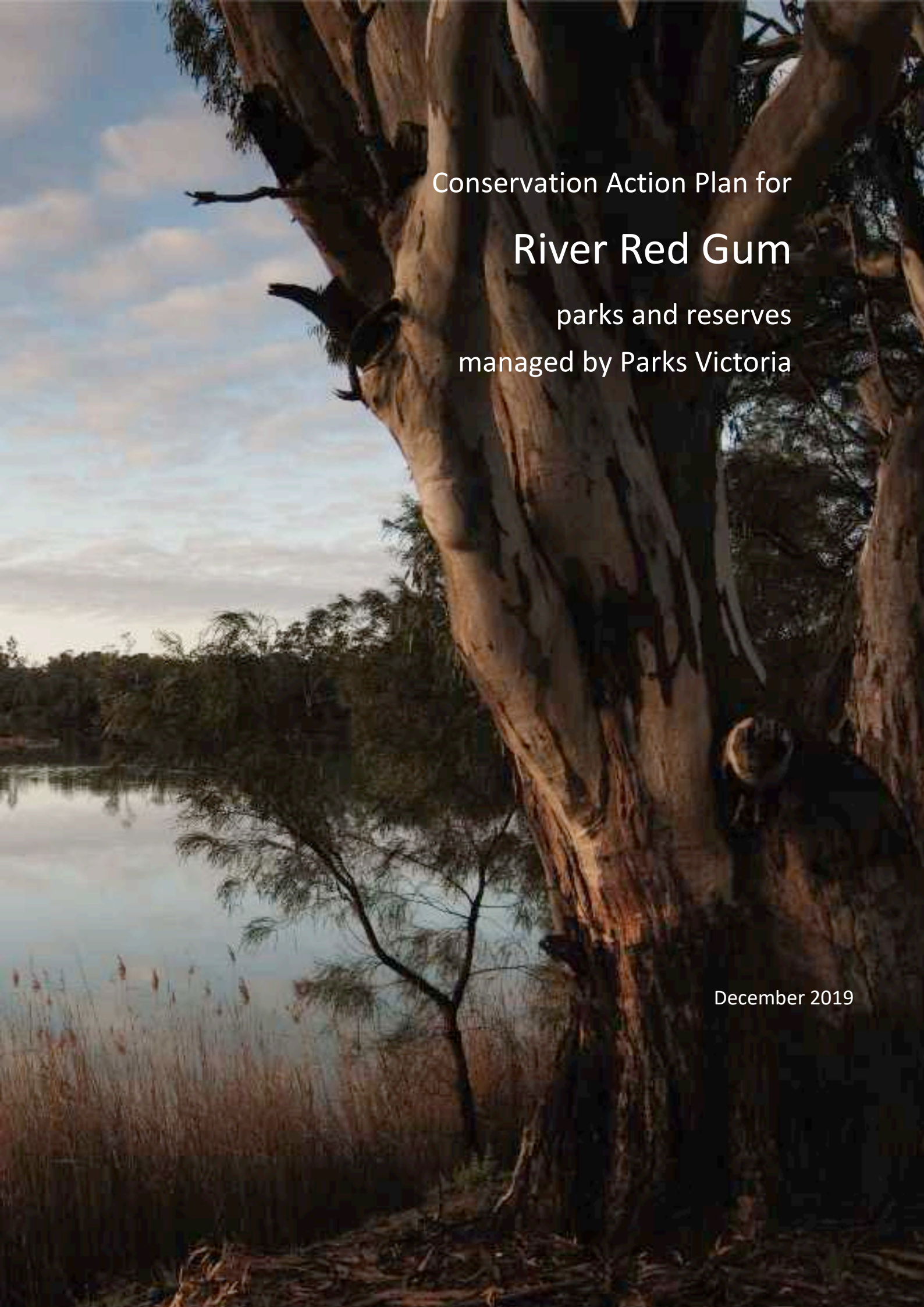


Conservation Action Plan for

River Red Gum

parks and reserves

managed by Parks Victoria

December 2019

Authorised and published by Parks Victoria
Level 10, 535 Bourke Street, Melbourne VIC 3000

ISBN: 978-0-6483776-0-3 (paperback)

A catalogue record for this book is available from the National Library of Australia

For further information Phone: 13 1963
Copies may be downloaded from the Parks Victoria website www.parkweb.vic.gov.au

Conservation Action Plan for

River Red Gum

parks and reserves

managed by Parks Victoria

December 2019

Disclaimer
This plan is prepared without prejudice to any negotiated or litigated outcome of any native title determination applications covering land or waters within the plan's area. It is acknowledged that any future outcomes of native title determination applications may necessitate amendment of this plan; and the implementation of this plan may require further notifications under the procedures in Division 3 of Part 2 of the *Native Title Act 1993* (Cwlth).
The plan is also prepared without prejudice to any future negotiated outcomes between the Government/s and Traditional Owner Communities. It is acknowledged that such negotiated outcomes may necessitate amendment of this plan.
Every effort has been made to ensure that the information in this plan is accurate. Parks Victoria does not guarantee that the publication is without flaw of any kind and therefore disclaims all liability for any error, loss or other consequence that may arise from you relying on any information in the publication.

Acknowledgements
Participants in the River Red Gum Park Landscape Conservation Action Planning process are thanked for their technical input and sharing their local knowledge.

Iterations
The first iteration of this plan was approved by Parks Victoria in December 2019.

This document may be cited as:
Parks Victoria 2019. Conservation Action Plan for Parks and Reserves Managed by Parks Victoria. River Red Gum. Parks Victoria: Melbourne, Australia.

Photo credits: Dale Appleton 42; Geoffrey Barrow 48; Tina Konstantinidis 64; Patrick Pigott x, 46, 114; Amy Russel, NCCMA, 32; Annette Ruzicka 4,52; Kathryn Schneider 29, 36, 50; Kathryn Stanislawski 22, 26, 38, 40, 86; Parks Victoria 12, 56, 60, 62, 65, 68, 71, 76, 80, 89, 92, 101, 105, 108, 113; Keith Ward, GBCMA, cover, 34; Bruce Wehner 44, 58; Leeza Wishart 21; Luke Woodford, ARI 63

Foreword

To realise its vision — a world-class park service ensuring healthy parks for healthy people — Parks Victoria is committed to delivering works on the ground across Victoria's park network to protect, conserve and enhance park values. Our primary responsibility is to ensure parks are healthy and resilient for current and future generations.

Parks Victoria acknowledges, respects and works closely with Traditional Owners and other Aboriginal communities and organisations across Victoria. We pay our respects to Elders past and present, and to emerging Aboriginal leaders.

Parks Victoria recognises the diversity of Aboriginal cultures in Victoria and the deep connections that Traditional Owners have with the lands and waters covered by the River Red Gum Conservation Action Plan, as well as their rights and responsibilities. We recognise that the ancient landscape we see today has been modified over many thousands of years of occupation and influenced by the skills, knowledge and activities of generations of Aboriginal land managers. We also acknowledge the impacts of more recent land use and the impacts that introduced threats and intensive water resource management have had on this unique cultural landscape. The plan presented here is offered as a starting place for conversations with Traditional Owners on the importance of the nature and wildlife of this Country.

The plan focuses primarily on the first of Parks Victoria's three strategic themes:

- Conserving Victoria's special places
- Connecting people and parks
- Providing benefits beyond park boundaries.

The plan is guided by *Protecting Victoria's Environment — Biodiversity 2037*, Victoria's plan to stop the decline of our native plants and animals (DELWP, 2017a). It is also guided by the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) and the state legislation for the conservation of significant places, species and communities, and for the management of ecologically threatening processes.

The plan outlines Parks Victoria's understanding of the major threats to nature and wildlife in this ancient and unique cultural landscape and the potential actions we can take with the Traditional Owners and other partners to care for and improve the health of the River Red Gum Park Landscape.

Matthew Jackson
Chief Executive Officer
Parks Victoria

Commonly used terms and abbreviations

CMA	Catchment management authority
DELWP	Victorian Department of Environment, Land, Water and Planning
EPBC Act	The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, under which threatened species, communities and locations can be listed for protection. Administered by the Federal Department of the Environment and Energy
FFG Act	The Victorian *Flora and Fauna Guarantee Act 1988*, under which threatened species and communities can be listed for protection against potentially threatening processes
Functional groups	Group of species that share similar characteristics (e.g. colonial-nesting birds, riverine and wetland specialist fish)
Living Murray icon sites	Important locations along the River Murray, based on ecological and cultural significance. The Living Murray program is a partnership between the Australian Government and the Murray–Darling Basin Authority to improve environmental health at these sites.
MDBA	Murray–Darling Basin Authority
Ramsar	The Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat, an intergovernmental treaty that provides the framework for the conservation and wise use of wetlands of international importance. Ramsar sites are wetlands listed under the Ramsar Convention.

Summary

The River Red Gum Park Landscape is a linear oasis, with many of its ecosystems periodically connected by floodwaters. The landscape provides diverse, unique, high-quality habitats essential for the persistence of threatened species that rely upon seasonally inundated wetlands and floodplain environments. It is characterised by iconic large, old trees, vast floodplains, and internationally significant wetlands.

This landscape retains strong Aboriginal cultural connections. Evidence of long-term occupation and use of the land for traditional practices can be found throughout. The landscape includes traditional lands of the Bangerang, Barapa Barapa, Dhudhuroa, Latji Latji, Ngintait, Nyeri Nyeri, Tatti Tatti, Taungurung, Wadi Wadi, Wamba Wamba, Waywurru, Yaithmathang, and Yorta Yorta peoples. The First People of the Millewa-Mallee Aboriginal Corporation and the Yorta Yorta Nation Aboriginal Corporation have recognised rights in parts of the landscape, the latter with co-management and joint management arrangements over certain parks. As well as being an important cultural landscape, the area is highly valued for recreational purposes, including fishing, birdwatching, camping and sightseeing.

This Conservation Action Plan defines and prioritises conservation strategies for the River Red Gum Park Landscape and broadly describes the expected outcomes of these strategies. The plan is designed to evolve and adapt according to changes in circumstance and scientific evidence. The plan outlines what can be realistically achieved to tackle the threats that pose the most risk to ecosystems. While conservation action planning does not address the health or management of cultural heritage, Parks Victoria recognises the wealth of traditional ecological knowledge held by Australia's First Peoples and the links between the health of cultural and ecological assets. Conservation action plans may assist in informing future joint management plans.

This Conservation Action Plan will help Parks Victoria achieve our landscape conservation vision that:

The resilience of natural assets in the River Red Gum Park Landscape is increased and ecosystem services are maintained in the face of climate change and other stressors.

The development, implementation and review of the plan follows Parks Victoria's cyclical 10-step conservation action planning process, which is based on an internationally recognised process developed by The Nature Conservancy. This plan covers the first seven steps in this process:

1 Scope planning, people and resources.
2 Identify conservation assets.
3 Assess viability of conservation assets and set conservation outcomes.
4 Identify and assess threats to conservation outcomes.
5 Conduct situational analysis and develop action options.
6 Assess and select preferred strategies and actions.
7 Set performance measures.

Eight ecosystems have been identified as conservation assets in the River Red Gum Park Landscape: Riverine Forest and Woodland, Ephemeral Freshwater Wetlands, Permanent Freshwater Wetlands, Saline Wetlands, Plains Woodland, Box Ironbark Forest, Mixed Dry Forest, and Chenopod Shrubland. A range of nested assets, such as threatened species and important ecological assemblages, have also been identified within each of these assets. In addition, four wetlands listed as internationally important under the Ramsar Convention have been identified as subsets of the other conservation assets.

The plan also identifies a range of key ecological attributes — the components believed to best reflect the health of the asset. The plan describes the current condition (very good, good, fair, poor) and the trend in condition (improving, stable, declining) of each key ecological attribute, and anticipates their future condition. These measures allow an assessment of the overall condition of each asset. Without management intervention, most conservation assets are stable or declining. The drying impacts of climate change in this inundation-dependent landscape are shifting objectives for conservation management from recovery to the identification and protection of climate refugia.

The plan identifies eight key threats to the conservation assets in the Park Landscape:

- inappropriate hydrological regimes
- fire regimes and management
- grazing by introduced mammalian herbivores and overabundant native macropods
- invasive exotic fish
- introduced terrestrial predators
- invasion by introduced and native flora
- climate change
- recreational activities and resource extraction.

River regulation in particular has had serious consequences in this landscape. Many of the wetlands and floodplains within the River Red Gum Park Landscape now remain dry for extended periods of time. Consequently, the plant and animals that have evolved in these wetter environments no longer flourish.

Importantly, implementation of this plan is aligned with key actions of the Murray–Darling Basin Plan, particularly in buffering the river system from stress. This will help ecosystems transition to projected hotter and drier conditions.

The following conservation strategies will be undertaken to tackle these threats. They have been selected for their impact, feasibility and cost in achieving the desired conservation outcome.

- **Control introduced terrestrial predators** — Implement targeted control of foxes and cats at high-priority sites, integrating available methods of control, to reduce predation.
- **Manage introduced pest fish** — Implement best practice measures to reduce the impact of invasive aquatic fauna and allow for the improvement of the key ecological attributes of inundation-dependent assets.
- **Manage fire for healthy assets** — Undertake communications and compliance activities to reduce the risk of human-induced ignitions, and where possible protect significant values from loss during fires.
- **Manage total grazing pressure** — Control pest and overabundant native herbivores using culturally appropriate methods to improve the quality of native vegetation and riparian zone integrity, and protect culturally important sites across the Park Landscape.
- **Manage environmental weeds** — Control environmental weeds through surveillance and rapid management intervention to prevent the establishment of new and emerging weeds and maintain established weeds at acceptable densities.
- **Manage water for conservation outcomes** — Improve water regimes by implementing on-ground actions and working in partnership with environmental water managers to facilitate the delivery of environmental water and increase the extent of natural floods.
- **Establish collaborative partnerships to coordinate management strategies and address key knowledge gaps** — Integrate research and management activities to improve management effectiveness.

- **Plan for climate change in the River Red Gum Park Landscape** — Incorporate planning for climate change and the transition to drier conditions and more frequent severe weather events into land management practices to facilitate the adaptation of ecosystems to drier conditions.

For each strategy, a results chain has been developed to help guide implementation and monitoring indicators. These chains test the ability of park management to achieve the conservation outcomes defined for each of the assets. Activity measures, threat measures and conservation outcomes can be used to evaluate the implementation of the plan.

Contents

1 Background

1.1 Adaptive management

Conservation action planning is an important component of Parks Victoria's approach to adaptive management and evidence-based decision-making. It uses a collaborative approach to identify conservation priorities and develop strategies to address those priorities. These strategies are designed to achieve defined and measurable conservation outcomes once implemented.

Through conservation action planning, Parks Victoria identifies and focuses on strategies that target clearly defined elements of the natural environment (conservation assets) for which threats have been identified and where success can be measured. Understanding how to best use the resources available for conservation to achieve the greatest improvement in the overall health of ecosystems is a complex challenge for land managers.

Conservation experience, scientific understanding, local environmental knowledge, traditional ecological knowledge, and strategic thinking are all key components of successful conservation action planning.

Conservation strategies are based on the best available knowledge and will enable specific operational activities to be implemented, monitored for success and further refined. Where possible, the conservation action plan complements existing park management plans. Conservation strategies detailed in the park management plans have been reviewed during the conservation action planning process and updated for inclusion where relevant.

The plan is intended to guide Parks Victoria staff in their management of conservation values and articulation of our conservation priorities and strategies to stakeholders, land management partners and the public.

1.2 Park landscapes

Parks Victoria is applying conservation action planning to parks and reserves in park landscapes, which are natural values management units determined using a combination of ecological attributes, land forms and administrative boundaries. They form a logical unit for conservation action planning and delivering specific operational activities in groups of parks and reserves. Parks Victoria has divided Victoria in 18 park landscapes (Figure 1.1).

1.3 Planning method

Parks Victoria uses the conservation action planning methodology developed by The Nature Conservancy. This methodology is based on the Open Standards for the Practice of Conservation developed by the Conservation Measures Partnership, an international partnership of conservation organisations (Conservation Measures Partnership, 2019). Parks Victoria's approach to conservation action planning is suitable for planning conservation projects with a range of partners and stakeholders. It is consistent with the land management approach used by many other Victorian agencies.

Conservation action planning emphasises identifying strategies that tackle high-risk threats to high-priority conservation assets and their key ecological attributes, and which will contribute most to meeting the expected conservation outcomes.

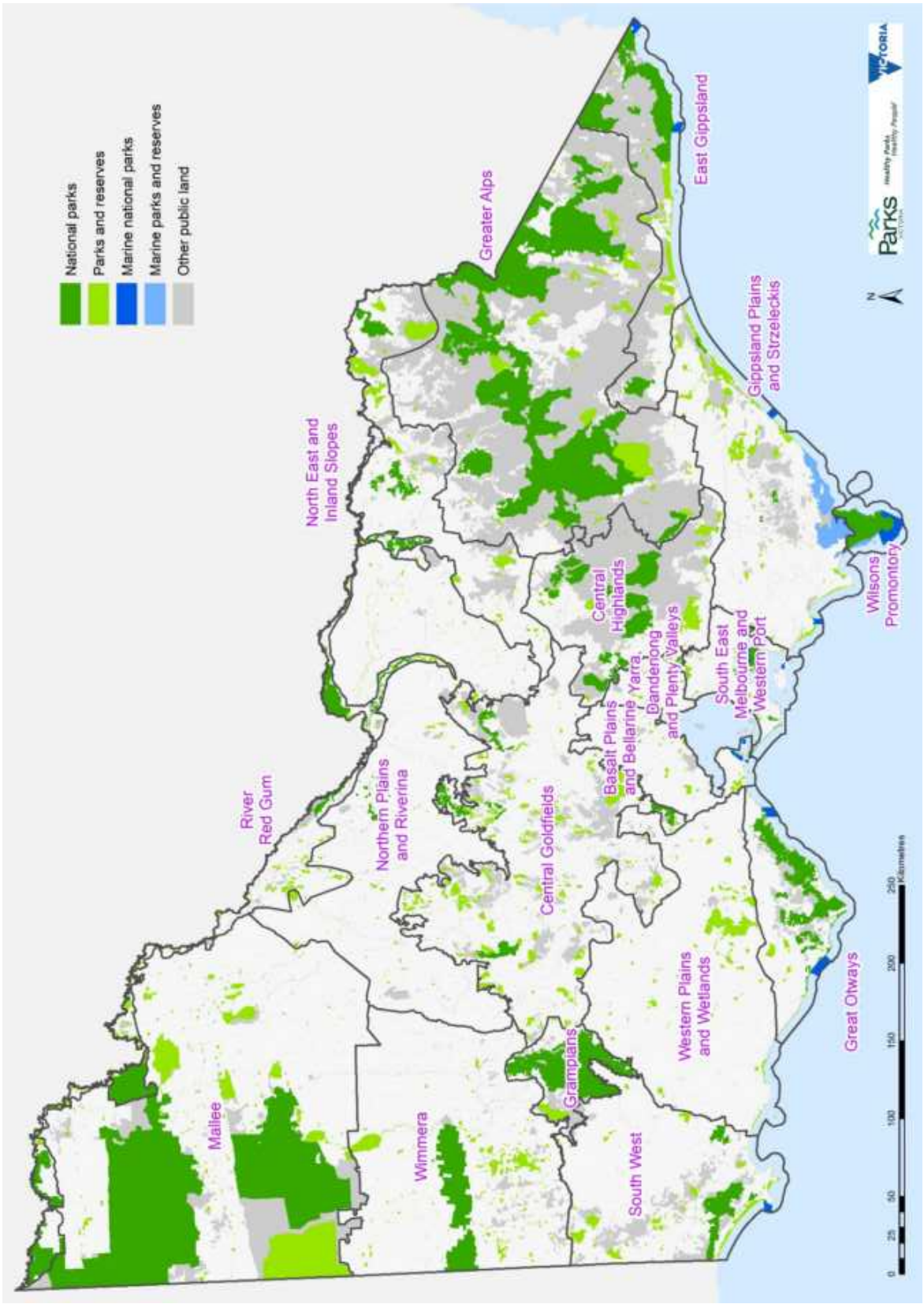


Figure 1.1 Parks Victoria's park landscapes

Parks Victoria's conservation action planning process involves a series of workshops with participants from Parks Victoria and other organisations. It follows 10 steps (Figure 1.2):

1 Scope planning, people and resources.
2 Identify conservation assets.
3 Assess viability of conservation assets and set conservation outcomes.
4 Identify and assess threats to conservation outcomes.
5 Conduct situational analysis and develop action options.
6 Assess and select preferred strategies and actions.
7 Set performance measures.
8 Plan work.
9 Implement operational plans.
10 Evaluate and adapt the Conservation Action Plan and operational activities.

This Conservation Action Plan is an output of steps 1 to 7, and provides directions for environmental conservation management for the next 15 years (Figure 1.2). Regional staff will implement the conservation strategies (steps 8 and 9) at the operational level.

After five years, the plan will be reviewed (step 10). Progress will be evaluated against the outcomes identified for conservation assets, threat mitigation objectives and implementation of identified high-priority actions, in order to revise and enhance the plan.

Figure 1.2 The 10-step conservation action planning process

2 Scope

2.1 Geographic scope

This River Red Gum Park Landscape Conservation Action Plan supports high-level planning for the River Red Gum Park Landscape in northern Victoria. The River Red Gum Park Landscape is a fragmented linear corridor of parks and reserves which roughly follow the Murray River and its tributaries (Figure 2.1). It covers parks and reserves managed by Parks Victoria that protect more than 242 000 hectares. The parks and reserves contain parts of Australia's largest River Red Gum forests, internationally significant wetlands, and refuge for endangered plant and animal species; they also protect thousands of significant cultural heritage places. The parks in this landscape are also important recreational and tourism destinations for Victorians and visitors. The planning area covers over 157 000 hectares of parks managed under the *National Parks Act 1975* (Vic.) and more than 100 other parks and reserves (totalling over 65 000 hectares) managed under various other legislation.

The River Red Gum Park Landscape includes 122 individual reserves (Appendix E), including national parks, state parks and wildlife reserves. Table 1.1 lists the areas managed by Parks Victoria.

Table 1.1 Major parks within the River Red Gum Park Landscape

Site name	Area (ha)	Level of protection*	Protected areas category (IUCN)
Barmah National Park**	28 537	A2	2 — National Park
Gunbower National Park	9 333	B	2 — National Park
Hattah–Kulkyne National Park	49 993	A1	2 — National Park
Murray–Sunset National Park (part of), including Lindsay Island, Lake Walla Walla and Mulcra Island	57 472 (of the total 666 615)	A1	2 — National Park
Warby–Ovens National Park	14 706	A2	2 — National Park
Lower Goulburn National Park	9 321	B	2 — National Park
Leaghur State Park	2 046	B	2 — National Park
Kings Billabong Park	2 194	A2	2 — National Park
Nyah–Vinifera Park	1 370	B	2 — National Park
Gadsen Bend Park	1 623	B	2 — National Park
Murray–Kulkyne Park	4 545	B	3 — Natural Monument or Feature

*See Appendix A.

**Barmah National Park is managed under a joint management arrangement with the Yorta Yorta Traditional Owner Land Management Board.

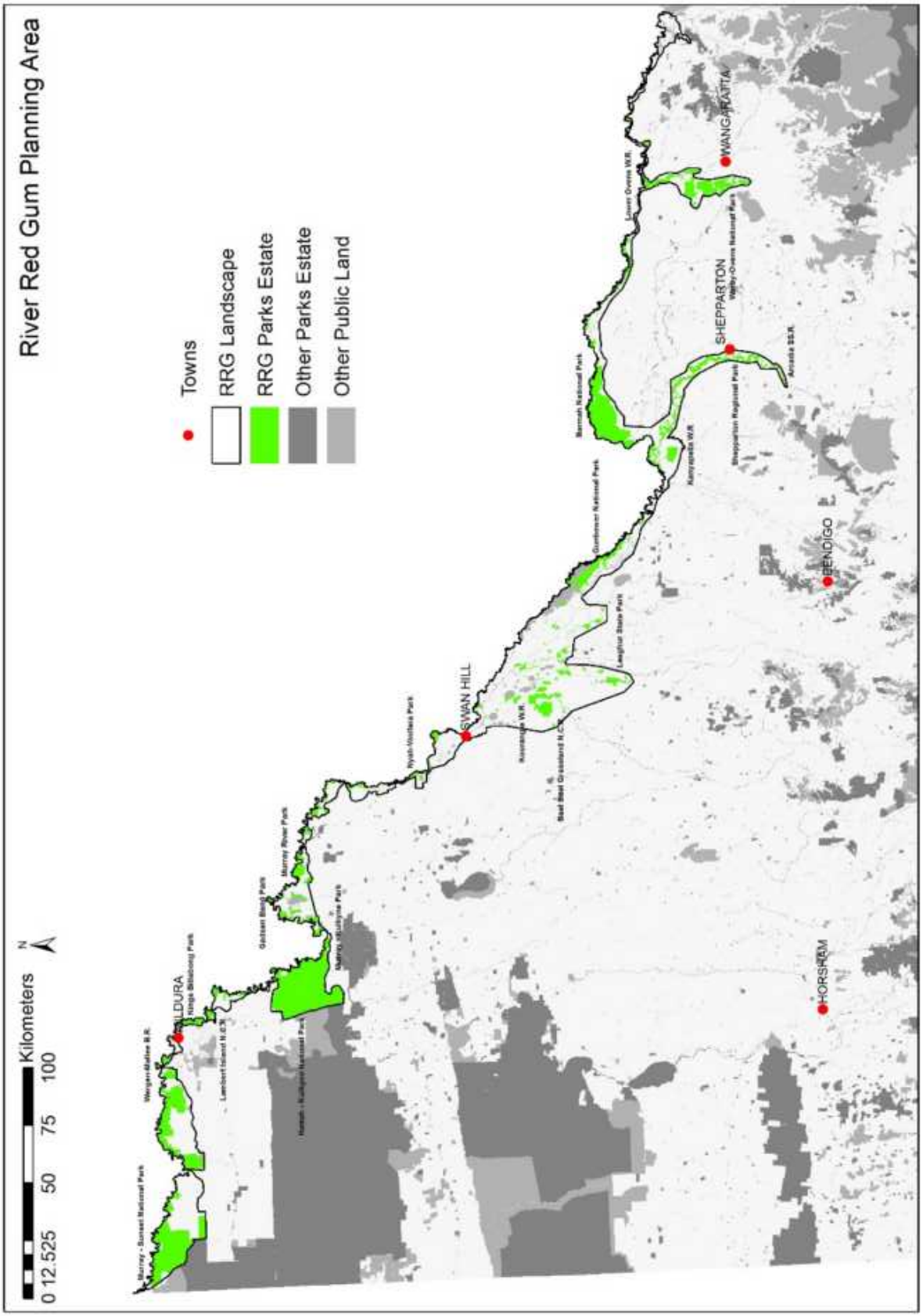


Figure 2.1 Geographic scope of conservation planning for River Red Gum Park

Some parks and reserves were established many years ago and have had a varied history of land use. As a result of government decisions on the Victorian Environment Assessment Council's *River Red Gum Forests Investigation* (VEAC, 2008), some existing parks were expanded and new parks established in 2010. This includes some forest areas which were used for timber harvesting until recently; for example, in Barmah National Park. Some of these parks have received new visitor facilities to encourage community use and enjoyment of the parks. In addition, a proposed Murray River Park includes long stretches along the Murray River from east of Wodonga to west of Mildura, much of which is less than 100 metres wide. Together with various national and other parks, the proposed Murray River Park provides for public access to most of the river frontage.

Natural values of significance in the River Red Gum Park Landscape include:

- four wetlands listed as internationally important under the Ramsar Convention on Wetlands (Barmah Forest, Gunbower Forest, Kerang Lakes and Hattah–Kulkyne Lakes)
- 39 nationally important wetlands
- diverse vegetation communities, including five nationally threatened ecological communities –
  - Buloke Woodlands of the Riverina and Murray–Darling Depression Bioregions
  - Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia
  - Natural Grasslands of the Murray Valley Plains
  - Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains
  - White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland
- the occurrence of over 35 per cent of Victoria's known vascular flora species
- the large river system and areas of natural flood plains, including –
  - threatened flora: 67 species listed under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) and 16 species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
  - threatened fauna: 87 FFG-listed and 20 EPBC-listed species
- Migratory species subject to bilateral migratory bird agreements and conventions –
  - 29 listed under the China–Australia Migratory Bird Agreement (CAMBA)
  - 28 listed under the Japan–Australia Migratory Bird Agreement (JAMBA)
  - 25 species listed under the Republic of Korea – Australia Migratory Bird Agreement (ROKAMBA)
  - 26 species listed under the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Geographically, the River Red Gum Park Landscape also lies within the Murray–Darling Basin. This catchment area encompasses the Australian Capital Territory and crosses the Queensland, New South Wales, Victorian and South Australian borders.

2.2 Cultural significance

The River Red Gum Park Landscape includes the traditional lands of the Bangerang, Barapa Barapa, Dhudhuroa, Latji Latji, Ngintait, Nyeri Nyeri, Tatti Tatti, Taungurung, Wadi Wadi, Wamba Wamba, Waywurru, Yaithmathang, and Yorta Yorta peoples. The First People of the Millewa-Mallee Aboriginal Corporation and the Yorta Yorta Nation Aboriginal Corporation are registered Aboriginal parties over parts of the landscape, giving them legislated rights and responsibilities for cultural heritage management.

Aboriginal people have been part of this landscape for tens of thousands of years. Some of these lands are now parks and reserves, each of which is extremely important to Traditional Owner groups in maintaining

their cultural connections. The River Red Gum Park Landscape remains rich in Aboriginal cultural heritage, both material sites and non-material places closely linked to traditional stories and embedded in customary access to and use of Country.

The highly productive floodplain environments in the River Red Gum Park Landscape have provided abundant, continuous resources for Traditional Owners, and the landscape contains a high density of cultural values and places of importance to Traditional Owner groups. The aspirations of Traditional Owner groups are key considerations for the management of the Park Landscape, and are articulated in the *River Red Gum Parks Management Plan* (Parks Victoria, 2018a). However, Barmah National Park, jointly managed by the Yorta Yorta people and Parks Victoria, was excluded from the *River Red Gum Parks Management Plan* as it will be covered by a joint management plan being prepared by the Yorta Yorta Traditional Owner Land Management Board and the Department of Environment, Land, Water and Planning (YYTOLMB and DELWP, 2019). The information, strategies, objectives and milestones from this Conservation Action Plan may be used to inform natural values components of joint management plans. Implementation of this Conservation Action Plan through on-ground land management can provide opportunities for Traditional Owner employment on Country and further sharing of contemporary and traditional land management learnings. Implementation should also explore opportunities and partnerships to involve Traditional Owners.

Traditional Owners are understood to be restoration partners in conservation planning and are the custodians of a living cultural heritage. The forest, river, plants and animals are all part of Country and the cultural identity of Traditional Owners. Protecting, managing and enjoying the land are important parts of this connection. Traditional Owner knowledge and perspectives are critical in best practice land and natural resource management; they bring benefits to both the parks and the whole community. One method used in Victoria to develop effective partnerships with Traditional Owners is the Aboriginal Waterway Assessments program under the Murray–Darling Basin Plan. In this program, Traditional Owners record and describe the cultural health of places important to them (Murray–Darling Basin Authority, 2016).

Exploration and settlement of the land following European contact have left their own marks in the form of built structures, diverse past land uses, stories and connections. Everything that has happened in the past is part of the story of the River Red Gum parks and reserves that continues today.

2.3 Legislative and planning context

Management of the land and water resources, cultural heritage, and flora and fauna in the River Red Gum Park Landscape is guided by many pieces of both federal and state legislation.

The River Red Gum Park Landscape is fully encompassed within the Murray–Darling Basin (the Basin), a large catchment area which includes the Murray River and its tributaries. Accordingly, the landscape is within the jurisdiction of the Murray–Darling Basin Authority (MDBA), which is responsible for coordinating the water resources of the Basin. The MDBA manages this through implementation of the *Water Act 2007* (Cwlth) and the associated Basin Plan, which sets the amount of water that can be taken from the Basin each year while leaving enough for rivers, lakes and wetlands.

Part of this management includes recovering water for the environment (environmental water) and constructing infrastructure to deliver this water efficiently. For example, the MDBA-managed Living Murray program has administered large-scale infrastructure works programs to enable the delivery of environmental water. The works include building channels, regulators and pump systems to deliver water and levees to control the flow of water across the landscape. The Living Murray program focuses on maintaining the health of six icon sites that occur on the Murray River in New South Wales, Victoria and South Australia. These sites were chosen for their high ecological and economic value, and their cultural and heritage significance to Aboriginal people. The sites are areas of high conservation value — the

floodplains, wetlands and forests along the Murray River, the Murray's estuary and the river itself. The River Red Gum Park Landscape covers the Victorian component of four of the six icon sites:

- Barmah–Millewa Forest
- Gunbower–Koondrook–Perricoota Forests
- Hattah Lakes
- Chowilla Floodplains and Lindsay–Wallpolla–Mulcra Islands.

Future planning through the Basin Plan is likely to result in the construction of additional infrastructure for environmental water deliveries at these, or other, sites on the Parks Victoria estate.

Of the River Red Gum Park Landscape, 169 264 hectares is reserved and managed under the provisions of the National Parks Act, with a further 161 hectares proposed as additions under its schedules. Other areas managed include over 100 parks and reserves (covering over 59 143 hectares) managed under Victorian legislation including the *Crown Land (Reserves) Act 1978* and the *Wildlife Act 1975*. The proposed Murray River Park is pending proclamation under the Crown Land (Reserves) Act.

The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Victoria has 12 Ramsar-listed wetlands, four of which occur in the River Red Gum Park Landscape.

The convention obliges contracting parties to manage Ramsar sites in such a way as to maintain their ecological character equivalent to that at the time of listing. The primary purpose of management of a declared Ramsar wetland (as outlined in the Australia's Environment Protection and Biodiversity Conservation Regulations 2000) must be:

a) to describe and maintain the ecological character of the wetland; and
b) to formulate and implement planning that promotes:
   (i) conservation of the wetland; and
   (ii) wise and sustainable use of the wetland for the benefit of humanity in a way that is compatible with maintenance of the natural properties of the ecosystem.

Parks Victoria does not manage the Murray River water body; however, some assets and species associated with the water body may be influenced by Parks Victoria's management in adjacent areas. In these instances, those values have been incorporated into this plan.

Fire management on public land is governed by Victoria's Code of Practice for Bushfire Management on Public Land (Department of Sustainability and Environment, 2012). This sets the objectives for fire on public land, including Parks Victoria's estate, by delineating fire management zones as a tool to guide bushfire management outcomes.

Parks Victoria's planning framework

Conservation action plans contribute to park management plans and give a more in-depth review of natural values and their condition. Conservation action plans should provide a more robust framework for evaluating the health of the landscape and include targeted goals based on condition of ecosystems which complement actions in the park management plans. Conservation action planning does not specifically address visitor management or cultural asset management; however, in some cases cultural and visitor values will share threats, management actions and condition goals.

2.4 Alignment with regional catchment strategies and other plans

In managing the River Red Gum Park Landscape, Parks Victoria interacts with other agencies that also have legislative responsibility for aspects of land, water, flora and fauna, and cultural heritage

management. This Conservation Action Plan is an important step for Parks Victoria in documenting the intent of its on-ground land management and supporting activities in the River Red Gum Park Landscape.

