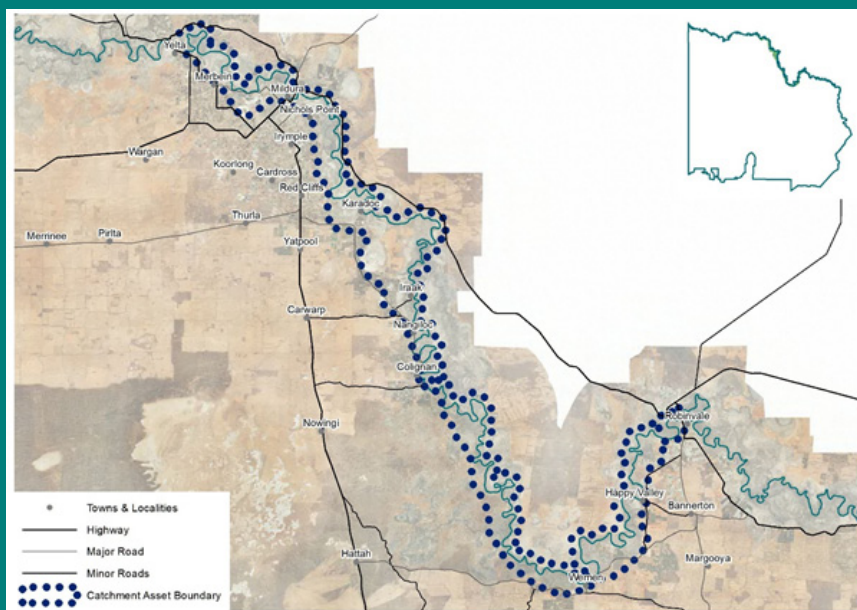


4 – Murray River & Floodplain - Robinvale to Merbein

Regional Catchment Strategy Implementation Plan



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Section 1 - Overview

Catchment Asset Significance

The Murray River & Floodplain: Robinvale to Merbein Catchment Asset begins at Robinvale and extends approximately 254km downstream along the Murray River to Merbein and includes all or part of the towns of Robinvale, Wemen, Nangiloc - Colignan, Mildura and Merbein.

This section of the Murray River includes the Murray River Reserve, Murray-Kulkyne Regional Park, Kings Billabong Wildlife Reserve, Karadoc Nature Conservation Reserve, Lambert Island Flora Reserve and Tarpaulin Bend Reference Area. The Hattah Lakes are not included in this Catchment Asset area.

Key environmental assets include the Kings Billabong Wetlands and Lake Ranfurly. Both of these wetland systems listed in the national Directory of Important Wetlands. They (and many of the other wetland units within this asset area) are home to migratory birds listed in international migratory bird agreements (JAMBA, CAMBA and ROKAMBA).

It includes significant areas of associated vegetation including Riverine Grassy Woodland and supports several threatened flora and fauna species such as the Regent Parrot (*Polytelis anthopeplus monarchoides*), Growling Grass Frog (*Litoria raniformis*) and Bush Stone Curlew (*Burhinus grallarius*). The river reaches, anabranches and floodplain wetlands provide habitat for aquatic species like Murray Hardyhead (*Craterocephalus fluviatilis*) and Murray Cod (*Maccullochella peelii peelii*).

Numerous sites of cultural heritage are also located in this area. Most of the floodplain has high cultural heritage for local Indigenous Communities, particularly areas of river frontage and wetlands. Important Indigenous cultural heritage sites include Major Mitchell's lagoon. Throughout this entire area the large concentration of burials is unique to Victoria and there are significantly large number of meeting places, ceremonial places, scarred trees and artifact sites. The area is also important for European heritage, as the Murray River was the focus of early settlement and transportation following exploration by Charles Sturt and Major Thomas Mitchell. It also saw the beginning of irrigation in Australia.

Catchment Asset Value

This section examines the relative values of the Regional Assets that lie within this Catchment Asset. It provides an overview of the asset analysis in order to inform prioritisation of management actions that are intended to minimise the impact of the threatening processes upon Regional Assets and improve the status or quality of the Regional Assets within the Catchment Asset Area.

The asset value indicates the relative importance of the Regional Asset within the Catchment Asset Area. The valuation is determined from a range of indicators, many specific to each of the Regional Assets that describe the importance of the Asset relative to social, economic and environmental values.

Table 1 below provides a summary of the value of each of the Regional Assets in this Catchment Asset. Greater detail about each of the Regional Assets in this Catchment Asset can be found in Section 2 – Regional Assets in this Catchment Asset

Table 1: Value of Regional Assets in this Catchment Asset

Regional Asset	Value
Rivers	VERY HIGH
Wetlands	VERY HIGH
Threatened Species and Communities	HIGH
Terrestrial Habitat	VERY HIGH

Soils	HIGH
Agricultural Land	HIGH
Groundwater	NONE
Cultural Heritage	HIGH
Community Capacity	NONE

A detailed explanation of how these values were defined and applied can be found in Appendix 1. The Value of Regional Assets within a Catchment Asset.

Threatening Processes

This section examines the threatening processes that may be impacting upon Regional Assets that lie within this Catchment Asset. It provides an overview of each of the threatening processes in order to inform prioritisation of management actions that are intended to minimise their impact upon Regional Assets and improve the status or quality of the Regional Assets within the Catchment Asset Area.

Table 2 below provides a summary of the threat level posed by each of the threatening processes that are active in this Catchment Asset. Greater detail about each of the threatening processes and their scope, scale and relative impact within this Catchment Asset can be found in Section 3 – Threatening Processes in this Catchment Asset.

Table 2: Threat Priority across this Catchment Asset

Threatening Process	Priority of Action
Land & Water Salinisation	MEDIUM
Invasive Plants	HIGH
Invasive Animals	HIGH
Altered Hydrological Regimes	HIGH
Soil Erosion	MEDIUM
Inappropriate Water Use Practices	HIGH
Recreational Pressures	HIGH
Land Use Change	HIGH
Direct off-site interactions	LOW
Misaligned community perceptions	MEDIUM
Inappropriate fire regimes	MEDIUM
Constrained regenerative capacity	HIGH

A detailed explanation of how these threat levels were defined and applied can be found in Appendix 2. Categorising Threatening Processes.

Management Plans

This Catchment Asset Area is subject to a diverse range of natural resource management instruments that are intended to protect, preserve and enhance the area's natural resources for the benefit of the

Mallee region. These instruments can be either broad in their focus (covering many regional assets), focused on a particular area of interest (such as an individual Regional Asset) or tightly focused on a specific location or species. These management plans are prepared and owned by range of entities such as local government, statutory authorities, community groups and government departments at both State and Federal levels. Responsibility for their implementation can rest with a single entity or it may be divested across a broad range of organisations and groups. Some management plans are prepared to satisfy a legislative requirement while others are prepared to provide direction towards an organisational goal. Regardless of the reason and purpose of the management plan, they all have a common feature – they typically contain specific management direction or actions that are to be delivered through the implementation of the plan.

The identified existing management plans have been listed in Appendix 3. *Management Plans Relevant to this Catchment Asset*

Management Actions

Actions within the management plans in the table above are typically diverse in their wording, structure and complexity. However, they are broadly similar in terms of their intent. As a result, they can usually be easily classified into broad categories. Within each of these categories are a range of common management actions. Each of these common management actions can also be said to target specific threatening processes. These management categories, the management actions within each of them, their definitions and the targeted threatening processes are shown in Appendix 4.

Management Action Definitions

The result of the classification process of the actions within Appendix 3. Management Plans Relevant to this Catchment Asset is contained in Appendix 5. Management Actions from Existing Management Plans. The classification table includes some detail about each action to support the classification. It is advised that if more information about a specific management action within a management plan is required then the original management plan should be consulted rather than relying specifically on the data in that classification table.

Priorities

This section examines the potential management action groups from the management plans relevant to this Catchment Asset Area that are listed in the Management Plans section above and summarised Appendix 5. Management Actions from Existing Management Plans. The intent is to prioritise these potential management actions in terms of:

- The priorities of the regional asset within the catchment asset area (outlined in the Catchment Asset Value section above);
- section above);
- the priority to address a threatening process (outlined in the Threatening Processes section above);
- the capacity of the management action to address the threatening process; and
- the level of investment (in both of time and money) required to exercise that capacity.

The individual management actions from the plans listed in the Management Plans section were grouped and scored by consensus against agreed criteria and then each potential management action group within the Catchment Asset was assigned to a category that defines the prospective priority to the implementation. Further information regarding the definition and application of each of these categories can be found in Appendix 6. *Prioritising Potential Management Actions*.

The findings of the analysis are summarised in Table 3 below. The detailed priority matrices from which the summary table is taken can be found in Appendix 7. Management Action Priorities.

Table 3: Summary of the Priority of Potential Management Actions

Management Action	Priority	Threatening Processes Addressed
Pest Plant Control	High	Invasive Plants; Constrained Regenerative Capacity
Pest Animal Control	Medium	Invasive Animals; Soil Erosion; Constrained Regenerative Capacity
Habitat Protection	Medium	Invasive Animals; Soil Erosion; Recreational Pressure; Land Use Change; Direct Off-Site Interactions; Constrained Regenerative Capacity
Habitat Restoration	Medium	Land & Water Salinisation; Soil Erosion; Recreational Pressure; Direct Off-Site Interactions; Constrained Regenerative Capacity
Revegetation	Low	Land & Water Salinisation; Soil Erosion; Recreational Pressure; Direct Off-Site Interactions; Constrained Regenerative Capacity
Environmental Watering	High	Altered Hydrological Regimes; Constrained Regenerative Capacity
Soil Erosion Control	Medium	Soil Erosion
Threatened Species Interventions	High	Constrained Regenerative Capacity
Enhancing Land Management Regimes	Medium	Land & Water Salinisation; Soil Erosion; Inappropriate Water Use Practises; Land Use Change; Direct Off-Site Interactions
Supporting Human Capacity for NRM	Medium	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity
Supporting Institutional Capacity for NRM	Medium	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity
Supporting Social Capacity for NRM	Low	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity

Institutional Planning for NRM	Medium	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity
Community Driven Planning for NRM	Medium	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity
Landholder Driven Planning for NRM	Medium	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity
Research to improve knowledge	Medium	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity
Asset condition monitoring and assessment	Medium	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity

Regional Delivery Partners

The individuals and organisations listed below have various roles to play within the Catchment Asset area in delivering and implementing the management actions described in previous sections that will in turn contribute to the aims and expected outcomes of the Mallee RCS. This list is not considered exhaustive and can be expected to change over time. More detail about the specific role and responsibilities of these entities with respect to the RCS can be found below.

- Aboriginal Affairs Victoria
- Aboriginal Communities (Traditional Owners & Organisations)
- Birdlife Mildura
- Catchment Management Authorities – Mallee (VIC), Murray (NSW)

- Crown Frontage Licence Holders
- Department of Environment & Primary Industries (VIC)
- Landcare Groups
- Lower Murray Water
- Mildura Rural City Council
- Murray Darling Basin Authority
- Murray Lower Darling Rivers Indigenous Nations
- NSW Department of Primary Industries - Office of Water; Catchments & Lands; Fisheries
- NSW Office of Environment & Heritage
- NSW Transport & Maritime
- Parks Victoria
- Private Land Managers
- RDA Loddon Mallee
- Research Bodies – Arthur Rylah Institute, Invasive Animals CRC, Murray Darling Freshwater Research Centre
- Swan Hill Rural City Council
- VicRoads
- VR Fish
- Waterwatch

Community NRM Groups

This section provides a summary of these stakeholder groups that are active within this Catchment Asset. This is not an exhaustive list and will be updated on a regular basis. Further detail on the community NRM groups can be found in Attachment 1 – Mallee NRM Interest Groups.

Landcare Groups

The Landcare movement has been active in the Mallee since the late 1980s, with 23 active Landcare groups operating today. From our first group, Millewa-Carwarp (established 1989), to the newest, Cabarita (established 2012), Landcare has been instrumental in harnessing and promoting the interests of local communities in natural resource management.

Many groups initially formed due to the issues of rabbits and weeds. Salinity, soil conservation and biodiversity issues have evolved and continued to propel the Landcare movement into the 21st century. Our Landcare groups are keen to ensure that the legacy of Landcare continues and actively support a range of Junior Landcare Groups activities across the region.

Northern Mallee Landcare Consortium

- Kulkyne Way
- Millewa-Carwarp
- Yelta

Eastern Mallee Consortium

- Robinvale & District

Other Groups

There are a broad range of community, industry, indigenous and specialist groups that have a role to play in NRM within this catchment asset. The tables in this section provide a listing of the groups currently known to be active within the asset area.

Traditional owner groups provide opportunities for our local indigenous communities to have input into how the regions landscapes are managed; and to enhance regional awareness of the cultural values inherent within these landscapes.

A wide range of special interest groups provide the means for individuals to become engaged in activities and programs which reflect their particular concerns. They also provide the region with a vital source of knowledge and understanding on specific issues.

The region's industry based groups have an important role in developing and promoting best practice for competitive and sustainable agricultural sectors.

Advisory groups to statutory bodies like CMA's and water authorities are important forums for both the community and the authorities involved. These groups provide management advice and community feedback to the convening authority while at the same time communicating with the wider community about the activities of the advisory group and the organisation in general.

Registered Aboriginal Parties

There is currently no registered aboriginal party determined for this catchment asset area

Special Interest and Recreational Groups

- Sunraysia Field Naturalists
- BirdLife Mildura
- Friends of Merbein Common
- Friends of Kings Billabong
- Murray Darling Association
- Murray Lower Darling Rivers Indigenous Nations
- Waterwatch

Industry Groups

- Victorian Farmers Federation (VFF)
- Victoria No-Till Farmers Association (VNTFA)
- Australian Table Grape Association Inc (ATGA)
- Dried Fruits Australia (DFA)
- Mallee Sustainable Farming Inc (MSF)
- Murray Valley Citrus Board (MVCB)
- Murray Valley Winegrowers' Inc (MVW)
- Pistachio Growers Association Incorporated (PGAI)
- Sunraysia Branch of the Victorian Apiarists Association
- Sunraysia Citrus Growers Inc (SCG)

Advisory Groups

- Aboriginal Reference Group (ARG)
- Mallee CMA Land and Water Advisory Committee (LWAC)
- Mallee CMA Technical Advisory Committees (TACs)
- Lower Murray Water Customer Service Advisory Committees (Rural)
- Goulburn-Murray Water Services Committees (WSCs)
- The Living Murray (TLM) Icon Site Community Reference Groups

Section 2 – Regional Assets in this Catchment Asset

Regional Assets in the Mallee NRM region were defined and applied in accordance with guidelines provided by DSE to support the Victorian Catchment Management Council RCS Guidelines. Each of the following sub-sections provides a background to these Regional Assets and the available information about their significance within this Catchment Asset. This follows on to an assessment of the relative value of the Regional Asset based on the criteria contained in Appendix 1. *The Value of Regional Assets within a Catchment Asset*

Rivers

The Murray River is Australia's largest river and firmly entrenched in the national psyche. It forms the northern boundary of the Victorian Mallee NRM region, and the border between Victoria and New South Wales (NSW). While management of the main river is the statutory responsibility of NSW, Victoria is responsible for the management of its southern floodplain from the 1881 winter level mark. The River's floodplain, anabranches and associated wetland systems dominate the area.

The primary riverine assets within this catchment asset are the crown frontage to the Murray River between Robinvale and Merbein and the associated Murray River floodplain that includes the public reserves known as River Murray Reserve, Murray-Kulkyne Regional Park and Kings Billabong Wildlife Reserve. The Living Murray Initiative is a program of measures established by the Murray-Darling Basin Ministerial Council with a focus on achieving environmental benefits for six significant ecological assets through the recovery of up to 500 gigalitres over five years. The Murray River channel is one of the six Icon sites included in the Living Murray Initiative.

The Mallee Waterway Strategy (2014-22) identifies priority reaches for future management using an Asset Based Approach; facilitating targeted planning and implementation processes to deliver greatest social, cultural and economic returns on our efforts. Each River asset occurring within this Catchment Asset is ascribed a priority of 'high', 'medium', 'low', or 'additional' under this framework.

Based on the available data concerning their extent, quality and policy significance within this landscape, the Rivers within this Catchment Asset are considered to be of **very high** value.

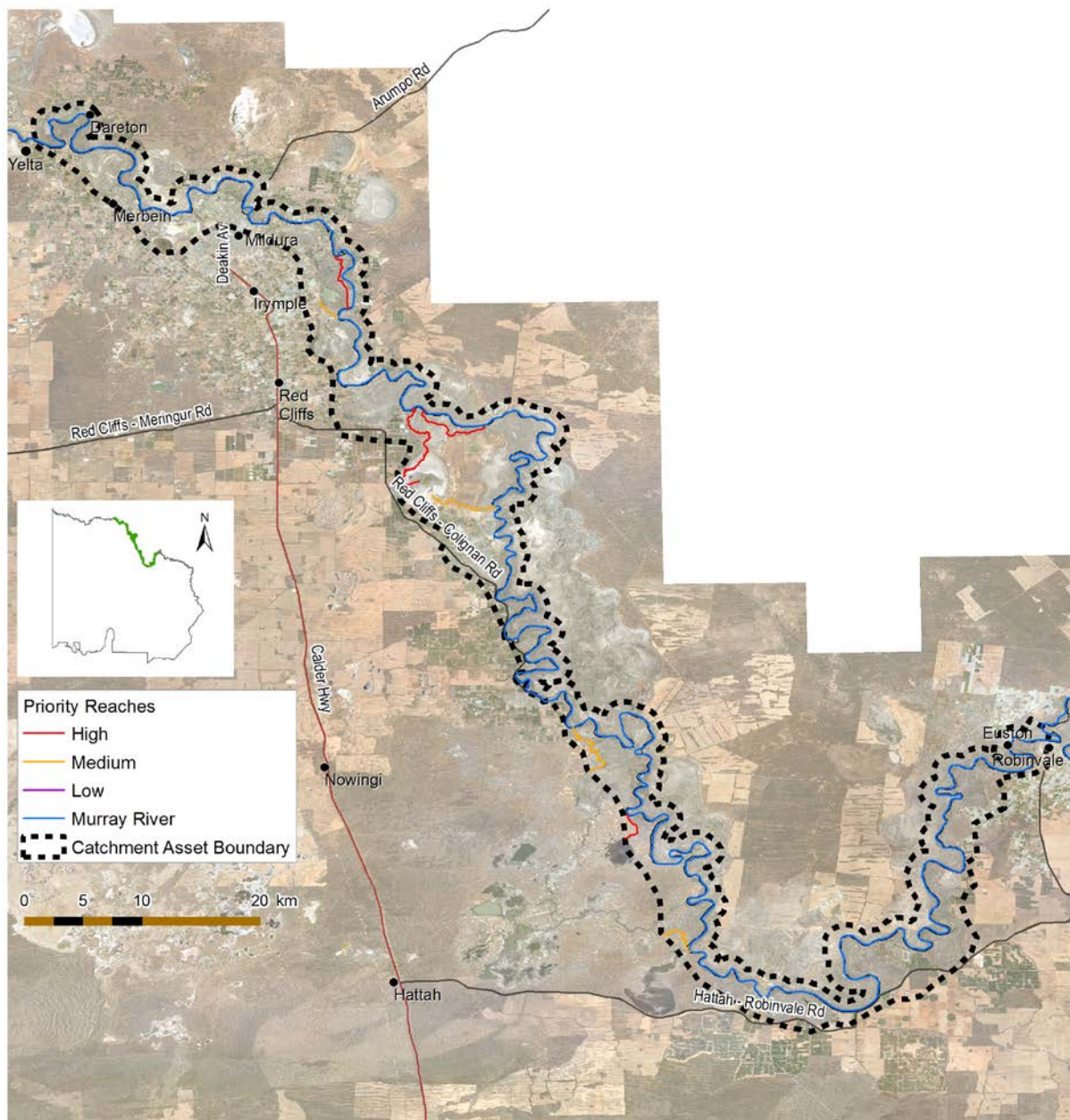


Figure 1: River Reaches

Wetlands

This catchment asset contains a significant number of wetland systems that are typically associated with and linked to the Murray River. These systems are replenished when there is a sufficient volume of water in the river itself.

Of all the systems, two (Kings Billabong Wetlands and Lake Ranfurly) are listed on the national Directory of Important Wetlands. They also provide habitat to migratory bird species recognised in international migratory bird agreements (JAMBA, CAMBA and ROKAMBA).

The Kings Billabong Wetlands contains a mosaic of wetland and vegetation types spread across 506 hectares that support a diverse population of flora and fauna. Its listing in the Directory of Important Wetlands is driven by not only its ecological significance within the region but also its cultural and historical significance to Sunraysia. This reflects its long history of use by Aboriginal people, its role as an integral component of the area's irrigation development and the resource the area provides to the Mildura area in terms of recreational activities and tourism opportunities.

Lake Ranfurly is a permanent saline lake (covering 265 hectares) on the Murray River floodplain immediately to the west of Mildura. It has become highly saline due to groundwater disposal from the Mildura-Merbein Groundwater Interception Scheme. When water levels are low, the lake is split into two sections by a causeway. As a result, the western half may become hypersaline while the east half is often fresher due to input of stormwater runoff. As a shallow drainage lake, it provides ideal feeding grounds for a broad range of waterbirds (approximately 40 species) which prompted its listing in the Directory and in international migratory bird agreements.

Other wetland systems of note within this Catchment Asset include Lake Karadoc, Lake Iraak, Woorlong Wetlands and Lake Hawthorn.

