Parks and Reserves of Yanchep and Neerabup

Draft Management Plan 2010

Department of
Environment and Conservation

Our environment, our future

Conservation Commission
WESTERN AUSTRALIA

PARKS AND RESERVES OF YANCHEP AND NEERABUP

Draft Management Plan

2010

Department of Environment and Conservation

Conservation Commission of Western Australia

VISION

Yanchep and Neerabup parks and reserves will be recognised as an important biodiversity stronghold of the Perth Metropolitan area on the Swan Coastal Plain where natural values, such as tuart and banksia woodlands, wetlands, caves and karst features, and threatened flora, fauna and ecological communities, and our knowledge of them, will be conserved and enhanced for future generations.

This historic landscape, known as 'Perth's natural and cultural meeting place', will be recognised for its great aesthetic appeal and recreational legacy that is unique amongst national parks of today, and for its rich Indigenous heritage and stewardship, which will be encouraged through involvement of Nyoongar people in managing 'country' as they have done in the past. A unique collection of 1930s buildings and activities such as rowing boats, viewing koalas and visiting caves will remind visitors of our early 20th century heritage, which was a driving force in establishing this area as a healthy recreational oasis within the Perth Metropolitan area.

People will gain enjoyment from, and an appreciation, awareness and understanding of, the natural, cultural and social environment of the parks and reserves. They will provide visitors with a range of safe nature-based recreation opportunities, facilities and services that are compatible with conservation and recreation requirements. These will enrich visitor experiences dependent upon natural, cultural and recreational values and, reflecting a custodial spirit that will benefit future generations. The parks and reserves will provide a range of educational and interpretation opportunities that are set within, and reach out to, metropolitan communities beyond the parks and reserves.

The parks and reserves will be managed in partnership with the community to nurture appreciation and understanding of the importance of the area's natural, cultural and social values and their protection. They will promote community ownership through volunteers and clubs using the area, and boost conservation efforts and resources available for the protection of the environment. In turn, the planning area will be responsive to the community's evolving needs.

INVITATION TO COMMENT

This Draft Management Plan is an opportunity to provide information, express your opinion, suggest alternatives and have your say on how the Parks and Reserve of Yanchep and Neerabup will be managed over the next 10 years.

MAKE YOUR COMMENTS COUNT
What to Consider

In making your submission, it is important to understand that legislation and policy imposes certain obligations on the Department to manage lands and waters vested with the Conservation Commission and that there may be little room to manage some issues outside of these constraints and responsibilities. Nevertheless, it is important to hear from the public about the management of these issues. There are also some issues which may have a number of management options over the life of the plan, or where the Department has developed a proposal and wants to gauge public opinion about management.

Issues that the Department and the Conservation Commission would particularly like to seek feedback on during the public comment period of this draft management plan include the proposed:

- Key Performance Indicators mentioned through various sections of the plan;
- Strategies identified for sections of interest;
- Outsourcing of the golf course as outlined in sections 30.2 *Golf* and 31 *Commercial Tourism Operations*;
- Retention of koalas (see Section 30.4 *Wildlife Viewing and Interaction*); and
- Provision of camping (see sections 30.8 *Overnight Stays* and 31 *Commercial Tourism Operations*).

How to Make Effective Comments

It is important to indicate those strategies and recommendations you agree with as well as those with which you disagree. Each submission is important, but those that give reasons for concerns, give support where appropriate and offer information and constructive suggestions are most useful.

If you prefer not to write your own submission you could make a joint submission with others. To ensure your submission is as effective as possible:

- make it clear and concise;
- list your points according to the subject sections and page numbers in the Plan;
- describe briefly each subject or issue you wish to discuss;
- say whether you agree or disagree with any or all of the aims or strategies within each subject or just those of specific interest to you - clearly state your reasons (particularly if you disagree) and provide supportive information where possible; and
- suggest alternatives to deal with issues with which you disagree.

WHERE TO SEND YOUR COMMENTS

Submissions are welcome for two months after the release date of the draft management plan and can be made online at: http://www.dec.wa.gov.au/haveyoursay or by writing to:

Planning Coordinator
Parks and Reserve of Yanchep and Neerabup Draft Management Plan
Department of Environment and Conservation
Locked Bag 104, Bentley Delivery Centre
BENTLEY WA 6983

Alternatively, submissions can be sent to: Planning@dec.wa.gov.au

HOW YOUR COMMENTS WILL BE CONSIDERED

All submissions will be summarised according to topics discussed. The Management Plan will then be reviewed in the light of submissions, according to established criteria (see below). A summary of the submissions will be prepared along with the Final Management Plan, including an indication of how the Plan was amended or not amended in response to the submissions:

1. The draft management plan *will* be amended if a submission:
   (a) provides additional information of direct relevance to management;
   (b) provides additional information on affected user groups of direct relevance to management;
   (c) indicates a change in (or clarifies) Government legislation, management commitment or management policy;
   (d) proposes strategies that would better achieve management objectives; or
   (e) indicates omissions, inaccuracies or a lack of clarity.

2. The draft management plan will not be amended if a submission:
   (a) clearly supports proposals in the plan;
   (b) makes general statements and no change is sought;
   (c) makes statements already in the plan or were considered during the plan preparation;
   (d) addresses issues beyond the scope of the plan;
   (e) is one amongst several widely divergent viewpoints received on the topic but the text/strategies in the plan are still considered the preferred option;
   (f) contributes options that are not feasible (generally due to conflict with existing legislation, Government policy, lack of resource capacity or lack of research knowledge to make decisions);
   (g) is based on unclear, factually incorrect information; or
   (h) provides details that are not appropriate or necessary for inclusion in a document aimed at providing management direction over the long term.

EXECUTIVE SUMMARY

All national parks, conservation parks and nature reserves in Western Australia are vested in the Conservation Commission of Western Australia (Conservation Commission), a community based body, and managed by the Department of the Environment and Conservation (the Department or DEC) under provisions of the *Conservation and Land Management Act 1984* (CALM Act).

The *Parks and Reserves of Yanchep and Neerabup draft Management Plan 2010* has been prepared by the Department on behalf of the Conservation Commission and provides a statement of policies and guidelines proposed to be followed and a summary of operations proposed to be undertaken in the management plan area as specified under the CALM Act. The term of the final management plan will be 10 years once approved by the Minister for Environment, or until the plan is superseded by a new management plan.

This draft management plan provides some background information to provide context to the planning area's values, issues and subsequent management decisions. The Parks and Reserves of Yanchep and Neerabup planning area will in the future form part of a new, larger sub-regional planning area and subsequent plans will be consistent with the approach being considered for such regional planning areas. The final management plan will be reduced in size and will only have an emphasis on the objectives and strategies.

This draft management plan covers Yanchep National Park, Neerabup National Park, Neerabup Nature Reserve, proposed addition known as Ridges and smaller reserves adjacent to Neerabup National Park (a total area of 6371 ha). Collectively, these are known as the planning area and are located in the northwest sector of the Perth Metropolitan area within the local government area of the City of Wanneroo.

The planning area is an important conservation area set within an urban context, containing unique cave and karst features, a relatively undisturbed freshwater wetland system, diverse and undisturbed remnant vegetation and rich diversity of native fauna. Yanchep National Park features a wetland of national importance, supporting a diverse range of flora and fauna including migratory waterbirds. The planning area also contains Threatened Ecological Communities such as the root mat communities within the caves of Yanchep National Park, which have been found to support relictual endemic fauna species. The diverse and relatively undisturbed remnant vegetation of the planning area, occurring on the largely cleared swan coastal plain, contributes as a corridor to contiguous fauna movement for species such as the 'endangered' Carnaby's cockatoo and 'vulnerable' chuditch. This draft management plan includes strategies to reduce the detrimental effects threats such as land clearing, introduced animals, weeds and declining groundwater levels can have on the natural values of the planning area.

Several wetlands and their associated vegetation are significant for their Indigenous and non-Indigenous cultural values. Some parts of the planning areas were originally part of a historical Indigenous migratory route and later became a stock route. There are many sites of Indigenous mythological, ceremonial and other significant sites associated with several of the wetlands and caves located in the planning area. In addition, clusters of heritage listed buildings located in Yanchep National park are now rare and depict a popular recreational setting from the late 1930s. This draft management plan includes a range of strategies to protect the unique cultural values, while maintaining the opportunity for sustainable use of the area.

The planning area is a place of recreation and relaxation in close proximity to growing urban centres. It has many aquatic and terrestrial environments and landscapes of high aesthetic qualities that offer opportunities for a range of recreational activities including wildlife viewing, picnicking, golfing, bushwalking, guided walks/activities and boating. The collection of natural and cultural values provides opportunities for a variety of recreational nature-based tourism activities and services. There are also many opportunities to establish tourism businesses based on the unique natural and cultural values and the provision of high quality facilities. This management plan includes strategies to consolidate services and facilities in the McNess Recreational Area and avoid duplication of recreational opportunities within close proximity to the planning area.