In addition, many other existing formal plans contain a range of management objectives for many of the sites within this landscape. The custodians of these documents include Parks Victoria, Traditional Owner groups, catchment management authorities (CMAs), DELWP, the Murray–Darling Basin Authority and the Victorian Environmental Water Holder. Examples include:

- regional catchment strategies
- Ramsar site management, evaluation, reporting and improvement plans
- threatened species recovery plans
- healthy country plans
- environmental water management plans
- flood management strategies
- seasonal watering proposals and delivery plans
- the statewide Seasonal Watering Plan
- the Basin Plan
- Living Murray operating strategies
- site-specific management plans.

An appropriate hydrologic regime is a critical driver of the health of much of the River Red Gum Park Landscape, and the delivery of environmental water has become a key management tool used restore the health of the flood-dependent assets. The governance of environmental water deliveries is driven by two key parties: CMAs (who plan the annual deliveries for individual sites) and the Victorian Environmental Water Holder (who allocates the available water). Parks Victoria actively participates in this environmental water planning and delivery process in a supporting partnership role, providing on-ground knowledge and expertise about the sites, identifying risks and mitigation strategies, and planning and implementing on-ground works that complement the environmental water deliveries.

The various assets identified within these documents include:

- rivers
- wetlands
- threatened species
- terrestrial habitat
- culture and heritage
- biodiversity
- partnerships.

This plan will support the broader objectives and actions for these assets by:

- protecting and enhancing the environmental values of watercourses
- supporting the delivery of water to waterways and wetlands
- maintaining the current extent and restoring the health and distribution of threatened Ecological Vegetation Classes (EVCs)
- reducing the impacts of pest plants and animals on natural resources
- protecting the extent and condition of cultural heritage sites
- maintaining and enhancing the health of biodiversity resources
- managing public land collaboratively.

2.5 Key sources of information

The *River Red Gum Parks Management Plan* (Parks Victoria, 2018a) was developed by Parks Victoria in parallel with this plan. The Conservation Action Plan more comprehensively describes the strategies and actions required to manage the conservation assets of the River Red Gum Park Landscape. Ramsar site management plans incorporated within the regional waterway strategies produced by CMAs and ecological character descriptions produced by DELWP have also directly informed this Conservation Action Plan.

The Strategic Management Prospects (SMP) tool (a component of DELWP's NatureKit) has been used, with field-based evidence, as a decision-support tool to help prioritise threats and actions. SMP outputs focus on biodiversity and may need to be balanced with organisational and community priorities when implementing conservation strategies.

2.6 Participation

A series of conservation action planning workshops were held to support the planning process for this River Red Gum Park Landscape Plan.

The success of the workshops drew from the great depth of knowledge and experience of participants, including staff from Parks Victoria's city office, regions and districts, DELWP and catchment management authorities, and community stakeholders. Due to the length of time between workshops for identifying assets, assessing threats and prioritising strategies, follow-up discussions were held with local staff to ensure information was current.

3 Conservation assets

3.1 Methodology for identifying conservation assets

For planning and managing the terrestrial environment, Parks Victoria has classified conservation assets in its park according to similarities in biodiversity and natural values, and management drivers. The classification is based on the eight terrestrial ecosystem groups (Department of Natural Resources and Environment, 1997):

- alps
- coastal
- dry forest and woodland
- grassland
- heathland
- inland waters and wetlands
- mallee
- wet forest and rainforest.

Within each of these ecosystem groups, sub-ecosystems have also been identified, defined by groupings of Ecological Vegetation Classes and Divisions (EVCs and EVDs) (White, 2012).

Conservation assets within the park landscapes have been identified by grouping ecosystems, sub-ecosystems and habitats that have similar ecological processes and threats.

On a finer scale, environmental components that are an important focus of conservation efforts have also been identified to help define each conservation asset more comprehensively. These 'nested assets' are mostly species assemblages and communities but may also include habitat features and ecosystem services. Individual species are aggregated with others if they co-occur across the landscape and have similar attributes that are important in determining their persistence in the landscape (for example, 'migratory and resident shore birds' is a nested asset within the conservation asset Permanent Freshwater Wetlands). Keystone species, and rare, threatened or endemic species, are also included as nested assets if they have specific conservation requirements, are of local importance, or are the subject of long-term monitoring or recovery efforts.

3.2 Conservation assets of the Park Landscape

Eight ecosystems — four terrestrial and four fully or partially/temporarily aquatic — were identified as conservation assets in the River Red Gum Park Landscape (Greening Australia 2014a, 2014b, 2014c). Each conservation asset is also associated with numerous nested assets. The extent and distribution of these conservation assets are presented in Table 3.1 and Figures 3.1 and 3.2. The EVCs and EVDs associated with each terrestrial ecosystem are listed in Appendix B.

Table 3.1 Areas of conservation assets (ecosystems) in the River Red Gum Park Landscape. The total includes 49 447 hectares of Ramsar wetlands.

Conservation asset	Area (ha)
Riverine Forest and Woodland	130 001
Ephemeral Freshwater Wetlands	19 556
Permanent Freshwater Wetlands	7 170
Saline Wetlands	1 421
Plains Woodland	7 741
Box Ironbark Forest	3 222
Mixed Dry Forest	9 101
Chenopod Shrubland	11 570

Note: Mallee and Semi-arid Woodland ecosystems in the River Red Gum Park Landscape have not been included as conservation assets in this plan. For asset descriptions and strategies for these ecosystems, refer to the Mallee Conservation Action Plan (Parks Victoria, 2019).

Within the River Red Gum Park Landscape conservation assets listed in Table 3.1, four Ramsar wetlands have been defined as individual assets. These Ramsar wetlands occur in five of the conservation assets: Riverine Forest and Woodland, Ephemeral Freshwater Wetlands, Permanent Freshwater Wetlands, Saline Wetlands and Plains Woodland. The Ramsar sites have been listed separately because their high-priority protection status and the provision of environmental water has influenced their condition. For this reason, their condition, trend and associated asset goals are separately defined. The Ramsar sites within the River Red Gum Park Landscape, which total 49 447 hectares, are:

- Barmah Forest
- Gunbower Forest
- Kerang Wetlands
- Hattah–Kulkyne Lakes.

Listing the Ramsar wetlands as individual conservation assets is designed to ensure a clear linkage with other planning mechanisms for these internationally significant sites, and to recognise their importance for ecological conservation and the need for prioritisation of associated management activities to retain the values for which they were listed.

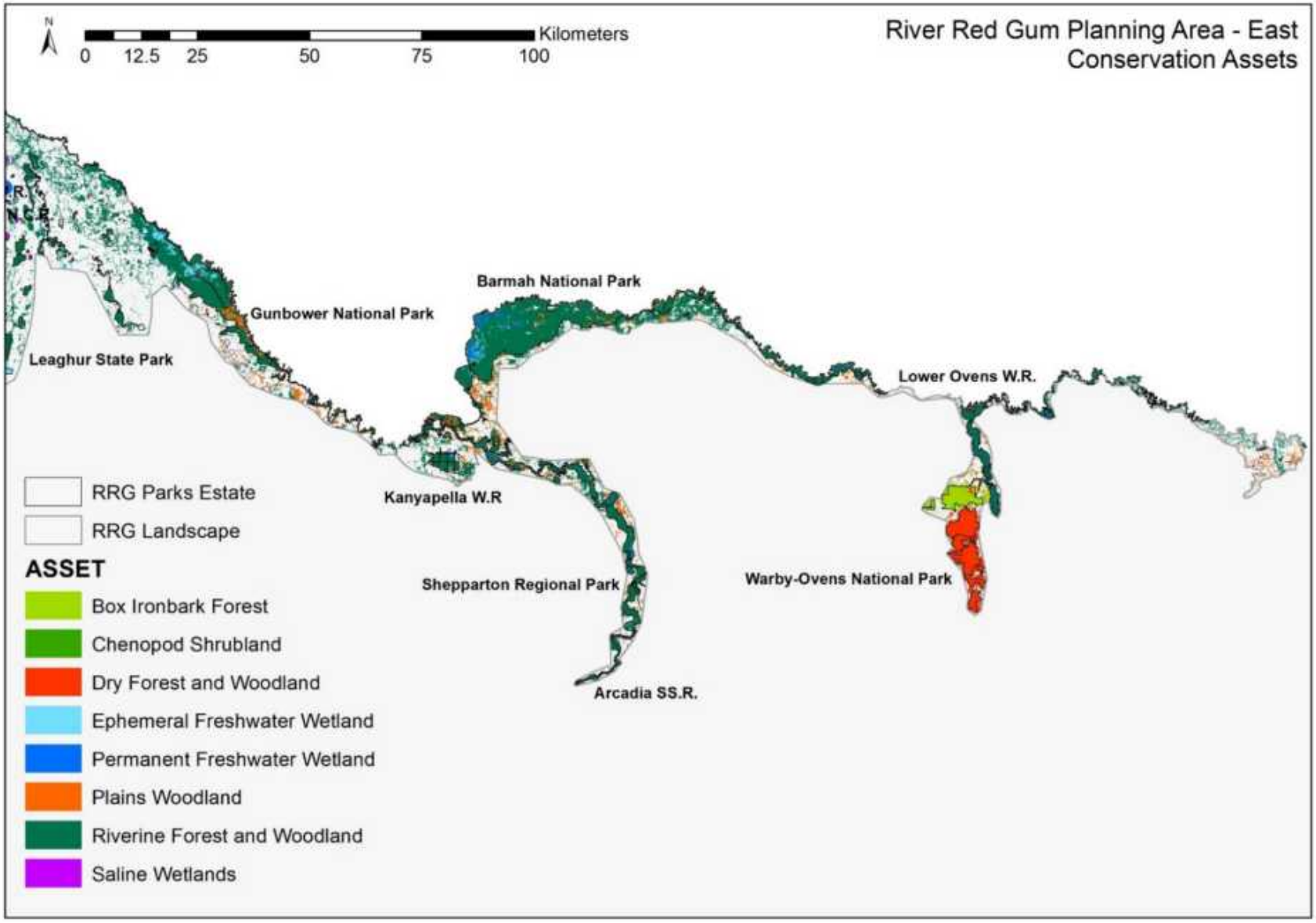


Figure 3.1 Conservation assets in the eastern River Red Gum Park Landscape

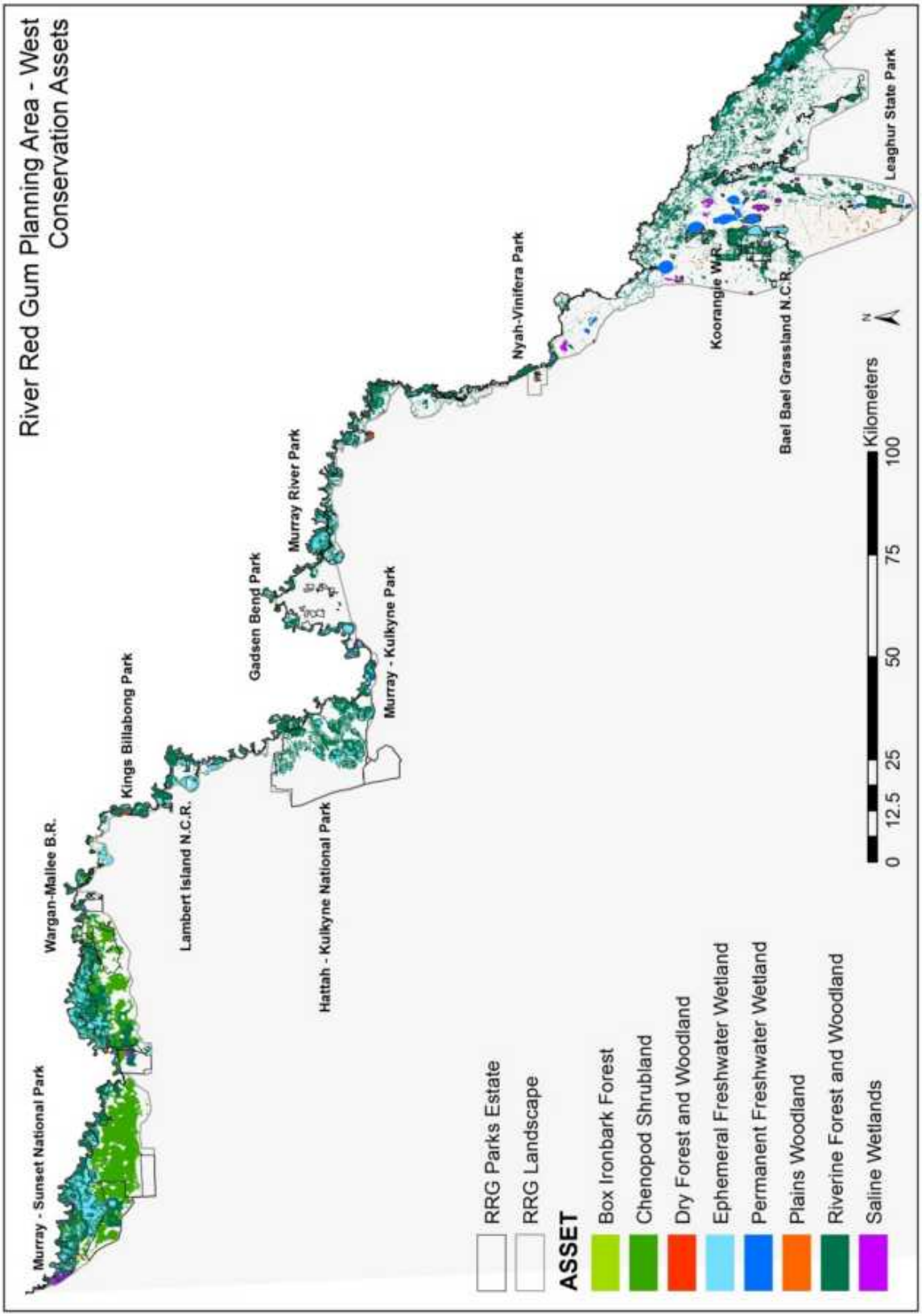


Figure 3.2 Conservation assets in the western River Red Gum Park Landscape

4 Conservation outcomes

Setting conservation outcomes involves defining a conservation vision for the River Red Gum Park Landscape and envisaging the desired future for the overall health of each asset. The conservation vision is based on Parks Victoria's broader vision for conserving its special places, and is an aspirational statement that describes what the Park Landscape should be like in the future.

Conservation outcomes for specific assets are derived from a comparison of the current and desired condition of the conservation asset overall: Where are we now? Where do we want to be? They are articulated as SMART (specific, measurable, achievable, relevant and time-bound) goals.

4.1 Vision

The vision below describes the intended outcome of management and the future state of the River Red Gum Park Landscape.

> *The resilience of natural assets in the River Red Gum Park Landscape is increased and ecosystem services are maintained in the face of climate change and other stressors.*

The River Red Gum Park Landscape is a linear oasis, with many of its conservation assets periodically connected by floodwaters. The landscape provides diverse, unique, high-quality habitats essential for the persistence of threatened species and to provide a healthy forest with iconic large, old trees and internationally significant wetlands. These forests have a strong community and cultural connection and depend on the availability of water.

Australia is the driest inhabited continent on earth and is highly sensitive to the impacts of climate change (Garnaut, 2011). Water scarcity is already a serious issue, and the demand for water from competing uses will increase as water availability continues to decrease. With increased water consumption, reduced rainfall and prolonged drought anticipated in the future, some wetlands and creeks that once received water from the Murray River will no longer do so. Therefore, it is important that management gives a high priority to high-quality drought refugia for species in this landscape. These areas will continue to receive environmental water and be the focus of complementary land management actions to ensure the persistence of the high-quality habitat into the future.

4.2 Viability

Assessing the overall health of a conservation asset involves identifying the critical factors required for its long-term viability — the key ecological attributes. These include attributes of structure, composition and process related to the assets. A key ecological attribute must be readily measurable using one or more indicators. The current and desired conditions of the attribute can then be assessed, and the overall viability of the asset can be assigned to a defined category.

The assessment of the viability (or overall health) of a conservation asset is a five-step process using key ecological attributes:

1 **Identify a small number of key ecological attributes (typically 3–5) for each conservation asset.** Common key ecological attributes include structure (for example, remnant size or population abundance, distribution of communities, and configuration of patches or age classes); composition (for example, relative abundance and diversity of species); interactions, and biotic and abiotic processes (for example, hydrological regime or water quality).

2 **Identify appropriate indicators for each key ecological attribute.** An indicator is a readily measurable parameter that can be used to assess the condition of a key ecological attribute. For example, the presence or absence of a habitat-sensitive species may be an appropriate indicator for species diversity or habitat condition.

3 **Develop criteria for rating the current value of each indicator.** Developing criteria for rating the value of each indicator is an iterative process. Typically, a simplified qualitative assessment (for example, many, some, few) is progressively developed into more refined and measurable numeric values (for example, 1000 megalitres of water for three months during late spring). A value range for the indicator is defined to correspond with a value rating for poor, fair, good, and very good.

4 **Determine the current and desired conditions of each indicator.** The rankings used are poor, fair, good, and very good. A condition goal for each indicator is an aspirational target assessed over a 15-year period and should consider the role, if any, of management intervention to maintain long-term viability.

5 **Determine the overall viability of conservation assets.** For each conservation asset, the overall current and desired condition is determined using the condition rankings for key ecological attributes and their associated indicators. The desired condition for each conservation asset is based on what is realistically achievable in the 15-year timeframe through the implementation of all relevant conservation strategies. Each conservation asset is rated for the current and desired conditions of its key ecological attributes and overall condition.

5 Conservation asset descriptions

The following pages describe the conservation assets within the River Red Gum Park Landscape and the outcomes sought from management. For each asset, they present key ecological attributes, including conservation outcomes and asset descriptions, and assessments of the current and desired status. These attributes and outcomes have been used to guide the development and prioritisation of conservation strategies.

The descriptions are set out in the following format, and the terms used are defined in Table 5.1.

Conservation asset

A habitat type (group of EVCs) or specific management area (for example, Ramsar wetlands) representing an ecosystem or the overarching value that is to be managed. The ecosystem or habitat type, its condition, predominant drivers of condition, and their effect on nested assets is described.

Nested assets

Nested assets are a series of values that are present within the asset, or that rely on the asset for their health. These are often iconic species for the system, threatened species, ecological (fauna) assemblages and species with particular management requirements or that are the subject of long-term monitoring. Comprehensive lists of species held on national and Victorian databases are used to inform the selection of nested assets.

Condition

This sets out the key ecological attributes, indicators for those attributes, the current condition and trends in condition of the attribute, and the anticipated future status of the attributes and asset if all conservation strategies relevant to the conservation asset are implemented (as in the example below).

Key ecological attributes	Indicator	Current condition	Current trend	Condition goal
Ground-dwelling mammals: diversity and extent	Species richness and occupancy of suitable habitat	Fair	→	Good
Vegetation structure and composition	Percentage cover and distribution	Fair	↘	Good

Conservation outcome

This statement reflects the key ecological attributes of the asset and includes key improvements in asset viability that will achieve the desired conservation outcome (as in the example below).

Riparian	Current condition	Desired trend	Desired condition
In the 15 years to 2034, maintain critical habitat features (e.g. vegetation structure), functions (e.g. hydrology, water quality and quantity) and connectivity of riparian and in-stream ecosystems to provide habitat and refugia.	Good	↗	Very good

Trends are indicated as follows: Improving ↗ Stable → Declining ↘

The assessments of current condition and desired future status are represented by the following categories. Measures to assess this classification are documented in the monitoring, evaluation and reporting plan.

VERY GOOD (optimal integrity) — The attribute is functioning at an ecologically desirable status, and requires little human intervention to maintain or improve health.

GOOD (minimum integrity) — The attribute is functioning within its range of acceptable variation; it may require some human intervention.

FAIR (vulnerable) — The attribute is outside its range of acceptable variation and requires human intervention to recover or be restored. If unchecked, the target will be vulnerable to serious degradation.

POOR (imminent loss) — Allowing the attribute to remain in this condition for an extended period of time will make restoration or preventing extinction practically impossible.

Table 5.1 Explanation of terms found in condition tables

Indicator	Description
Demography	Identifies the age class of individuals as a surrogate measure of recruitment success over time (e.g. presence of young-of-year fish and turtles through to mature age; identification of eggs or fledgling birds in nesting colonies)
Extent	Area of cover of a particular species or functional group, attribute or area subjected to particular conditions (e.g. flooding, salinity)
Health	Measured for long-lived flora and fauna that require certain conditions to maintain health. This indicator can be used to identify whether those conditions are achieved, and repeat surveys can detect change over time. A key example is tree health, which is maintained through an appropriate flooding and drying regime.
Index of wetland condition (IWC) score	An assessment procedure used in Victoria to assess the condition of wetlands to assist in management decisions and prioritisation of sites
Site occupancy	The presence of a particular species or functional group within a suitable habitat. Repeated surveys provide greater confidence in data, particularly for mobile fauna, and seasonal flora. Key examples are waterbird surveys and the emergence of aquatic flora in wetlands during floods.
Percentage cover	Compares the cover of a particular species or functional group to another. Can be used to identify change in dominance of species or functional groups over time. Particularly important in wetlands in which flora composition changes in response to wetland phases (e.g. wet/receding/dry) or changed hydrological conditions
Representativeness	Compares the type and/or number of species, or presence of a particular representative indicator species, identified within a defined benchmark such as a functional group or EVC
Spatial distribution	Identifies presence and cover of species or functional groups across the landscape. Can be used to detect movement of species between habitats, or change in habitat qualities that may favour different, rather than expected, species. A key example here is the progression of terrestrial dominant flora into typically wetter environments, suggesting a change in flooding regime.
Species richness	Identifies how many different species are present at a particular location or across a landscape area

Riverine Forest and Woodland

The Riverine Forest and Woodland conservation asset covers 132 808 hectares and is the most extensive water-dependent conservation asset in the River Red Gum Park Landscape. It contains a diverse array of habitats for terrestrial species of the flood-tolerant vegetation communities. When seasonally inundated, this asset also provides important floodplain habitat for aquatic fauna (such as frogs and fish) that disperse from refuge areas and breed in large numbers across the forest floor. Waterbirds, including waders, eat the abundant food in the flooded understorey and nest in the overstorey or in reed beds.

Under natural pre-regulation conditions, and before the construction of barriers (such as elevated roadways) and flood mitigation infrastructure (such as levees), this asset was frequently inundated by overbank flooding of the adjoining river and creek systems.

Seasonal flooding initiates plant germination and contributes to the floristic diversity of the asset, which is dominated by River Red Gum forests and Black Box woodlands. In lower, more frequently flooded areas, River Red Gum predominates with a ground layer of aquatic plants such as rushes and sedges. At higher elevations, the overstorey transitions from River Red Gum to Black Box, with an understorey, typically of grasses and herbs, that tolerates intermittent flooding. Some sites support Tangled Lignum or chenopod shrublands, depending on local topography and soils.

The Riverine Forest and Woodland asset consists of plant species and communities that are of conservation significance within Victoria, including the depleted Riverine Chenopod Woodland and Floodplain Grassy Wetland EVCs. The asset also contains a small area of the Alluvial Plains Semi-arid Grassland EVC, which is largely restricted to the margins of low-lying depressions in the Murray–Sunset National Park. This latter vegetation community is poorly known and its management requirements are assumed to be similar to other vegetation types within this asset.

The Riverine Forest and Woodland asset provides important habitat for a range of wetland and woodland bird communities that rely on this ecosystem for foraging, breeding and watering. Specifically, this asset is critical for the conservation of a significant number of woodland birds listed under the Flora and Fauna Guarantee Act, many of which comprise the Victorian Temperate Woodland Bird Community (for example, the localised Grey-crowned Babbler and the migratory Swift Parrot). Other birds in this community, such as the Barking Owl and the Superb Parrot are additionally listed as vulnerable under the Environment Protection and Biodiversity Conservation Act. Widespread flooding across the forest floor is thought to be a precursor for the large-scale waterbird breeding (numbering in the thousands), including species protected under international migratory bird agreements such as the endangered Eastern Curlew and Australian Painted Snipe. Additionally, the subset of the Riverine Forest and Woodland asset that are Ramsar sites are of international importance.

During periods of inundation, this asset also provides critical habitat for native fish. It is particularly important for fish that rely on floods to connect rivers, wetlands and the floodplain so they can disperse between permanent systems. The temporarily flooded habitats of this asset provide a unique and important component of the lifecycle of many species. The resulting connectivity is also critical in the movement of carbon from the floodplain back to river systems, which increases productivity in river channels.

The Riverine Forest and Woodland asset supports a diverse array of native frogs, reptiles and turtles, such as the Proximus Blind Snake, the Broad-shelled Turtle and the EPBC- and FFG-listed Growling Grass Frog. The landscape supports a range of mammals, including the Yellow-footed Antechinus, the Sugar Glider and the FFG-listed Squirrel Glider. Preferred habitat for most fauna has declined in recent decades. The condition of this asset, and the presence of its characteristic flora and fauna, varies significantly across the River Red Gum Landscape.

A legacy of forestry in floodplain forests has influenced River Red Gum tree growth for the purpose of sustaining commercial timber production, with secondary objectives for conservation. Past and contemporary silviculture practices have modified the structure and condition of the forest by removing ecologically significant trees (for example, large, old, hollow-bearing), stimulating the regeneration of even-aged forests and causing significant loss of forest floor habitat. Stopping forestry in areas previously managed for forestry has resulted in dense stands of single-aged trees. These trees outcompete other species for light and water; in some areas this has reduced floristic diversity and available habitat. Ecological thinning to modify forest structure, generate habitat and stimulate understorey regeneration is a potential management option in these floodplain forests (Gorrod et al., 2017).

River regulation (along with drought and changing climate) has affected the condition of Riverine Forest and Woodland and other assets in this landscape (Mac Nally et al., 2011). Inundation-dependent vegetation communities that now receive only infrequent seasonal flooding are showing significant signs of stress. This includes reduced canopy condition in the River Red Gum forests and Black Box woodlands, and limited regeneration of the aquatic understorey, allowing terrestrial plant species to dominate. In addition, River Red Gum saplings that establish during floods are not naturally thinned out by follow-up floods, and these in turn alter wetland vegetation and condition. Active management interventions, such as delivering environmental water, have supported the water regime requirements of some areas of this landscape. This has improved vegetation condition and provided the seasonal aquatic habitat required by the fauna that migrate into these areas to take advantage of the flourishing food resources.

However, environmental water can only be delivered to areas where physical infrastructure, such as supply networks for irrigation and domestic use, is available or where water can be pumped directly from a source, such as a river or creek. Some sites, such as the MDBA's Living Murray icon sites, some of the Ramsar wetlands and other sites where specific water entitlements have been set aside, have had the benefit of infrastructure construction and environmental water deliveries.

Investigations continue into bringing new sites into the delivery network to increase the area that can be inundated with environmental water. However, the proportion of this landscape that can receive environmental water will remain relatively small in proportion to the overall size of this asset because of the diminishing availability of overall water resources, the scale and cost of works that would be required to deliver water to many parts of this landscape, and a range of other delivery constraints (for example, delivery capacity of channels and pipelines, limited appetite for flooding of private property). Future management of this asset will need to take into account the limited ability to maintain an appropriate water regime into the longer term. It will require complementary on-ground action to ensure the available water (either environmental water or from natural floods) is used most efficiently, and to enable a more successful transition to drier conditions.

Nested assets

Nine nested assets have been identified within the Riverine Forest and Woodland asset (see the table below). All species in these nested assets depend on the range of key ecological attributes below. Many of these nested assets depend on appropriate hydrological regimes and vegetation condition and structure. Characteristic flora comprise a selection of representative species from both the wetter and drier phases of the inundation cycle.

Nested asset	Examples of components
Cultural (tangible and intangible)	Food and fibre, physical sites, bush medicine, meeting places, ceremonial sites
Characteristic flora	River Red Gum, Black Box, New Holland Daisy, Warrego Summer-Grass, Golden Everlasting, Mallee Annual Bluebell, Common Spike-sedge, Common Nardoo, saltbushes
Significant flora	Riverina Bitter-cress, Pale Flax-lily, Western Water-starwort, Winged Pepper-cress, Small Scurf-pea, Mueller Daisy
Hollow-dependent fauna	Regent Parrot, Superb Parrot, bats
Reptiles	Broad-shelled Turtle, Inland Carpet Python, Mueller's Skink
Fish and crayfish species assemblage and functional groups	FFG-listed Lowland Riverine Fish Community of the Murray–Darling Basin, wetland specialists
Crevice-dependent soil fauna	Giles' Planigale, De Vis' Banded Snake, Giant Banjo Frog, Red-naped Snake
Bird species and functional groups	Barking Owl, Superb Parrot, Intermediate Egret, colonial nesters, ducks, piscivores
Freshwater invertebrates	Platypus

Condition[1]

Key ecological attributes	Indicators	Current condition	Current trend	Condition goal
Vegetation structure and composition	Species richness, tree canopy health, EVC benchmarks	Fair	→	Fair
Victorian temperate woodland bird community	Species richness	Fair	→	Fair
Function and connectivity	Extent of asset subject to appropriate hydrological regimes	Poor	↗	Fair
Habitat features (terrestrial and aquatic)	Hollows, nesting sites, presence of aquatic vegetation or coarse woody debris	Fair	→	Fair
Fish	Species richness	Poor	→	Poor
Presence of ground-dwelling fauna and reptiles	Species richness	Fair	→	Fair

[1] The current condition, condition trend, and condition goal in this asset excludes the Ramsar Wetlands asset (which incorporates the Living Murray icon sites), where environmental water can be used to improve the water regime at those locations. Dominated by forests and woodlands, the position of this asset in the topography of the landscape is higher than that of the semi-permanent and permanent wetlands, making it more complex to construct (or manipulate existing) infrastructure that can effectively deliver large enough volumes of water to create widespread flooding.

Key ecological attributes	Indicators	Current condition	Current trend	Condition goal
Presence and abundance of freshwater invertebrates	Number and representativeness of functional groups	Unknown	Unknown	Fair

Conservation outcome

Riverine Forest and Woodland	Current condition	Desired trend	Desired condition
Over the 15 years to 2034, support a healthy and diverse vegetation community within existing and new areas that can be targeted by environmental water deliveries; where environmental water cannot be used to supplement the water regime, identify strategies that will facilitate transition to drier climatic conditions.	Fair		Fair

Ephemeral Freshwater Wetlands

The Ephemeral Freshwater Wetlands conservation asset covers 19 193 hectares of the River Red Gum Park Landscape and represents 40.1 per cent of the statewide extent of this water-dependent conservation asset. This conservation asset is widespread throughout the River Red Gum Park Landscape. A subset of these wetlands occur within Ramsar sites and are described in the Ramsar Wetlands conservation asset. The Ephemeral Freshwater Wetlands asset also occurs across a range of other parks, including Murray–Sunset National Park, Kings Billabong Park and the proposed Murray River Park.

Ephemeral wetlands are often subject to sporadic and at times extended inundation, which varies depending on their position in the landscape. They differ from permanent wetlands in being shallower and more diverse in size, shape and aquatic plant assemblages. Water is supplied by flood runners (depressions) that dissect the low-lying areas of the Riverine Forest and Woodland conservation asset, extending the area of temporary wetland habitat available. The shallow nature of these systems means that they dry out between floods, leading to a boost of productivity on rewetting.

Ephemeral wetlands support a diverse and productive array of aquatic plants that persist in the wetland bed during dry periods (in seed banks or as specially adapted underground parts, such as rhizomes and tubers) and germinate on rewetting. Trees and shrubs occur both within the wetland and on the margins, with some of the best examples of freshwater tree-dominated wetlands being found within this asset. These wetlands provide highly productive habitats for a range of fish species that access the forest during floods, as well as shelter and productive foraging areas for waterbirds, bats and mammals.

The Ephemeral Freshwater Wetlands asset consists of several flood-dependent EVCs that provide an indicator of the frequency of inundation. EVCs common to this conservation asset include Disused Floodway Shrubby Herbland, Floodplain Grassy Wetland, Floodway Pond Herbland, Riverine Swamp Forest, Lake Bed Herbland, Lignum Shrubland, Lignum Swamp and Riverine Ephemeral Wetland.

These areas provided important seasonal resources for Traditional Owners, and a wide range of cultural places and connections are present. High natural value areas are now mainly located within the Living Murray icon sites of Lindsay–Mulcra–Wallpolla, Hattah Lakes, Gunbower Forest and Barmah National Park. Additionally, the subset of this asset that occurs in Ramsar sites is of international importance under the Ramsar Convention.

Flooding frequency, depth and timing are the main drivers of condition within this asset and representative examples of these Ephemeral Freshwater Wetlands persist where appropriate hydrological regimes occur.

As with the Riverine Forest and Woodland asset, the connectivity created by seasonal floods between adjoining rivers, the floodplain and the Ephemeral Freshwater Wetlands asset is critical in the movement of carbon from these wetlands back to river systems, which increases productivity in river channels.

River regulation and the construction of barriers (such as elevated roadways) and flood mitigation infrastructure (such as levees) have significantly reduced the frequency and duration of inundation of these wetlands by overbank flooding of the adjoining river and creek systems.

In addition, some ephemeral wetlands have a history of unnatural prolonged inundation, having been used for permanent or temporary water storage or outfall of water excess to irrigation needs, resulting in stands of dead, drowned, River Red Gums within or surrounding these wetlands. Fortunately, with the advent of more efficient water management practices within the irrigation system, the practice of discharging excess irrigation water is now uncommon, except during high rainfall events to prevent flooding.

The chequered history of these wetlands has resulted in significant variation in the condition of the Ephemeral Freshwater Wetlands asset across the landscape. Inundation-dependent areas that now receive infrequent seasonal flooding are showing significant signs of stress. This includes limited regeneration of aquatic species (and greater dominance of species more suited to a terrestrial environment) and the invasion of River Red Gums.

Active management interventions, such as the delivery of environmental water, have supported the water regime requirements of some areas of this landscape. This has provided seasonal aquatic habitat for the fauna that migrate into these areas to take advantage of the flourishing food resources.

However, environmental water can only be delivered to areas where physical infrastructure, such as supply networks for irrigation and domestic use, is available (including regulated rivers such as the Murray and Goulburn rivers where environmental water can be released from upstream storages) or where existing waterways or flood runners remain connected to river and creek systems. Some sites, such as the MDBA's Living Murray icon sites, some of the Ramsar wetlands and other sites where specific water entitlements have been set aside, have had the benefit of infrastructure construction and environmental water deliveries.

Investigations continue into bringing new sites into the delivery network to increase the area that can be inundated with environmental water. However, the proportion of this landscape that can receive environmental water will remain relatively small in proportion to the overall size of this asset because of the diminishing availability of overall water resources, the scale and cost of works that would be required to deliver water to many parts of this landscape, and a range of other delivery constraints (for example, delivery capacity of channels and pipelines, limited appetite for flooding of private property). Future management of this asset will need to take into account the limited ability to maintain an appropriate water regime into the longer term.

Nested assets

Eight nested assets have been identified within the Ephemeral Freshwater Wetlands asset (see the table below). All these nested assets depend on appropriate hydrological regimes and vegetation condition and structure. Characteristic flora comprise a selection of representative species from both the wetter and drier phases of the inundation cycle.

