

Lake McLarty Nature Reserve

2008
Management Plan No 60



Department of
Environment and Conservation
Our environment, our future



 Conservation
Commission
WESTERN AUSTRALIA

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PART A: INTRODUCTION

The planning area is located on the Swan Coastal Plain approximately 90 km south east of Perth on the eastern side of the Harvey Estuary, within the Shire of Murray (see Map 1).

It comprises two ‘class A’ reserves; Reserve 39404 and Reserve 44978 (see Map 2). Together they cover 219 ha, and have the purpose of ‘Conservation of Flora and Fauna’. The reserves are vested in the Conservation Commission of Western Australia (Conservation Commission) and managed by the Department of Environment and Conservation (the Department, DEC). The management plan recommends that the two reserves be amalgamated (see section 9 *Land Tenure*) and officially named Lake McLarty Nature Reserve. For the purposes of this plan, they will be referred to as such.

Lake McLarty, a freshwater lake, is an integral part of the Peel–Yalgorup System, located south of Mandurah (CALM 1990). This system is one of the largest and most diverse estuarine complexes in Western Australia and includes examples of coastal saline, brackish and freshwater lakes, and marshes (such as Lakes McLarty, Mealup, Clifton and Preston). It is internationally important as a habitat and refuge site for waterbirds and was included on the List of Wetlands of International Importance in 1990 (Ramsar 1990), comprising Ramsar site number 482. The southern part of Lake McLarty was added to this Ramsar listing in 2001.

Lake McLarty, like other shorebird sites in Australia, lies within the geographical area known as the East Asian–Australasian Flyway. Migratory species which use the site are listed under the China–Australia Migratory Bird Agreement (CAMBA), the Japan–Australia Migratory Bird Agreement (JAMBA) and more recently, the Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA) (See section 7 *Obligations and Agreements*).

Lake McLarty is included as a wetland of national significance in the *Directory of Important Wetlands in Australia* (EA 2001), and is classified as a Conservation Category Wetland in the *Geomorphic Wetlands Swan Coastal Plain* dataset¹. In addition, Lake McLarty, together with Lake Mealup, was listed on the Register of the National Estate as part of the Peel–Harvey Estuarine System in May 1990, primarily for their significance to waterbirds (Department of the Environment and Water Resources 2007a).

Lake McLarty is a regionally significant wetland and a key site in Western Australia for birdwatching. It provides significant landscape value in a region of increasing residential development, and is an important site for educational and research opportunities.

¹ The Department’s Geomorphic Wetlands Swan Coastal Plain dataset is the peak custodial wetland dataset used to identify wetland resources on the Swan Coastal Plain. The Dataset displays the location, boundary, geomorphic classification and management category of wetlands on the Swan Coastal Plain.

1. MANAGEMENT PLAN AREA

This management plan includes Reserve number 39404, which covers the majority of Lake McLarty, and Reserve number 44978, which encompasses the southern area of the lake. Therefore throughout the plan any reference to Lake McLarty Nature Reserve will include Reserve numbers 39404 and 44978, as shown in Map 2².

2. KEY VALUES

Maintaining or enhancing the key values of the reserve is the major focus of this management plan. The objectives and strategies in the plan are targeted to ensure this is achieved (see *Management Summary Table*). The way in which these values relate to the auditing of the management plan is detailed in section 8 *Performance Assessment*.

The outstanding values of the Lake McLarty Nature Reserve are those that contribute to its listings, both as a Ramsar site and as a nationally important wetland. These values include that it:

- supports populations of bird species important for maintaining the biological diversity of the Swan Coastal Plain;
- provides a major refuge for migratory waterbirds, especially some rarer species favouring freshwater wetlands;
- is an internationally significant waterbird habitat which regularly supports one percent (or more) of the national populations of seven species of waterbird³; and
- is a rare or unique example of a natural or near natural wetland, characteristic of those that were once widespread on the Swan Coastal Plain.

(EA 2001, DEH 2003)

Other key values are:

- the importance of the reserve for the protection of threatened and priority fauna species;
- vegetation communities representative of those once widespread on the Swan Coastal Plain; and
- community involvement – the local ‘ownership’ and interest shown in Lake McLarty as demonstrated by the high level of volunteerism to undertake works and monitoring.

² The plan only covers the Lake McLarty Nature Reserve and does not include adjoining nature reserves, as funding was provided to the Swan Coastal District to investigate, through a management planning process, options for habitat management, particularly with regards to cattle grazing.

³ see Waterbirds in section 14 *Native Animals and Habitats*.

3. ECOLOGICAL CHARACTER⁴

Lake McLarty is one of the most ecologically important freshwater, seasonal lakes on the Swan Coastal Plain. It has been estimated that 80% of the original wetlands on the plain have been either lost or seriously degraded due to filling, clearing and other land use impacts since European settlement (Balla 1996). The closed heath vegetation community around the lake is representative of communities that were once more extensive on the coastal plain. When flooded, this community is particularly important for moulting avian species such as the Eurasian coot (*Fulica atra*). The emergent vegetation at Lake McLarty consists predominantly of some sedge margins which are important for breeding swans and other waterbirds. Small fragments of the introduced aquatic weed *Typha orientalis* also provide some habitat value.

Lake McLarty consistently supports a high number of waterbirds (Storey *et al.* 1997). The lake also supports a range of invertebrate species that provide an abundant food source to the numerous water and shorebirds that inhabit it. The current water regime at the lake creates suitable feeding habitats for palaeartic waders and is one of the few local lakes to support this pre-migration feeding (Craig *et al.* 2004). Over the past 25 years, the number of times over 20 000 waterbirds have been counted at Lake McLarty has increased.

Lake McLarty provides fresh water in summer for the birds of Peel Inlet and Harvey Estuary and supports a resident bird population, as well as a large number and variety of transequatorial shorebirds. In addition, occasional winter observations of red-necked stint (*Calidris ruficollis*), curlew sandpiper (*Calidris ferruginea*) and common greenshank (*Tringa nebularia*) indicate that when suitable habitat is available at the lake, it also provides habitat for first year migrants who remain in Australia over the Austral winter (Craig *et al.* 2004). Lake McLarty regularly supports more than one percent of the total Australian/world population of two Australian resident wader species, the red-necked avocet (*Recurvirostra novaehollandiae*) (5.1% of the Australian population) and red-capped plover (*Charadrius ruficapillus*) (1.6%), which qualifies it as being of international significance under Ramsar guidelines.

A total of 160 bird species have been recorded within the nature reserve, including 81 species of waterbirds, 31 and 36 of which are protected under the JAMBA and CAMBA respectively (M. Singor, *pers. comm.*). In total, 41 wader species have been recorded at Lake McLarty, of which 29 species are migratory waders that use the lake on a seasonal basis (M. Singor *pers. comm.*). Lake McLarty is the only wetland in the broader Lake McLarty system (comprising Lake McLarty, an unnamed swamp immediately north-west, Mealup Lake, 'Robert Bay Swamp'

⁴ Ecological Character is defined in the Ramsar Convention (Resolution IX.1 of the 9th meeting of the Conference of Parties to the Convention on Wetlands, Uganda, November 2005) as "...the combination of the ecosystem components, processes and benefits/services that characterise the wetland at a given point in time" (Lambert and Elix 2006).

and ‘Carraburmup Swamp’) in which the ruff (*Philomachus pugnax*) regularly occurs (albeit in low numbers) (DEH 2000b). Uncommon migratory waders, such as the long-toed stint and pectoral sandpiper, rest at the lake and it is also occasionally a drought refuge for ducks on the Swan Coastal Plain.

At the time of writing this management plan, the Department, in association with the Peel Harvey Catchment Council had commissioned the preparation of an Ecological Character Description (ECD) for the Peel-Yalgorup System Ramsar site. This is being done in accordance with the nationally agreed Framework for Describing the Ecological Character of Ramsar Wetlands (Department of the Environment and Water Resources 2006). ECDs typically consider all aspects of a wetland; its biota, hydrology, geomorphology, physico-chemistry and social, cultural and economic significance. The Commonwealth Department of Environment and Water Resources has provided part funding, with cash and in kind contributions from DEC, the Peel Harvey Catchment Council and the City of Mandurah.

The specific objectives for the Peel-Yalgorup System ECD have been summarised as follows:

- identify the ecosystem components and processes of the wetlands, and the ecosystem services they deliver;
- develop a conceptual model(s) that describes the ‘ecological character’ in terms of ecosystem components, processes and services;
- identify key ecological attributes that are impacted by threatening processes and “limits of acceptable change” for these attributes upon which management actions and monitoring can be based; and
- identify and summarise knowledge gaps in the data available for the wetlands.

4. REGIONAL CONTEXT

Lake McLarty is located within the Peel–Yalgorup System, which, at the time of writing, was one of only 12 Ramsar sites in Western Australia (Department of the Environment and Water Resources 2007b). At 26 530 ha (EA 2001), it is the largest Ramsar site in the south-west of Western Australia (Weaving 1999). The Peel–Yalgorup System includes the Peel Inlet, Harvey Estuary, Lakes Mealup and McLarty and the Yalgorup Lakes (Lake Clifton, Lake Preston, Duck Pond, Boundary Lake, Lake Pollard, Martins Tank, Lake Yalgorup, Lake Hayward, North and South Newnham Lake (Burbidge and Craig, 1996b). Although not listed in its own right, Lake McLarty alone meets the Ramsar criteria for international significance with respect to waterbirds⁵ (Burbidge and Craig 1996b).

⁵ Criterion 5: A wetland should be considered internationally important if it regularly supports 20 000 or more waterbirds. Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

The Peel–Yalgorup System is the most important area for waterbirds in south-western Australia, with more than 150 000 individuals recorded in February 1977 (DEH 2000b). The site is recognised as important habitat for species listed in JAMBA, CAMBA (Wetlands Conservation Society 1996) and ROKAMBA, and is an important regional resource for Western Australia. The Peel–Yalgorup System has been placed on the Register of National Estate (WA Government 1992).

The catchment of the Peel Inlet and Harvey Estuary is 11 300 km² and is mostly cleared (DEH 2000a). Land uses surrounding Lake McLarty within the Peel-Harvey Inlet catchment include:

- the Kooljerrenup Nature Reserve (Reserve number 23756), gazetted for the purpose of Conservation of Flora and Fauna, located to the south of the lake;
- Lake Mealup, which is located to the north of Lake McLarty. Part of Lake Mealup is contained within Lake Mealup Nature Reserve (Reserve No. 6627) and the balance is owned and managed by the Lake Mealup Preservation Society Inc.; and
- agricultural development zoned ‘special rural’ to the north-east, south-west and east, and residential development to the west.

The western side of the nature reserve is bordered by a rural – residential subdivision (Birchmont Estate). This subdivision has a minimum lot size of two hectares with an emphasis on “merging of development with the landscape” (Shire of Murray 2004). In order to conserve the rural environment, the Shire has stipulated that all trees and vegetation shall be retained unless their removal is authorised by Council. Other conditions include the requirement for a 92 000 L water storage tank prior to house construction (minimising the requirement for groundwater extraction) and for all drainage water generated within the estate, whether from roads or the land, to be contained on-site. Hence, adjoining land uses pose significant threat to the values of the reserve. To this end, the Department has prepared a *Good Neighbour Policy* (DEC 2007), to formally state its aim to build and maintain mutually beneficial relations with all of its neighbours, and to outline the way in which the Department deals with a range of cross-boundary management issues, including:

- weed and pest animal control;
- access and activities on Department-managed lands and waters;
- off reserve conservation;
- natural resource management;
- fencing;
- fire management; and
- community input to Department planning and operations.

Threats to Lake McLarty from the surrounding catchment include continued residential development, subsequent groundwater extraction, and the addition of nutrients to the lake system via groundwater or surface runoff (DEH 2000a). The completion of the Peel Deviation of the Kwinana freeway to the east of the lake (expected in 2009) will increase access to land within the catchment and facilitate further residential development, placing increased pressure on Lake McLarty (WAPC 1997).

PART B: MANAGEMENT DIRECTIONS AND PURPOSE

5. VISION

The vision for Lake McLarty Nature Reserve is:

To be recognised by the community for its international significance as a wetland providing refuge for both migratory waders and local waterbirds, and as a place where natural, cultural and aesthetic values are appreciated and protected. Natural systems and processes will continue to function, and habitats will be managed in partnership with the community to maintain and improve the lake's Ramsar and other natural values.

6. LEGISLATIVE FRAMEWORK

Legislation and Policies

Nature reserves are created under the *Land Administration Act 1997*, vested in the Conservation Commission and managed by DEC. The Department has prepared this management plan in accordance with the legislative specifications of the *Conservation and Land Management Act 1984* (CALM Act). The objective for management plans for nature reserves as defined in section 56 of the CALM Act is to '*maintain and restore the natural environment and to protect, care for and promote the study of indigenous flora and fauna, and to preserve any feature of archaeological, historic or scientific interest*'.

The Department is also responsible for administering the *Wildlife Conservation Act 1950* (Wildlife Conservation Act), which provides for the conservation and protection of indigenous flora and fauna on all lands and waters within the State.

There are a number of other Acts affecting the Department's activities or conferring specific powers on the Department. Some of these Acts are briefly described below.

Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes a legislative framework that allows the Commonwealth to manage environmental protection through an assessment and approvals process, and biodiversity conservation through species and site

listing, recovery and management planning. The ecological values of Ramsar wetlands are listed as a matter of national importance under this Act, as are migratory species listed under the Act, nationally listed threatened species and ecological communities, and the national heritage values of National Heritage places (Macintosh and Kennedy 2004).

The presence of the migratory birds protected under the JAMBA and CAMBA, and more recently ROKAMBA, affords the planning area additional protection under the EPBC Act. Any action that has, will have, or is likely to have a significant impact on a matter of National Environmental Significance (such as Ramsar wetlands and migratory species listed under international treaties) is required to undergo an environmental assessment and approvals process. This is likely to include, for example, land subdivisions in the surrounding area.

The EPBC Act also established standards for managing Ramsar wetlands through the Australia Ramsar Management Principles, which are stated as regulations under the Act. The Act describes the principles and guidelines for the management of Ramsar wetlands (EA 2001).

Environmental Protection Act 1986

The *Environmental Protection Act 1986* (Environmental Protection Act) provides for the prevention, control and abatement of pollution and environmental harm, and for the conservation, preservation, protection, enhancement and management of the environment. Activities that impact on wetlands, such as filling, draining, mining, discharges or clearing, are prohibited without authorization under this Act.