Declining groundwater levels in the planning area and surrounding areas are a constant threat to ecosystems including the threatened root mat communities and wetlands. The issue of declining groundwater levels is being addressed by cross-government initiative called the Gnangara Sustainability Strategy.

The planning area remains an urban hub for volunteer groups and an educational resource for schools due to its array of natural and cultural heritage values in close proximity to growing urban centres that provide valuable opportunities for community education and the raising of cultural and environmental awareness. The

Department and the Conservation Commission also understand that effective management of the planning area depends on the support, cooperation and participation of the community, and therefore seek to ensure that there is ample opportunity for the community to be involved – both in the preparation of the management plan as well as the ongoing management of the planning area. Strategies in the plan have been developed by taking into consideration comments received from the community and key stakeholders during preparation of the draft plan. There is now further opportunity to provide information, express your opinion or suggest alternatives on how the planning area should be managed over the next 10 years.

This management plan is a values and issues based document. It outlines specific management requirements to address the protection of key values, predominantly focussing on minimising their associated threats. The management planning area's key values are identified in Section 4.

Once finalised, the Conservation Commission and Department will seek to achieve the plan's objectives by taking the actions specified, dependent upon, to some extent, the provision of necessary resources. Reports by the Conservation Commission on the implementation of the plan will make it clear if any actions have not been progressed and for what reasons.

Changes since the previous management plan

Yanchep National Park is the only reserve within this draft management plan's planning area with a current management plan; *Yanchep National Park Management Plan 1989-1999* (CALM 1989a). Several changes have taken place in the planning area since 1989:

- Pipidinny and Beonaddy Swamps were significant additions to Yanchep National Park in 2002;
- a number of studies have been undertaken in response to concerns about the changes in regional groundwater levels (see Part C *Managing the Natural Environment*);
- management and monitoring of, and investigation into, declining groundwater within the Gnangara groundwater system and the natural environment on which it depends has continued since 1995, and the *Gnangara Sustainability Strategy* has been established as a cross-government initiative to ensure the sustainable use of water for drinking and commercial purposes and to protect the environment; and
- visitor numbers at Yanchep National Park have increased from about 122 000 per year in 1994 to 233 000 in 2008. This has been, in part, a result of an expanding metropolitan population, greater awareness of the environment by the community as well as improvements to recreation facilities in the area.

ACKNOWLEDGEMENTS

This management plan was prepared by Department planning officers Helen Holzheuer, Terese Dimascia, Paul Roberts and Paul McCluskey.

Assistance was provided by Ray De Jong, Phil Smeeton, Mike Meinema, Alison Pritchard, Brad Johnson, John Wheeler, Gil Field, Stev Slavin, Tracy Churchill, Jeremy Flynn, Koodah Cornwall, David Mitchell, Lyndon Mutter, Melissa Hoskins, Alan Sands, Paul Brown and Leigh Sage.

The planning team would like to thank the many other Departmental staff that contributed to and commented on sections of this plan.

The assistance of current members of the Yanchep National Park Advisory Committee is also especially acknowledged:

- Hugo Bekle (Chair);
- Peter Gibbes;
- Grant Williamson;
- Laura Gray;
- Peter Brookes;
- Alan Tapper; and
- Pascal Scherrer.

Graeme Rundle from The Conservation Commission has, on occasion been an observer for this plan.

The assistance of members of the Yanchep National Park Caves Advisory Committee:

- Lex Bastian (Chair);
- Rob Foulds;
- Rob Susac;
- Richard Wood;
- Eve Taylor;
- Inga Price; and
- Jeff Murray.

Speleological groups:

- Western Australian Speleological Group; and
- Australian Speleological Federation.

Front cover main image: Crystal Cave. Photo by DEC.
Front cover other images: Loch McNess. Photo by DEC.
Yanchep Rose. Photo by DEC.

NOMENCLATURE

Inclusion of a name in this publication does not imply its approval by the relevant nomenclature authority. The meanings of abbreviations and general terms used throughout this plan are given below, however a glossary of technical terms and phrases is also provided (see *Glossary*).

The term 'Director General' refers to the Director General of the Department of Environment and Conservation.

The 'Minister' refers to the Minister for Environment responsible for administering the *Conservation and Land Management Act 1984* (CALM Act).

The 'Conservation Commission' refers to the Conservation Commission of Western Australia, which is the controlling body for the terrestrial conservation reserve system in WA.

The 'Department' or 'DEC' refers to the Department of Environment and Conservation.

The 'planning area' refers to the existing and proposed Crown lands and waters that will be covered by this management plan.

The 'South-west' refers to the general south-west corner of WA between Geraldton and Esperance.

When 'region' is used in this plan, it refers to the 'Perth Metropolitan' planning region used by the WA Planning Commission (see Section 2 *Regional Context*). This provides an appropriate scale for this plan to link with regional development and planning for local government.

The biogeographic boundaries for this area are referred to as 'bioregions'.

The Department's regional boundaries for this area are referred to as the 'Swan Region' (see Section 12 *Administration*).

The term 'Nyoongar' refers to Indigenous people who live in the south-west corner of Western Australia, between Jurien Bay and Esperance. The word 'Nyoongar' can be spelt in different ways, and spelling in this form should also be seen to encompass the Noongar, Nyungar, Noongah and Nyungah spellings.

In many instances throughout this management plan, the reader is referred to the Department's website for further information. The website address for The Department is http://www.dec.wa.gov.au/ . This website also contains a range of other information that can be accessed that is of relevance to this management plan.

CONTENTS

PART A. INTRODUCTION

1. BRIEF OVERVIEW

This draft management plan covers Yanchep National Park, Neerabup National Park, Neerabup Nature Reserve and proposed addition known as Ridges and smaller reserves adjacent to Neerabup National Park (a total area of 6371 ha) (see Map 1).

The planning area is located in the northern suburbs of Perth and contains extensive areas of tuart and Banksia vegetation communities and the Yanchep suite of wetlands.

The planning area has a number of important key values (see Section 4 *Key Values*) and is recognised for a number of geological, hydrological, flora, fauna and ecological community values, which are subject to a range of threatening processes. The area also has a long and valued cultural history, both through Indigenous occupation and early 20th century settlement. Recreation and tourism are key values of the planning area, boasting unique services such as the koalas, rowboats and cave tours. The area is a valuable setting for education and community opportunities due to its close proximity to the metropolitan area.

2. REGIONAL CONTEXT

The planning area is located in the northwest sector of the Perth Metropolitan area within the local government area of the City of Wanneroo.

Yeal Nature Reserve, Gnangara Park and the Wilbinga/Caraban conservation areas are situated north-east of Yanchep National Park. The proximity of these conservation reserves or proposed conservation reserves to the planning area, along with their relatively undeveloped surrounds, provide valuable opportunities for strengthening wildlife corridors.

Along the coast to the west of the planning area, land use is dominated by urban development. The northwest sector of the metropolitan area has recorded consistent population growth, and projections indicate continued growth to at least 2031 (WAPC 2005) (see Figure 1). The development of infrastructure for transport and public utilities along the western side of the planning area for example, has, and will continue to directly impact upon the values of Yanchep and Neerabup national parks. Other pressures associated with urbanisation include increases in introduced animals, environmental weeds, unauthorised access/use and the risk of wildfire. On the other hand, the increase in local population also provides opportunities for improving community awareness of and support for conservation management and engendering community ownership over, and support for, the conservation reserves.

Embedded in an increasingly urban setting, the reserves of the planning area provide the local population with valued opportunities for nature-based recreation and tourism. The combination of uncommon features such as caves, opportunities to learn about Nyoongar culture, historic buildings and urban bushland contribute significantly to the diversity of recreational opportunities available in the broader region, and are a significant drawcard for interstate, international and local visitors. Other regional recreational opportunities include those provided through restaurants, wineries, botanic gardens, golf courses, regional parks, wildlife parks and the coast.

East of the planning area, the land use is predominantly State forest (mainly pine plantation) and rural/semi-rural. Previously, the *Gnangara Park – A Preliminary Concept Plan* (CALM 1998a) provided some broad guidance on major conservation and recreation initiatives in the region and involved the progressive harvesting of the existing pine plantations (see Map 2), subsequent revegetation with native species and the establishment of conservation and recreation area. In 2009 the *Draft Gnangara Sustainability Strategy* (DoW 2009) was released for public comment and provided further direction and clarification on a range of water and land use matters in the area including:

- improved groundwater protection and recharge;
- strengthening of wildlife movement corridors; and
- opportunities for diverse, yet complementary, nature-based recreation.