Nested asset	Examples of components
Cultural (tangible and intangible)	Food and fibre, physical sites, bush medicine, meeting places, ceremonial places
Characteristic flora	Phragmites, Cumbungi, Common Water-ribbons, Watermilfoil, Moira Grass, Yellow Bladderwort, Matted Water-starwort, Cotton Sneezeweed

Nested asset	Examples of components
Fauna	Giles' Planigale, De Vis' Banded Snake, Inland Carpet Python
Significant flora	Plains Spurge, Fat Spectacles, Wavy Marshwort, Moira Grass, Western Water-starwort, River Swamp Wallaby-grass, Riverina Bitter-cress, Dwarf Bitter-cress, Hairy Darling-pea
Wetland bird species and functional groups	Pink-eared Duck, Chestnut Teal, Freckled Duck, Brolga, Australian Painted Snipe, Australasian Bittern, White-bellied Sea-eagle, crakes, rails, waders, colonial nesters, migratory shorebirds, piscivores
Fish functional groups	FFG-listed Lowland Riverine Fish Community, wetland specialists
Turtles	Broad-shelled Turtle
Frogs	Giant Banjo Frog

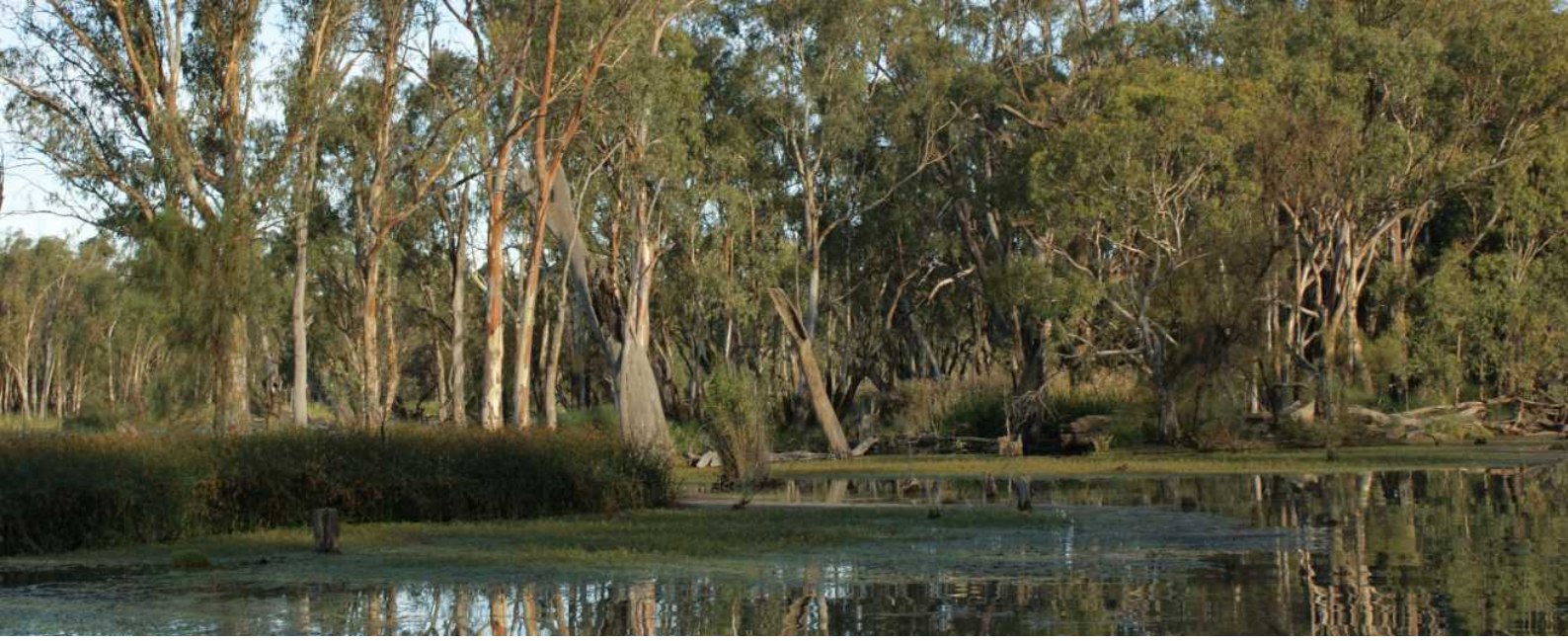
Condition[2]

Key ecological attributes	Indicator	Current condition	Current trend	Condition goal
Vegetation structure and composition	Species richness, tree canopy health, EVC benchmarks	Poor	↘	Poor
Function and connectivity	Extent of asset subject to appropriate hydrological regimes, water quality (e.g. salinity), index of wetland condition (IWC) score	Poor	↘	Poor
FFG-listed Lowland Riverine Fish Community	Species richness, population structure (of wetland specialists)	Poor	↘	Poor
Waterbird abundance	Recruitment, diversity, scale of populations	Poor	↘	Poor
Amphibians	Species richness	Poor	↘	Poor
Reptiles	Presence, population structure, occupancy	Fair	→	Fair
Diversity and abundance of freshwater invertebrates	Number and representativeness of functional groups	Poor	↘	Poor

Conservation outcome

Ephemeral Freshwater Wetlands	Current condition	Desired trend	Desired condition
Over the 15 years to 2034, restore and enhance the condition of Ephemeral Freshwater Wetlands (where environmental water can be delivered) to support flora and fauna species dependent on this habitat; where environmental water cannot be used to supplement the water regime, identify strategies that will facilitate transition to drier climatic conditions.	Poor	→	Poor

[2] The current condition, condition trend, and condition goal in this asset excludes the Ephemeral Freshwater Wetlands that occur within the Ramsar Wetlands asset (which incorporate the Living Murray icon sites), where environmental water can be used to improve the water regime at these locations. Some of these wetlands have water entitlements (such as the Boort Wetlands on the Loddon River) and so can be targeted with environmental water, but some of the wetlands of this asset remain 'stranded', with no physical ability to deliver environmental water to supplement their water regime.



Permanent Freshwater Wetlands

The Permanent Freshwater Wetlands conservation asset covers 7235 hectares of the River Red Gum Park Landscape and includes water bodies with a range of aquatic and semi-aquatic flora, with trees and shrubs occurring only on the margins. Permanence of water in these systems is driven by the frequency of flooding or wetland depth (that is, the amount of time it takes for water to evaporate once filled is less than the typical intervals between floods). Although permanent wetlands usually hold some water, they can dry out during prolonged dry periods.

This asset also includes billabongs, oxbows and floodplain wetlands within the River Red Gum forest matrix in areas such as the Barmah, Murray–Sunset and Gunbower national parks. The permanent inundation of these areas provides important habitat and supports source populations of native fish that disperse to the wider forest floodplain during floods. During dry periods the wetlands provide a drought refuge for native fish and waterbirds. The deeper water in permanent wetlands provides reliable breeding habitat for waterbirds and food sources for piscivorous and insectivorous birds and bats.

The Permanent Freshwater Wetlands asset consists of a number of EVCs of conservation significance, including Aquatic Herbland, Floodplain Grassy Wetland, Red Gum Swamp, Rushy Riverine Swamp, Shallow Freshwater Marsh, Spike-sedge Wetland, and Tall Marsh. These wetlands provided important resources for Traditional Owners across this landscape. The almost permanent water found in these areas provided an ongoing food resource and, accordingly, a wide range of cultural sites and connections are present within this conservation asset.

Similar to the Ephemeral Freshwater Wetlands conservation asset, flooding frequency, depth and timing are the main drivers of condition, and representative high-quality examples of these wetlands persist where appropriate hydrological regimes occur or where these have been supplemented with environmental water. The condition of this asset varies across the extent of the Murray River corridor. The shallower and less frequent flooding caused by river regulation and the construction of barriers (such as elevated roadways) and flood mitigation infrastructure (such as levees) has resulted in a transition to vegetation communities more typical of semi-permanent wetlands and the encroachment of River Red Gums.

Some of the permanent wetlands are supported through active management interventions such as the delivery of environmental water. This has provided critical refuge during drought periods for fauna species that require permanent aquatic habitat.

The diminishing availability of overall water resources, the scale and cost of works that would be required to deliver water to many parts of this landscape and a range of other delivery constraints (for example, delivery capacity of channels and pipelines, limited appetite for flooding of private property) mean that

the proportion of this landscape that can receive environmental water will remain limited. Future management of this asset will need to take into account the limited ability to maintain an appropriate water regime into the longer term.

Some of the best representations of this asset are areas of Barmah National Park, Murray–Sunset National Park, Cullens Lake Wildlife Reserve, Warby–Ovens National Park, the proposed Murray River Park, Kings Billabong Park and Gunbower National Park. Additionally, the subset of this asset that occurs in Ramsar sites is of international importance under the Ramsar Convention.

Nested assets

Six nested assets have been identified within the Permanent Freshwater Wetlands asset (see the table below). All species in these nested assets depend on the range of key ecological attributes listed below. Habitat values and quality in this system is driven by the appropriate application of environmental water in the absence of large-scale floods.

Nested asset	Examples of components
Fish species	Murray River Rainbow Fish, Southern Purplespotted Gudgeon, Flathead Gudgeon, Southern Pygmy Perch
Wetland bird species and functional groups	Pink-eared Duck, Chestnut Teal, Freckled Duck, Australian Painted Snipe, Banded Stilt, Australasian Bittern, crakes, rails, colonial nesters, ducks, piscivores
Migratory and resident shore birds	EPBC-listed community
Flora	Wavy Marshwort, Lagoon Spurge, Flat-sedges, Cotton Sneezeweed
Frogs	Growling Grass Frog
Turtles	Broad-shelled Turtle
Freshwater invertebrates	

Condition

Key ecological attributes	Indicator	Current condition	Current trend	Condition goal
Vegetation structure and composition (aquatic and surrounding terrestrial)	Species richness, tree canopy health, EVC benchmarks	Fair	→	Fair
Function and connectivity	Extent of asset subject to appropriate hydrological regimes, water quality	Fair	→	Fair
FFG-listed Lowland Riverine Fish Community	Species richness, population structure (of wetland specialists)	Poor	→	Fair
EPBC-listed migratory shorebirds	Abundance	Fair	→	Fair
Waterbird abundance	Recruitment, diversity, scale of populations	Poor	→	Fair
Turtles	Presence, population structure, site occupancy	Poor	→	Poor
Freshwater invertebrates	Occupancy, abundance	Unknown	Unknown	Unknown

Conservation outcome

Permanent Freshwater Wetlands	Current condition	Desired trend	Desired condition
Over the 15 years to 2034, enhance the condition of Permanent Freshwater Wetlands (in locations where environmental water can be delivered) so their habitat value as refuges for threatened flora and fauna species is maximised; at sites where environmental water cannot be delivered, support the transition to drier climatic conditions in which these wetlands may become more ephemeral or dry.	Fair		Fair

Saline Wetlands

The Saline Wetlands conservation asset covers 1514 hectares within the Park Landscape and is one of the categories of wetland least impacted by European settlement. This water-dependent conservation asset includes wetlands on sodic soils, permanent and semi-permanent salt lakes, and seasonal mildly saline shrublands dominated by chenopods and succulents. Rare within the planning area, saline wetlands are largely restricted to the lower Loddon River floodplain and Murray–Sunset National Park.

The Saline Wetlands asset is dominated by salt-tolerant plants such as the FFG-listed Salt Paperbark and Sea Tassel, fringed by Chenopod Shrubland on the wetland margins. The asset consists of a number of EVCs, including Saline Lake Aggregate, Samphire Shrubland and Sub-saline Depression Shrubland, and Water Body – Salt.

Saline wetlands provide habitat for a diverse range of native flora and fauna species, particularly the endangered Murray Hardyhead. Good light penetration through the saline water means submerged macrophytes can support high numbers of invertebrates (such as Brine Shrimp), providing an abundant food resource for waterbirds. The combination of food availability, exposed mudflats and open water areas can support diverse populations of waterbirds in high numbers, including migratory shore birds listed under international agreements. Additionally, the subset of this asset that occurs in Ramsar sites is of international importance under the Ramsar Convention.

The condition of the Saline Wetlands asset is strongly influenced by its hydrology, which drives salinity levels that influence the ecological values these systems support. Hydrology is affected by both the frequency of inflows and groundwater intrusions. Historic and current irrigation practices have changed the hydrology of these systems, including the practice of using saline wetlands as drainage water disposal basins to reduce salt loads entering the Murray River. In some locations, this has increased salinity levels beyond natural levels. The management of water in these systems is critical where Murray Hardyhead occurs to ensure salinity levels remain within the tolerable limits and degree of variation for this species.

Nested assets

Four nested assets have been identified within the Saline Wetlands asset (see the table below). All species in these nested assets depend on the range of key ecological attributes listed below.

Nested asset	Examples of components
Migratory shore birds	Curlew Sandpiper, Glossy Ibis, Black-tailed Godwit, EPBC-listed migratory shorebirds
Wetland bird species and functional groups	Caspian Tern, Latham's Snipe, Freckled Duck, Magpie Goose, waders, ducks, piscivores
Fish	Murray Hardyhead
Aquatic flora	Ruppia
Terrestrial flora	Spiny Lignum, Noon-flower, Thorny Lawrencia
Aquatic invertebrates	Brine Shrimp

Condition

Key ecological attribute	Indicator	Current condition	Current trend	Condition goal
Number of EPBC-listed migratory shorebirds	Abundance	Fair	→	Fair
Waterbird abundance	Recruitment, number of individuals by species	Fair	→	Fair
Murray Hardyhead	Presence, occupancy	Poor	→	Poor
Ruppia	Extent	Poor	→	Poor
Vegetation structure and composition (surrounding terrestrial)	Species richness, EVC benchmarks	Good	→	Good
Brine Shrimp	Presence, occupancy	Fair	→	Fair

Conservation outcome

Saline Wetlands	Current condition	Desired trend	Desired condition
Over the 15 years to 2034, support delivery of a water regime that sustains a submerged salt-tolerant aquatic plant assemblage, facilitates the recovery of Murray Hardyhead and provides wader habitat.	Fair	→	Fair

Ramsar Wetlands

The Ramsar Wetlands conservation asset covers 49 447 hectares within the River Red Gum Park Landscape. Wetlands listed under the Ramsar Convention are recognised as being of international importance. Four of Victoria's 12 Ramsar sites are included within the River Red Gum Landscape: Barmah Forest, Gunbower Forest, Hattah–Kulkyne Lakes and Kerang Wetlands.

To be listed as Ramsar site, wetlands must meet one or more internationally accepted criteria based on the type of wetlands they contain or their role in conserving biological diversity. These criteria are used to describe the ecological character of the wetland at its time of listing and the amount of change that is acceptable over time (limits of acceptable change). This aims to ensure that the ecological values recognised as being of international significance are protected over time.

As for much of the River Red Gum Park Landscape, the ecological health (or 'character' in Ramsar terminology) of these Ramsar sites depends on appropriate hydrological regimes. The sites are typified by vegetation communities that rely on regular seasonal flooding to promote flora recruitment and provide the water needed to sustain tree health. They support an array of native fauna, providing habitat for native fish, frogs and waterbirds, including breeding sites for colonial-nesting species such as egrets.

Regulation of flow in the Murray River system has reduced the frequency of flooding at these sites, as well as affecting the magnitude and timing of flooding. These changes to flow patterns have reduced the environmental values of these sites by affecting the health of the vegetation communities and limiting the ecosystem processes they support. Offsetting these hydrological changes by delivering environmental flows plays a critical role in maintaining the ecological character of this asset, its key ecological attributes and the nested assets that occur within the system.

When flooded, these Ramsar sites provided a rich and diverse supply of resources, including food, medicines, shelter, clothing and tools for Traditional Owner groups. There are many places of Indigenous significance in these areas, including mounds, scarred trees, middens, burials, hearths, surface scatters and isolated artefacts.

Given the international importance of Ramsar sites, each site is regarded as an individual conservation asset. The Ramsar approach to describing the ecological character is adopted:

- The critical components, processes and services of the Ramsar site comprise the ecological character description and correspond with the nested assets and key ecological attributes identified in this plan.
- The limits of acceptable change determines the condition (current and future condition) rating, which is –
    - poor — if all of the components of the key ecological attributes are outside of the limits of acceptable change

- fair — if some of the components of the key ecological attributes are outside of the limits of acceptable change
- good — if most of the components of the key ecological attributes are within of the limits of acceptable change
- very good — if all of the components of the key ecological attributes are within of the limits of acceptable change.

Each Ramsar site consists of one or more of the water-dependent conservation assets described above (Riverine Forest and Woodland; Ephemeral Freshwater Wetlands, Permanent Freshwater Wetlands, Saline Wetlands). Accordingly, the conservation objectives and outcomes sought for those conservation assets also apply where they sit within a Ramsar site.

Each of these Ramsar sites is described below, with a focus on the Ramsar criteria. However, it can be assumed that the assets, key ecological attributes, and indicators listed for the relevant water-dependent conservation asset types also apply.

Conservation asset	Ramsar sites where the conservation asset is present
Riverine Forest and Woodland	Gunbower Forest, Barmah Forest
Ephemeral Freshwater Wetlands	Hattah–Kulkyne Lakes, Kerang Wetlands, Gunbower Forest, Barmah Forest
Permanent Freshwater Wetlands	Hattah–Kulkyne Lakes, Kerang Wetlands, Gunbower Forest, Barmah Forest
Saline Wetlands	Kerang Wetlands
Plains Woodland	Gunbower Forest, Barmah Forest

Note: The Box Ironbark Forest, Mixed Dry Forest and Chenopod Shrubland conservation assets are not present within the Ramsar sites.

Hattah–Kulkyne Lakes

The Hattah–Kulkyne Lakes Ramsar site covers 955 hectares and consists of 12 lakes situated on the floodplain of the Murray River in Victoria's Mallee region. The lakes lie approximately 15 kilometres from the Murray River and are connected by Chalka Creek. The lakes can hold water for up to 10 years without flooding and are important aquatic habitat in a semi-arid landscape, particularly for waterbirds and fish.

At the time of listing in 1982, the Hattah–Kulkyne Lakes met five Ramsar criteria. In summary, the characteristics of the site that enabled its listing related to:

- wetland functioning — its representativeness as an intact series of wetlands, its capacity to support a number of wetland-dependent threatened species and its importance in maintaining the biological diversity of the biogeographic area
- habitat values — its role in supporting a large number of wetland birds and native fish at critical life stages, and in providing food resources and spawning and nursery habitats for fish.

The future management of the Hattah–Kulkyne Lakes will conserve these characteristics, which have informed the key ecological attributes and indicators identified by this plan.

Nested assets

Nested asset	Examples of components
Fish	Wetland specialists
Waterbirds	Australian Pelican, Australian Wood Duck, Black-winged Stilt, Australasian Darter, Great Cormorant, Great Crested Grebe, Little Black Cormorant, Masked Lapwing, Pacific Black Duck, White-faced Heron, Yellow-billed Spoonbill
Threatened flora	Winged Pepper-cress
Threatened fauna	Regent Parrot (eastern)
Habitat	Lake Bed Herbland

Condition

Key ecological attribute	Indicator*	Current condition	Current trend	Condition goal
Flow regime functioning and connectivity	Extent (hydrological regime is of suitable frequency and duration of filling events (natural flooding and environmental water) at key wetlands)	Fair	→	Good
Wetland vegetation — spatial distribution of species	Site occupancy (presence of Winged Pepper-cress between Lake Hattah and Lake Bulla)	Fair	→	Good
Native fish — spatial distribution of species	Site occupancy, spatial distribution (of wetland specialist native fish species)	Fair	→	Good
Waterbird — spatial distribution and diversity of key species at key sites	Site occupancy, representativeness, species richness (number of species present and their distribution)	Poor	→	Fair
Threatened species — abundance	Site occupancy (presence of Regent Parrot (eastern) at Ramsar site on an annual basis)	Fair	→	Good
Lake Bed Herbland spatial distribution	Extent (of Lake Bed Herbland vegetation)	Fair	→	Good

* Each indicator should remain within the limits of acceptable change defined in the relevant Ramsar site management plan.

Conservation outcome

Hattah–Kulkyne Lakes Ramsar site	Current condition	Desired trend	Desired condition
Over the 15 years to 2034, manage the key ecological attributes within the limits of acceptable change identified in the ecological character description for the Hattah–Kulkyne Lakes Ramsar site (Butcher and Hale, 2011a).	Fair	↗	Good

Kerang Wetlands

The Kerang Wetlands Ramsar site is part of an extensive system of wetlands located on the western extremity of the Riverine Plain of the Loddon–Murray Region. The site covers approximately 9419 hectares, and the wetlands feature an incredible diversity of permanent and temporary wetlands, permanent freshwater lagoons, permanent open freshwater lakes, deep freshwater marshes, and saline and hypersaline lakes.

The wetlands included in the Ramsar site occur on a range of land tenures, with differing land managers (Appendix F). Of the 24 wetlands, Parks Victoria manages 13: Scott's Creek, the Kerang Weir Pool, Town Swamp, Lake Cullen, Johnson Swamp, Hird Swamp, Fosters Swamp, Stevenson Swamp, Cemetery Swamp, Lake Bael Bael, First Marsh, Second Marsh and Third Marsh.

At the time of listing in 1982, the Kerang Wetlands met six Ramsar criteria. In summary, the characteristics of the site that enabled its listing related to:

- wetland functioning — its representativeness as a near-natural wetland typical of the biogeographical region, its role in the natural functioning of a major river basin, and its capacity to maintain genetic and ecological diversity within the region
- waterbird habitat — its ability to support over 20 000 waterbirds when inundated, including substantial numbers of individuals from particular groups of waterbirds.

The future management of the Kerang Lakes will conserve these characteristics, which have informed the key ecological attributes and indicators identified by this plan.

Nested assets

Nested asset	Examples of components
Waterbird functional groups and species	Banded Stilt, Australasian Bittern, Curlew Sandpiper, Australian Shelduck, Musk Duck Ducks, herbivores, waders, piscivores, shorebirds, migratory shorebirds, colonial nesters, spoonbills
Wetland diversity — physiochemistry (salinity)	Fresh (less than 4000 EC), brackish (4000 EC to 10 000 EC), saline (10 000 EC to 100 000 EC), hypersaline (greater than 100 000 EC)

Condition

Key ecological attribute	Indicator*	Current condition	Current trend	Condition goal
Flow regime functioning and connectivity	Extent (hydrological regime is of suitable frequency and duration of filling events (natural flooding and environmental water)), water quality within acceptable tolerances	Fair	→	Fair
Waterbirds — recruitment, abundance and diversity	Demography (evidence of breeding, recruitment of juveniles), occupancy, species richness	Fair	→	Good
Threatened species — abundance	Occupancy (presence of Australasian Bittern in five out of 10 years in Hird and / or Johnsons swamps, presence of Curlew Sandpiper in the Ramsar site in no less than five years out of 10)	Fair	→	Good
Wetland vegetation — spatial distribution of functional groups and diversity of species	Extent (total extent across the entire Ramsar site — including areas not managed by Parks Victoria — of the key vegetation communities remains), species richness, spatial distribution	Fair	→	Fair

* Each indicator should remain within the limits of acceptable change defined in the relevant Ramsar site management plan.

Conservation outcome

Kerang Wetlands Ramsar site*	Current condition	Desired trend	Desired condition
Over the 15 years to 2034, manage the key ecological attributes within the limits of acceptable change identified in the ecological character description for the Kerang Lakes Ramsar site (Butcher and Hale, 2016).	Fair	→	Fair

* The current condition, current trend, condition goal and conservation outcome are only indicative of the Parks Victoria–managed portion of the Kerang Wetlands Ramsar site.

Gunbower Forest

The Gunbower Forest Ramsar site covers 19 931 hectares along the Murray River floodplain between Torrumbarry and Koondrook. The Ramsar site consists of River Red Gum forest and a network of permanent and temporary wetlands, including lakes, swamps and lagoons. The wetlands and surrounding floodplain forest provide habitat for large numbers of birds and native fish.

This Ramsar site has mixed land tenure, including 8892 hectares of national park, 1666 hectares of Crown land frontage managed by Parks Victoria, and 8843 hectares of state forest managed by DELWP.

Due to its significance as a large River Red Gum floodplain and Ramsar site along the Murray River, Gunbower Forest (and the adjacent Koondrook Forest) has also been classified as an icon site under the Murray–Darling Basin Authority's Living Murray project. This status has given the site a higher priority for funding for construction of environmental water delivery infrastructure as well as access to the Living Murray environmental water entitlement, which is used to help meet the hydrological objectives for the site.

At the time of Ramsar listing in 1982, Gunbower Forest met four criteria under the Ramsar Convention. In summary, the characteristics of the site which enabled its listing related to:

- intactness — as a large and relatively intact forested floodplain, its representativeness as an example of this wetland type in the bioregion and its capacity to support a large number of threatened plant and animal species
- habitat values — its importance as a site for breeding of waterbirds and native fish, and as nursery habitat for native fish recruitment because of its connectivity with the Murray River.

The future management of Gunbower Forest will conserve these characteristics, which have informed the key ecological attributes and indicators identified by this plan.

Nested assets

Nested asset	Examples of components
Fish species and assemblages	Australian Smelt, Carp Gudgeon, Dwarf Flathead Gudgeon, Flathead Gudgeon, Flyspecked Hardyhead, Murray River Rainbowfish, Murray Cod, Silver Perch
Waterbirds	Australasian Bittern, colonial nesters
Threatened flora	River Swamp Wallaby-grass, Winged Pepper-cress
Flora communities and species	River Red Gum Floodplain Forest, Spike-sedge Wetland, Tall Marsh Wetland

Condition

Key ecological attribute	Indicator*	Current condition	Current trend	Condition goal
Flow regime functioning and connectivity	Extent (hydrological regime is of suitable frequency, duration and magnitude of filling events (natural flooding and environmental water) at key wetlands)	Fair	→	Fair
River Red Gum health and habitat features	Canopy health and availability of tree hollows	Fair	→	Fair
Wetland vegetation spatial distribution of functional groups and species	Extent, spatial distribution	Fair	→	Fair
Threatened species — abundance	Occupancy (presence of River Swamp Wallaby-grass in permanent and intermittent wetlands)	Poor	→	Fair
Native fish — spatial distribution of species	Occupancy (presence of key wetland specialists in no less than two in five annual surveys)	Fair	→	Fair
Waterbird recruitment and spatial distribution	Demography (evidence of breeding success of colonial nesters), occupancy (presence of Australasian Bittern when Tall Marsh is inundated)	Poor	→	Fair

* Each indicator should remain within the limits of acceptable change defined in the relevant Ramsar site management plan.

Conservation outcome

Gunbower Forest Ramsar site*	Current condition	Desired trend	Desired condition
Over the 15 years to 2034, manage the key ecological attributes within the limits of acceptable change identified in the ecological character description for the Gunbower Forest Ramsar site (Butcher and Hale, 2011b).	Fair	→	Fair

* The current condition, current trend, condition goal and conservation outcome are only indicative of the Parks Victoria–managed portion of the Gunbower Forest Ramsar site.

Barmah Forest

The Barmah Forest Ramsar site covers 28 515 hectares (Department of Environment and Primary Industries, 2013) and is part of the largest complex of tree-dominated floodplain wetlands in southern Australia. Together with the Millewa Forest (on the New South Wales side of the Murray River), it represents the largest continuous stand of River Red Gum forest in Australia. Barmah Forest Ramsar site is located on the Murray River floodplain within Victoria between the downstream end of the Ulupna Island and Barmah township. Barmah Forest is subject to periodic inundation and features a variety of permanent and temporary wetlands, including lakes, swamps, lagoons and flooded forest.

Barmah Forest was first listed as a Ramsar site in 1982 at a time when it was managed as state forest (Butcher and Hale, 2011c). In 1987, approximately one-third of the area was re-classified as state park or reference area. In 2010, most of the area was proclaimed a national park, which is now jointly managed by the Yorta Yorta and Parks Victoria, guided by a Traditional Owner land management agreement (Yorta Yorta Traditional Owner Land Management Board and DELWP, 2019). The national park boundary includes Ulupna Island, which is not in the Ramsar site, but excludes Barmah Island, which is within the Ramsar site. Barmah Island is managed solely by Parks Victoria but remains within the Yorta Yorta Whole of Country Plan (Yorta Yorta Nations Aboriginal Corporation, 2012).

Due to its ecological significance, Barmah Forest (and the adjacent Millewa Forest) has also been classified as an icon site under the Murray–Darling Basin Authority's Living Murray project. This status has given the site a higher priority for funding for construction of environmental water delivery infrastructure as well as access to the Living Murray environmental water entitlement, which is used to help meet the hydrological objectives for the site.

At the time of listing in 1982, Barmah Forest met six Ramsar criteria. In summary, the characteristics of the site which enabled its listing related to:

- intactness — the floodplain's size and intact nature, encompassing valuable freshwater tree-dominated wetlands and vast expanses of Moira Grass, are bioregionally significant
- waterbird values — its capacity to support more than 20 000 waterbirds when inundated
- habitat values — its ability to provide important migratory routes between river and floodplain habitats for native fish recruitment, and its capacity to support large numbers of breeding waterbirds, frogs, native fish and turtles when inundated.

The future management of Barmah Forest will conserve these characteristics, which have informed the key ecological attributes and indicators identified by this plan.

Nested assets

Nested asset	Examples of components
Fish assemblages	Australian Smelt, Carp Gudgeon, Dwarf Flathead Gudgeon, Flathead Gudgeon, Unspecked Hardyhead, Murray River Rainbowfish, Murray Cod, Trout Cod, Silver Perch
Waterbird species and functional group	Australasian Bittern, colonial nesters
Vegetation communities and species	River Red Gum Forest, River Red Gum Woodland, Floodplain Marsh, Giant Rush, Moira Grass
Threatened flora	Moira Grass, Mueller Daisy, River Swamp Wallaby-grass
Threatened Fauna	Superb Parrot

Condition

Key ecological attribute	Indicator*	Current condition	Current trend	Condition goal
Flow regime functioning and connectivity	Extent (suitable frequency, duration and magnitude of filling events at key wetlands)	Fair	→	Fair
Wetland vegetation — spatial distribution	Extent (of key vegetation communities, particularly Moira Grass and Giant Rush)	Poor	↘	Fair
Wetland vegetation — structure and composition	Canopy health	Good	→	Good
Threatened species	Site occupancy (of River Swamp Wallaby-grass and Mueller Daisy in permanent and intermittent wetlands)	Poor	→	Fair
Native fish — spatial distribution of species	Site occupancy (presence of key wetland specialists in no less than two in five annual surveys, and of Murray Cod, Trout Cod and Silver Perch in three out of five annual surveys)	Fair	→	Good
Waterbird recruitment, abundance and spatial distribution	Demography (evidence of breeding success of colonial nesters), species richness, spatial distribution (number of individuals within, and frequency of establishment of, nesting colonies), site occupancy (presence of Australasian Bittern when reed beds are inundated, and of Superb Parrot and evidence of annual breeding)	Fair	→	Fair

*Each indicator should remain within the limits of acceptable change defined in the relevant Ramsar site management plan.

Conservation outcome

Barmah Forest Ramsar site	Current condition	Desired trend	Future status
Over the 15 years to 2034, manage the key ecological attributes within the limits of acceptable change identified in the ecological character description for the Barmah Forest Ramsar site (Butcher and Hale, 2011c).	Fair	→	Fair

Plains Woodland

The Plains Woodland conservation asset covers 3872 hectares of the River Red Gum Park Landscape. It is part of the Grey Box (*Eucalyptus microcarpa*) Grassy Woodland and Derived Native Grasslands of South-eastern Australia ecological community that is listed as endangered under the EPBC Act. This community is associated with relatively fertile soils and has been historically cleared to make way for agriculture, and the remaining areas are fragmented and degraded.

The Plains Woodland asset is characterised by a grassy understorey with a low and sparse open canopy. The canopy is dominated by eucalypt species, including Grey Box or Black Box, and Buloke (in the Plains Woodland EVC). Canopy height can extend up to 15 metres, with a cover often less than 20 per cent.

The condition of the asset varies across the landscape with many of the remaining fragments subject to grazing pressure (by native and introduced species) and having limited canopy recruitment. The introduction of weeds has significantly altered the composition of this ecosystem. Generally, this has reduced the diversity of both flora and fauna species within the Plains Woodland conservation asset. Fire has a limited role in maintaining the health of the Plains Woodland ecosystem. In La Niña conditions, which may increase the growth of grasses, the Plains Woodland sub-ecosystems can tolerate and recover rapidly from low severity fires.

The Plains Woodland asset often occurs on the ecotone between more terrestrial landscape dominated by drier forest communities such as Box Ironbark Forest and Mixed Dry Forest, and communities with inundation-tolerant vegetation, such as Riverine Forest and Woodland and Ephemeral Freshwater Wetlands. Inundation has a limited role in maintaining the health of the Plains Woodland ecosystem, which sits relatively high in the landscape — above the usual extent of the floodplain except for extreme and rare rainfall events when it may be shallowly inundated for a short period of time.

Due to the small area of this conservation asset within the River Red Gum Park Landscape, and its greater presence within the adjoining Mallee, Northern Plains and Riverina, and North East and Inland Slopes landscapes, threat management and monitoring for this asset will be informed by plans for these adjoining landscapes.

Nested assets

Three nested assets have been identified within the Plains Woodland asset (see the table below). All species in these nested assets depend on the range of key ecological attributes below. Habitat quality in this ecosystem is driven by the management of grazing, habitat connectivity and weediness.

Nested asset	Examples of components
Flora	Neverfail, Riverine Flax-lily
Reptiles	Carpet Python, Broad-shelled Turtle, Mueller's Skink,
Bird assemblages	Woodland birds

Condition

Key ecological attributes	Indicator	Current condition	Current trend	Condition goal
Non-eucalypt woodland vegetation growth stage, structure, composition and habitat features	Demography (growth stage distribution), extent (of ground cover distribution and coarse woody debris)	Fair	↘	Good
Eucalypt woodland vegetation growth stage, structure, composition and habitat features	Demography (growth stage distribution), extent (of ground cover distribution and coarse woody debris) hollow-bearing trees	Fair	↘	Good
Woodland bird diversity and abundance	Site occupancy, species richness, spatial distribution	Fair	↘	Good

Conservation outcome

Plains Woodland	Current condition	Desired trend	Desired condition
Over the 15 years to 2034, maintain and enhance the condition and connectivity of Plains Woodland communities to support declining flora and fauna species.	Fair	↗	Good

Box Ironbark Forest

The Box Ironbark Forest conservation asset in the River Red Gum Park Landscape occurs almost entirely within the Warby–Ovens National Park. This asset covers 3222 hectares and represents only one per cent of Box Ironbark forests managed by Parks Victoria.

Box Ironbark forests occur on relatively poor soils. Various species of eucalypt flower at different times of year and provide a substantial nectar resource that supports nectivorous fauna throughout the year. The ecosystem is noted for being a particularly important winter-flowering eucalypt resource that supports seasonal migrants such as the Swift Parrot. The open understorey consists of sparse shrubs and a grassy ground layer. In the River Red Gum Park Landscape, Box Ironbark Forest is confined to the Warby–Ovens National Park and neighbouring smaller reserves, near the north-eastern boundary of the Park Landscape.

