</i>	Red Wattlebird		
<i>Artamus leucorhynchus</i>	White-breasted Woodswallow		
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo		
<i>Cacatua sanguinea</i>	Little Corella		
<i>Cacatua tenuirostris</i>	Long-billed Corella		
<i>Chrysococcyx basalis</i>	Horsfield's Bronze-Cuckoo		
<i>Circus assimilis</i>	Spotted Harrier		
<i>Climacteris picumnus</i>	Brown Treecreeper		
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		
<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike		
<i>Corvus coronoides</i>	Australian Raven		
<i>Corvus spp.</i>	Ravens and Crows		
<i>Cracticus nigrogularis</i>	Pied Butcherbird		
<i>Dacelo novaeguineae</i>	Laughing Kookaburra		
<i>Elanus axillaris</i>	Black-shouldered Kite		
<i>Eolophus roseicapilla</i>	Galah		
<i>Falco berigora</i>	Brown Falcon		
<i>Falco cenchroides</i>	Nankeen Kestrel		
<i>Falco subniger</i>	Black Falcon	CR	
<i>Glossopsitta concinna</i>	Musk Lorikeet		
<i>Grallina cyanoleuca</i>	Magpie-lark		
<i>Gymnorhina tibicen</i>	Australian Magpie		
<i>Haliastur sphenurus</i>	Whistling Kite		
<i>Hirundo neoxena</i>	Welcome Swallow		
<i>Malurus cyaneus</i>	Superb Fairy-wren		
<i>Manorina melanocephala</i>	Noisy Miner		
<i>Melithreptus lunatus</i>	White-naped Honeyeater		
<i>Melopsittacus undulatus</i>	Budgerigar		
<i>Milvus migrans</i>	Black Kite		
<i>Ocyphaps lophotes</i>	Crested Pigeon		
<i>Pardalotus striatus</i>	Striated Pardalote		
<i>Parvipsitta porphyrocephala</i>	Purple-crowned Lorikeet		
<i>Passer domesticus</i>	House Sparrow*		
<i>Petrochelidon ariel</i>	Fairy Martin		
<i>Petrochelidon nigricans</i>	Tree Martin		
<i>Petroica goodenovii</i>	Red-capped Robin		
<i>Phaps chalcoptera</i>	Common Bronzewing		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Platycercus eximius</i>	Eastern Rosella		
<i>Psephotus haematonotus</i>	Red-rumped Parrot		
<i>Ptilotula penicillata</i>	White-plumed Honeyeater		
<i>Rhipidura leucophrys</i>	Willie Wagtail		
<i>Sturnus vulgaris</i>	Common Starling*		
<i>Tyto alba</i>	Barn Owl		
Vegetation			
<i>Eleocharis acuta</i>	Common Spike-sedge**		
<i>Eucalyptus camaldulensis</i>	River Red-gum**		
<i>Sporobolus mitchellii</i>	Rat-tail Couch**		
<i>Typha spp.</i>	Bulrush**		
<i>Vallisneria australis</i>	Eel Grass**		

*Alien species, **seen during IWC 2022 assessment

11.2.3 Wooroonook Lake

Table 27. Species recorded in the VBA and ALA for Wooroonook Lake: January 2012 – September 2022. Water-dependent native species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Bidyanus bidyanus</i>	Silver Perch (stocked)	EN	CR
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
Frogs			
<i>Crinia parinsignifera</i>	Eastern Sign-bearing Froglet		
<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog**		
<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog (race unknown)		
<i>Litoria peronii</i>	Peron's Tree Frog		
Waterbirds			
<i>Acrocephalus (Acrocephalus) australis</i>	Australian Reed Warbler		
<i>Anas castanea</i>	Chestnut Teal		
<i>Anas gracilis</i>	Grey Teal**		
<i>Anas rhynchotis</i>	Australasian Shoveler		
<i>Anas superciliosa</i>	Pacific Black Duck**		
<i>Anhinga novaehollandiae</i>	Australasian Darter		
<i>Ardea alba</i>	Great Egret		
<i>Ardea pacifica</i>	White-necked Heron		
<i>Aythya (Nyroca) australis</i>	Hardhead	VU	
<i>Biziura lobata</i>	Musk Duck	VU	
<i>Chenonetta jubata</i>	Australian Wood Duck		
<i>Chlidonias (Pelodes) hybrida</i>	Whiskered Tern		
<i>Chroicocephalus novaehollandiae</i>	Silver Gull		
<i>Cygnus atratus</i>	Black Swan**		
<i>Egretta novaehollandiae</i>	White-faced Heron		
<i>Euseyonis melanops</i>	Black-fronted Dotterel		
<i>Erythronys cinctus</i>	Red-kneed Dotterel		
<i>Fulica atra</i>	Eurasian Coot**		
<i>Gallinula (Gallinula) tenebrosa</i>	Dusky Moorhen		
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck		
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant**		
<i>Nycticorax caledonicus</i>	Nankeen Night-Heron		
<i>Oxyura australis</i>	Blue-billed Duck	VU	
<i>Pelecanus conspicillatus</i>	Australian Pelican		
<i>Phalacrocorax carbo</i>	Great Cormorant		
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant		
<i>Phalacrocorax varius</i>	Pied Cormorant		
<i>Platalea flavipes</i>	Yellow-billed Spoonbill		
<i>Platalea regia</i>	Royal Spoonbill		
<i>Plegadis falcinellus</i>	Black Curlew		
<i>Podiceps cristatus</i>	Great Crested Grebe		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe		
<i>Spatula rhynchotis</i>	Australasian Shoveler		
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe		
<i>Tadorna tadornoides</i>	Australian Shelduck		
<i>Threskiornis molucca</i>	Australian White Ibis		
<i>Threskiornis spinicollis</i>	Straw-necked Ibis		
<i>Todiramphus (Todiramphus) sanctus</i>	Sacred Kingfisher		
<i>Tribonyx ventralis</i>	Black-tailed Native Hen		
<i>Vanellus miles</i>	Masked Lapwing		
Woodland birds			
<i>Artamus cyanopterus</i>	Dusky Woodswallow		
<i>Cacatua tenuirostris</i>	Long-billed Corella		
<i>Climacteris picumnus</i>	Brown Treecreeper		
<i>Corvus coronoides</i>	Australian Raven		
<i>Eolophus roseicapilla</i>	Galah		
<i>Glossopsitta concinna</i>	Musk Lorikeet		
<i>Grallina cyanoleuca</i>	Magpie-lark		
<i>Gymnorhina tibicen</i>	Australian Magpie		
<i>Hirundo neoxena</i>	Welcome Swallow		
<i>Manorina melanocephala</i>	Noisy Miner		
<i>Ocyphaps lophotes</i>	Crested Pigeon		
<i>Pardalotus striatus</i>	Striated Pardalote		
<i>Platycercus eximius</i>	Eastern Rosella		
<i>Psephotus haematonotus</i>	Red-rumped Parrot**		
<i>Rhipidura leucophrys</i>	Willie Wagtail		
Vegetation			
<i>Azolla</i> sp	Azolla**		
<i>Cycnogeton procerum</i> s.s.	Common Water-ribbons**		
<i>Eleocharis pusilla</i>	Small Spike Rush		
<i>Eucalyptus camaldulensis</i>	River Red Gum**		
<i>Eucalyptus largiflorens</i>	Black Box		