The Mallee Waterway Strategy (2014-22) identifies priority wetlands for future management using an Asset Based Approach; facilitating targeted planning and implementation processes to deliver greatest social, cultural and economic returns on our efforts. Each Wetland asset occurring within this Catchment Asset is ascribed a priority of 'high', 'medium', 'low', or 'additional' under this framework.

Based on the available data concerning their extent, quality and policy significance within this landscape, the Wetlands within this Catchment Asset are considered to be of **very high** value.

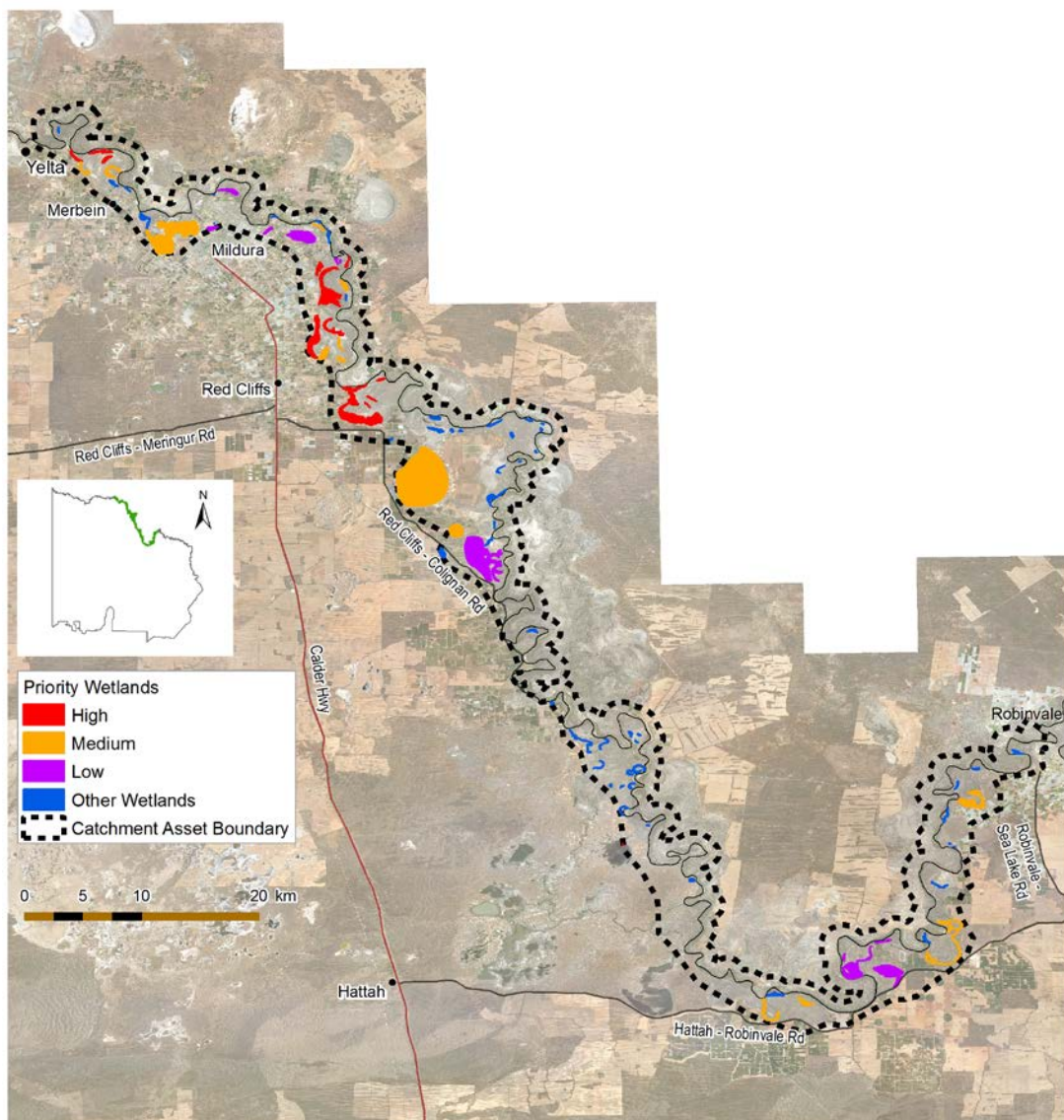


Figure 2: Wetlands

Threatened Species and Communities

A significant range of flora and fauna species that are listed in Federal and State instruments have been observed and recorded within the area of this catchment asset over time. These species are listed in the tables that follow along with their current status as described in the listing instrument. The listing instruments are: Environmental Protection and Biodiversity Conservation (EPBC) Act 1999; Flora and Fauna Guarantee (FFG) Act 1998 and the Victorian Threatened Species Advisory Lists issued by the Department of Environment and Primary Industries (DEPI) (Flora: 2005, Fauna: 2013). The species names included in the following tables (Table 4 & Table 5) may not reflect the full range of threatened flora and fauna species that may inhabit the catchment area. Rather they reflect only species whose presence has been observed and recorded by suitably qualified observers since 1980.

The Catchment Asset area supports a number of threatened species including the Regent Parrot (*Polytelis anthopeplus monarchoides*), Swift Parrot (*Lathamus discolor*), Murray Hardyhead (*Craterocephalus fluviatilis*), Australasian Bittern (*Botaurus poiciloptilus*) and the Growling Grass Frog (*Litoria raniformis*). Other significant fauna species for Victoria that have been observed here include the Hooded Robin (*Melanodryas cucullata cucullata*), Scarlet-chested Parrot (*Neophema splendida*), Diamond Dove (*Geopelia cuneata*), Major Mitchell's Cockatoo (*Lophocroa leadbeateri*), White-browed Tree Creeper (*Climacteris affinis*), and a range of nomadic and migratory waterbirds. The area is also home to more than 130 significant plant species including the EPBC listed Desert Greenhood (*Pterostylis xerophila*).

The river reaches, anabranches and floodplain wetlands contained within this Catchment Asset area provide habitat for some of the members of the Lowland Riverine Fish Community of the Southern Murray–Darling Basin (see Table 7). This is a community of fish species that is listed under the Victorian FFG Act and so qualifies as a threatened ecological community in this context. The Mallee Bird Community is another listed ecological community under the FFG Act. However, only two species (Southern Scrub-robin and Gilbert's Whistler) from this group has been recorded within the catchment since 1980 and neither species is not considered to be threatened.

Based on the available data concerning their extent, quality and policy significance within this landscape, the Threatened Species and Communities within this Catchment Asset are considered to be of **high** value.

Table 4: Threatened Flora Species observed since 1980

Scientific Name	Common Name	EPBC	FFG	DSE Advisory List
<i>Abutilon fraseri</i>	Dwarf Lantern-flower		Listed	Endangered
<i>Abutilon malvifolium</i>	Mallow-leaf Lantern-flower		Listed	Endangered
<i>Abutilon otocarpum</i>	Desert Lantern			Vulnerable
<i>Acacia colletioides</i>	Wait-a-while			Rare
<i>Acacia loderi</i>	Nealie			Vulnerable
<i>Acacia melvillei</i>	Yarran			Vulnerable
<i>Acacia victoriae subsp. victoriae</i>	Bramble Wattle			Rare
<i>Allocasuarina luehmannii</i>	Buloke		Listed	
<i>Amaranthus grandiflorus</i>	Large-flower Amaranth			Vulnerable

<i>Amaranthus macrocarpus</i> var. <i>macrocarpus</i>	Dwarf Amaranth			Vulnerable
<i>Ammannia multiflora</i>	Jerry-jerry			Vulnerable
<i>Amyema linophylla</i> subsp. <i>orientale</i>	Buloke Mistletoe			Vulnerable
<i>Aristida holathera</i> var. <i>holathera</i>	Tall Kerosene Grass			Vulnerable
<i>Asperula gemella</i>	Twin-leaf Bedstraw			Rare
<i>Asperula wimmerana</i>	Wimmera Woodruff			Rare
<i>Atriplex limbata</i>	Spreading Saltbush		Listed	Vulnerable
<i>Atriplex lindleyi</i> subsp. <i>conduplicata</i>	Baldoo			Rare
<i>Atriplex lindleyi</i> subsp. <i>lindleyi</i>	Flat-top Saltbush			Poorly known
<i>Atriplex nummularia</i> subsp. <i>omissa</i>	Dwarf Old-man Saltbush			Rare
<i>Atriplex papillata</i>	Coral Saltbush			Rare
<i>Atriplex pseudocampanulata</i>	Mealy Saltbush			Rare
<i>Atriplex rhagodioides</i>	Silver Saltbush		Listed	Vulnerable
<i>Atriplex spinibractea</i>	Spiny-fruit Saltbush			Endangered
<i>Bergia ammannioides</i>	Jerry Water-fire			Vulnerable
<i>Bergia trimera</i>	Small Water-fire			Vulnerable
<i>Brachyscome</i> aff. <i>gracilis</i> (Kings Billabong)	Billabong Daisy		Listed	Vulnerable
<i>Brachyscome gracilis</i>	Dookie Daisy		Listed	Vulnerable
<i>Calandrinia volubilis</i>	Twining Purslane			Rare
<i>Calostemma purpureum</i> s.l.	Garland Lily			Rare
<i>Calotis cuneifolia</i>	Blue Burr-daisy			Rare
<i>Calotis lappulacea</i>	Yellow Burr-daisy			Rare
<i>Cardamine tenuifolia</i>	Slender Bitter-cress			Poorly known
<i>Carpobrotus</i> aff. <i>rossii</i> (N.W. Victoria)	Mallee Pigface			Rare
<i>Casuarina obesa</i>	Swamp Sheoak		Listed	Endangered
<i>Centipeda thespidioides</i> s.l.	Desert Sneezeweed			Rare
<i>Ceratophyllum demersum</i>	Hornwort			Poorly known
<i>Chenopodium desertorum</i> subsp. <i>desertorum</i>	Frosted Goosefoot			Rare
<i>Craspedia haplorrhiza</i>	Plains Billy-buttons			Poorly known
<i>Cullen cinereum</i>	Hoary Scurf-pea		Listed	Endangered
<i>Cullen pallidum</i>	Woolly Scurf-pea		Listed	Endangered
<i>Cullen patens</i>	Spreading Scurf-pea		Listed	Endangered
<i>Cullen tenax</i>	Tough Scurf-pea		Listed	Endangered

<i>Cymbonotus lawsonianus</i>	Bear's-ear			Rare
<i>Cynodon dactylon</i> var. <i>pulchellus</i>	Native Couch			Poorly known
<i>Cyperus flaccidus</i>	Lax Flat-sedge			Vulnerable
<i>Cyperus nervulosus</i>	Annual Flat-sedge		Listed	Endangered
<i>Cyperus pygmaeus</i>	Dwarf Flat-sedge			Vulnerable
<i>Cyperus rigidellus</i>	Curly Flat-sedge		Listed	Endangered
<i>Cyperus squarrosus</i>	Bearded Flat-sedge			Vulnerable
<i>Cyperus victoriensis</i>	Yelka			Poorly known
<i>Dactyloctenium radulans</i>	Finger Grass			Rare
<i>Dianella porracea</i>	Riverine Flax-lily			Vulnerable
<i>Digitaria ammophila</i>	Silky Umbrella-grass			Vulnerable
<i>Dissocarpus biflorus</i> var. <i>biflorus</i>	Twin-flower Saltbush			Rare
<i>Duma horrida</i> subsp. <i>horrida</i>	Spiny Lignum			Rare
<i>Elachanthus glaber</i>	Smooth Elachanth			Rare
<i>Elachanthus pusillus</i>	Small Elachanth			Rare
<i>Eleocharis pallens</i>	Pale Spike-sedge			Poorly known
<i>Eleocharis plana</i>	Flat Spike-sedge			Vulnerable
<i>Epaltes cunninghamii</i>	Tall Nut-heads			Vulnerable
<i>Eragrostis australasica</i>	Cane Grass			Vulnerable
<i>Eragrostis exigua</i>	Slender Love-grass			Endangered
<i>Eragrostis lacunaria</i>	Purple Love-grass			Vulnerable
<i>Eragrostis setifolia</i>	Bristly Love-grass			Vulnerable
<i>Eremophila bignoniiflora</i>	Bignonia Emu-bush		Listed	Vulnerable
<i>Eremophila divaricata</i> subsp. <i>divaricata</i>	Spreading Emu-bush			Rare
<i>Eremophila maculata</i> subsp. <i>maculata</i>	Spotted Emu-bush			Rare
<i>Eucalyptus intertexta</i>	Gum-barked Coolibah			Poorly known
<i>Euryomyrtus ramosissima</i> subsp. <i>prostrata</i>	Nodding Baeckea			Rare
<i>Fimbristylis aestivalis</i>	Summer Fringe-sedge			Poorly known
<i>Fimbristylis velata</i>	Veiled Fringe-sedge			Rare
<i>Frankenia serpyllifolia</i>	Bristly Sea-heath			Rare
<i>Frankenia sessilis</i>	Small-leaf Sea-heath			Rare
<i>Glossostigma cleistanthum</i>	Small-flower Mud-mat			Rare
<i>Glycine canescens</i>	Silky Glycine		Listed	Endangered
<i>Haloragis glauca</i> f. <i>glauca</i>	Bluish Raspwort			Poorly known

<i>Hibiscus brachysiphonius</i>	Low Hibiscus		Listed	Endangered
<i>Hydrilla verticillata</i>	Hydrilla			Rare
<i>Isolepis australiensis</i>	Inland Club-sedge			Poorly known
<i>Isolepis congrua</i>	Slender Club-sedge		Listed	Vulnerable
<i>Jasminum didymum subsp. lineare</i>	Desert Jasmine			Vulnerable
<i>Leiocarpa leptolepis</i>	Pale Plover-daisy		Listed	Endangered
<i>Lepidium papillosum</i>	Warty Peppercross			Poorly known
<i>Lepidium phlebopetalum</i>	Veined Peppercross			Endangered
<i>Lepidium pseudohyssopifolium</i>	Native Peppercross			Poorly known
<i>Leptochloa fusca subsp. fusca</i>	Brown Beetle-grass			Rare
<i>Lipocarpha microcephala</i>	Button Rush			Vulnerable
<i>Maireana aphylla</i>	Leafless Bluebush			Poorly known
<i>Maireana georgei</i>	Slit-wing Bluebush			Vulnerable
<i>Maireana sedifolia</i>	Pearl Bluebush			Rare
<i>Maireana triptera</i>	Three-wing Bluebush			Rare
<i>Malacocera tricornis</i>	Goat Head			Rare
<i>Marsdenia australis</i>	Doubah			Vulnerable
<i>Minuria cunninghamii</i>	Bush Minuria			Rare
<i>Minuria denticulata</i>	Woolly Minuria			Rare
<i>Minuria integerrima</i>	Smooth Minuria			Rare
<i>Myoporum montanum</i>	Waterbush			Rare
<i>Najas tenuifolia</i>	Water Nymph			Rare
<i>Ophioglossum polyphyllum</i>	Upright Adder's-tongue			Vulnerable
<i>Phyllanthus lacunarius</i>	Lagoon Spurge			Vulnerable
<i>Phyllanthus lacunellus</i>	Sandhill Spurge			Rare
<i>Picris squarrosa</i>	Squat Picris			Rare
<i>Poa lowanensis</i>	Mallee Tussock-grass			Rare
<i>Potamogeton perfoliatus</i>	Perfoliate Pondweed			Poorly known
<i>Pterostylis xerophila</i>	Desert Greenhood	Vulnerable	Listed	Endangered
<i>Ptilotus nobilis var. nobilis</i>	Yellow Tails			Endangered
<i>Ptilotus polystachyus</i>	Long Tails			Endangered
<i>Ptilotus sessilifolius</i>	Crimson Tails			Poorly known
<i>Ranunculus pumilio var. politus</i>	Ferny Small-flower Buttercup			Poorly known
<i>Sarcozona praecox</i>	Sarcozona			Rare

<i>Sclerolaena lanicuspis</i>	Woolly Copperburr			Endangered
<i>Sclerolaena muricata</i> var. <i>muricata</i>	Black Roly-poly			Poorly known
<i>Sclerolaena patenticuspis</i>	Spear-fruit Copperburr			Vulnerable
<i>Sesbania cannabina</i> var. <i>cannabina</i>	Yellow Pea-bush			Vulnerable
<i>Sida ammophila</i>	Sand Sida			Vulnerable
<i>Sida fibulifera</i>	Pin Sida			Vulnerable
<i>Sida intricata</i>	Twiggy Sida			Vulnerable
<i>Sporobolus caroli</i>	Yakka Grass			Rare
<i>Stuartina hamata</i>	Prickly Cudweed			Rare
<i>Swainsona microphylla</i>	Small-leaf Swainson-pea			Rare
<i>Swainsona phacoides</i>	Dwarf Swainson-pea		Listed	Endangered
<i>Swainsona reticulata</i>	Kneed Swainson-pea		Listed	Vulnerable
<i>Swainsona sericea</i>	Silky Swainson-pea		Listed	Vulnerable
<i>Tecticornia triandra</i>	Desert Glasswort			Rare
<i>Templetonia egena</i>	Round Templetonia			Vulnerable
<i>Tetragonia eremaea</i> s.s.	Desert Spinach			Poorly known
<i>Tetragonia moorei</i>	Annual Spinach			Poorly known
<i>Teucrium albicaule</i>	Scurfy Germander			Poorly known
<i>Tragus australianus</i>	Small Burr-grass			Rare
<i>Triglochin dubia</i>	Slender Water-ribbons			Rare
<i>Triraphis mollis</i>	Needle Grass			Rare
<i>Velleia arguta</i>	Grassland Velleia			Rare
<i>Wahlenbergia tumidifructa</i>	Mallee Annual-bluebell			Rare
<i>Zygophyllum angustifolium</i>	Scrambling Twin-leaf			Rare

Table 5: Threatened Fauna Species observed since 1980

Scientific Name	Common Name	EPBC	FFG	DSE Advisory List
<i>Accipiter novaehollandiae novaehollandiae</i>	Grey Goshawk		Listed	Vulnerable
<i>Actitis hypoleucos</i>	Common Sandpiper			Vulnerable
<i>Anas rhynchos</i>	Australasian Shoveler			Vulnerable
<i>Ardea intermedia</i>	Intermediate Egret		Listed	Endangered
<i>Ardea modesta</i>	Eastern Great Egret		Listed	Vulnerable
<i>Arenaria interpres</i>	Ruddy Turnstone			Vulnerable

<i>Aythya australis</i>	Hardhead			Vulnerable
<i>Bidyanus bidyanus</i>	Silver Perch		Listed	Vulnerable
<i>Biziura lobata</i>	Musk Duck			Vulnerable
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Endangered	Listed	Endangered
<i>Burhinus grallarius</i>	Bush Stone-curlew		Listed	Endangered
<i>Calidris canutus</i>	Red Knot			Endangered
<i>Calidris ferruginea</i>	Curlew Sandpiper			Endangered
<i>Calidris tenuirostris</i>	Great Knot		Listed	Endangered
<i>Chelodina expansa</i>	Broad-shelled Turtle		Listed	Endangered
<i>Chlidonias hybridus javanicus</i>	Whiskered Tern			Near threatened
<i>Chrysococcyx osculans</i>	Black-eared Cuckoo			Near threatened
<i>Climacteris affinis</i>	White-browed Treecreeper		Listed	Vulnerable
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (south-eastern ssp.)			Near threatened
<i>Coracina maxima</i>	Ground Cuckoo-shrike		Listed	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Endangered	Listed	Critically endangered
<i>Demansia psammophis</i>	Yellow-faced Whip Snake			Near threatened
<i>Dromaius novaehollandiae</i>	Emu			Near threatened
<i>Egretta garzetta nigripes</i>	Little Egret		Listed	Endangered
<i>Falco subniger</i>	Black Falcon			Vulnerable
<i>Furina diadema</i>	Red-naped Snake		Listed	Vulnerable
<i>Gelochelidon nilotica macrotarsa</i>	Gull-billed Tern		Listed	Endangered
<i>Geopelia cuneata</i>	Diamond Dove		Listed	Near threatened
<i>Grantiella picta</i>	Painted Honeyeater		Listed	Vulnerable
<i>Grus rubicunda</i>	Brolga		Listed	Vulnerable
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle		Listed	Vulnerable
<i>Hydroprogne caspia</i>	Caspian Tern		Listed	Near threatened
<i>Lathamus discolor</i>	Swift Parrot	Endangered	Listed	Endangered
<i>Lerista timida</i>	Dwarf Burrowing Skink		Listed	Endangered
<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater			Vulnerable
<i>Limosa limosa</i>	Black-tailed Godwit			Vulnerable
<i>Litoria raniformis</i>	Growling Grass Frog	Vulnerable	Listed	Endangered
<i>Lophocroa leadbeateri</i>	Major Mitchell's Cockatoo		Listed	Vulnerable
<i>Lophoictinia isura</i>	Square-tailed Kite		Listed	Vulnerable
<i>Macquaria ambigua</i>	Golden Perch			Near threatened