The Box Ironbark Forest asset consists of a single EVC, Box Ironbark Forest. In the long-term management of this EVC, fire is an element in maintaining a diverse ecological structure, particularly in the understorey, and is also a factor in hollow development in trees. However, bushfire can also reduce biodiversity through local extinction of particular species and reduced abundance of habitat features such as fallen timber, dead standing trees and hollow-bearing trees.

Management of this asset for fire protection for surrounding rural communities, while maintaining ecological diversity, remains an ongoing challenge for land managers. The condition of this asset varies within the Warby–Ovens National Park, with fire management and weed invasion being the key drivers of condition.

The Box Ironbark Forest conservation asset makes up a relatively small proportion of the area covered by this River Red Gum Park Landscape Conservation Action Plan. A far greater extent occurs in the surrounding landscapes of the North East and Inland Slopes and the Central Goldfields, which are dominated by this asset type. Therefore, threat management and monitoring will be undertaken as informed by adjoining landscape plans.

Nested assets

Five nested assets have been identified for the Box Ironbark Forest asset (see the table below). All nested assets depend on a mixed canopy age with appropriate understorey strata, including open patches.

Nested asset	Examples of components
Woodland bird community	Regent Honeyeater, Swift Parrot
Reptiles	Carpet Python, Dwyer's Snake
Small mammals	Yellow-footed Antechinus
Arboreal mammals	Squirrel Glider
Large forest owls	Barking Owl

Condition

Key ecological attributes	Indicator	Current condition	Current trend	Condition goal
Vegetation structure and composition	Demography (growth stage distribution), extent of shrub and groundcover distribution	Fair	↘	Good
Habitat features	Extent of coarse woody debris and tree hollows	Fair	→	Good
Woodland bird diversity and extent	Site occupancy, species richness, spatial distribution	Fair	↘	Fair
Ground-dwelling reptiles	Site occupancy, species richness	Fair	→	Good
Arboreal mammals	Site occupancy, species richness, representativeness (including presence of indicator species such as Feather-tailed Glider and Squirrel Glider)	Fair	→	Good

Conservation outcome

Box Ironbark Forest	Current condition	Desired trend	Desired condition
Over the 15 years to 2034, maintain and enhance the condition of Box Ironbark Forest to support declining bird and other fauna species dependent on this habitat.	Fair	↗	Good

Mixed Dry Forest

The Mixed Dry Forest conservation asset occurs across 9101 hectares of the Park Landscape, including the Warby–Ovens National Park, Murray–Sunset National Park, Kings Billabong Park, Heywood Lake Wildlife Reserve and the proposed Murray River Park. These parks contain 99.7 per cent of this conservation asset in the Park Landscape.

The Mixed Dry Forest asset consists of a number of EVCs, including Granitic Hills Woodland, Grassy Dry Forest, Grassy Woodland, Heathy Dry Forest, Rocky Outcrop Shrubland, Rocky Outcrop Herbland and Valley Grassy Forest. It occurs as eucalypt forest with a low grassy or shrubby understorey on a variety of soil types. Smaller trees such as Cypress Pine and wattles may be prominent. Fire is a driver of condition within this system, with timing, intensity and frequency all seen as determinants of condition. The condition of this asset varies across the extent of the Murray River corridor. Good representation of the asset will include large hollow-bearing trees and diverse understorey vegetation. The vegetation in this asset is particularly susceptible to the threat of *Phytophthora cinnamomi*, which causes obvious dieback of dry forest vegetation and is particularly visible in the decline and death of grass trees and canopy dieback.

Due to the small area of this conservation asset within the River Red Gum Park Landscape, and its greater presence within the adjoining North East and Inland Slopes Landscape, threat management and monitoring will be undertaken as informed by the latter landscape's conservation action plan.

Nested assets

Two nested assets have been identified within the Mixed Dry Forest asset (see the table below). All species in these nested assets depend on the listed key ecological attributes. This vegetation structure is driven by the appropriate application of ecological fire and the absence of large-scale bushfire.

Nested asset	Examples of components
Significant flora species	Wedge Diuris, Spur-wing Wattle
Hollow-dependent fauna	Superb Parrot, Apostlebird, Regent Parrot, Carpet Python

Condition

Key ecological attributes	Indicator	Current condition	Current trend	Condition goal
Vegetation growth stage	Demography, spatial distribution of growth stages, habitat complexity and time since burnt	Poor	↘	Good
FFG-listed Temperate Woodland Bird Community	Species richness	Unknown		Unknown
Ground-dwelling reptiles	Site occupancy, species richness	Fair	↘	Fair
Large forest owls	Site occupancy	Fair	→	Good
Arboreal mammals	Site occupancy, species richness, representativeness	Unknown		Unknown

Conservation outcome

Mixed Dry Forest	Current condition	Desired trend	Desired condition
Over the 15 years to 2034, maintain and enhance the condition of Mixed Dry Forest to support declining bird and other fauna species dependent on this habitat.	Fair	↗	Good

Chenopod Shrubland

The Chenopod Shrubland conservation asset is associated with saline soils and accounts for 11 571 hectares of the River Red Gum Park Landscape. It is predominantly found in the flat alluvial terraces of the Murray River in the north-west of the River Red Gum Park Landscape, but it also occurs on the salt flats of relict lakebed surfaces and can be found in narrow bands fringing raak and saline lakes.

This asset consists of a single EVC, Low Chenopod Shrubland, which is characterised by low shrubby vegetation to a height of up to 1.5 metres. Hardy drought- and salt-tolerant shrub species, including saltbushes and Streaked Copperburr (both in the chenopod sub-family) and Nitre Bush, occupy the upper strata with a groundcover of a variety of annual herbs and succulents. A relatively high proportion of the asset has no vascular flora, and the alkali clay soils are stabilised by a cryptogamic crust (of mosses, lichens, algae and bacteria) that helps to prevent soil erosion from wind and rain. The intactness of this asset is most affected by weed invasion and grazing, which can disturb the cryptogamic crust. Like much of the River Red Gum Park Landscape, the Chenopod Shrubland asset has a history of grazing (cattle and sheep). Although stock have been removed from the Park Landscape, the cryptogamic crust can take tens to hundreds of years to recover.

The cryptogamic crust is also damaged by off-road driving and vehicle use. Due to the low height of the shrubland vegetation, this asset is particularly susceptible to off-road driving. New tracks establish readily and are very slow to rehabilitate. Floristic recruitment of Chenopod Shrubland species is continuous and does not require fire for species regeneration.

Chenopod Shrubland provides habitat for a wide range of reptiles and feeding grounds for microbats that use hollows in mallee eucalypt species in adjacent areas.

Nested assets

Three nested assets have been identified within the Chenopod Shrubland asset (see the table below). All species in these nested assets depend on the listed key ecological attributes. This vegetation structure is driven by the intactness of the cryptogamic crust, availability of open ground and density of introduced flora species.

Nested asset	Examples of components
Reptiles	Tessellated Gecko, Tree Dtella, Bynoe's Gecko, Thick-tailed Gecko, Eastern Hooded Scaly-foot, Stumpy-tail, Samphire Skink
Small mammals	Fat-tailed Dunnart, microbats
Desert Glasswort	

Condition

Key ecological attributes	Indicator	Current condition	Current trend	Condition goal
Vegetation structure	Spatial distribution (of shrubs, ground and cryptogram cover)	Fair	→	Fair
Reptile abundance and diversity	Site occupancy, species richness	Fair	→	Good

Conservation outcome

Chenopod Shrubland	Current condition	Desired trend	Future status
Over the 15 years to 2034, maintain the condition of Chenopod Shrubland structure and diversity.	Fair	→	Fair

6 Threats to conservation outcomes

6.1 Methodology for assessing threats

Parks Victoria's method for assessing threats broadly follows the process outlined in the current standard for risk management (AS/NZS ISO 31000: 2009). Threats to conservation assets are assessed against their impact on achieving the defined conservation outcome for each asset and their direct impact on key ecological attributes. The assessment is a three-step process.

1 **Identify threats to conservation outcomes.**

   Threats to conservation assets are identified by assessing the threat agents as well as the impact of the threatening process on key ecological attributes. For example, the effect of foxes (agent) is predation (process), which reduces the abundance and diversity of small ground-dwelling fauna (impact).

2 **Classify threats.**

   Threats are classified according to a risk assessment matrix that defines both the likelihood and ecological consequence of the identified threats impacting on key ecological attributes (Carey et al., 2007). Threats are rated as extreme, high, moderate or low risk. Priority areas for the risk abatement of threats are mapped.

3 **Develop threat management objectives.**

   Threat management objectives are developed to mitigate the impact of the threats that are the greatest risk to conservation assets. Threat management objectives specify the change in high-risk threats required to achieve a particular conservation outcome for a conservation asset.

6.2 Threats to conservation assets

A broad range of key threats to the conservation assets of the River Red Gum Park Landscape were identified by participants in the conservation action planning workshops. These threats have been assessed and ranked using the methodology described above (Table 6.1). This plan directly addresses the highest rated threats.

The key threats to the conservation assets are those that affect the key ecological attributes; generally considered to be those having the greatest impact on the regeneration, recruitment and restoration of species and ecological communities. Identifying these threats ensures that management focuses on ensuring that species and ecological communities are functioning within acceptable bounds to maintain key species (for example, Moira Grass in Ramsar wetlands) and threatened flora and fauna populations (for example, Regent Parrots, native fish, waterbirds). Although pathogens such as phytophthora and chytrid fungus are known to affect the vegetation and amphibians in this Park Landscape, the highly modified nature of the landscape means that they are not likely to have further manageable impacts.

Threats generated by visitor use and illegal activities are largely addressed in the *River Red Gum Parks Management Plan* (Parks Victoria, 2018a). The management plan also includes strategies to reduce or abate threat impacts.

Table 6.1 Key threats and risk levels for the conservation assets of the River Red Gum Park Landscape

Threatening process	Threat agent and impact	Riverine Forest and Woodland	Ephemeral Freshwater Wetlands	Permanent Freshwater Wetlands	Saline Wetlands	Plains Woodland	Mixed Dry Forest	Box Ironbark Forest	Chenopod Shrubland
Alteration to natural hydrological regimes	Hydrological regimes impacted by river regulation infrastructure or lack of ability to deliver environmental water	**High**	**Extreme *sites receiving env. water = Moderate**	**Extreme *sites receiving env. water = Moderate**	**Moderate *Murray Hardyhead = Extreme**	**High**	-	-	-
Fire — regimes and management	Too frequent, infrequent, wrong season/severity/scale, causing the degradation of habitat, landscape functioning and connectivity. Reduced capacity for landscape to support biodiversity	**High**	**Low**	**Low**	**Low**	**High**	**High**	**High**	**Low**
Recreational activities	Recreational activities such as camping, prospecting and wood collection for campfires degrade habitat by disturbing soil and vegetation and depleting available coarse woody debris (already reduced by past land use).	**Low**	**Moderate**	**Moderate**	-	**Moderate**	**Low**	**Low**	-
Terrestrial grazing, browsing and trampling	Introduced herbivores and overabundant macropods affect the regeneration and recruitment of native species, resulting in simplification of vegetation structure and reduced floral diversity.	**High**	**Moderate *Moira Grass plains in Barmah Forest = Extreme**	**High *Barmah Forest = Extreme**	**High**	**High**	**Moderate**	**Moderate**	**High**
Aquatic grazing and predation	Introduced aquatic pest fish disrupt aquatic ecosystems by preying on native fish and frogs and competing for available resources.	-	**High**	**Moderate**	**Moderate *Murray Hardyhead = High**	-	-	-	-

Table 6.1 Key threats and risk levels for the conservation assets of the River Red Gum Park Landscape (continued)

Threatening process	Threat agent and impact	Riverine Forest and Woodland	Ephemeral Freshwater Wetlands	Permanent Freshwater Wetlands	Saline Wetlands	Plains Woodland	Mixed Dry Forest	Box Ironbark Forest	Chenopod Shrubland
Weed invasion — terrestrial and aquatic	Weeds displace native species, alter vegetation structure and impact fire regimes. Overabundant native species displace existing flora and congest streams.	High	Moderate	Moderate	Low	Moderate	Moderate	Moderate	Moderate
Habitat fragmenta-tion	New management tracks/inappropriate development/strategic firebreaks degrade habitat, cause edge effects and facilitate the movement of pest plants, animals and pathogens.	Moderate	–	–	–	Moderate	Moderate	Moderate	Moderate
Legacy resource management and past land use	Grazing licences (past and current)/historic land use/legacy of campsites/historic timber harvesting have continuing effects in the landscape.	High	–	–	–	Moderate	–	High	–
Diseases	Direct decline in vegetation caused by phytophthora dieback	Low	–	–	–	Moderate	Moderate	Moderate	–
Off-road driving	Off-road driving (legal and illegal), disturbs habitat, creates barriers to species movement through the displacement of groundcover vegetation and removes soil crust, causing erosion.	Low	Moderate	Moderate	–	Moderate	Low	Low	Moderate

Inappropriate hydrological regimes

Threat description

Riparian, floodplain and wetland ecosystems depend on appropriate hydrological regimes. The timing, duration and frequency of floods determine the composition and characteristics of any inundation-dependent vegetation community. Natural hydrological regimes have been significantly altered across the landscape, degrading the ecological character of many inundation-dependent systems. Water supply to some areas has been reduced by:

- upstream water capture in large storage dams to enable regulated deliveries and diversions for irrigation control (river regulation)
- upstream water capture in many small farm dams that capture rainfall run-off
- localised extractions
- areas being physically cut off from the surrounding landscape by infrastructure such as roads, channels and levees.

Some other areas now face more frequent inundation; for example, systems used for irrigation channel outfall or water storage.

Highly modified flows in the Murray River, as well as its tributaries including the Goulburn, Broken, Campaspe and Loddon rivers, have changed the hydrological regime across the inundation-dependent conservation assets in the Park Landscape: Riverine Forest and Woodland, Ephemeral Freshwater Wetlands, Permanent Freshwater Wetlands, Saline Wetlands and Ramsar Wetlands. Alteration of the natural hydrological regime has significantly changed the ecological character of many of these systems from their natural state.

While the water itself provides critical aquatic habitat and the opportunity for aquatic flora and fauna to thrive during inundation events, there are also other consequences of an inappropriate hydrological regime. Wetland-dependent species require floods with a timing, duration, frequency, and depth that matches their lifecycle requirements. However, river regulation alters the pattern of flooding. In general, floods are less frequent, and the small-to-medium floods do not occur because the run-off from rainfall events that would cause these is captured in upstream dams and storages. Similarly, larger floods are often of shorter duration because overbank floods do not occur until the upstream storages are full and begin to spill.

Another impact of changes to hydrology is that the altered flow regime can be more favourable for invasive species (introduced and native), allowing them to dominate. In some locations, this has allowed some species to encroach into areas where they would not normally survive; for example, species that require floods to initiate germination and whose population is then usually regulated by subsequent floods. This pattern is described further in the threat description for invasion by introduced and native flora.

The interaction between surface water and groundwater are complex; however, hydrological regimes at this interface have also changed. The quality and quantity of groundwater have changed, and in turn this affects the health of inundation-dependent systems. In some areas, groundwater has become depleted, which can reduce the volume of river flows and wetland depth (and rate of evaporation). In other areas, rising groundwater (in some locations saline groundwater) is also affecting the health of both inundation-dependent and terrestrial ecosystems.

Another key driver of change in hydrological regime is climate change. Changes to the seasonality of flood and dry events, and generally the reduced frequency and duration of rainfall, has exacerbated the already significant impact of river regulation and produced significantly drier inundation-dependent systems.

Reinstating a more natural flow regime through changes to current regulated river operations, along with the delivery of environmental water, will mitigate some of the impacts of an inappropriate hydrological regimes and increase the health of key ecological attributes and the nested assets that occur within each of the inundation-dependent conservation assets. However, this may only be possible in areas targeted for environmental water delivery.

Threat objective

By 2024, targeted areas of inundation-dependent conservation assets are stable or improving in condition because of managed environmental water deliveries that improve the hydrological regime.

Fire regimes and management

Threat description

The River Red Gum Park Landscape has a history of Aboriginal communities using fire for domestic and land management activities at small scales (Gott, 2005; in Palmer and Cahir, 2010).

Today, fires in the Park Landscape are used primarily for recreation (that is, campfires), or fire is used as a tool for fuel reduction or ecological purposes. The greatest threat of bushfire ignitions in this landscape are human induced, with the majority starting from escaped campfires.

The role of fire in maintaining the health of River Red Gum ecosystems is limited, with the majority of vegetation types within the Park Landscape cued to regenerate by floods rather than fire. The dominant conservation asset in this landscape, Riverine Forest and Woodland, has a minimum tolerable fire interval of greater than 30 years, with possibly no upper limit — highlighting that the vegetation community structure and diversity can persist during very long periods without fire. The development of large nesting hollows in River Red Gum trees can take many decades, and the progression of large limbs developing and then falling to become coarse woody debris, can take a century or more.

Established, hollow-bearing River Red Gum trees can be lost or damaged by fires that cause burnout and subsequent collapse (Palmer and Cahir, 2010). This depletes the available nesting hollows for hollow-dependent fauna such as the Regent Parrot. Many large old trees that can be lost through fire are also Aboriginal scarred trees. Coarse woody debris that provides habitat for small terrestrial mammals, invertebrates, reptiles and birds is also susceptible to destruction by fire.

Fires in the riverine system have not historically been prone to developing into large-scale bushfires. However, under the right conditions, particularly in summer, the risk of large intense fires can be high. This risk is compounded by other threats such as river flow regulation causing premature drying of riverbeds and climate change–induced weather events, resulting in harsher fire weather.

The Mixed Dry Forest, Plains Woodland and Box Ironbark Forest assets may benefit from the appropriate application of fire to maintain growth structure and species diversity, particularly in the understorey and ground cover strata. However, they too will maintain floristic complexity and diversity in the absence of fire for long periods of time or indefinitely. Ecosystems such as Saline Wetlands and Chenopod Shrubland are less flammable, while vegetation types like the more elevated and drier Plains Woodland ecosystem burn more readily.

Fire management activities can also impact conservation assets. New tracks or control lines support vehicle access to areas previously only accessible on foot. This risks the spread of pathogens and weeds, and may also put Aboriginal cultural heritage sites such as middens and scarred trees at risk of being damaged during fire operations. The use of fire retardants, particularly around and near aquatic ecosystems, is also a threat to the high proportion of water-dependent assets in this landscape.

Threat objective

By 2024, protect large River Red Gums from fire and minimise the likelihood of large-scale bushfires through campfire awareness and visitor planning. Use fire where appropriate to increase the structural diversity of understorey vegetation in Plains Woodland, Mixed Dry Forest and Box Ironbark Forest.

Terrestrial grazing, browsing and trampling by introduced herbivores and macropods

Threat description — browsing, grazing and trampling by large herbivores

Total grazing, browsing and trampling pressure is a risk to all assets across the River Red Gum Park Landscape, affecting the regeneration of vegetation in many ecosystems. The threat of grazing and trampling is exacerbated by other threats, such as drought and fire, which can reduce the availability of food for herbivores and result in palatable regenerating vegetation. The Park Landscape's linear area, history of grazing and adjacent agricultural land all contribute to the presence of a suite of domestic escapees, game and feral species. These include feral goats, pigs, sheep, horses, cattle, and deer (Sambar, Fallow and Red).

Kangaroo species can become problematic as they undergo significant population increases following favourable conditions, leading to an overabundance.

Fluctuations in populations of feral pigs are also linked to environmental conditions; numbers will boom during floods. Pigs are a particular threat to riparian habitats and high-value Ramsar sites because they trample riparian areas and reduce water quality. Pig diggings are evident along the banks of the Murray River and its tributaries, and have a high impact at localised scales. Pigs also have a direct impact on nesting waterbird colonies, having been observed eating eggs.

Goats are widespread throughout the Park Landscape. Although extensive control has previously been undertaken in the Warby–Ovens area, their overall extent and population is increasing. They are considered a particularly high-risk threat to vulnerable vegetation communities in the north-western section of the landscape and are also regularly observed in Barmah Forest and the Lower Goulburn National Park. Goats are controlled in the Toupnein Creek Reference Area, but continual incursions are thought to occur across the New South Wales border.

Deer have been present in locations such as Barmah Forest, Gunbower Forest and the Lower Goulburn National Park for at least the past decade, and the extent of deer species is also increasing. In addition to their grazing impacts, stags have the additional impact of rubbing against trees, which can cause ring-barking. There is some concern about the Fallow Deer that have become established in the north-west, with a population present on Lambert Island, in the north-west of the state.

Feral cattle are localised in the landscape; a small population remains on Lindsay Island, in the Murray–Sunset National Park, where they cause damage similar to that caused by deer. This population is a legacy of previous grazing use. While over 160 free-ranging individuals have been removed by shooting, the difficulty of locating the remaining individuals in the dense riverine scrub has prevented their complete eradication. A small, eradicable population of feral sheep is present in the far east of the Barmah National Park.

Horse, pig, deer and sheep grazing threaten Moira Grass plains in the Barmah Forest Ramsar site. Horses are localised in the landscape with the major population occurring in Barmah National Park. In addition to their impact on the regeneration and successful recruitment of a range of native species, they also cause significant soil disturbance to wetland systems.

Threat description — grazing and erosion by European Rabbits

European Rabbits are widespread across the landscape and have a particularly high impact in the Murray–Sunset National Park and other public land in north-western Victoria where deep sandy soils permit the easy establishment of warrens. Rabbits degrade vegetation, outcompete native fauna and exacerbate erosion. Rabbits ringbark woody vegetation and eat regenerating seedlings and seeds. The effect of their browsing is worsened at times when food is scarce, such as after fires and drought. The impact of this invasive species is thought to be, in part, responsible for the local extinction of small mammals, such as the Chuditch and Bilby, in arid environments.

Biocontrol viruses myxomatosis and rabbit haemorrhagic disease virus (RHDV) are less effective in arid areas than in higher rainfall areas. Over time, rabbits with a resistance to strains of RHDV and myxomatosis will increase in population. Supplementary control methods depend heavily on physical destruction of warrens using machinery.

Rabbits numbers in this Park Landscape are driven by climatic events, with large rainfall events leading to large increases in population size. Ongoing management of this species in the north-west section of the Park Landscape has achieved target densities of less than one rabbit per spotlight-kilometre, which is low enough to allow vegetation regeneration.

Rabbits are also responsible for the widespread excavation and destruction of Aboriginal cultural heritage, including sensitive Aboriginal Ancestral resting places. Due to the large number of Aboriginal Ancestral burials across the landscape, rabbit control must use techniques that cause minimal ground disturbance. Past methods such as deep ripping have caused irreversible damage to Aboriginal Ancestral burial places. Less than five per cent of the landscape has been surveyed for Aboriginal cultural heritage, so the true extent of Aboriginal cultural heritage is unknown. A precautionary approach is therefore necessary, and protocols for rabbit control must be developed in partnership with Traditional Owner groups.

Threat objective — large herbivores and rabbits

By 2024, reduce browsing pressure from herbivores and trampling pressure from large herbivores and macropods across the landscape to a level that allows for regeneration of key species in each conservation asset.

Invasive exotic fish

Threat description

Introduced exotic fish are a risk to inundation-dependent conservation assets across the River Red Gum Park Landscape through both habitat degradation and predation pressure. This threat contributes to a range of factors that have a clear and demonstrated impact on the composition of native fish and amphibian communities and the condition and regeneration of inundation-dependent ecosystems.

Carp, Gambusia, Redfin, Goldfish and Oriental Weatherloach are all invasive aquatic fauna, and each species has a different impact on the River Red Gum Park Landscape. Gambusia and Redfin are extremely successful predatory fish, directly reducing the survival of native fish and frog species through predation of eggs and larvae of fish and eggs and tadpoles of frogs. Carp also eat fish and their eggs, but their main impact is caused by their feeding behaviour. Carp suck in sediments from the substrate and expel unwanted material into the water column, a behaviour known as 'mumbling'. This causes two key threatening processes —uprooting plants and suspending sediments — hindering the growth of aquatic flora directly and also indirectly due to reduced water quality, clarity and light penetration. Reduced light also makes it harder for visual-feeding fish to find food, and settling sediments can smother egg masses of native fish and frogs.

Managing these threats is an essential factor in allowing the regeneration of native aquatic flora and fauna species and improving water quality across a range of systems. All of the inundation-dependent conservation assets — Riverine Forest and Woodland, Ephemeral Freshwater Wetlands, Permanent Freshwater Wetlands, Saline Wetlands and Ramsar Wetlands — have been affected to some degree by invasive aquatic fauna. This has significantly altered the ecological character of many of these systems from their natural state.

While each of these invasive species has detrimental impacts, it is widely recognised that the greatest current threat is from Carp. Biological control of Carp is under investigation through the National Carp Control Plan, while partner agencies continue to identify options to manage these and other invasive species via other mechanisms, such as drying regimes and mesh screening.

Threat objective

Continue to support partner agencies to trial and implement a range of techniques to manage invasive aquatic fauna in inundation-dependent conservation assets to reduce impacts on key ecological attributes of aquatic systems.

Predation by foxes and cats

Threat description

Feral cats and Red Foxes pose a high risk to most of the fauna identified as nested assets across the River Red Gum Park Landscape. The immediate effect of predation is the degradation of faunal assemblages, particularly species in the 'critical weight range' for predation. This has flow-on effects where those species support ecological processes. These impacts occur in the terrestrial components of all conservation assets and have contributed to a decline in the population size, abundance and diversity of ground-dwelling fauna and bird assemblages.

Predation of vulnerable chicks and eggs can reduce the reproductive success of colonial-nesting birds in wetlands. Turtle nests and hatchlings are extremely vulnerable during spring and summer.

Programs that focus on a single predator species may inadvertently lead to increased populations of other predators and have undesirable consequences for prey species. Control of predators also needs to consider their relationship with exotic prey animals such as rabbits. Fox control may reduce predation pressure on rabbit populations, particularly on young rabbits. Controlling rabbit populations at low densities may have the benefit of decreasing fox abundance through reduced availability of prey. For these reasons, effective management of terrestrial predation pressure requires an integrated approach.

Although the relationships between predators and prey have been studied, the effects of predator management on abundance and recovery of native prey species are less well known (Robley et al., 2016). There is also a gap in our knowledge about the roles of native predators, especially those that have been lost from the Park Landscape. Building this knowledge will support the ongoing effective management of overall predation pressure.

Threat objective

By 2024, sufficiently reduce the impact of predation at key locations to allow predation-sensitive fauna to occupy the majority of available habitat at key locations.

Juvenile River Red Gum encroachment into wetland

Invasion by introduced and native flora

Threat description

The Murray River corridor and its seasonal flood regimes facilitate the spread of environmental weeds across the River Red Gum Park Landscape. The threat of weed invasion will change over time with shifting climate, the introduction of new weeds, and the further spread of existing weeds. A number of high-threat weed species currently affect the conservation assets of the Park Landscape and limit the recovery and restoration of important sites. Weeds displace pre-existing native vegetation, choke waterways and invade spaces of open woodlands, changing the structure of forests.

Due to changes in hydrological regimes and climate, some invasive flora species are natives that have moved into areas where they have not previously occurred. For example, shorter inundation periods have aided the encroachment of River Red Gums in systems previously comprising non-woody vegetation, reducing the available riparian vegetation required for fish spawning. Other variations to species distribution include the encroachment of Tangled Lignum, which is more drought tolerant than other riparian species, and Giant Rush, which particularly affects high-value Moira Grass wetlands in the Barmah Forest Ramsar site. The native herbaceous species Cumbungi and Phragmites are also increasing in abundance and causing waterway congestion and altering flow regimes.

Some weed species are likely to expand their range and colonise new habitats following major disturbance events such as fire and or flooding. While the impacts of these weeds may be localised and contained, their impact could rapidly increase in scope and scale after a disturbance. For example, Arrowhead, Bathurst Burr, Noogoora Burr and willows can thrive after a flood, and thistles after a fire.

New and emerging weeds also present a potential threat to the River Red Gum Park Landscape. Because of the largely unknown nature of these weeds, the level of threat will vary between species and locations. Prevention and readiness strategies to reduce the potential for invasion and enable timely responses will reduce the likelihood that new and emerging weeds become problematic in the future.

Threat objective

During the five years to 2024, eradicate any new and emerging weeds wherever they occur and control established high-priority weeds to acceptable levels where key ecological attributes are at risk.

Climate change

Threat description

Under a climate-changed future, the character and function of the River Red Gum Park Landscape will be affected by changes in weather and precipitation. Examples of altered function are loss of habitat and microhabitats, disruption of environmental cues (flowering, breeding and dispersal) and temperatures and conditions outside what species can tolerate. Increases in climate-driven disturbances, and the severity and frequency of floods, droughts and fires will also require greater and faster ecosystem recoveries (Selwood et al., 2019).

CSIRO and the Bureau of Meteorology (2015) have produced climate projections for natural resource management regions in Australia based on climate model simulations of four emissions-management scenarios. These Climate Change in Australia projections include a confidence rating produced using the method used by the Intergovernmental Panel on Climate Change. The effects of climate change can be difficult to separate from natural variability in the climate system in the short term (annual to decadal basis) (CSIRO and Bureau of Meteorology, 2015), so only projections with a confidence rating of high and very high have been included in this summary. Climate projections for the Murray Basin include decreases in annual rainfall and increases in average temperatures and the number of hot days, leading to increases in evaporation.

Using the Climate Change in Australia resources, Parks Victoria staff subjectively assessed the climate change–induced threats most relevant to the Park Landscape to produce a risk rating for individual conservation assets (Table 6.2). These climate change–induced threats may compound the effects of other identified threats in the landscape.

Presently, only selected sites in the landscape are allocated environmental water, and many sites that do not receive water allocations are in poor condition. Decreased annual rainfall and increased evaporation will mean that, under the current irrigation and supply regimes, less water will be available and demand will increase for this water.

This is likely to have a negative impact on the water regimes of water-dependent assets such as Riverine Forest and Woodland and wetlands. Sites that will continue to receive environmental water allocations are less at risk, and it is likely that land management will increasingly focus on high-priority sites where water is made available (for example, Living Murray icon sites, Ramsar sites, and ecological havens as defined by Selwood et al. (2019)).

Winter rainfall is projected to decline, leading to reduced plant flowering in spring, which is an important food source for fauna. When heavy rainfall does occur, it is projected to intensify, which will increase the likelihood of flood. However, there is only medium confidence that duration of meteorological drought and the frequency of extreme drought will increase over the course of the century.

Expected changes to the landscape include the dieback of eucalypts and poor seedling survivorship, leading to reduced recruitment of canopy species. This may allow the encroachment of salt- and drought-dependent species such as lignums and chenopods, potentially shrinking the extent of some conservation assets and increasing others (that is, Chenopod Woodland encroaching on Riverine Forest and Woodland).

The incidence of large-scale fire is likely to increase under a harsher fire weather climate. Dry eucalypt woodland conservation assets are likely to be affected by an increased incidence of bushfire and fire intensity under drier and warmer conditions. Fire seasons are also likely to become longer, with less winter rainfall leading to dry conditions early in the season.

Under drought conditions, grazing pressure will increase as the competition for food resources increases, putting stress on native fauna populations to compete for reduced resources.

Freshwater ecosystems are expected to have the highest proportion of species threatened with extinction under a changed climate (Millennium Ecosystem Assessment, 2005). Fauna that depend on the timing of flowering plants are at risk of resource unavailability, which can cause poor breeding success or survival. Some aquatic species, such as the Australian Smelt, are also likely to be affected by a lack of resources as increased temperatures disrupt the synchrony between breeding cycles and prey availability (Balcombe et al., 2011). Such impacts have the potential to produce cascading effects on ecosystems where these species provide critical services (Butt et al., 2015). Specific key ecological attributes, such as woodland bird diversity and freshwater aquatic fauna diversity, are likely to be negatively affected.

There is broad uncertainty on the impacts of climate change on landscape components such as specific conservation assets, key ecological attributes and species interactions. This can make it difficult to prioritise actions that will be effective in mitigating risk and improving the resilience of ecosystem components.

Threat objective

During the five years to 2024, review climate change–planning frameworks, adapt strategies to be ‘climate smart’ and integrate climate change planning into land management planning.

Table 6.2 Climate projections and risks to conservation assets

Projected threat	Riverine Forest and Woodland	Ephemeral Freshwater Wetlands	Permanent Freshwater Wetlands	Saline Wetlands	Plains Woodland	Box Ironbark Forest	Mixed Dry Forest	Chenopod Shrubland
Average temperatures will continue to increase in all seasons (with very high confidence).	Moderate	High	Extreme	High	Moderate	Moderate	Moderate	Low
More hot days and warm spells are projected (with very high confidence).	Moderate	Extreme	Extreme	High	High	Moderate	Moderate	Low
Heavy rainfall intensity is projected to increase (with high confidence).	Low	Moderate	Moderate	Moderate	Low	Low	Low	–
Rainfall is projected to decline during the cool season (with high confidence).	Moderate	High	Moderate	Moderate	High	Low	Low	–
A harsher fire weather climate in the future (with high confidence).	High	Low	Low	Low	Extreme	High	High	Low

Recreational activities and resource extraction

Threat description

Recreational and resource extraction activities in the River Red Gum Park Landscape include four wheel driving, trail bike riding, fossicking and prospecting, camping and firewood collection. These activities are permitted in designated areas across the Park Landscape, but often occur outside these areas. Although human impacts are generally localised, the effects are intense. The linear arrangement of the Park Landscape makes it particularly vulnerable to these activities, which often occur close to or on the public–private land interface due to easy accessibility. The river corridor also offers a variety of recreational opportunities, many of which have not been historically regulated or confined to specific areas.

Camping is the biggest recreational threat to the River Red Gum Park Landscape because it is linked to the collection of wood for campfires, littering, undesignated campfires, human waste problems and the development of ad hoc trails by walkers and vehicles to access undesignated sites. Collecting logs from forest ecosystems for solid fuel campfires depletes the available coarse woody habitat for a range of ground-dwelling fauna, including invertebrates, reptiles and small mammals such as the Yellow-footed Antechinus. Campfires are also the primary source of bushfire ignitions in the Park Landscape.

Vehicles creating ad hoc tracks in the landscape also act as vectors for the spread of weeds and diseases into areas currently not infested or infected. Recreational fishing and using live bait and soiled equipment can also spread diseases and parasites to native fish and amphibians. Similarly, fossicking and prospecting can spread soil-borne pathogens through the use of contaminated equipment. These activities also disturb soil and vegetation and could disturb Aboriginal cultural heritage places through the unintended excavation of remains and artefacts.

The historical extraction of River Red Gums as a forestry resource has changed the structural diversity of both the overstorey and understorey components of the landscape. This has affected habitat availability for terrestrial and ground-dwelling species, and will require innovative on-ground actions to complement other strategies to restore vegetation structure in the long term.

Most threats caused by recreational activities and resource extraction are described in the *River Red Gum Parks Management Plan* (Parks Victoria, 2018a), which sets out a number of goals and corresponding strategies for dealing with this threat.

Threat objective

By 2024, minimise the incidence of unauthorised or illegal park use and manage authorised uses to minimise impacts on conservation assets.