*Alien species, **seen during IWC 2022 assessment

11.3 MALLEE CMA REGION

11.3.1 Beulah Weir Pool

Table 28. Species recorded in the VBA and ALA for Beulah Weir Pool: January 2012 – September 2022. Water-dependent species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
Frogs			
<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog		
Waterbirds			
<i>Acrocephalus australis</i>	Reed-Warbler		
<i>Anas superciliosa</i>	Pacific Black Duck		
<i>Anhinga novaehollandiae</i>	Australasian Darter		
<i>Aphelocephala leucopsis</i>	Southern Whiteface		
<i>Ardea pacifica</i>	White-necked Heron		
<i>Chenonetta jubata</i>	Australian Wood Duck		
<i>Egretta novaehollandiae</i>	White-faced Heron		
<i>Elseyornis melanops</i>	Black-fronted Dotterel		
<i>Fulica atra</i>	Eurasian Coot		
<i>Pelecanus conspicillatus</i>	Australian Pelican		
<i>Todiramphus sanctus</i>	Sacred Kingfisher		
<i>Tringa glareola</i>	Wood Sandpiper	EN	
Woodland birds			
<i>Artamus personatus</i>	Masked Woodswallow		
<i>Anthochaera carunculata</i>	Red Wattlebird		
<i>Artamus superciliosus</i>	White-browed Woodswallow		
<i>Cincloramphus mathewsi</i>	Rufous Songlark		
<i>Climacteris picumnus</i>	Brown Treecreeper		
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		
<i>Columba livia</i>	Domestic Pigeon*		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		
<i>Corcorax melanorhamphos</i>	White-winged Chough		
<i>Corvus coronoides</i>	Australian Raven		
<i>Corvus mellori</i>	Little Raven		
<i>Dacelo novaeguineae</i>	Laughing Kookaburra		
<i>Daphoenositta chrysoptera</i>	Varied Sittella		
<i>Eolophus roseicapilla</i>	Galah		
<i>Epthianura albifrons</i>	White-fronted Chat		
<i>Falco cenchroides</i>	Nankeen Kestrel		
<i>Geopelia placida</i>	Peaceful Dove		
<i>Glossopsitta concinna</i>	Musk Lorikeet		
<i>Grallina cyanoleuca</i>	Magpie-lark		
<i>Gymnorhina tibicen</i>	Australian Magpie		
<i>Hirundo neoxena</i>	Welcome Swallow		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Lalage tricolor</i>	White-winged Triller		
<i>Malurus lamberti</i>	Variegated Fairy-wren		
<i>Manorina melanocephala</i>	Noisy Miner		
<i>Merops ornatus</i>	Rainbow Bee-eater		
<i>Milvus migrans</i>	Black Kite		
<i>Ocyphaps lophotes</i>	Crested Pigeon		
<i>Pardalotus striatus</i>	Striated Pardalote		
<i>Passer domesticus</i>	House Sparrow*		
<i>Petrochelidon ariel</i>	Fairy Martin		
<i>Petrochelidon nigricans</i>	Tree Martin		
<i>Platycercus eximius</i>	Eastern Rosella		
<i>Pomatostomus superciliosus</i>	White-browed Babbler		
<i>Psephotus haematonotus</i>	Red-rumped Parrot		
<i>Ptilotula penicillata</i>	White-plumed Honeyeater		
<i>Rhipidura leucophrys</i>	Willie Wagtail		
<i>Sturnus vulgaris</i>	Common Starling*		
<i>Turdus merula</i>	Common Blackbird		

*Alien species

11.3.2 Green Lake

Table 29. Species recorded in the VBA and ALA for Green Lake: January 2012 – September 2022. Water-dependent native species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
Waterbirds			
<i>Anas (Nettion) castanea</i>	Chestnut Teal		
<i>Anas gracilis</i>	Grey Teal		
<i>Anas superciliosa</i>	Pacific Black Duck		
<i>Anhinga novaehollandiae</i>	Australasian Darter		
<i>Ardea alba</i>	Great Egret		
<i>Ardea pacifica</i>	White-necked Heron		
<i>Aythya (Nyroca) australis</i>	Hardhead	VU	
<i>Chenonetta jubata</i>	Australian Wood Duck		
<i>Chroicocephalus novaehollandiae</i>	Silver Gull		
<i>Cygnus atratus</i>	Black Swan		
<i>Calidris (Erolia) acuminata</i>	Sharp-tailed Sandpiper		
<i>Chlidonias (Pelodes) hybrida</i>	Whiskered Tern		
<i>Egretta novaehollandiae</i>	White-faced Heron		
<i>Elseya melanops</i>	Black-fronted Dotterel		
<i>Fulica atra</i>	Eurasian Coot		
<i>Himantopus himantopus</i>	Pied Stilt		
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck		
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant		
<i>Nycticorax caledonicus</i>	Nankeen Night Heron		
<i>Oxyura australis</i>	Blue-billed Duck		
<i>Pelecanus conspicillatus</i>	Australian Pelican		
<i>Phalacrocorax carbo</i>	Great Cormorant		
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant**		
<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe		
<i>Porzana (Porzana) fluminea</i>	Spotted Crake		
<i>Recurvirostra novaehollandiae</i>	Australian Red-necked Avocet		
<i>Spatula rhynchotis</i>	Australasian Shoveler		
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe		
<i>Todiramphus sanctus</i>	Sacred Kingfisher		
<i>Tadorna tadornoides</i>	Australian Shelduck		
<i>Tribonyx ventralis</i>	Black-tailed Native-hen		
<i>Tringa nebularia</i>	Common Greenshank	EN	
<i>Vanellus miles</i>	Masked Lapwing		
Woodland birds			
<i>Acanthiza nana</i>	Yellow Thornbill		
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar		
<i>Artamus personatus</i>	Masked Woodswallow		
<i>Artamus superciliosus</i>	White-browed Woodswallow		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Barnardius zonarius</i>	Australian Ringneck		
<i>Barnardius zonarius barnardi</i>	Mallee Ringneck		
<i>Barnardius zonarius zonarius</i>	Port Lincoln Parrot		
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo		
<i>Climacteris picumnus</i>	Brown Treecreeper		
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		
<i>Corcorax melanorhamphos</i>	White-winged Chough		
<i>Corvus coronoides</i>	Australian Raven		
<i>Dacelo novaeguineae</i>	Laughing Kookaburra		
<i>Dicaeum hirundinaceum</i>	Mistletoebird		
<i>Gerygone fusca</i>	Western Gerygone		
<i>Grallina cyanoleuca</i>	Magpie-lark		
<i>Gymnorhina tibicen</i>	Australian Magpie		
<i>Hirundo neoxena</i>	Welcome Swallow		
<i>Malurus cyaneus</i>	Superb Fairy-wren		
<i>Manorina melanocephala</i>	Noisy Miner		
<i>Merops ornatus</i>	Rainbow Bee-eater		
<i>Myiagra inquieta</i>	Restless Flycatcher		
<i>Nymphicus hollandicus</i>	Cockatiel		
<i>Pachycephala pectoralis</i>	Golden Whistler		
<i>Pachycephala rufiventris</i>	Rufous Whistler		
<i>Petrochelidon nigricans</i>	Tree Martin		
<i>Petroica goodenovii</i>	Red-capped Robin		
<i>Phaps chalcoptera</i>	Common Bronzewing		
<i>Philemon citreogularis</i>	Little Friarbird		
<i>Platycercus eximius</i>	Eastern Rosella		
<i>Plectorhyncha lanceolata</i>	Striped Honeyeater		
<i>Polytelis anthopeplus monarchoides</i>	Regent Parrot	VU	VU
<i>Psephotellus varius</i>	Mulga Parrot		
<i>Psephotus haematonotus</i>	Red-rumped Parrot		
<i>Ptilotula ornata</i>	Yellow-plumed Honeyeater		
<i>Ptilotula penicillata</i>	White-plumed Honeyeater		
<i>Rhipidura leucophrys</i>	Willie Wagtail		
Vegetation			
<i>Carex bichenoviana</i>	Plains Sedge		
<i>Duma florulenta</i>	Tangled Lignum		
<i>Eleocharis acuta</i>	Common Spike-sedge		
<i>Eucalyptus largiflorens</i>	Black Box		
<i>Juncus bufonius</i>	Toad Rush		
<i>Acacia oswaldii</i>	Umbrella Wattle	CR	
<i>Alectryon oleifolius subsp. canescens</i>	Cattle Bush		
<i>Arctotheca calendula</i>	Cape Weed		
<i>Asphodelus fistulosus</i>	Onion Weed		
<i>Austrostipa acroclita</i>	Graceful Spear-grass		
<i>Austrostipa elegantissima</i>	Feather Spear-grass		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Austrostipa spp.</i>	Spear Grass		
<i>Avena ludoviciana</i>	Winter Wild-oat		
<i>Beyeria lechenaultii</i>	Pale Turpentine-bush		
<i>Brachyscome dentata</i>	Lobe-seed Daisy		
<i>Brachyscome lineariloba</i>	Hard-head Daisy		
<i>Brassica tournefortii</i>	Mediterranean Turnip		
<i>Bromus diandrus</i>	Great Brome		
<i>Bromus rubens</i>	Red Brome		
<i>Bulbine semibarbata</i>	Leek Lily		
<i>Calandrinia eremaea</i>	Small Purslane		
<i>Callitris gracilis</i>	Slender Cypress-pine		
<i>Cassytha melantha</i>	Coarse Dodder-laurel		
<i>Chenopodium curvispicatum</i>	Cottony Saltbush		
<i>Chenopodium desertorum subsp. microphyllum</i>	Small-leaf Goosefoot		
<i>Cirsium vulgare</i>	Spear Thistle*		
<i>Convolvulus erubescens s.l.</i>	Pink Bindweed		
<i>Crassula colorata</i>	Dense Crassula		
<i>Cynodon dactylon</i>	Couch		
<i>Ehrharta longiflora</i>	Annual Veldt-grass		
<i>Eremophila longifolia</i>	Berrigan		
<i>Erodium crinitum</i>	Blue Heron's-bill		
<i>Eucalyptus dumosa</i>	Dumosa Mallee		
<i>Euchiton involucratu s.l.</i>	Common Cudweed		
<i>Euphorbia drummondii s.l.</i>	Flat Spurge		
<i>Glycyrrhiza acanthocarpa</i>	Southern Liquorice		
<i>Goodenia fascicularis</i>	Silky Goodenia		
<i>Goodenia pinnatifida</i>	Cut-leaf Goodenia		
<i>Hakea leucoptera subsp. leucoptera</i>	Silver Needlewood		
<i>Helichrysum leucopsidium</i>	Satin Everlasting		
<i>Heliotropium europaeum</i>	Common Heliotrope		
<i>Helminthotheca echioides</i>	Ox-tongue		
<i>Hordeum glaucum</i>	Northern Barley-grass		
<i>Hordeum leporinum</i>	Barley Grass		
<i>Hyalosperma semisterile</i>	Orange Sunray		
<i>Hypochaeris glabra</i>	Smooth Cat's-ear		
<i>Lactuca serriola</i>	Prickly Lettuce		
<i>Lamarckia aurea</i>	Golden-top		
<i>Linum marginale</i>	Native Flax		
<i>Lolium rigidum</i>	Wimmera Rye-grass		
<i>Maireana decalvans s.l.</i>	Black Cotton-bush		
<i>Marsilea drummondii</i>	Common Nardoo		
<i>Medicago minima</i>	Little Medic		
<i>Millotia myosotidifolia</i>	Broad-leaf Millotia		
<i>Olearia passerinoides</i>	Slender Daisy-bush		
<i>Onopordum acaulon</i>	Stemless Thistle		
<i>Oxalis perennans</i>	Grassland Wood-sorrel		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Parapholis incurva</i>	Coast Barb-grass		
<i>Parietaria debilis</i> s.l.	Shade Pellitory		
<i>Pauridia glabella</i> var. <i>glabella</i>	Tiny Star		
<i>Pauridia glabella/vaginata</i> spp. agg.	Tiny/Yellow Star species aggregate		
<i>Pittosporum angustifolium</i>	Weeping Pittosporum		
<i>Plantago hispida</i>	Hairy Plantain		
<i>Poa annua</i> s.l.	Annual Meadow-grass		
<i>Ptilotus seminudus</i>	Rabbit Tails		
<i>Rhodanthe corymbiflora</i>	Paper Sunray		
<i>Rhodanthe pygmaea</i>	Pygmy Sunray		
<i>Rytidosperma pilosum</i>	Velvet Wallaby-grass		
<i>Rytidosperma setaceum</i>	Bristly Wallaby-grass		
<i>Rytidosperma setaceum</i> var. <i>setaceum</i>	Bristly Wallaby-grass		
<i>Rytidosperma setaceum</i> var. <i>setaceum</i>	Bristly Wallaby-grass		
<i>Santalum acuminatum</i>	Sweet Quandong		
<i>Schismus barbatus</i>	Arabian Grass		
<i>Scorzonera laciniata</i>	Scorzonera		
<i>Scorzonera</i> spp.	Scorzonera		
<i>Senecio glossanthus</i> s.l.	Slender Groundsel		
<i>Senecio quadridentatus</i>	Cotton Fireweed		
<i>Senna artemisioides</i> subsp. <i>filifolia</i>	Fine-leaf Desert Cassia		
<i>Silene apetala</i> var. <i>apetala</i>	Mallee Catchfly		
<i>Silene nocturna</i>	Mediterranean Catchfly		
<i>Sisymbrium erysimoides</i>	Smooth Mustard		
<i>Sisymbrium orientale</i>	Indian Hedge-mustard		
<i>Sonchus asper</i> s.l.	Rough Sow-thistle		
<i>Sonchus oleraceus</i>	Common Sow-thistle		
<i>Spergularia</i> spp.	Sand Spurrey		
<i>Stellaria media</i>	Chickweed		
<i>Stellaria pallida</i>	Lesser Chickweed		
<i>Stemodia glabella</i> s.l.	Blue Rod		
<i>Stuartina muelleri</i>	Spoon Cudweed		
<i>Trifolium arvense</i> var. <i>arvense</i>	Hare's-foot Clover		
<i>Triptilodiscus pygmaeus</i>	Common Sunray		
<i>Veronica peregrina</i> subsp. <i>xalapensis</i>	Wandering Speedwell		
<i>Vittadinia cervicalis</i>	Annual New Holland Daisy		
<i>Vittadinia gracilis</i>	Woolly New Holland Daisy		
<i>Vulpia muralis</i>	Wall Fescue*		
<i>Vulpia myuros</i> f. <i>myuros</i>	Rat's-tail Fescue		
<i>Vulpia myuros</i> f. <i>myuros</i>	Rat's-tail Fescue		
<i>Vulpia</i> spp.	Fescue		
<i>Wahlenbergia capillaris</i> s.l.	Tufted Bluebell		
<i>Wahlenbergia</i> spp.	Bluebell		
<i>Wurmbea dioica</i>	Common Early Nancy		