<i>Melanodryas cucullata cucullata</i>	Hooded Robin		Listed	Near threatened
<i>Melanotaenia fluviatilis</i>	Murray-Darling Rainbowfish		Listed	Vulnerable
<i>Morelia spilota metcalfei</i>	Carpet Python		Listed	Endangered
<i>Neophema splendida</i>	Scarlet-chested Parrot		Listed	Vulnerable
<i>Nycticorax caledonicus hillii</i>	Nankeen Night Heron			Near threatened
<i>Oreoica gutturalis gutturalis</i>	Crested Bellbird		Listed	Near threatened
<i>Oxyura australis</i>	Blue-billed Duck		Listed	Endangered
<i>Phalacrocorax varius</i>	Pied Cormorant			Near threatened
<i>Platalea regia</i>	Royal Spoonbill			Near threatened
<i>Plegadis falcinellus</i>	Glossy Ibis			Near threatened
<i>Pluvialis fulva</i>	Pacific Golden Plover			Vulnerable
<i>Polytelis anthopeplus monarchoides</i>	Regent Parrot	Vulnerable	Listed	Vulnerable
<i>Porzana pusilla palustris</i>	Baillon's Crake		Listed	Vulnerable
<i>Scotorepens greyii</i>	Little Broad-nosed Bat			Near threatened
<i>Stictonetta naevosa</i>	Freckled Duck		Listed	Endangered
<i>Struthidea cinerea</i>	Apostlebird		Listed	
<i>Tandanus tandanus</i>	Freshwater Catfish		Listed	Endangered
<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard			Near threatened
<i>Todiramphus pyrropygia pyrropygia</i>	Red-backed Kingfisher			Near threatened
<i>Tringa glareola</i>	Wood Sandpiper			Vulnerable
<i>Tringa nebularia</i>	Common Greenshank			Vulnerable
<i>Tringa stagnatilis</i>	Marsh Sandpiper			Vulnerable
<i>Varanus varius</i>	Lace Monitor			Endangered

Table 6: Mallee Bird Community as listed under FFG Act
(including individual species listing and number of records since 1980 from Victorian Biodiversity Atlas)

Species Name	Common Name	Records since 1980	EPBC	FFG	DSE Advisory List
<i>Amytornis striatus striatus</i>	Striated Grasswren	No Records			Near Threatened
<i>Cinclosoma castanotus castanotus</i>	Chestnut Quail-thrush	No Records			Near Threatened
<i>Drymodes brunneopygia</i>	Southern Scrub-robin	1			
<i>Hylacola cautus cautus</i>	Shy Heathwren	No Records			

<i>Leipoa ocellata</i>	Malleefowl	No Records	Vulnerable	Listed	Endangered
<i>Manorina melanotis</i>	Black-eared Miner	No Records	Endangered	Listed	Critically Endangered
<i>Pachycephala inornata</i>	Gilbert's Whistler	3			
<i>Pachycephala rufogularis</i>	Red-lored Whistler	No Records	Vulnerable	Listed	Endangered
<i>Stipiturus mallee</i>	Mallee Emu-wren	No Records	Endangered	Listed	Endangered

Table 7: Lowland Riverine Fish Community of the Southern Murray–Darling Basin as listed under FFG Act
(including individual species listing and number of records since 1980 from Victorian Biodiversity Atlas)

Species Name	Common Name	Records since 1980	EPBC	FFG	DSE Advisory List
<i>Ambassis agassizii</i>	Agassiz's Chanda Perch	No Records		Listed	Regionally Extinct
<i>Bidyanus bidyanus</i>	Silver Perch	No Records		Listed	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	2	Endangered	Listed	Critically Endangered
<i>Craterocephalus stercusmuscarum fulvus</i>	Non-specked Hardyhead	5			
<i>Galaxias rostratus</i>	Flat-headed Galaxias	No Records			Vulnerable
<i>Hypseleotris klunzingeri</i>	Western Carp Gudgeon	6			
<i>Maccullochella macquariensis</i>	Trout Cod	No Records	Endangered	Listed	Critically Endangered
<i>Maccullochella peelii peelii</i>	Murray Cod	No Records	Vulnerable	Listed	Vulnerable
<i>Macquaria ambigua</i>	Golden Perch	14			Near Threatened
<i>Macquaria australasica</i>	Macquarie Perch	No Records	Endangered	Listed	Endangered
<i>Melanotaenia fluviatilis</i>	Murray-Darling Rainbowfish	5		Listed	Vulnerable
<i>Mogurnda adspersa</i>	Southern Purple-spotted Gudgeon	No Records			Regionally Extinct
<i>Nematoalosa erebi</i>	Bony Bream	2			
<i>Philypnodon grandiceps</i>	Flat-headed Gudgeon	4			
<i>Tandanus tandanus</i>	Freshwater Catfish	7		Listed	Endangered

Terrestrial Habitat

This catchment asset contains a little over 27,000 hectares of terrestrial habitat which represent about 85% of the total catchment asset area. Most of this remnant habitat has been given a bioregional conservation status of either 'depleted' or 'vulnerable'. However, the greater proportion of this habitat is maintained on public land and is afforded some level of protection from further development.

As with the other riverine catchment asset areas in the Mallee, this catchment asset is also one of the more diverse in terms of Ecological Vegetation Classes (EVC) with almost half of the Mallee's EVCs being found within the asset. The catchment asset lies almost entirely within the Victorian portion of the Interim Biogeographic Regionalisation for Australia (IBRA) sub-region known as the Robinvale Plains (see Figure 3). This sub-region is itself part of the Riverina IBRA bioregion which extends eastwards upriver to take in the lower Murrumbidgee, mid Murray and lower Goulburn & Broken River valleys. However, the catchment asset also takes in a small section of the adjacent Murray Mallee IBRA sub-region which is part of the Murray-Darling Depression IBRA bioregion that takes in the lower south western portion of the Murray-Darling Basin, spread across Victoria, South Australia and New South Wales.

Vegetation on frontages adjacent to the River is comprised predominantly of River Red Gum (*Eucalyptus camaldulensis*) communities with the floodplains further back characterised by Black Box (*Eucalyptus largiflorens*) woodlands, lignum shrublands and grasslands. The floodplain area adjoins large, open areas of semi-arid grasslands and chenopod shrublands.

The table below lists each of the Catchment Asset's EVCs along with the IBRA subregion within which they are contained, their Bioregional Conservation Status (BCS) and their area in hectares.

Table 8: Area of Ecological Vegetation Classes and their Bioregional Conservation Status

Ecological Vegetation Class	IBRA Subregion	Conservation Status	Area (hectares)
Alluvial Plains Semi-arid Grassland	Murray Scroll Belt	Vulnerable	60.55
	Robinvale Plains	Vulnerable	73.90
Bare Rock/Ground	Murray Mallee	Not Applicable	1.51
	Murray Scroll Belt	Not Applicable	44.43
	Robinvale Plains	Not Applicable	316.86
Chenopod Mallee	Murray Mallee	Vulnerable	240.59
	Murray Scroll Belt	Vulnerable	7.52
	Robinvale Plains	Vulnerable	172.35
Floodway Pond Herbland	Murray Scroll Belt	Depleted	20.89
	Robinvale Plains	Depleted	322.58
	Murray Mallee	Vulnerable	14.63
Grassy Riverine Forest	Murray Mallee	Depleted	43.61
	Murray Scroll Belt	Depleted	113.94
	Robinvale Plains	Depleted	1,516.92
Grassy Riverine Forest/Floodway Pond Herbland Complex	Murray Mallee	Depleted	38.97
	Robinvale Plains	Depleted	366.35

Intermittent Swampy Woodland	Murray Scroll Belt	Depleted	75.33
	Robinvale Plains	Depleted	1,256.56
	Murray Mallee	Vulnerable	113.75
Lake Bed Herbland	Robinvale Plains	Depleted	89.81
	Murray Scroll Belt	Vulnerable	457.81
Lignum Shrubland	Murray Mallee	Least Concern	140.73
	Murray Scroll Belt	Least Concern	148.11
	Robinvale Plains	Least Concern	1,966.62
Lignum Swamp	Murray Mallee	Vulnerable	48.62
	Murray Scroll Belt	Vulnerable	49.86
	Robinvale Plains	Vulnerable	1,199.64
Lignum Swampy Woodland	Murray Scroll Belt	Depleted	340.95
	Robinvale Plains	Depleted	3,788.26
	Murray Mallee	Vulnerable	469.01
Loamy Sands Mallee	Murray Mallee	Least Concern	35.20
	Robinvale Plains	Least Concern	200.65
Low Chenopod Shrubland	Murray Mallee	Depleted	1.48
	Murray Scroll Belt	Depleted	359.79
	Robinvale Plains	Depleted	61.32
Plains Grassland	Murray Mallee	Endangered	6.82
	Robinvale Plains	Endangered	1.00
Plains Woodland	Robinvale Plains	Endangered	1.77
Ridged Plains Mallee	Murray Mallee	Endangered	0.78
Riverine Chenopod Woodland	Murray Mallee	Depleted	308.22
	Murray Scroll Belt	Depleted	815.90
	Robinvale Plains	Depleted	4,579.96
Riverine Grassy Woodland	Murray Mallee	Depleted	106.85
	Robinvale Plains	Depleted	1,284.93
Semi-arid Chenopod Woodland	Murray Scroll Belt	Depleted	186.75
	Murray Mallee	Vulnerable	541.25
	Robinvale Plains	Vulnerable	401.59
Semi-arid Parilla Woodland	Murray Mallee	Vulnerable	361.56
	Robinvale Plains	Vulnerable	56.06
Semi-arid Woodland	Murray Mallee	Vulnerable	231.87
	Murray Scroll Belt	Vulnerable	23.39

	Robinvale Plains	Vulnerable	713.97
Shallow Freshwater Marsh	Murray Mallee	Vulnerable	18.38
	Robinvale Plains	Vulnerable	257.25
Shrubby Riverine Woodland	Murray Mallee	Least Concern	147.46
	Murray Scroll Belt	Least Concern	219.90
	Robinvale Plains	Least Concern	1578.82
Spike-sedge Wetland	Robinvale Plains	Vulnerable	83.96
Sub-saline Depression Shrubland	Robinvale Plains	Depleted	84.29
Tall Marsh	Robinvale Plains	Depleted	55.75
	Murray Mallee	Least Concern	13.55
Water Body - Fresh	Robinvale Plains	Not Applicable	13.98
Woorinen Mallee	Murray Mallee	Vulnerable	88.74
	Robinvale Plains	Vulnerable	58.67
Woorinen Sands Mallee	Murray Mallee	Depleted	31.52
	Murray Scroll Belt	Depleted	0.01
	Robinvale Plains	Depleted	598.75

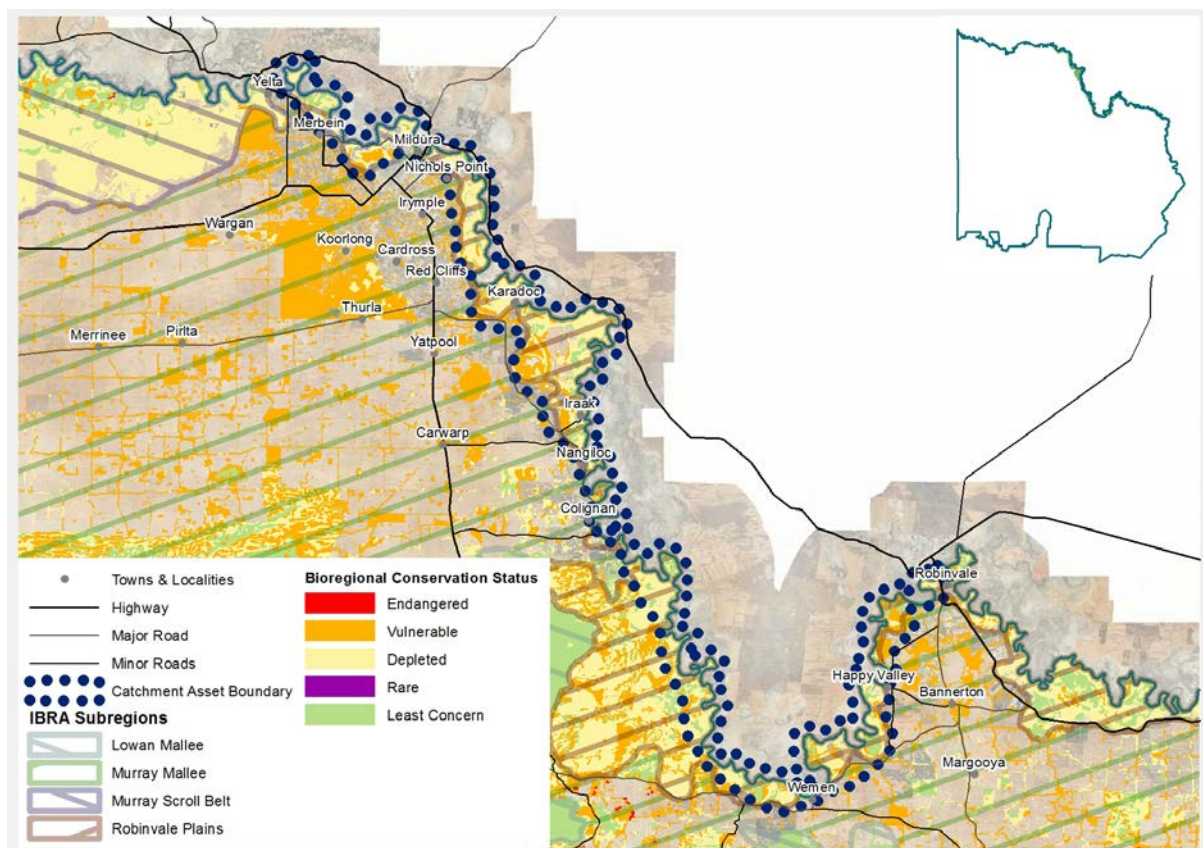


Figure 3: Bioregional conservation status of EVCs and IBRA sub-regions

DEPI's NaturePrint model is a landscape scale spatial planning mechanism that provides an analysis of biodiversity values across Victoria and combines the available information about biodiversity values, threatening processes and ecosystem function. It provides an analysis of the ecological value of a portion of landscape compared across the entire Victorian landscape. It is based on the following measures:

- Mathematical models of species distributions and habitats;
- The condition of these habitats;
- Pathways for connectivity across landscapes;
- Connectivity potential and recoverability;
- Threats to species persistence.

For background information about the model, its output and its significance, refer to:

<http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/natureprint>.

The NaturePrint model considers that about 36% of this Catchment Asset contains terrestrial habitat that is of the highest ecological value to Victoria and therefore high priority for protection and conservation.

Based on the available data concerning their extent, quality and policy significance within this landscape, the Terrestrial Habitat within this Catchment Asset is considered to be of **very high** value.

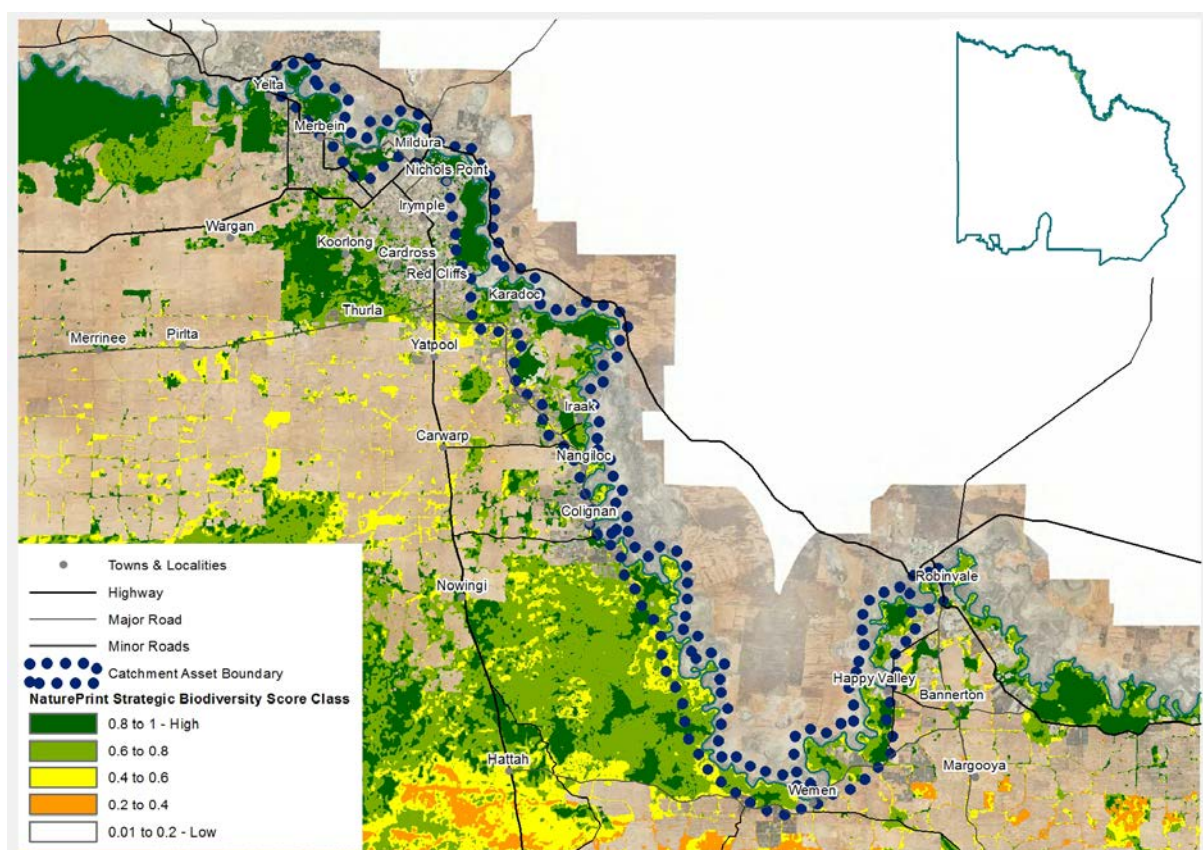


Figure 4: Terrestrial Habitat given high ecological value by NaturePrint Version 3

Soils

This riverine catchment asset area is dominated by bands of either Vertosols or Calcarosols. The former are heavy grey cracking clays that are remnants of the ancient lake system that once dominated this region. These are coarsely structured soils that are typically sodic, gypseous and somewhat saline. The latter are soils with a broad mix of textures that are either clay or sand dominant. They are the preferred agricultural soil in the Mallee. In this catchment asset area they tend to be lighter and sandier types.

There is also a band of Tenesol soils associated with the Hattah Lake system that bisects the catchment asset area. Tenesols are the loose red-brown sands that form the east-west dune systems for which the Mallee region is well known. This is also the portion of the asset area that has the greatest susceptibility to wind erosion of the soil should they become exposed. The data suggests that some 13.5% (4,385 hectares) of the soil surface within this catchment asset area has either high or very high susceptibility to wind erosion.

The soils of this Catchment Asset area are predominantly valued for their capacity to provide for terrestrial habitat and the support the production of food and fibre. However, there is also an understanding that the structure of the soil and its natural capacity to resist threatening processes such as wind erosion is also of substantial value.

There is currently no accepted framework to categorise our soil asset in terms of value from lower to higher based purely upon the social, economic and environmental values and services they provide. Such a framework has only been considered to date in terms of the threatening processes that may impinge on the capacity of our soils asset to provide the services we have come to expect. This will be discussed later in this document. Despite this limitation, the most appropriate course of action is to consider the relative value of the soil asset according to its intrinsic capacity to support the other regional assets within this catchment asset as the basis for applying a value category.

Therefore, the Soils within this Catchment Asset are considered to be of **high** value.

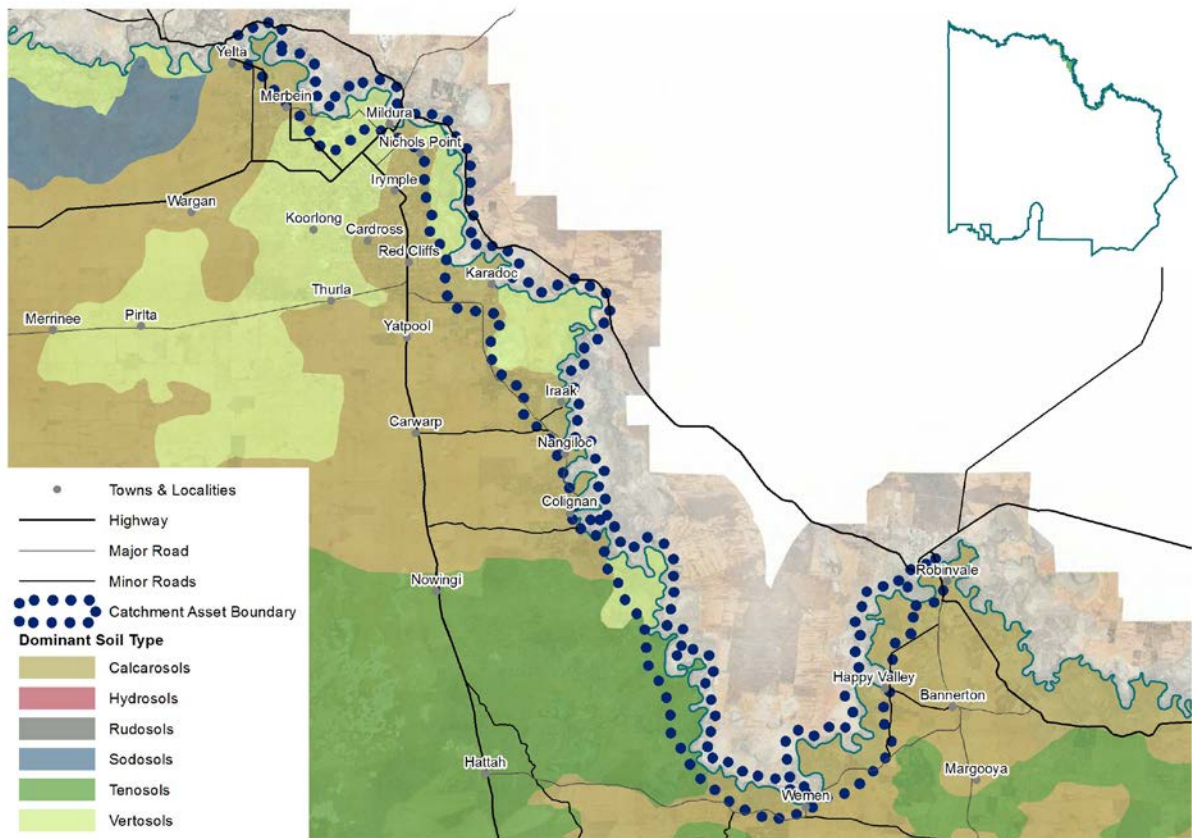


Figure 5: Dominant Soil Types

Agricultural Land

Irrigated agriculture is one of the most significant land use activities in this catchment asset area. About 45% (16,941 hectares) of the catchment asset area is given over to irrigated agricultural activities. A further 1% is identified as being used for dryland agriculture.