The final Gnangara Sustainability Strategy will provide strategic direction for management of the Gnangara area.

The proposed Gnangara Park, with the exception of those areas proposed for addition to Yanchep National Park (see Map 2), offers valuable opportunities for meeting some of the demand for more intensive recreational activities and addressing unauthorised access/use of the planning area (see Section 29 *Visitor Access*). Until suitable alternative areas are provided elsewhere in the region for activities such as trail bike and horse riding, preventing unauthorised use of the planning area for such purposes is likely to remain a significant management challenge.

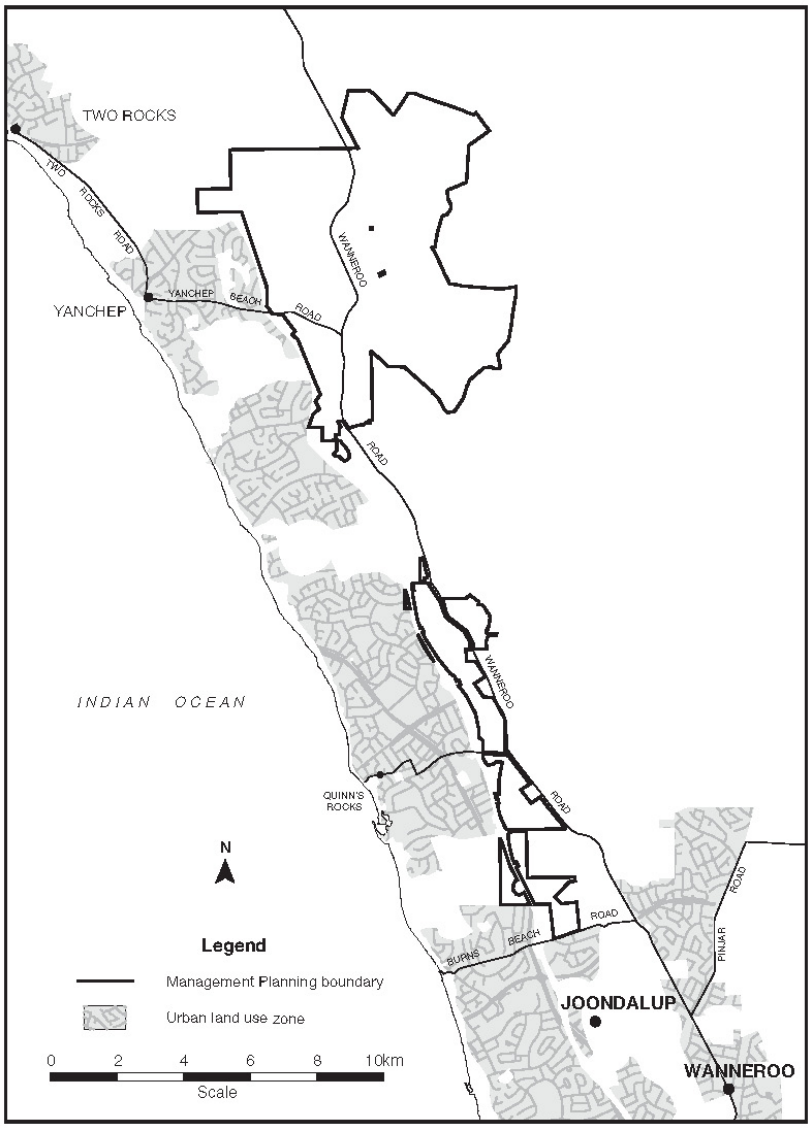


Figure 1: Projected urban expansion by 2030

Major industries in the region include construction, manufacturing, horticulture and retail trade. A small industrial area to the east of Neerabup National Park and Neerabup Nature Reserve provides for a wide range of industrial activities (e.g. production, processing storage, wholesale and distribution processes).

3. MANAGEMENT PLAN AREA

This management plan covers the following areas (Map 1 and 2):

- Yanchep National Park;
- Neerabup National Park; and
- Neerabup Nature Reserve.

The planning area also includes several proposed additions to the conservation estate in the future, such as:

- the 'Ridges' area within State forest 65 to be added to Yanchep National Park;
- reserves 13713, 25252 and 25253 identified as a future part of Neerabup National Park; and
- Lots 14, 11, 52, 2 and 66 as part of the Bush Forever Scheme No. 383 to be incorporated into Neerabup National Park (Map 2) (see Section 10 *Existing and Proposed Reserves*).

The provisions of the final management plan will apply to these areas if they become part of the conservation reserve system managed under the *Conservation and Land Management Act 1984* (CALM Act).

4. KEY VALUES

The key values of the planning area include:

Natural

- unique cave and other karst features of biological, scientific and cultural importance;
- a relatively undisturbed freshwater wetland system (including a wetland of national importance) that supports a diversity of native flora, fauna and communities (including numerous resident and migratory birds) that are dependent on the wetlands;
- diverse and relatively undisturbed remnant vegetation, occurring on the largely cleared Swan Coastal Plain, and contributing to a significant relatively contiguous fauna movement corridor;
- a rich diversity of native fauna and habitat including habitat important in the protection of quenda, water rats, Carnaby's cockatoos, waterbirds, brush wallaby and bats; and
- unique and threatened fauna including relictual endemic species from when Australia was part of Gondwanaland.

Cultural

- several Indigenous sites of mythological, ceremonial and other significance;
- part of a historical use as an Indigenous migratory route;
- part of a historical stock route; and
- clusters of heritage-listed buildings of a type that are now rare from pre-1950s.

Recreation and Tourism

- aquatic and terrestrial environments that offer opportunities for a range of recreational activities including wildlife viewing, picnicking, golf, bushwalking, guided walks/activities and boating;
- an array of natural and cultural values within close proximity to urban centres that provide significant opportunities for a variety of recreational nature-based tourism activities and services;
- natural and cultural visual landscapes of high aesthetic quality; and
- a place of recreation and relaxation in close proximity to growing urban areas.

Education and Community

- an array of natural and cultural heritage values within easy access of populous urban centres that provide valuable opportunities for community education and the raising of cultural and environmental awareness;
- an urban hub for volunteer groups; and
- an educational resource for schools.

Scientific

- diverse and relatively undisturbed mixture of flora, fauna and geological features of scientific interest in an area within easy access of Perth and the State's major research institutions.

Social and Economic

- opportunities to establish tourism businesses based on the unique natural and cultural values and the provision of high quality facilities.

PART B. MANAGEMENT DIRECTIONS AND IMPLEMENTATION

5. LEGISLATIVE FRAMEWORK

Planning for conservation reserves occurs at a number of levels. Management plans are a part of a broad suite of planning undertaken by relevant managing agencies. Management plans are guided by legislation and policy (Figure 2), and in turn provide guidance for subsidiary management documents such as fire response plans, weed and feral animal control plans and recreation site development plans.

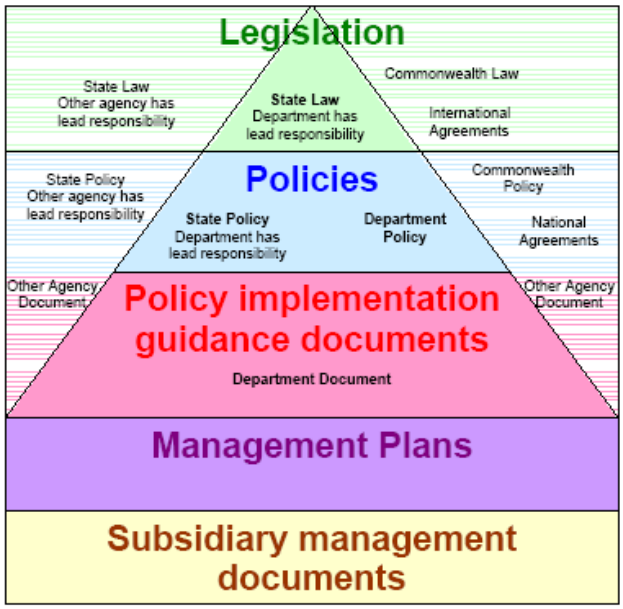


Figure 2: Management Planning Hierarchy Legislation

This shows that management plans are guided by legislation and policy and in turn provide guidance for subsidiary management documents such as fire response plans, weed and feral animal control plans and recreation site development plans.

Legislation

The CALM Act establishes the Conservation Commission of Western Australia (Conservation Commission). The lands vested in the Commission are managed by the Department. On behalf of the Conservation Commission, the Department prepares regional, specific area or several areas within a defined geographic area plans on a priority basis. The Conservation Commission issues draft plans for public comment and provides a final plan for approval by the Minister for Environment.