*Alien species, **seen during IWC 2022 assessment

11.3.3 Hopetoun storage (Willow Lake)

Table 30. Species recorded in the VBA and ALA for Hopetoun Storage: January 2012 – September 2022. Water-dependent native species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Bidyanus bidyanus</i>	Silver Perch (stocked)	EN	CR
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
Frogs			
<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog **		
Waterbirds			
<i>Anas gracilis</i>	Grey Teal		
<i>Anas superciliosa</i>	Pacific Black Duck**		
<i>Ardea pacifica</i>	White-necked Heron		
<i>Aythya australis</i>	Hardhead	VU	
<i>Biziura lobata</i>	Musk Duck	VU	
<i>Chenonetta jubata</i>	Australian Wood Duck**		
<i>Chlidonias hybrida</i>	Whiskered Tern		
<i>Chroicocephalus novaehollandiae</i>	Silver Gull		
<i>Cygnus atratus</i>	Black Swan		
<i>Egretta novaehollandiae</i>	White-faced Heron		
<i>Elseyornis melanops</i>	Black-fronted Dotterel		
<i>Gallinula tenebrosa</i>	Dusky Moorhen		
<i>Himantopus leucocephalus</i>	Pied Stilt		
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant**		
<i>Oxyura australis</i>	Blue-billed Duck	VU	
<i>Pelecanus conspicillatus</i>	Australian Pelican		
<i>Phalacrocorax carbo</i>	Great Cormorant**		
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant		
<i>Phalacrocorax varius</i>	Pied Cormorant		
<i>Tadorna tadornoides</i>	Australian Shelduck		
<i>Tribonyx ventralis</i>	Black-tailed Native-hen**		
<i>Vanellus miles</i>	Masked Lapwing		

*Alien species, **seen during IWC 2022 assessment

11.3.4 Lake Lascelles

Table 31. Species recorded in the VBA and ALA for Lake Lascelles: January 2012 – September 2022. Water-dependent native species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Bidyanus bidyanus</i>	Silver Perch (stocked)	EN	CR
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
<i>Maccullochella peelii</i>	Murray Cod	EN	VU
Reptiles			
<i>Emydura macquarii</i>	Murray River Turtle	EN	
Waterbirds			
<i>Anas (Nettion) castanea</i>	Chestnut Teal		
<i>Anas gracilis</i>	Grey Teal		
<i>Anas superciliosa</i>	Pacific Black Duck		
<i>Anas superciliosa</i> X <i>Anas platyrhynchos</i>	Pacific Black Duck/Mallard Hybrid*		
<i>Anhinga novaehollandiae</i>	Australasian Darter		
<i>Ardea alba</i>	Great Egret		
<i>Ardea pacifica</i>	White-necked Heron		
<i>Aythya australis</i>	Hardhead	VU	
<i>Biziura lobata</i>	Musk Duck	VU	
<i>Casmerodius modesta</i>	Eastern Great Egret	VU	
<i>Chenonetta jubata</i>	Australian Wood Duck		
<i>Chlidonias hybrida</i>	Whiskered Tern		
<i>Chroicocephalus novaehollandiae</i>	Silver Gull		
<i>Cladorhynchus leucocephalus</i>	Banded Stilt		
<i>Cygnus atratus</i>	Black Swan		
<i>Egretta novaehollandiae</i>	White-faced Heron		
<i>Elseya melanops</i>	Black-fronted Dotterel		
<i>Fulica atra</i>	Eurasian Coot		
<i>Gallinula tenebrosa</i>	Dusky Moorhen		
<i>Himantopus leucocephalus</i>	Pied Stilt		
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck		
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant		
<i>Oxyura australis</i>	Blue-billed Duck	VU	
<i>Pelecanus conspicillatus</i>	Australian Pelican		
<i>Phalacrocorax carbo</i>	Great Cormorant		
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant		
<i>Phalacrocorax varius</i>	Pied Cormorant		
<i>Podiceps cristatus</i>	Great Crested Grebe		
<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe		
<i>Porphyrio melanotus</i>	Australasian Swamphen		
<i>Spatula rhynchotis</i>	Australasian Shoveler	VU	
<i>Stictonetta naevosa</i>	Freckled Duck	EN	
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe		
<i>Tadorna tadornoides</i>	Australian Shelduck		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Threskiornis spinicollis</i>	Straw-necked Ibis		
<i>Todiramphus (Todiramphus) sanctus</i>	Sacred Kingfisher		
<i>Tribonyx ventralis</i>	Black-tailed Native-hen		
<i>Vanellus miles</i>	Masked Lapwing		
<i>Vanellus (Lobivanellus) tricolor</i>	Banded Lapwing		
Woodland birds			
<i>Anthochaera carunculata</i>	Red Wattlebird		
<i>Artamus personatus</i>	Masked Woodswallow		
<i>Artamus superciliosus</i>	White-browed Woodswallow		
<i>Cacatua sanguinea</i>	Little Corella		
<i>Cheramoeca leucosterna</i>	White-backed Swallow		
<i>Columba livia</i>	Domestic Pigeon*		
<i>Corvus spp.</i>	Ravens and Crows		
<i>Cracticus nigrogularis</i>	Pied Butcherbird		
<i>Eolophus roseicapilla</i>	Galah		
<i>Glossopsitta concinna</i>	Musk Lorikeet		
<i>Grallina cyanoleuca</i>	Magpie-lark		
<i>Gymnorhina tibicen</i>	Australian Magpie		
<i>Haliastur sphenurus</i>	Whistling Kite		
<i>Hirundo neoxena</i>	Welcome Swallow		
<i>Manorina melanocephala</i>	Noisy Miner		
<i>Merops ornatus</i>	Rainbow Bee-eater		
<i>Milvus migrans</i>	Black Kite		
<i>Nymphicus hollandicus</i>	Cockatiel		
<i>Ocyphaps lophotes</i>	Crested Pigeon		
<i>Pachycephala rufiventris</i>	Rufous Whistler		
<i>Pardalotus striatus</i>	Striated Pardalote		
<i>Passer domesticus</i>	House Sparrow*		
<i>Petrochelidon nigricans</i>	Tree Martin		
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater		
<i>Platycercus eximius</i>	Eastern Rosella		
<i>Psephotus haematonotus</i>	Red-rumped Parrot		
<i>Ptilotula penicillata</i>	White-plumed Honeyeater		
<i>Rhipidura leucophrys</i>	Willie Wagtail		
<i>Sturnus vulgaris</i>	Common Starling*		
Vegetation			
<i>Eucalyptus camaldulensis</i>	River Red Gum		
<i>Eucalyptus largiflorens</i>	Black Box		
<i>Acacia oswaldii</i>	Umbrella Wattle	CR	