The agricultural land of this Catchment Asset area is mainly valued for its capacity to support the production of food and fibre. This in turn provides for a range of other social and economic services that are important to the Mallee region. In addition, when these services are available, they support the local community in its efforts to maintain and enhance not only their agricultural land but other other regional assets.

There is currently no accepted framework to categorise our agricultural land asset in terms of value from lower to higher based purely upon the social and economic values and services they provide. Such a framework has only been considered to date in terms of the threatening processes that may impinge on the capacity of our agricultural land asset to provide the services we have come to expect. This will be discussed later in this document. As a result, the most appropriate course of action is to consider the relative value of the agricultural land asset at a regional scale rather than at a catchment asset scale and in accordance to its capacity to provide and support social and economic values.

Therefore, the Agricultural Land within this Catchment Asset and across the region is considered to be of **high** value.

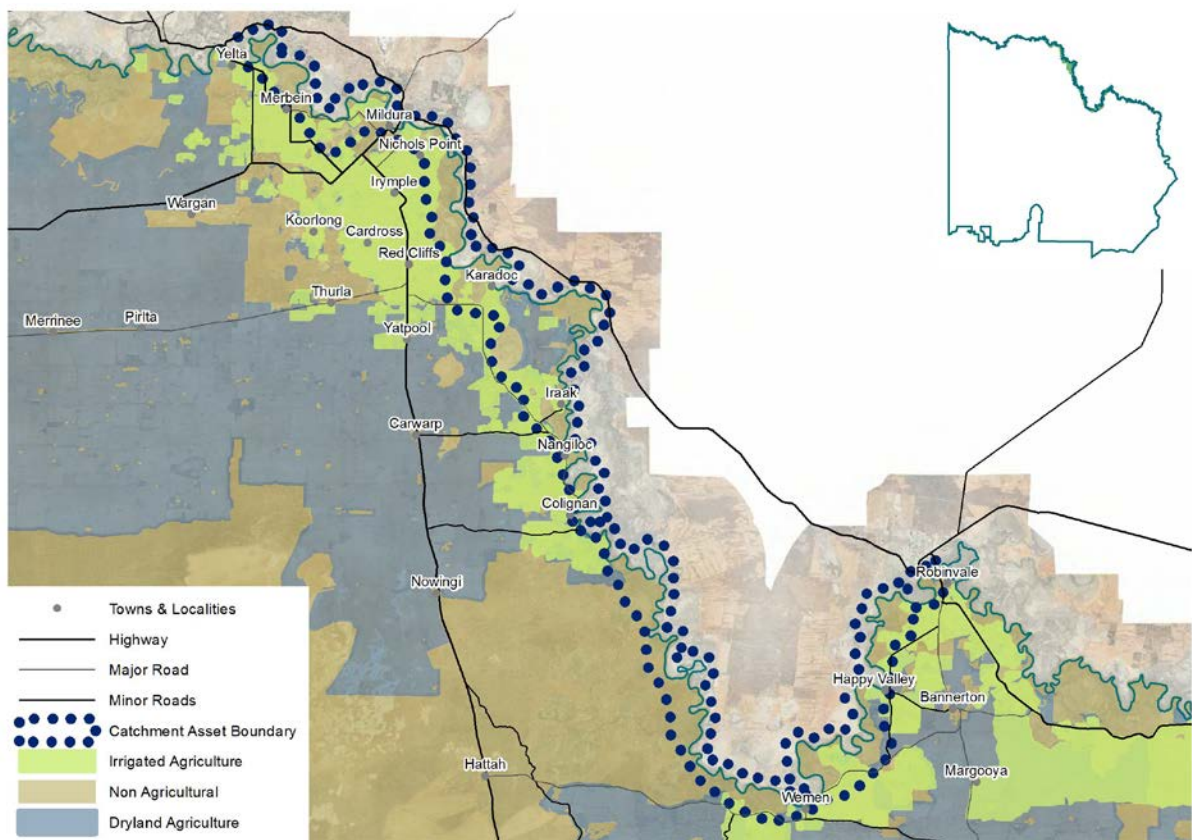


Figure 6: Agricultural land use

Groundwater

Groundwater aquifers that lie underneath this Catchment Asset area are not known to be utilised to provide a water resource for human uses. Therefore, the Mallee's groundwater asset is not of significance to this Catchment Asset.

Cultural Heritage

The catchment asset area has important Indigenous and non-Indigenous cultural value. Aboriginal people have had a connection to this area for tens of thousands of years. A significant number of cultural heritage sites occur in this area, ranging from small sites and earth features to larger sites containing artefacts, ovens and midden sites. From a European perspective, the area contains a number of heritage overlays that encompass sites of historical significance. Figure 7 provides a visualisation of where sites of indigenous and European cultural significance have been recorded.

Cultural heritage sites in this Catchment Asset area are predominantly valued for the connection they provide to the community between the social and cultural landscape that we currently enjoy and the stories, ideas and history of how that came to be. These sites provide individuals and families with a physical representation of their connection to the Mallee landscape and their place in it. These connections are extremely important to these people and, in turn, can reflect upon how they value and relate to the Mallee landscape that they are familiar with today. Therefore it is important to all that these sites are managed and protected in a manner that is sympathetic to those connections and values. Heritage significance is typically assessed under a three-tier legislative system that determines the local, state, national or commonwealth significance of an item. Heritage items can also be included on non-statutory listings (such as the National Trust classifications). However, there is no single and simple approach to categorise our cultural heritage asset in terms of value to the region. Tradition distinctions between different types of value (such as economic, social and environmental values) can be determined but this data is only patchily available given the number and range of

cultural heritage sites across the Mallee. The most appropriate course of action at this point is to give equal value to all recognised cultural heritage sites in the Mallee regardless of their age, form and historical background.

Therefore, Cultural Heritage within this Catchment Asset and across the region is considered to be of **high** value. Any further processes undertaken to prioritise and target management actions will rely on assessments of risk likelihood and impact to those sites.

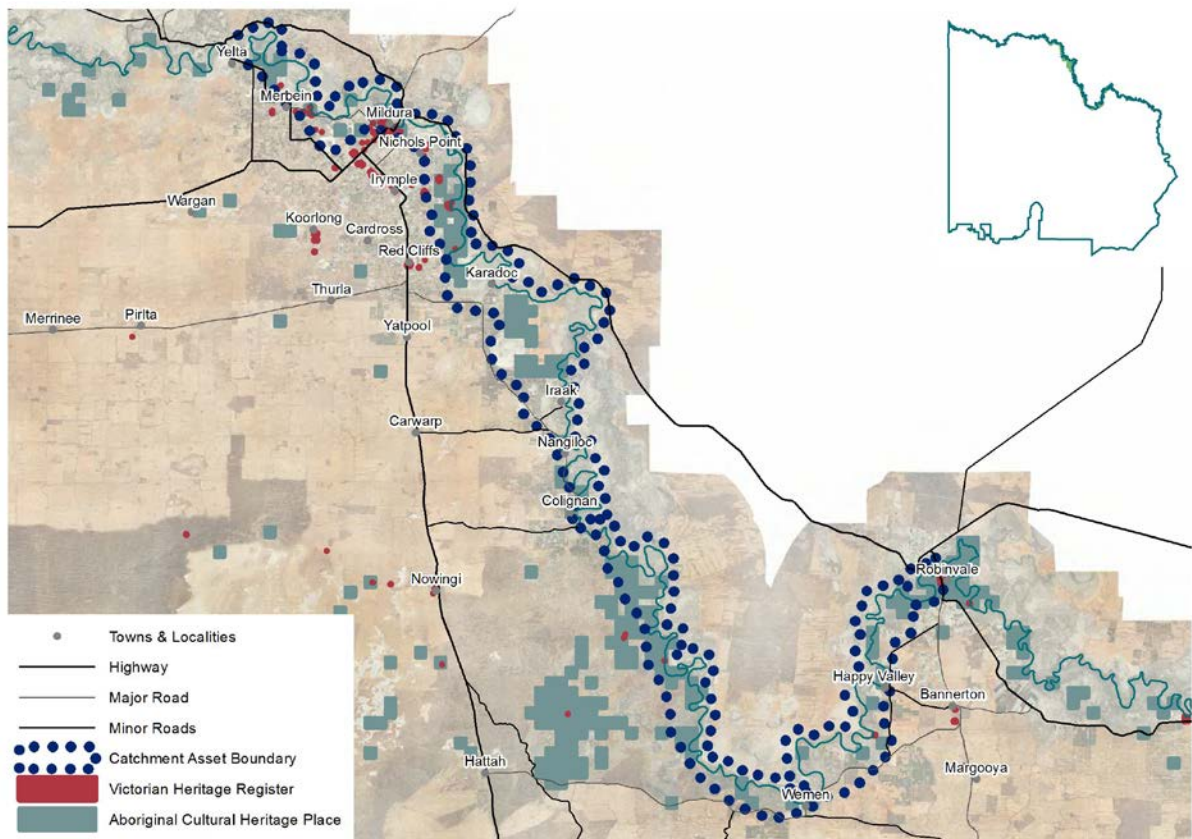


Figure 7: Areas of Cultural Value

Community Capacity

Community capacity is an important asset as positive and long-lasting NRM outcomes are dependent on an active, willing and capable community. In order to achieve regional scale NRM outcomes, people have to play a major role, often in partnership with government and industry, in the ongoing conservation and sustainable use of our Regional Assets. This requires Mallee communities to have the capacity to work cooperatively, apply economic resources, use networks and acquire and use relevant knowledge and information to achieve NRM outcomes. Maintaining and improving this capacity is dependent not only on the financial, physical and natural resources contained within or available to a community but also its social resources.

Community capacity therefore requires ongoing development, conservation and management as its relative condition can influence the achievement of all other biophysical goals and actions outlined within the RCS.

Our communities' capacity is defined by their characteristics and resources which, when combined, determine their ability to identify, evaluate and address key issues.

Characteristics of strong regional community capacity include:

- Individuals within the community being aware of regional NRM issues, and understanding the link between these issues and the long-term viability of the community
- Natural resource managers and users being able and willing to access the necessary information, data and science – biophysical, social and economic – to make sound NRM decisions
- Natural resource managers and users being equipped with or having access to, the necessary technical, people management, project management and planning skills to Social, participate in the development and implementation of sustainable NRM at the property, local and regional scales
- Community being engaged and motivated, and exercising ownership over NRM decision making processes and effectively implementing actions arising from these processes (DAFF 2006).

This catchment asset area is one of the major population areas of the Mallee region. However, the human population tends to be concentrated towards either end of the asset area. Robinvale, Happy Valley and Wemen in the East and the discontinuous spread of Sunraysia from Colignan downstream past Mildura to Merbein. In most cases, the asset area only takes in a small portion of these towns and their residents but because of the popularity and importance of the river and its environs to these communities they are a major influence on the asset area regardless. Therefore, these communities are of critical importance to the ongoing management of the catchment asset. However, given the popularity of this catchment asset as a tourism venue, there is a far wider population of occasional users whose capacity for effective and sustainable natural resource management is potentially also quite influential.

This catchment asset area is particularly well serviced by community driven NRM organisations which reflects well on the capacity of the local community to contribute to effective NRM outcomes. There are five active Landcare groups (Cabarita; Kulkyn Way; Red Cliffs; Robinvale & Districts and Yelta) whose areas of influence lie partially or wholly within the asset area.

A complete listing of all the known community NRM organisations within the catchment asset can be found in the Community NRM Groups section.

Whilst there are a number of methods available to evaluate the relative 'condition' of our community's capacity for NRM there is currently no accepted framework to categorise the community capacity asset in terms of value from low to high based upon the values and services it may provide. As a result, the most appropriate course of action is to consider the relative value of community capacity for NRM in terms of its potential contribution to NRM outcomes at a regional scale and what those NRM outcomes might be (and how sizeable the resources required to achieve them) if that contribution was not forthcoming. Under those circumstances, it is relatively easy to come to the conclusion that, without the communities' investment into NRM through exercising that community capacity asset, the scale and success of our NRM outcomes will be curtailed while their cost in resources increases. Such a situation would not benefit the Mallee region or its Regional Assets.

Therefore, Community Capacity within this Catchment Asset and across the region is considered to be of **high** value.

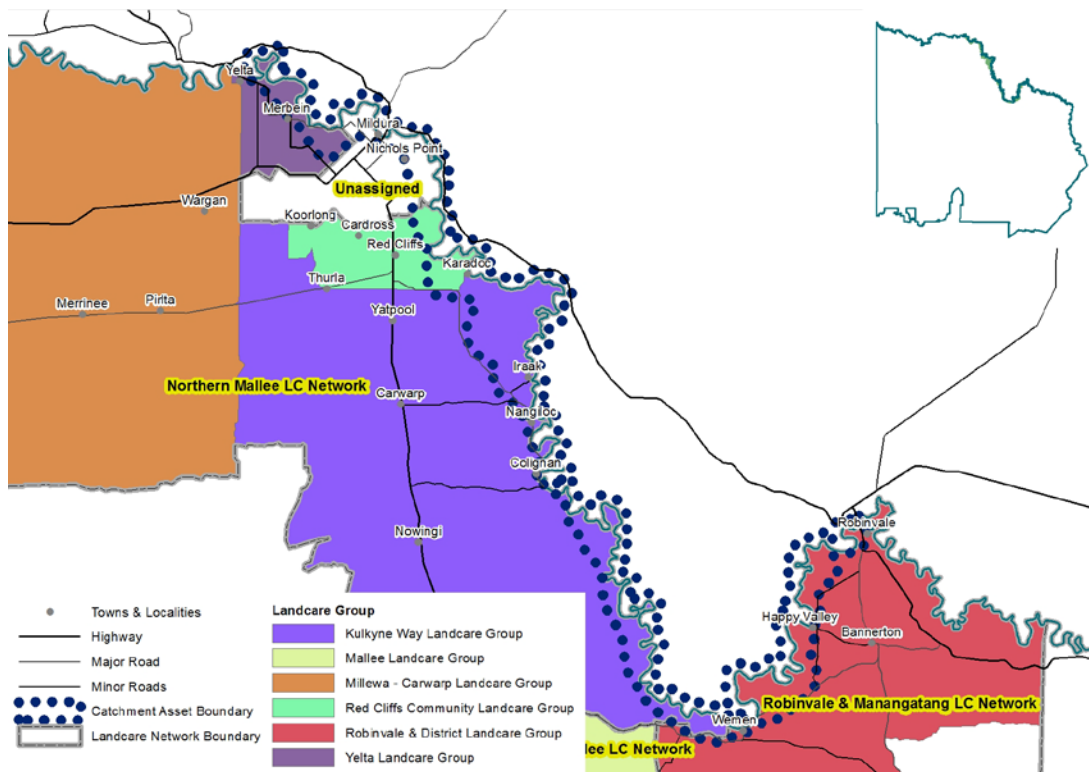


Figure 8: Landcare Groups

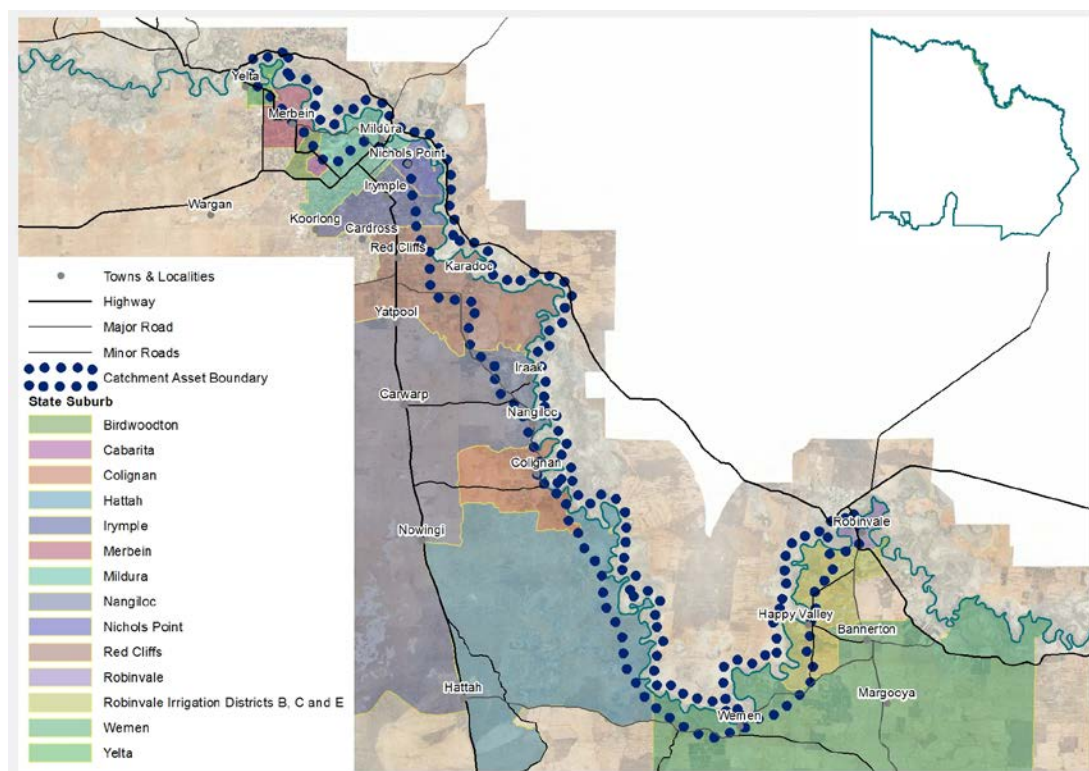


Figure 9: State Suburbs

Section 3 – Threatening Processes in this Catchment Asset

Threatening processes in the Mallee NRM region were defined and applied as part of the development of Mallee Regional Catchment Strategy by the Regional Catchment Strategy Steering Committee. Each of the following sub-sections provides a background to these threatening processes, available information about their form within this Catchment Asset and some discussion regarding the impact of these processes on our regional assets. This follows on to an assessment of the relative threat level posed by each the threatening processes based on the criteria contained in Appendix 2. *Categorising Threatening Processes*.

Land & water salinisation

Land and water salinisation is defined as: “Salinisation of the soil and water resources through the displacement of salt as a result of natural and human induced drivers.”

Salinisation of soils is caused by discharge of groundwater to the atmosphere by direct transpiration of groundwater by vegetation or by capillary rise from the water table through the soil profile to either the soil surface (evaporation) or the bottom of the plant root zone. Salt contained in the water that is evaporated and/or transpired is left behind and accumulates in the soil. High rates of groundwater discharge, and hence salt accumulation, only occur in areas where water tables are shallow (typically less the 10 m, with the most severe effects when the water table is less than 5 m).

There are many naturally saline wetlands and wetland complexes in the Mallee that are situated in areas where the underlying water tables are naturally shallow. Better known examples of these natural systems include the Tyrrell Basin, Raak Plain and the Pink Lakes. These are natural saline systems that have historically developed and been maintained in a balance that provided for stable ecological communities. However, agricultural development in the last century has altered the long term balance of these systems. The removal of much of the Mallee vegetation and the use of land management techniques that were comparatively inefficient users of rainfall (compared to Mallee woodlands) allowed deep drainage past the root zone. Depending on the location, this deep drainage either manifest itself as localised discharge zones in dune swales or contributed to further shallowing of the regional water table. As water tables came closer to the surface, more wetlands and wetland ecosystems were threatened by increasing salinity and increasing areas of salinised landscape.

The incremental improvement in agricultural land management techniques to maximise water use efficiency and minimise through drainage over the last two decades coupled with the broad scale effect of the so-called Millennium Drought have begun to swing the balance back towards a more neutral status. Water table depths have fallen and correspondingly so have salinity impacts in the landscape.

Despite these recent advances, the risks remain. Many of the triggers in the landscape that created the salinisation problem still remain. Most notable of these are the altered flow regimes in our watercourses and wetlands and the large, open areas cleared of perennial Mallee vegetation. These are historical landscape modifications that are not expected to be rectified since they have provided for the bulk of the Mallee’s resultant economic and social activity. Lapses in our current regimes of effective land and water management coupled with a changing climate can easily contribute to the return of a significant period of land and water salinisation.

This catchment asset does not contain any significant areas that are naturally saline. Classification of induced and natural saline surfaces in 2009 indicates there is less than 30 hectares of naturally saline surfaces in the catchment asset area (Mock & Grinter, 2009). However, there are a number of wetland that have been subjected to induced salinity primarily through their use as irrigation drainage disposal basins. These wetlands include Lake Hawthorn, Lake Ranfurly and Psyche Lagoon. The same classification process found that these areas of induced salinity amount to a little over 580 hectares. In total, just 1% of the catchment asset area is subjected to saline surfaces that indicate area of saline discharge.