The CALM Act governs the declaration and management of protected areas and in the process imposes certain obligations relating to management planning of these areas. With regard to management plans, Sections 54-56 of the Act specify that:

- the Conservation Commission is responsible for the preparation of management plans, through the agency of the Department, for all land vested in it;
- a management plan must contain a statement of policies or guidelines to be followed in the management of the area, and a summary of the operations proposed to be taken over the life of the plan; and
- the management objectives for various categories of land (see Section 9 *Land Tenure and Classification* for the categories of land with the planning area).

The procedure to make an amendment to a gazetted management plan is governed by section 61 of the CALM Act and involves a public consultation process.

The Department is also responsible for administration of the *Wildlife Conservation Act 1950* and associated regulations 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. These and other statutory provisions of relevance to the planning area are referred to throughout this plan where relevant.

There are a number of other Acts affecting the Department's activities or conferring specific powers on the Department. These and other statutory provisions of relevance to the planning area are referred to throughout this plan where relevant. Of most importance to this plan are:

- *Aboriginal Heritage Act 1972* (Aboriginal Heritage Act). Under this Act the Department is required to report Indigenous heritage sites and ensure that sites are protected.
- *Bush Fires Act 1954* (Bush Fires Act). This management plan is required to conform to this Act and satisfy the Fire and Emergency Services Authority that adequate fire protection will be provided. Under section 34 (1a)(a) of the Act, management plans require approval from the Authority. Under section 45 of the Bush Fires Act, the Department may take responsibility for the suppression of fires threatening the conservation estate.
- *Environmental Protection Act 1986* (Environmental Protection Act). This Act provides for protection of the environment across the State. The Act provides for the development of Environmental Protection Policies and the assessment of development proposals and planning schemes for potential environmental impacts. Significant development proposals may be referred to the Environmental Protection Authority under the auspices of this Act.
- *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC Act). This Act contains provisions relating to the protection of nationally-listed threatened species and ecological communities, listing of key threatening processes, heritage protection and will also apply to areas that become listed under the Ramsar Convention on Wetlands.
- *Heritage of Western Australia Act 1990* (Heritage of Western Australia Act). This Act provides for the registration and protection of places of historic interest on land as 'heritage places'.
- *Native Title Act 1993* (Native Title Act). This Act requires native title claimants and representative bodies to be advised when a management plan is being prepared or major public works undertaken.
- *Planning and Development Act 2005* (Planning and Development Act). This Act allows the WA Planning Commission (WAPC) to prepare planning strategies for the State. Such planning strategies are prepared to coordinate and promote regional land use planning and land development, and guide Government departments, authorities and local government.
- *Mining Act 1978* (Mining Act) and *Petroleum and Geothermal Energy Resources Act 1967* (Petroleum and Geothermal Energy Resources Act). Both Acts take precedence over the CALM Act. Any activities authorised under either of these Acts may override the contents of this management plan (see Section 34 *Mineral and Petroleum Exploration and Development*).

In addition to legislative specifications, this management plan also conforms to other statutory policies and policies of the Department.

Policies and Strategies

Government and Departmental policies specifically mentioned in this plan relate to the management of Department-managed land for matters such as weeds, fire, disease, rehabilitation, recreation and tourism, community involvement, flora, fauna, visual landscape and visitors. These policies are referred to below and in the appropriate sections of this plan.

Good Neighbour Policy

Whilst the Department's management is limited to the public conservation estate, there may be significant biodiversity conservation values in adjoining lands, which may be significant in their own right and/or complementary to the Department's management of the conservation estate. The Department manages land surrounded by many neighbouring properties, making common cross-boundary management important in dealing with a range of mutual issues of interest. To this end, the Department has released its *Good neighbour*

policy (DEC 2007a), which is aimed at building and maintaining mutually beneficial relationships with neighbours to deal with a range of cross boundary management issues.

Obligations and Agreements

Australia is a participant or signatory to a number of important international and national conservation agreements, which may affect management of the planning area. They include the following:

- *Convention of Biological Diversity (Rio Convention)*;
- *Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) and Korea-Australia Bird Agreement (ROKAMBA);*
- *Bonn Convention;*
- *Forest Management Plan 2004-2013;*
- *Metropolitan Region Scheme;*
- *Convention on Wetlands of International Importance (Ramsar Convention);*
- *National Wetlands Program*; and
- *Burra Charter*.

6. MANAGEMENT ARRANGEMENTS WITH INDIGENOUS PEOPLE

Traditional custodians have a strong desire to 'care for country' according to their traditional laws, to be involved in the management of conservation estate in Western Australia and to strengthen cultural ties to the land. Working together with Indigenous people to care for the land will be beneficial to the preservation of natural and cultural heritage, as well as enriching cross-cultural awareness. The involvement of traditional custodians in the joint management of conservation estate also provides a suite of cultural, spiritual and economic benefits to Indigenous people.

The Conservation Commission and the Department acknowledge the aspirations of Indigenous people to obtain native title over their traditional lands and waters under the provisions of the Native Title Act. Both agencies acknowledge that native title rights and interests may be found to exist, except where they have been legally extinguished under Australian law.

6 – Management Arrangements with Indigenous People

The objective is to facilitate joint management between the Department and the Indigenous people.

This will be achieved by:

1. contributing to the negotiations of an Indigenous Land Use Agreement under the provisions of the Native Title Act;
2. incorporating values of the traditional custodians to inform and guide management actions;
3. providing training and employment opportunities for Indigenous people in all aspects of management; and
4. where appropriate, using traditional Indigenous names for the planning area.

7. MANAGEMENT PLANNING PROCESS

The Department initiates the preparation of management plans according to State-wide priorities and in consultation with, and on behalf of, the Conservation Commission. The process of producing a management plan (Figure 3) is an integral and ongoing part of management of the planning area and protection of its key values.

The process of producing a management plan is as follows:

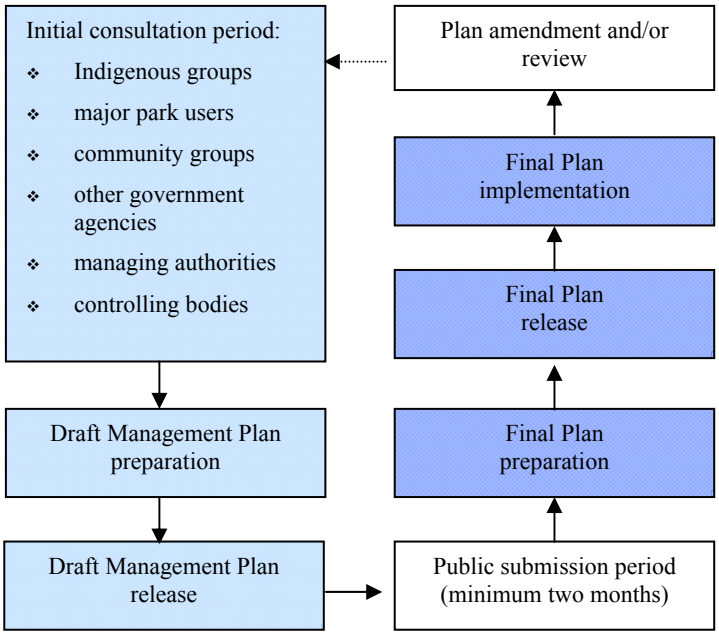


Figure 3: Management Planning Framework[1]

8. PUBLIC PARTICIPATION

This draft management plan has been developed in consultation with key stakeholders, park users and other interested parties in the following ways:

- development and distribution of an 'Issues Paper' to inform and assist the public in participating in the management planning process;
- meetings with the Yanchep National Park Advisory Committee and Yanchep National Park Caves Advisory Committee;
- meetings with key stakeholders;
- providing regular updates to keep interested parties informed of developments in the planning process (ie. the Department's 'Planning Diary' newsletter);
- providing regular media releases at key stages of the planning project; and
- consultation with government agencies including the Department of Indigenous Affairs, Department of Water and 'City of Wanneroo'.

The assistance of the Yanchep National Park Advisory Committee in facilitating public input to the management plan is especially acknowledged.

9. LAND TENURE AND CLASSIFICATION

Land tenure is used to describe the form of right or title to land and is usually designated private (freehold) land or Crown land. In Western Australia, the security of tenure of Crown reserves created under the *Land Administration Act 1997* varies, depending upon whether the reserve is 'class A' or 'other than class A' (unclassified). This system therefore determines the degree of difficulty involved in changing the tenure of Crown reserves. A change to a class 'A' reserve requires the agreement of both Houses of Parliament. Changes to an unclassified reserve require approval at Ministerial level.