The *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* was developed under Part III of the Environmental Protection Act. The purpose of this policy is to protect the environmental values of lakes on the Swan Coastal Plain. The policy affords the protection of the ecosystem health of approximately 1100 specified wetlands on the Swan Coastal Plain, including the protection of the ecological structure, function and processes of the wetland, as well as the protection of the beneficial uses including its use for study, education, recreation, aesthetic enjoyment and the benefit of the public generally (EPA 1992). Hence, it protects the environmental values of Lake McLarty and prohibits any unauthorised filling, excavation or mining, drainage (into and out of the wetland), effluent discharge and alteration of water levels.

The *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* were developed under the Environmental Protection Act to ensure that any clearing of native vegetation is done under the authority of a permit, unless the clearing is for an exempt purpose. Exceptions do not apply in identified Environmentally Sensitive Areas⁶, of which Lake McLarty is one.

⁶ Environmentally Sensitive Areas are generally areas where the vegetation has high conservation value and cannot be cleared.

Aboriginal Heritage Act 1972

All registered sites within the planning area are protected under the *Aboriginal Heritage Act 1972* (Aboriginal Heritage Act). This Act also ensures the protection of places and objects customarily used by or traditional to, the original inhabitants of Australia. A register of such places and objects is maintained under the Act, however, all sites are protected under the Act whether they have been entered on the register or not.

Native Title Act 1993

The Commonwealth *Native Title Act 1993* (Native Title Act) requires that native title claimants and representative bodies be advised when a management plan is being prepared or major public works undertaken. The South-West Aboriginal Land and Sea Council is the native title representative body for the planning area and has a number of functions prescribed under the Native Title Act.

The following State and Commonwealth policies relate specifically to the management of wetlands:

Wetlands Policy of the Commonwealth Government of Australia 1997

This policy provides strategies to ensure that the activities of the Commonwealth Government promote the conservation, ecologically sustainable use and, where possible, enhancement of wetland functions. A principle aim is to ensure that the Commonwealth Government's actions are consistent with those expected under the Ramsar Convention and, in particular, to promote the adoption of Ramsar's 'wise use' principle for managing wetlands (ANCA 1997).

Wetlands Conservation Policy for Western Australia 1997

The *Wetlands Conservation Policy for Western Australia 1997* (Wetlands Conservation Policy) is the result of the Government's recognition of the fundamental importance of conserving and managing wetlands in a sustainable manner. It outlines the Government's commitment to identifying, maintaining and managing the State's wetland resources, including the full range of wetland values, for the long term, and identifies the agencies involved and their responsibilities. Under this policy, a Wetlands Coordinating Committee was established, with representatives from various agencies and community conservation groups, to facilitate interaction between management agencies, and coordinate the implementation of the policy and the activities of relevant agencies with respect to wetlands. This Committee is chaired by the Department and provides a forum for information exchange regarding the management of wetlands within Western Australia.

Departmental Policies

Policies of the Department specifically mentioned in this plan relate to the management of threatened species and ecological communities, weeds, fire, plant diseases, pest

animals, rehabilitation, recreation and tourism, community education and interpretation, community involvement and the Department's Good Neighbour policy. These policies are listed in the *Reference* section.

7. OBLIGATIONS AND AGREEMENTS

Australia is a participant of, and signatory to, a number of important international conservation agreements that influence the management of Lake McLarty by promoting consistent standards of management for wetlands. In becoming signatory to such agreements, Australia is committed to fulfill certain obligations in managing important wetlands. Such agreements include the Convention on Wetlands (Ramsar, Iran, 1971), JAMBA, CAMBA, ROKAMBA and the Convention on the Conservation of Migratory Species of Wild Animals.

The Convention on Wetlands (Ramsar, Iran 1971)

The Convention on Wetlands, (more commonly known as the Ramsar Convention), is an intergovernmental treaty dedicated to the conservation and 'wise use' of wetlands. It encourages Contracting Parties to designate sites containing representative, rare or unique wetland types, or that are important for conserving biological diversity to the list of Wetlands of International Importance (Ramsar sites). These sites need to be managed to ensure their species ecological values are maintained or improved. Australia became a Contracting Party in 1974. Lake McLarty, as part of the Peel–Yalgorup System Ramsar site, is included on this list.

The Peel–Yalgorup System Ramsar site meets four of the eight Ramsar criteria for listing:

1. includes the largest and most diverse estuarine complex in south-western Australia and also particularly good examples of coastal saline lakes and freshwater marshes;
3. is one of only two locations in south-western Australia and one of very few in the world where living thrombolites (a type of microbialite, superficially similar in appearance to stromatolites) occur in hyposaline water;
5. comprises the most important area for waterbirds in south-western Australia, supporting in excess of 20 000 waterbirds annually, with greater than 150 000 individuals recorded at one time (February 1977); and
6. regularly supports 1% of the population of at least six shorebirds: red-necked avocet (*Recurvirostra novaehollandiae*), red-necked stint (*Calidris ruficollis*), red-capped plover (*Charadrius ruficapillus*), banded stilt (*Cladorhynchus leucocephalus*), caspian tern (*Sterna caspia*) and fairy tern (*Sterna nereis*).

(DEH 2003)

The Ramsar Information Sheet for this site can be accessed via the webpage of the Department of the Environment and Water Resources at:

<<http://www.environment.gov.au/cgi-bin/wetlands/search.pl?smode=RAMSAR>>.

Under the Ramsar Convention, contracting parties must be informed at the earliest possible time if the ecological character of any wetland in its territory and included in the list of wetlands has changed, is changing or is likely to change as the result of technological developments, pollution or other human interference.

Japan–Australia Migratory Bird Agreement (JAMBA)/ China–Australia Migratory Bird Agreement (CAMBA)/ Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

Australia has signed treaties with Japan and China to protect migratory birds. The JAMBA and CAMBA treaties provide for co-operation between the respective governments to protect migratory species and their habitats. Lake McLarty supports a total of 31 and 36 JAMBA and CAMBA species respectively, which places it as the fourth highest-ranking wetland for these species in south-western Australia (Burbidge and Craig 1996a). It is also the highest-ranking non-estuarine site for these species in the south-west (Burbidge and Craig 1996a).

In December 2006 Australia entered into a further agreement with the government of the Republic of Korea (South Korea) for the protection of migratory birds. The agreement, known as the Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA) came into effect on 13 July 2007.

The text of the ROKAMBA is similar to the JAMBA and CAMBA agreements, requiring protection of migratory birds from take or trade, exchange of research information and publications, formulation of joint awareness raising activities, and participation in flyway cooperative activities. It includes a list of migratory birds, all of which are also included in JAMBA and/or CAMBA (Asia-Pacific Shorebird Network 2007).

Together these three agreements provide for bilateral cooperation with the countries responsible for key staging areas for migratory shorebirds in the East Asian-Australasian Flyway. The agreements also give a strong foundation for the conservation efforts of the recently launched East Asian-Australasian Flyway Partnership (Asia-Pacific Shorebird Network 2007).

Convention on the Conservation of Migratory Species of Wild Animals (Bonn, 1979)

The aim of the Convention on Migratory Species is to protect listed species across their entire migratory range. Australia has

been a Range State⁷ under this Convention since 1991. The Convention obligates contracting parties to take measures for the conservation of migratory species of wild animals listed under the Convention, and for which they are a range state. Migratory species listed under this Convention are a matter of national environmental significance under the EPBC Act's assessment and approval provisions.

8. PERFORMANCE ASSESSMENT

The Conservation Commission has the responsibility of auditing the implementation of this management plan and will measure the overall management performance and the effectiveness of it by assessing the Key Performance Indicators (KPIs) as listed in the *Management Summary Table*, and other parameters as appropriate. It is not efficient to measure all aspects of management given resource and technical impediments – consequently, indicators will target 'key' components of the plan. Key performance indicators are the minimum set of indicators that enable major trends and impacts on values to be determined. In the case of this plan, it includes evaluation of a measure and target, minimum reporting requirements and a management response to any target shortfall. These components provide a basis for adaptive management, whereby management is altered if necessary to meet a desired outcome.

The Department is responsible for providing information to the Conservation Commission to allow it to assess the success of the Department's management in meeting targets specified in the KPIs. The frequency of these reports will depend upon the requirements of each KPI, the satisfactory establishment of baseline information against which to audit, and any unforeseen changes to the environmental conditions. Where a report identifies a target shortfall, a response to the Conservation Commission is required. The response may identify factors that have led to the target shortfall, and propose alternative management actions where appropriate. The Conservation Commission will consider the Department's response on the target shortfall and evaluate the need for action in the context of its assessment and audit function under section 19(1)(g)(iii) of the CALM Act. The Conservation Commission will make the results of audits available to the public.

9. LAND TENURE

The planning area comprises two 'class A' nature reserves: Reserve number 39404, covering an area of 184.37 ha, and Reserve number 44978, covering 34.73 ha. Both have the purpose 'Conservation of Flora and Fauna' and are vested in the Conservation Commission and managed by the Department. They should be amalgamated into a single reserve of 219 ha.

⁷ A Range State is defined as any state that exercises jurisdiction over any part of the range of that migratory species, or a state, flag vessels of which are engaged outside national jurisdictional limits in taking that migratory species.

Although the planning area is commonly referred to as Lake McLarty Nature Reserve, it has never been named officially. It is recommended that the two consolidated reserves be officially named Lake McLarty Nature Reserve.

A gazetted road reserve marks the eastern boundary of the reserve, although it is not used and is currently vegetated (see Map 2). Due to the narrow vegetated buffer around the lake, the Department and the Conservation Commission believe the road reserve should be added to the conservation estate. Similarly, there is also a significant amount of vegetation on the private property adjacent to the eastern side of the nature reserve which effectively doubles the width of the vegetated buffer. Subject to reaching agreement with the owners, consideration should be given to acquiring these vegetated areas by direct purchase, or as a condition of subdivision if the current agricultural land is subdivided in future. In the meantime, the Department will actively encourage landowners to retain and/or enhance native vegetation on their properties through voluntary agreements.

In addition to the legislative requirements described in section 6 *Legislative Framework*, the Department and the Conservation Commission will recommend that any future subdivisions will be subject to the principle of net conservation benefit, and that environmental conditions to minimise environmental impacts should be duly placed on proponents. This could include:

- minimum setbacks of 100 m from the wetland boundary (as identified in the *Geomorphic Wetlands Swan Coastal Plain* dataset⁸ (DEC 2006c)) for any development (this distance may need to be increased, depending upon the threats posed by the adjacent land uses);
- requirements for vegetated buffers;
- retention or acquisition of native vegetation on private property contiguous with the reserve boundary, and revegetation requirements;
- limits to bore extraction on adjacent private property (e.g. maximum draw of 500 kL/annum as per Birchmont subdivision);
- large on-site water storage capacity for any developments;
- physical separation of private subdivisions and the reserve by a vehicle access track/road and dog-proof fencing;
- no public access to the reserve except at (1) clearly designated entrances through the fence and (2) on defined pathways; and
- incorporation of best management practices by adjacent landowners.

⁸ Geomorphic wetland boundaries have been determined in the dataset based on characteristics of soils, hydrology and vegetation and provides a more accurate representation of the wetland boundary than does the high water mark.

PART C: MANAGING THE NATURAL ENVIRONMENT

10. BIOGEOGRAPHY

The National Reserve System Program (NRS) was adopted to preserve Australia's native biodiversity on a regional scale, and initiate a protected reserve system that meets the world's best standards in terms of comprehensiveness, adequacy and representativeness (Thackway and Cresswell 1995). As a framework for developing this reserve system, the NRS initiated the Interim Biogeographic Regionalisation for Australia (IBRA), which provides a framework for conservation planning for a comprehensive, adequate and representative system of protected areas to conserve Australia's terrestrial biodiversity. The NRS divides Australia into 85 bioregions, each reflecting a unifying set of major environmental influences, which shape the occurrence of flora and fauna and their interaction with the physical environment. Twenty-six bioregions occur in WA (EA 2001).

Lake McLarty is located in the Swan Coastal Plain sub-region of the Swan Coastal Plain bioregion, a low-lying coastal plain, mainly covered with woodlands, which is dominated by banksia (*Banksia* spp.) or tuart (*Eucalyptus gomphocephala*) on sandy soils, swamp sheoak (*Allocasuarina obesa*) on outwash plains, and paperbarks (*Melaleuca* spp.) in swampy areas. In the east, the plain rises and is dominated by jarrah (*E. marginata*) woodland, while the outwash plains, once dominated by swamp sheoak-marri (*Corymbia callophylla*) woodlands and paperbark shrublands, are extensive only in the south (EA 2000).

At the time of writing this management plan, 10.39% of the Swan Coastal Plain sub-region was secure in conservation reserves⁹, with an additional 5.46% otherwise managed by the Department (mainly as State forest)¹⁰. Proposals in the *Forest Management Plan 2004–2013* (Conservation Commission 2004) will increase representation. The Swan Coastal Plain has the largest percentage of area cleared of any IBRA region in Western Australia (CALM 2003). Therefore it is vital to protect Lake McLarty Nature Reserve as it contains remnants of the native vegetation of this region.

The Peel–Yalgorup System is recognised as one of four internationally significant wetlands in the Swan Coastal Plain bioregion, with the smaller Lake McLarty System identified as one of 25 nationally important wetlands within the bioregion (CALM 2003).

⁹ Conservation Reserves tenure categories comprise State forest, timber reserve, national park, conservation park, nature reserve, marine nature reserve, marine park, marine management area, section 5(1)(g) reserve, section 5(1)(h) reserve, Executive Director freehold and miscellaneous reserve.

¹⁰ Tenure is current as of July 2007 and IBRA is version 6.1.

11. GEOLOGY, LANDFORM AND SOILS

Lake McLarty is a shallow, oval, medium-sized, freshwater lake with a gently sloping bottom. Open water covers a maximum area of approximately 2.1 km (north to south) by 1.25 km (east to west) (Craig *et al.* 2004). The lake lies in a natural drainage depression within the coastal plains and is isolated from the eastern shoreline of the Harvey Estuary (distance of 600 m) by a vegetated fossil dune ridge (Craig *et al.* 2004).

The lake is part of the 'Bibra' suite of wetlands which occur as a linear belt near the interface of the Bassendean and Spearwood dune systems on the Swan Coastal Plain (Semenuk 1988). The wetlands form as contact depressions with groundwater impounded against a Spearwood ridge (Environmental Capability 1995).