Depth to the regional watertable and the general trends in groundwater levels were modelled in 2010 throughout the Mallee based on analysis of available groundwater data. Depth to water table was typically found to be relatively shallow (within 10 metres of ground level) compared to other asset areas due to the low relief of the river corridor. However, truly shallow water tables are uncommon with just 1.5% (562 hectares) of the asset area having the watertable within 2 meters of the ground level. Otherwise, depth to the watertable is less than 5 metres below ground level across approximately 20% of the asset area.

Given the current status of land and water salinisation in the Catchment asset area and consideration of the future potential of this threatening process to produce negative impacts within the area, the priority of action with respect to each Regional Asset has been determined. They are listed in Table 9 below.

Table 9: Prospective Priority of Action to address Land and Water Salinisation upon Regional Assets

Regional Asset	Priority of Action	Summary Logic
Rivers	HIGH	To be documented
Wetlands	HIGH	To be documented
Threatened Species and Communities	MEDIUM	To be documented
Terrestrial Habitat	MEDIUM	To be documented
Soils	HIGH	To be documented
Agricultural Land	MEDIUM	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	NONE	To be documented
Community Capacity	NONE	To be documented

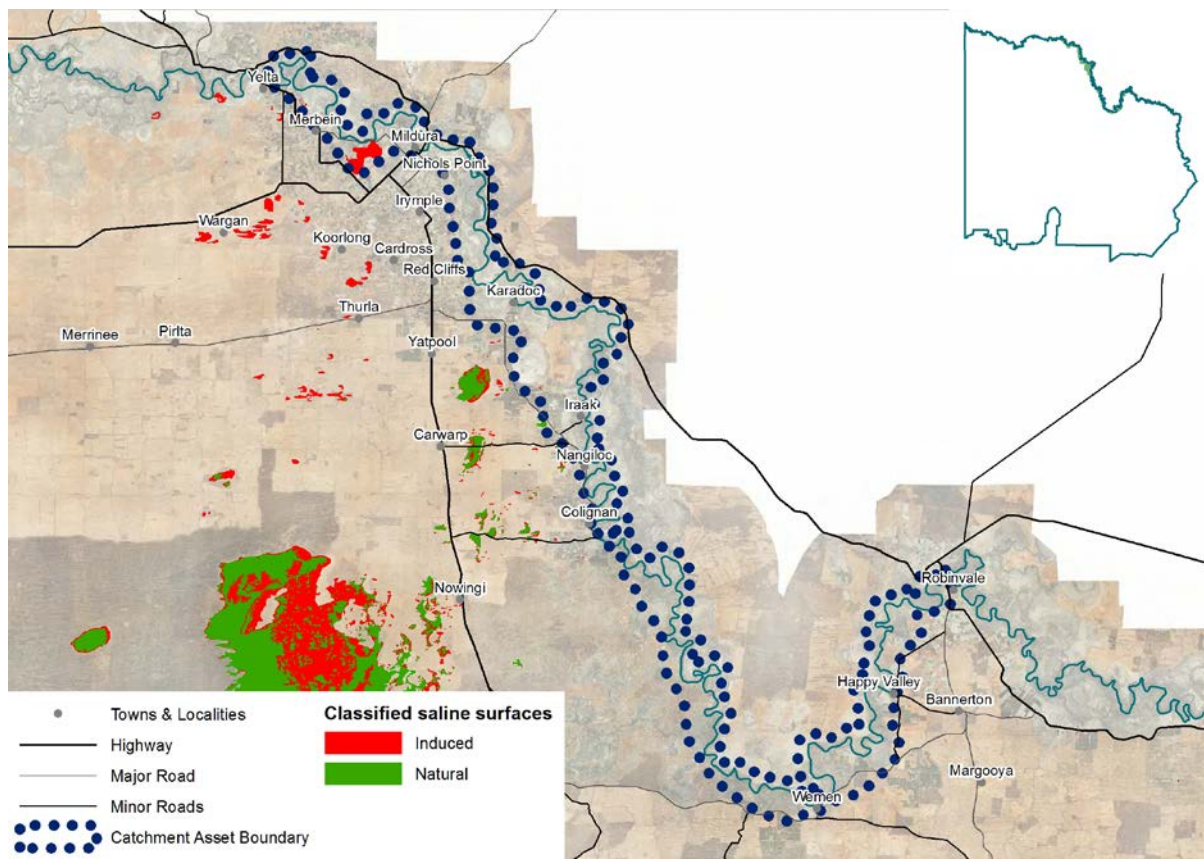


Figure 10: Natural and Induce Saline Surfaces

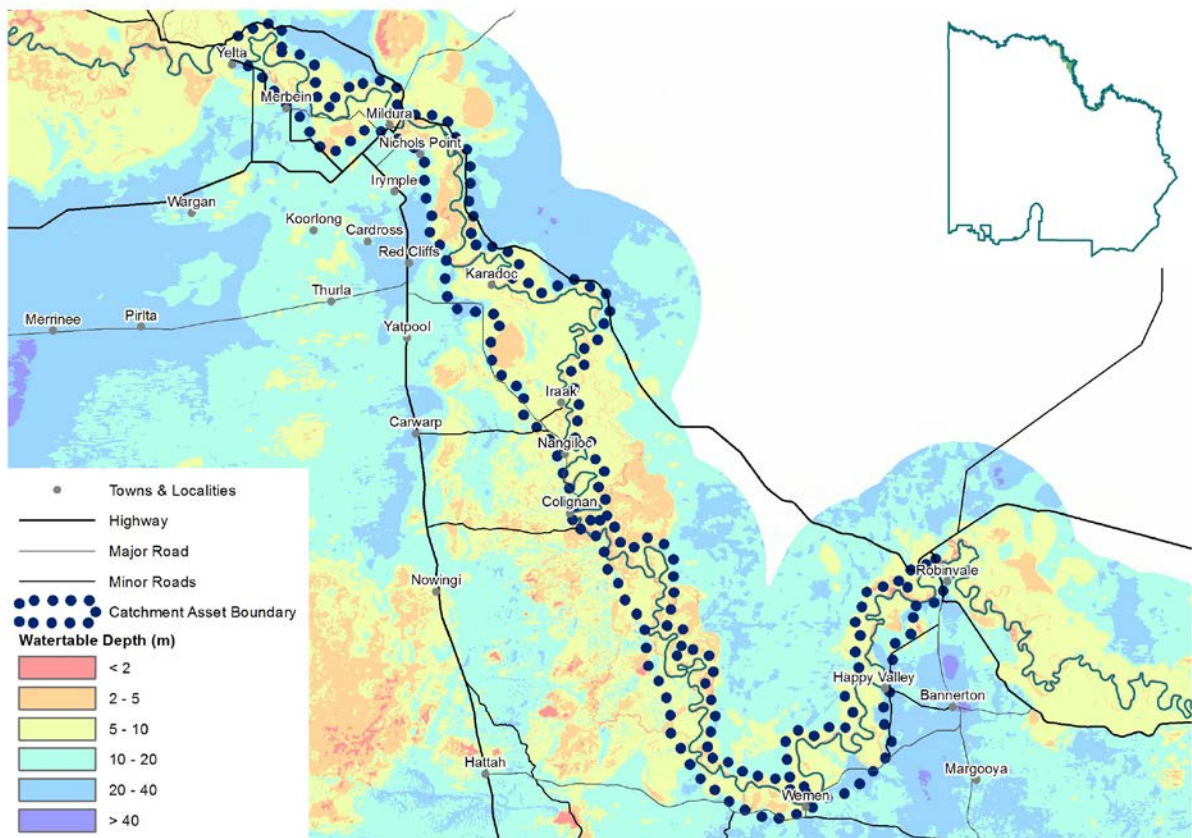


Figure 11: Estimated Depth to the Water table

Invasive Plants

Currently there are 25 State Prohibited Weeds, 4 Regionally Prohibited Weeds and 14 Regionally Controlled Weeds listed under the Catchment and Land Protection (CaLP) Act for the Mallee region. In addition to the conventional ways that weeds spread (e.g. wind and water) in the Mallee, disturbance from pest animals such as rabbits, goats and pigs also create good conditions for weed growth and contribute to weed spread.

Invasive plants in the Mallee threaten both biodiversity and the productive capacity of land. In many cases, weed infestation has changed the composition and character of the ecological landscape. Weed infestations also impact on the use of popular recreational spots in riparian areas, affecting aesthetic values and limiting access. Environmental weeds compete with established and regenerating indigenous species, threatening the quality and extent of native vegetation and reducing the diversity and availability of habitat. Environmental weeds present a significant risk to remnant roadside vegetation, as the 'edge effect' is particularly difficult to manage in these long, thin areas.

Agricultural weeds cause significant losses for horticulture and dryland farming through competition with crops and by reducing the quality of produce. Their control increases the cost of production and, in extreme cases, can diminish the productive capability of the land.

While the presence of recognised weed species in the asset area is almost certain, there is insufficient data available to adequately describe the current scope and scale of pest plant populations for the purposes of effective regional control. The available spatial data on invasive plant infestations dates back to 2007 and was generated as part of the Priority Weed Mapping project in 2008. This information is obviously now far out of date. The current information and response capacity

relies heavily on local activity at a local scale in response to local weed infestations. This approach, while often very successful, tends to preclude centralised management and control at a regional scale. Therefore, the priority of action to address invasive plants is strongly influenced by local scale data derived from local planning instruments and informal community consultation at the local level. On the other hand, limited knowledge and understanding of the vulnerability of the Mallee landscape to future weed incursions is available given the current listing of known invasive plants, the current understanding of their biological requirements and the planning and response framework provided by regional scale plans such as the Mallee Invasive Plants and Animals Management Strategy (IPAWS).

The IPAWS identifies 21 regional assets (based on geographic areas) across the Mallee region. This Catchment Asset area generally aligns with one of them: Murray River & Floodplain - Robinvale to Merbein. This asset area was considered to be of medium priority for on-ground action to manage invasive plants and animals.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with invasive plants with respect to each Regional Asset has been determined. They are listed in the Table 10 below.

Table 10: Prospective Priority of Action to address Invasive Plants upon Regional Assets

Regional Asset	Priority of Action	Summary Logic
Rivers	HIGH	To be documented
Wetlands	HIGH	To be documented
Threatened Species and Communities	HIGH	To be documented
Terrestrial Habitat	HIGH	Most remnant habitat in asset area is small and linear in shape; much lies within the high priority IPAWS asset area
Soils	HIGH	To be documented
Agricultural Land	HIGH	To be documented
Groundwater	NONE	This regional asset is not present within this catchment asset
Cultural Heritage	HIGH	Weeds of concern include Boxthorn, a number of Cactus species, Noogoora Burr and Spiny Rush
Community Capacity	NONE	Invasive plants do not pose a significant threat to community capacity at this time

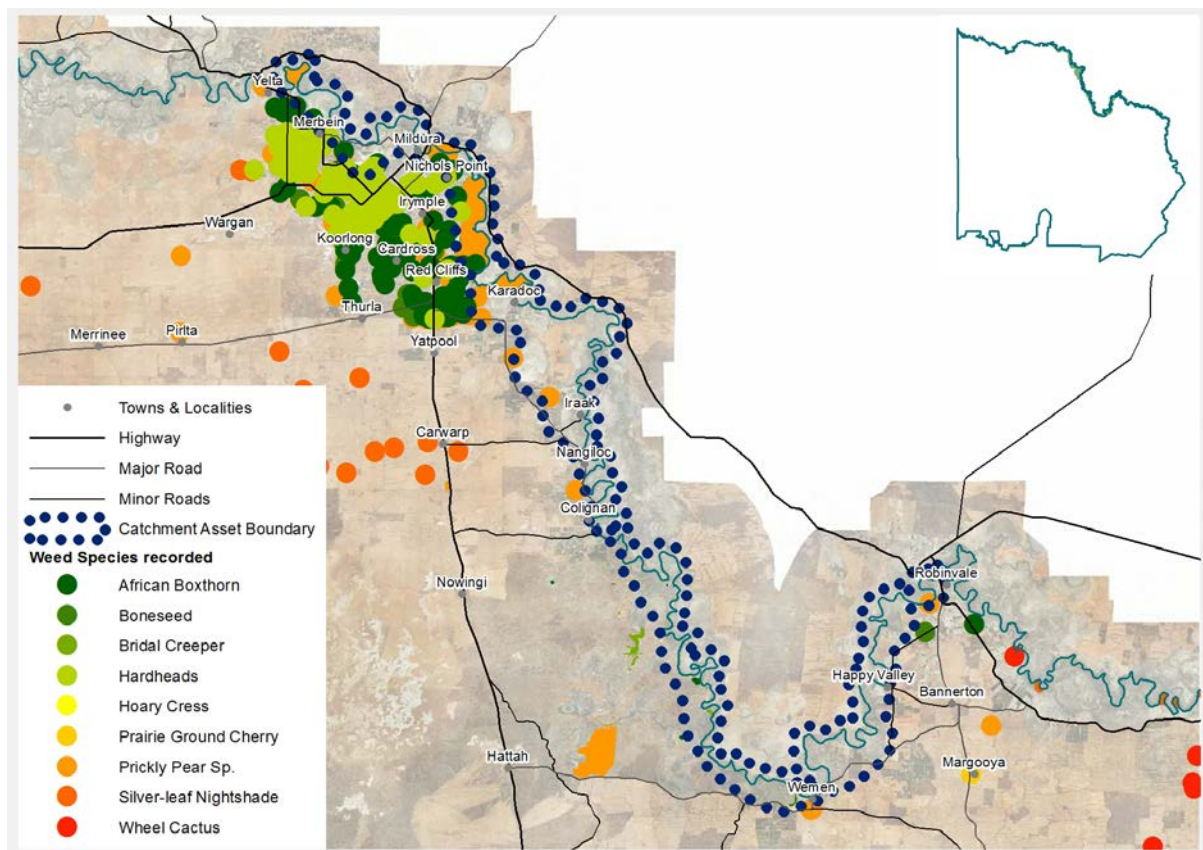


Figure 12: Priority Weed Infestations Recorded Between 2005 and 2007

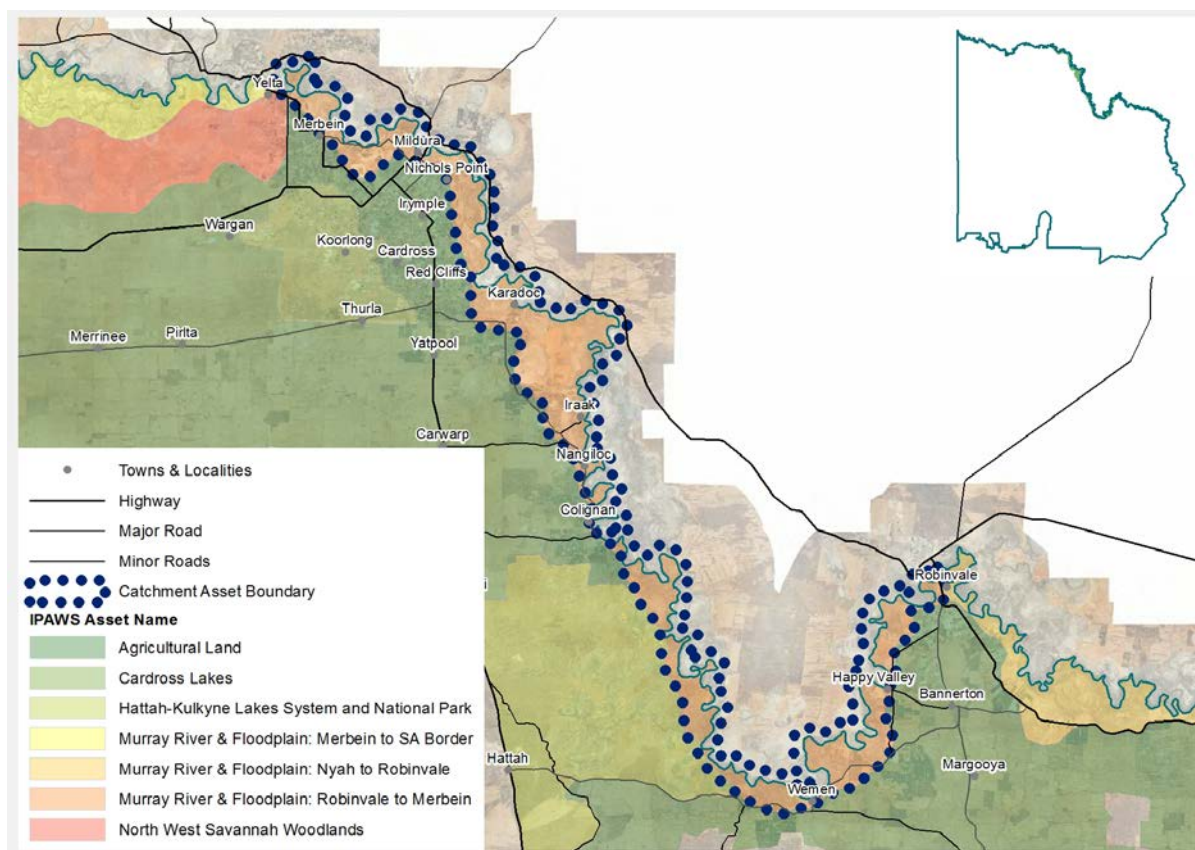


Figure 13: Regional Assets from the Mallee Invasive Plants and Animal Strategy

Invasive Animals

Invasive animals in terms of the Mallee RCS are regarded as those established invasive pest animals as defined in Part 8 of the CaLP Act 1994

Australia is host to 56 invasive vertebrate animal species. Of these, the ones with the most impact (in order of damage estimates) are: European Red Fox, feral cats, rabbits, feral pigs, wild dogs, the house mouse, carp and goats. The Mallee region hosts populations of all of these species. However, of most significance to the Mallee is the European Red Fox and Rabbits – both are declared under the Catchment and Land Protection (CaLP) Act 1994.

Invasive species are considered to be pests when they have, or have the potential to have, an undesirable economic, environmental or social/cultural impact. Such impacts may include damage to agricultural crops, livestock predation, indigenous fauna predation, soil erosion and land degradation, spread of weeds, pasture/food and habitat competition, and the potential spread of disease. Gong et al. (2009) estimated the overall direct economic impact of several pest animal species (foxes, rabbits, wild dogs, feral pigs, birds and mice) in Australia to be \$740 million annually. This included \$620.8 million of production losses in agriculture (including horticulture) and \$122.7 million on expenditure on pest animal management, administration and research in Australia. Some of the social impacts of pest animals include damage to infrastructure or cultural/historical sites, being 'a nuisance', causing traffic accidents, as well as significant social/psychological impacts on primary producers; for example, through distress of wild dog predation on livestock.

Other non-declared pest animals present in the Mallee include feral Bees, European Wasps, Hares, Starlings, Snails, Rats, Mice and Locusts.

Some of the remnant vegetation that fringes the river corridor and wetlands are susceptible to rabbit activity. 2,650 hectares (7%) of the catchment asset area is considered highly susceptible

to rabbit activity. A further 16,600 hectares (44%) is considered susceptible to rabbit activity. However, there is little available data to describe the impact rabbits are currently having on the asset area.

The asset area is also known to be home to populations of foxes, goats and cats. As with rabbits, there is little concrete data available to scale of threat these populations pose this asset

As with invasive plants, the presence of invasive animals like rabbits and foxes in the asset area is recognised. However, there is only limited data available to adequately describe the current scope and scale of pest animal populations for the purposes of effective regional control. The current information and response capacity relies heavily on local activity at a local scale. This approach, while often very successful, tends to preclude centralised management and control at a regional scale. Therefore, the priority of action to address invasive animals is strongly influenced by local scale data derived from local planning instruments and informal community consultation at the local level. On the other hand, knowledge and understanding of the vulnerability of the Mallee landscape to future incursions or outbreaks is available for some species given the current understanding of their biological requirements and the planning and response framework provided by regional scale plans such as the Mallee Invasive Plants and Animals Management Strategy (IPAWS).

The IPAWS identifies 21 regional assets (based on geographic areas) across the Mallee region. This Catchment Asset area aligns with one of these geographic assets: Murray River and Floodplain from Robinvale to Merbein. This asset area is considered to be of medium priority for on-ground action to manage invasive plants and animals.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with invasive plants with respect to each Regional Asset has been determined. They are listed in Table 11 below.