Crown land managed by the Department fall into three broad categories:

- Crown reserves vested in the Conservation Commission, Marine Parks and Reserves Authority (MPRA) or Conservation and Land Management Executive Body (formerly the Executive Director Body Corporate);

[1] The framework outline in Figure 1 is not a statutory but rather a policy framework.

- State forests and timber reserves created under the CALM Act, which are vested in the Conservation Commission; and
- unmanaged Crown reserves and UCL that fall outside the Perth Metropolitan area and town sites.

Management by the Department is carried out according to Government policies and as specified in management plans submitted by the controlling bodies and approved by the Minister for Environment.

Table 1: Land Category, Purpose, Class and Management Objective

Land Category	Purpose	Class	Management Objective
Nature reserve	Conservation of Flora and/or Fauna*	Either class A or other than class A (unclassified)	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
National park	National park *	Mostly class A	To fulfil so much of the demand for recreation as is consistent with the proper maintenance and restoration of the natural environment, the protection of indigenous flora and fauna, and the preservation of any features of archaeological, historic or scientific interest
State forest	Various, including conservation, recreation, water catchment protection and timber production on a sustained yield basis, as well as other purposes prescribed by the regulations, which may include beekeeping	** Similar to class A, requiring Parliamentary approval to excise or cancel	To achieve the optimum yield in production consistent with the satisfaction of long-term social and economic needs

* Created under the Land Act, Land Administration Act or any other Act for the purpose specified.

Land Categories

Section 5(1) of the CALM Act lists ten categories of lands and waters to which the Act applies.

The categories relevant to the planning area are listed in Table 1.

10. EXISTING AND PROPOSED RESERVES

Existing Reserves

This management plan covers the three existing CALM Act Reserves (Table 2) of:

- Yanchep National Park;
- Neerabup National Park; and
- Neerabup Nature reserve.

Yanchep National Park was originally gazetted on 25 August 1905 for the purpose of 'Protection and preservation of caves and flora' and 'for health and pleasure resort'. It became a National Park in 1969. The 18.1 ha Pipidinny Swamp (Swan Location 13711) and 16.2 ha Beonaddy Swamp (Swan Location 13712) were added to Yanchep National Park on 12 September 2002. Yanchep National Park is an official name, which was gazetted on 9 May 1969.

Neerabup National Park was originally gazetted on 2 July 1965 for the purpose of 'national park', and the current name was officially gazetted on 24 December 1976.

Neerabup Nature Reserve was originally gazetted on 2 November 1956 as a 'Sanctuary for fauna', but was changed to the purpose of 'conservation of flora and fauna' on 29 January 1993. There has been no official gazettal of the reserve's name.

Table 2: Existing CALM Act Reserves

Reserve	Purpose	Vesting	Class	Area (ha)	Proposed Changes
Yanchep National Park (Crown Reserve No. 9858)	National Park	Conservation Commission	A	2,877	Incorporation of the 'Ridges' area of State Forest 65. Incorporation of Yeal Swamp road reserve.
Neerabup National Park (Crown Reserve No. 27575)	National Park	Conservation Commission	A	937	Incorporation of Reserves 13713, & 25253 into Reserve 27575. Establishment of Reserve 25252 as a section 5(1)(h) reserve. Incorporation of Lots 14, 11, 52, 2 and 66 into Reserve 27575.
Neerabup Nature Reserve (Crown Reserve No. 24581)	Conservation of flora and fauna	Conservation Commission	A	132	
TOTAL				3,946	

Proposed Reserves

The provisions of the final management plan will apply to these proposed reserves if they become part of the conservation reserve system managed under the *Conservation and Land Management Act 1984* (CALM Act).

Yanchep National Park Additions

Part of State Forest 65, known as the 'Ridges' area, has been subject to a long-standing proposal for addition to Yanchep National Park (Map 2). There was a recommendation to include the 'Ridges' into Yanchep National Park in several reports and policies, including:

- System 6 report (Department of Conservation and Environment 1983);
- *Northern Forest Regional Management Plan 1987-1997;*
- *Yanchep National Park Management Plan 1989-1999*; and
- *Forest Management Plan 2004-2013.*

The 'Ridges' has high conservation value, and is sought to supplement and buffer Yanchep National Park. There are mineral interests in the 'Ridges' area (see Section 38 *Mineral and Petroleum Exploration and Development*).

Yeal Swamp road, which traverses through Yanchep National Park and Ridges, had long been planned to become a sealed road. It is recommended that the road reserve be added to the planning area as an offset to the excisions made for the Mitchell Freeway extension.

Neerabup National Park Additions

There are also three small reserves proposed for addition to Neerabup National Park, which are all located along the eastern boundary of the park (Map 2) and they will increase the area of the park by 42.7 ha:

- Reserve 13713, which was originally gazetted in 1911, is a 16.2 ha 'C' class reserve vested with the City of Wanneroo for the purpose of 'camping'.
- Reserve 25252, which was originally gazetted in 1959, is a 6.3 ha 'C' class reserve vested with the City of Wanneroo for the purpose of 'land fill site'.
- Reserve 25253, which was originally gazetted in 1959, is a 20.2 ha 'C' class reserve vested with the City of Wanneroo for the purpose of 'quarry'.

The above proposals originate from a variety of sources including:

- additions agreed to in compensation for excisions from the park for the purpose of developing the transportation corridor (ie. Mitchell Freeway and railway extension);
- additions arising from various Metropolitan Region Scheme (MRS) Amendments.

There are several issues regarding the addition of reserve 25252, mainly relating to the site having been reported as a possible contaminated site by the City of Wanneroo in accordance with reporting requirements of the *Contaminated Sites Act 2003*. This particular reserve has also been subject to weed infestation and rubbish dumping in the past, although the District has carried out some weed control and rubbish removal. It is likely that the other two reserves (25253 and 13713) will be transferred as class 'A' reserves and that reserve 25252 should be subject to further investigation of any possible contamination at the site. It is likely that reserve 25252 may initially be established as a section 5(1)(h) reserve until such a time it can be incorporated into Neerabup National Park.

Other additions to Neerabup National Park include five parcels of WAPC freehold land (see Map 2), which will increase the area of the park by 308.3 ha. These parcels of land have been acquired through the Bush Forever scheme (Site no. 383) and various MRS Amendments. The proposed areas to be added to Neerabup National Park include:

- Lot 14 (111.49 ha);
- Lot 11 (140.2 ha);
- Lot 52 (37.9 ha);
- Lot 2 (8.7 ha); and
- Lot 66 (10.0 ha).

Three small areas have been disconnected from the western side of Neerabup National Park due to the proposed extension of the Mitchell Freeway (see Map 2). These small areas are in close proximity to Tamala Park and Burns Beach Bushland, both of which were created from MRS Amendments allocating the land for purposes of 'parks and recreation' and are part of the Bush Forever Site 232. It is recommended that the management of the three isolated parcels of land be associated with Tamala Park and Burns Beach Bushland.

All identified proposed additions will be managed consistent with the objectives and strategies in this management plan once they are vested with the Conservation Commission. Any other reserve additions not identified as part of this planning process but occurring in the vicinity of the planning area will be managed in accordance with the principles of this management plan.

Lot 51 near the south-east boundary of Yanchep National Park had been identified as containing high conservation values such as karst and its associated significant vegetation communities. Consideration should be given to purchasing this area.

10 – Existing Reserves

The objective is to protect conservation reserves of the planning area by providing maximum security of tenure, class and purpose.

This will be achieved by:

1. initiating all tenure actions for which the Department and the Conservation Commission are responsible for, as specified in Table 2; and
2. continuing to make acquisitions as property becomes available, subject to an assessment of its natural values against the criteria for a CAR reserve system.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
10.1 Tenure actions for which the Department and Conservation Commission are responsible.	10.1 Complete all tenure actions for which the Department and Conservation Commission are responsible for.	After 5 years.

11. PERFORMANCE ASSESSMENT AND MONITORING

The functions of the Conservation Commission under section 19(1)(g) of the CALM Act are:

- to develop guidelines for monitoring and assessing the implementation of the management plans by the Department;

- to set performance criteria for assessing and auditing the performance of the Department in carrying out and complying with management plan(s); and
- to assess and audit the performance of the Department in carrying out and complying with management plan(s).

It is not efficient to measure all aspects of management given resource and technical impediments – consequently indicators will target key components or values of the plan. Each key performance indicator (KPI) comprises evaluation of a measure and target, reporting requirements and a management response to any shortfall.

KPIs are an integral component of adaptive management. Adaptive management is a process whereby monitoring and other research is utilised to evaluate whether the management being implemented is adequately meeting the management objectives, and, whereby management can be adapted as necessary in the light of new knowledge or conditions. This is a reiterative process in which there are ongoing adjustments in management as needed to take account of and respond to changing conditions.