*Alien species, **seen during IWC 2022 assessment

11.3.5 Ouyen Lake

Table 32. Species recorded in the VBA and ALA for Ouyen Lake: January 2012 – September 2022. Water-dependent native species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Bidyanus bidyanus</i>	Silver Perch (stocked)	EN	CR
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
Waterbirds			
<i>Anas (Nettion) castanea</i>	Chestnut Teal		
<i>Anas gracilis</i>	Grey Teal		
<i>Anas superciliosa</i>	Pacific Black Duck		
<i>Anhinga novaehollandiae</i>	Australasian Darter		
<i>Ardea pacifica</i>	White-necked Heron		
<i>Aythya australis</i>	Hardhead	VU	
<i>Calidris (Ereunetes) ruficollis</i>	Red-necked Stint		
<i>Charadrius (Charadrius) bicinctus</i>	Double-banded Plover		
<i>Charadrius (Charadrius) ruficapillus</i>	Red-capped Plover		
<i>Chenonetta jubata</i>	Australian Wood Duck		
<i>Chlidonias hybrida</i>	Whiskered Tern		
<i>Chroicocephalus novaehollandiae</i>	Silver Gull		
<i>Cygnus atratus</i>	Black Swan		
<i>Egretta novaehollandiae</i>	White-faced Heron		
<i>Elseya melanops</i>	Black-fronted Dotterel		
<i>Fulica atra</i>	Eurasian Coot		
<i>Gelochelidon macrotarsa</i>	Australian Gull-billed Tern	EN	
<i>Himantopus himantopus</i>	Pied Stilt		
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck		
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant**		
<i>Phalacrocorax carbo</i>	Great Cormorant**		
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant**		
<i>Platalea flavipes</i>	Yellow-billed Spoonbill		
<i>Poliocephalus poliocephalus</i>	Hoary-headed Dabchick		
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe		
<i>Tadorna tadornoides</i>	Australian Shelduck		
<i>Tribonyx ventralis</i>	Black-tailed Native Hen		
<i>Vanellus miles</i>	Masked Lapwing		
Woodland birds			
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater		
<i>Anthochaera carunculata</i>	Red Wattlebird		
<i>Cacatua sanguinea</i>	Little Corella		
<i>Circus assimilis</i>	Spotted Harrier		
<i>Climacteris picumnus</i>	Brown Treecreeper		
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		
<i>Corvus coronoides</i>	Australian Raven		
<i>Eolophus roseicapilla</i>	Galah**		
<i>Gavicalis virescens</i>	Singing Honeyeater		

Scientific Name	Common Name	FFG Status	EPBC Status
<i>Grallina cyanoleuca</i>	Magpie-lark		
<i>Gymnorhina tibicen</i>	Australian Magpie		
<i>Hieraaetus morphnoides</i>	Little Eagle	VU	
<i>Hirundo neoxena</i>	Welcome Swallow		
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo	CR	
<i>Malurus lamberti</i>	Variegated Fairy-wren		
<i>Manorina flavigula</i>	Yellow-throated Miner		
<i>Merops ornatus</i>	Rainbow Bee-eater		
<i>Milvus migrans</i>	Black Kite		
<i>Ocyphaps lophotes</i>	Crested Pigeon		
<i>Pardalotus striatus</i>	Striated Pardalote		
<i>Passer domesticus</i>	House Sparrow*		
<i>Petrochelidon nigricans</i>	Tree Martin		
<i>Pomatostomus superciliosus</i>	White-browed Babbler		
<i>Psephotus haematonotus</i>	Red-rumped Parrot		
<i>Ptilotula penicillata</i>	White-plumed Honeyeater		
<i>Purnella albifrons</i>	White-fronted Honeyeater		
<i>Rhipidura leucophrys</i>	Willie Wagtail		
<i>Turdus merula</i>	Common Blackbird*		
<i>Olearia pimeleoides</i>	Showy Daisy-bush		
<i>Limonium sinuatum</i>	Perennial Sea Lavender		

*Alien species, **seen during IWC 2022 assessment

11.3.6 Rainbow Lake

Table 33. Species recorded in the VBA and ALA for Rainbow Lake: January 2012 – September 2022. Water-dependent native species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Waterbirds			
<i>Anas superciliosa</i>	Pacific Black Duck**		
<i>Fulica atra</i>	Eurasian Coot**		
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant**		
Woodland birds			
<i>Ocyphaps lophotes</i>	Crested Pigeon**		

*Alien species, **seen during IWC 2022 assessment

11.3.7 Tchum Lake (south)

Table 34. Species recorded in the VBA and ALA for Tchum Lake (south): January 2012 – September 2022. Water-dependent native species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Fish			
<i>Bidyanus bidyanus</i>	Silver Perch (stocked)	EN	CR
<i>Macquaria ambigua</i>	Golden Perch (stocked)		
Waterbirds			
<i>Anas (Nettion) castanea</i>	Chestnut Teal		
<i>Anas gracilis</i>	Grey Teal		
<i>Anas rhynchotis</i>	Australasian Shoveler		
<i>Anas superciliosa</i>	Pacific Black Duck**		
<i>Anhinga novaehollandiae</i>	Australasian Darter		
<i>Biziura lobata</i>	Musk Duck**	VU	
<i>Chenonetta jubata</i>	Australian Wood Duck		
<i>Dendrocygna eytoni</i>	Plumed Whistling-duck		
<i>Egretta novaehollandiae</i>	White-faced Heron		
<i>Fulica atra</i>	Eurasian Coot		
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant		
<i>Pelecanus conspicillatus</i>	Australian Pelican		
<i>Phalacrocorax carbo</i>	Great Cormorant		
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant**		
<i>Spatula rhynchotis</i>	Australasian Shoveler	VU	
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe		
<i>Tadorna tadornoides</i>	Australian Shelduck**		
<i>Tribonyx ventralis</i>	Black-tailed Native Hen		
<i>Vanellus miles</i>	Masked Lapwing		
Vegetation			
<i>Eleocharis acuta</i>	Common Spike-sedge**		
<i>Eucalyptus largiflorens</i>	Black Box**		
<i>Duma florulenta</i>	Tangled Lignum**		
<i>Juncus spp.</i>	Rush**		

*Alien species, **seen during IWC 2022 assessment

11.3.8 Yaapeet (Turkey Bottom Lake)

Table 35. Species recorded in the VBA and ALA for Yaapeet Storage (Turkey Bottom Lake): January 2012 – September 2022. Water-dependent native species are shaded.