Table 11: Prospective Priority of Action to address Invasive Animals upon Regional Assets

Regional Asset	Priority of Action	Summary Logic
Rivers	HIGH	To be documented
Wetlands	HIGH	To be documented
Threatened Species and Communities	HIGH	To be documented
Terrestrial Habitat	HIGH	To be documented
Soils	HIGH	To be documented
Agricultural Land	HIGH	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	HIGH	To be documented
Community Capacity	NONE	To be documented

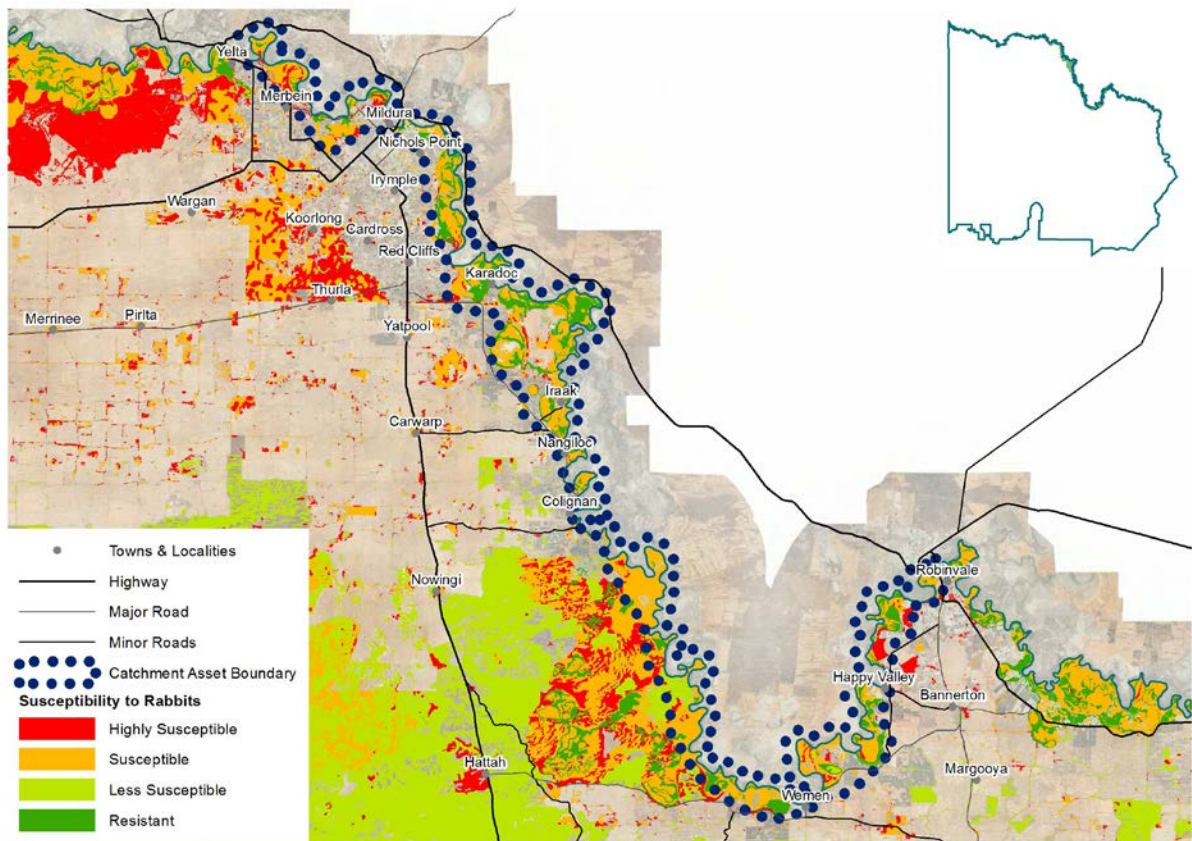


Figure 14: Susceptibility of Remnant Native Vegetation to Rabbits

Altered Hydrological Regimes

Modification of the natural flow regimes in our river systems has occurred over time to meet the various needs of navigation, agriculture and urban water use. Flow regulation has resulted in changes in the frequency, magnitude and duration of flows, and the restriction of small to medium flood events. River regulation, including the effect of locks, weirs and dams, has altered wetting and drying phases of many wetlands and ephemeral anabranches, by either permanently inundating the area, or restricting flows. Engineering works, such as the building of levees, have alienated large areas of floodplain which alters flood conveyance and flood storage. These changes have great significance for: fringing and floodplain forest communities; populations of fish, macroinvertebrates, algae, macrophytes; nutrient cycling; water quality; and channel shape and form.

Wetlands across the Mallee region have also been subject to modification of natural flow regimes which poses a threat to all priority wetland units. The flow regime, or hydrology, of a wetland is typically determined by climactic conditions and the inflows and outflows of surface and groundwater. Changes in hydrology affect most aspects of wetland ecology, including nutrient cycling; water quality; wetland shape and form; biodiversity; vegetation health, type and extent; and the composition and size of faunal communities. A wetland's flow regime has three main components: frequency, duration and seasonality of inundation. Any activity that changes one or more of these components will alter the natural hydrological regime of a wetland. Examples of these activities include: changes the flow regime of the wetland's water source; interference with flows in and out of, or even within, the wetland; water disposal to or extraction from the wetland; and modification of wetland depth (which alters evaporation rates and affects inundation duration).

The river system adjacent to and anabranch system within this asset area has been subject to extensive modification of hydrological regimes to the influence of weirs and locks and alteration of seasonal flow patterns to benefit irrigated agriculture. Index of Stream Condition analysis in 2004

indicates that, of the 21 river reaches in the asset area, 10 are considered to be in moderate condition and 11 are in a poor condition, primarily due to the typically poor scores for hydrology.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with altered hydrological regimes with respect to each Regional Asset has been determined. They are listed in Table 12 below.

Table 12: Prospective Priority of Action to address Altered Hydrological Processes

Regional Asset	Priority of Action	Summary Logic
Rivers	HIGH	To be documented
Wetlands	HIGH	To be documented
Threatened Species and Communities	HIGH	To be documented
Terrestrial Habitat	HIGH	To be documented
Soils	HIGH	To be documented
Agricultural Land	HIGH	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	HIGH	To be documented
Community Capacity	NONE	To be documented

Soil Erosion

Soil erosion in the Mallee is primarily confined to two processes: wind erosion and water erosion. Wind erosion is typically a regional scale process whereas water erosion primarily occurs in discrete locations on the sides and banks of some watercourses.

Wind erosion is the process by which soil particles are detached from the land surface and transported by the wind. Wind erosion occurs when the forces exerted by the wind overcome the gravitational and cohesive forces of soil particles on the surface of the ground. Wind erosion degrades the soil, reducing its capacity to sustain biodiversity and to support agricultural production. It can also have significant off-site impacts on infrastructure, air quality and respiratory health.

The movement of soil particles by the wind occurs in three ways, each of which is dependent on the size of the particles in question. The first method is known as creep. Larger particles (like sand) are generally too heavy to be lifted by the wind, so they are rolled along the surface by wind drag or moved by bombardment by other moving particles. The next method is known as saltation and this is when middling sized soil particles (typically 0.1 to 0.5 mm) are lifted by the wind, and then fall back to the ground, so they move in a hopping or bouncing fashion. This abrades the soil surface and as they hit other particles they break into smaller particles. It is these smaller particles (typically less than 0.1 mm) that form the suspended dust that is carried away from the erosion site by the wind and is typical of a Mallee dust event.

The susceptibility of a soil to erosion is dependent on its erodibility; its exposure to erosive winds; and on its moisture content. Soil erodibility refers to the inherent properties of the soil that make it susceptible to movement should the soil be exposed to strong winds (for example when they have been completely cleared or cultivated). These properties include: surface texture, organic matter content and stability of soil aggregates. The most erodible soil types are those with single grained structure and poor aggregate stability, such soils commonly comprising a large proportion of fine sand particles.

Soil erosion susceptibility in the Mallee can be spatially described due to a recognised relationship between soil type and the terrain. Landform component mapping took advantage of the relationship and served as a basis for predicting soil properties that determine erodibility based on prevailing terrain and soil types. It is an extension of the description and mapping of Mallee land systems in 1963 by Rowan and Downes which provides information about the land, its capabilities and its susceptibilities. The mapping used soil texture as the measure of erodibility and considered the frequency and direction of erodible winds (from south-west to westerly) to be consistent across the study area. The erosion susceptibility map for this Catchment Asset area is presented in Figure 15 below.

Wind erosion susceptibility mapping does not reflect the actual threat (or likelihood) of erosion occurring. Whilst a soil's inherent susceptibility to wind erosion is important, the actual likelihood of erosion occurring also depends on how the land is managed. Land management (such as vegetation cover) and climatic conditions (such as wind strength) play an important role in the occurrence of erosion. Where inappropriate management occurs severe wind erosion can be initiated on soils with low susceptibility and conversely erosion can be minimised on soils with high susceptibility with good management practises (Lorimer, 1985). When predicting the threat of erosion, both the landform component's inherent susceptibility to erode and its current state of management must be considered.

Most of the soil types in the catchment asset area have a low vulnerability to wind erosion. In this circumstance they are not particularly susceptible to wind erosion even in the event that the correct precursors (such as reduced groundcover) for such erosion exist. However, there are small areas between Iraak and Karadoc and particularly within the Hattah Lakes area which are more susceptible. These areas of high and very high susceptibility soils account for about 2,900 hectares or a little over 4.5% of the catchment asset area.

It should be pointed out that more than a third of this catchment asset area is public land and therefore not intensively managed for agricultural purposes. A similar proportion is associated with areas of human occupation and residence. It is considered that the soils of these lands are less likely to be exposed to wind erosion through the removal of ground cover as is seasonally the case with much agricultural land, especially those lands given over to cropping. Furthermore, most agricultural land in this catchment asset area is given over to perennial irrigation predominantly based on grapes so these soils are typically protected from wind erosion by the grape vines and their supporting trellis structures. Therefore, the actual area of soil within this catchment asset area that might be exposed and conducive to wind erosion at any particular time is likely to be comparatively small and not a particularly significant threat to regional assets within this catchment asset area.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with soil erosion with respect to each Regional Asset has been determined. They are listed in Table 13 below.

Table 13: Prospective Priority of Action to address Soil Erosion

Regional Asset	Priority of Action	Summary Logic
Rivers	LOW	To be documented
Wetlands	LOW	To be documented
Threatened Species and Communities	LOW	To be documented
Terrestrial Habitat	LOW	To be documented
Soils	LOW	To be documented
Agricultural Land	LOW	To be documented

Groundwater	NONE	To be documented
Cultural Heritage	HIGH	To be documented
Community Capacity	NONE	To be documented

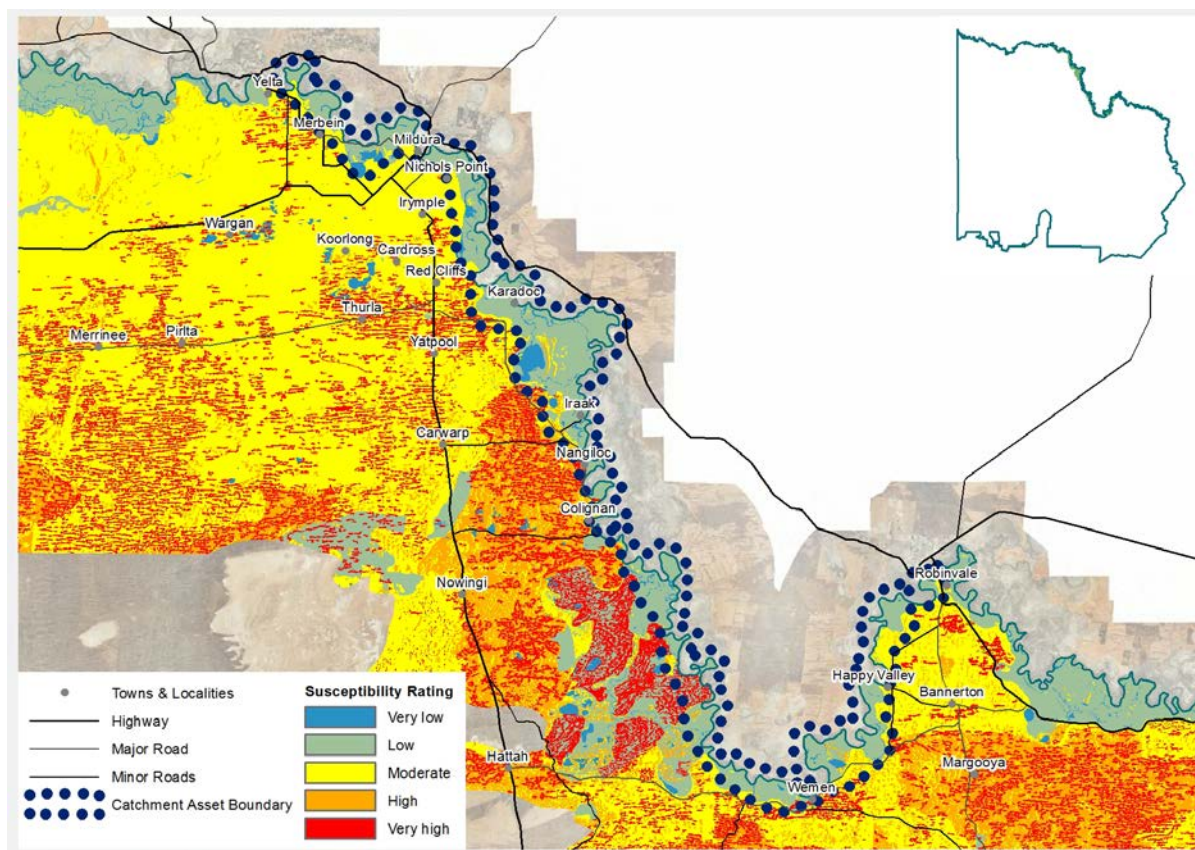


Figure 15: Wind Erosion Susceptibility

Inappropriate Water Use Practices

Inappropriate water use practices in agricultural activities in both the irrigation and dryland zones have been demonstrated to result in excessive volumes of deep drainage past the root zone of crops and pasture and therefore contribute to the raising of local and regional water tables.

Approximately 55% (about 11,800 hectares) of the asset area is given over to agricultural activities. There is insufficient information to determine the extent to which inappropriate water use practices remain in place.

Considerable effort has been expended by land managers and support agencies in recent years to substantially improve water management practices in irrigated agriculture throughout the region. This catchment asset area has been one of the major beneficiaries of the improvement process. However, the capacity to adequately describe the extent to which inappropriate water use practises remain in place currently remains elusive. The complexity of irrigated crop types, irrigation systems, water use and practises and the application of best practise benchmarks has, to date, constrained the capacity to reliably and meaningfully determine irrigation efficiency at a district scale and therefore determine the scale of inappropriate water use practises. However, measures are underway to rectify this inadequacy in the life of this RCS.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with inappropriate water use practices with respect to each Regional Asset has been determined. They are listed in Table 14 below.

Table 14: Prospective Priority of Action to address Inappropriate Water Use Practices

Regional Asset	Priority of Action	Summary Logic
Rivers	HIGH	To be documented
Wetlands	HIGH	To be documented
Threatened Species and Communities	HIGH	To be documented
Terrestrial Habitat	HIGH	To be documented
Soils	HIGH	To be documented
Agricultural Land	HIGH	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	HIGH	To be documented
Community Capacity	NONE	To be documented

Recreational Pressures

Recreational pressure can contribute to impacts including littering, track proliferation, fishing pressures, firewood collection, soil compaction and site erosion. The nature of the impacts is typically localised around the particular site and is highly dependent on the accessibility, popularity and sensitivity of the site along with the level of management that the location receives.

This catchment asset is a popular area for day use recreation and camping. Especially popular are the river frontages in Merbein Common, Kings Billabong Reserve and the Hattah Lakes area. The State of the Parks survey identifies a range of potential impacts arising from this recreational use. However, the scope, scale and extent of the impacts that results from this recreational pressure have not been quantified.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with recreational pressures with respect to each Regional Asset has been determined. They are listed in Table 15 below.

Table 15: Prospective Priority of Action to address Recreational Pressures

Regional Asset	Priority of Action	Summary Logic
Rivers	HIGH	To be documented
Wetlands	HIGH	To be documented
Threatened Species and Communities	HIGH	To be documented
Terrestrial Habitat	HIGH	To be documented
Soils	NONE	To be documented
Agricultural Land	NONE	To be documented
Groundwater	NONE	To be documented

Cultural Heritage	HIGH	To be documented
Community Capacity	NONE	To be documented

Land Use Change

Land use change as a threatening process in this context is considered to be the change of land management or use practices from either a steady state or from accepted best practice management system. Examples include the removal of native vegetation, conversion of dryland property to irrigation development (or the reverse), change from no-till cropping to traditional fallow techniques, conversion from perennial pasture to cropping (or the reverse)

There is insufficient quality and quantity of data available to adequately describe the nature and level of impact resulting from this threatening process on this catchment asset at this time.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with land use change with respect to each Regional Asset has been determined. They are listed in Table 16 below.

Table 16: Prospective Priority of Action to address Land Use Change

Regional Asset	Priority of Action	Summary Logic
Rivers	HIGH	To be documented
Wetlands	HIGH	To be documented
Threatened Species and Communities	HIGH	To be documented
Terrestrial Habitat	HIGH	To be documented
Soils	HIGH	To be documented
Agricultural Land	HIGH	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	HIGH	To be documented
Community Capacity	NONE	To be documented

Direct Off-site Interactions

Direct off-site interactions are the direct physical impacts from land management activities on neighbouring off-site assets such as areas of remnant native vegetation or wetlands. Such interactions may include chemical spray drift; parking or storage of machinery and equipment; or incremental drift of cultivation into the asset.

There is insufficient quality and quantity of data available to adequately describe the nature and level of impact resulting from this threatening process on this catchment asset at this time.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with direct off-site interactions with respect to each Regional Asset has been determined. They are listed Table 17 below.

Table 17: Prospective Priority of Action to address Direct Off-site Interactions

Regional Asset	Priority of Action	Summary Logic
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Rivers	LOW	To be documented
Wetlands	LOW	To be documented
Threatened Species and Communities	LOW	To be documented
Terrestrial Habitat	LOW	To be documented
Soils	LOW	To be documented
Agricultural Land	LOW	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	LOW	To be documented
Community Capacity	NONE	To be documented

Misaligned Community Perceptions

Misaligned community perceptions are community opinions, approaches & values that run counter to the messages & knowledge available about natural resource management AND threaten the success of the wider communities' efforts to enhance their environment. Such perceptions include 'right of unfettered access' that results in removal of traffic management infrastructure installed near river banks; and 'we are doing no harm' where individuals are not aware of the cumulative and incremental harm of some of their actions (along with those of the rest of the community) when they are making use of our assets

There is insufficient quality and quantity of data available to adequately describe the nature and level of impact resulting from this threatening process on this catchment asset at this time. However, there is a range of anecdotal information from a range of sources that suggest the threat is present and ongoing.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with misaligned community perceptions with respect to each Regional Asset has been determined. They are listed in Table 18 below.

Table 18: Prospective Priority of Action to address Misaligned Community Perceptions

Regional Asset	Priority of Action	Summary Logic
Rivers	MEDIUM	To be documented
Wetlands	MEDIUM	To be documented
Threatened Species and Communities	MEDIUM	To be documented
Terrestrial Habitat	MEDIUM	To be documented
Soils	MEDIUM	To be documented
Agricultural Land	MEDIUM	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	MEDIUM	To be documented
Community Capacity	MEDIUM	To be documented

Inappropriate Fire Regimes

Fire is an ongoing challenge for land managers and communities alike. Fire is also a major force determining the structure, function and sustainability of Australia's ecosystems. A substantial proportion of Australia's unique biota is dependent, to varying degrees, on fire and the variety of fire regimes for its continued existence and development. In this context, inappropriate fire regimes can mean either too little or too much fire

There is insufficient quality and quantity of data available to adequately describe the nature and level of impact resulting from this threatening process on this catchment asset at this time.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with inappropriate fire regimes with respect to each Regional Asset has been determined. They are listed in Table 19 below.

Table 19: Prospective Priority of Action to address Inappropriate Fire Regimes

Regional Asset	Priority of Action	Summary Logic
Rivers	NONE	To be documented
Wetlands	NONE	To be documented
Threatened Species and Communities	LOW	To be documented
Terrestrial Habitat	LOW	To be documented
Soils	NONE	To be documented
Agricultural Land	NONE	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	NONE	To be documented
Community Capacity	NONE	To be documented

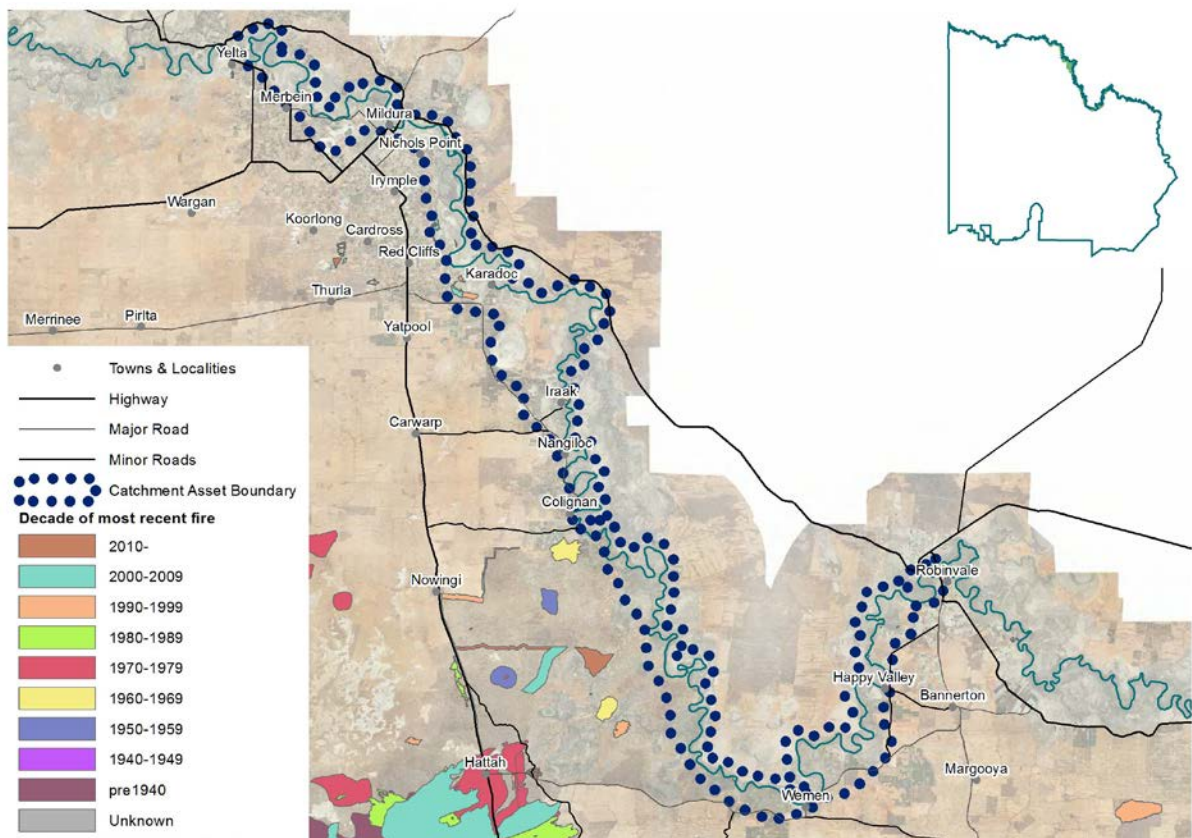


Figure 16: Fire History

Constrained Regenerative Capacity

The decline in vegetation cover and habitat complexity within remnant native vegetation can constrain or prevent regeneration which can lead to loss of habitat in the longer term. There are many contributors to this threatening process including weed invasion, excess grazing pressure, and habitat fragmentation. Loss of understorey flora and associated fauna are a possible outcome, also leading to a reduction in the capacity of the remnant to support flora and fauna species or maintain current population numbers, thus impacting on the biodiversity value of the asset.