The Department is responsible for providing information to the Conservation Commission to allow it to evaluate 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. Where a report identifies a target shortfall, a response to the Conservation Commission is required. The response will 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. The Conservation Commission will make the results of audits available to the public.

The application of a KPI is identified for relevant sections throughout the plan.

12. ADMINISTRATION

For administrative purposes, the Department is structured into nine Regional centres that are further sub-divided into Districts. The planning area is in the Swan Coastal District of the Swan Region. The day-to-day implementation of the final management plan will be the responsibility of the District Manager of the Swan Coastal District, who coordinates the operational management of parks and reserves in the planning area, as well as the Park Manager of Yanchep National Park. This is largely undertaken from the Yanchep National Park office and the District office in Wanneroo. Other staff based at the District office such as Nature Conservation leaders and Landscape Architects are responsible for overseeing various projects in the Swan Coastal District, including those undertaken in the planning area.

Many park staff are also based within Yanchep National Park, which contains a number of buildings for administration and management, park entry, residential and maintenance services, as well as for a variety of other cultural, recreation and economic uses (see Section 30.1 *Day Use – McNess Recreation Area*). Specifically, park staff based at Yanchep, such as ground staff, Park Rangers and the Operations manager are responsible for the day-to-day maintenance of Yanchep and Neerabup National parks and reserves.

13. TERM OF THE PLAN

The management plan for the planning area, including Yanchep National Park, Neerabup National Park and Neerabup Nature Reserve will guide management of the planning area for a period of ten years from the date the final management plan is gazetted. During this time, amendments to the final management plan are allowed under section 61 of the CALM Act. If an amendment is necessary, the proposed changes will be released for public comment.

At the end of the ten-year period, the management plan may be reviewed and a new management plan prepared. The new management planning process requires full public consultation and approval from the Minister for Environment. In the event that the plan is not reviewed and replaced by the end of the ten-year period, this plan will remain in force unless revoked by the Minister for Environment.

PART C. MANAGING THE NATURAL ENVIRONMENT

Urban and other development within the Perth Metropolitan area and on the Swan Coastal Plain has had, and continues to have, dramatic impacts on the natural environment. The parks and reserves of the planning area, being isolated remnants of natural bushland within the highly modified landscape, are increasingly important refuges for a range of natural values (see Section 4 *Key Values*), but are also increasingly susceptible to many pressures, particularly those associated with fragmentation[2] of native vegetation and changes in regional groundwater levels.

In addressing these pressures, it is important to recognise the often significant influences of 'external' factors (ie. in the surrounding landscape) on the biodiversity and ecological processes of the planning area reserves, and to foster integrated, co-operative approaches to minimise any potential adverse impacts on the planning area's natural environment.

This chapter will describe the natural values, the threats to these values and strategies proposed by the Department to mitigate the threats. Major foci for managing the planning area's natural environment within this management plan are to:

- include the 'Ridges' area and other reserve additions into the management of the parks and reserves (see Section 14 *Bioregions*);
- improving knowledge of, and conserving, karst features (see Section 15 *Geology, Landforms and Soils*);
- protecting, maintaining and monitoring the health of wetlands and organic-rich soils (see Section 15 *Geology, Landforms and Soils*);
- protecting and conserving threatened flora, ecological communities and fauna, particularly the endemic cave invertebrates species restricted to Yanchep (see Section 19 *Ecological Communities*);
- continuing to control priority introduced and other problem animals and environmental weeds, particularly in areas that may impact on threatened species and communities (see Section 20 *Environmental Weeds* and Section 21 *Introduced and Other Problem Animals*);
- identifying protectable areas that are not infested by *Phytophthora cinnamomi* (see Section 22 *Diseases*);
- managing fire to protect and promote the biodiversity of ecosystems and to protect life and community assets, particularly the protection of wetlands and organic-rich soils (see Section 23 *Fire*); and
- gaining better knowledge and understanding of the natural values, threatening processes and their impacts within the planning area and adapting management accordingly.

14. BIOREGIONS

The National Reserve System (NRS) is a Commonwealth Government initiative adopted to preserve Australia's native biodiversity on a regional scale and establish a protected reserve system that meets the world's best standards in terms of comprehensiveness, adequacy and representativeness (CAR) (Thackway and Cresswell 1995). A benchmark reservation level has been set for this reserve system with at least 15% of each region and any subregion within it being managed as part of the public conservation estate (CALM 2003a).

The Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell 1995) is the planning framework used to implement this reserve system, dividing Australia into 85 bioregions and the State into 26 bioregions based on dominant landscape characteristics of climate, lithology, geology, landforms and vegetation (National Resource Management Ministerial Council 2004).

The planning area lies within the Swan Coastal Plain biogeographic region, which consists of a low-lying coastal plain, mainly covered with woodlands dominated by *Banksia* or tuart on sandy soils, swamp oak (*Casuarina obesa*) on outwash plains, paperbark in swampy areas and Jarrah to the east (CALM 2002). The Swan Coastal

[2] These are numerous but may include for example: impacts on wide-ranging or migratory species; changes in species composition; disturbances to key ecological relationships (e.g. plant-pollinator, predator-prey, parasite-host); reduction of genetic diversity; and increased susceptibility to weeds, pest animals or inappropriate fire regimes.

Plain is subdivided into the 'Dandaragan Plateau Subregion' (also known as SWA 1) and the 'Perth Subregion' (SWA 2). The planning area is completely within the 'Perth Subregion' (see Figure 4).

The Perth Subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone and includes a complex series of seasonal wetlands (CALM 2002). The total area of the subregion is 1,142,170 ha.

At the time of writing, the conservation reservation system includes approximately 10.5% of the pre-European extent of native vegetation cover within the Swan Coastal Plain bioregion and 11.6% of the pre-European extent of native vegetation cover within the Perth Subregion.

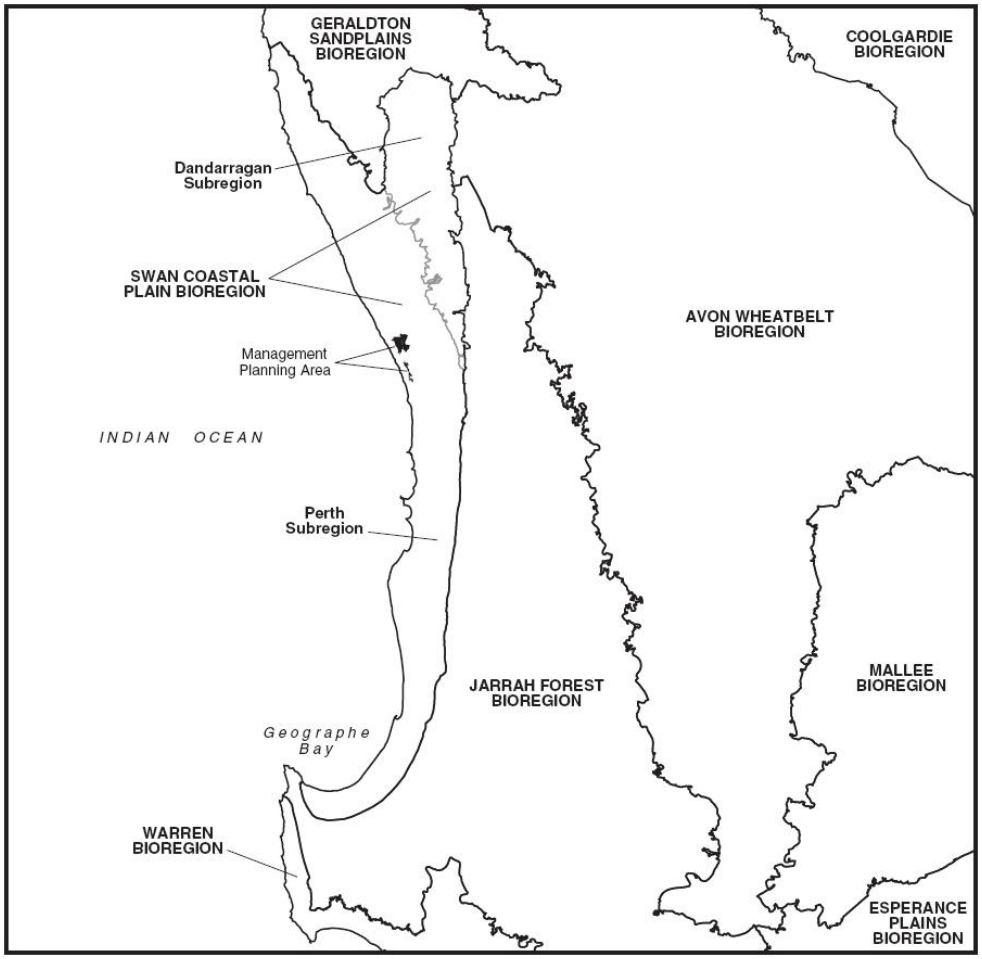


Figure 4: Bioregions

14 – Biogeography

The objective is to contribute towards a comprehensive, adequate and representative conservation reserve system that will protect biodiversity in the planning area.