7 Conservation strategies

7.1 Prioritising conservation strategies

A broad range of conservation strategies have been considered, including those in existing park management plans and regional catchment strategies as well as additional strategies identified by regional staff and conservation partners. These strategies have been assessed for their impact, feasibility and cost in relation to achieving the conservation outcomes identified in this plan. Through this process, strategies have been ranked as low, medium or high priority. High-priority strategies have been further ranked through a structured decision-making process to establish the greatest overall impact and feasibility within a given resource allocation. Strategies for managing the threats of illegal activity and visitor use are described in the *River Red Gum Parks Management Plan* (Parks Victoria, 2018a).

Each strategy may be suitable for further refinement or development with conservation partners and stakeholders who wish to further support conservation outcomes in the River Red Gum Park Landscape.

Strategies prioritised through this process are to:

- manage water for conservation outcomes
- manage fire for healthy assets
- manage total grazing pressure
- manage invasive exotic fish
- control introduced terrestrial predators
- manage environmental weeds
- plan for climate change in the River Red Gum Park Landscape
- establish collaborative partnerships to coordinate management strategies and address key knowledge gaps.

7.2 Priority strategies

Priority strategies have been further developed to establish guiding statements around the key implementation components of each strategy. These were tested through the development of results chains, which test the logic of the strategy in a stepwise manner for delivering the desired outcomes. These results chains were used to develop key implementation milestones for each strategy, which include measurable outputs and outcomes that help managers to understand the impacts of management on improving the viability of conservation assets and managing threats.

Conservation strategy

Conservation strategy development has focused on either addressing key threats, improving the health of key conservation assets or both. These high-priority strategies have been developed using results chains to ensure that the actions defined within the strategy directly address the plan's objectives and conservation outcomes. Each strategy is captured in a statement which describes:

- the impacts of the strategy on key threats
- the approaches to be applied
- the measures of success
- the impact of the strategy on conservation outcomes.

Conservation outcomes

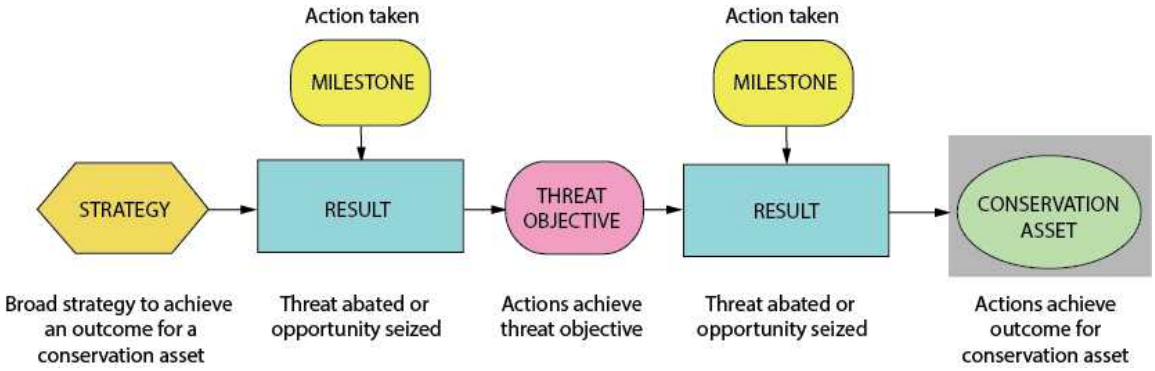
The conservation outcome is an attainable goal realised by implementing the conservation strategy. These outcomes are unlikely to be realised immediately and are generally a long-term achievement, with asset condition maintained or improving over a 15-year period.

Strategy summary

A brief summary of the intent of the conservation strategy.

Results chain

A results chain has been developed for each conservation strategy. It expresses the relationship between the conservation strategy, identified threats and an improvement in the desired state of conservation assets, as well as the assumptions that underpin how we think a conservation strategy will contribute to maintaining one or more conservation assets. The results chain helps visualise and identify some initial monitoring indicators and milestones. Below is an example of a simple results chain.



Implementation milestones

Milestones from the results chain and a statement of what implementation success looks like.

Manage water for conservation outcomes

This strategy focuses on options to improve water regimes within the River Red Gum Park Landscape. Environmental flow deliveries will be more effectively managed by implementing on-ground works to enable additional environmental water deliveries, addressing barriers to natural flow paths, and implementing appropriate measures in preparation for floods. These actions will complement the conservation strategies for managing both aquatic and terrestrial pest plant and animals, and will also establish collaborative partnerships.

Measures to improve the water regime will enhance the resilience of, and contribute to a recovery in the health of, a significant area of flood-dependent conservation assets within the River Red Gum Park Landscape.

Parks Victoria will work with partners to plan the delivery of water using existing infrastructure, by providing on-ground knowledge to identify values and risks as part of annual planning. In addition, implementing complementary on-ground works (such as pest plant and animal control and vegetation restoration) will bring ecological benefits in addition to those that can be achieved with environmental water alone.

The area of the Red Gum Park Landscape that can be targeted with environmental water could be increased by constructing new infrastructure, or upgrading existing. Works will also focus on assets within the Park Landscape that impede flooding, including structures that are a legacy of past forestry operations or private irrigation schemes, levees, roads and banks. Redundant infrastructure can reduce conservation values by interrupting natural flow paths and therefore the extent to which natural floodwaters can inundate flood-dependent vegetation communities.

Parks Victoria will work in partnership with relevant agencies to develop plans for such infrastructure, contributing site-based knowledge and advice, facilitating the appropriate approvals process, and implementing on-ground works to remove or modify redundant assets.

This strategy recognises the lead role of catchment management authorities as environmental water managers in the planning of environmental water activities, and Parks Victoria's role as a partner agency in this process. However, this strategy focuses on those park management activities conducted by Parks Victoria that are relevant to environmental water planning, such as on-ground works and risk management that complement environmental water deliveries. The strategy also identifies opportunities for partnership and knowledge exchange to integrate actions and achieve shared ecological objectives.

The strategy includes actions that target flood management infrastructure to ensure flood preparedness and that ensure that mitigation activities conform with best practice environmental and cultural heritage management, that public safety risks are managed, and that built assets within the Park Landscape are designed to withstand flooding. Established processes are in place to manage for, and respond to, floods, and no new actions are proposed as part of this conservation strategy.

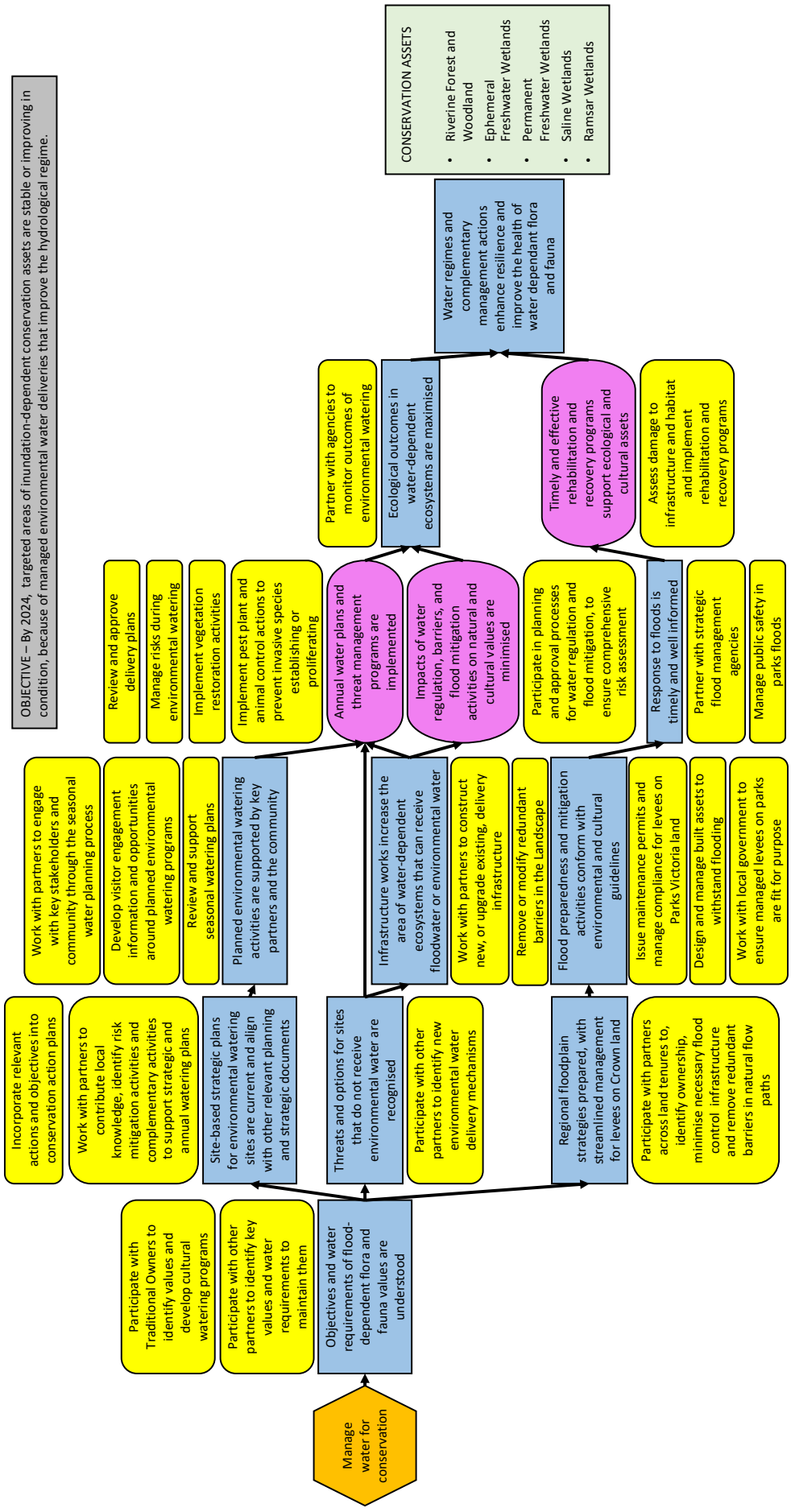
Conservation outcomes

Appropriate water regimes and complementary management actions enhance the resilience and improve the health of water-dependent flora and fauna.

Strategy summary

Improve water regimes by implementing on-ground actions and working in partnership with environmental water managers to facilitate the delivery of environmental water and increase the extent of natural floods.

Results chain



Implementation milestones

Result	Activities
Objectives and water requirements of flood-dependent flora and fauna values are understood.	Participate with Traditional Owners to identify values and develop cultural watering programs. This includes actively seeking opportunities to improve Traditional Owner capacity to achieve their objectives for environmental and cultural water. Participate with other partners to identify key values and water requirements to maintain them. This includes active Parks Victoria participation in relevant forums to improve knowledge and strategies to improve environmental water and associated complementary activity management practice.
Site-based strategic plans for environmental watering sites are current and align with other relevant planning and strategic documents.	Work with partners to contribute local knowledge, identify risk mitigation activities and complementary activities to support strategic and annual watering plans. This includes collaboration with CMAs to assist and/or lead the development of environmental water plans for wetland conservation assets managed by Parks Victoria. Incorporate relevant actions and objectives into conservation action plans
Planned environmental watering activities are supported by key partners and the community.	Review and support seasonal watering plans Develop visitor engagement information and opportunities around planned environmental watering programs, including implementing activities that encourage park users to support environmental watering activities (e.g. promoting the *Healthy Parks Healthy People* philosophy by creating opportunities that celebrate improvements to ecology and therefore recreational activities, including birdwatching, fishing, nature appreciation, camping and canoeing) Work with partners to engage with key stakeholders and community through the seasonal water planning process
Threats and options for sites that do not receive environmental water are recognised.	Participate with other partners to identify new environmental water delivery mechanisms to increase the area of water-dependent assets that receive water via managed inundation events
Regional floodplain strategies are prepared, with streamlined management for levees on Crown land.	Participate with partners across land tenures to identify ownership, minimise necessary flood control infrastructure, and plan for the removal of redundant barriers in natural flow paths. This should include an inventory of water management infrastructure including levees, gates, channels and other infrastructure that is on the Parks Victoria estate Identify areas subject to altered hydrological regimes due to alterations to the flood plain. This may include areas subject to increased flooding as well as exclusion from flooding during natural floods.
Infrastructure works increase the area of water-dependent ecosystems that can receive floodwater or environmental water.	Work with partners (such as CMAs) to construct new, or upgrade existing, delivery infrastructure Work with partners to remove or modify redundant barriers in the landscape to maximise the extent of natural flooding and environmental watering

Result	Activities
Flood preparedness and mitigation activities conform with environmental and cultural guidelines.	Issue maintenance permits and manage compliance for levees on Parks Victoria land. In line with the requirements of the *Victorian floodplain management strategy* (DELWP, 2016b). This includes supporting CMAs in the issue of Crown land levee maintenance permits, by providing reasonable conditions on the permit to minimise the impact of any required maintenance activities (conducted by the permit holder, i.e. the beneficiary) on Crown land values. Design and manage built assets to withstand flooding Work with local government to ensure managed levees on parks are fit for purpose
Annual water plans and threat management programs are implemented.	Implement timely pest plant and animal control actions to prevent invasive species establishing or proliferating, and enhance the outcomes of environmental watering activities. This includes identifying opportunities where flooding or environmental watering can assist with the activities of other programs, including weed control or pest management, and coordinating with those programs. Implement vegetation restoration activities that align with hydrological conditions Manage risks during environmental watering, including those identified in seasonal water plans and delivery plans, such as public safety risks (e.g. limited access, flooded conditions) Review and approve delivery plans
Impacts of water regulation, barriers and flood mitigation activities on natural and cultural values are minimised.	Participate in planning and approval processes for water regulation and flood mitigation activities, to ensure comprehensive risk assessment of park natural and cultural assets
Response to floods is timely and well informed.	Partner with strategic flood management agencies Manage public safety in parks during floods
Ecological outcomes in water-dependent ecosystems are maximised.	Partner with agencies to monitor outcomes of environmental watering. This includes implementation of agreed actions within relevant plans and strategies (e.g. Ramsar monitoring, evaluation, reporting, and improvement (MERI) plans, seasonal watering proposals).
Timely and effective rehabilitation and recovery programs support ecological and cultural assets.	Assess damage to infrastructure and habitat and implement rehabilitation and recovery programs in a timely manner
Water regimes and complementary management actions enhance resilience and improve health of water-dependent flora and fauna.	

Manage fire for healthy assets

While lightning-ignited bushfires are a natural event in the River Red Gum Park Landscape, fire has a limited role in maintaining diversity because the health of the inundation-dependent assets is largely determined by water regimes. Other assets — Mixed Dry Forest, Plains Woodland and Box Ironbark Forest — can benefit from the appropriate application of fire to maintain growth structure and species diversity, particularly in the understorey. Parks Victoria works closely with DELWP and Traditional Owners to manage fire appropriately in this landscape.

A key element of managing the threat of fire in the landscape is preventing human-induced (unplanned) ignitions. This is jointly managed through visitor engagement and planning, which are covered in the *River Red Gum Parks Management Plan* (Parks Victoria, 2018a), and patrols to ensure compliance with limits on campfires, which are often undertaken with DELWP on days of significant fire danger.

When fires do occur, they are best managed from existing roads, tracks and identified strategic fire breaks. This reduces the physical impact of management activities, the spread of pathogens and weeds, and the possibility of inadvertent damage to cultural sites. Limiting the use of fire retardants, particularly near flood-prone areas and aquatic ecosystems, is also important. A rapid response to all fire ignitions, including from lightning, is important to manage the risk of fire spreading to a significant scale.

Planned burning can be an important tool for ecological outcomes, such as managing encroachment of undesirable species. The spread of Giant Rush, which outcompetes Moira Grass within the Barmah Ramsar site, can be managed through a combination of fire and flooding. Fire could also be trialled as a control technique for River Red Gum saplings encroaching on tree-less wetland areas.

The high incidence of Aboriginal scarred trees and other cultural places necessitates special care when burning in this landscape. Also, large hollow-bearing River Red Gums are important for conservation. Current programs are investigating how best to protect significant trees during planned burning operations. Cataloguing sites in high-risk areas (such as within the Plains Woodland asset) will help ensure their protection. When significant trees (and their limbs) are made safe after fires, special attention should be paid to minimising the loss of tree hollows or cultural values.

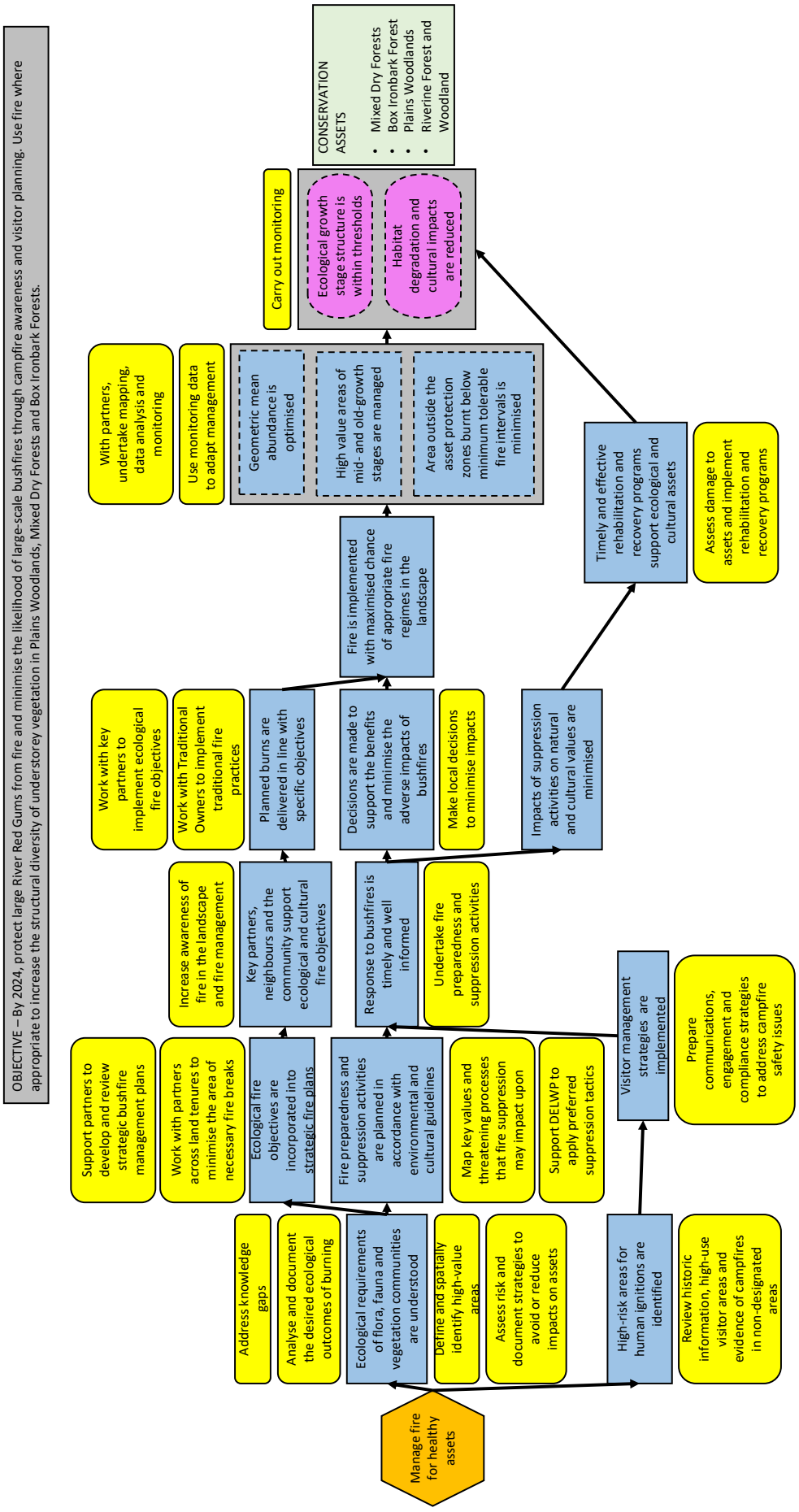
Conservation outcomes

Appropriate fire management benefits the diversity and growth stages of assets in the landscape.

Strategy summary

Undertake communications and compliance activities to reduce the risk of human-induced ignitions, and where possible ensure a rapid response to bushfire to prevent loss of significant values during fires.

Results chain



Implementation milestones

Result	Activities
Ecological requirements of flora, fauna and vegetation communities are understood.	Address knowledge gaps Analyse and document desired ecological growth stage structure (spatial and temporal), geometric mean abundance and tolerable fire intervals (TFIs) Assess risk and document strategies to avoid or reduce impacts on assets. Identify opportunities where bushfire will benefit ecosystems Define and spatially identify high-value areas
Ecological fire objectives are incorporated into strategic fire plans.	Partner with strategic bushfire management agencies (DELWP) and community to develop and review strategic bushfire management plans Where possible, work with partners across land tenures to minimise the area of necessary fire breaks
Key partners, neighbours and the community support ecological and cultural fire objectives.	Use the Fire Operations Plan as a public communication tool to increase awareness of fire in the landscape, considerations of management, and the use of non-burn fuel treatments
Planned burns are delivered in line with objectives, e.g. high intensity, low intensity, mosaics or cultural.	Work with key partners (DELWP, Country Fire Authority and the community), to implement ecological fire objectives Work with Traditional Owners to implement traditional fire practices where practical
Fire is implemented with maximised chance of appropriate fire regimes in the landscape.	
Geometric mean abundance (a measure of biodiversity) is optimised. High-value areas of mid- and old-growth stages are managed. Area outside the asset protection zones burnt below minimum tolerable fire intervals is minimised.	Undertake mapping, data analysis and monitoring Use monitoring data to adapt management
Fire preparedness and suppression activities are planned in accordance with environmental and cultural guidelines.	Map key values (natural and cultural) and threatening processes (weeds, pests and pathogens) that can be made worse by fire suppression Support DELWP to apply preferred suppression tactics
High-risk areas for human ignitions are identified.	Review historic information, high-use visitor areas and evidence of campfires in non-designated areas
Visitor management strategies are implemented.	Prepare communications, engagement and compliance strategies to address campfire safety issues
Response to bushfires is timely and well informed.	Undertake fire preparedness and suppression activities in accordance with strategies, guidelines and legislation
Decisions are made to support the benefits and minimise the adverse impacts of bushfires.	Make local decisions to minimise fire management impacts, such as the placement of dozer breaks
Impacts of suppression activities to natural and cultural values are avoided.	
Timely and effective rehabilitation and recovery programs support ecological and cultural assets.	Assess damage to assets and implement rehabilitation and recovery programs in a timely manner

Result	Activities
Ecological growth stage structure is within thresholds.	Carry out monitoring
Habitat degradation and impacts on cultural assets are reduced.	

Grazing exclusion plot to the left and area where ungulates are able to trample and graze to the right.

Manage total grazing pressure

This strategy is a long-term approach to managing grazing pressure and preventing damage to Aboriginal cultural heritage sites in the landscape. The strategy lists species with their management objective, control methods and priority locations (Table 7.1). Managing the threat of grazing and browsing will promote the regeneration of key canopy species and increase the health of assets through the establishment of diverse age class structures across a range of systems. This will also help to restore canopies and restore a diverse, connected ground layer in areas where there has been substantial impact (for example, Riverine Forest and Woodland, Plains Woodland). Reducing the number of ungulates (hoofed mammals) in the landscape will also reduce the impacts of trampling in sensitive riparian areas, improving wetland integrity and water quality.

The management objective for cattle and sheep is eradication. Feral cattle are believed to occur only in small numbers on Lindsay Island (Murray–Sunset National Park), and a low number of feral sheep occur in Barmah National Park. Although neither species is particularly invasive, ongoing surveillance for future incursions will help prevent future populations becoming established after their initial eradication.

Local eradication is also the management objective for goats in some sites (Bumbang, Gadsen Bend, Gunbower, Lower Goulburn and Warby–Ovens); however, achieving total eradication is not considered possible in the threat objective period (until 2024). In other areas, such as Hattah–Kulkyne National Park, containment is the preferred management strategy.

Parks Victoria has developed a draft *Strategic action plan: protection of floodplain marshes in Barmah National Park and Barmah Forest Ramsar site* (Parks Victoria, 2018b). The plan includes actions that target all introduced, large, terrestrial grazers, and also includes specific recommendations for horse management for this site. This strategic action plan should be referred to for the management of these species, particularly horses, in the River Red Gum Park Landscape.

Deer occur throughout the landscape, but priority asset protection areas are identified at high-value sites such as Ramsar sites and riparian areas. Eradication is the management objective for Red Deer, and for Sambar Deer where they are locally eradicable (in and west of Gunbower National Park). For Sambar Deer in other areas and Fallow Deer, the objective is to reduce population numbers to reduce impacts.

Feral pigs are also widespread throughout the Park Landscape and are found in a wide range of habitats. They are of particular threat to riparian habitats, especially to high-value assets such as Ramsar sites. Fluctuations in pig populations are driven largely by climate with floods leading to significant booms and droughts reducing population extent and dramatically increasing the effectiveness of control methods (that is, baiting). The potential for trialling the use of hunting dogs in areas that have not previously permitted their use should be explored. This includes the use of gun dogs (pointers) and bailing dogs (hounds) for stalking and flushing out game and pests to increase the effectiveness of shooting programs.

Managing total grazing pressure includes monitoring and abating the impacts from native herbivores such as kangaroos, particularly in Hattah–Kulkyne National Park and Murray–Sunset National Park. The management of herbivores in the floodplain vegetation communities in north-western (Mallee) parks is described in more detail in the total grazing management plan (Taylor and Pegler, 2016). Rabbit management in this landscape is a complex issue: rabbits sometimes excavate Aboriginal burials and some methods of rabbit control further damage these sites. Draft guidelines for the management of rabbits in culturally sensitive areas are currently in development. Due to the density and extent of burials in the landscape, the guidelines should be the principal guide to rabbit management methods in the River Red Gum Park Landscape.

Grazers such as pigs, rabbits and macropods experience seasonal booms in numbers after periods of high rainfall when food is abundant. Their impacts are compounded during drought years when food is scarce; however, their management is more effective during drought years — competition for resources is greater and the rate of bait take is higher. A concerted effort should be made to increase the control efforts of these species, particularly pigs, during drought periods.

Implementation of control actions should incorporate:

- engaging with Traditional Owners to ensure proposed management approaches and methods are legislatively compliant and respectful, and do not adversely affect cultural heritage values
- identifying capacity-building opportunities where Aboriginal people are able to work on Country
- prioritising control and preventative actions where there are new and emerging or expanding populations of exotic or overabundant native fauna
- increasing the use of volunteer hunters as part of a coordinated pest control program.

Conservation outcomes

Vegetation structure and quality is improved, damage to cultural sites is minimised and trampling of riparian areas by ungulates is reduced.

Strategy summary

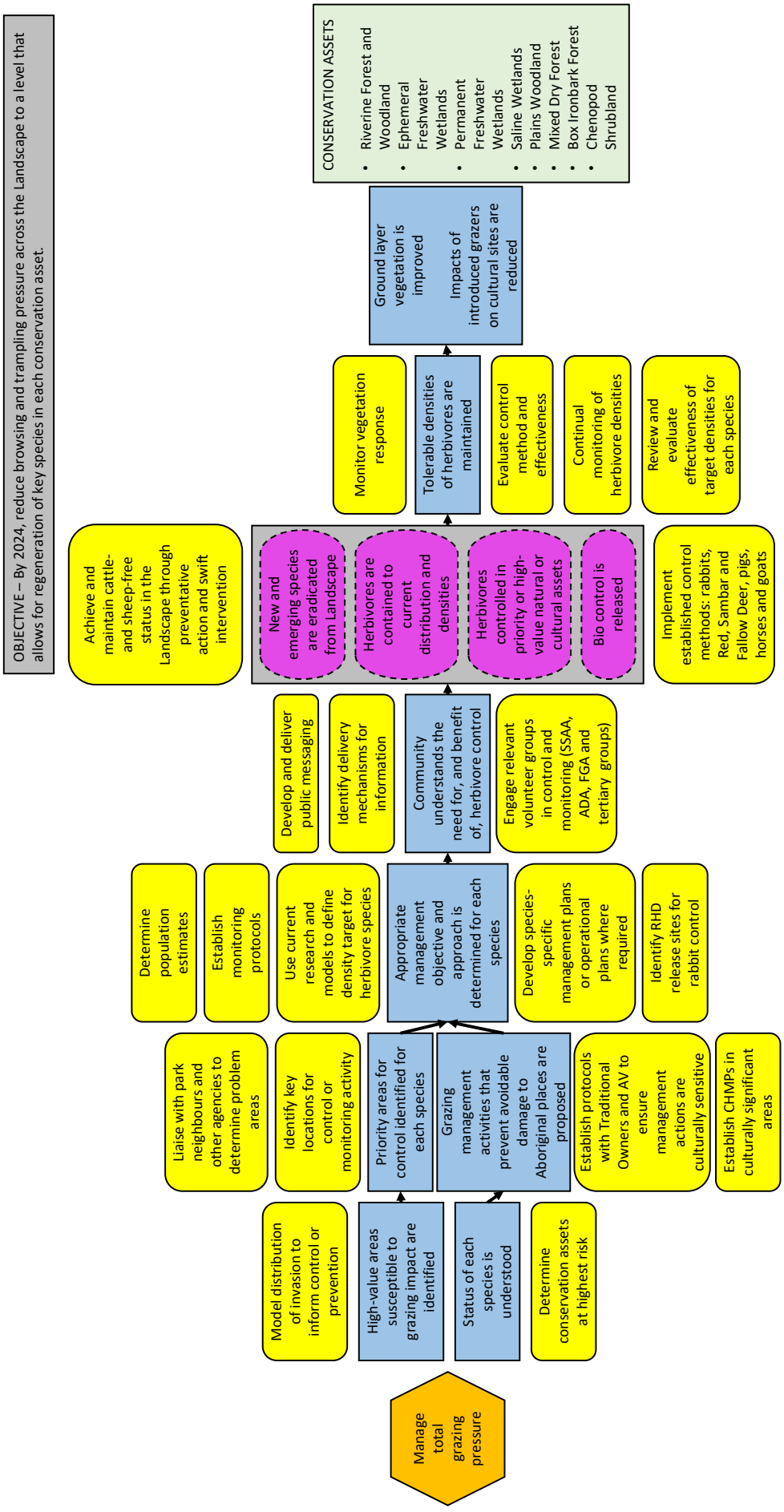
Control herbivores using culturally appropriate methods to improve the quality of native vegetation and riparian zone integrity and to protect culturally important sites across the Park Landscape.

Table 7.1 Species, control methods and priority locations for herbivore control

Species	Control method	Priority location	Control target	Objective
Rabbits	Appropriate management approach is developed with Traditional Owners	Murray–Sunset NP, Kings Billabong WR, Hattah–Kulkyne NP, Murray River Park (prop.)	• Establish and maintain rabbit densities of less than one per spotlight-kilometre • Release RHDV1 K5 (rabbit haemorrhagic disease virus, or calicivirus) in high-priority areas in partnership with the Department of Jobs, Precincts and Regions (DJPR) • Increase control efforts during dry periods to increase effectiveness	Asset protection
		Cultural sites in the Kerang Lakes, Lower Goulburn NP and Gunbower NP, Nyah–Vinifera Park	• Establish and maintain rabbit densities of less than one per spotlight-kilometre • Work with Traditional Owners to employ culturally appropriate control methods	Asset protection
Goats	Ground shooting (volunteer and professional), aerial shooting and trapping	Hattah–Kulkyne NP, Murray–Sunset NP, Murray River Park (prop.)	• Reduce goat densities to levels that allow understorey and sapling regeneration • Trial use of dogs to assist with ground shooting	Asset protection
		Bumbang Island HA, Gadsen Bend Park, Gunbower NP, Barmah NP, Murray River Park (prop.), Lower Goulburn NP, Warby–Ovens NP	• Eradicate small and isolated populations of goats • Prevent future goat incursions • Trial use of dogs to assist with ground shooting	Eradication
Deer (Fallow, Sambar and Red)	Trapping, ground and aerial shooting	River Red Gum Park Landscape	• Understand distribution, abundance and potential impact by 2021	Monitor
		Gunbower NP, Lambert Island NCR, Lower Goulburn NP, Lower Ovens WR	• Contain or eradicate Red Deer	Eradication
		Gunbower NP, and areas east, including Barmah NP	• Reduce Fallow Deer densities • Reduce impacts on sensitive Ramsar values	Asset protection
		West of and including Gunbower NP	• Contain or eradicate Sambar Deer populations	Containment
		East of Gunbower NP, including Lower Goulburn NP, Lower Ovens WR and the Murray River corridor	• Reduce Sambar Deer population densities	Asset protection

Species	Control method	Priority location	Control target	Objective
Cattle	Trapping, ground and aerial shooting	Murray–Sunset NP, Murray–Kulkyne NP	• Eradicate feral cattle from Lindsay Island • Prevent new cattle incursions	Eradication
Pigs	Ground and aerial shooting, trapping and baiting	River Red Gum Park Landscape	• Monitor impacts and implement control actions if required	Asset protection
		Kings Billabong Park, Bottle Bend, Murray River Park (prop.), Lambert Island NCR, Gadsen Bend Park, Bumbang Island HA, Murray–Sunset NP (Lindsay Island)	• Reduce pig densities in established populations	Asset protection
		Ramsar sites in Hattah–Kulkyne NP, Kerang Lakes (Koorangie WR, Hird Swamp), Barmah NP and Gunbower NP	• Reduce pig densities in established populations • Increase control efforts during dry periods to increase effectiveness	Asset protection
		Lower Goulburn NP, Warby–Ovens NP, Murray River Park (prop.)	• Eradicate small and isolated pig populations	Eradication
Horses	Trapping, rehoming and ground shooting	Barmah NP, Murray River Park (prop.) (Barmah Island)	• Staged removal of horses	Asset protection
Sheep	Trapping and ground shooting	Barmah NP	• Eradicate feral sheep • Prevent new incursions in the Park Landscape	Surveillance
Kangaroos	Ground shooting	Murray–Sunset NP (Lindsay Island), Hattah–Kulkyne NP	• Control to specified target levels for red and western grey kangaroos. • Control to levels that allow rich perennial shrub and ground layers	Asset protection

Results chain



Implementation milestones

Result	Activities
High-value areas susceptible to grazing impacts are identified.	Model distribution of invasion to inform control or prevention of grazing species
Priority areas for control are identified for each species.	Liaise with park neighbours and other agencies to determine problem areas Identify key locations for control or monitoring activity
The status of each grazing species is understood.	Determine conservation assets at highest risk from grazing pressure
Grazing management activities that prevent avoidable damage to Aboriginal places are proposed.	Establish protocols with Traditional Owners and Aboriginal Victoria (AV) to ensure management actions are culturally sensitive Establish cultural heritage management plans (CHMPs) in culturally significant areas
Appropriate management objective and approach is determined for each species.	Determine population estimates Establish monitoring protocols Use current research and models to define density target for herbivore species Develop species-specific management plans or operational plans where required Identify rabbit haemorrhagic disease (RHD) virus release sites for rabbit control
Community understands the need for, and benefit of, herbivore control.	Develop and deliver public messaging Identify mechanisms for information. Engage relevant volunteer and tertiary education groups in control and monitoring activities (Sporting Shooters Association Australia (SSAA), Australian Deer Association (ADA), Field & Game Australia (FGA))
New and emerging species are eradicated from the landscape. Herbivores are contained to current distribution and densities. Herbivores are controlled in high-priority or high-value natural or cultural assets. Biocontrol is released.	Achieve and maintain cattle- and sheep-free status in the landscape through preventative action and swift intervention Implement established control methods for rabbits, Red Deer, Sambar Deer, Fallow Deer, pigs, horses and goats
Tolerable densities of herbivores are maintained.	Monitor vegetation response Evaluate control method and effectiveness Continual monitoring of herbivore densities Review and evaluate the effectiveness of target densities for each species
Ground layer vegetation is improved. Impacts of introduced grazers on cultural sites are reduced.	