Habitat fragmentation is one useful indicator of constrained regenerative capacity. A high level of fragmentation will severely limit the capacity of a vegetation community and the ecology it supports to maintain its health and reproductive capacity. It will also hamper our efforts to improve the health and condition of remnant landscapes at a broad scale due to the level of additional resources that each remnant patch would require (such as restoration or revegetation) rather than being able to simply protect the remnant (through fencing and invasive species control) and then rely upon its own internal regenerative resources to bring about an improvement in health and condition.

Modelling of habitat fragmentation using a spatial tool (Vogt, et al. 2007) can demonstrate the level of habitat fragmentation of a landscape. Using a combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with constrained regenerative capacity with respect to each Regional Asset has been determined. They are listed in Table 20 below.

Table 20: Prospective Priority of Action to address Constrained Regenerative Capacity

Regional Asset	Priority of Action	Summary Logic
Rivers	MEDIUM	To be documented
Wetlands	MEDIUM	To be documented
Threatened Species and Communities	MEDIUM	To be documented
Terrestrial Habitat	MEDIUM	To be documented
Soils	NONE	To be documented
Agricultural Land	NONE	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	NONE	To be documented
Community Capacity	NONE	To be documented

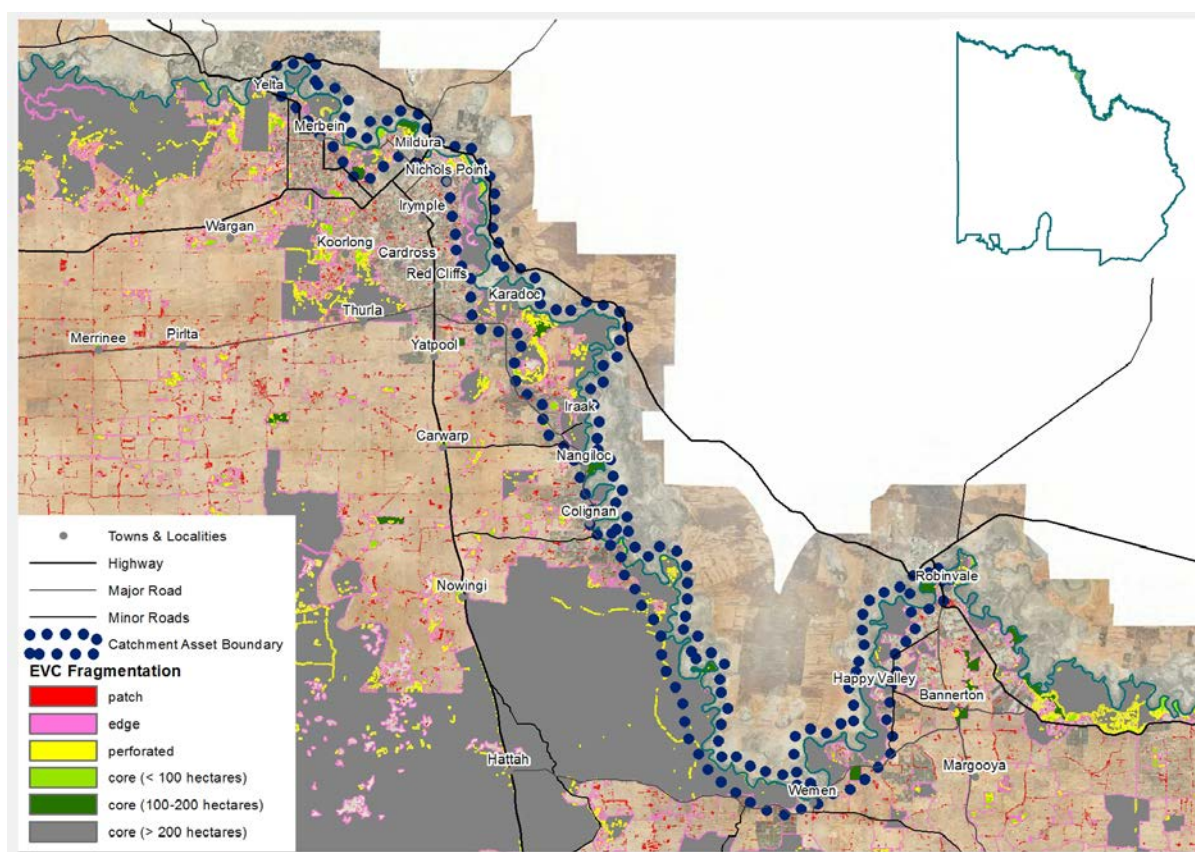


Figure 17: Habitat Fragmentation

Section 4 – References & Appendices

References

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- Vogt, P., K. Riitters, C. Estreguil, J. Kozak, T. Wade, and J. Wickham. "Mapping spatial patterns with morphological image processing." *Landscape Ecology* 22, 2007: 171-177.

1. The Value of Regional Assets within a Catchment Asset

The Regional Asset value indicates the relative importance of the Regional Asset within the Catchment Asset Area. The valuation is determined from a range of indicators, many specific to each of the Regional Assets, that describe the importance of the Asset relative to social, economic and environmental values. One common example of an indicator of asset value is legislative significance which provides an indication of whether part or all of a Regional Asset is of significance at a local, regional, State, National or international level. These indicators were grouped and scored by consensus against agreed criteria and then each Regional Asset within the Catchment Asset was assigned a category that defines the prospective asset value and relative importance of and priority for maintaining or improving the value of the Asset.

Five category levels were identified:

None – indicates that the Regional Asset is unknown or not present within the Catchment Asset area.

Low – indicates that the Regional Asset is of relatively low status or importance within the Catchment Asset area. It may also indicate that there is insufficient knowledge or data available to define or quantify the asset value and therefore prioritise it with confidence. Further research may be required to rectify this situation.

Medium – indicates that the Regional Asset is locally or regionally important but relatively well known or secure at the Catchment Asset scale. This may be due in part to previously successful management interventions. Ongoing monitoring may be required as will some level of intervention (particularly at a local scale) to ensure previous management gains are not lost.

High – indicates that the Regional Asset within the Catchment Asset Area is of significance at a regional, State or National scale and that action is likely required over the life of the RCS in order to maintain or improve the value of the Regional Asset within the Catchment Asset Area.

Very High - indicates that the Regional Asset within the Catchment Asset Area is of significance at a National or international scale and that action is likely required over the life of the RCS in order to maintain or improve the value of the Regional Asset within the Catchment Asset Area.

2. Categorising Threatening Processes

The categorisation of the threatening processes in order to prioritise management actions was based on the current scope and scale of the impacts arising from the threatening process along with consideration of potential future impact of the threatening process. The categorisation was based on consensus against agreed criteria. Each threatening process acting upon each Regional Asset was assigned a category that defines the prospective priority of action to address that threatening process.

Four category levels were identified:

None – indicates that either the threatening process, or the regional asset itself, is unknown or not present within the catchment Asset area.

Low – indicates that, while the threatening process is known to be present, it is at a low level or the Regional Asset itself is not overly susceptible to or impacted by the threat. It may also indicate that there is insufficient knowledge or data available to define or quantify the interaction between the asset and the threatening process and therefore prioritise it with confidence. Further research may be required to rectify this situation.

Medium – indicates that the threatening process is real but that the Regional Asset is not under immediate threat at the Catchment Asset scale. This may be due to previously successful interventions. Ongoing monitoring will be required as will some level of intervention (particularly at a local scale) to ensure previous management gains are not lost.

High – indicates that: there is a high level of potential harm to the Asset as a result of the threatening process; there are a variety of management actions available that are known to be successful at reducing harm and which are generally supported by land managers; and that action is required over the life of the RCS in order to prevent further impact as a result of the threatening process.

3. Management Plans Relevant to this Catchment Asset

Table 21: Management Plans Relevant to this Catchment Asset

Name	Type	Author/Owner	Year
North West Region Mildura Fire District Fire Protection Plan	Management Plan	Department of Sustainability & Environment	2008
Robinvale to Merbein Murray River Frontage Action Plan	Management Plan	Mallee Catchment Management Authority	2003
Victorian Mallee Irrigation Area Land and Water Management Plan (Draft)	Management Plan	Mallee Catchment Management Authority	2011
The River Murray Channel Icon Site Environmental Management Plan 2006-2007	Management Plan	Murray Darling Basin Authority	2006
Hattah Lakes Environmental Water Management Plan 2012	Management Plan	Murray Darling Basin Authority	2012
Mallee Parks Management Plan	Management Plan	Parks Victoria	1996
Kings Billabong Management Plan 2008	Management Plan	Parks Victoria	2008
Murray Riverfront Reserves Management Plan (2011-15)	Management Plan	Sunraysia Environmental for Mildura Rural City Council	2010
Wetland Management Plan for Constructed and Naturally Occurring Wetlands in the Swan Hill Municipality 2006-2008	Management Plan	Swan Hill Rural City Council	2006
Swan Hill Rural City Council Plan 2009-2013	Management Plan	Swan Hill Rural City Council	2009
Swan Hill Rural City Council Roadside Management Plan 2007-2009	Management Plan	Swan Hill Rural City Council	2007
Swan Hill Rural City Council Strategic Linkages Plan 2008 – 2011	Management Plan	Swan Hill Rural City Council	2008
Northern Region Sustainable Water Strategy	Strategy	Department of Sustainability & Environment	2009
Mallee River Health Strategy 2005	Strategy	Mallee Catchment Management Authority	2006
Mallee Wetland Strategy 2006-2011	Strategy	Mallee Catchment Management Authority	2006
Mildura Rural City Council Significant Linkages Strategy 2007	Strategy	Mildura Rural City Council	2007
Mildura Rural City Council Sunraysia Remnant Linkage Strategy	Strategy	Mildura Rural City Council	2003
Sunraysia Drainage Strategy	Strategy	Mildura Rural City Council	2002

Native Fish Strategy for the Murray-Darling Basin 2003-2013	Strategy	Murray Darling Basin Authority	2003
Mallee Invasive Plants and Animals Management Strategy	Strategy	Mallee Catchment Management Authority	2011
Robinvale-Annuello Landcare Group Action Plan 2012-2017	Action Plan	Robinvale-Annuello Landcare Group	2012
National Recovery Plan for the Murray Cod <i>Maccullochella peelii peelii</i>	National Recovery Plan	Department of Sustainability & Environment (Victoria)	2010
National Recovery Plan for the Murray Hardyhead <i>Craterocephalus fluviatilis</i>	National Recovery Plan	Department of Sustainability & Environment (Victoria)	2008
National Recovery Plan for the Yellow Swainson-pea <i>Swainsona pyrophila</i>	National Recovery Plan	Department of Sustainability & Environment (Victoria)	2010
National Recovery Plan for the Regent Parrot (eastern subspecies) <i>Polytelis anthopeplus monarchoides</i>	National Recovery Plan	Department of Sustainability & Environment (Victoria)	2011
Flora & Fauna Guarantee Action Statement White-bellied Sea-eagle <i>Haliaeetus leucogaster</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2003
Flora & Fauna Guarantee Action Statement Spotted Bowerbird <i>Chlamydera maculata</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2003
Flora & Fauna Guarantee Action Statement White-browed Treecreeper <i>Climacteris affinis</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2003
Flora & Fauna Guarantee Action Statement Bush Stone-Curlew <i>Burhinus grallarius</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2004
Flora & Fauna Guarantee Action Statement Major Mitchell's Cockatoo <i>Cacatua leadbeateri</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2004
Flora & Fauna Guarantee Action Statement Freckled Duck <i>Stictonetta naevosa</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2004
Flora & Fauna Guarantee Action Statement Barking Owl <i>Ninox connivens</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2004
Flora & Fauna Guarantee Action Statement Great Egret <i>Ardea alba</i> Intermediate Egret <i>Ardea intermedia</i> Little Egret <i>Egretta garzetta</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2001
Flora & Fauna Guarantee Action Statement Twelve threatened Swainson-peas and Darling-peas (<i>Swainsona</i> species)	Action Statement	Department of Sustainability & Environment (Victoria)	2003
Flora & Fauna Guarantee Action Statement Mildura Ogyris <i>Ogyris subterrestis subterrestis</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2003
Flora & Fauna Guarantee Action Statement Blue-billed Duck <i>Oxyura australis</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2003
Flora & Fauna Guarantee Action Statement Inland Carpet Python <i>Morelia spilota metcalfei</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2003
Flora & Fauna Guarantee Action Statement Painted Honeyeater <i>Grantiella picta</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2003
Flora & Fauna Guarantee Action Statement Freshwater Catfish <i>Tandanus tandanus</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2005
Flora & Fauna Guarantee Action Statement Silver Perch <i>Bidyanus bidyanus</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2005

4. Management Action Definitions

Management Action Category	Management Action	Definition	Threatening Processes Addressed
On-ground Works	Pest Plant Control	Control and eradication of pest plant species	Invasive Plants; Constrained Regenerative Capacity
	Pest Animal Control	Control and eradication of pest animal species	Invasive Animals; Soil Erosion; Constrained Regenerative Capacity
	Habitat Protection	Habitat protection through exclusion fencing or other physical means	Invasive Animals; Soil Erosion; Recreational Pressure; Land Use Change; Direct Off-Site Interactions; Constrained Regenerative Capacity
	Habitat Restoration	Restoration of degraded terrestrial habitat by planting vegetation	Land & Water Salinisation; Soil Erosion; Recreational Pressure; Direct Off-Site Interactions; Constrained Regenerative Capacity
	Revegetation	Re-creation of terrestrial habitat by planting vegetation (e.g. new wildlife corridor plantings)	Land & Water Salinisation; Soil Erosion; Recreational Pressure; Direct Off-Site Interactions; Constrained Regenerative Capacity
	Environmental Watering	Delivering environmental water to wetlands and floodplains; maintaining appropriate watering regimes	Altered Hydrological Regimes; Constrained Regenerative Capacity
	Soil Erosion Control	Control of soil erosion through engineering works and other structures	Soil Erosion
	Threatened Species Interventions	Interventions to improve outcomes for threatened species and ecological communities	Constrained Regenerative Capacity
	Enhancing Land Management Regimes	Interventions to enhance land management regimes on both public and private land (e.g. water use efficiency on irrigated land; maintaining appropriate soil cover in dryland agriculture; improved management or protection regimes)	Land & Water Salinisation; Soil Erosion; Inappropriate Water Use Practises; Land Use Change; Direct Off-Site Interactions
Capacity Building	Supporting Human Capacity for NRM	Provision of new skills and training in NRM; Delivery of publicity and awareness raising paraphernalia	All
	Supporting Institutional Capacity for NRM	Development and support of regional partnerships between institutions with a stake in NRM	All
	Supporting Social Capacity for NRM	Supporting community organisations that have a stake in NRM by aiding	All

		governance and provision of material	
NRM Planning	Institutional Planning for NRM	Development and implementation of NRM planning by regional institutions. Examples include institutional NRM plans, regional asset plans and sub-strategies	All
	Community Driven Planning for NRM	Development and implementation of NRM planning by community based organisations. Examples include Landcare Group Action Plans.	All
	Landholder Driven Planning for NRM	Development and implementation of NRM planning by landholders. Examples include property management plans and conservation agreements	All
Knowledge Building	Research to improve knowledge	Any research or other work delivered to improve or expand current knowledge or fill knowledge gaps in any NRM topic relevant to regional assets	All
Asset Assessment	Asset condition monitoring and assessment	Monitoring and collection of data concerning indicators of regional asset condition and/or threatening processes impacting on regional assets; Efforts to determine and/or evaluate trends in the condition of assets or the scope and scale of threatening processes impacting on regional assets.	All

5. Management Actions from Existing Management Plans

Table 22: Management Actions from Existing Management Plans

Instrument	Management Action	Details
North West Region Mildura Fire District Fire Protection Plan	Supporting Institutional Capacity for NRM	Investing in integrated fire management to balance community needs with ecological requirements
	Research to improve knowledge	Determining appropriate ecological fire regimes
Robinvale to Merbein Murray River Frontage Action Plan	Pest Plant Control	reducing the impact of pest plants on frontages
	Pest Animal Control	reducing the impact of pest animals on frontages
	Habitat Protection	definition of camp sites using vehicle barriers; track rationalisation; removal of unused water diversion

		infrastructure; guidelines for new water diversion infrastructure; protect frontages and instream habitat with high biodiversity values; protect cultural heritage sites
	Habitat Restoration	Restore degraded frontages
	Revegetation	Restore degraded frontages
	Environmental Watering	Use watering to restore degraded frontages
	Supporting Human Capacity for NRM	education campaign for recreational users, grazing license holders; cultural heritage education activities
	Supporting Institutional Capacity for NRM	capacity raising and partnerships between regional authorities; Coordinate early detection and rapid control responses for new and emerging weeds
	Research to improve knowledge	R&D to improve knowledge of floodplain nutrient dynamics and effectiveness of measures to minimise sedimentation and nutrient inputs to Murray River
Victorian Mallee Irrigation Area Land and Water Management Plan (Draft)	Enhancing Land Management Regimes	improving water use efficiency; modernising infrastructure
	Supporting Human Capacity for NRM	Education and community awareness development on a range of land, water and biodiversity management issues
	Supporting Institutional Capacity for NRM	Maintaining partnerships and communication channels amongst regional and State partners
	Institutional Planning for NRM	Considerable (and diverse) planning and policy development to enhance water trading rules, improve efficiency of water use and incorporate environmental watering into the water management process
	Landholder Driven Planning for NRM	Whole farm planning for irrigation properties
	Research to improve knowledge	Various research topics on water use efficiency improvements and the potential impacts of irrigation on biodiversity and land use management
	Asset condition monitoring and assessment	waterway salinity, groundwater and irrigation drainage monitoring
The River Murray Channel Icon Site Environmental Management Plan 2006-2007	Pest Plant Control	Invasive species management
	Pest Animal Control	Invasive species management
	Habitat Restoration	restoration of fish passage through locks and weirs
	Environmental Watering	Regulating structures for specific wetlands and anabranches (exclude un-seasonal flows; improve wetting/drying regime)
Hattah Lakes Environmental Water Management Plan 2012	Habitat Restoration	Protect, and where appropriate enhance, ecosystem processes, habitats and species
	Environmental Watering	Maintain or seek to restore appropriate water regimes
	Threatened Species Interventions	maintain habitat for Freckled Duck, White bellied Sea-Eagle and Murray Hardyhead
Mallee Parks Management Plan	Pest Plant Control	reducing the impact of pest plants on native species and communities

	Pest Animal Control	reducing the impact of pest animals on native species and communities
	Habitat Protection	the existing diversity of native flora and fauna will be maintained, and a management regime of minimal disturbance adopted. Significant natural and cultural features will be given special protection
	Habitat Restoration	active revegetation in areas of localised extinction and rarity; adopting manipulative fire regimes where they can be demonstrated to be of value to the Parks' environments and ecosystems
	Revegetation	Wildlife corridors between the Parks and other major blocks of public land in the region will be established
	Environmental Watering	Restoring a more natural hydrological regime within all Parks
	Threatened Species Interventions	Manage Flora and Fauna Guarantee listed species and communities according to approved action statements
	Supporting Human Capacity for NRM	Numerous actions to assist visitors to discover, enjoy and appreciate the natural and cultural features of the Mallee Parks, and the value of National Parks and their management
	Supporting Institutional Capacity for NRM	Maintaining partnerships and communication channels amongst regional and State partners
	Research to improve knowledge	Encourage research on Mallee ecosystems, vegetation communities, and significant flora and fauna species
	Asset condition monitoring and assessment	Monitor control and rehabilitation programs
Kings Billabong Management Plan 2008	Pest Plant Control	Control and where possible eradicate pest plant species from the reserve
	Pest Animal Control	Control and where possible eradicate pest animal species from the reserve
	Habitat Protection	Protect indigenous flora and vegetation communities, particularly rare or threatened species: Protect and enhance indigenous fauna, particularly threatened species
	Habitat Restoration	Restore native vegetation in areas where non-indigenous plants have been removed
	Supporting Human Capacity for NRM	Promote and encourage visitors' discovery, enjoyment and appreciation of the reserve's natural and cultural values in a safe and appropriate manner through information, interpretation and education
	Supporting Institutional Capacity for NRM	Maintaining partnerships and communication channels amongst local and regional partners; Co-ordinate the delivery and implementation of actions from a range of similar plans such as the Frontage Action Plan
	Supporting Social Capacity for NRM	Liaise with local community groups and land holders and, as appropriate, involve them in relevant aspects of planning and managing the Parks
	Asset condition monitoring and assessment	Monitoring and evaluation of plan implementation
Murray Riverfront Reserves Management Plan & Action Plan (2011-15)	Pest Plant Control	Concerns the strip of riparian land between Sandilong Park near Mildura and Chaffey's Landing at Merbein, excluding the length of riverfront between the Mildura Marina and Lock 11
	Pest Animal Control	