This will be achieved by:

1. implementing the land tenure changes proposed in this plan;
2. when opportunities arise and funds are available, acquiring lands adjoining the planning area that have significant conservation values or management benefits; and
3. encouraging and facilitating off-reserve conservation and complementary cross-boundary management (including support of ecological linkages, liaison with key stakeholders and provision of advice on proposals relating to the surrounding land use).

15. GEOLOGY, LANDFORMS AND SOILS

Geology

Yanchep and Neerabup national parks and Neerabup Nature Reserve lie within a deep linear trough of sedimentary rocks known as the Perth Basin. The sedimentary rocks present in the planning area consist of Tamala Limestone and Safety Bay Sands and are also known as the Spearwood and Quindalup Dune System (Cockbain 1990). Within the Spearwood Dune System, there are two further subcategories of systems known as the Cottesloe sands, located to the west of the planning area and the Karrakatta sands which lie to the east of the planning area. These dune systems run roughly parallel to the coast, comprise of wind deposited marine sediments and are reflective of past sea level regressions and transgressions. Wetlands within the planning area represent areas where the watertable and depressions between the dunes intersect.

The inclusion of areas of transitional zones between the two dune systems (and between other dune systems) are considered to be of particular conservation value as transition areas (sometimes referred to as ecotones) are not well represented in the conservation reserve system and are generally associated with a relatively high biological diversity – supporting species and communities of the bordering areas as well as others restricted to the transition zone. Some of the area of Quindalup Dune System will be disturbed and/or isolated from the rest of the park once the Mitchell Freeway is extended along its western boundary (see Section 29 *Visitor Access*), and the department will need to continue to liaise with and provide advice to the relevant landholders and agencies to minimise adverse impacts on conservation values.

Much of the Spearwood Dune System in the metropolitan area has also been cleared for urban development, and the planning area represents a significant proportion of that which is within conservation reserves[3]. Large limestone ridges associated with this system are of conservation significance (Weston and Gibson 1997), however most of those in the metropolitan area have been lost to or are threatened by urban development and mining pressures. The proposed addition of the Ridges area to Yanchep National Park is sought to provide greater protection to some of the few and best remaining examples of massive limestone ridges (and associated flora and fauna communities) currently poorly represented in the conservation reserve system.

Karst

The sediments of the Spearwood Dune System (and to a much lesser extent the Quindalup Dune System) are conducive to the development of karst under particular physical conditions (e.g. those giving rise to the significant intersection of groundwater with the dune system). An extensive karst system is encompassed within Yanchep National Park, where the predominant water flow into the limestone is as diffuse groundwater flow from below (from east to west), and where the watertable in the underlying sand intersects the base of the Tamala limestone (Finlayson and Hamilton-Smith 2003)[4].

Over 570 limestone cave and karst features have formed in the Tamala limestone existing in and adjacent to Yanchep National Park (Christie Mahony *pers. comm.* 2008), although further survey and mapping over time may reveal more karst features. Because the Quaternary limestone is not well cemented, collapses of cave chambers and passages are a common characteristic (Finlayson and Hamilton-Smith 2003). Load bearing capacity varies in such dynamic karst landscapes (e.g. depends on the degree and nature of cementation) and therefore specialised geotechnical assessments are required prior to undertaking construction (e.g. of buildings, roads, walk trails) or using heavy machinery in the vicinity of caves (for example). Visitor safety implications of karst hazards also need to be considered (see Section 32 *Visitor Safety).*

The majority of the caves are decorated by cave formations known as speleothems (e.g. stalactites, stalagmites, shawls, columns, straws), and have been subject to vandalism (and/or accidental damage). Past vandalism within Crystal cave has necessitated the sealing of access and the repair of formations, and the access roads have been gated to prevent unauthorised access. Littering within and around caves of the planning area has also been problematic, also impacting on aesthetic values and introducing potential pollutants.

[3] The planning area includes approximately 38% of the Spearwood Dune System encompassed in metropolitan region lands managed by the Department (excluding State forest).
[4] The caves at Yanchep are very unique in this way, as most other caves in aeolian calcarenite are fed from swamp lands rather than groundwater created.

Soils

The soils of the planning area are predominantly those associated with the Spearwood Dune System and are generally nutrient poor with low water holding capacity (Table 3). Small areas of Quindalup Dune System are located near the western boundary of Yanchep National Park.

Table 3: Soils in the planning area

Soil Description	Location
Calcareous sands with organic staining (to approximately 30 centimetres) over pale brown sand with definite cementation below 1 metre.	Small areas at north western and south western boundaries of Yanchep National Park (Quindalup Dune System).
Dark grey-brown sand (to approximately 50 centimetres) over pale brown sands.	Small areas at North Western and South Western boundaries of Yanchep National Park (Quindalup Dune System).
Light grey sands.	Fringing water in the base of karst depressions. Imperfectly drained sand plains and depressions.
Shallow calcareous sand over limestone.	Low hills and ridges with shallow sands and limestone outcrops.
Yellow sand over limestone at 1-2 metres.	Low hilly to gently undulating terrain. Most of Neerabup National Park.
Shallow brown sands.	Areas of karst depressions or limestone outcrop.
Iron podzols.	Area of low hilly to gently undulating terrain within proposed 'Ridges' additions to Yanchep National Park.
Sands (sometimes with diatomite) over organic hardpan.	Flat swampy areas within proposed 'Ridges' additions to Yanchep National Park.

Wetlands within the planning area are associated with Holocene swamp deposits. These are peats associated with clays, sands and silts in various proportions. There are significant fire issues associated with the drying of such soils – peat fires can be extremely difficult to extinguish, they can burn for long periods of time and result in considerable ecological impact, both from fire control activities as well as the fire itself (Loomes *et al*. 2003). These soils are also prone to the creation of Acid Sulphate Soils, which can adversely impact on the values of the planning area (see below).

Historical use of some of the wetlands within the planning area prior to their addition to the conservation estate has seen considerable disturbance to their soils. Pipidinny and Beonaddy swamps and Nowergup Lake for example, have previously been used for market gardening, marl extraction and subject to significant disturbance from trail-bikes and other vehicles.

Acid Sulphate Soils

Acid sulphate soils are best managed by avoiding disturbance to the soils containing iron sulphide layers. Iron sulphides will not impact on the environment while covered by water. The risk of acid sulphate soils is most likely on land adjacent to the planning area, however, for site-specific management, the distribution of acid-producing sediments, their buffering capacity, and the potential to pollute the groundwater resource at high risk sites within the planning area need detailed investigation (McHugh and Bourke 2008).

Erosion

The wearing away of soil through wind, water and general weather conditions is a natural process, but one which can be significantly increased through human activities (such as development of roads and any other activities that lead to removal of overlying vegetation). De-vegetation and associated soil/landform erosion is of particular management significance in karstic terrains, as the integrity of subterranean ecosystems depend on maintenance of connections and inter-relationships with surface environments. For example, surface vegetation and soils play an important role in regulating water infiltration, carbon dioxide production, and atmospheric conditions in the sub-surface environment (Hamilton-Smith *et al.* 1998).

15 – Geology, Landforms and Soils

The objective is to maintain the integrity of the geomorphological values and processes.

This will be achieved by:

1. liaising with government agencies and other relevant stakeholders as necessary and appropriate to minimise adverse impacts on geomorphology values and processes including karst wetlands, Quindalup and Spearwood Dunes;
2. undertaking specialised (e.g. geotechnical) assessments to protect karst (and associated values) prior to construction or where otherwise necessary and minimise safety hazards;
3. maintaining detailed mapping and inventory of caves in the planning area to facilitate conservation and management, and to minimise safety hazards;
4. managing access to caves, including use of gating if necessary, to reduce potential for accidental or deliberate damage to speleothems or other impacts on cave values;
5. considering karst and associated values and processes in any environmental impact assessments of activities and developments that have the potential to impact on those values;
6. providing appropriate information, interpretation and/or education opportunities for visitors to increase their knowledge, appreciation and understanding of karst, and associated values and processes;
7. providing opportunities for continued community involvement in karst conservation and management, including speleological and/or other stakeholders (e.g. ACKMA, ASF, SRG, WASG);
8. preventing disturbance of areas with the potential for acid sulphate soil development wherever possible and, where disturbance is unavoidable, identifying and employing risk mitigation measures as necessary to limit environmental impacts; and
9. ensuring the potential for soil erosion is considered and mitigated for in planning and development of visitor and management access (e.g. roads, walk trails) or other infrastructure, and that eroded areas are rehabilitated (see Section 24 *Ecosystem Rehabilitation* and Section 29 *Visitor Access*).