Lake McLarty is located within the Spearwood dune system and lies on the Cottesloe soil association. This association is characterised by shallow soils, with limestone frequently exposed near the surface (WAPC 1997). The Spearwood dune system is classified as having moderate agricultural potential, although productivity relies on large quantities of groundwater and added nutrients, particularly nitrogen and phosphorus (WAPC 1997).

The lake bed comprises a thin layer of silt which develops into a thicker layer (40 mm maximum) of silty mud at the northern end. This overlays a firm sand with shell fragment substrate (Craig *et al.* 2004).

Lake McLarty is classified as having a high to moderate acid sulphate soils disturbance risk. The land surrounding the lake is classified as low risk in shallow soils (0–3 m) and high to moderate in soils greater than 3 m in depth (DEC 2006a).

Acid sulphate soils are naturally occurring soils and sediments that contain sulfide minerals, predominantly pyrite (an iron sulfide). Below the watertable in an undisturbed state, these soils are benign. However, if the soils are drained, excavated or exposed by lowering the water table, the sulfides will react with oxygen to form sulfuric acid (DEP 2003). The acidic water which leaches from these soils is often high in arsenic and heavy metals. In addition, the oxidation of iron sulphide minerals (mainly pyrite) may make the soil extremely acidic (Appleyard 2005).

Disturbance of acid sulphate soils can cause ecological damage to aquatic and riparian ecosystems, contaminate groundwater with arsenic, aluminium and heavy metals and reduce agricultural productivity through metal contamination of soils (predominantly by aluminium) (DEP 2003). Once disturbed it is very difficult to stop the soils generating acidity with disturbed sites continuing to discharge sulfuric acid and metals into the environment for centuries (Appleyard 2005).

The land on the eastern side of the Harvey Estuary has previously been considered unsuitable for rural living purposes, as it is low lying with a high water table. However, development is already

occurring on the western side of Lake McLarty. This development will increase and demand for rural–residential subdivision on the eastern side of the lake is likely with completion of the Peel Deviation of the Kwinana Freeway.

There are currently no major threats to the soils or landforms of the nature reserve from active recreation as such activities are restricted to walking and nature appreciation.

12. WETLAND AND CATCHMENT PROTECTION

Hydrology

Lake McLarty, like the majority of the wetlands on the Swan Coastal Plain, is a surface expression of the groundwater with water levels rising and falling seasonally, depending on rainfall. Wetlands of the south-west of Western Australia are influenced by a Mediterranean climate. Within this climate regime, water levels generally rise during the wetter winter months and decrease dramatically in summer. This seasonal hydrological cycle creates biological, chemical and physical characteristics unique to the wetlands of the Swan Coastal Plain.

There is no natural surface drainage system for much of the Swan Coastal Plain as rainfall on the sandy soils rapidly permeates through the soil to the groundwater (WAPC 1996). There are no streams flowing into Lake McLarty.

The general gradient of the groundwater drainage patterns in the Peel–Harvey Catchment are via the slow westerly movement of groundwater from the scarp to the sea. This is relatively consistent across the Swan Coastal Plain (WAPC 1996). As evaporation and a reduction in groundwater levels reduce the water levels in the lake, the gradient of the groundwater moves to re-fill the lake from the east and west.

The eastern side of the lake within the Bassendean dune system is low lying, flat, poorly drained with high groundwater conditions. The groundwater can rise to, or above, the surface and waterlogging or flooding occurs. These groundwater conditions render the land less suitable for urban/housing development (WAPC 1996). Traditional approaches to alleviate waterlogging/flooding used subsoil drainage to lower the groundwater in development areas. However this approach was not appropriate and policies were introduced by the then Department of Environment to prevent lowering of the groundwater table (WAPC 1996).

Several drains that were constructed in the Lake McLarty area in the early 20th century have altered natural overland drainage into the lake. Drainage continued into the 1960s, when the drain on the southern side of the lake was constructed to enable the southern areas to be more viable for farming (G. Langley *pers. comm.*). The natural water system that ran into the lake from the east was blocked and diverted at time of drain construction. Prior to that time, much of the land surrounding the lake was inundated.

There is now one major drain associated with Lake McLarty. The drainage channel immediately to the south of the lake has been breached and diverted east-west. It is presumed that this channel was formed to reduce water levels in the lake and provide better conditions for pasture growth in adjacent areas (Environmental Capability 1995). The western section of the channel leads to the Harvey Estuary and the eastern section into farmland. In 1996 a weir was constructed on the western section of the channel to control water flow from the lake to the estuary, although it has never been opened. Apart from this recent change, the current hydrology regime has existed for at least 25 years (Craig *et al.* 2004).

Management of the drain and weir is the responsibility of the Department. Management of groundwater resources within the Peel Harvey Catchment is the responsibility of the Department of Water.

Managing Water Levels

Lake McLarty is located in the Peel Harvey Catchment within an area of predominantly winter rainfall (approx. 880 mm/annum) and with a high surface evaporation rate (approx. 1800 mm/annum, mainly in summer). Rainfall recorded adjacent to the lake averages 1082 mm/annum (G. Mathews, *pers. comm.*). The lake is marginally seasonal, drying out in most years for 1–5 months during late summer and autumn. The pattern of water level changes within the lake is predominantly dictated by local rains, both via a direct surface inflow and an increase in the water table (Craig *et al.* 2004).

The water levels of the lake have been monitored monthly on the western side of the lake by the Peel Preservation Group since 1996. Between 1996 and 2003, the average maximum depth of the lake was 1 m (B. Bucktin, *pers. comm.*). Between 1996 and 1999, the maximum depth usually occurred between August and September. However, between the years of 2000 and 2003, maximum depth was recorded in October (B. Bucktin, *pers. comm.*). When water levels are high (even at the lowest observed peak level), the lake floods well into the *Melaleuca* fringe and inundates the pastures immediately to the south (Craig *et al.* 2004).

Generally, rainfall within the Peel–Harvey Catchment decreases markedly from October and is insufficient to provide inflow to the lake. This, in combination with a high rate of surface evaporation and a lowering of the water table (as a result of high summer temperatures), results in a gradual decrease in the water levels of the lake (Craig *et al.* 2004).

The cycle of inundation and drying of the lake has varied significantly over the years in which the lake has been monitored. In 1988, fringing shrubs were inundated in spring, the lake was shallow (most less than 0.3 m) by late summer and dry for at least one month in autumn (Craig *et al.* 2004). More recently (in 2002 and 2003), the lake dried much earlier, in January and February, and remained dry for a longer period, six and five months respectively. Summer drying aids in reducing nutrient

cycling within the wetlands, thus reducing overall nutrient levels.

The timing of inundation and drying of Lake McLarty is important for bird species and bird numbers. Although the timing of lake drying was variable within the years of sampling, the low water levels and abundant food supply, required to ensure migratory waders build up body weight, were maintained (Craig *et al.* 2004).

The impacts of future development on land surrounding Lake McLarty on the hydrology of the lake is unknown. However there is potential for (a) an increase in groundwater extraction in the area surrounding the lake, (b) a reduction in natural groundwater inflows and (c) additional nutrients entering the lake, via the groundwater or as runoff. Changes in hydrology of the lake may result in premature drying or prolonged flooding, thus impacting on the feeding habitat of the waders. Lake McLarty's current water regime creates suitable feeding habitats for palaeartic waders and is one of the few local lakes to support this pre-migration feeding (Craig *et al.* 2004).

Conditions for residential development surrounding the lake prohibit the lowering of groundwater by subsoil drainage, with cost implications for development (WAPC 1996). The conditions of the 'special rural' subdivision to the west of the lake require all landowners to have a 92 000 L rainwater tank. As a comparison, the residential per capita consumption of water in the Perth metropolitan area in 2004/05 financial year was 296 L per day (Water Corporation 2007). Restrictions on groundwater extraction from domestic bores apply within the subdivision in relation to gardens and lawns, with a bore licence required from the Local Council. The flat topography and high groundwater table make drainage an important consideration in planning for residential development around the lake.

Groundwater levels at Lake McLarty are currently monitored twice annually by the Department of Water from four bores located within a three kilometer radius of the lake. The establishment of further monitoring bores within the subdivision and to the east of the lake is required to determine the impact of continued residential development on groundwater levels within the catchment.

Managing Water Quality

The water quality of Lake McLarty is influenced by groundwater and, during periods of high rainfall, runoff from surrounding land. Nutrients are added to the lake system as a result of runoff from adjacent land and due to the presence of cattle in the reserve. Water quality monitoring is currently undertaken on a monthly basis by the Peel Preservation Group (PPG), and at least twice a year by the Department.

Monthly monitoring by the PPG between 2001 and early 2004 indicated that the pH of the lake was within the normal range (7.0–8.5) (B. Bucktin *pers. comm.*) for a non-coloured wetland in southwestern Australia (DEH 2000a). Salinity of the lake

was highly correlated with water depth, with the average highest salinity recorded in summer and the lowest in winter. The levels of salinity at the lake ranged from 1350 mg/L in spring to 9300 mg/L in late autumn. The presence of samphire (*Sarcocornia* spp.) at the lake is an indicator that it may be becoming more saline (see section 15 *Environmental Weeds*). Continued water quality monitoring at the lake is essential to establish patterns/cycles in the water quality of Lake McLarty over time. Monitoring of water levels, dissolved oxygen, pH, salinity, presence of macroinvertebrates as well as total nitrogen, phosphorus and chlorophyll a would give a good indication of the health of the wetland system.

The Department has established a wetlands monitoring program in the south-west, as a component of the project "Wetlands Mapping, Classification and Evaluation Program for Priority Areas, SW Western Australia". The project, which includes Lake McLarty, is being conducted to establish baseline condition for a small selection of representative wetlands. The monitoring will be conducted every six months, in Autumn and Spring, and includes water quality, macroinvertebrates, waterbirds and vegetation.

Increased residential development on land surrounding the lake has the potential to increase nutrient runoff, from fertilisers and effluent disposal systems, thus affecting the water quality of the lake. Fertilisers have been applied to the land surrounding the lake to maintain pasture growth for cattle. Under the conditions of the Birchmont subdivision on the western side of the lake, the breeding or keeping of stock will not be permitted without the written approval of the Shire of Murray in consultation with the Department of Agriculture and Food. Given the soil structure, the western side of the lake is more able to sustain this land use than the eastern side.

A condition of the surrounding development is that any drainage waters generated within the subdivision will be contained on-site. In addition, public education through local and State Government agencies could assist in reducing over-fertilising and loss of nutrients to drainage. Environmental Capability (1995) advised that surrounding developments should be required to have alternative effluent disposal systems rather than conventional septic tanks and leach drains.

Establishing new and maintaining existing buffer vegetation is vital in assisting to maintain and improve water quality. A buffer will act as a filter and storage for nutrients, as well as providing a physical barrier to problem insects such as midges between the lake and surrounding development. To maximise buffers around the lake, fringing vegetation should be re-established in degraded areas such as the western and southern shorelines. Similarly, the Department will (1) seek to add the vegetated road reserve to the east of the nature reserve, and (2) liaise with landowners around the lake to maintain any existing vegetation on their private property. Consideration should also be given to including remnant vegetation on the eastern side of the lake as a conservation offset if agricultural land is subdivided in future (see section 9 *Land Tenure*).

Many of the ecological problems facing Lake McLarty and other lakes on the coastal plain relate to whole of catchment issues, with most of the 3072 km² catchment of the Swan Coastal Plain being cleared (Weaving 1999). Appropriate management of groundwater quality and levels is required throughout the Peel Harvey Catchment in order to ensure the health of Lake McLarty and the ecosystems it supports. Therefore involvement by the Department, the Shire of Murray, the Peel Harvey Catchment Council and local landholders is required to manage the whole catchment with an integrated approach.

In response to a history of high phosphorous levels in the Peel-Harvey catchment, the Environmental Protection Authority (EPA), with assistance and coordination provided by the Peel Harvey Catchment Council, is developing a Water Quality Improvement Plan (WQIP) for the Peel Harvey catchment (DEH 2006). The WQIP will be supported by the prescriptions in the ECD for the Peel-Yalgorup System Ramsar site.

Nearly 70% of the phosphorous discharges within the catchment come from agricultural activities (DEH 2006). Urban areas only account for six per cent of the land use by area but contribute more than 20 percent of the phosphorous inputs, predominantly from gardens, lawns and septic tanks (DEH 2006). The WQIP aims to reduce current phosphorous discharges from the Peel-Harvey coastal catchment by at least 48 percent in order to reach targets set by the EPA in 1992. It contains key recommendations to achieve load reductions, including:

- full connection of all current and future homes to reticulated sewerage or effective alternative onsite systems to replace existing septic tanks; and
- all new developments to incorporate water and nutrient sensitive design according to local planning policies.

(DEH 2006)

The Department will support such recommendations, particularly when commenting on development proposals on land adjoining Lake McLarty to minimise impacts of such developments on the lake.

13. NATIVE PLANTS AND PLANT COMMUNITIES

The vegetation communities of the Lake McLarty Nature Reserve have been identified as representative of types once more extensive on the coastal plain which are now of restricted occurrence elsewhere. However, the vegetation within the nature reserve has changed considerably over the last 60 years.

Between the years of 1951 and 1967 sections of the nature reserve near the Birchmont homestead were farmed. The southern section of the lake was cleared, burnt and ploughed for crops. This area was fenced and cattle grazed the remainder of the southern regions of the lake. During this time the western side of the lake was densely covered with bulrushes (species unknown) and the remainder of the lake was open water (G. Langley *pers. comm.*).

In 1981, a study of the lake indicated that the emergent vegetation comprised extensive stands of introduced bulrush (*Typha orientalis*) in the open water areas and broad areas of *Baumea* (including *B. articulata*) sedges along the margins (Craig *et al.* 2004). At this time, areas of open water only occurred at the north and south ends of the lake and the overgrowth of bulrush was considered a possible threat. A narrow fringe of low shrubs and paperbarks was most extensive at the northern end (Jaensch 1988). Little bottom vegetation was recorded at the lake until autumn 1997, when extensive growth, predominantly duckweed (*Lemna* sp.), was observed (Craig *et al.* 2004).

Gibson *et al.* (1994) classified the Lake McLarty Nature Reserve as a vegetation type representative of deeper wetlands (seasonally inundated to 1 m), dominated by species such as flooded gum (*Eucalyptus rudis*), freshwater paperbark (*Melaleuca raphiophylla*) and robin redbreast bush (*M. lateritia*). Average species richness was very low which was thought to reflect the long period of inundation of this wetland.