Scientific Name	Common Name	FFG Status	EPBC Status
Waterbirds			
<i>Charadrius ruficapillus</i>	Red-capped Dotterel**		
<i>Chenonetta jubata</i>	Australian Wood Duck		
<i>Egretta novaehollandiae</i>	White Faced Heron		
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant**		
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe		
<i>Tadorna (Casarca) tadornoides</i>	Australian Shelduck		
<i>Vanellus miles</i>	Masked Lapwing		
Woodland birds			
<i>Artamus cyanopterus</i>	Dusky Woodswallow		
<i>Artamus superciliosus</i>	White-browed Woodswallow		
<i>Climacteris picumnus</i>	Brown Treecreeper		
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		
<i>Eolophus roseicapilla</i>	Galah		
<i>Gavialis virescens</i>	Singing Honeyeater		
<i>Geopelia placida</i>	Peaceful Dove		
<i>Grallina cyanoleuca</i>	Magpie-lark		
<i>Gymnorhina tibicen</i>	Australian Magpie**		
<i>Hirundo neoxena</i>	Welcome Swallow		
<i>Manorina flavigula</i>	Yellow-throated Miner		
<i>Melopsittacus undulatus</i>	Budgerigar		
<i>Merops ornatus</i>	Rainbow Bee-eater		
<i>Ocyphaps lophotes</i>	Crested Pigeon		
<i>Pardalotus striatus</i>	Striated Pardalote		
<i>Petrochelidon ariel</i>	Fairy Martin		
<i>Petrochelidon nigricans</i>	Tree Martin**		
<i>Phaps chalcoptera</i>	Common Bronzewing		
<i>Psephotus haematonotus</i>	Red-rumped Parrot		
<i>Ptilotula penicillata</i>	White-plumed Honeyeater		
<i>Rhipidura leucophrys</i>	Willie Wagtail**		
<i>Sturnus vulgaris</i>	Common Starling*		

*Alien species, **seen during IWC 2022 assessment

12 APPENDIX 4: INDEX OF WETLAND CONDITION

The IWC has six sub-indices: Wetland Catchment, Physical Form, Hydrology, Water Properties, Soils, and Biota. Each sub-index has one or more measures of the ecological components relevant to that sub-index. Measures are based on the ecological component, or potential impacts or threatening activities to the component (Table 36).

Table 36. Sub-indices, components and measures used in the IWC (DELWP 2020).

IWC sub-index	Key ecological component	Measure	Measure type
Wetland catchment	Wetland catchment	Land-use intensity adjacent to the wetland	Threat
	Wetland buffer	Average width of the buffer	Component
		Percentage of wetland perimeter with a buffer	Component
Physical form	Area of the wetland	Percentage reduction in wetland area	Component
	Wetland form	Percentage of wetland where activities have resulted in a change in bathymetry	Threat
Hydrology	Water regime	Severity of change to the water regime expected from activities identified as altering the water regime	Threat
Water properties	Nutrients	Severity of nutrient enrichment	Threat
	Salinity	Severity of change in salinity	Threat
Soils	Soil physical properties	Severity and extent of wetland soil disturbance	Impact
Biota	Wetland plants	Critical life forms	Component
		Presence of weeds	Impact
		Indicators of altered processes	Impact
		Vegetation structure and health	Component

Wetland catchment

The wetland's catchment is defined by its geomorphic setting and the water source for the wetland. Clearing of native vegetation and many land uses within the wetland catchment may lead to changes in surface water flows, groundwater levels, and levels of nutrients, sediments and pollutants entering the wetland. Native vegetation adjacent to the wetland (the wetland buffer) plays an important role in ameliorating these impacts. It also provides protection from disturbance to wetland fauna.

The IWC includes a threat-based measure of land-use intensity adjacent to the wetland and two measures of the wetland buffer: average width, and the percentage of the wetland perimeter with a buffer.

Physical form

A wetland's physical form influences the flooding depth, duration of inundation, and the mixing regime of the wetland. It also influences biological components and physical processes. The area of the wetland determines the amount and proportion of available habitat for biota. The bathymetry (topography) of a wetland is a determinant of the biotic habitats present in a wetland.

The principal threats to physical form are a reduction in wetland area (when wetlands or part thereof are permanently converted to dry land, e.g. by infilling or draining) and excavation or landforming of the wetland bed. The impacts on the wetland include loss of habitat, changes in habitat, and changes in depth.

The IWC includes measures for a reduction in the area of the wetland, and for the percentage of the wetland where activities have resulted in a change in bathymetry.

Hydrology

Wetland hydrology drives many wetland processes. The wetland water regime is the frequency, duration and timing of inundation. The frequency of inundation refers to the average number of times a wetland is filled in a given period of time. Duration is the length of time surface water is present. Timing refers to time of year (season) in which inundation typically occurs.

Threats to the water regime of the wetland are activities that change the flow regime of the wetland water source, activities that interfere with the natural connectivity of flow to and from the wetland, disposal of water into the wetland, extraction of water directly from the wetland, or activities that change the natural depth of the wetland. Changes in hydrology can be expressed as changes to one or more elements of the water regime.

The IWC includes a threat-based measure for hydrology: the severity of change to the water regime expected from activities identified as altering the water regime.

Water properties

The water properties influence many of the biotic components of wetlands and their processes (e.g. feeding, growth and reproduction of fauna, and growth of flora). Water properties are either physical or chemical. Physical properties include temperature, turbidity and suspended solids. Chemical properties include macronutrients, micronutrients, cations, anions, metals, silicon, colour, dissolved gases, electrical conductivity, alkalinity, pH, redox potential and dissolved organic carbon. The IWC includes threat measures for nutrients and salinity. Measures for other components of water properties are not included, because potential measures did not meet the requirements of the IWC (DSE 2005).

Threats that can lead to an increase in nutrients include clearing and activities such as grazing by livestock or feral animals, and aquaculture. Increased nutrients in the wetland can lead to changes in primary productivity and subsequent changes in food webs. Secondary salinisation of wetlands can be caused by catchment clearing and poor irrigation practices, which raise water tables and mobilise salts in the soil. Wetland secondary salinisation can lead to changes in wetland biota abundance, diversity and richness, increases in water clarity and, potentially, salinity stratification of the water column. Naturally saline wetlands can also become fresh from unnatural freshwater inputs (e.g. irrigation).

The IWC includes two threat-based measures for water properties: severity of nutrient enrichment and severity of a change in salinity.

Soils

Wetland soils provide a physical substrate for aquatic plants (including macrophytes and algae), and habitat for benthic invertebrates and microorganisms. They store nutrients that are important for primary production, bind toxicants such as heavy metals, provide a site for many chemical transformations and enable nutrient cycling.

Soils have physical, chemical and biological components. Physical components include the soil structure, texture and consistency. Chemical components include the soil's redox potential, salinity, acidity, dissolved organic carbon, nutrients, trace elements, etc. The biological components of soils are its biota and include microorganisms, invertebrates, fungi and plants. The IWC includes an impact measure (soil disturbance) relating to the soil's physical components. Measures are not included for the soil chemical and biological components because potential measures did not meet the requirements of the IWC (DSE 2005).

Threats to the physical properties of wetland soils are activities such as pugging by livestock and feral animals, human trampling, driving of vehicles in the wetland, and carp mudding. These activities cause soil disturbance, which can reduce the water storage capacity of the soil, have negative impacts on some invertebrates, and increase turbidity during filling.

The IWC includes a measure for the severity and extent of physical soil disturbance.

Biota

Wetland biota depends on wetlands for all or part of their life cycle. Wetland biota includes phytoplankton, wetland plants (e.g. herbs, ferns, shrubs and trees), aquatic invertebrates, vertebrates (e.g. fish, amphibians, birds, mammals and reptiles) and microorganisms (e.g. fungi, diatoms and microbes). The types and abundance of biota present in a wetland are strongly influenced by its hydrology and physicochemical environment. Wetland biota are characterised by their tolerance and/or dependence on flooding. Wetland biota can also influence other wetland components and processes, such as nutrient and energy cycling.

All the threats that lead to changes in hydrology (changes in the water properties of the wetland) can affect the biota as well as leading to physical loss of wetland habitat or changes to habitat. In addition, there may be direct threats to biota, such as clearing of native wetland vegetation, or the introduction of invasive species.

Impacts on biota include changes in wetland productivity, altered flora and fauna community assemblages, and a loss or reduction in fauna habitat. The IWC includes a measure for the assessment of wetland vegetation quality. Measures for other biota components are not included because potential measures did not meet the requirements of the IWC (DSE 2005).

The IWC includes four measures of wetland vegetation condition.

IWC scoring and reporting

The total IWC score for a wetland is calculated by summing each sub-index score multiplied by its respective weight (Table 3). This can be represented by the following formula:

$$IWC_{total} = \sum_{i=1}^6 (w_i s_i)$$

where IWC_{total} is the total IWC score, s_i is the sub-index score and w_i is the weight of the corresponding subindex (Table 4).

Score calculation

The IWCDMS automatically calculates the sub-index scores and the IWC total score, and assigns condition categories based on these scores.

Table 3. Weights for each sub-index.

IWC sub-index	Weight
Biota	0.190
Wetland catchment	0.068
Water properties	0.122
Hydrology	0.081
Physical form	0.021
Soils	0.018

Each sub-index has a maximum score of 20. After the weights are applied, the maximum possible total score is 10. This score should then be rounded to the nearest whole number to determine its wetland condition category (Table 37). Where data is not available for one or more sub-indices (due to prolonged dry conditions, for example), no total score should be given and the wetland should be assigned the category 'insufficient data'.

Table 37. Wetland condition categories and their respective score ranges.