Manage introduced pest fish

Managing the threat of introduced fish is an essential factor in allowing the regeneration of native aquatic flora and fauna species and improving water quality across a range of systems. All the inundation-dependent conservation assets — Riverine Forest and Woodland, Ephemeral Freshwater Wetlands, Permanent Freshwater Wetlands, Saline Wetlands and Ramsar Wetlands — have been affected to some degree by invasive aquatic fauna. This has significantly altered the ecological character of many of these systems from their natural state. Introduced fish posing a threat to aquatic ecosystems in the landscape include Carp, Gambusia, Redfin, Oriental Weatherloach and Goldfish.

Carp are currently the key threat and have catastrophic impacts on aquatic habitats for both flora and other fauna. The current management strategy adopted by natural resource managers is to try to provide conditions that limit the biomass of Carp while still providing habitat suitable for the survival of native species. Research has shown that reducing the biomass of Carp to less than 88 kilograms per hectare can significantly reduce impacts to flora and fauna and could result in long-term population control (DELWP, 2017b).

Carp biomass is reduced by a combination of supplementing the hydrological regime with environmental water (where possible) delivered via pathways that do not facilitate Carp movement, installing barriers, physically removing Carp, and restoring habitat. Drying phases are also used to reduce numbers of invasive aquatic fauna. Carp management plans have been developed for some sites (Barmah Forest and Gunbower Forest) to prioritise and schedule the most effective control methods to limit the impact of this threat. Additionally, research under the National Carp Control Plan has identified a virus specific to Carp that may cause significant mortality if released under ideal conditions.

Further investigation into more effective control measures for introduced fish is needed so natural resource managers can protect inundation-dependent assets from further damage and enable recovery from the significant amount of damage that has already been done.

Parks Victoria can help implement management activities that aim to provide conditions that limit the biomass of Carp, by supporting or conducting:

- physical removal of Carp and barrier installation
- environmental water programs that supplement the hydrological regime to create favourable conditions for native fish — including both wet and dry phases
- habitat restoration projects that complement environmental watering activities.

Conservation outcomes

The impact of introduced fish on the habitat values of inundation-dependent assets is reduced, susceptible wetland vegetation has some opportunity for regeneration, and native fish populations remain stable or are increasing.

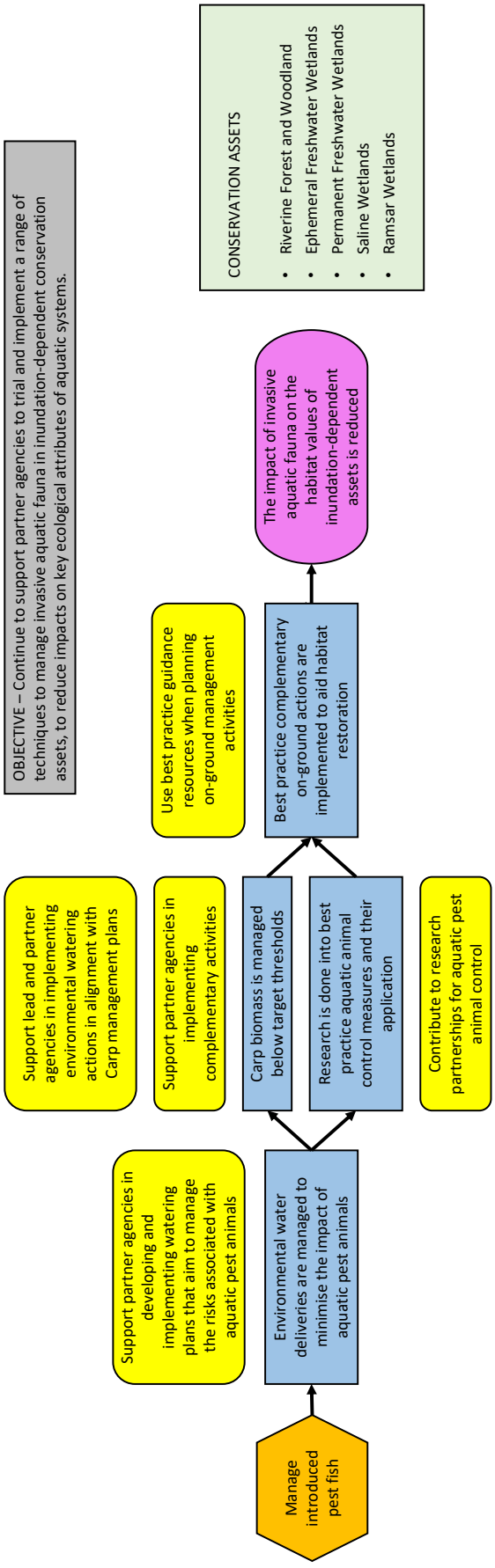
Strategy summary

Implement best practice measures to reduce the impact of introduced fish to improve the key ecological attributes of inundation-dependent assets.

Implementation milestones

Result	Activities
Environmental water deliveries are managed to minimise the impact of aquatic pest animals.	Support partner agencies in developing and implementing watering plans that aim to manage the risks associated with aquatic pest animals
Carp biomass is managed below target thresholds.	Support lead and partner agencies in implementing environmental watering actions in alignment with Carp management plans Support partner agencies in implementing complementary activities
Best practice aquatic animal control measures are researched and applied.	Contribute to research partnerships for aquatic pest animal control
Best practice complementary on-ground actions are implemented to aid habitat restoration.	Use best practice guidance resources when planning on-ground management activities
The impact of invasive aquatic fauna on the habitat values of inundation-dependent assets is reduced.	

Results chain



Control introduced terrestrial predators

Predator control is primarily implemented to increase the abundance, distribution and extent of predation-sensitive fauna within terrestrial and wetland assets. Understanding the remaining fauna population strongholds and targeting an appropriate scale and method (or methods) of control to those areas are the first steps to managing predation pressure in the River Red Gum Park Landscape.

Fox populations can be managed using range of techniques at different scales, including shooting, trapping and baiting. Until recently, cat control techniques were limited to shooting and trapping. Alternative approaches, including poison baits and new delivery mechanisms, have been developed and trialled with varied success in other Australian jurisdictions.

Feral cats have now been declared an established pest animal on specified Crown land in Victoria under the *Catchment and Land Protection Act 1994* (Vic.) Feral cat control will be implemented in accordance with a Victorian feral cat management code of practice. Changes to regulations now permit the use of cat bait products in parks and reserves under permit from the Department of Jobs, Precincts and Regions (DJPR). At the time of publication, there are plans to trial cat baiting in the Hattah Lakes under the Victorian Government's Biodiversity Response Planning program.

As a priority, predator control should be targeted to high-value asset protection (for example, turtles, breeding birds and Brolgas) at key sites, including Hattah–Kulkyne Lakes and the Lindsay–Walpolla, Koorangie, Hird, Gunbower, Barmah and Warby Ranges areas. Collaboration with volunteer hunters may assist in seasonal or continuous fox and cat control in smaller reserves.

While not currently implemented, large-scale, cross-tenure fox-baiting programs could be established to protect a broad spectrum of values at Ramsar wetland sites, Living Murray icon sites and other sites where environmental water allocations are being made to improve habitat value and increase the abundance of water-dependent fauna.

Establishing small-scale exclusion fences around existing or reintroduced populations of predation-sensitive species is another potential strategy to abate the threat of predation. The potential establishment of large exclusion areas within Hattah–Kulkyne National Park is beyond the scope of this plan, but would effectively allow for rewilding programs to be undertaken at scale, as described in the Mallee Conservation Action Plan (Parks Victoria, 2019).

Conservation outcomes

Predation-sensitive species have the opportunity to recover and occupy suitable habitat in the landscape at viable population levels.

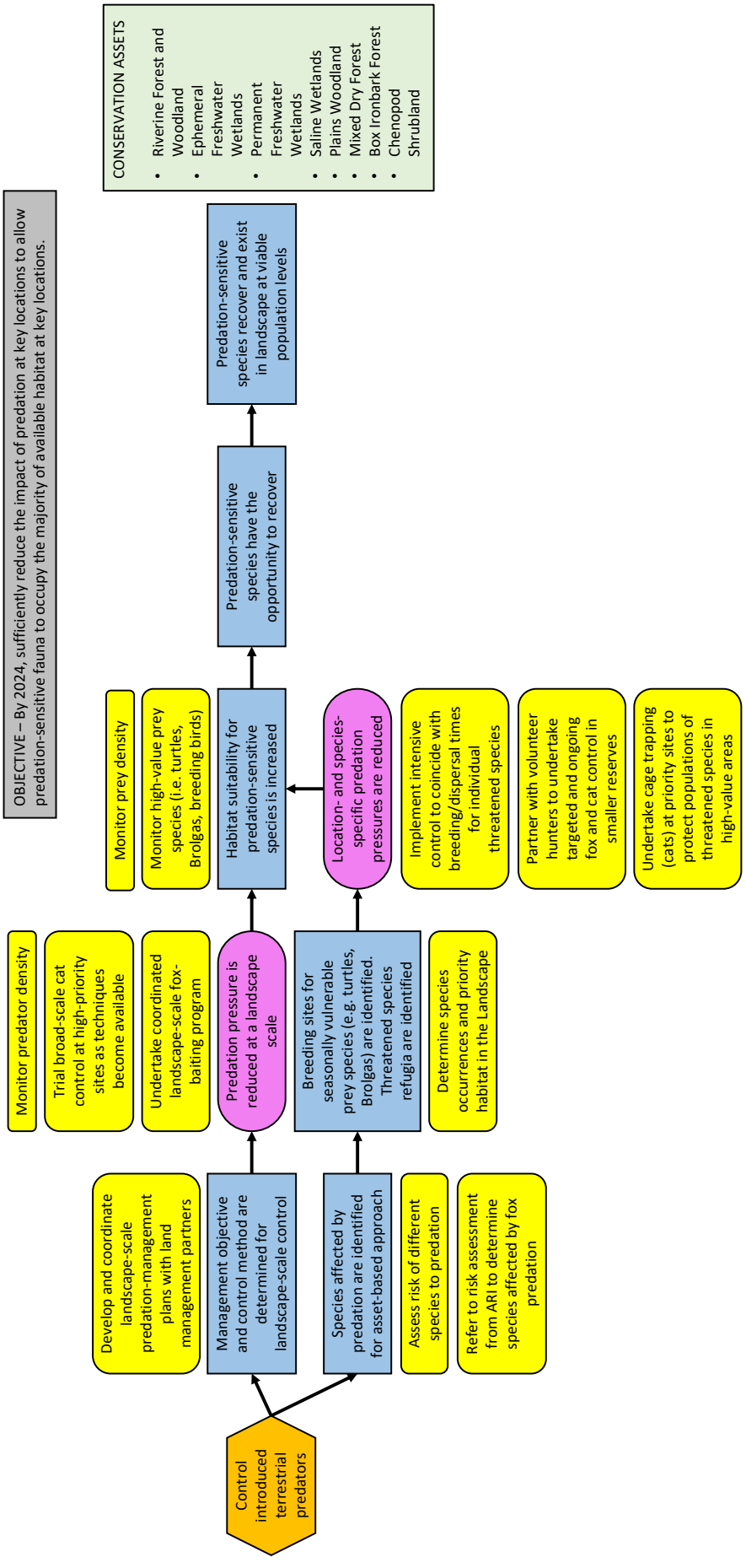
Strategy summary

Implement targeted control of foxes and cats at high-priority sites for threatened and migratory species, integrating available methods of control, to reduce predation.

Implementation milestones

Result	Activities
Management objective and control method are determined for landscape-scale control.	Develop and coordinate landscape-scale predation-management plans with land management partners
Predation pressure is reduced at a landscape scale.	Undertake coordinated, landscape-scale fox-baiting program in conjunction with private landholders, public land managers and Landcare groups Trial broad-scale cat control at high-priority sites (e.g. Hattah and Living Murray icon sites) as techniques become available Monitor predator density
Species affected by predation are identified for species-specific asset protection–based approach.	Assess risk of different species to predation Refer to risk assessment from Arthur Rylah Institute (ARI) to determine species affected by fox predation
Breeding sites for seasonally vulnerable prey species (e.g. turtles, Brolgas) are identified. Threatened species refugia are identified.	Determine species occurrences and priority habitat in the landscape
Location-specific and species-specific predation pressures are reduced.	Implement intensive control to coincide with breeding/dispersal times for individual threatened species Partner with volunteer hunters to undertake targeted and ongoing fox and cat control in smaller reserves (natural features reserves, Kerang Lakes) Undertake cage trapping (of cats) at high-priority sites (Lindsay–Walpolla, Koorangie, Hird, Gunbower, Barmah and Warby Ranges) to protect populations of threatened species in high-value areas
Habitat suitability for predation-sensitive species is increased.	Monitor high-value prey species (i.e. turtles, Brolgas, breeding birds) Monitor prey density
Predation-sensitive species have the opportunity to recover.	
Predation-sensitive species occupy suitable habitat in the landscape at viable population levels.	

Results chain



Manage environmental weeds

This strategy involves a range of actions for reducing the spread, establishment and impacts of non-native and native plant species. The strategy focuses on species that have, or are likely to have, significant impacts on the health of conservation assets and ecological processes within the River Red Gum Park Landscape.

The Victorian Government takes a standard biosecurity approach to pest plant management, which involves identifying the threat of an invasive species and assessing its relative risk to determine an appropriate intervention. There are four general management responses to controlling weeds: prevention, eradication, containment and asset protection (explained further in Appendix D). The management responses to weeds in this strategy are based on their current extent and the level of risk they present to the Park Landscape. Described below are the management responses to different types of weeds, the control objective of each response and the predominant examples of species in the landscape subject to control types.

A number of best practice manuals for controlling specific high-risk species are available through Agriculture Victoria's website or the Commonwealth Department of the Environment's website for Weeds of National Significance. These should be referred to when considering an appropriate method of control. In addition to considering the risk rating, the management approach will depend on whether a weed is new and emerging or established. Management approaches to control weeds in the River Red Gum Park Landscape depend on the type of weed, its impact and stage of invasion.

The same biosecurity principles and management objectives apply to aquatic weeds as terrestrial weeds; however, the control of aquatic species can be complex. Ongoing monitoring is required to ensure the early detections of new infestations that can be rapidly spread downstream and during floods.

New and emerging weeds

New and emerging weed species are those that are relatively new to the landscape and not well established. Any new weed species identified within the Park Landscape needs to be controlled rapidly to prevent its establishment and spread. Prevention and eradication responses require resources to be readily available to undertake swift intervention, reducing the potential for these weeds to establish. Quick responses can be achieved by identifying the most likely invasion points and pathways, which are often vehicle access sites, parking areas, and places where animals are likely to act as vectors. Locations where incursions have been observed previously are also likely to be key invasion points. Preventing the spread of species into new areas includes ensuring that vehicle and equipment hygiene is maintained to ensure that plant propagules are not transported to new areas. The same hygiene practices reduce the risk of spreading pathogens.

Eradication is the objective for this group of weeds, which includes species such as Buffel Grass (invading from the north-west), Chilean Needle Grass, Common Thorn-apple (in Gunbower) and Cabomba (in the Lower Goulburn).

Established weeds

A key focus of this strategy is to significantly reduce or contain the spread of weed species that are already established. Targeting species that alter ecological processes is likely to be effective in improving the health of assets. Working with local landowners on private land to control regulated weeds (under the Catchment and Land Protection Act) will increase the effectiveness of the program.

Bushfires and planned burns can cause significant weed invasion. Working with authorities, government departments and contractors involved in fire management to incorporate weed management into fire management planning will be an important step in integrated weed control throughout the Park Landscape. Parks Victoria fire management staff and contractors should adopt standards for best practice hygiene procedures, techniques and equipment.

Species identified for containment within the Park Landscape include: Banded Periwinkle, One-leaf Cape Tulip, St John's Wort, White Arum-lily, Cootamundra Wattle, Olive, African Boxthorn, and Sweetbriar Rose.

Overabundant native species

Similarly, ongoing surveillance of invasive native species is required to maintain the character of wetlands, particularly within Ramsar sites. The encroachment of invasive native species spreading outside of their previous distribution is likely to become more prevalent under a climate-changed future and where hydrological regimes are altered. Examples of this are where River Red Gums encroach upon tree-less wetlands and drought tolerant-species such as Tangled Lignum displace native aquatic species.

Table 7.2 presents a shortlist of known infestations at high-priority locations with specific management objectives for each species. Pest plant management priorities should be continually reviewed.

Opportunity for biological control

A range of biological control agents have been applied across the landscape in the past. These programs generally have initial positive impacts but become less effective over time. The persistence of biological control agents is often limited so reintroductions are required for ongoing results.

Biological controls are effective in reducing the density and rate of spread of a species, but persistence of the control agent can depend on the presence of sufficient numbers of the target species. A biological control agent will only be introduced if the target species has sufficient geographic extent and population density to allow the control agent to breed and disperse. Potential control agents include a fungal rust for species such as Bridal Creeper and invertebrates that feed exclusively on a target species.

Biological control agents are not a 'set and forget' method of managing pests. Without ongoing resource availability, monitoring and reintroductions where required, a target species can recover following control efforts. Biological controls are currently available for the following species: Montpellier Broom, Bridal Creeper, Paterson's Curse, Prickly Pear, Horehound, Dock, African Boneseed and Blackberry.

Table 7.2 Management objectives for particular weeds at high-priority locations

Location	Control objective	Weed species
Gunbower Ramsar site	Eradication	New and emerging species, Buffel Grass, Noogoora Burr
	Containment	African Boxthorn, Bathurst Burr, Paterson's Curse, Horehound, St John's Wort, Bridal Creeper*
	Asset protection	Blackberry, Arrowhead Overabundant native populations of Phragmites and Cumbungi, River Red Gum in tree-less wetlands
Barmah Ramsar site	Eradication	New and emerging species, Gazania, Chilean Needle Grass
	Containment	Montpellier Broom, Desert Ash, African Boxthorn, willows, Sweetbriar Rose, Olive, Blackberry*, Bathurst Burr, Paterson's Curse, Horehound, St John's Wort
	Asset protection	Bridal Creeper*, Perennial Veldt grass, Kaki Weed, Soursob Overabundant native populations of Phragmites and Cumbungi, River Red Gum in tree-less wetlands
Hattah–Kulkyne Ramsar site	Eradication	New and emerging species, Gazania, Buffel Grass
	Containment	Prickly Pear*, Recurved Thorn-apple, Spiny Emex, Horehound, Caltrop, Crownbeard, Noogoora Burr, Paterson's Curse*
	Asset protection	False Caper, Bridal Creeper*; River Red Gum in tree-less wetlands
Lower Goulburn National Park	Eradication	All new and emerging species
	Containment	Prickly Pear*, Blackberry, Olive, African Boxthorn, Sweetbriar Rose, Paterson's Curse*, Horehound, St John's Wort, Noogoora Burr, Bridal Creeper*
	Asset protection	Arrowhead. Overabundant populations of Phragmites and Cumbungi, River Red Gum in tree-less wetlands
Kerang Lakes	Asset protection	African Boxthorn, Blackberry, Hairy Fiddleneck
Gadsen Bend Park	Eradication	All new and emerging species
	Containment	Prickly Pear, African Boxthorn, Paterson's Curse*, Noogoora Burr, Bathurst Burr, Scotch Thistle
	Asset protection	False Caper, River Red Gum in tree-less wetlands

Kings Billabong Park	Eradication	All new and emerging species
	Containment	Pepper Tree, Weeping Willow, Devil's Rope, Spiny Rush, African Boxthorn, Prickly Pear, Noogoora Burr, Flaxleaf Fleabane, Scotch Thistle
	Asset protection	Bridal Creeper*, Golden Dodder, False Caper River Red Gum in tree-less wetlands
Murray–Kulkyne Park	Eradication	New and emerging species, Gazania, Buffel Grass
	Containment	African Boneseed, Recurved Thorn-apple, Prickly Pear African Boxthorn, Olive, Paterson's Curse, Horehound, Noogoora Burr, Crownbeard
	Asset protection	Bridal Creeper*, False Caper River Red Gum in tree-less wetlands
Murray–Sunset National Park	Eradication	New and emerging species, Buffel Grass
	Containment	African Boxthorn, Prickly Pear, willows, Hairy Fiddleneck, Paterson's Curse, Horehound, Bathurst Burr, Saffron Thistle, Scotch Thistle, Noogoora Burr
	Asset protection	Ward's Weed, Onion Weed, False Caper, Golden Dodder
Murray River Park (proposed)	Eradication	New and emerging species, Buffel Grass
	Containment	African Boxthorn, Prickly Pear, willows, African Boneseed, Sweetbriar Rose, Horehound, Paterson's Curse, Noogoora Burr, False Caper, Bridal Creeper*
	Asset protection	Arrowhead, Groundcherry River Red Gum in tree-less wetlands

*Option for biological control

Management priorities for sites and species not tabled should be based on the risk rankings in the *Advisory list of environmental weeds in Victoria* (White et al., 2018) and the *Advisory list of environmental weeds of aquatic habitats of Victoria* (Adair et al., 2008). Where species are not identified in these lists, the *Managing weeds: assess the risk guide* (Blood et al., 2016) can be used. Following bushfire, prioritised species-based management responses should be guided by the *Post-fire weeds triage manual* (Zimmer et al., 2012).

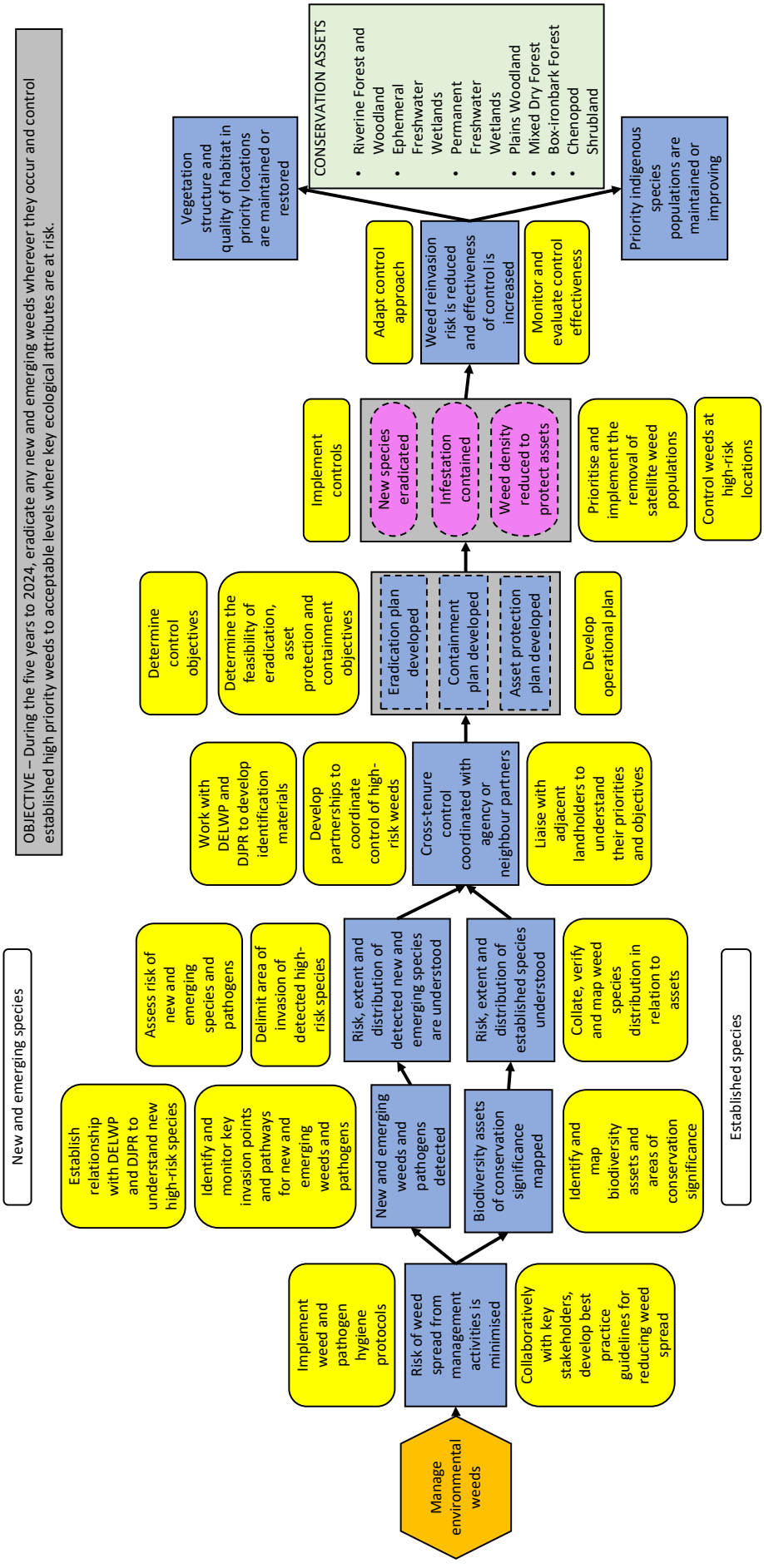
Conservation outcomes

The vegetation structure, surface flow regimes and quality of habitat are maintained or restored. The condition of priority populations of indigenous flora species is maintained or improved.

Strategy summary

Control environmental weeds through surveillance and rapid management intervention to prevent the establishment of new and emerging weeds and maintain established weeds at acceptable densities.

Results chain



Implementation milestones

Result	Activities
New and emerging species	
The risk of weeds spreading from management activities is minimised.	Implement weed and pathogen hygiene protocols
New and emerging weeds and pathogens with the potential to spread into the landscape are identified and quickly detected if present in landscape.	Identify and monitor key invasion points and pathways for new and emerging weeds and pathogens. Landcare groups and other community-led groups can assist with locations and monitoring. Establish relationships with DELWP and DJPR to understand new high-risk species
Risk, extent and distribution of detected new and emerging species are understood.	Assess level of risk for new and emerging species using biosecurity approach Delimit the extent of detected high-risk species within parks
Cross-tenure control is coordinated with agency partners and adjacent land managers.	Develop partnerships with CMAs, Traditional Owners, Landcare groups and neighbouring landholders to coordinate control of high-risk weeds on public and private land Work with DELWP and DJPR to develop identification materials, specially to help landholders identify young plants
Eradication plan is developed. Containment plan is developed. Asset protection plan is developed.	Determine control objectives Determine the feasibility of eradication, asset protection and containment objectives
New species are eradicated. Infestations are contained. Weed density is reduced to protect assets.	Implement coordinated, cross-tenure responses to eradicable and containable infestations
Weed reinvasion risk is reduced, and the effectiveness of weed control is increased.	Monitor and evaluate the effectiveness of weed control Adapt the control approach
Vegetation structure and quality of habitat in priority locations is maintained.	

Result	Activities
Established species	
The risk of weeds spreading from management activities is minimised.	Work with DJPR and DELWP to develop best practice guidelines for reducing the spread of weeds
Biodiversity assets of conservation significance are mapped.	Identify and map conservation assets and areas of conservation significance
The risk, extent and distribution of detected species are understood.	Collate, verify and map weed species distribution in relation to assets
Cross-tenure control is coordinated with agency or neighbour partners.	Liaise with adjacent landholders to understand their priorities and objectives
Eradication plan is developed. Containment plan is developed. Asset protection plan is developed.	Scope the biosecurity objectives and locations for priority species Work with park neighbours to develop containment plans Develop asset protection plans for priority environmental assets Determine the feasibility of local eradication, containment or asset protection for pest plant species
New species are eradicated. Infestations are contained. Weed density is reduced to protect assets.	Prioritise and implement the removal of satellite weed populations Control weeds at high-value and high-risk locations
Weed reinvasion risk is reduced, and the effectiveness of weed control is increased.	Monitor and evaluate the effectiveness of weed control and relevant key ecological attribute indicators for condition Adapt the control approach
Vegetation structure and quality of habitat in priority locations are maintained or restored.	
Priority indigenous species populations are maintained or improving.	

Implement management actions to address climate change

Ongoing availability of water for the environment is particularly critical to the inundation-dependent assets of this landscape in our changed climate, with reduced average rainfall and longer periods of dry and drought. Securing water availability, and identifying options for recovering water for environmental purposes, is undertaken at the intergovernmental policy level. Partner agencies, particularly CMAs, will respond to climate change by delivering environmental water using an adaptive management approach: trialling techniques, monitoring outcomes and adapting the delivery pattern (Murray–Darling Basin Authority, 2019). It is also important to continue building our understanding of how climate change will affect water resources and applying climate science to water management (DELWP, 2016a).

Tools are being developed to select the on-ground actions that will have the greatest positive ecological impact and help land managers prioritise areas where effort should be focused. These tools will give ecosystems a greater ability to adapt to projected climate scenarios. A number of resources specific to the Murray Basin region offer guidance, including plant restoration guidelines (Broadhurst et al., 2016) and an exploration of adaptation pathways in the Murray Basin (Dunlop et al., 2016). Additionally, Parks Victoria, in collaboration with Deakin University, established a framework for identifying ecological havens for the Parks Victoria estate (Selwood et al., 2019) to help land managers identify areas in the River Red Gum Park Landscape that should be prioritised for long-term management. These havens are areas that maintain high-quality forest stands in both drought and wet periods, enhancing the biota's capacity to withstand and recover from poor conditions.

Incorporating a collaborative management response to address climate risks at the planning level is required to ensure that species and ecological communities are functioning within acceptable bounds that maintain key species and threatened flora and fauna populations. However, in a drying climate, on-ground environmental projects need to explore actions that support adaptation to climate change and facilitate transition to drier climatic conditions. Reduced water availability may mean that some inundation-dependent assets in the landscape cannot be maintained. Working with partners to manage the landscape in a coordinated manner will be critical in prioritising and retaining key values within landscape assets.

Other actions include working with research partners to identify indicators of change, undertaking long-term monitoring and implementing mitigating actions.

Enhanced recognition of the benefits that a healthy park landscape provides in and of itself, as part of the response to climate change, is also critical. Providing evidence of the benefits of a healthy park to the local environment (for example, as habitat and refuge), as well as to the broader environment (for example, for survival of populations of species, ecological processes and carbon cycling) will justify the resources required to adequately manage the River Red Gum Park Landscape.

A major challenge is to flexibly allocate resources to projects when they will be most effective. Some management activities (for example, pig baiting) are more effective during dry and drought conditions whereas others (for example, revegetation) are more successful in wetter years. Parks Victoria will investigate adjusting environmental management resourcing (for example, establishing longer term funding contracts or a climate trust fund) to help increase project effectiveness by making resources available at optimal times.

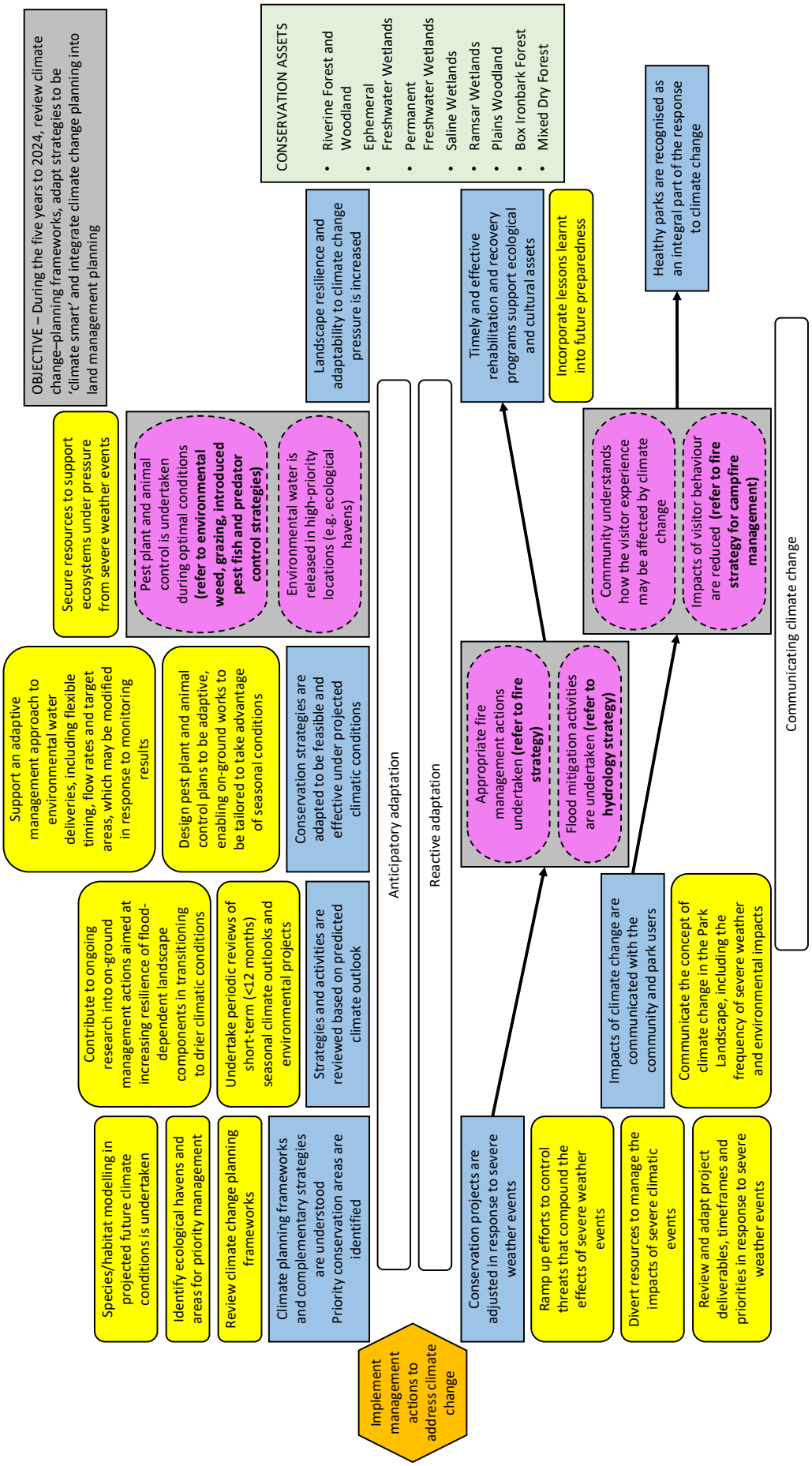
Conservation outcomes

Landscape resilience and adaptability to climate change is increased, timely and effective ecological restoration and recovery programs support healthy assets, and healthy parks are recognised as an integral part of the response to climate change.

Strategy summary

Incorporate planning for climate change and the transition to drier conditions and more frequent severe weather events into land management practices to facilitate the adaptation of ecosystems.