By 2001, it was reported that the lake floor was almost barren, with only fragments of *T. orientalis* remaining (Craig *et al.* 2004). Sedge margins had essentially disappeared, although strikes were recurring temporarily as the water receded in late summer (Craig *et al.* 2004). Since the reduction in sedges, sparse/short ephemeral grasses and weeds have colonised the newly exposed lake areas. The events contributing to the loss of sedges and reeds at the lake are not known.

The survey by Craig *et al.* (2004) describes stands of banbar (*Melaleuca teretifolia*) and freshwater paperbark fringing the northern and eastern margins of the lake, with an understorey of *Typha orientalis* in places. The south-western corner of the lake is dominated by pasture and the mid-western shore is an open eucalypt woodland with a grass understorey (Craig *et al.* 2004). Davis (2000) recorded Tuart woodlands on higher ground further from the lake.

A general survey of the lake's vegetation in 2004 listed approximately 30 plant species. This survey identified banbar as the dominant species within the fringing vegetation (R. Kerslake *pers. comm.*). Large tuarts and flooded gums persist on the western side, with swamp peppermints (*Taxandria linearifolia* ms¹¹) and tuarts located on the eastern side of the lake. Other species present include spearwood (*Kunzea glabrescens*), freshwater paperbark, golden-wreath wattle (*Acacia saligna*), peppermint (*Agonis flexuosa*) and sheoaks (*Allocasuarina* spp.).

Six species of orchid have been recorded in the nature reserve, including two species, pink fairy (*Caladenia latifolia*) and cowslip (*Caladenia flava*), that were observed in the southern and northern regions respectively (R. Kerslake *pers. comm.*). Emergent sedges and rushes were located on the western and eastern sides of the lake, predominantly *Juncus kraussi* and native and introduced bulrush species, with a proportion of the

¹¹ This species is considered to be a manuscript name, awaiting publication.

T. orientalis located in the centre of the lake (R. Kerslake *pers. comm.*). *T. orientalis* was also present in disturbed areas of the lake, such as the southern and eastern sides. Agricultural grasses and legumes found on neighbouring farms were recorded on the eastern and southern areas of the lake (see section 15 *Environmental Weeds*).

The western side of the lake has been highly degraded as a result of historical land use, with almost all of the original vegetation removed. In July 2003, this area was fenced and rehabilitated with native species that were grown from seed collected in the area. This rehabilitation to restore the fringing wetland vegetation was undertaken by the Peel Preservation Group, in conjunction with Pinjarra High School.

Rehabilitation has been successful with planted species becoming established and regeneration of native species occurring (see section 19 *Rehabilitation*), although weeds remain a problem. The presence of significant areas of marine couch (*Sporobolus virginicus*), a native ground cover, within this rehabilitation area is encouraging and likely a result of the exclusion of stock.

All native flora in Western Australia is protected under the Wildlife Conservation Act. Protected flora that is likely to become extinct or is rare or otherwise in need of special protection can be declared to be 'rare flora' under section 23F of the Wildlife Conservation Act, and is currently managed in accordance with the Department's proposed *Policy Statement No. 9 – Conserving Threatened Species and Ecological Communities* (subject to finalisation). In addition, species that either do not meet criteria for listing as threatened because of insufficient information, have been recently removed from the threatened list, or are near threatened and require monitoring are placed on the Department's Priority Flora list. Species on this list are grouped into Priority categories 1 through to 5 (where 1 is of highest priority).

There are no known records of rare or priority flora in the Lake McLarty Nature Reserve. However, two declared rare flora, one Priority 1¹², four Priority 3, three Priority 4 (rare taxa) species and two Threatened Ecological Communities (TECs) (one vulnerable and one endangered) are located in the adjacent Kooljerrenup Nature Reserve to the south. The Austin Bay Nature Reserve to the north of Lake McLarty also supports two TECs (vulnerable) and the McLarty Nature Reserve (A247329), to the north of Lake McLarty, contains closed heath which supports the uncommon plant species *Brachyloma pressii* (DEH 2003).

¹² Priority 1 species (poorly known taxa) are those that are known from one or a few (generally <5) populations which are under threat.

Priority 3 species (poorly known taxa) are those that are known from several populations and are not believed to be under immediate threat.

Priority 4 species (rare taxa) are those considered to have been adequately surveyed and while being rare (in Australia) are not currently threatened by any identifiable factors.

14. NATIVE ANIMALS AND HABITATS

Lake McLarty, along with nearby Lake Mealup, provides fresh water in summer for the birds of Peel–Yalgorup Inlet and Harvey Estuary and supports a resident bird population. The bed of Lake McLarty supports areas of sedge, which are important for breeding swans and other waterbirds (DEH 2003). On occasions between late spring and early summer, over 20 000 birds have been observed on a single day (Craig *et al.* 2004).

There has been one survey for invertebrates at Lake McLarty, conducted in the summer of 2000, which identified that the lake supports a high diversity of invertebrate fauna (Davis 2000). A total of 46 species of invertebrates were identified, which are an important food source for the waterbirds that use the lake (Davis 2000).

The Wildlife Conservation Act provides for the Minister for the Environment to declare native species as “...fauna which is likely to become extinct, or is rare, or otherwise in need of special protection”. Four species recorded at Lake McLarty – Carnaby’s black cockatoo (*Calyptorhynchus latirostris*), forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*), the Australasian bittern¹³ and the peregrine falcon (*Falco peregrinus*) – are afforded such protection.

The Department’s proposed *Policy Statement No. 9 – Conserving Threatened Species and Ecological Communities* (subject to finalisation) also provides for the recognition of ‘priority’ species. The masked owl (*Tyto novaehollandiae*) is classified a Priority 3 species (taxa with several, poorly-known populations, some on conservation lands). This classification identifies that additional research is required to determine true conservation status.

The chuditch (*Dasyurus geoffroii*), which is also classified as ‘rare or likely to become extinct’, is found in the Kooljerrenup Nature Reserve to the south of Lake McLarty.

Waterbirds

A total of 160 bird species have been recorded within the nature reserve, including 81 species of waders and other waterbirds, 31 and 36 of which are protected under the JAMBA and CAMBA respectively (M. Singor, *pers. comm.*). Forty-one wader species have been recorded at Lake McLarty, of which 29 species are migratory waders that use the lake on a seasonal basis (M. Singor *pers. comm.*). Recent counts of high numbers of waterbirds at the lake include 39 249 birds on 27 December 2002 and 31 256 on 16 January 2003 (M. Singor, *pers. comm.*). Lake McLarty is known to be an excellent place to observe waders in summer and is one of the best sites in south-western Australia.

¹³ The Australasian Bittern has only been recorded at Lake McLarty on one occasion, in November 1983 when it was heard calling. It has not been recorded there since and is no longer a resident or visitor there (M.Singor, *pers. comm.*).

The Ramsar Information Sheet (RIS) for the Peel-Yalgorup Ramsar site (DEH 2003) identifies six wader species which the site regularly supports significant populations of (see section 7 *Obligations and Agreements*). Four of these have been recorded at Lake McLarty: red-necked avocet (*Recurvirostra novaehollandiae*), red-necked stint (*Calidris ruficollis*), red-capped plover (*Charadrius ruficapillus*) and banded stilt (*Cladorhynchus leucocephalus*). More recent surveys at Lake McLarty have identified internationally significant populations of three additional species not listed in the RIS: black-winged stilt (*Himantopus himantopus*), curlew sandpiper (*Calidris ferruginea*), and sharp-tailed sandpiper (*Calidris acuminata*) (M. Singor, pers. comm.). It is anticipated that when the RIS for the Peel-Yalgorup System is next updated, this information will be incorporated.

Lake McLarty meets the criterion for national significance for at least 10 species: the seven named above as well as marsh sandpiper (*Tringa ategnatilis*), common greenshank (*T. nebularia*) and wood sandpiper (*T. glareola*). The long-toed stint (*Calidris subminuta*) and pectoral sandpiper (*C. melanotos*) do not have a minimum count criterion, although based on recent counts in the reserve, Lake McLarty is nationally significant for the long-toed stint. The lake has the highest counts of pectoral sandpipers from Australia (M. Singor pers. comm., Burbidge and Craig 1996b), and is regionally significant for at least 15 species of waterbirds. In addition, 14 waterbird species have been recorded breeding at various times at the lake between 1983 and 2006 (M. Singor pers. comm.).

The number of birds visiting the lake has increased since documented monitoring commenced in the early 1980s. Since an extensive survey of the waders and waterbirds at Lake McLarty was conducted by Jaensch *et al.* (1988) between 1981–85, the ecology of the lake has been significantly modified with the loss of extensive *T. orientalis* beds and *Baumea* sedge margins, leaving open water and mudflats (Craig *et al.* 2004). The disappearance of the lake's emergent vegetation has had an impact on the species of birds that visit the lake (Craig *et al.* 2004). For example little grassbirds (*Megalurus gramineus*), crakes and Australian reed warblers (*Acrocephalus australis*) have become less common in the reserve as the emergent vegetation has disappeared, although reed warblers are still common enough (M. Singor pers. comm.). However, although the diversity of species may have decreased slightly, the overall numbers of birds visiting Lake McLarty has increased since this original survey (from the late 1990s onwards). It should be noted that the number of birds potentially visiting the lake is subject to the size of migrating populations and global variations and trends.

Lake McLarty currently provides a range of habitats that support a variety of bird species at different times of the year. Habitats such as low rush-land interspersed with areas of open water or mud are important for feeding by long-toed stints, wood sandpipers, other uncommon waders, egrets and herons (Jaensch *et al.* 1988).

Exposed mudflats are an essential habitat and feeding ground for migratory waders, which use the lake as a mid-term and post-departure feeding site (Craig *et al.* 2004). Between the drying out of the lake and its re-filling as a result of the winter rains, the wader species present are restricted to Australian resident species such as the black-winged stilt (Craig *et al.* 2004). High water levels exclude migratory waders and as a result, these birds do not use the lake until weeks or months after their arrival in the area.

The southern part of the lake is consistently used by a large number of waterbirds, such as the glossy ibis (*Plegadis falcinellus*), yellow-billed spoonbill (*Platalea flavipes*) and royal spoonbill (*Platalea regia*)¹⁴, and including migratory waders (A.N. Burbidge *pers. comm.*). Resident Australian waders and migratory northern hemisphere species differ in their utilisation of the lake, but both use the lake as a non-breeding feeding ground and refuge area (Craig *et al.* 2004).

Cattle have grazed in the reserve since the 1880s. The Department has informally allowed this practice to continue as the cattle reduce the level of grasses surrounding the lake, and have, over a period of many years, effectively contributed to the creation of habitat for the range of waterbirds that now utilise the lake on a regular basis.

To ensure the continued presence and diversity of birds that utilise Lake McLarty, it is essential to protect the range of habitats that the lake provides. This could entail, for example, controlling the amount of both *Typha orientalis* and native emergent rushes and sedges to prevent excessive encroachment onto the lakebed. Reducing grass/weed levels surrounding the lake is also vital to ensure that exposed mudflats remain available for utilisation by wading birds.

A decline in the numbers of long-toed stint, wood sandpiper and to a lesser extent pectoral sandpiper and ruff has been recorded in recent years (Craig *et al.* 2004). However, the reduction in these species has not been restricted to Lake McLarty, with the long-toed stint and wood sandpiper showing a marked decline over the whole of the Swan Coastal Plain including Forrestdale Lake, Kogolup Lake and Thomsons Lake (Craig *et al.* 2004).

The opening of the Dawesville Channel in April 1994 significantly changed the water levels of the Peel-Harvey Estuary, thus reducing the accessibility of mudflats to smaller waders (Craig *et al.* 2004). This change may have contributed to the significant increase in numbers of red-necked stint and sharp-tailed sandpiper at Lake McLarty (Craig *et al.* 2004).

In addition, adverse environmental changes at wetlands in surrounding areas (such as the increase in salinity at Lake Mealup) may have contributed to the change in bird numbers. Disturbances from the Peel-Harvey Estuary such as power boats, jet-skis, fishing, crabbing and other recreational activities

¹⁴ These species did not originally occur in the south-west and have gradually extended their ranges since late in the 19th Century as a result (probably) of human-induced changes to habitat and climate change.

may have an impact on use of the lake by waterbirds. Given these impacts, and increasing salinity levels in Lake Mealup, there is greater emphasis on the regional importance of Lake McLarty for the resident bird population. Increased development and associated impacts (e.g. increased nutrient run-off, utilisation of groundwater resources, disturbance from people and pets) within the Lake McLarty catchment area has the potential to significantly impact on this important wetland ecosystem. These factors need to be considered when developing management strategies for the nature reserve.

Cattle

Cattle have been grazed within the area that is Lake McLarty Nature Reserve since the 1880s. Until recently, cattle from neighbouring properties continued to graze parts of the southern half of the reserve on an *ad hoc* basis. This practice had continued without a formal leasing arrangement with the Department. However, at the time of writing, cattle had not been in the reserve for a number of years, and opinions vary as to whether or not they should be reinstated.

The presence of cattle appears to have both positive and negative effects on the values of the reserve. Observations over the years indicate that there have been benefits from cattle in reducing the level of introduced grasses surrounding the lake, which has contributed to the creation and maintenance of suitable habitat (e.g. mudflats) for a range of waterbirds.

The long history of cattle grazing at Lake McLarty has contributed to its highly modified environment, which is how it was when it was nominated for, and gained, its Ramsar listing. Hence, it is acknowledged that cattle grazing was part of the process that contributed to these circumstances.

However, there are also negative impacts of grazing. Cattle can adversely impact wetland ecosystems through erosion, the introduction and spread of weeds, nutrient enrichment, grazing and trampling of native vegetation, and compaction of soil. Under the CALM Act and Regulations, cattle grazing would not generally be permitted within a nature reserve.

Possible alternatives to grazing as a means of maintaining habitat should be investigated by the Department, and should it be found that continued absence of cattle from Lake McLarty is preferable, other methods of weed control would need to be implemented. Otherwise the lake would most likely become a closed fen – much like Herdsmen Lake and the southern part of Lake Joondalup. Based on the knowledge gained from research elsewhere (e.g. Nilsson *et al* 1982, Nilsson 1985), the current grazing regime is likely to pose less risk to the habitat of the internationally significant waterbird species than would the immediate cessation of all grazing, the effect of which is currently unknown.

Department scientists are of the opinion that a scientific assessment of the impacts and benefits of cattle grazing should be undertaken before the use of grazing as a management tool

is disregarded. Consequently, closely monitored and restricted cattle grazing will be reinstated within parts of the nature reserve, in the short-term at least, to prevent loss of mudflat habitats until the impacts or other management options (to maintain habitat) are more fully assessed. These options include (a) regular slashing/mowing of the grass and (b) limited application of herbicide, both of which have constraints associated with them (see section 15 *Environmental Weeds*). Both of these would be undertaken in conjunction with a rehabilitation program.