Sub-index score range (except hydrology and biota)	Hydrology score	Biota sub-index score range	IWC total score range	Wetland condition category
0–5	0	0–8	0–2	Very poor
>5–9	5	>8–13	3–4	Poor
>9–13	10	>13–16	5–6	Moderate
>13–17	15	>16–18	7–8	Good
>17–20	20	>18–20	9–10	Excellent

13 APPENDIX 5: WEIGHTED MCA SCORES

The following tables present the MCA scores and priority rankings when an individual criterion score is doubled. The break in scores for each group were:

- >11 scores high priority for watering
- 9-11 scores a medium priority for watering
- <9 scores a low priority for watering.

Table 38. MCA with Supports ecosystem types criterion doubled.

	Supports ecosystem types	Supports biodiversity	Supports threatened species	Supports EVCs	Refugia for flora and fauna	Surrounding landuse	Total
Brim Weir Pool	2	2	1	2	1	1	9
Lake Marma	2	3	3	1	3	1	13
Warracknabeal Weir Pool	2	2	1	2	1	1	9
Watchem Lake	4	1	1	1	1	1	9
Donald Caravan Park Lake	2	3	1	1	1	1	9
Walkers Lake	2	3	3	1	1	1	11
Wooroonook Lake	2	3	2	3	1	2	13
Beulah Weir Pool	2	1	1	2	1	2	9
Green Lake	2	3	2	2	1	3	13
Hopetoun Storage (Willow Lake)	2	1	2	1	3	1	10
Lake Lascelles	6	3	3	3	1	2	18
Ouyen Lake	2	2	1	1	1	2	9
Rainbow Lake	2	1	1	1	1	1	7
Tchum Lake	4	2	1	3	1	2	13
Yaapeet Storage (Turkey Bottom Lake)	2	1	1	1	1	2	8

Table 39. MCA with Supports biodiversity criterion doubled.

	Supports ecosystem types	Supports biodiversity	Supports threatened species	Supports EVCs	Refugia for flora and fauna	Surrounding landuse	Total
Brim Weir Pool	1	4	1	2	1	1	10
Lake Marma	1	6	3	1	3	1	15
Warracknabeal Weir Pool	1	4	1	2	1	1	10
Watchem Lake	2	2	1	1	1	1	8
Donald Caravan Park Lake	1	6	1	1	1	1	11
Walkers Lake	1	6	3	1	1	1	13
Wooroonook Lake	1	6	2	3	1	2	15
Beulah Weir Pool	1	2	1	2	1	2	9
Green Lake	1	6	2	2	1	3	15
Hopetoun Storage (Willow Lake)	1	2	2	1	3	1	10
Lake Lascelles	3	6	3	3	1	2	18
Ouyen Lake	1	4	1	1	1	2	10
Rainbow Lake	1	2	1	1	1	1	7
Tchum Lake	2	4	1	3	1	2	13
Yaapeet Storage (Turkey Bottom Lake)	1	2	1	1	1	2	8

Table 40. MCA with Supports threatened species criterion doubled.

	Supports ecosystem types	Supports biodiversity	Supports threatened species	Supports EVCs	Refugia for flora and fauna	Surrounding landuse	Total
Brim Weir Pool	1	2	2	2	1	1	9
Lake Marma	1	3	6	1	3	1	15
Warracknabeal Weir Pool	1	2	2	2	1	1	9
Watchem Lake	2	1	2	1	1	1	8
Donald Caravan Park Lake	1	3	2	1	1	1	9
Walkers Lake	1	3	6	1	1	1	13
Wooroonook Lake	1	3	4	3	1	2	14
Beulah Weir Pool	1	1	2	2	1	2	9
Green Lake	1	3	4	2	1	3	14
Hopetoun Storage (Willow Lake)	1	1	4	1	3	1	11
Lake Lascelles	3	3	6	3	1	2	18
Ouyen Lake	1	2	2	1	1	2	9
Rainbow Lake	1	1	2	1	1	1	7
Tchum Lake	2	2	2	3	1	2	12
Yaapeet Storage (Turkey Bottom Lake)	1	1	1	1	1	2	7

Table 41. MCA with Supports EVCs criterion doubled.

	Supports ecosystem types	Supports biodiversity	Supports threatened species	Supports EVCs	Refugia for flora and fauna	Surrounding landuse	Total
Brim Weir Pool	1	2	1	4	1	1	10
Lake Marma	1	3	3	2	3	1	13
Warracknabeal Weir Pool	1	2	1	4	1	1	10
Watchem Lake	2	1	1	2	1	1	8
Donald Caravan Park Lake	1	3	1	2	1	1	9
Walkers Lake	1	3	3	2	1	1	11
Wooroonook Lake	1	3	2	6	1	2	15
Beulah Weir Pool	1	1	1	4	1	2	10
Green Lake	1	3	2	4	1	3	14
Hopetoun Storage (Willow Lake)	1	1	2	2	3	1	10
Lake Lascelles	3	3	3	6	1	2	18
Ouyen Lake	1	2	1	2	1	2	9
Rainbow Lake	1	1	1	2	1	1	7
Tchum Lake	2	2	1	6	1	2	14
Yaapeet Storage (Turkey Bottom Lake)	1	1	1	2	1	2	8

Table 42. MCA with provides refugia for flora and fauna criterion doubled.

	Supports ecosystem types	Supports biodiversity	Supports threatened species	Supports EVCs	Refugia for flora and fauna	Surrounding landuse	Total
Brim Weir Pool	1	2	1	2	2	1	9
Lake Marma	1	3	3	1	6	1	15
Warracknabeal Weir Pool	1	2	1	2	2	1	9
Watchem Lake	2	1	1	1	2	1	8
Donald Caravan Park Lake	1	3	1	1	2	1	9
Walkers Lake	1	3	3	1	2	1	11
Wooroonook Lake	1	3	2	3	2	2	13
Beulah Weir Pool	1	1	1	2	2	2	9
Green Lake	1	3	2	2	2	3	13
Hopetoun Storage (Willow Lake)	1	1	2	1	6	1	12
Lake Lascelles	3	3	3	3	2	2	16
Ouyen Lake	1	2	1	1	2	2	9
Rainbow Lake	1	1	1	1	2	1	7
Tchum Lake	2	2	1	3	2	2	12
Yaapeet Storage (Turkey Bottom Lake)	1	1	1	1	2	2	8

Table 43. MCA with the surrounding landuse criterion doubled.

	Supports ecosystem types	Supports biodiversity	Supports threatened species	Supports EVCs	Refugia for flora and fauna	Surrounding landuse	Total
Brim Weir Pool	1	2	1	2	1	2	9
Lake Marma	1	3	3	1	3	2	13
Warracknabeal Weir Pool	1	2	1	2	1	2	9
Watchem Lake	2	1	1	1	1	2	8
Donald Caravan Park Lake	1	3	1	1	1	2	9
Walkers Lake	1	3	3	1	1	2	11
Wooroonook Lake	1	3	2	3	1	4	14
Beulah Weir Pool	1	1	1	2	1	4	10
Green Lake	1	3	2	2	1	6	15
Hopetoun Storage (Willow Lake)	1	1	2	1	3	2	10
Lake Lascelles	3	3	3	3	1	4	17
Ouyen Lake	1	2	1	1	1	4	10
Rainbow Lake	1	1	1	1	1	2	7
Tchum Lake	2	2	1	3	1	4	13
Yaapeet Storage (Turkey Bottom Lake)	1	1	1	1	1	4	9

14 APPENDIX 6: RECREATION FACILITIES

The following information was compiled by the Wimmera CMA. It presents additional data on the characteristics of the recreation lakes and lists infrastructure and facilities located at each.

14.1 BRIM WEIR POOL

Brim weir pool is one of the smallest recreational water facilities in Wimmera-Southern Mallee, with a basin volume of 120 megalitres.

Annual 'top-up' volume from the Wimmera Mallee Pipeline meets the evaporation and seepage losses and is supplemented by natural runoff in wet periods. The pipeline supply is delivered at a heavily subsidised rate per megalitre which reflects the engagement undertaken by GWMWater with its customer base in development of pricing submissions.

Redda's Park is the recreational complex on Yarriambiack Creek at the Brim Weir. It offers camping in a bushland setting, amenities, walking tracks, powered and non-powered sites and BBQ facilities. The park was landscaped and constructed by Brim Lions Club in 2001.

Yarriambiack Silo Art Trail was pioneered with the artwork on silos at Brim, and the Reserve Committee of Management suggests that it is difficult to separate specific visitation for the weir including those people camping or caravanning on-site.

Visitor numbers dropped considerably in 2020-21 but the reduction was somewhat compensated by increases in the average length of stay by overnight visitors.

Recreation and visitor facilities

Brim Redda's Park

- On Brim Weir Pool foreshore
- Powered and non-powered sites
- Powered and non-powered boating activities permitted on Brim Weir Pool
- Rubbish-disposal facilities
- Fishing, bird-watching and walking-track facilities
- Barbecue facilities
- Amenities building
- Picnic tables
- Swimming area

14.2 LAKE MARMA

Lake Marma at Murtoa has a basin volume of 170 megalitres.

Annual 'top-up' volume from the Wimmera Mallee Pipeline meets the evaporation and seepage losses and is supplemented by natural runoff in wetter periods. The pipeline supply is delivered at a heavily subsidised rate per megalitre which reflects the engagement undertaken by GWMWater with its customer base in development of pricing submissions.