Results chain



Implementation milestones

Result	Activities
Anticipatory adaptation	
Climate planning frameworks and complementary strategies are understood. Priority conservation areas are identified (drought refugia, critical habitat).	Undertake species and/or habitat modelling in projected future climate conditions with research partners Identify ecological havens and areas for priority habitat management Review climate change frameworks and plans by partner agencies
Strategies and activities are reviewed based on predicted climate outlook.	Contribute to ongoing research into effective on-ground management actions aimed at increasing resilience of flood-dependent ecosystem components, to support the transition to drier climatic conditions Undertake periodic reviews of short-term (<12 months) seasonal climate outlooks and environmental projects and programs
Conservation strategies are adapted to be feasible and effective under projected climatic conditions.	Support an adaptive management approach to environmental water deliveries, including flexible timing, flow rates and target areas, which may be modified in response to monitoring results Design pest plant and animal control plans to be adaptive, enabling on-ground works to be tailored to take advantage of seasonal conditions
Pest plant and animal control is undertaken during optimal conditions (refer to environmental weed, grazing, introduced pest fish and predator control strategies). Environmental water is released in high-priority locations (e.g. ecological havens).	Secure resources to support ecosystems under pressure from severe weather events
Landscape resilience and adaptability to climate change pressure is increased.	

Result	Activities
Reactive adaptation	
Conservation projects and programs are adjusted in response to severe weather events.	Ramp up efforts to control threats that compound the effects of severe weather events Divert resources to manage the impacts of severe climatic events Review and adapt project and program deliverables, timeframes and priorities in response to severe weather events
Appropriate fire management actions are undertaken (refer to fire strategy). Flood mitigation activities are undertaken (refer to hydrology strategy).	
Timely and effective rehabilitation and recovery programs support ecological and cultural assets.	Incorporate lessons learnt into future preparedness

Result	Activities
Climate communications	
Impacts of climate change are communicated with the community and park users.	Communicate the concept of climate change in the Park Landscape context, including the frequency of severe weather events and environmental impacts Leverage from major events (drought, eutrophication events) to connect climate change messaging with impacts to park visitor values that resonate with different sectors of the community
The community understands how the visitor experience may be affected by climate change. Impacts of visitor behaviour are reduced (refer to fire strategy for campfire management).	
Healthy parks are recognised as an integral part of the response to climate change.	

Establish partnerships to coordinate management strategies and address key knowledge gaps

A number of agencies have an interest in or responsibility for managing resources in the River Red Gum Park Landscape. A strong collaborative effort, including coordinating actions, aligning planning and sharing knowledge among partners, is needed to coordinate the multitude of actions each agency intends to implement on the Parks Victoria estate.

This strategy intends to increase the level of collaboration and partnership between Parks Victoria, other land managers, partner agencies (such as CMAs and water authorities), Traditional Owners and researchers to effectively identify, test and apply adaptive management approaches to improve overall outcomes for the River Red Gum Park Landscape.

Water regime planning is a key part of the management required in the flood-dependent conservation assets within this landscape. This aspect of management is coordinated by the catchment management authorities, and Parks Victoria plays a supporting role. However, the associated land management activities are usually coordinated and implemented by Parks Victoria.

Ongoing collaboration among relevant agencies will improve knowledge sharing and ensure that management activities for water and other land activities are integrated to get the best overall outcomes.

Traditional Owners continue to develop their goals for the ongoing management of this landscape, including extending the provision of cultural flows in the flood-dependent conservation assets. Parks Victoria plays a key role in supporting these aspirations, building the capacity of Traditional Owners, and incorporating their involvement into site planning to facilitate on-ground action.

Many knowledge gaps have been identified as requiring investigation, and innovative and adaptive management actions must be implemented to address these. For example, knowledge is lacking on the impact of historical forestry activities and the actions that can be used to improve habitat availability and water efficiency over the long term. The *River Red Gum Parks Management Plan* (Parks Victoria, 2018a) lists many of these key research questions. Information sharing and collaborative project implementation will lead to the development of up-to-date best management practices that can be implemented by all.

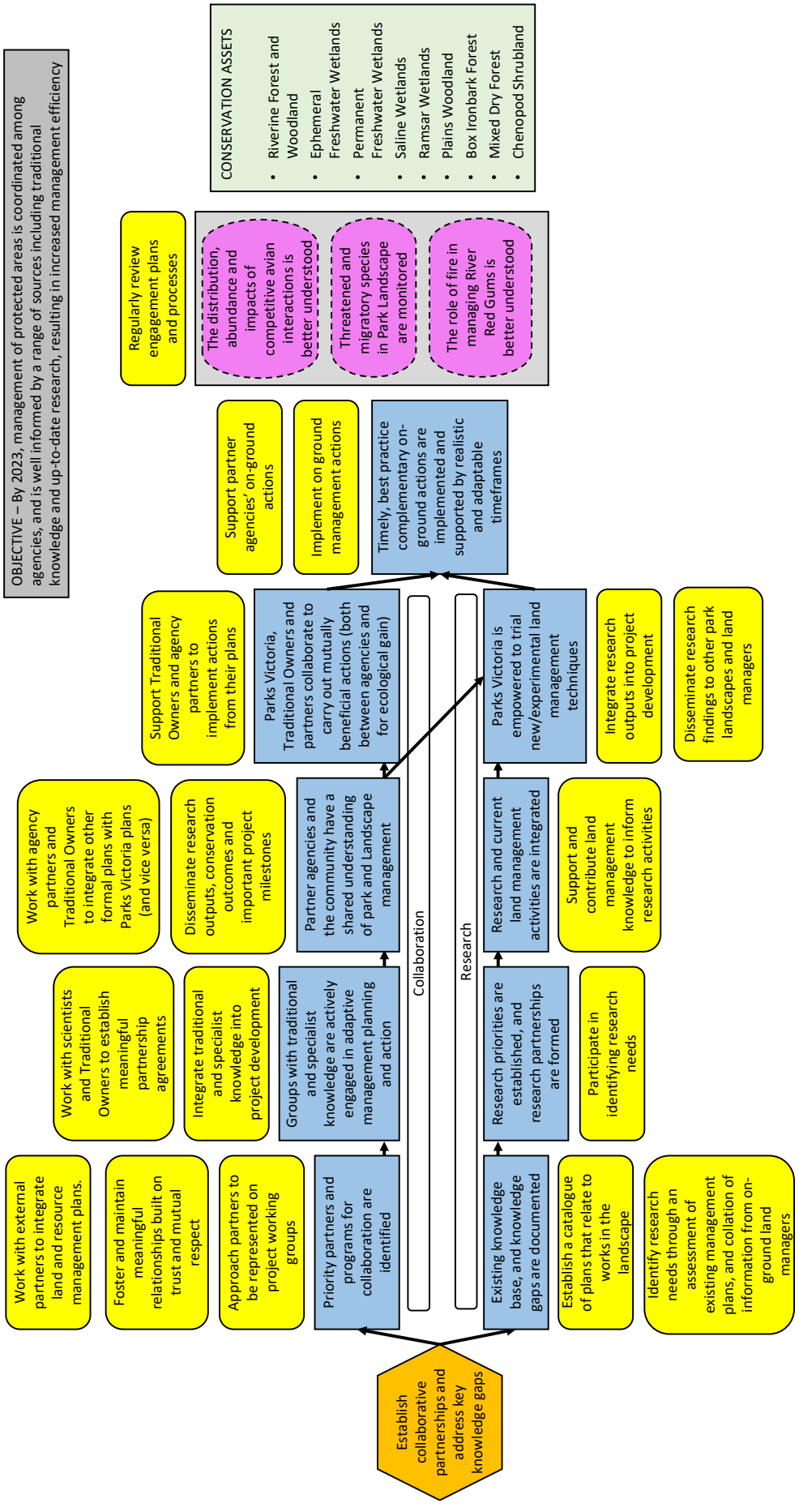
Conservation outcomes

Management of protected areas is coordinated among agencies, and is well informed by a range of sources including traditional knowledge and up-to-date research, resulting in increased management efficiency.

Strategy summary

Integrate research and management activities to improve management effectiveness.

Results chain



Implementation milestones

Result	Activities
Priority partners and programs for collaboration are identified.	Work with external partners to integrate existing and new site-based and landscape plans Foster and maintain meaningful relationships built on trust and mutual respect Approach partners to be represented on project working groups
Groups with traditional and specialist knowledge are actively engaged in adaptive management planning and action.	Work with scientists (e.g. ecologists) and Traditional Owners to establish meaningful and respectful partnership agreements Seek traditional ecological knowledge and apply throughout the planning and implementation of actions
Partner agencies and the community have a shared understanding of park and landscape management.	Work with agency partners and Traditional Owners to integrate other formal plans with Parks Victoria plans (and vice versa) Disseminate research outputs, conservation outcomes and important project milestones through media channels, interpretation materials and activities
Parks Victoria, Traditional Owners, and partners collaborate to carry out mutually beneficial actions (both between agencies and ecologically).	Support Traditional Owners and agency partners to implement actions from their plans
Existing knowledge base and knowledge gaps are documented.	Identify research needs through an assessment of existing management plans, and collation of information from on-ground managers Establish a catalogue of plans that relate to works in this landscape
Research priorities are established and research partnerships are formed.	Establish and maintain partnerships with relevant research groups to identify research priorities: • the distribution, abundance and impacts of Noisy Miners, Galahs and Little Corellas • threatened and migratory species abundance/density • the role of fire in managing the encroachment of River Red Gums in grasslands and the relationship between fire and coarse woody debris
Research and current land management activities are integrated.	Support and contribute land management knowledge to inform research activities
Parks Victoria is empowered to trial new/experimental land management techniques.	Integrate new research into project plans for future works Produce management-focused communications materials and distribute to other Park Landscapes and land managers including reports and papers
Timely, best practice, complementary on-ground actions are implemented, supported by realistic, adaptable funding timeframes.	Implement on-ground management actions Support partner agencies' on-ground actions
The distribution, abundance and impacts of competitive avian interactions is better understood. Threatened and migratory species in River Red Gum Park Landscape are monitored. The role of fire in managing River Red Gums is better understood.	Regularly review engagement plans and processes

8 Measuring performance

Monitoring, evaluation and reporting enables Parks Victoria to quantify the effectiveness of implementing the prioritised conservation strategies. It also supports continuous improvement through decision-making based on values and evidence.

Measuring performance in conservation action planning involves assessing the effects of management actions in relation to the desired state of key ecological attributes and conservation assets. A critical step in developing an effective conservation action plan is to agree before works are implemented on what will be measured and how measurement will be made. Performance measures enable an integrated assessment of:

- the quantity and quality of management actions (activity measures)
- the impacts of an activity on threats (threat measures)
- the results of management on the conservation asset (outcome measures).

The following performance measures, developed in collaboration with experts in this field, provide a useful starting point for developing a monitoring, evaluation and reporting plan for the River Red Gum Park Landscape. They can guide interim assessments of performance until a detailed plan is established.

Manage water for conservation outcomes

This strategy will result in an improvement in the health of a range of water-dependent conservation assets, particularly wetlands and River Red Gum forest. Implementing this strategy involves a range of measures to meet the water requirements of these ecosystems through natural and managed floods. It also focuses on minimising potential risks through the improved management of privately owned irrigation infrastructure and unmanaged levees within the parks and reserves.

Activity measures for the strategy are the:

- number of parks where water management infrastructure is captured in asset management systems
- number of artificial structures identified within the flood plain
- area of water-dependent conservation assets subject to appropriate flow regimes
- number of levee maintenance permits issued
- number of licences issued for the use and maintenance of privately owned infrastructure on Crown land
- area of complementary pest plant and animal control programs treated.

The key threats managed under this strategy are inappropriate hydrological regimes, for which the following **threat measures** can be used:

- barriers to the natural movement of water (number of flow restrictions removed)
- shortfalls in water requirements of flood-dependent ecosystems (area, frequency and extent of environmental water delivered)
- external threats to achieving desired outcomes from environmental water deliveries (measured by pest plant and animal control programs)
- area of conservation assets where the impact of artificial structures has been reduced.

Conservation outcomes of the strategy can be measured by the:

- diversity and abundance of native aquatic plant species

- condition of River Red Gum forest, particularly tree canopy health
- ecological character of Ramsar sites
- frequency and scale of waterbird breeding events
- diversity and abundance of native fish and frog populations
- suitability of hydrological regimes for flood-dependent assets.

Manage fire for healthy assets

Implementing this strategy will involve communications and compliance activities to reduce the risk of human-induced ignitions and where possible protect significant values from loss during fires.

Activity measures for the strategy are the number of:

- Aboriginal cultural heritage places catalogued
- park visitors reached through campfire education, engagement and compliance
- protocols developed and in place for managing fire in sensitive (culturally and environmentally) areas.

The key threat managed under this strategy is fire regimes and management, for which the following **threat measures** can be used:

- number of campfire-related incidents
- percentage of the Park Landscape maintained within tolerable fire intervals
- area of Park Landscape that has been surveyed for Aboriginal cultural heritage places.

Conservation outcomes of this strategy can be measured by the:

- age-class structure of canopy species
- vegetation species composition
- occurrence and diversity of fauna
- degree of protection of cultural heritage.

Manage total grazing pressure

Implementing this strategy to control herbivores using culturally appropriate methods will improve the quality of native vegetation and riparian zone integrity, and protect culturally important sites across the Park Landscape.

Activity measures for the strategy are the:

- number of pest animals with impacts, control methods, control level and high-priority locations identified
- extent, frequency and method of control (number and type of animal removed)
- percentage of high-priority locations with control activities undertaken.

The key threat managed under this strategy is terrestrial grazing, browsing and trampling pressure by introduced herbivores and macropods, for which the following **threat measures** can be used:

- herbivore density
- extent of damage to cultural sites
- extent and area of pig wallows.

Conservation outcomes for the strategy can be measured by the:

- structure and composition of native vegetation
- degree of protection of cultural sites.

Manage introduced pest fish

Implementing this strategy will involve collaborating with stakeholders and resource management partners to reduce the impact of invasive aquatic fauna on the habitat values of inundation-dependent assets. This will give susceptible wetland vegetation the opportunity to regenerate, and allow native fish populations to remain stable or increase.

The **activity measure** for the strategy is the:

- treatment effort (number of person-days, areas treated, invasive species removed).

The key threat managed under this strategy is invasive aquatic fauna, for which the following **threat measures** can be used:

- abundance of aquatic pests in established areas
- number of hectares which are free of aquatic pest animals.

Conservation outcomes of the strategy can be measured by the:

- abundance of native fish populations
- biomass of aquatic pest species.

Control introduced terrestrial predators

Implementing this strategy will improve the ability of threatened and migratory species to persist in the landscape. Key actions include controlling predators at vulnerable stages in the predator species' life cycle and when the prey species are most vulnerable (for example, during breeding). An effective landscape-scale approach to predator control is an integrated management approach that considers both competition between predators (cats and foxes) and predator–prey dynamics.

Activity measures for the strategy are the:

- extent, frequency and method of fox control (number of fox baits laid)
- extent and frequency of cat and fox trapping (number of cat trap-nights).

The key threat managed under this strategy is predation by foxes and cats, for which the following **threat measures** can be used:

- cat activity (as measured by camera)
- fox activity (as measured by bait take)
- area of Park Landscape where predation is actively managed.

Conservation outcomes of the strategy can be measured by the:

- extent of occupancy of suitable habitat by predation-sensitive species
- population size of predation-sensitive species
- number of predation-sensitive species with increasing populations.

Manage environmental weeds

Implementing this strategy will involve controlling environmental weeds through surveillance and rapid management intervention to prevent the establishment of new and emerging weeds and maintain established weeds at acceptable densities.

Activity measures for the strategy are the:

- number of environmental weeds with impacts, control methods and priority locations identified
- extent, frequency and method of control (number and type of environmental weed removed)
- percentage of high-priority locations with control activities undertaken.

The key threat managed under this strategy is invasion by introduced and native fauna, for which the following **threat measures** can be used:

- extent and cover of environmental weeds
- number of new and emerging weed species identified within the River Red Gum Park Landscape.

Conservation outcomes of the strategy can be measured by the:

- health of conservation assets where environmental weeds are, or were, present
- condition of Ramsar sites.

Planning for climate change in the River Red Gum Park Landscape

Implementing this strategy will improve the capacity for the landscape to adapt to a changing climate and ensure that the changes in the landscape are both planned for and well understood by park managers and the community.

Activity measures for the strategy are the number of:

- projects delivered in optimal conditions
- assets/hectares in which climate threats have been considered or climate impacts modelled
- communication opportunities and messages in which climate change impacts are communicated to park users and local community.

This strategy will contribute to the management of all key threats. They can be measured using the following **threat measures**:

- time taken for rehabilitation or recovery
- number of hectares protected from severe climatic events
- level of decline or local extinction of flora and fauna vulnerable to climate change.

Conservation outcomes of the strategy can be measured by the:

- number of hectares prioritised as drought refuges
- habitat quality of drought refuges, using respective EVC benchmarking.

Establish partnerships to coordinate management strategies and address key knowledge gaps

Implementing this strategy will improve the health of conservation assets in the River Red Gum Park Landscape by strengthening effective collaboration and partnerships between Parks Victoria and restoration partners. This will support connected, cross-tenure and cross-agency management across a landscape with a diversity of stakeholders in land and water management.

Collaborative partnerships share research outcomes, align projects and increase planning and implementation efficiency. Developing and adopting common monitoring metrics will help capture a bigger picture of landscape health and project implementation success.

Activity measures for the strategy are the number of:

- projects implemented across land tenures in which Parks Victoria is a partner
- days participating in events that share knowledge and best practice with other land managers and citizen scientists
- research partner projects supported
- third party projects delivered on Parks Victoria estate.

This strategy will contribute to the management of all key threats. They can be measured using the following **threat measures**:

- total effort to manage each threat
- total cost to manage a unit of threat.

Conservation outcomes of the strategy can be measured by the:

- extent to which new and local knowledge and expertise are integrated into future planning
- number of parks that are managed with Traditional Owners
- degree of agency Traditional Owners have in planning and on-ground management
- extent to which decision-making is supported by current research.

9 Plan implementation

A monitoring, evaluation and reporting plan will be developed from the interim performance indicators in this Conservation Action Plan. It will include key evaluation questions, more specific monitoring questions, and appropriate metrics, measures and reporting standards. It will be a key component of adaptive management and an outcomes-focused approach to managing for conservation in parks and reserves. Specifically, the monitoring, evaluation and reporting plan is essential for:

- determining whether the conservation strategies and specific operational activities are achieving the desired conservation outcomes
- showing trends in the condition of conservation assets and the levels of threat
- demonstrating the effectiveness and efficiency of resources invested in the Conservation Action Plan.

The plan will address the collection, storage and collation of data as well as its analysis and interpretation. The analysis and interpretation of data is the cornerstone of applying a 'learning by doing' approach, in which knowledge gaps are identified and addressed through targeted scientific research. The evaluation of the Conservation Action Plan is an important step in documenting lessons learnt and communicating ideas around the improvement of policy, planning and management within Parks Victoria and to external audiences.

Steps 8, 9 and 10 of the 10-step process for conservation planning (see section 1.3) follow on from implementing the strategies outlined here, and are beyond the scope of this Conservation Action Plan. Steps 8 and 9 will be carried out at an operational level within the Parks Victoria region that has management responsibility for the River Red Gum Park Landscape. Step 10 is a review of this Conservation Action Plan in the light of what is learnt during implementation.

Step 8 Plan work

In adapting a Conservation Action Plan into a works program, conservation strategies are converted to projects for specific geographic locations. Project planning, which includes time-bound activity planning, should inform on-ground works and build on the steps in the results chains by providing additional detail to achieve the identified results.

The project planning phase is the time to consider logistical issues such as site access, high areas of visitation and cultural heritage impacts.

During this phase, Traditional Owner engagement and opportunities for collaboration are investigated, resource requirement are identified, applications for relevant approvals are made, and project-specific outcomes are developed.

Step 9 Implement plan

This Conservation Action Plan will be implemented by a regional team, often in collaboration with other agencies, Friends groups and volunteers. Operational conservation activities will be implemented in accordance with relevant Parks Victoria policies and procedures and legislative obligations.

Step 10 Adapt the Conservation Action Plan and operational activities

In the context of adaptive management, evaluating the Conservation Action Plan is important in determining and communicating whether or not the conservation strategies and specific on-ground activities have abated threats and achieved the desired conservation outcomes. The Conservation Action Plan is not a static document. It will be revised in response to the outcomes of the monitoring, evaluation and reporting plan, and in response to emerging issues. Revising this Conservation Action Plan may result in restructured conservation strategies, including amended results chains and their underlying assumptions and refined specific on-ground activities. The review and adaptation of the plan is likely to be done in part through a process of small workshops involving a similarly representative group of people as were involved in developing the original plan.

References

Adair R, Cheal D and White M (2008) *Advisory list of environmental weeds of aquatic habitats of Victoria*. Victorian Department of Sustainability and Environment: Melbourne.

Balcombe SR, Sheldon F, Capon SJ, Bond NR, Marsh N, Hadwen WL and Bernays, SJ (2011) Climate-change threats to native fish in degraded rivers and floodplains of the Murray–Darling Basin, Australia. *Marine and Freshwater Research* 62: 1099–1114.

Blood K, James R and Panetta FD (2016) *Managing weeds: assess the risk guide. A guide for assessing the risk for weeds at the early stage of invasion on public land in Victoria*. Department of Environment, Land, Water and Planning: Victoria.

Broadhurst L, Wilson J, Skinner A, Dwyer S, Brunt K, Day P, Baker T, Doerr V, and Rogers D (2016) *Climate-ready restoration: some practical guidelines for plant restoration in an uncertain future*. CSIRO: Australia.

Butcher R and Hale J (2011a) *Ecological character description for Hattah-Kulkyne Lakes Ramsar site*. Report to the Department of Sustainability, Environment, Water, Population and Communities: Canberra.

Butcher R and Hale J (2011b) *Ecological character description for the Gunbower Forest Ramsar site*. Report to the Department of Sustainability, Environment, Water, Population and Communities: Canberra.

Butcher R and Hale J (2011c) *Ecological character description for the Barmah Forest Ramsar site*. Report to the Department of Sustainability, Environment, Water, Population and Communities: Canberra.

Butcher R and Hale J (2016) *Addendum to ecological character description for the Kerang Wetlands Ramsar site*. Department of Environment, Land, Water and Planning: East Melbourne.

Butt N, Seabrook L, Maron M, Law BS, Dawson TP, Syktus J, and McAlpine CA (2015) Cascading effects of climate extremes on vertebrate fauna through changes to low-latitude tree flowering and fruiting phenology. *Global Change Biology* 21:3267-3277.

Carey JM, Burgman MA, Boxshall A, Beilin R, Flander L, Pegler P, and White AK (2007) *Identification of threats to natural values in Victoria's marine national parks and sanctuaries*. Parks Victoria Technical Series 33. Parks Victoria: Melbourne.

Conservation Measures Partnership (2019) The open standards for the practice of conservation. Available at <cmp-openstandards.org>.

Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar), opened for signature 2 February 1971 (entered into force 21 December 1975).

CSIRO and Bureau of Meteorology (2015) *Climate change in Australia: Information for Australia's natural resource management regions*. Technical Report, CSIRO and Bureau of Meteorology, Australia.

DELWP (2016a) *Water for Victoria: Water plan*. Department of Environment, Land, Water and Planning: Victoria.

DELWP (2016b) *Victorian floodplain management strategy*. Department of Environment, Land, Water and Planning: Victoria.

DELWP (2017a) *Protecting Victoria's Environment — Biodiversity 2037*. Department of Environment, Land, Water and Planning: Victoria.

DELWP (2017b) *Impact of Carp in wetlands.* Fact sheet 4*,* Department of Environment, Land, Water and Planning: Victoria.

Department of Environment and Primary Industries (2013) *Barmah Forest Ramsar site boundary description*. Technical Report, Department of Environment and Primary Industries: East Melbourne, Victoria.

Department of Natural Resources and Environment (1997) *Victoria's biodiversity — our living wealth*. Department of Natural Resources and Environment: East Melbourne, Victoria.

Department of Sustainability and Environment (2012) *Code of practice for bushfire management on public land*. Department of Sustainability and Environment: Victoria.

Dunlop M, Gorddard R, Ryan P, MacKenzie J, Waudby H, Skinner A and Bond T (2016) *Exploring adaptation pathways in the Murray Basin*. CSIRO: Australia.

Garnaut R (2011) *The Garnaut Review 2011: Australia in the global response to climate change*. Cambridge University Press: Port Melbourne.

Gorrod EJ, Childs P, Keith DA, Bowen S, Pennay M, O'Kelly T, Woodward R, Haywood A, Pigott JP and McCormack C (2017). Can ecological thinning deliver conservation outcomes in high density River Red Gum forests? Establishing an adaptive management experiment. *Pacific Conservation Biology* 23: 262–276.

Gott B (2005) Aboriginal fire management in south-eastern Australia: aims and frequency. *Journal of Biogeography* 32: 1203–1208.

Greening Australia (2014a) River Red Gum Parks Landscape summary Part 1: Summary and Appendices 1-8. Report to Parks Victoria.

Greening Australia (2014b) River Red Gum Parks Landscape summary Part 1: Appendices 9–17. Report to Parks Victoria.

Greening Australia (2014c) *River Red Gum Parks Management Plan: review of environmental conservation management priorities*. Report to Parks Victoria.

Mac Nally R, Cunningham SC, Baker PJ, Horner GJ and Thomson JR (2011). Dynamics of Murray–Darling floodplain forests under multiple stressors: the past, present, and future of an Australian icon. *Water Resources Research* 47(12).

Millennium Ecosystem Assessment (2005) *Ecosystems and human well-being: synthesis*. Island Press: Washington, DC.

Murray–Darling Basin Authority (2016) *Towards a healthy, working Murray–Darling Basin: Basin Plan annual report 2015–16.* Murray–Darling Basin Authority: Canberra.

Murray–Darling Basin Authority (2019) *Climate change and the Murray–Darling Basin Plan*. MDBA Discussion Paper, Murray–Darling Basin Authority: Canberra.

Palmer G and Cahir F (2010) *Fire on River Red Gum communities: literature review*. Report to Parks Victoria, Centre for Environmental Management, University of Ballarat: Ballarat.

Parks Victoria (2018a) *River Red Gum Parks Management Plan*. Parks Victoria: Melbourne.

Parks Victoria (2018b) *Strategic action plan: protection of floodplain marshes in Barmah National Park and Barmah Forest Ramsar site*. Parks Victoria: Melbourne, Australia.

Parks Victoria (2019) *Conservation Action Plan for Parks and Reserves Managed by Parks Victoria. Mallee.* Parks Victoria: Melbourne, Australia.

Robley A, Howard K, Lindeman M, Cameron R, Jardine A and Hiscock D (2016) The effectiveness of short-term fox control in protecting a seasonally vulnerable species, the Eastern Long-necked Turtle (*Chelodina longicollis*). *Ecological Management and Restoration* 17: 63–69.

Selwood KE, Cunningham SC and Mac Nally R (2019) Beyond refuges: identifying temporally dynamic havens to support ecological resistance and resilience to climatic disturbances. *Biological Conservation*, 233: 131–138.

Taylor L and Pegler P (2016) Total grazing management plan for the restoration of semi-arid woodland and floodplain vegetation communities in north-western (Mallee) parks 2016–2021. Parks Victoria: Melbourne, Australia.

Victorian Environment Assessment Council (2008) *River Red Gum Forests Investigation final report*. Victorian Environmental Assessment Council: East Melbourne.

White AK (2012) *Ecosystem conceptual models for Victorian ecosystems*. Parks Victoria Technical Series 65. Parks Victoria: Melbourne.

White M, Cheal D, Carr GW, Adair R, Blood K and Meagher D (2018) *Advisory list of environmental weeds in Victoria*. Arthur Rylah Institute for Environmental Research Technical Report Series No. 287. Department of Environment, Land, Water and Planning: Heidelberg, Victoria.

Yorta Yorta Nation Aboriginal Corporation (2012) *Yorta Yorta Nation Caring for Country and Culture: Whole of Country Plan 2012–2017*. Yorta Yorta Nation Aboriginal Corporation.

Yorta Yorta Traditional Owner Land Management Board and DELWP (2019) *Draft joint management plan Barmah National Park*. Yorta Yorta Traditional Owner Land Management Board and Department of Environment, Land, Water and Planning, Melbourne.

Zimmer H, Cheal D and Cross E (2012) *Post-fire weeds triage manual: Black Saturday Victoria 2009 — Natural values fire recovery program.* Arthur Rylah Institute for Environmental Research, Department of Sustainability and Environment: Heidelberg, Victoria.

Bibliography

Department of Sustainability and Environment (2004). *Kerang Wetlands Ramsar site: strategic management plan*. Department of Sustainability and Environment: Victoria.

Low G (2003) *Landscape-scale conservation: a practitioners guide*. The Nature Conservancy, 4th edition.

Museum Victoria (2016) *The Murray explored: biodiversity, history and community engagement*. Report produced by Museum Victoria for the Gannawarra Shire.

North Central Catchment Management Authority (2017), *Kerang Wetlands Ramsar site action plan 2017–2025*, section 2.2 'Ramsar Site Overview — catchment setting'. North Central Catchment Management Authority: Victoria.

Smales I (2016) *Monitoring waterbird abundance in response to environmental watering at the Hattah Lakes Icon Site: 2016*. Report prepared for the Mallee Catchment Management Authority by Biosis Pty Ltd: Melbourne.

Wood D and Brown P (2016) *Lateral fish movement at the Hattah Lakes icon site: 2016*. Final Report prepared for the Mallee Catchment Management Authority by The Murray–Darling Freshwater Research Centre, MDFRC Publication 95/2016, March, 38pp.

Appendices

Appendix A — Protection categories

Levels of Protection for natural values management

Levels of Protection is a tool to aid planning and resource allocation by placing individual parks in a statewide context. Parks have been classified (or grouped) according to composition and representation of attributes classified at the EVC and species scale (Table A.1). A key principle of the framework is that protected area planning is conducted in a bioregional context. The bioregional value, and hence management priority, of biodiversity attributes in parks and reserves has been assessed on the basis of:

- conserving the range of ecosystems and existing biotic diversity
- the occurrence of attributes that depend on a particular park for their security.

The protected areas category system

The protected area management categories of the International Union for Conservation of Nature and Natural Resources (IUCN) classify protected areas according to their management objectives. The categories are recognised by international bodies such as the United Nations and by many national governments as the global standard for defining and recording protected areas, and as such are increasingly being incorporated into government legislation. For further information, see the IUCN website: http://www.iucn.org/theme/protected-areas/about/categories.

Category Ia Strict Nature Reserve — strictly protected area set aside to protect biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited.

Category Ib Wilderness Area — usually large unmodified or slightly modified area, retaining its natural character and influence without permanent or significant human habitation.

Category II National Park — large natural or near-natural area set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area.

Category III Natural Monument or Feature — set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove.

Category IV Habitat/Species Management Area — aims to protect particular species or habitats, and management reflects this priority.

Category V Protected Landscape/Seascape — protected area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value.

Category VI Protected area with sustainable use of natural resources — conserves ecosystems and habitats together with associated cultural values and traditional natural resource management systems.

Table A.1 Park groups and their attributes

Park group	General description of park group attributes
A1	All parks represent at least two bioregions. Parks generally greater than 10 000 ha (up to 660 000 ha), all scheduled under the *National Parks Act 1975* (Vic.) Most parks very large or have contiguity with state forest areas (or both), and have very high area-to-boundary ratios. All have very high diversity in terms of both vegetation communities and species, and represent a high proportion of the bioregions' species diversity (about 40–60%). Parks have a very large number of threatened species present and are important for protecting a relatively high proportion of those species. Internal fragmentation is highly variable across the scale of these parks as are areas of highly disturbing previous land use.
A2	With park group A1, captures representation of all bioregions. Park size generally greater than 1000 ha (up to 21 600 ha), mostly parks scheduled under the National Parks Act but also includes high-value nature conservation reserves. All have relatively high diversity of both vegetation communities and species, and represent a high proportion of the bioregions' species diversity (about 40–60%). Large number of threatened species present, and the park is important for protecting a relatively high proportion of those species. A greater degree of exposure to threatening processes at their edge (than A1), as well as from previous disturbing land uses.
A – Marine	Marine national parks scheduled under the National Parks Act.
B	Represents full range of bioregions, except for three bioregions completely conserved within parks in A1 and A2. Park sizes range from 50 ha to 40 000 ha; majority of nature conservation reserves. Parks are protecting vegetation communities that are largely of moderate significance and well represented in the parks system. Parks have relatively lower species diversity, representing a moderate proportion of the bioregions' species diversity (about 20–40%). Parks have a moderate number of threatened species present and are important for protecting a small number of those species.
B – Marine	Marine sanctuaries scheduled under the National Parks Act.
C	Park size ranges from 1 ha to 142 300 ha, predominantly nature conservation reserves, with a small number of parks scheduled under the National Parks Act that have relatively low or common biodiversity values. Parks are protecting vegetation communities largely of low-to-moderate significance and that are well represented in the parks system. Generally have moderate-to-high levels of internal fragmentation and adjacency to non-native vegetation. Parks have relatively lower species diversity, representing a moderate proportion of the bioregions' species diversity (about 10–30%). Moderate but variable number of threatened species present and important for protecting a small number of those species.
D	Park sizes range from 10 ha to 15 000 ha, and are conservation reserves. Parks have relatively lower species diversity, representing a moderate proportion of the bioregions' species diversity (about 2–15%). Relatively small number of threatened species present.
E	Generally have very low or no recorded values of low biodiversity conservation significance.

Appendix B — Conservation assets

Areas of ecosystems (conservation assets), sub-ecosystems, Ecological Vegetation Divisions (EVDs) and Ecological Vegetation Classes (EVCs) within the River Red Gum Park Landscape.