Any grazing that does occur will only do so under a formal lease/licence, with cattle likely to be restricted to (i) specified areas in the southern and south-eastern part of the reserve and (ii) seasonal use; until the impact of this activity on the wetland system is better understood and a suitable, alternative method of effectively reducing levels of introduced grasses is identified. Allowing controlled grazing to occur within sections of the nature reserve will aid in determining the impact of cattle in the short-term on:

- waterbird populations;
- control of pasture grasses; and
- general vegetation and wetland health.

This will enable long-term decisions to be made about the ongoing use of cattle as a management tool in the nature reserve.

The area of the reserve to be grazed will be determined through negotiations with potential lessees and based on the suitability/viability for cattle to graze certain sections of the lake and habitat maintenance objectives. The lessee will be required to construct temporary fencing to contain the cattle. However, if necessary, the Department may contribute to the cost of this. Stipulations on the number of cattle permitted within the reserve will be outlined as part of the lease arrangements.

Invertebrates

Invertebrates are an essential component of wetland food webs, comprising much of the diet of waterbirds and waders. In addition, they may act as indicators for assessment of wetland health (Davis *et al.* 1993).

In the summer of 2000, an informal survey of the invertebrates was conducted at Lake McLarty (Davis 2000). Prior to this study, there had been no previous surveys conducted of invertebrates in or around the lake. Invertebrates were sampled from five locations around the lake so as to include free-swimming invertebrates from shallow and deep water, and core samples from throughout the lake. A total of 46 species of invertebrates were identified, seven species from the orders Ostracoda, Zygoptera and Diptera. These seven species were considered important due to their abundance in the lake and role in the food webs that exist within the lake community, providing abundant food for the numerous waterbirds and shorebirds that

inhabit Lake McLarty (Davis 2000). The more abundant and dominant species present were considered to provide a large proportion of bird diets over summer.

Further studies of the invertebrates at Lake McLarty are required as the previous survey was only undertaken at one point in time and the relative quality or health of the lake is difficult to establish. Summer sampling would also understate the number of invertebrate species present (Davis 2000). However, the productivity of the aquatic invertebrate fauna is considered high and capable of supporting a large waterbird population (Craig *et al.* 2004). It was hypothesised that the large numbers of birds present on the lake during summer months may be attributed to the abundant life that exists in the lake sediment and shallow waters near the lake edges, such as Chironomid (midge) larvae, other Diptera (fly) larvae and Coleoptera (beetle) larvae and adults (Davis 2000). The energy resources provided by invertebrates found in the lake are used by estuarine, inland and migratory birds.

The use of bio-indicators from single invertebrate orders may provide a useful means of biological monitoring (EPA 1987). Species such as damselfly nymphs (*Xanthagrion erythronurum*), aquatic beetles (*Berosus* spp.) and biting midge larvae (Ceratopogonidae), which are associated with healthy urban lakes, are present at Lake McLarty. These species are sensitive to changes in water quality and their abundance is a direct indication of the water quality status (EPA 1987).

15. ENVIRONMENTAL WEEDS

The *Environmental Weed Strategy for Western Australia* (CALM 1999) (Environmental Weed Strategy) describes environmental weeds as ‘... plants that establish themselves in natural ecosystems and proceed to modify natural processes, usually adversely, resulting in decline of the communities they invade’. Weeds displace indigenous plants, particularly on disturbed sites, by competing with them for light, nutrients and water. Some of their other impacts include the prevention of seedling recruitment, changes to soil nutrients, and changes to the abundance of indigenous fauna. They can also have a significant adverse impact on other conservation values by altering animal habitats, harbouring pests and diseases, and increasing fire hazard or changing fire regimes.

The Environmental Weed Strategy (CALM 1999) provides an integrated approach to weed management and rates environmental weeds as high, moderate, mild and low according to their potential invasiveness, distribution and environmental impacts. This rating system provides the basis for identifying control strategies, with the highest rated species and species that pose a threat to conservation values within the reserve, being the focus for weed management (see *Management Summary Table*). Further guidance for management is provided by the Department’s *Policy Statement No. 14 – Weeds on CALM Lands* (CALM 1986b) and proposed *Policy Statement – Environmental Weed Management* (subject to final consultation).

As the inter-relationship between soil disturbance, weed invasion and native plants is complex, weed control should be undertaken in a strategic and integrated manner with guidance from the Environmental Weed Strategy (CALM 1999). Rehabilitation of areas following weed removal is important to prevent re-invasion of weed species (see section 19 *Rehabilitation*).

A total of 13 weed species were identified during a survey within the Lake McLarty Nature Reserve in 2005 (R. Kerslake *pers. comm.*). According to the Environmental Weed Strategy, two of these species are High impact species (see below), seven Moderate, two Low, and two either unlisted or not rated (CALM 1999). Many of these weeds are pasture grasses and legumes that have encroached from neighbouring farm properties. The majority of the 13 weed species are located on the eastern side of the lake in areas where cattle have been allowed to graze. The spread of these weed species has been facilitated by the presence of cattle in the reserve. In addition, the increasing spread of goosefoot (*Chenopodium pumilio*) on the northern edge of the nature reserve, and the presence of samphire (*Sarconia* spp.) are indicators that these areas may be becoming more saline.

Great brome grass (*Bromus diandrus*) and introduced bulrush (*Typha orientalis*) are rated as high priority weed species and pose the greatest threat to native vegetation in the reserve. To date there have been no major control programs undertaken for either of these weeds. Great brome grass is a serious weed of pastures and crops in southern Western Australia (Hussey *et al.* 1997). Introduced bulrush is an aggressive coloniser in disturbed wetlands in the Swan Coastal Plain (Hussey *et al.* 1997) and has the potential to reduce the area of open water and exposed mudflats at Lake McLarty.

Exposed mudflats around Lake McLarty are an essential habitat and feeding ground for migratory waders. Colonisation and spread of *T. orientalis* around Lake McLarty has the potential to significantly displace and change fringing vegetation and hence alter waterbird habitat. To ensure the continued presence of waders at Lake McLarty, it is essential that the amount of *T. orientalis* be controlled to prevent encroachment onto the lakebed or lake edges. In addition, as the lake dries in the summer months, the *T. orientalis* dries creating a significant fire hazard. The current distribution *T. orientalis* around the lake provides shelter, nesting sites and a food source for birds and other wildlife, and acts as a buffer to nutrient input. Therefore its complete removal needs to be carefully considered and integrated with revegetation strategies incorporating *Typha* species that are endemic to the region.

Unlike Lake Mealup to the north where *T. orientalis* dominates the main lakebed, the distribution of *T. orientalis* at Lake McLarty is predominantly confined to the eastern and northern edges of the lake and is not currently considered a major threat. It is not clear why Lake McLarty has a reduced infestation of *T. orientalis* compared to Lake Mealup, although water levels may influence the current distribution patterns. Lake McLarty is generally deeper and holds water for a longer period throughout the year than Lake Mealup, which may reduce

conditions favourable for the establishment of *T. orientalis* (P. Wilmot *pers. comm.*). Mapping and monitoring the distribution of *T. orientalis* at Lake McLarty and initiation of appropriate control methods is required to ensure waterbird habitat is not lost (see *Management Summary Table*).

Weeds that are, or may be, a problem to agriculture or the environment can be 'declared' under the *Agriculture and Related Resources Protection Act 1976*. This Act stipulates that landholders with declared plants on their property are obliged to control them, although it also preserves the Department's right to determine priorities and the level of control according to resources. Cotton bush (*Gomphocarpus fruticosus*), a declared weed, was located in a small clump on the north-western side of the lake close to the road during the 2005 survey. Outbreaks of this weed have since been treated and removed. However, control and ongoing monitoring of its presence throughout the planning area is required over the life of this plan.

Pasture grasses dominate the terrestrial weeds at Lake McLarty, particularly in the more disturbed areas (western and southern sides) surrounding the lake. This is the result of use for rural activities and cattle grazing since the 1880s (see section 14 *Native Animals and Habitats*).

Priorities for weed control within the reserve are based on the principles and rankings of the Environmental Weed Strategy (CALM 1999), as well as their potential impacts on biodiversity at a local level. Other local concerns such as ongoing maintenance to limit the return of species previously controlled are also considered.

In the absence of cattle in the reserve, it is possible that pasture grasses will continue to proliferate and reduce the area of mudflat available to waterbirds. Hence, the plan emphasises the need to investigate other options for controlling these weeds, such as herbicide application and removal by mechanical means. However, there are constraints associated with both of these methods. The latter is labour intensive and expensive, requires frequent management action, and may in itself lead to further habitat degradation, while the former could have impacts on non-target species if not carefully applied or applied at the wrong time of year. Most herbicides should not be used near waterways and those that can, such as glyphosate, have been demonstrated in laboratory studies to be slightly toxic to birds, fish, invertebrates and mammals (United States Department of Agriculture, Forest Service 1995).

Suffice to say, herbicide use is acknowledged as an alternative control method for emergent vegetation. It is possible there may be a window of opportunity for the use of herbicide but as stated previously, further research into the benefits and/or impacts of this is needed before any such action would be undertaken in the reserve (see section 14 *Native Animals and Habitats*). That said, it is highly unlikely that it will be used at Lake McLarty over the life of this management plan.

Any weed control will be undertaken in conjunction with rehabilitation with native species. Rehabilitation of the western

and southern edges of the lake is planned. This will facilitate the re-establishment of native species in place of the numerous weed species that have dominated these areas in the past (see section 19 *Rehabilitation*).

16. INTRODUCED AND OTHER PROBLEM ANIMALS

Problem animals are those species that have the potential to cause serious impact on natural systems through direct effects such as predation, habitat destruction, competition for food and territory, introduction of disease and through environmental degradation (i.e. overgrazing). Problem animals can be either native species that are impacting on natural or agricultural values, or feral animals that are introduced species that have become established as wild or naturalised populations.

A primary objective of the Department is to achieve the systematic and safe control of pest animals on lands that it manages. The Department's proposed *Policy Statement – Management of pest animals on CALM-managed lands* (subject to final consultation) provides guidance for this by identifying State-wide priorities and strategic approaches to management.

Feral animals such as cats, rabbits and foxes, and domestic pets (cats and dogs) pose a threat to the ecosystems within the Lake McLarty Nature Reserve. There are also a number of acclimatised 'native' species present in the nature reserve that might compete with native fauna for nest hollows, such as galahs (*Cacatua roseicapilla*) and corellas (both long-billed and little) (*C. tenuirostris* and *C. sanguinea*)¹⁵. These species, and feral bee colonies, will be controlled when and as necessary in accordance with operational priorities, but at the time of writing this plan, were not deemed to be a significant problem at Lake McLarty.

A strategic approach to the management of any pest animal or assemblage of pest animals should be based on four key activities (after Braysher 1993):

- defining the level of damage to identified values and the reduction in pest animal density required to reduce or prevent the damage;
- developing clear objectives in terms of the desired conservation outcome, and developing options for pest animal management (e.g. local eradication, strategic management, crisis management and no management);
- implementing the favoured option: large-scale (regional) approaches to pest animal management is usually most effective but requires co-ordinated action by both private and Government land managers; and
- monitoring/evaluating the plan to assess the efficiency of any specific control operation.

¹⁵ Galahs and corellas (little and long-billed) are native species formerly not found on the Swan Coastal Plain.

Cats and foxes are efficient predators and can have a devastating effect on native fauna of the lake (WRC 2001). Historically oblong turtles (*Chelodina oblonga*) were prolific at the lake but appear to have largely disappeared (foxes have been reported to dig up hibernating turtles) (Craig *et al.* 2004) and may be a major contributor to their demise.

A fox baiting program commenced in the nature reserve at the end of 2006. The program is planned to continue on a monthly basis for at least five years, until the end of 2011. At the end of the five years, the Department will assess the success of the program and determine whether there is a need for it to continue, resources permitting.

Feral cats are present within the reserve but the extent of their impact is not known. The potential of cats (both feral and domestic) to prey on waterbirds, particularly hatchlings, is a significant concern. Rabbits are also present and can inhibit the regeneration of native plants, hindering the re-establishment of understorey species or grazing on planted seedlings.

Control of feral cats and rabbits is not currently undertaken at Lake McLarty. Control programs covering a larger area, inclusive of Kooljerrenup and Mealup Nature Reserves and possibly surrounding agricultural land (in collaboration with landowners), may be considered in the future as such programs are currently being undertaken at Lake Mealup (National Heritage Trust 2003). However at the time of writing, the outcomes of this program had not been quantified (Lake Mealup Preservation Society, *pers. comm.* 2006).

Under the CALM Regulations, dogs are not allowed onto the reserve without lawful authority. In the case of Lake McLarty, this is consistent with protection of the natural values of the lake, in particular the high number of waterbirds. A dog-resistant fence exists between the lake and the subdivision on the western side of the lake in order to reduce the impact of straying domestic dogs. The effectiveness of the fence in excluding dogs may need to be improved during the life of the plan. In addition, an education program informing the public of the impact of dogs and cats on waterbirds is required. One such program was established in 2005 by members of local community groups (such as Peel Preservation Group and Coolup Land Conservation District Committees and local Shires) and individuals associated with the Shorebird Conservation Project (see section 25 *Information, Education and Interpretation*).

Midges and Mosquitoes

Midges and mosquitoes are natural components of aquatic ecosystems on the Swan Coastal Plain, although nutrient enrichment promotes higher densities of larvae. As poor water quality of a wetland can be attributed to factors occurring throughout the catchment, management of midges and mosquitoes is undertaken on a case-by-case basis in conjunction with local government.

Midges breed in wetlands, intertidal areas and the edges of streams and rivers. Midge swarms from wetlands occur during spring and summer and can affect residents living up to a kilometre from the wetlands. Midges are not currently a problem at Lake McLarty. However, with increased residential development surrounding the lake, problems may arise in the future.

Chemical control can be used for short-term reduction in midge numbers. Monitoring of midge larvae is carried out by local governments to determine the timing of larvicide treatments and to assess the effectiveness of treatments. In the long-term, restoring wetland health and establishing buffers between the lake and residential areas will reduce midge numbers and subsequent problems from these.