Marma is in the heart of Murtoa's urban area. A 'Lake Marma Loop' encircles the main lake and takes in the main area of Murtoa, giving Murtoa a reputation as 'a lakeside town'

There is a selection of Murtoa - Lake Marma walking trails which encompass natural and historic areas of interest. Originally a small dammed natural swamp, it became incorporated into the Wimmera Mallee water supply system more than a century ago and was the source of Murtoa's drinking water until recently, when water was piped to town.

This lake is a tranquil oasis with abundant birdlife and treed surrounds. The Lake has always been a haven for wildlife, due to its safe location within Murtoa, and is famous for sunset and sunrise views. The lake consistently

has amounts of ribbon weed, and a management committee is trying to control the extent of weed to reduce impact on recreational activities - fishing, swimming and kayaking.

There is a small caravan park at Lake Marma, popular with grey-nomad-type travellers who tend to stay for extended periods. Three new cabins have recently completed, complementing the caravan park sites. In 2020-21, overall numbers reduced but there was an increase in the average length of stay at the caravan park and cabins.

Participation/visitation levels at Lake Marma were among the most consistent of all lakes during 2016-17 to 2019-20.

Recreational and visitor facilities

Part of an expansive town recreation area adjoined by sports reserves, playgrounds and parkland.

Murtoa Caravan Park

- On Lake Marma foreshore
- Powered and non-powered sites
- Amenities
- Barbecue facilities
- Rubbish-disposal facilities
- Walking tracks

Murtoa Cabins on Lake Marma

- On Lake Marma foreshore, Three holiday cabins

14.3 WARRACKNABEAL WEIR POOL

The Weir Pool on the Yarriambiack Creek at Warracknabeal, with a basin volume of 210 megalitres, provides recreational water security through an annual volume allocation from the Wimmera Mallee Pipeline to meet evaporation and seepage losses and to supplement natural flows and runoff in wet periods. The pipeline supply is delivered at a heavily subsidised rate per megalitre which reflects the response by GWMWater to its engagement with the customer base in developing pricing submissions.

In Warracknabeal, the weir pool and the creek meandering through town are part of the recreational water facilities.

Warracknabeal Caravan Park is near the banks of the weir pool section of the creek, providing powered and unpowered sites, bathroom amenities, barbecues and laundry facilities.

Warracknabeal Weir Pool is used widely by residents and community groups for walking and other forms of regular exercise. The creek banks also offer many sites for tranquil picnics, fishing and relaxation.

There is a fauna park in a main section of the creek, near Warracknabeal's commercial district, and several walking tracks that transect walking bridges across the creek.

Among regular users of the creek and weir pool at Warracknabeal are: The Warracknabeal Angling Club; Warracknabeal Ski Club; Woodbine Centre Incorporated; schools; informal walking groups.

Warracknabeal's annual Easter festival focuses strongly on activities along the creek

Recreation and visitor facilities

Warracknabeal Caravan Park

- On the banks of the Yarriambiack Creek
- En-suite sites available, Powered and non-powered camping sites,
- Barbecue facilities

14.4 WATCHEM LAKE

Part of Djadjawryybg and Djabwyrung traditional land, Watchem was settled by Europeans in the 1870s. Lake Watchem is on the Watchem-Warracknabeal Road 1.3 kilometres to the west of Watchem township and Sunraysia Highway. It is a focal point of the town, which now has a limited commercial centre.

The lake has a small island in the centre which breaks waves created by speed boats and makes Watchem ideal for water skiing. The lake is also established for swimming, fishing and camping/caravanning.

Lake Watchem holds about 260 megalitres of water. Annual 'top-up' volume from the Wimmera Mallee Pipeline meets the evaporation and seepage losses and is supplemented by natural run-off in wetter periods.

The pipeline supply is delivered at a heavily subsidised rate per megalitre which reflects the engagement undertaken by GWMWater with its customer base in development of pricing submissions.

The waterway manager - under the Marine Safety Act, 2010 - is the Lake Watchem Committee of Management, and boating activities are subject to Victorian state boating regulations. Watchem Lake is a focal point for the town of Watchem.

The lake is popular for water skiing, swimming, fishing, picnics and camping/caravanning. Lake Watchem users peak during the Christmas holiday period and Easter. At other times, the lake is frequented by caravaners and residents.

Recreation and visitor facilities

- Powered and unpowered camping sites
- Barbecue areas
- Pets allowed
- Drinking water
- Playground
- Boat ramp
- Toilets
- Allows campfires
- Fishing and swimming opportunities

14.5 DONALD CARAVAN PARK LAKE

Donald (Folletti) Caravan Park Lake is a recreational facility in the heart of the Donald urban area. It is mostly used for fishing, kayaking/canoeing and environmental amenity - walks, picnics and camping on the foreshore.

As a centrally located, urban lake, many of the visitors, in the past, stayed for extended periods to access facilities in Donald and/or as a base to visit friends and relatives.

Since 2017-18 a local football club has had responsibility for many of the management functions at the lake, on behalf of Buloke Shire Council which had previously employed a non-resident part-time manager.

The number of visitors using the lake and the lake environs improved substantially in 2017-18, - although visit nights reduced somewhat due to removal of some tenants who had become semi-permanent - and overnight visits further increased in 2018-19, while in 2019-20 overnight visit numbers were down but the length of stay increased.

Donald's Folletti Caravan Park Lake holds 50 megalitres of water. Annual 'top-up' volume from the Wimmera Mallee Pipeline meets the evaporation and seepage losses and is supplemented by natural runoff in wetter periods. The pipeline supply is delivered at a heavily subsidised rate per megalitre which reflects the engagement undertaken by GWMWater with its customer base in development of pricing submissions.

The waterway manager - under the Marine Safety Act, 2010- is Buloke Shire Council, and boating activities are subject to Victorian state boating regulations.

Donald's (Folletti) caravan park lake is a recreational facility in the heart of Donald urban area. It is mostly used for fishing and as an environmental amenity.

Recreation and visitor facilities

Donald Caravan Park

- Powered and unpowered sites
- Barbecue facilities
- Toilet and laundry facilities
- Pets allowed
- Drinking water
- Playground
- Fishing opportunities

14.6 WALKERS LAKE

Walkers Lake is located at Avon Plains, with the nearest Wimmera Southern Mallee towns being Donald, St Arnaud, Marnoo, Rupanyup and Minyip. The lake is overseen by a Committee of Management and is open for camping with some toilet facilities.

Walkers Lake has a basin volume of 900 megalitres. Annual 'top-up' volume from the Wimmera Mallee Pipeline meets the evaporation and seepage losses and is supplemented by natural runoff in wetter periods. The pipeline supply is delivered at a heavily subsidised rate per megalitre which reflects the engagement undertaken by GWMWater with its customer base in development of pricing submissions.

When full, it covers an area of around 27 hectares.

There are no specific clubs or organisations making regular use of facilities at Walkers Lake, but a few host events at the lake from time to time - for example, St Arnaud Anglers Club.

The lake is a relatively un-promoted gem for people looking for a great fishing, kayaking and boating spot in a secluded location. It is very popular with locals.

However, participation in 2019-20 was decimated. From mid-November until late-February the lake was closed to recreational use due to blue-green algae and there were massive fish mortalities during this period - in early February.

The official blue-green algae warning period extended from November 17, 2019 to February 24 and then again from March 17 to May 27, 2020, the latter overlapping with the start of COVID-19 pandemic restrictions.

Following the decimation of participation in 2019-20, Walkers Lake rebounded somewhat in 2020-21 despite the ongoing COVID pandemic affects. It was one of very few WSM waterbodies to record an increase in participation.

Recreation and visitor facilities

- Boat ramp
- Free camping
- Toilet
- Swimming, fishing, boating opportunities

14.7 LAKE WOOROONOOK

Lake Wooroonook is a natural lake 13 kilometres west of Charlton on the Borung Highway.

A recreational water facility is at the western end of a larger natural lake system known as Wooroonook Lakes. Middle and eastern lakes have irregular water volumes.

The lake volume is 700 megalitres. Annual 'top-up' volume from the Wimmera Mallee Pipeline meets the evaporation and seepage losses and is supplemented by natural runoff in wetter periods. The pipeline supply is delivered at a heavily subsidised rate per megalitre which reflects the engagement undertaken by GWMWater with its customer base in development of pricing submissions.

Waterway manager - under the Marine Safety Act, 2010 - is Buloke Shire Council, and foreshore management is the responsibility of the Wooroonook Committee of Management.

The system was an important source of water for Aboriginal communities for tens of thousands of years and, more recently, in Charlton's early colonial settlement as a place for fishing, swimming and boating. The lake is well suited to nature walks, water skiing, swimming, fishing, and camping or caravanning on the foreshore. Adjacent wetlands in the system are suited to duck hunting in season.

Wooroonook attracts retired couples and small groups seeking a quiet and relatively isolated location for camping and caravanning.

On weekends during warmer months, the lake is popular as a fishing destination.

A new amenities block was built in 2017-18.

A Wooroonook Lakes 'Discovery trail' for wildlife and environmental enthusiasts, and fishing, kayaking, skiing, sailing and/or open water swimming challenges were among a summary of potential improvements.