	Habitat Protection	
	Habitat Restoration	
	Revegetation	
	Supporting Human Capacity for NRM	
	Supporting Institutional Capacity for NRM	
	Supporting Social Capacity for NRM	
	Institutional Planning for NRM	
	Asset condition monitoring and assessment	
Wetland Management Plan for Constructed and Naturally Occurring Wetlands in the Swan Hill Municipality 2006-2008	Pest Plant Control	Priority weed control
	Pest Animal Control	European Carp, Rabbit and Fox control
	Habitat Protection	Exclusion of stock and recreational access to habitat
Swan Hill Rural City Council Plan 2009-2013	Supporting Institutional Planning for NRM	Support development an implementation of various Council sub-strategies to benefit NRM
	Supporting Institutional Capacity for NRM	Development and support of regional partnerships between institutions with a stake in NRM
	Supporting Human Capacity for NRM	Informing & educating the community on sustainability and NRM issues
Swan Hill Rural City Council Roadside Management Plan 2007-2009	Supporting Human Capacity for NRM	Informing & educating the community on NRM issues associated with roadside management
	Supporting Institutional Capacity for NRM	Provides benchmarks and processes for management of roadsides; partnership arrangements for roadside management
	Institutional Planning for NRM	Preparation and implementation of local plans and laws to manage and protect roadside habitat
Swan Hill Rural City Council Strategic Linkages Plan 2008 – 2011	Habitat Protection	Exclusion of stock and recreational access to priority roadsides (Towan Plains-Nyah West; Meridian)
	Habitat Restoration	Restoration planting within priority roadsides (Towan Plains-Nyah West; Meridian)
	Revegetation	Revegetate to link discontinuous remnants along priority roadsides (Towan Plains-Nyah West; Meridian)
	Supporting Human Capacity for NRM	Informing & educating the community on NRM issues associated with roadside management
	Supporting Institutional Capacity for NRM	Partnership arrangements for roadside management; Development and implementation of local planning arrangements
	Landholder Driven Planning for NRM	Supporting and promoting establishment of covenants on neighbouring habitat to along priority roadsides (Towan Plains-Nyah West; Meridian)

	Asset condition monitoring and assessment	condition of habitat along priority roadsides (Towan Plains-Nyah West; Meridian)
Northern Region Sustainable Water Strategy	Environmental Watering	A range of policies and actions at a regional scale that are intended to support environmental water actions
	Supporting Institutional Capacity for NRM	A range of policies and actions that support institutional partnership arrangements to improve bulk water management for irrigators, consumers and the environment
	Asset condition monitoring and assessment	Water quality and quantity monitoring in surface and groundwater resources; ecological monitoring of rivers and wetlands
Mallee River Health Strategy 2005	Pest Plant Control	Planning, coordination and implementation of priority weed control programs
	Pest Animal Control	Planning, coordination and implementation of priority pest control programs
	Environmental Watering	A range of policies and actions at a regional scale that are intended to support environmental water actions
	Supporting Institutional Capacity for NRM	Partnerships between State and regional organisations to close knowledge gaps and provide for co-ordinated implementation of a range of management plans relevant to this catchment asset
	Supporting Social Capacity for NRM	Community education via schools, Landcare and Waterwatch groups
	Research to improve knowledge	Numerous research topics to improve knowledge of river reaches and their ecological requirements within this catchment asset
Mallee Wetland Strategy 2006-2011	Pest Plant Control	Focus on willows and aquatic weeds
	Pest Animal Control	Focus on rabbits & carp
	Habitat Protection	Identification of priority sites; protection from stock grazing
	Habitat Restoration	Identification of priority sites with works to occur at five of them across the region
	Environmental Watering	Determine appropriate water regimes
	Threatened Species Interventions	Identify three priority species and implement key recommendations from their Action Statements or Recovery Plans as relevant to wetlands
	Supporting Human Capacity for NRM	Raising awareness and improving knowledge of wetland values and threats in the community; improving knowledge of indigenous wetland values
	Institutional Planning for NRM	preparation and implementation of local planning overlays and wetland management plans
	Research to improve knowledge	improve knowledge of wetland values and threats to those values
	Asset condition monitoring and assessment	Determine wetland condition; monitor responses arising from interventions
Mildura Rural City Council Significant Linkages Strategy 2007	Pest Plant Control	There are two identified corridors with components within this catchment asset: Karadoc Swamp (N4) and Regent Parrots (N5)
	Pest Animal Control	
	Habitat Restoration	

	Revegetation	
	Supporting Human Capacity for NRM	
	Supporting Institutional Capacity for NRM	
	Supporting Social Capacity for NRM	
	Landholder Driven Planning for NRM	
	Asset condition monitoring and assessment	
Mildura Rural City Council Sunraysia Remnant Linkage Strategy	Pest Plant Control	Focused on four zones within the asset: First is the Riverine zone from Chaffey Bend, Merbein to Cowra Ave, Irymple; second is the Merbein Common: third and fourth are the eastern Murray River ends of the Sunnycliffs and Red Cliffs zones
	Pest Animal Control	
	Habitat Restoration	
	Supporting Human Capacity for NRM	
	Supporting Institutional Capacity for NRM	
	Supporting Social Capacity for NRM	
	Asset condition monitoring and assessment	
Sunraysia Drainage Strategy	Habitat Protection	outlining how urban development and the existing irrigation development will be serviced with surface and sub-surface drainage to the year 2050
	Enhancing Land Management Regimes	
	Supporting Institutional Capacity for NRM	
	Institutional Planning for NRM	
Native Fish Strategy for the Murray-Darling Basin 2003-2013	Pest Animal Control	Control of carp and other alien fish
	Habitat Protection	protect key aquatic and riparian habitat; protect key linkages between floodplains and aquatic habitats
	Habitat Restoration	improve fish passage/water quality/key aquatic & riparian habitats
	Institutional Planning for NRM	preparation and implementation of species and fish community recovery plans
	Supporting Institutional Capacity for NRM	enhance knowledge of and partnership support for the Strategy
	Supporting Human Capacity for NRM	enhance knowledge of and support for the Strategy and native fish in general

Mallee Invasive Plants and Animals Management Strategy 2011	Pest Plant Control	prevent new introductions; contain high risk weed species
	Pest Animal Control	prevent new introductions; contain high risk pest animal species
	Supporting Human Capacity for NRM	improve community knowledge and awareness of invasive plants and animals and methods of control
	Supporting Institutional Capacity for NRM	support partnership arrangements between organisations with responsibilities for control and management of invasive plants and animals
	Supporting Social Capacity for NRM	Support community organisations carrying out targeted invasive plant and animal management with information, education, extension, enforcement and the identification of funding opportunities; Actively seek community participation and create partnerships with community groups in all IPA management project and programs
	Asset condition monitoring and assessment	monitor invasive plants and animals against both past interventions and for future actions;
National Recovery Plan for the Murray Cod <i>Maccullochella peelii peelii</i>	Environmental Watering	Develop and implement flow management practices to benefit recovery of Murray Cod populations
	Supporting Human Capacity for NRM	
	Supporting Institutional Capacity for NRM	
	Research to improve knowledge	
	Asset condition monitoring and assessment	
National Recovery Plan for the Murray Hardyhead <i>Craterocephalus fluviatilis</i>	Threatened Species Interventions	Establish and maintain the Murray Hardyhead in captivity; Establish new populations of Murray Hardyhead in the wild
	Supporting Human Capacity for NRM	
	Research to improve knowledge	
	Asset condition monitoring and assessment	
National Recovery Plan for the Yellow Swainson-pea <i>Swainsona pyrophila</i>	Threatened Species Interventions	ex-situ seedbank
	Supporting Human Capacity for NRM	increase community knowledge/support for conservation
	Landholder Driven Planning for NRM	encourage use of covenants or similar to protect populations found on private land
	Research to improve knowledge	

	Asset condition monitoring and assessment	
National Recovery Plan for the Regent Parrot (eastern subspecies) <i>Polytelis anthopeplus monarchoides</i>	Revegetation	filling gaps in and expanding width of known flyways
	Threatened Species Interventions	
	Supporting Human Capacity for NRM	Increase community involvement in the eastern Regent Parrot recovery program
	Supporting Institutional Capacity for NRM	
	Institutional Planning for NRM	
	Research to improve knowledge	
	Asset condition monitoring and assessment	
Flora & Fauna Guarantee Action Statement White-bellied Sea-eagle <i>Haliaeetus leucogaster</i>	Habitat Protection	buffers/barriers to protect nest sites from disturbance
	Supporting Human Capacity for NRM	community education
	Institutional Planning for NRM	incorporate suitable habitat into appropriate management plans in order to protect such habitat
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	Species population monitoring; threat status monitoring
Flora & Fauna Guarantee Action Statement Spotted Bowerbird <i>Chlamydera maculata</i>	Supporting Human Capacity for NRM	Extension and awareness raising to raise profile of species
	Asset condition monitoring and assessment	Monitor for presence in catchment asset
Flora & Fauna Guarantee Action Statement White-browed Treecreeper <i>Climacteris affinis</i>	Pest Animal Control	rabbit control in pine-buloke woodlands
	Habitat Restoration	restoration of degraded pine-buloke woodland core species habitat
	Supporting Human Capacity for NRM	training and extension to improve staff and community identification of species
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
Flora & Fauna Guarantee Action Statement Bush Stone-Curlew <i>Burhinus grallarius</i>	Pest Animal Control	Fox control in and near key habitat
	Supporting Human Capacity for NRM	Raise community awareness of species; target golf courses with remnant habitat with specific education and land management material
	Institutional Planning for NRM	Develop or amend planning scheme regulations to protect key habitat areas

	Landholder Driven Planning for NRM	Encourage and support a) fencing of remnant habitat; and/or b) the creation of covenants; to protect species on private land
Flora & Fauna Guarantee Action Statement Major Mitchell's Cockatoo <i>Cacatua leadbeateri</i>	Habitat Restoration	conserve and enhance species preferred habitat
	Supporting Human Capacity for NRM	Raise community awareness of species; training and extension to improve staff and community knowledge of species requirements
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
Flora & Fauna Guarantee Action Statement Freckled Duck <i>Stictonetta naevosa</i>	Threatened Species Interventions	wetland closures to hunting
	Supporting Human Capacity for NRM	hunter education
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	targeted searches
Flora & Fauna Guarantee Action Statement Barking Owl <i>Ninox connivens</i>	Supporting Human Capacity for NRM	Raise community awareness of species
	Supporting Institutional Capacity for NRM	Support municipal councils and other agencies responsible for land management in effectively managing species habitat
	Institutional Planning for NRM	Alter and update appropriate plans to reflect species ecology and habitat requirements
	Landholder Driven Planning for NRM	Encourage and support the creation of covenants to protect species on private land
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	targeted searches
Flora & Fauna Guarantee Action Statement Great Egret <i>Ardea alba</i> Intermediate Egret <i>Ardea intermedia</i> Little Egret <i>Egretta garzetta</i>	Environmental Watering	Maintain appropriate water regimes in wetlands and creeks systems
	Asset condition monitoring and assessment	Species population monitoring; threat status monitoring
Flora & Fauna Guarantee Action Statement Twelve threatened Swainson-peas and Darling-peas (Swainsona species)	Pest Plant Control	Control competing weeds in known populations
	Habitat Protection	Exclusion of stock and vehicular access to known habitat/populations
	Supporting Human Capacity for NRM	Raise community awareness of species
	Institutional Planning for NRM	prepare and implement management plans for public reserves containing species
	Landholder Driven Planning for NRM	Encourage and support a) fencing of remnant habitat; and/or b) the creation of covenants; to protect species on private land

	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	Species population monitoring; threat status monitoring
Flora & Fauna Guarantee Action Statement Mildura Ogyris Ogyris subterrestis	Habitat Protection	fencing to protect known habitat
	Habitat Restoration	restoration of degraded species habitat
	Threatened Species Interventions	reintroduction of species to Mildura Cemetery
	Supporting Human Capacity for NRM	Raise community awareness of species; training and extension to improve staff and community knowledge of species and its requirements
	Institutional Planning for NRM	Alter and update appropriate plans to reflect species ecology and habitat requirements
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	survey known populations annually
Flora & Fauna Guarantee Action Statement Blue-billed Duck Oxyura australis	Pest Animal Control	Fox control in and near key habitat
	Habitat Protection	Exclusion of stock and vehicular access to known habitat/populations; minimise disturbance through wetland closure etc.
	Supporting Human Capacity for NRM	Raise community awareness of species; target golf courses with remnant habitat with specific education and land management material
	Landholder Driven Planning for NRM	Encourage and support a) fencing of remnant habitat; and/or b) the creation of covenants; to protect species on private land
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	Species population monitoring; threat status monitoring
Flora & Fauna Guarantee Action Statement Inland Carpet Python Morelia spilota metcalfei	Habitat Protection	Exclusion of stock and vehicular access to habitat; management of recreation activities in preferred habitat
	Pest Animal Control	Rabbit and fox control
	Threatened Species Interventions	Numerous interventions to manage known populations
	Supporting Human Capacity for NRM	Raise community awareness of species
	Research to improve knowledge	Numerous research topics to improve knowledge on species and its requirements
	Asset condition monitoring and assessment	Species population monitoring

Flora & Fauna Guarantee Action Statement Painted Honeyeater <i>Grantiella picta</i>	Supporting Human Capacity for NRM	awareness raising to improve reporting rates
	Institutional Planning for NRM	update regional planning instrument to reflect species habitat requirements
	Research to improve knowledge	encourage university and other institutions to conduct appropriate ecological research
	Asset condition monitoring and assessment	survey known habitats
Flora & Fauna Guarantee Action Statement Freshwater Catfish <i>Tandanus tandanus</i>	Environmental Watering	provide for appropriate water regimes to suit species requirements
	Threatened Species Interventions	reintroductions
	Supporting Human Capacity for NRM	awareness raising of species status and means to minimise harm to species
	Institutional Planning for NRM	planning and prioritisation tools developed or modified
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	routine species population survey
Flora & Fauna Guarantee Action Statement Silver Perch <i>Bidyanus bidyanus</i>	Environmental Watering	provide for appropriate water regimes to suit species requirements
	Threatened Species Interventions	reintroductions
	Supporting Human Capacity for NRM	awareness raising of species status and means to minimise harm to species
	Institutional Planning for NRM	planning and prioritisation tools developed or modified
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	routine species population survey
Robinvale-Annuello Landcare Group Action Plan 2012-2017	Pest Plant Control	Wheel Catcus control
	Pest Animal Control	Rabbit and fox control; rabbit control in priority assets
	Habitat Restoration	restoration works in priority areas
	Supporting Human Capacity for NRM	Improve local knowledge about sustainable farming & NRM techniques
	Supporting Institutional Capacity for NRM	improve partnerships with local organisations eg Annuello CFA

6. Prioritising Potential Management Actions

Potential management action categories are prioritised in terms of:

- the value of a regional asset within the catchment asset area;
- the priority to address a threatening process to those values;
- the capacity of the management action to address the threatening process; and
- the level of investment (in both of time and money) required to exercise that capacity.

Individual management actions are grouped and scored by consensus against agreed criteria and then each potential management action group within the Catchment Asset is assigned to a category that defines the prospective priority to the implementation.

Four category levels were identified:

None – indicates that either the management action group not contained in management plans relevant to the Catchment Asset area or the targeted threatening processes that it addresses is unknown or not present within the Catchment Asset area.

Low – typically indicates either that the targeted threatening processes are of low priority within this Catchment Asset area or the management action category is known to be generally not effective at mitigating the threatening process. It may also indicate that there is insufficient knowledge or data available to define or quantify the effectiveness of the management action to mitigate the threatening process and therefore prioritise it with confidence. Further research may be required to rectify this situation.

Medium – typically indicates that the targeted threatening processes are of medium priority within this Catchment Asset area and the management action category is known to be generally effective at mitigating the threatening process and is within the region's capacity to implement over the life of the RCS. It may also indicate that there is some uncertainty with the effectiveness of the potential management action upon a high priority threatening process in terms of either the scale of the threat, the known capacity of the action or the investment required to exercise that capacity.

High – indicates that the targeted threatening processes are of high priority within this Catchment Asset area and the management action category is known to be effective at mitigating the threatening process and is within the region's capacity to implement over the life of the RCS and that action is required urgently in order to prevent further impact as a result of the threatening process.

7. Management Action Priorities

Threatening Processes Priority of Action

Table 23 below represents the findings of a group based analysis in June 2013 of the threat level posed by threatening processes upon Regional Assets within this Catchment Asset based on the criteria contained in Appendix 2. *Categorising Threatening Processes*. The bottom row of the table contains a median 'score' for the threat level posed by each of the threatening processes across the Catchment Asset. These 'scores' are the same as those shown in Table 2.

Table 23: Threatening Process Priority of Action Summary

	Land & water salinisation	Invasive Plants	Invasive Animals	Altered Hydrological Regimes	Soil Erosion	Inappropriate Water Use Practices	Recreational Pressures	Land Use Change	Direct off-site interactions	Misaligned community perceptions	Inappropriate fire regimes	Constrained regenerative capacity
Rivers	high	high	high	high	medium	high	high	high	low	medium	none	high

Wetlands	high	high	high	high	medium	high	high	high	low	medium	none	high
Threatened Species	medium	high	high	high	medium	high	high	high	low	medium	medium	high
Terrestrial Habitat	medium	high	high	high	medium	high	high	high	low	medium	medium	high
Soils	high	high	high	high	medium	high	none	high	low	medium	none	none
Agricultural Land	medium	high	high	high	medium	high	none	high	low	medium	none	none
Groundwater	none	none	none	none	none	none	none	none	none	none	none	none
Cultural Heritage	none	high	high	high	high	high	high	high	low	medium	none	none
Community Capacity	none	none	none	none	none	none	none	none	none	medium	none	none
ALL REGIONAL ASSETS	Medium	High	High	High	Medium	High	High	High	Low	Medium	Medium	High

Management Action Priority Matrix

The table below represents the findings of an integration and analysis of the following components:

- the threatening processes priority of action table shown above;
- the management actions from existing management plans shown in Table 22;
- knowledge and evidence supporting past successes (or otherwise) of various management actions in the Mallee or in this Catchment Asset area; and
- the likelihood of implemented management actions addressing or mitigating threatening processes over the life of the RCS.

The criteria used to apply a value to each management action against each Regional Asset is contained in Appendix 6. *Prioritising Potential Management Actions*. The far right column of the table contains a median 'score' for each the management action priority across the Catchment Asset. These 'scores' are the same as those shown in Table 3.

Table 24: Management Action Priority Summary

	Rivers	Wetlands	Threatened Species	Terrestrial Habitat	Soils	Agricultural Land	Groundwater	Cultural Heritage	Community Capacity	Across All Assets
Pest Plant Control	High	High	High	High	High	High	None	High	None	High
Pest Animal Control	High	High	High	High	High	High	None	High	None	High
Habitat Protection	High	High	High	High	High	Low	None	High	None	High

Habitat Restoration	Medium	Medium	Medium	Medium	Low	Low	None	Medium	None	Medium
Revegetation	Low	Medium	Low	Low	Low	Low	None	Medium	None	Low
Environmental Watering	High	High	High	High	High	Medium	None	High	None	High
Soil Erosion Control	Medium	Medium	Medium	Medium	Medium	Medium	None	High	None	Medium
Threatened Species Interventions	High	High	High	High	None	None	None	None	None	High
Enhancing Land Management Regimes	High	High	Medium	Medium	High	High	None	High	None	High
Supporting Human Capacity for NRM	Medium	Medium	Medium	Medium	Medium	Medium	None	Medium	Medium	Medium
Supporting Institutional Capacity for NRM	Medium	High	Medium	Medium	High	Medium	None	High	Low	Medium
Supporting Social Capacity for NRM	Medium	Low	Low	Low	Low	Medium	None	Medium	Medium	Medium
Institutional Planning for NRM	High	High	High	High	High	High	None	High	Medium	High
Community Driven Planning for NRM	Medium	Medium	Medium	Medium	Medium	Medium	None	Medium	Low	Medium
Landholder Driven Planning for NRM	Medium	High	High	High	High	High	None	High	Medium	High
Research to improve knowledge	High	High	High	High	High	High	None	High	Medium	High
Asset condition monitoring and assessment	High	High	High	High	High	High	None	High	Low	High

Therefore, the highest priority management actions within this Catchment Asset over the life of the Regional Catchment Strategy should be:

- Pest Plant Control;
- Pest Animal Control;
- Habitat Protection;
- Environmental Watering;
- Threatened Species Interventions;
- Enhancing Land Management Regimes;
- Institutional Planning for NRM;
- Landholder Driven Planning for NRM;
- Research to improve knowledge; and

- Asset condition monitoring and assessment.

Implementation of these actions should provide the greatest impact on the mitigation of the most concerning threatening processes within this Catchment Asset and make a significant contribution to the achievement of the expected outcomes of the Mallee Regional Catchment Strategy.

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