Mosquitoes are native insects that breed in salt, brackish or fresh water. The species of mosquito present within freshwater and saltwater systems vary. Unlike mosquito species found associated with saltmarshes (e.g. *Aedes camptorhynchus*), species of freshwater mosquito are not commonly known for carrying mosquito-borne diseases such as Ross River Virus (S. Harrington *pers. comm.*). Lake McLarty is therefore unlikely to support large populations of mosquitoes vectoring viruses and to date has not been subject to aerial spraying to reduce numbers (D. Eastwell *pers. comm.*).

Nevertheless, Lake McLarty is monitored for mosquito larvae and adult mosquitoes by the Shire of Murray. A mosquito monitoring site is located at the western end of Mills Rd, south of Lake McLarty (Environmental Capability 1995). This site has recorded high numbers of *A. camptorhynchus* in the vicinity of the trapping site and *A. clelandi*, *A. camptorhynchus* and *Culex* sp. in the trap. These mosquitoes favour warm shallow water in shaded areas at the periphery of wetlands in which to breed (Environmental Capability 1995).

Mosquito numbers will continue to be monitored at Lake McLarty and spraying programs may be considered if problems arise with increasing numbers of residents in the area. However, records from elsewhere show that spraying has led to wader mortalities (Craig *et al.* 2004).

The Conservation Commission opposes, in principle, mosquito control on nature reserves, Ramsar wetland sites and other wetlands with high conservation value. However, it does recognise that mosquito control adjacent to residential areas is sometimes necessary to reduce the risk of mosquito borne diseases (such as Ross River virus and Australian encephalitis) or to reduce an extreme nuisance.

With an increase in the population surrounding the lake and nearby Harvey Estuary, there is a possibility of future pressure for control of mosquitoes and midges at their known breeding sites. The establishment of an adequate vegetation buffer between the lake and surrounding development will reduce the impact of these pest insects on residents (Bowen *et al.* 2002).

17 DISEASE

At present, the most significant disease threat to plants within the planning area is the disease known as ‘dieback’, caused by the introduced microscopic pathogen *Phytophthora*. There are now known to be eight species of *Phytophthora* occurring within the native plant communities of Western Australia, although it is recognised that *P. cinnamomi* is the most damaging. Susceptible plants, once infested, are killed and in many cases eliminated from the site leading to dramatic and permanent changes to native plant communities and their dependent fauna. As a result of this fungus-like pathogen, increases in salinity have been detected at other sites as well as a reduction of aesthetic values.

Infection of native vegetation with *Phytophthora cinnamomi* results in the destruction of susceptible species and a dramatic change in vegetation community structure. This introduced soil-borne plant pathogen kills a range of susceptible plant species, particularly those belonging to the families Proteaceae, Myrtaceae, Epacridaceae and Papilionaceae (Dieback Working Group 2005). The result is not only a loss of vegetation communities but of habitat and food sources for native animals.

P. cinnamomi is naturally dispersed via surface and sub-surface water flow and by root-to-root contact between infected plants. However, the most significant spread of the pathogen over large distances is via the movement of infected moist soil and plant material by vectors such as humans, vehicles and animals. Infestation is most common where human activities and use have taken place in the absence of a strict hygiene regime.

A disease interpretation assessment was conducted at Lake McLarty Nature Reserve and McLarty Nature Reserve (to the north of the lake) in October 2004. This assessment identified whether or not the nature reserves were ‘interpretable’ for the presence of disease (particularly *P. cinnamomi*). The entire Lake McLarty Nature Reserve and sections of the McLarty Nature Reserve were identified as ‘uninterpretable’ for the presence of *P. cinnamomi*. Uninterpretable areas are those dominated by resistant vegetation, such as freshwater paperbark. These resistant species ‘shade out’ susceptible plant species making it impossible to interpret whether disease is present.

The preliminary assessment of McLarty Nature Reserve did identify large interpretable areas, in which *Armillaria* sp. was found to be present. However, this fungus is native to the area and will not pose a significant threat to the health of the vegetation unless the environmental conditions within or surrounding the reserve are changed to favour the spread of the fungus.

Dieback management within both of the nature reserves will occur in accordance with the Department’s *Policy Statement No. 3 – Management of Phytophthora and disease caused by it* (CALM 1998). It is recommended that a disease survey be undertaken within the McLarty Nature Reserve to identify and map areas of dieback and those areas that are protectable. This

will ensure that any infested areas are appropriately managed, particularly with regards to the disturbance or movement of infected soil, so it does not impact adversely on Lake McLarty Nature Reserve.

18. FIRE

Some wetlands have adapted to a natural cycle of burning. However, in the case of Lake McLarty, wildfire is a significant threat both to the natural values of the nature reserve and to adjoining properties. Disturbance by wildfire could lead to the invasion of agricultural weeds (a major problem in many reserves with narrow buffers such as Lake McLarty), preventing the regeneration of native species. Wildfire could also lead to an increase in *Typha orientalis* across the lakebed. This species is highly flammable, persists and spreads after fire, and large infestations constitute a major fire hazard.

In the event of a fire within the nature reserve, the Department is guided by the provisions of the *Bush Fires Act 1954* and *Policy Statement No. 19 – Fire Management* (CALM 2005). The intent of the Department's fire suppression works will be to minimise the size of any wildfires.

The Department has the lead role in fire suppression within the reserve and would be assisted by the Shire of Murray (Fire Protection Officers and bushfire volunteers). Shire of Murray brigades would most likely form the initial attack due to their close proximity to the reserve.

Pre- and post-suppression works is the responsibility of the Department and would include rehabilitation of any fire lines that are constructed as part of suppression efforts.

No prescribed burning is currently undertaken within Lake McLarty Nature Reserve and none is proposed for the term of this plan.

The Department maintains a fire access track for emergency use along the southern boundary in conjunction with a 50 metre fuel reduced buffer. A bore and concrete tank are located on the south-western corner of the reserve to provide water for fire-fighting purposes.

19. REHABILITATION

Rehabilitation is the establishment of a stable, self-regulating ecosystem following disturbances, consistent with the purpose for which the area is managed. The Department's *Policy Statement No. 10 – Rehabilitation of Disturbed Land* (CALM 1986a) provides guidelines for the rehabilitation of lands managed by the Department based on the following principles:

- manage (as far as possible) to avoid disturbance;
- rehabilitation should be the last option in a series of management decisions designed to protect environmental values; and

- rehabilitation should aim to restore original values and help to enhance all potential uses provided the priority uses are not adversely affected.

In 2003, the western side of the lake was rehabilitated by the Peel Preservation Group with assistance from a local school as part of a Southern Peel Partnership Landcare Project (*‘Crossing the Boundaries’*). The project aimed to re-connect the existing native fringing vegetation in the south with that in the north by rehabilitating an area along the western boundary. This section of the lake was chosen for rehabilitation as it was anticipated that the lake and surrounds would be exposed to human and domestic animal intrusion in the near future, particularly from the subdivision along its western borders.

The rehabilitation area of 2.3 ha was fenced to be kangaroo and emu friendly, but restrictive of dogs and cattle. Seed collected at the site was used to propagate species for planting (K. Wilson, *pers. comm.*). The rehabilitation has been successful with both planted species and natural revegetation establishing well, facilitated by the exclusion of cattle. Monitoring of the success of the rehabilitation and degree of weed establishment will continue to be carried out by the Department and the Peel Preservation Group.

Rehabilitation is planned for the southern and south-eastern sides of the reserve once restrictions on cattle access are in place. Further rehabilitation works will also be undertaken in the south west corner adjacent to the Birchmont subdivision, and some infill planting will be done in the older rehabilitation near the water tank on the western side of the lake.

Any rehabilitation activity at the nature reserve should only include local native plant species and soils that are free of *Phytophthora* and other plant diseases. The Department welcomes community input and involvement in rehabilitation projects at the nature reserve (see section 26 *Working with the Community*).

PART D: MANAGING CULTURAL HERITAGE

20. INDIGENOUS HERITAGE

The conservation of Indigenous heritage is important in maintaining the identity, health and well being of Indigenous people (AHC 2002). In Western Australia, the *Aboriginal Heritage Act 1972* protects places and objects customarily used by, or traditional to, the original inhabitants of Australia. A register of such places and objects is maintained under the Act, however all sites are protected under the Act regardless of whether they have been entered on the register.

A key issue for management is to ensure that Aboriginal sites are protected from damage, and that obligations are fulfilled according to the *Aboriginal Heritage Act* and the *Commonwealth Native Title Act 1993* before any planning or public works occur.

The latter act requires the Department to notify Aboriginal representative bodies and Native Title claimants of any intended public work or management plan.

Although an extensive study of the area has not yet been undertaken, there are no known Aboriginal sites within the Lake McLarty Nature Reserve. However, nearby sites within the Peel Inlet/Harvey Estuary region include Warrangup Spring, Stony Point, Herron Point and Island Point. These sites are known to have been Aboriginal camping grounds.

21. NON-INDIGENOUS HERITAGE

Lake McLarty was named after one of the first and most prominent pioneering families of the Murray District. John McLarty was originally a tenant farmer in the 1840s, and later a building contractor and one of Pinjarra's first publicans.

In 1860 John and his wife, Mary Ann, built the 'Blythewood Homestead' which is still located south of Pinjarra (Craig *et al.* 2004). John McLarty developed a cattle business centered on Blythewood and other properties in the district. McLarty was given the contract to build the seawall behind the Peninsula Hotel (Mandurah) in 1872 in an attempt to keep the sea entrance to the Peel Inlet open (Craig *et al.* 2004). In the 1870s, Edward McLarty, son of John and Mary Ann, established the significant homestead property of Edenvale in Pinjarra which, like the Blythewood Homestead, still exists today (H. Burgess *pers. comm.*). In 1972 the Old Blythewood homestead was given to the National Trust (DEH 2005).

Lake McLarty and its surrounds have had a history of farming for an extended period of time. In 1848 Arthur Birch established his farm besides a wetland known as 'Big Lake', now known as Lake McLarty. By the 1870s Birch had built a limestone cottage next to the lake, which he named 'Birchmont' and by 1880 Birch held 1000 acres of freehold land and leased 70 000 acres of Crown land between Harvey Estuary and the Peel Inlet. In addition to growing wheat, the family had 2000 sheep, 100 cattle and bred horses (about 500 on the property) (Craig *et al.* 2004). In the days of the homestead, the household water supply was provided by a spring near the homestead (Richards 1978). Since the 1880s, the south and south-western side of the lake have been used for rural activities (feed stock and irrigated market gardens) (Richards 1978).

The old Birchmont Homestead still stands, located on a small rise close to the south-west boundary of the lake. The homestead remains in private ownership. It is historically significant as a good example of the early settlement in the area and is listed on the Shire of Murray's Municipal Heritage Inventory (Heritage Council of Western Australia 2004), although this provides it with limited statutory protection.

The land immediately surrounding the Lake McLarty Nature Reserve, which was subject to farming development soon after European settlement, is currently extensively cleared. The land on the eastern side of the lake is used for grazing a small number

of cattle, some of which still range the surroundings of the lake (Craig *et al.* 2004). Approximately 22 ha of the original farmland surrounding the old homestead and the remaining property has been sold and sub-divided by developers. An application to subdivide the homestead property of 26 ha into 10 lots was considered by the Shire of Murray and approved by the Western Australian Planning Commission in December 2005, subject to a number of conditions, one being that the homestead is to remain at its current site.

PART E: MANAGING VISITOR USE

22. VISITOR OPPORTUNITIES

As a nature reserve, Lake McLarty is gazetted for the purpose of 'conservation of flora and fauna'. As such, only low impact recreation is permitted, and then only when it does not adversely affect the natural values and ecosystems of the reserve.

The Department's *Policy Statement No. 18 – Recreation, Tourism and Visitor Services* (DEC 2006b) outlines the principles, operational guidelines, procedures and administrative controls in relation to facilitating recreation and tourism on the public conservation estate. This management plan complies with Policy Statement No. 18.

As Lake McLarty is a nature reserve, gazetted for the purpose of conservation of flora and fauna, only facilities providing for passive recreation pursuits will be provided. Furthermore, commercial licences will only be considered for passive recreational activities (for example bird watching tours or guided nature walks) which are compatible with the reserve's purpose and the objectives of this management plan. Applications for such licences will be considered on a case-by-case basis, and would be required to be in line with the Department's policy (DEC 2006b) on commercial activities in nature reserves.

Any increase in visitor use resulting from residential development around Lake McLarty will need to be carefully managed.

23. ACCESS

Access to Lake McLarty is provided for passive recreational uses (such as birdwatching and nature appreciation), as well as for management and emergency vehicles.

Vehicular access to the southern part of the reserve to allow off-road parking may be considered if and when future subdivisions occur.

Access to the reserve for pedestrians, including birdwatchers, is currently restricted to two points: a gate located on the western side of the lake and another gate to the south of the lake off Mills Road. Many parts of the lake are inaccessible during winter. There is currently little demand for designated pedestrian-only

tracks within the reserve, and so none have been provided to date. This could be reviewed over the life of the plan if demand for pedestrian access increases as a result of adjacent residential development.

The firebreaks and management tracks are gated and provide access for management and emergency vehicles only.

The use of recreational watercraft (including model boats) in the lake is prohibited. However the use of canoes for research and management purposes by approved users will continue to be allowed.

24. VISITOR USE

Visitor use at Lake McLarty is expected to increase over the life of the management plan as residential development on adjoining land progresses and the area becomes more accessible with the completion of the Peel Deviation Freeway to the east of the lake (expected in 2009). Any such increase will need to be carefully managed as it will place added pressure on the natural values of the reserve. Hence it will be considered and planned for through this management plan (see section 23 *Access*).

The natural values of the reserve provide opportunities for nature appreciation, bird watching and environmental education, and this will remain the focus for visitor activities during the life of this management plan.

Birdwatching and Nature Appreciation

The importance of Lake McLarty as a place of refuge and a feeding ground for nationally and internationally significant waterbird species attracts birdwatchers from around Australia and the world, with birdwatching being the main recreational pursuit in the reserve. The southern and western sides are the most accessible points for birdwatching.

To facilitate birdwatching and nature study at the reserve, it is proposed to construct a viewing platform on the western side of the lake. This is to be complemented by educational information at the site. Defined access points are also required to ensure the wetland ecosystem is not adversely impacted upon by visitors.

Walking

With increasing residential development immediately surrounding the lake, and the associated increase in population in the area, there is likely to be greater pressure to provide opportunities for walking within the reserve. However, disturbance to waterbirds from walkers is a major concern. To address this potential problem pedestrian access will be limited to the two existing entry points, on the western and southern boundaries.

Opportunities for bushwalking also exist in nearby Kooljerrenup Nature Reserve to the south.