Recreation and visitor facilities

Wooroonook Lakes Campground

- Amenities block
- Powered and non-powered sites
- Drinking water
- Barbecue area
- Picnic tables
- Playground
- Fire pits
- Boat ramp
- Fishing, swimming and boating opportunities

14.8 BEULAH WEIR POOL

Beulah weir across the Yarriambiack Creek is part of a recreation area with powered and unpowered camping sites, a playground, barbecue facilities.

Recent new amenities have been installed including a landscaped grassed area and rubbish-disposal facilities.

The Beulah park is within the town's recreation precinct, offering access to a municipal swimming pool, tennis courts and playground.

Boating is permitted on the Beulah Weir Pool and fishing, bird watching, and walking are popular. There is also a public swimming pool in the grounds. Two new cabins, overlooking the weir pool, were constructed at the Beulah Reserve in 2019 and these provide a good complement to the caravan park sites.

Commercial realities have reduced opportunities for visitors to Beulah's weir pool to spend money locally.

Recreation and visitor facilities

Beulah Caravan Park

- Powered and non-powered sites
- Playground, Barbecue facilities, New amenities, Grassed recreation area, Rubbish-disposal facilities
- Powered and non-powered boating activities permitted on Beulah Weir Pool
- Fishing, bird-watching and walking tracks
- Public swimming pool

Beulah Creekside Camping Area

(on opposite shore to Beulah Caravan Park)

Free camping

14.9 GREEN LAKE – NEAR SEA LAKE – SUPPLIED BY MURRAY SYSTEM

Green Lake at Sea Lake was empty during the millennium drought of the early 2000s. It filled from natural inflows and pipeline supply in 2011-12, but the high seepage losses that occurred resulted in a collective decision that there be no further pipeline supply until the seepage issues were addressed.

In 2018, following a great deal of work by the community, state and local government agencies a State Government funded remediation project to rework and compact the lakebed was completed. A GWMWater pipeline supply from the Murray River commenced in September 2018 and reached full supply by September 2019.

This lake was included in the socio-economic value assessment in the third and fourth years. Green Lake became a popular recreational destination for Sea Lake locals immediately after pipeline water started to fill the lake in mid-2018-19 with day participants almost reaching 2000 in that first operating year. In 2019-20 the lake reached around 2700 day participants and an estimated 3472 visit nights from both local residents and intra and interstate people

Recreation and visitor facilities

Green Lake Caravan Park

- Powered and non-powered campsites
- Toilets
- Barbecue and picnic areas
- Showers
- Playground
- Sign-posted walking track
- Fishing, swimming and boating opportunities

14.10 HOPETOUN LAKE (WILLOW LAKE)

Specific details about Willow Lake are not included in WDA report, but the lake forms part of an expansive Lake Lascelles amenity in Hopetoun.

On observation, it provides a supportive environmental asset alongside nearby Lake Corrong to the major Lake Lascelles recreation area, which has extensive recreation and socio-economic value. – Dean Lawson, Wimmera CMA

Recreation and visitor facilities

Same as Lake Lascelles – this is a small lake next to Lake Lascelles and part of overall Lake Lascelles parkland.

14.11 LAKE LASCELLES

Lake Lascelles, at Hopetoun is a popular holiday and day visit destination. It is ideal for walking, swimming, boating, skiing, kayaking, fishing and bird watching. Lake Lascelles has a variety of accommodation options and a management committee secured funding in 2020 for an all-abilities amenities block at a Bush Retreat at the lake.

Lake Lascelles is recreational water facility people use year-round. It is a tourist attraction in its own right and Hopetoun's key physical asset, and a focal point for Hopetoun district. Its economic contribution is sizable now that pipeline water offers reasonable security.

Heritage and environment, silo art trail and Hopetoun promotions are listed in a summary of potential improvements.

Recreation and visitor facilities

Lascelles Camping Ground

- Powered and unpowered sites

- Amenities and laundry facilities: Free barbecue, Playground, Rotunda, Rubbish-disposal facilities, Adjacent to the historic Minapre Hotel

Mallee Bush Retreat

Willow Lake at Hopetoun, while not part of the WDA study, is adjacent to Lake Lascelles.

14.12 LAKE OUYEN – SUPPLIED BY MURRAY SYSTEM

Ouyen Lake was completed in the 2018-19 and by 2019-20 was fully operational as a recreational waterway.

Support infrastructure around the lake such as landscaping, a toilet block and outdoor furniture is still being developed but the lake is full and open to the public.

Water is delivered to Ouyen Lake by GWMWater through the Northern Mallee Pipeline. It has a basin volume of 450 megalitres.

Fish stocked at Lake Ouyen in from 2019 to 2021 included 1005 Rainbow trout; 3500 Golden perch and 74,000 Silver perch. Some of the stocked fish reached legal sizes by 2020-21 and attracted local anglers. Participation at Ouyen Lake is likely to build over future years as the infrastructure around the lake is further enhanced and the landscaped vegetation matures. The COVID pandemic slowed this growth in 2020-21.

Recreation and visitor facilities

- Toilets
- Picnic facilities
- Boat ramp
- Children's playground
- Manicured and irrigated grass areas
- Camping and sightseeing
- Fishing, swimming and boating opportunities
- Development expansion plans

14.13 RAINBOW LAKE

Rainbow Lake is a new addition to the southern Mallee recreation-supply lakes, having received its first piped supply of water in July, 2022.

As such, its details were not included in WDA report.

It is part of a former Rainbow water-storage system and development to encourage recreation and environmental assets and attractions at the lake are rapidly underway. An enthusiastic Rainbow Lake Association featuring a diverse community membership is leading this activity.

Despite being a relatively small lake – it has a piped allocation of 50 megalitres – bird, bat and insect life has immediately responded and flocked to a new water body in a dry landscape. – Dean Lawson, Wimmera CMA

Recreation and visitor facilities

- Facilities-development plan
- The erection of a BBQ shelter
- Installation of picnic table and seating
- Installation of a toilet block
- All access pathways
- Native plant garden

14.14 TCHUM LAKE

Tchum Lake system is on the Birchip-Wycheproof Road, about eight kilometres east of Birchip.

The natural lakes area includes sections to the north and south of the road. A southern lake has been modified to provide for permanent recreational water activities, while a northern lakes area is an irregular wetlands area.

The recreational southern lake volume is about 730 megalitres of water. Annual 'top-up' volume from the Wimmera Mallee Pipeline meets the evaporation and seepage losses and is supplemented by natural runoff in wetter periods. The pipeline supply is delivered at a heavily subsidised rate per megalitre which reflects the engagement undertaken by GWMWater with its customer base in development of pricing submissions. Waterway manager - under the Marine Safety Act, 2010- is Tchum Lake Aquatic Club, and the club is also responsible for foreshore management.

Tchum Lake is a popular holiday spot for campers and water skiers. Lake users also participate in fishing and swimming. The lake is busy at Easter and other holiday periods and tends to be relatively quiet at other times of the year.

As a holiday-period recreational lake facility, Tchum attracts large family groups rather than the retired and 'grey nomad' caravanning group that frequent other Wimmera and southern Mallee water facilities.

In recent years, the management committee has arranged an on-site manager during busy months. Tchum Lake is a popular holiday spot for campers and water skiers. Lake users also participate in fishing and swimming.

One of the points in a summary of potential improvements was to establish trails to water playgrounds and nature and wetlands.

Potential events include a 'Tchum Lakes Discovery' for indigenous plant, wildlife and environmental enthusiasts; fishing, kayaking, sailing, skiing and/or open-water swimming challenges.

Recreation and visitor facilities

Tchum Lake Caravan Park

- Powered and non-powered sites
- Toilets
- Barbecue areas, drinking water
- Playground
- Boat ramp
- Fishing, swimming opportunities

14.15 YAAPEET STORAGE (TURKEY BOTTOM LAKE)

Turkey Bottom Lake details were not included in WDA report but the lake is former reservoir for the town of Yaapeet that started receiving Wimmera Mallee Pipeline recreation supply in 2020.

As part of a landscape timbered depression, it also receives any run-off from local catchment has developed into a community and environmental hub.

The lake is popular with recreational activities in warmer months, stocking of native fish has started to encourage angling and the area has become popular with travelling nature lovers and bird-watchers exploring the region's nearby terminal-lakes and Wyperfeld parkland

Parks Victoria manages surrounding bushland and the lake amenities are managed by Yaapeet Community Club. – Dean Lawson, Wimmera CMA

Recreation and visitor facilities

The lake is part of a broader parkland area that includes a recreation oval, community pavilion, caravan park and bushland reserve.

At Turkey Bottom Lake

- Unpowered camp sites
- Water on tap
- Toilets
- Non-combustion engine boating access
- Picnic tables

- Fire pits
- Fishing, swimming, boating and bird-watching opportunities

Yaapeet Caravan Park

- Powered and unpowered camp sites
- Water on tap
- Toilets, showers and changerooms
- Recreation reserve
- Events opportunities

(Wimmera CMA stocktake, August, 2022 inspection and tour)