Asset	Sub-ecosystem	EVD	EVC	Total (ha)
Riverine Forest and Woodland	Riverine Forest and Woodland	Riverine Woodland/Forest	Drainage-line Aggregate/Sedgy Riverine Forest Mosaic	23
			Floodplain Grassy Wetland/Floodway Pond Herbland Mosaic	5.8
			Floodplain Grassy Wetland/Riverine Swamp Forest Mosaic	103.9
			Floodplain Grassy Wetland/Riverine Swampy Woodland Mosaic	1.5
			Floodplain Riparian Woodland	5 371.6
			Floodplain Riparian Woodland/Floodway Pond Herbland Mosaic	2.5
			Floodplain Riparian Woodland/Riverine Grassy Woodland Mosaic	5.2
			Floodplain Riparian Woodland/Riverine Swamp Forest Mosaic	219.7
			Floodplain Riparian Woodland/Sedgy Riverine Forest Mosaic	138.5
			Floodplain Riparian Woodland/Tall Marsh Mosaic	0.7
			Floodway Pond Herbland/Riverine Swamp Forest Mosaic	0.6
			Grassy Riverine Forest	6 209.5
			Grassy Riverine Forest/Drainage-line Aggregate Mosaic	2.7
			Grassy Riverine Forest/Floodway Pond Herbland Complex	1 074.8
			Grassy Riverine Forest/Floodway Pond Herbland Mosaic	4.6
			Grassy Riverine Forest/Plains Grassy Woodland/Grassy Woodland Mosaic	0.2
			Grassy Riverine Forest/Riverine Grassy Woodland Mosaic	23.5
			Grassy Riverine Forest/Riverine Swamp Forest Complex	3 195.7
			Grassy Riverine Forest/Riverine Swamp Forest Mosaic	67.7
			Grassy Riverine Forest/Riverine Swampy Woodland Mosaic	1
			Grassy Riverine Forest/Sedgy Riverine Forest Mosaic	342.2
			Grassy Riverine Forest/Tall Marsh Mosaic	2
			Mosaic of Drainage-line Aggregate/Grassy Riverine Forest – Riverine Swamp Forest Complex	147.2

Asset	Sub-ecosystem	EVD	EVC	Total (ha)
			Mosaic of Drainage-line Aggregate/Sedgy Riverine Forest – Riverine Swamp Forest Complex	19.1
			Mosaic of Floodplain Grassy Wetland/Grassy Riverine Forest – Riverine Swamp Forest Complex	21.1
			Mosaic of Floodplain Grassy Wetland/Sedgy Riverine Forest – Riverine Swamp Forest Complex	1.8
			Mosaic of Floodway Pond Herbland/Grassy Riverine Forest – Riverine Swamp Forest Complex	367.9
			Mosaic of Floodway Pond Herbland/Sedgy Riverine Forest – Riverine Swamp Forest Complex	8.4
			Mosaic of Grassy Riverine Forest/Floodway Pond Herbland – Riverine Swamp Forest Complex	22.7
			Mosaic of Grassy Riverine Forest/Sedgy Riverine Forest – Riverine Swamp Forest Complex	57.6
			Mosaic of Grassy Riverine Forest – Riverine Swamp Forest Complex/Riverine Swamp Forest	191.1
			Mosaic of Riverine Grassy Woodland/Floodway Pond Herbland – Riverine Swamp Forest Complex	1.2
			Mosaic of Riverine Swamp Forest/Floodway Pond Herbland – Riverine Swamp Forest Complex	898.9
			Mosaic of Riverine Swampy Woodland/Sedgy Riverine Forest – Riverine Swamp Forest Complex	32.8
			Mosaic of Sedgy Riverine Forest/Floodway Pond Herbland – Riverine Swamp Forest Complex	30.3
			Mosaic of Sedgy Riverine Forest/Sedgy Riverine Forest – Riverine Swamp Forest Complex	271.2
			Mosaic of Sedgy Riverine Forest – Riverine Swamp Forest Complex/Floodway Pond Herbland – Riverine Swamp Forest Complex	76.6
			Mosaic of Sedgy Riverine Forest – Riverine Swamp Forest Complex/Tall Marsh	6.9
			Riverine Chenopod Woodland	28 003.2
			Riverine Grassy Woodland	14 670.3
			Riverine Grassy Woodland/Grassy Riverine Forest – Riverine Swamp Forest Complex	2.7
			Riverine Grassy Woodland/Plains Woodland Complex	19.3
			Riverine Grassy Woodland/Plains Woodland/Gilgai Wetland Complex	3.1
			Riverine Grassy Woodland/Plains Woodland/Riverine Chenopod Woodland Complex	0.3
			Riverine Grassy Woodland/Riverine Swamp Forest Mosaic	13.6
			Riverine Grassy Woodland/Riverine Swampy Woodland Mosaic	678.7

Asset	Sub-ecosystem	EVD	EVC	Total (ha)
			Riverine Grassy Woodland/Sedgy Riverine Forest Mosaic	551.1
			Riverine Grassy Woodland/Sedgy Riverine Forest/Wetland Formation Mosaic	0.04
			Riverine Swamp Forest	7 662
			Riverine Swamp Forest/Riverine Swampy Woodland Mosaic	51.5
			Riverine Swamp Forest/Sedgy Riverine Forest Mosaic	279.7
			Riverine Swamp Forest/Sedgy Riverine Forest – Riverine Swamp Forest Complex	1 172.2
			Riverine Swamp Forest/Spike-sedge Wetland Mosaic	6.2
			Riverine Swamp Forest/Tall Marsh Mosaic	573.1
			Riverine Swampy Woodland	2 665.2
			Riverine Swampy Woodland/Sedgy Riverine Forest Mosaic	318.3
			Sedgy Riverine Forest	13 880.2
			Sedgy Riverine Forest/Riverine Swamp Forest Complex	4054.9
			Sedgy Riverine Forest/Spike-sedge Wetland Mosaic	0.5
			Sedgy Riverine Forest/Tall Marsh Mosaic	1.8
			Shrubby Riverine Woodland	7267.8
		Treed Swampy Wetland	Creekline Grassy Woodland	76.4
			Drainage-line Aggregate/Riverine Swamp Forest Mosaic	745.5
			Drainage-line Aggregate/Riverine Swamp Forest Mosaic	61.8
			Intermittent Swampy Woodland	8381.9
			Lignum Swampy Woodland	16 226.6
			Lignum Swampy Woodland/Lake Bed Herbland Mosaic	34.6
			Mosaic of Drainage-line Aggregate/Floodway Pond Herbland – Riverine Swamp Forest Complex	0.6
			Spring Soak Woodland	4.1
			Riverine Forest and Woodland Sub-ecosystem total	**126 359.7**
	Grassland	Alluvial Plains Grassland	Alluvial Plains Semi-arid Grassland	3 120.5
			Chenopod Grassland	362.1
			Plains Grassland/Plains Grassy Woodland/Gilgai Wetland Mosaic	2.3
			Riverine Grassland	67.7
		Basalt Grassland	Plains Grassland	47.2
			Grassland total	**3 599.8**

Asset	Sub-ecosystem	EVD	EVC	Total (ha)
	Coastal – Terrestrial	Coastal	Sandy Beach	41.5
			Riverine Forest and Woodland asset total	**130 001**
Ephemeral Freshwater Wetlands	Ephemeral Freshwater Wetland	Freshwater Wetland (ephemeral)	Disused Floodway Shrubby Herbland	22.9
			Floodplain Grassy Wetland	570
			Floodway Pond Herbland	1074.7
			Floodway Pond Herbland/Riverine Swamp Forest Complex	872.6
			Lake Bed Herbland	3044.2
			Lignum Shrubland	11882
			Lignum Swamp	2088.8
			Riverine Ephemeral Wetland	0.9
			Ephemeral Freshwater Wetlands asset total	**19 556**
Permanent Freshwater Wetlands	Permanent Freshwater Wetland	Freshwater Wetland (permanent)	Aquatic Herbland	144.9
			Aquatic Herbland/Floodplain Grassy Wetland Mosaic	58.5
			Aquatic Herbland/Floodway Pond Herbland Mosaic	0.7
			Aquatic Herbland/Riverine Swamp Forest Mosaic	1.2
			Aquatic Herbland/Tall Marsh Mosaic	68
			Billabong Wetland Aggregate	657.1
			Draining-line Aggregate/Tall Marsh Mosaic	2.8
			Floodplain Grassy Wetland/Spike-sedge Wetland Mosaic	21.9
			Floodplain Grassy Wetland/Tall Marsh Mosaic	20.6
			Floodplain Wetland Aggregate	320.6
			Floodway Pond Herbland/Tall Marsh Mosaic	6.1
			Freshwater Lake Aggregate	626.0
			Mosaic of Aquatic Herbland/Floodway Pond Herbland – Riverine Swamp Forest Complex	1.6
			Mosaic of Aquatic Herbland/Sedgy Riverine Forest – Riverine Swamp Forest Complex	0.3
			Mosaic of Floodplain Grassy Wetland/Floodway Pond Herbland – Riverine Swamp Forest Complex	0.8
			Mosaic of Tall Marsh/Floodway Pond Herbland – Riverine Swamp Forest Complex	83.0
			Red Gum Swamp	114.3
			Rushy Riverine Swamp	170.8
			Shallow Freshwater Marsh	614.7
			Spike-sedge Wetland	499.1

Asset	Sub-ecosystem	EVD	EVC	Total (ha)
			Spike-sedge Wetland/Tall Marsh Mosaic	58.6
			Tall Marsh	867.9
			Tall Marsh/Aquatic Herbland Mosaic	7.1
			Tall Marsh/Non-vegetation Mosaic	15.9
			Tall Marsh/Open Water Mosaic	155.3
			Tall Marsh/Riverine Swamp Forest Mosaic	2.8
			Water Body – Fresh	2 646.9
			Wetland Formation	2.7
			Permanent Freshwater Wetlands asset total	**7 170.2**
Saline Wetlands	Saline Wetland	Saline Wetland	Saline Lake Aggregate	175.6
			Samphire Shrubland	432.9
			Sub-saline Depression Shrubland	783.3
			Water Body – Salt	29.5
			Saline Wetlands asset total	**1 421.3**
Plains Woodland	Plains Woodland	Inland Plains Woodland	Alluvial Terraces Herb-rich Woodland	30.6
			Alluvial Terraces Herb-rich Woodland/Creekline Grassy Woodland Mosaic	89
			Plains Grassy Woodland	22
			Plains Woodland	3 598.7
			Ridged Plains Mallee	127.8
			Plains Woodland Sub-ecosystem total	**3 868.1**
	Heathland	Heathland (sands)	Shallow Sands Woodland	3.5
			Plains Woodland asset total	**3 871.6**
Mixed Dry Forest	Mixed Dry Forest	Foothills Forest	Valley Grassy Forest	299.2
		Forby Forest	Grassy Woodland	171.8
		Granitic Hillslopes	Granitic Hills Woodland	3 740.7
		Grassy/Heathy Dry Forest	Grassy Dry Forest	1 061.2
			Heathy Dry Forest	2 835.4
		Rocky Knoll	Bare Rock/Ground	960.1
			Rocky Outcrop/Shrubland	0.8
			Rocky Outcrop/Shrubland/ Rocky Outcrop Herbland Mosaic	32
			Dry Forest and Woodland asset total	**9 101.2**
Box Ironbark Forest	Box Ironbark Forest	Ironbark/box	Box Ironbark Forest	3 222

Asset	Sub-ecosystem	EVD	EVC	Total (ha)
Chenopod Shrubland	Chenopod Shrubland	Chenopod Shrubland	Low Chenopod Shrubland	11 570.8
Semi-arid Woodland*	Semi-Arid Woodland	Dry Woodland (non-eucalypt)	Low Rises Woodland/Riverine Swampy Woodland Mosaic	1.5
			Plains Savannah	3.8
			Sand Ridge Woodland	134.9
			Semi-arid Chenopod Woodland	9 078.1
			Semi-arid Parilla Woodland	590.5
			Semi-arid Woodland	10 743.3
			Semi-arid Woodland Sub-ecosystem total	**20 552.1**
Mallee*	Mallee	Hummock-grass Mallee	Loamy Sands Mallee	12 131.2
			Woorinen Sands Mallee	11 721.5
		Saltbush Mallee	Chenopod Mallee	1 997.8
			Woorinen Mallee	6 077.1
			Mallee Ecosystem Total	**31 927.6**
			Landscape Total	**242 262.6**

* The Mallee and Semi-arid Woodland conservation assets are not captured in the River Red Gum Park Landscape. Refer to the Mallee Conservation Action Plan for conservation and threat objectives.

Appendix C — Scientific names of species mentioned in the plan

Common name	Scientific name
African Boneseed	*Chrysanthemoides monilifera* ssp. *monilifera*
African Boxthorn	*Lycium ferocissimum*
Apostlebird	*Struthidea cinerea*
Arrowhead	*Syngonium podophyllum*
Australasian Bittern	*Botaurus poiciloptilus*
Australasian Darter	*Anhinga novaehollandiae*
Australian Painted Snipe	*Rostratula australis*
Australian Pelican	*Pelecanus conspicillatus*
Australian Shelduck	*Tadorna tadornoides*
Australian Smelt	*Retropinna semoni*
Australian Wood Duck	*Chenonetta jubata*
Banded Periwinkle	*Austrolittorina unifasciata*
Banded Stilt	*Cladorhynchus leucocephalus*
Barking Owl	*Ninox connivens connivens*
Bathurst Burr	*Xanthium spinosum*
Bilby	*Macrotis lagotis*
Black Box	*Eucalyptus largiflorens*
Blackberry	*Rubus fruticosus* aggregate
Black-tailed Godwit	*Limosa limosa*
Black-winged Stilt	*Himantopus himantopus*
Blakely's Red Gum	*Eucalyptus blakelyi*
Bridal Creeper	*Asparagus asparagoides*
Brine Shrimp	*Artemia* and *Parartemia* spp.
Broad-shelled Turtle	*Chelodina expansa*
Brolga	*Grus rubicunda*
Buffel Grass	*Cenchrus ciliaris*
Buloke	*Allocasuarina luehmannii*
Bynoe's Gecko	*Heteronotia binoei*
Cabomba	*Cabomba* spp.
Caltrop	*Tribulus terrestris*
Carp	*Cyprinus carpio*
Carp Gudgeon	*Hypseleotris* spp.
Carpet Python	*Morelia spilota*
Caspian Tern	*Hydroprogne caspia*
Chestnut Teal	*Anas castanea*
Chilean Needle Grass	*Nassella neesiana*
Chuditch	*Dasyurus geoffroii*

Common Nardoo	*Marsilea drummondii*
Common Spike-sedge	*Eleocharis acuta*
Common thorn-apple	*Datura stramonium*
Common Water-ribbons	*Cycnogeton procerum*
Cootamundra Wattle	*Acacia baileyana*
Cotton Sneezeweed	*Centipeda nidiformis*
Crakes and rails	Family Rallidae
Crownbeard	*Verbesina* spp.
Cumbungi	*Typha* spp.
Curlew Sandpiper	*Calidris ferruginea*
Cypress Pine	*Callitris* spp.
De Vis' Banded Snake	*Denisonia devisi*
Desert Ash	*Fraxinus angustifolia*
Devil's Rope	*Cylindropuntia imbricata*
Dock	*Rumex* spp.
Dwarf Bitter-cress	*Rorippa eustylis*
Dwarf Flathead Gudgeon	*Philypnodon macrostomus*
Dwyer's Snake	*Parasuta dwyeri*
Eastern Curlew	*Numenius madagascariensis*
Eastern Hooded Scaly-foot	*Pygopus schraderi*
European Rabbit	*Oryctolagus cuniculus*
Fallow Deer	*Dama dama*
False Caper	*Euphorbia terracina*
Fat Spectacles	*Menkea crassa*
Fat-tailed Dunnart	*Sminthopsis crassicaudata*
Flathead Gudgeon	*Philypnodon grandiceps*
Flat-sedges	*Cyperus* spp.
Flaxleaf fleabane	*Erigeron bonariensis*
Flyspecked Hardyhead	*Craterocephalus stercusmuscarum*
Freckled Duck	*Stictonetta naevosa*
Galah	*Eolophus roseicapilla*
Gambusia	*Gambusia* spp.
Gazania	*Gazania linearis*
Giant Banjo Frog	*Limnodynastes interioris*
Giant Rush	*Juncus ingens*
Giles' Planigale	*Planigale gilesi*
Glossy Ibis	*Plegadis falcinellus*
Golden Dodder	*Cuscuta campestris*
Golden Everlasting	*Xerochrysum bracteatum*
Goldfish	*Carassius auratus*

Great Cormorant	*Phalacrocorax carbo*
Great Crested Grebe	*Podiceps cristatus*
Grey Box	*Eucalyptus microcarpa*
Grey-crowned Babbler	*Pomatostomus temporalis*
Groundcherry	*Physalis* spp.
Growling Grass Frog	*Litoria raniformis*
Hairy Darling-pea	*Swainsona greyana*
Hairy Fiddleneck	*Amsinckia calycina*
Horehound	*Marrubium vulgare*
Inland Carpet Python	*Morelia spilota metcalfei*
Intermediate Egret	*Ardea intermedia*
Lagoon Spurge	*Phyllanthus lacunarius*
Latham's Snipe	*Gallinago hardwickii*
Lesser Jack	*Emex spinosa*
Little Black Cormorant	*Phalacrocorax sulcirostris*
Little Corella	*Cacatua sanguinea*
Magpie Goose	*Anseranas semipalmata*
Mallee Annual Bluebell	*Wahlenbergia tumidifructa*
Masked Lapwing	*Vanellus miles*
Matted Water-starwort	*Callitriche sonderi*
Moira Grass	*Pseudoraphis spinescens*
Montpellier Broom	*Genista monspessulana*
Mueller Daisy	*Brachyscome muelleroides*
Mueller's Skink	*Lerista muelleri*
Murray Cod	*Maccullochella peelii*
Murray Hardyhead	*Craterocephalus fluviatilis*
Murray River Rainbowfish	*Melanotaenia fluviatilis*
Murray Swainson-pea	*Swainsona murrayana*
Musk Duck	*Biziura lobata*
Neverfail	*Eragrostis setifolia*
New Holland Daisy	*Vittadinia* spp.
Nitre Bush	*Nitraria billardierei*
Noisy Miner	*Manorina melanocephala*
Noogoora Burr	*Xanthium occidentale*
Noon-flower	*Disphyma crassifolium*
Olive	*Olea europaea*
One-leaf Cape Tulip	*Moraea flaccida*
Onion Weed	*Asphodelus fistulosus*
Oriental Weatherloach	*Misgurnus anguillicaudatus*
Pacific Black Duck	*Anas superciliosa*

Pale Flax-lily	*Dianella longifolia*
Paterson's Curse	*Echium plantagineum*
Pepper Tree	*Schinus molle*
Perennial Veldt Grass	*Ehrharta calycina*
Phragmites	*Phragmites australis*
Pink-eared Duck	*Malacorhynchus membranaceus*
Plains Spurge	*Euphorbia planitiicola*
Platypus	*Ornithorhynchus anatinus*
Prickly Pear	*Opuntia* spp.
Proximus Blind Snake	*Anilios proximus*
Recurved Thorn-apple	*Datura innoxia*
Red Deer	*Cervus elaphus*
Red Fox	*Vulpes vulpes*
Redfin	*Perca fluviatilis*
Red-naped Snake	*Furina diadema*
Regent Honeyeater	*Anthochaera phrygia*
Regent Parrot	*Polytelis anthopeplus*
River Red Gum	*Eucalyptus camaldulensis*
River Swamp Wallaby-grass	*Amphibromus fluitans*
Riverina Bitter-cress	*Cardamine moirensis*
Riverine Flax-lily	*Dianella porracea*
Royal Spoonbill	*Platalea regia*
Ruppia	*Ruppia* spp.
Saffron Thistle	*Carthamus lanatus*
Salt Paperback	*Melaleuca halmaturorum*
Saltbush	*Atriplex* spp
Sambar Deer	*Cervus unicolor*
Samphire Skink	*Morethia adelaidensis*
Scotch Thistle	*Onopordum acanthium*
Sea Tassel	*Ruppia megacarpa*
Silver Perch	*Bidyanus bidyanus*
Small Scurf-pea	*Cullen parvum*
Soursob	*Oxalis pes-caprae*
Southern Purple Spotted Gudgeon	*Mogurnda adspersa*
Southern Pygmy Perch	*Nannoperca australis*
Spiny Lignum	*Duma horrida* ssp. *horrida*
Spur-wing Wattle	*Acacia triptera*
Squirrel Glider	*Petaurus norfolcensis*
St John's Wort	*Hypericum perforatum*
Streaked Copperburr	*Sclerolaena tricuspis*

Stumpy-tail	*Tiliqua rugosa*
Sugar Glider	*Petaurus breviceps*
Superb Parrot	*Polytelis swainsonii*
Sweetbriar Rose	*Rosa rubiginosa*
Swift Parrot	*Lathamus discolor*
Tangled Lignum	*Duma florulenta*
Tessellated Gecko	*Diplodactylus tessellatus*
Thick-tailed Gecko	*Underwoodisaurus milii*
Thorny Lawrencia	*Lawrencia squamata*
Tree Dtella	*Gehyra variegata*
Trout Cod	*Maccullochella macquariensis*
Unspecked Hardyhead	*Craterocephalus fulvus*
Ward's Weed	*Carrichtera annua*
Warrego Summer-grass	*Paspalidium jubiflorum*
Watermilfoil	*Myriophyllum* spp.
Wavy Marshwort	*Nymphoides crenata*
Wedge Diuris	*Diuris dendrobioides*
Weeping Willow	*Salix babylonica*
Western Water-starwort	*Callitriche umbonata*
White Arum-lily	*Zantedeschia aethiopica*
White Box	*Eucalyptus albens*
White-bellied Sea-eagle	*Haliaeetus leucogaster*
White-faced Heron	*Egretta novaehollandiae*
Willows	*Salix* spp.
Winged Pepper-cress	*Lepidium monoplocoides*
Yellow Bladderwort	*Utricularia australis*
Yellow Box	*Eucalyptus melliodora*
Yellow-billed Spoonbill	*Platalea flavipes*
Yellow-footed Antechinus	*Antechinus flavipes*

Appendix D — Biosecurity principles

Prevention

Prevention is taking pre-emptive action to manage the risk of introducing weeds into the Park Landscape and ensure works or disturbance events do not provide an opportune environment for weed establishment. This is achieved by identifying the most likely invasion points, which are often vehicle access and parking sites and locations where animals are likely to act as vectors. Pre-emptive action includes measures such as maintaining vehicle and equipment hygiene, avoiding the introduction of soils, gravels and other materials which may carry seed, and ensuring that appropriate site preparation and risk identification are done before planned disturbance events, such as burning and environmental watering.

Eradication of new and emerging weeds

The initial part of the strategy is to ensure that resources are available to address the threat of new and emerging weeds before they can become established. Any new weed species identified within the Park Landscape should be assessed for its potential risk to the asset. Weeds with an unknown risk score are an eradication priority. Sites that are treated should be monitored for re-emergence. Once a species has become established, its eradication becomes less feasible and more resource intensive.

DELWP have designed a decision-making framework for managing Weeds at the Early Stages of Invasion (WESI). This framework will guide and support the management of new and emerging weeds. The WESI principles are based on a landscape approach to identifying new and emerging species. The process to address new and emerging weed threats should follow the six-step approach outlined in the Weeds at the Early Stages of Invasion framework. Eradication is the objective for new and emerging weeds where feasible.

Containment

Containment is an ongoing maintenance approach to managing the spread of established weeds. Management tracks, ridgelines and other landscape features are useful in defining containment boundaries. Containment is used when a species is not considered feasibly eradicable in the short-to-medium term; however, a strategy establishing containment lines and constricting the containment area over time may have a long-term eradication goal.

It is important to maintain and monitor a buffer around an established containment area to ensure efforts are effective and new populations are not establishing beyond containment boundaries. Where there are pathways of spread through a containment area (for example, vehicles, walkers, river corridors) a concerted effort should be made to undertake control works along tracks and waterways to decrease the likelihood of spread. Containment includes the eradication of satellite or local populations of weeds outside the containment area.

Asset protection

A range of weeds are well established and widespread within the River Red Gum Park Landscape. If a weed species presents a specific threat to a specific value, an asset protection approach to weed management may be undertaken. Assets include riparian corridors, threatened species, cultural heritage sites, visitor sites and infrastructure. Asset protection efforts will generally involve specifying a buffer around the asset and treating weeds within its perimeter. Biological controls can assist with containment efforts for established weeds, but are limited to species with an available control agent.

Appendix E — Parks and reserves in the River Red Gum Park Landscape

Park name	Reserve type	Area (ha)
Arcadia SSR	Natural Features Reserve — Streamside Reserve	1 060
Baillieu Lagoon WR	Natural Features Reserve — Wildlife Reserve (hunting)	247
Bannerton FFR	Nature Conservation Reserve — Flora and Fauna Reserve	200
Baranduda RP	Regional Park — not scheduled under the *National Parks Act 1975* (Vic.)	3 816.5
Barmah National Park	National Park — Schedule 2, National Parks Act	28 467
Beauchamp BR	Natural Features Reserve — Bushland Reserve	5.1
Beauchamp Salt Lake BR	Natural Features Reserve — Bushland Reserve	19
Benjeroop WR	Natural Features Reserve — Wildlife Reserve (hunting)	373
Berribee Homestead HR	Historic Reserve	0.8
Big Reedy Lagoon WR	Natural Features Reserve — Wildlife Reserve (hunting)	274
Bonegilla NCR	Nature Conservation Reserve	12
Bonegilla Wetland BR	Natural Features Reserve — Bushland Reserve	0.4
Boosey H42 BR	Natural Features Reserve — Bushland Reserve	18
Bumbang I261 BR	Natural Features Reserve — Bushland Reserve	21
Bumbang I262 BR	Natural Features Reserve — Bushland Reserve	563
Bumbang I264 BR	Natural Features Reserve — Bushland Reserve	11
Bumbang I38 BR	Natural Features Reserve — Bushland Reserve	13
Bumbang I39 BR	Natural Features Reserve — Bushland Reserve	65
Bumbang Island HA	Historic Reserve	633
Capels Grossing SSR	Natural Features Reserve — Streamside Reserve	324
Carlyle H115 BR	Natural Features Reserve — Bushland Reserve	5
Carwarp BR 2	Natural Features Reserve	6
Cobram RP	Regional Park — not scheduled under National Parks Act	457
Cohuna BR	Natural Features Reserve — Bushland Reserve	1.9
Cranes Lake BR	Natural Features Reserve — Bushland Reserve	34
Cullens Lake WR	Natural Features Reserve — Wildlife Reserve (hunting)	733
Dartagook WR	Nature Conservation Reserve — Wildlife Reserve (NCR classification pending reservation)	713
Dharnya Centre	Other	22
Duck Lake WR	Natural Features Reserve — Wildlife Reserve (hunting)	413
Echuca RP	Regional Park — not scheduled under National Parks Act	408
Ecologically Managed Minor Area	Other	25
Gadsen Bend Park	Other Park — Schedule 3, National Parks Act	1 618
Gannawarra Red Gum Swamp NCR	Nature Conservation Reserve	148

Park name	Reserve type	Area (ha)
Gemmill Swamp WR	Nature Conservation Reserve — Wildlife Reserve (no hunting)	216
Great Spectacle, Little Spectacle, Round Lake, Tobacco Lake, Little Lake Meran WR	Natural Features Reserve — Wildlife Reserve (SGR classification pending reservation)	143
Gunbower National Park	National Park — Schedule 2, National Parks Act	9 300
Harts Swamp WR	Natural Features Reserve — Wildlife Reserve (hunting)	42
Hattah–Kulkyne National Park	National Park — Schedule 2, National Parks Act	49 993
Heywood Lake WR	Natural Features Reserve — Wildlife Reserve (SGR classification pending reservation)	564
Hird Swamp WR	Natural Features Reserve — Wildlife Reserve (hunting)	465
Johnson Swamp WR	Natural Features Reserve — Wildlife Reserve (hunting)	721
Kanyapella WR	Natural Features Reserve — Wildlife Reserve (hunting)	486
Karadoc NCR	Nature Conservation Reserve	110
Kerang Regional Park	Regional Park — not scheduled under National Parks Act	364
Kerang WR	Natural Features Reserve — Wildlife Reserve (hunting)	810
Kings Billabong Park	Other Park — Schedule 3, National Parks Act	2 188
Koondrook HR	Historic Reserve	7.4
Koorangie WR	Natural Features Reserve — Wildlife Reserve (hunting)	3 246
Korrak Korrak BR	Natural Features Reserve — Bushland Reserve	57
Lake Boga LR	Natural Features Reserve — Lake Reserve	77
Lake Elizabeth WR	Natural Features Reserve — Wildlife Reserve (hunting)	121
Lake Kelly BR	Natural Features Reserve — Bushland Reserve	3.4
Lake Leaghur WR	Natural Features Reserve — Wildlife Reserve (hunting)	83
Lake Mannaor WR	Natural Features Reserve — Wildlife Reserve (SGR classification pending reservation)	84
Lake Moodemere LR	Natural Features Reserve — Lake Reserve	264
Lake Murphy WR	Natural Features Reserve — Wildlife Reserve (SGR classification pending reservation)	222
Lakes Powell and Carpul WR	Nature Conservation Reserve — Wildlife Reserve (no hunting)	725
Lambert Island NCR	Nature Conservation Reserve	1 288
Leaghur BR	Natural Features Reserve — Bushland Reserve	14
Leaghur State Park	State Park — Schedule 2B, National Parks Act	2 050
Lake Leaghur WR	Nature Conservation Reserve — Wildlife Reserve (NCR classification pending reservation)	3
Leitchville BR	Natural Features Reserve — Bushland Reserve	9
Little Lake Charm WR	Natural Features Reserve — Wildlife Reserve (hunting)	61
Loch Gary WR	Natural Features Reserve — Wildlife Reserve (hunting)	557
Lower Goulburn National Park	National Park — Schedule 2, National Parks Act	9 320
Lower Ovens WR	Natural Features Reserve — Wildlife Reserve (hunting)	1 207
Major Mitchell Lagoon HA	Historic Reserve	13

Park name	Reserve type	Area (ha)
McDonald Swamp WR	Natural Features Reserve — Wildlife Reserve (hunting)	215
McMillans Lake BR	Natural Features Reserve — Bushland Reserve	32
Mildura I15 BR	Natural Features Reserve — Bushland Reserve	85
Moira BR	Natural Features Reserve — Bushland Reserve	8
Moodemere NCR	Nature Conservation Reserve	73
Murrabit BR	Natural Features Reserve — Bushland Reserve	17
Murray–Kulkyne Park	Other Park — Schedule 3, National Parks Act	4 487
Murray–Sunset National Park	National Park — Schedule 2, National Parks Act	57 472
Murray River K15 SSR	Natural Features Reserve — Streamside Reserve	3.6
Murray River K16 SSR	Natural Features Reserve — Streamside Reserve	17
Murray–Sunset (Addition)	Proposed National Parks Act park or park addition	161
Myall BR 2	Natural Features Reserve — Bushland Reserve	32
Mystic Park BR	Natural Features Reserve — Bushland Reserve	646
Nyah BR	Natural Features Reserve — Bushland Reserve	162
Nyah–Vinifera Park	Other Park — Schedule 3, National Parks Act	1 354
Passage Camp NCR	Nature Conservation Reserve	21
Peechelba H104 BR	Natural Features Reserve — Bushland Reserve	13
Peechelba H105 BR	Natural Features Reserve — Bushland Reserve	2
Pelican Lake WR	Nature Conservation Reserve — Wildlife Reserve (NCR classification pending reservation)	38
Piangil BR	Natural Features Reserve — Bushland Reserve	0.2
Plumptons WR	Natural Features Reserve — Wildlife Reserve (hunting)	151
Proposed Murray River Park (part)	Other	21 883
Pyramid Creek NCR	Nature Conservation Reserve	50
Red Cliffs SR	Natural Features Reserve — Scenic Reserve	24
River Murray Reserve	Natural Features Reserve — River Murray Reserve	12 916
Rowland NCR	Nature Conservation Reserve	143
Salter BR	Natural Features Reserve — Bushland Reserve	3.8
Sandhill Lake BR	Natural Features Reserve — Bushland Reserve	165
Shepparton Regional Park	Regional Park — not scheduled under National Parks Act	2 798
Spence Bridge EA	Education Area	387
Spences Lake BR	Natural Features Reserve — Bushland Reserve	41
St Germains BR	Natural Features Reserve — Bushland Reserve	0.4
Stevenson Swamp WR	Natural Features Reserve — Wildlife Reserve (hunting)	93
Strathmerton BR	Natural Features Reserve — Bushland Reserve	35
Tocumwal RP	Regional Park — not scheduled under National Parks Act	214
Toltol FFR	Nature Conservation Reserve — Flora and Fauna Reserve	262
Toltol I263 BR	Natural Features Reserve — Bushland Reserve	235

Park name	Reserve type	Area (ha)
Toltol I40 BR	Natural Features Reserve — Bushland Reserve	21
Tresco West BR	Natural Features Reserve — Bushland Reserve	91
Tutchewop WR	Natural Features Reserve — Wildlife Reserve (hunting)	509
Undera BR	Natural Features Reserve — Bushland Reserve	1.3
Wakiti Creek SSR	Natural Features Reserve — Streamside Reserve	63
Wandella NCR	Nature Conservation Reserve — Flora and Fauna Reserve	981
Warby–Ovens National Park	National Park — Schedule 2, National Parks Act	14 713
Wargan-Mallee BR	Natural Features Reserve — Bushland Reserve	1 449
Wee Wee Rup BR	Natural Features Reserve — Bushland Reserve	7
Welton NCR	Nature Conservation Reserve	162
Westblades Swamp WR	Natural Features Reserve — Wildlife Reserve (hunting)	70
Wharparilla BR	Natural Features Reserve — Bushland Reserve	10
Winlaton NCR	Nature Conservation Reserve	86
Wodonga BR	Natural Features Reserve — Bushland Reserve	4.8
Woorinen South BR	Natural Features Reserve — Bushland Reserve	10
Wyuna NCR	Nature Conservation Reserve	18
Yarrawonga RP	Regional Park — not scheduled under National Parks Act	296
Yassom Swamp NCR	Nature Conservation Reserve — Flora and Fauna Reserve	369

Appendix F — Kerang Wetlands reserve status and land manager

Wetland	Reserve status	Land manager
Permanent regulated fresh open water wetlands		
Kangaroo Lake	Water supply reserve (*Crown Land (Reserves) Act 1978*)	Goulburn Murray Water
Racecourse Lake		Goulburn Murray Water
Lake Charm		Goulburn Murray Water
Little Lake Charm	Freehold land owned by Goulburn Murray Water	Goulburn Murray Water
Scotts Creek	Natural features reserve/State Wildlife Reserve (Crown Land (Reserves) Act and *Wildlife Act 1975*)	Parks Victoria
First Reedy Lake	Water Supply Reserve (Crown Land (Reserves) Act)	Goulburn Murray Water
Middle Reedy Lake		Goulburn Murray Water
Third Reedy Lake		Goulburn Murray Water
Regulated freshwater intermittent wetlands		
Kerang Weir Pool	Public purposes (Crown Land (Reserves) Act)	Parks Victoria
Town Swamp		Parks Victoria
Lake Cullen	Natural features reserve/State Wildlife Reserve (Crown Land (Reserves) Act and Wildlife Act)	Parks Victoria
Johnson Swamp		Parks Victoria
Hird Swamp		Parks Victoria
Saline/sewage disposal and drainage wetlands		
Lake Tutchewop	Salinity disposal reserves (Crown Land (Reserves) Act)	Goulburn Murray Water
Lake William		Goulburn Murray Water
Lake Kelly		Goulburn Murray Water
Little Lake Kelly		Goulburn Murray Water
Fosters Swamp	Natural features reserve/State Game Reserve (*Crown Land Legislation Amendment (Canadian Regional Park and Other Matters) Act 2016* and Wildlife Act)	Parks Victoria
Unregulated freshwater intermittent wetlands		
Stevenson Swamp	Natural features reserve/State Wildlife Reserve (Crown Land (Reserves) Act and Wildlife Act)	Parks Victoria
Cemetery Swamp	Natural features reserve/State Game Reserve (Crown Land Legislation Amendment (Canadian Regional Park and Other Matters) Act and Wildlife Act)	Parks Victoria
	Municipal purposes reserve (Crown Land (Reserves) Act and Wildlife Act)	Gannawarra Shire Council
Lake Bael Bael	Natural features reserve/State Wildlife Reserve (Crown Land (Reserves) Act and Wildlife Act)	Parks Victoria
First Marsh		
Second Marsh		
Third Marsh		


Parks
VICTORIA
Healthy Parks
Healthy People
VICTORIA
State
Government