PART F INVOLVING THE COMMUNITY

Various Departmental policy statements provide management direction for involving the community including:

- *Policy Statement No. 15 – Community involvement (Public Participation and Volunteers)* (CALM 1991);
- *Policy Statement No. 18 – Recreation, tourism and visitor services* (DEC 2006b);
- *Policy Statement No. 25 – Community education and interpretation* (CALM 1988); and
- *Good Neighbour Policy* (DEC 2007).

Further guidance is provided by the Department's Visitor Interpretation Manual and best practice principles.

A range of communication strategies that target different audiences is used, including: information; interpretation; education; community involvement; and liaison, consultation and advisory services to stakeholder groups.

25. INFORMATION, EDUCATION AND INTERPRETATION

Lake McLarty Nature Reserve provides a valuable opportunity for improving community awareness about wetland ecosystems and the values of Ramsar-listed wetlands. An effective information, education and interpretation program is vital to achieve the vision and objectives of maintaining, enhancing and communicating reserve values.

In 2004, Lake McLarty was selected as one of 10 priority shorebird sites across Australia for a range of community-driven shorebird conservation projects. The Shorebird Conservation Project was funded by the National Heritage Trust and coordinated by World Wildlife Fund Australia. The project, run over four years, aims to:

- increase the awareness, understanding and involvement by communities in conservation of shorebird habitat and where possible enable communities to conserve and wisely manage important shorebird sites;
- prepare a site communication plan, brochures and appropriate educational signage for the reserve;
- implement a more detailed monitoring program; and
- organise guided tours and information evenings about the wetland.

The program is concentrating on raising awareness about the reserve's conservation values, particularly those that contribute to its Ramsar listing, potential human impacts, and positive action visitors can take to support management of the reserve and of other wetlands. An important part of any interpretation/education program is the provision of information on the impacts of domestic cats and dogs on waterbirds.

Educational facilities at the reserve are limited to an information sign located on the western side of the lake. Given the importance of the site as waterbird habitat, it is a high priority to upgrade the signs and information for the purpose of public education and interpretation to assist in achieving conservation objectives. This may be undertaken as part of the Shorebird Conservation Project. In addition, it is proposed that a viewing platform be constructed on the western side of the lake. This structure could then support further interpretative signs and information on the values of reserve. Any signs will incorporate an explanation of the Ramsar Convention.

The internet, particularly the Department's NatureBase webpage, also provides a valuable means of distributing information on the significant values of the reserve.

The proximity of Lake McLarty to the Peel estuary increases the potential for visitors to be exposed to mosquitoes that have a high possibility of carrying Ross River virus. As mosquitoes are an essential part of the lake's ecosystem and mosquito control has the potential to jeopardise the natural values, the Department and the Conservation Commission would prefer not to take measures to reduce mosquito numbers. Instead, increasing visitor awareness may help reduce the incidence of infection.

26. WORKING WITH THE COMMUNITY

Community involvement is an integral component of the Department's operations. The community, as groups or individuals, is encouraged to be involved in both the planning and management of Lake McLarty Nature Reserve.

Lake McLarty Nature Reserve is highly valued by the local community and several community groups within the region are dedicated to conservation of the reserve. These groups have played an active role in the planning and management of this reserve. Such groups include the Peel Preservation Group, Coolup Land Conservation District Committee, the *Crossing the Boundaries* – Southern Peel-Harvey Landcare Project and local schools.

Ongoing community support is essential for the successful implementation of this management plan. The Department's *Policy Statement No. 15 – Community Involvement (Public Participation and Volunteers)* (CALM 1991) outlines initiatives to provide more volunteer opportunities and training to both the volunteers and Departmental staff in the management of volunteers.

Volunteer activities are encouraged and supported at Lake McLarty, and community groups, local schools and universities are encouraged to take part in volunteer activities such as waterbird surveys, water monitoring, rehabilitation, and interpretation and education. The Department will seek to co-ordinate community groups to facilitate such work.

27. SCIENTIFIC AND RESEARCH USE

There are many opportunities for research within the reserve, including studies of water levels and quality, invertebrates and, particularly, waterbirds. The Peel Preservation Group currently monitors water levels on a monthly basis, and members of Birds Australia conduct monthly monitoring of presence and numbers of bird species. The Shire of Murray conducts mosquito larvae testing as required.

Research by universities and community groups will continue to be encouraged and supported by the Department.

It is appropriate that research and monitoring programs involve a wide range of people and groups. The involvement of volunteers, educational institutions and individual researchers can reduce the costs of such programs and assist in providing information to the Department and to the broader community. However, it is important that all research undertaken in the reserve is coordinated by the Department, as this will ensure an integrated approach, avoid duplication, minimise impacts and enable projects to be prioritised.

PART G MONITORING AND IMPLEMENTING THE PLAN

The strategies outlined in the plan will be built into the works program of the Department's Swan Coastal District, which is responsible for the day-to-day management of the reserve.

The Conservation Commission will assess the effectiveness of this management plan via regular audits of Key Performance Indicators (KPIs) or other mechanisms as deemed necessary. KPIs for this management plan are listed in the *Management Summary Table*.

28. TERM OF THE PLAN

In accordance with the CALM Act, the term of this plan is for a period of 10 years from the date the plan is approved by the Minister for the Environment. At the end of the 10-year period, it is recommended that an audit of the management plan be undertaken and the plan reviewed with full public consultation and then re-submitted to the Minister for approval. The CALM Act also specifies that in the event of such a revision not occurring by the end of the plan's specified life span, the plan will remain in force in its original form, unless it is either revoked by the Minister or a new plan is approved. Revisions or amendments to the plan are allowed under Section 61 of the CALM Act.

The Conservation Commission may initiate a review of the management plan before the 10-year term expires. Should significant changes to this plan be required, public comment on the proposed amendments will be sought.

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PERSONAL COMMUNICATIONS

- A.N. Burbidge – Science Division, DEC.
- H. Burgess – Peel Heritage Council.
- D. Eastwell – Shire of Murray.
- S. Harrington – Department of Health, WA.
- R. Kerslake – Department of Agriculture and Food.
- G. Langley – former farmer of area surrounding Lake McLarty.
- G. Mathews – (Via submission to draft plan) – local resident.
- Lake Mealup Preservation Society – (Via submission to draft plan).
- M. Singor – Birds Australia.
- P. Wilmot – Lake Mealup Preservation Society.
- K. Wilson – Landcare Development Officer, Southern Peel-Harvey Landcare Project.

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MANAGEMENT SUMMARY TABLE

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS *		
		Performance Measure	Target	Reporting Requirements
PART B. MANAGEMENT DIRECTIONS AND PURPOSE				
<p>9. LAND TENURE</p> <ul style="list-style-type: none"> The planning area comprises two 'class A' nature reserves that should be amalgamated into a single reserve of 219 ha and officially named Lake McLarty Nature Reserve. A gazetted road reserve marks the eastern boundary of the nature reserve. This should be added to the nature reserve. There is a significant amount of vegetation on the private property adjacent to the eastern side of the nature reserve which effectively doubles the width of the vegetated buffer. Subject to reaching agreement with the owners, consideration should be given to acquiring these areas by direct purchase, or as an environmental contribution if the current agricultural land is subdivided in future. 	<p>OBJECTIVE</p> <p>To protect the values of the reserve by securing areas of greatest value into the conservation estate.</p> <p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> securing additions to the reserve wherever possible, including the road reserve on the eastern side of the lake; amalgamating Reserve 44978 into Lake McLarty Nature Reserve (Reserve number 39404), resulting in a consolidated reserve of 219 hectares; officially naming the two reserves that comprise the nature reserve "Lake McLarty Nature Reserve"; seeking to enter into voluntary agreements with reserve neighbours to protect remnant vegetation via future purchase of land for addition to the reserve; and 			

<ul style="list-style-type: none"> The Conservation Commission and the Department will recommend that any future subdivisions adjoining the reserve will be subject to the principle of net conservation benefit, and that environmental conditions to minimise environmental impacts should be duly placed on proponents. 	<p>5. negotiating environmental contributions with developers should further subdivisions be approved.</p>		
PART C. MANAGING THE NATURAL ENVIRONMENT			
<p>12. WETLAND AND CATCHMENT PROTECTION</p> <p>Managing Water Levels</p> <ul style="list-style-type: none"> Lake McLarty is a surface expression of groundwater that has formed where the water table intersects with the ground surface. Therefore, the lake's water levels are directly affected by management of the regional groundwater system. The surface water levels of the lake have been monitored monthly on the western side of the lake by the Peel Preservation Group since 1996. 	<p>OBJECTIVE</p> <p>To maintain a water level regime that supports the lake's water-dependent ecosystems and meets the needs of the range of waterbirds that use the lake.</p> <p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> negotiating a Memorandum of Understanding with State and local government agencies and other land managers to ensure integrated planning and management of Lake McLarty, to enable the Department to achieve the objectives of this plan; liaising with the Department of Water regarding the monitoring and maintenance of water levels; 	<p>Changes in groundwater levels.</p>	<p>No significant change to the current hydrology of the lake (including seasonal patterns).</p> <p>Every two–three years</p>

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		Performance Measure	Target	Reporting Requirements
<p>Managing Water Levels (continued)</p> <ul style="list-style-type: none"> The pattern of water level changes within the lake is dictated by local rains. The lake is marginally ephemeral and dries, on average, for 1–4 months of the year. The timing of inundation and drying of Lake McLarty is important for bird species and bird numbers. Groundwater, and subsequently, wetland water levels may be under threat as a result of a combination of dry climate and groundwater abstractions in surrounding areas. Management of the groundwater resource within the Peel-Harvey Catchment is the responsibility of the Department of Water. 	<p>THIS WILL BE ACHIEVED BY: (continued)</p> <ol style="list-style-type: none"> working cooperatively with the Department of Water to ensure that the management of the lake's water levels considers waterbird and other fauna habitats; and liaising with the Department of Water to establish at least two more water monitoring bores in the area surrounding the lake. 			

<ul style="list-style-type: none"> Groundwater levels at Lake McLarty are currently monitored twice annually by the Department of Water from four bores located within a three kilometer radius of the lake. The establishment of further monitoring bores within the subdivision and to the east of the lake is required to determine the impact of continued residential development on groundwater levels within the catchment. 			
<p>12. WETLAND AND CATCHMENT PROTECTION</p> <p>Managing Water Quality</p> <ul style="list-style-type: none"> Factors such as nutrient runoff from surrounding residential and rural land influence the water quality of Lake McLarty. The Department is responsible for monitoring the water quality in the lake. They are assisted by the Peel Preservation Group. 	<p>OBJECTIVE</p> <p>To maintain a healthy aquatic ecosystem, thereby ensuring the provision of a feeding ground and refuge for waterbirds and protection of the reserve's ecological values.</p>	<p>Changes in abundance, species diversity and structure of naturally occurring aquatic macro-invertebrate populations.</p>	<p>No decline in the abundance or diversity of naturally occurring aquatic macro-invertebrate populations based on 2000 levels.</p>
			<p>Every two–three years</p>

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		Performance Measure	Target	Reporting Requirements
<p>Managing Water Quality (continued)</p> <ul style="list-style-type: none"> Establishing new and maintaining existing buffer vegetation is vital in assisting to maintain and improve water quality. A buffer will act as a filter and storage for nutrients, as well as providing a physical barrier to problem insects such as midges between the lake and surrounding development. An integrated, whole of catchment approach is required for managing groundwater quality and levels throughout the Peel Harvey Catchment. The EPA, together with the Peel Harvey Catchment Council, is developing a Water Quality Improvement Plan for the catchment, which contains key recommendations to achieve reductions in phosphorous. 	<p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> supporting the Peel Preservation Group in continuing to monitor the water quality (including dissolved oxygen, pH, salinity, total nitrogen and phosphorus, and macro-invertebrates) of the lake every six months; ensuring that the management of water quality considers waterbird and other fauna habitats; continuing to re-establish buffer vegetation surrounding the lake; working cooperatively with state and local government authorities regarding the management of surface and subsurface drainage; maintaining the Department's role on the Peel-Harvey Catchment Council; and supporting the recommendations of the EPA's Water Quality Improvement Plan for the Peel Harvey catchment, particularly when commenting on development proposals on land adjoining Lake McLarty. 	<p>Changes in salinity and total nitrogen and phosphorus levels of the lake.</p>	<p>No significant increase in the salinity or changes in levels of total nitrogen and phosphorus in the lake.</p>	<p>Every two–three years</p>

<p>13. NATIVE ANIMALS AND HABITATS</p> <ul style="list-style-type: none"> • Lake McLarty, as part of the Peel-Yalgorup System, was designated to the List of Wetlands of International Importance under the Convention on Wetlands (Ramsar, Iran, 1971) in 1990. It is also listed in the Directory of Important Wetlands in Australia (as part of the McLarty System). • Cattle grazing has occurred within the reserve since the 1880s, although (at the time of writing) not within the past few years. Grazing at Lake McLarty has contributed to the creation of valuable habitat for waterbirds. • The planning area is an important breeding ground for local birds, and supports 31 and 36 species protected under the JAMBA and CAMBA, respectively, and is a summer refuge for 29 migratory wader species. • A total of 160 bird species have been recorded in the reserve, including 81 species of waterbirds, and supports four specially protected species and one priority fauna species. 	<p>OBJECTIVES</p> <ol style="list-style-type: none"> 1. To conserve indigenous fauna, with an emphasis on threatened and priority species and those protected by international agreements. 2. To conserve and enhance the reserve for waterbirds as per the management requirements for Ramsar-listed wetlands. <p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> 1. maintaining shorebird habitat by controlling the type and structure of shoreline vegetation by: <ul style="list-style-type: none"> – allowing cattle grazing to continue under a formal lease/licence, with cattle restricted to (i) specified areas in the southern and south-eastern part of the reserve and (ii) seasonal use, until the impact of this activity on the wetland system can be established; and – assessing and trialling alternative management options to cattle grazing for maintaining mudflat habitats for shorebirds; 2. protecting native fauna from introduced and problem animals through appropriate control regimes where necessary (see <i>Introduced and other Problem Animals</i>); 	<p>Number of migratory waterbirds utilising the lake as a summer refuge and feeding ground. Changes in species diversity and species composition of migratory waders.</p>	<p>Subject to natural variations, no decline in the number of migratory waterbirds visiting lake. Subject to natural variations, maintain or increase the species diversity and species composition of migratory birds from 2007 levels.</p>	<p>Every three years. Every three years.</p>
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<ul style="list-style-type: none"> • There are no known records of rare or priority flora in the Lake McLarty Nature Reserve. • The main threats to the vegetation are water levels and quality, environmental weeds, human disturbance (including pets), cattle grazing and fire. • The western side of the lake has been highly degraded as a result of historical land use, with almost all of the original vegetation removed. 	<ol style="list-style-type: none"> 2. maintaining vegetation biodiversity by reducing threatening processes; 3. maintaining the variety of habitats that are available at the lake to support the diversity of bird species, including encouraging some areas of emergent native vegetation to re-establish to provide habitat for targeted bird species (e.g. Australian reed warbler); 4. rehabilitating degraded areas around the lake to restore a vegetation buffer; and 5. maintaining fences within the reserve to ensure that cattle grazing occurs only in designated areas. 	<p>Changes in range of habitats available.</p>	<p>Maintain or increase the variety of habitats available at the lake from 2007 levels.</p>	<p>Every five years.</p>
<p>15. ENVIRONMENTAL WEEDS</p> <ul style="list-style-type: none"> • Thirteen weed species have been identified within the reserve. As rated in the <i>Environmental Weed Strategy for Western Australia</i> two species are rated as High and seven as Moderate according to their impact on biodiversity. 	<p>OBJECTIVE</p> <p>To prevent species loss and community decline from weed invasion.</p> <p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> 1. controlling environmental weeds rated as high or moderate in the <i>Environmental Weed Strategy for Western Australia</i>, and declared weeds, including cottonbush; 2. mapping and annually monitoring the distribution of <i>T. orientalis</i> and immediately controlling new satellite clumps; and 	<p>Changes in abundance and distribution of priority environmental weeds as identified in the <i>Environmental Weed Strategy for Western Australia</i>.</p>	<p>No increase in the abundance and distribution of high and moderate rated environmental weeds from 2007 levels.</p>	<p>Every three years.</p>

<ul style="list-style-type: none"> • There are no known records of rare or priority flora in the Lake McLarty Nature Reserve. • The main threats to the vegetation are water levels and quality, environmental weeds, human disturbance (including pets), cattle grazing and fire. • The western side of the lake has been highly degraded as a result of historical land use, with almost all of the original vegetation removed. 	<ol style="list-style-type: none"> 2. maintaining vegetation biodiversity by reducing threatening processes; 3. maintaining the variety of habitats that are available at the lake to support the diversity of bird species, including encouraging some areas of emergent native vegetation to re-establish to provide habitat for targeted bird species (e.g. Australian reed warbler); 4. rehabilitating degraded areas around the lake to restore a vegetation buffer; and 5. maintaining fences within the reserve to ensure that cattle grazing occurs only in designated areas. 	<p>Changes in range of habitats available.</p>	<p>Maintain or increase the variety of habitats available at the lake from 2007 levels.</p>	<p>Every five years.</p>
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KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		Performance Measure	Target	Reporting Requirements
<p>15. ENVIRONMENTAL WEEDS (continued)</p> <ul style="list-style-type: none"> <i>Typha orientalis</i> has the potential to further reduce the area of open water at Lake McLarty. Although its current distribution is limited, <i>Typha</i> has been widespread on the lakebed previously and may again become a management issue. Other weed species threatening reserve values include cottonbush (a declared weed), brome grass (high priority weed species) and goosefoot. 	<p>THIS WILL BE ACHIEVED BY: (continued)</p> <p>3. trialling different cost effective methods to control <i>T. orientalis</i> to determine the most effective method for Lake McLarty.</p>			
<p>16. INTRODUCED AND OTHER PROBLEM ANIMALS</p> <ul style="list-style-type: none"> Problem animals associated with the reserve include foxes, cats (feral and domestic), dogs and rabbits. 	<p>OBJECTIVE</p> <p>To prevent, and where possible, negate the impacts of problem animals on the reserve's values.</p>	<p>Changes in the numbers of mosquitoes trapped within the reserve.</p>	<p>No significant increase in the mosquito populations present at the lake.</p>	<p>Every five years.</p>

- Foxes and cats may pose a threat to native fauna, and it is thought that foxes may have been a major cause of decline in the local population of oblong turtles.
- A fox baiting program commenced in the nature reserve at the end of 2006, which is planned to continue on a monthly basis at least until the end of 2011.
- Mosquito and midge breeding within the lake is a potential problem for future residents. The Shire of Murray monitors mosquito larvae numbers adjacent to Lake McLarty.

THIS WILL BE ACHIEVED BY:

1. preparing a control program for problem animals based on the following criteria:
 - a. existing and potential impact of the species;
 - b. the efficiency and effectiveness of control measures;
 - c. availability of resources; and
 - d. the capacity for long-term monitoring of the population;
2. establishing a formal lease/licence to allow closely monitored cattle grazing to continue in the reserve (see *Native Animals and Habitats*);
3. reinforcing the vegetation buffer around the lake to negate potential problems with midges and mosquitoes;
4. referring proposals to spray for midge and mosquito control to the Conservation Commission; and
5. increasing community awareness of the need to keep domestic animals out of the reserve, and increasing the effectiveness of the dog-resistant fence on the western side of the lake if necessary.

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		Performance Measure	Target	Reporting Requirements
<p>17. DISEASE</p> <ul style="list-style-type: none"> • Lake McLarty Nature Reserve is 'uninterpretable' for the presence of <i>Phytophthora cinnamomi</i>. However sections of the adjacent McLarty Nature Reserve are 'interpretable' and susceptible to this pathogen. • <i>Phytophthora cinnamomi</i> could have an impact on revegetation programs in the reserve if the species planted are vulnerable to it. • <i>P. cinnamomi</i> can be spread by humans, vehicles and animals moving infested soil and plant material. 	<p>OBJECTIVE: To prevent the introduction and spread, of <i>Phytophthora cinnamomi</i>.</p> <p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> 1. surveying the adjoining McLarty Nature Reserve for <i>P. cinnamomi</i> infection and quarantining affected areas; 2. reducing the risk of introducing and spreading the disease to uninfected areas by limiting access to affected areas, and ensuring appropriate hygiene standards for machinery and vehicles when undertaking works within the reserve; 3. ensuring soils and other materials brought into the reserve are free of <i>P. cinnamomi</i>; and 4. raising community awareness of the impacts and management issues associated with dieback (see <i>Involving the Community</i>). 			

<p>18. FIRE</p> <ul style="list-style-type: none"> Wildfire is a significant threat to the natural values of the reserve, and to adjoining properties. The Department has the lead role in fire suppression within the reserve and, in the event of fire, would be assisted by the Shire of Murray Fire management at Lake McLarty is guided by the Bush Fires Act 1954 and the Department's Fire Management Policy. Fires in small reserves surrounded by agricultural land usually promote weed invasion. Large infestations of introduced bulrush are a fire hazard. 	<p>OBJECTIVE:</p> <p>To protect the biodiversity of the reserve, as well as people and property, by minimising the impact of wildfire.</p> <p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> minimising the area of <i>Typha</i> infestations to prevent the build up of fuel; maintaining the concrete tank and bore on the western side of the lake for fire fighting purposes; ensuring that access for fire protection purposes is considered and provided when any subdivisions are proposed; and considering selective prescribed burning only for the protection of specially protected, threatened or priority species. 	<p>OBJECTIVE</p> <p>To restore degraded areas of the reserve to a condition resembling the natural environment.</p>	<p>Change in the area of land rehabilitated within the reserve.</p>	<p>Land in the southern and western parts of the reserve satisfactorily rehabilitated.</p>	<p>Every five years.</p>
<p>19. REHABILITATION</p> <ul style="list-style-type: none"> Degradation and loss of natural vegetation, particularly on the western side of the lake, has occurred historically as a result of farming practices and cattle grazing. 					

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		Performance Measure	Target	Reporting Requirements
<p>19. REHABILITATION (continued)</p> <ul style="list-style-type: none"> Rehabilitation of the western side of the lake was undertaken in 2004 using native species grown from seed collected from the reserve. 	<p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> rehabilitating with plants that have been propagated from seeds and cuttings collected either from within the reserve or from provenance from the Swan Coastal Plain; coordinating rehabilitation works with weed control, fire protection and cattle exclusion; encouraging members of the local community, community groups and schools to participate in rehabilitation works, and to seek external funding for such works; ensuring mulch and soil used in rehabilitation works does not contain unwanted seeds or plant diseases; encouraging natural regeneration as much as possible by managing grazing pressure from cattle and rabbits; and undertaking rehabilitation works on the southern and south-eastern sides of the reserve, and continuing rehabilitation on the western side. 			

PART D. MANAGING CULTURAL HERITAGE	
<p>20. INDIGENOUS AND 21. NON-INDIGENOUS HERITAGE</p> <ul style="list-style-type: none"> There are no known Aboriginal sites in the reserve, although registered sites exist within the Peel Inlet/Harvey Estuary area. 	<p>OBJECTIVE</p> <p>To protect the reserve's cultural heritage.</p> <p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> notifying relevant Native Title Claimants and authorities when proposing to undertake public works in registered heritage sites; ensuring management activities do not impact upon cultural heritage values; and collating information on cultural heritage sites and adding them to the register on the Department's Recreation and Tourism Information System (RATIS) database.
PART E. MANAGING VISITOR USE	
<p>23. VISITOR ACCESS</p> <ul style="list-style-type: none"> Visitor access to the reserve is limited to gates located on the western and southern sides of the lake, although the southern access is for management vehicles only. Walkers also use management and fire access tracks. 	<p>OBJECTIVE</p> <p>To provide safe and convenient access within the reserve, for visitors and management, that is consistent with reserve values.</p>

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		Performance Measure	Target	Reporting Requirements
<p>23. VISITOR ACCESS (continued)</p> <ul style="list-style-type: none"> • Canoeing on the lake is only permitted for management and scientific research purposes. 	<p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> 1. maintaining designated access points to the reserve to facilitate walking and bird watching activities; 2. installing an information sign at each of the access points; 3. continuing to permit pedestrian access on management and fire access tracks unless otherwise signposted; 4. pending future subdivisions, considering upgrading vehicle access to the south of the lake off Mills Road to allow off-road parking; 5. pending a future increase in visitor numbers, consider developing defined walking trails if required; and 6. prohibiting the use of recreational watercraft (including model boats) in the lake, and allowing the use of canoes only for education, research and management purposes by approved users. 			










<p>24. VISITOR USE</p> <ul style="list-style-type: none"> • The most popular visitor uses at the reserve are bird watching and nature appreciation. • Visitor use at Lake McLarty is expected to increase over the life of the management plan as residential development on adjoining land progresses and the area becomes more accessible with the completion of the Peel Deviation Freeway. • Facilities are limited to an information board on the western side of the lake. 	<p>OBJECTIVE:</p> <p>To provide for passive, low-impact visitor uses in a manner that is consistent with the reserve’s purpose and values, and which minimises conflict between visitors.</p> <p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> 1. promoting visitor use that is consistent with the protection and promotion of the reserve’s values; 2. ensuring that visitor uses do not impact on the values of Lake McLarty; and 3. constructing a viewing platform on the western side of the lake . 			
PART F. INVOLVING THE COMMUNITY				
<p>25. INFORMATION, EDUCATION AND INTERPRETATION</p> <ul style="list-style-type: none"> • Information, education and interpretation provide targeted communication with the public. • It is important for the effective implementation of the management plan that community understanding and support is fostered 	<p>OBJECTIVES</p> <ol style="list-style-type: none"> 1. To increase community awareness, appreciation and understanding of the reserve’s values, and to gain support for management practices. 2. To increase community awareness, appreciation and understanding of Lake McLarty’s national and international importance for waterbirds. 			

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		Performance Measure	Target	Reporting Requirements
<p>INFORMATION, EDUCATION AND INTERPRETATION (continued)</p> <ul style="list-style-type: none"> There is limited community awareness of Lake McLarty's importance as a nationally and internationally significant wetland. 	<p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> providing information to visitors on reserve values and issues such as its importance for migratory waterbirds, visitor safety, permitted activities and regulations; and installing signs and information for the purpose of public education and interpretation to assist in achieving conservation objectives. 			
<p>26. WORKING WITH THE COMMUNITY</p> <ul style="list-style-type: none"> Community involvement is an integral component of the Department's operations. Community groups and individuals are encouraged to be involved in the management of Lake McLarty. Community support is essential for the successful implementation of this management plan. 	<p>OBJECTIVE</p> <p>To facilitate effective community involvement in the management of the reserve.</p> <p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> continuing to encourage, promote and support volunteers and community groups with essential resources to help them carry out their activities; and involving the community in the implementation of this management plan. 	<p>Change in the numbers of volunteers contributed to reserve management.</p>	<p>20 percent increase in the numbers of volunteer hours contributed to the management of the reserve from 2006 levels.</p>	<p>Every five years.</p>

<p>27. SCIENTIFIC AND RESEARCH USE</p> <ul style="list-style-type: none"> Data collected at the reserve includes water quality indicators, water levels, bird counts and mosquito larvae counts. Opportunities exist for further studies to complement proposals in this management plan, particularly in relation to impacts and/or benefits of cattle grazing and alternatives for habitat maintenance. All research should be co-ordinated by the Department. 	<p>OBJECTIVE</p> <p>To increase knowledge and understanding of key values to provide for improved management of the planning area and to monitor the possible impacts associated with implementing the management plan.</p> <p>THIS WILL BE ACHIEVED BY:</p> <ol style="list-style-type: none"> conducting research and monitoring, as resources permit and according to priority, that focuses on issues and values required to report on this management plan, and the establishment of baseline information; encouraging and supporting, wherever possible, external agencies, organisations, volunteer groups and individuals to undertake research and monitoring projects where they contribute to biodiversity conservation and reflect visitor's use of the area; and supporting, and where possible, seeking grant applications to encourage scientific research and monitoring within the planning area, particularly in relation to impacts and/or benefits of cattle grazing and alternatives for habitat maintenance. 	<p>Research within the reserve is conducted according to Departmental priorities and Government initiatives, and to assist with the performance assessment for this management plan.</p>	<p>Research undertaken is that which has been deemed a high priority.</p>	<p>Every five years.</p>
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*Note: the response to target shortfall for each of the key performance indicators is for the Department to investigate the cause and report to the Conservation Commission for action.

Map 1. Management Planning Area

-  Peel–Yalgorup Ramsar boundary
-  Proposed freeway extension
-  Sealed roads
-  Unsealed roads
-  National park
-  Conservation park
-  Nature reserve
-  CALM Act section 5(1)(g) & 5(1)(h) reserve
-  State forest