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
15.1 The extent of erosion/degradation in caves directly attributable to anthropogenic causes.	15.1 No increase in the extent of erosion/degradation in caves directly attributable to anthropogenic causes over the life of this plan.	After 5 years.

16. HYDROLOGY AND CATCHMENT PROTECTION

Hydrology

The planning area lies over the shallower margins of the largest groundwater mound within the superficial aquifer – the Gnangara Mound, which covers an area of about 2200 km^2 on the Swan Coastal Plain north of the Swan River. The Gnangara Mound is important in providing water resources for consumptive uses in the Perth region (see Section 35 *Water Resources*) as well as sustaining many ecosystems.

Access to adequate amounts of good quality water is fundamental to the health of ecosystems within the planning area. Wetlands, cave pools and streams are fed by water from the Gnangara Mound and cave ecosystems within the planning area are completely groundwater dependant.

There are a number of groundwater dependent ecosystems[5] (GDEs) in the planning area, for which the maintenance of natural hydrological regimes is particularly critical, including (i) wetlands, (ii) aquifer and cave ecosystems, (iii) terrestrial vegetation, and (iv) terrestrial fauna (Froend *et al.* 2004b). All wetlands of the Gnangara Mound are permanently or seasonally to some degree hydraulically connected with the regional water table.

Land use or management with the potential to significantly alter the quantity or quality of groundwater, or otherwise interfere with the natural hydrological systems and processes have particular implications for GDEs. Specific threats that need to be considered include:

- climate change;
- acid sulphate soils (see Section 15 *Geology, Landforms and Soils*).

[5] Groundwater dependent ecosystems are a complex community of organisms where groundwater is a key element required for consumptive use, biophysical processes or as habitat (Sinclair Knight Merz 2001).

- ecologically unsustainable abstraction of water (including both aquifer-wide and localised over-abstraction) (see Section 35 *Water Resources*);
- pollution (e.g. by sediment, nutrients, fertilisers, herbicides/insecticides, industrial waste, bacteria) (see Section 35 *Water Resources*);
- disturbance of interrelationships between surface and aquifer environments (e.g. clearing of vegetation and degradation of soils and landforms[6]); and
- introductions of exotic aquatic organisms (e.g. aquarium fish and invertebrates) into the aquifer ecosystems (see Section 21 *Introduced and Other Problem Animals*).

An understanding of the minimum water requirements of GDEs is inherent to addressing the threat of ecologically unsustainable abstraction of groundwater. Water requirements may include, for example, specific requirements with regards to (i) level, (ii) flow or flux, (iii) duration, timing and rate of seasonal flooding, and (iv) quality (Froend *et al*. 2004a).

Analysis using a specifically designed regional groundwater modelling system[7] suggests that under current water management regimes there will continue to be adverse impacts upon the GDEs within the planning area, over and beyond the life of this management plan (DoE 2005a). This modelling also indicated that whilst localised recovery in groundwater levels could be achieved through management changes, no broad -scale recovery is possible in the short term as climate change will continue to be a major factor (DoE 2005a).

A number of emergency response measures have been implemented in an attempt to sustain ecosystems under most immediate and significant threat from declining groundwater levels, including the establishment of artificial water supplementation systems aimed at maintaining aquatic cave fauna communities in a number of caves in the planning area and at Lake Nowergup. Where artificial supplementation measures have been employed within the planning area, these have only been successful in limiting, rather than completely halting or reversing adverse ecological impacts on the GDEs. Artificial water supplementation measures within the planning area will need to be evaluated on an ongoing basis as part of an adaptive management response to the continued decline in groundwater levels to sustain these GDEs wherever feasible and practicable.

The Department of Water is coordinating a multi-agency investigation into and response to declining regional groundwater issues including the identification of EWR and EWP for the Gnangara Mound. Further information on this issue is provided in the State of the Gnangara Mound report (DoE 2005a).

Wetlands

Wetlands are important centres or focal points of biodiversity, and also provide a range of other values. Approximately 75% of the wetlands of the Swan Coastal Plain have been filled or drained (Commonwealth of Australia 1997) and therefore the relatively undisturbed wetlands of the planning area have high conservation value. Wetlands in the planning area are used by a number of migratory bird species and support, either directly or indirectly, most of the wildlife of the Swan Coastal Plain (Seddon 1972 in Davis *et al.* 2001).

Davis *et al.* (2001) in considering factors influencing biodiversity in Swan Coastal Plain wetlands, indicated that maintaining a range of wetland types is important in conserving biodiversity in various wetland biotic groups (e.g. invertebrates, waterbirds, vegetation) and that these groups often respond in different ways to wetland environments.

The planning area has both permanently and seasonally inundated wetlands (i.e. lakes and sumplands) and therefore provides for the protection of a range of wetland types and habitat important to a variety of native fauna.

The planning area wetlands are associated with a natural wetland group known as the 'Yanchep Suite' and comprise approximately 30% of the total area of lakes and 10% of the total area of sumplands within the wetland group (Hill *et al.* 1996)[8].

[6] Surface vegetation and soils play an important role in regulating water infiltration, carbon dioxide production, and atmospheric conditions in the sub-surface environment.
[7] The Perth Regional Aquifer Modelling System or PRAMS. Analysis commissioned by the Department of Environment.
[8] Hill *et al* (1996) used natural wetland groups to "…identify wetlands which are similar and historically related, and provide regional context to assist determination of wetland representativeness." Classifying wetlands according to landform and water permanence, they defined lakes as 'permanently inundated basins', and sumplands as 'seasonally inundated basins'. This study also assigned management categories to wetlands. The management categories assigned to the wetlands within the

All of the wetlands within the planning area except Beonaddy Swamp have been previously identified as being of (at least) regional significance (Hill *et al.* 1996).

The wetlands within the planning area are groundwater dominated, and have some degree of interrelationship to the unconfined Superficial aquifer (Davis *et al.* 2001, DoE 2005a). However, the local hydrogeology within the planning area is not well understood. Wetland management would benefit from an improved understanding of relationships between wetlands and cave streams and of wetland groundwater capture and discharge zones.

Because the wetlands are part of ecological networks extending beyond the boundaries of the planning area, threats to values potentially arise through activities beyond, as well as within, these boundaries. Cooperative, coordinated and holistic approaches between various responsible land and water managers are required for effective management.

Alterations to Groundwater Regimes and Processes

Alterations in groundwater regimes and processes can clearly have numerous and significant impacts on groundwater dependent wetlands such as those that occur in the planning area. Declining regional groundwater has led to a number of adverse ecological effects within wetlands of the planning area. Declines in water levels have been recorded for all wetlands that have been subject to water level monitoring[9]. These falls in wetland water levels have been associated with impacts such as:

- death or declines in health of vegetation including:
  - thinning of fringing sedges such as jointed rush (*Baumea articulate*)[10] and pithy sword sedge (*Lepidosperma longitudinale*)[11];
  - deaths and/or declines in the health of wetland tree species such as swamp paperbark (*Melaleuca raphiophylla*) and flooded gum (*Eucalyptus rudis*)[12]; and
  - increased invasion of *Typha orientalis* and other exotic species into the wetland basin.

(Loomes *et al.* 2003, Froend *et al.* 2003 and Lam *et al.* 2002).

- drying of organic rich sediments (leading to an increased susceptibility to acidification and fire) which can:
  - reduce their habitat value for aquatic macroinvertebrates;
  - make *Typha orientalis* control more difficult (as the drying sediment provides a suitable substrate for it to colonise);
  - increase the vulnerability of the wetland to fire; and
  - result in the remobilisation of nutrients into the water column through the process of drying and re-wetting, which is exhibited (to various degrees) at Lakes Yonderup, Wilgarup and Nowergup (Horwitz and Benier 2003, Loomes *et al.* 2003).

- declines in aquatic invertebrate richness, which is evident at Lake Wilgarup and Lake Nowergup (Sommer and Horwitz 1999, Benier and Horwitz 2003, Froend *et al.* 2004b).

- increased invasion by exotic plant species such as the introduced bulrush *Typha orientalis*.

Ongoing and significant impacts on the wetlands of the planning area as a result of declining groundwater levels are highly likely (Froend *et al.* 2004b). The predicted magnitude and rate of drawdown for all wetlands in the planning area far exceeds that required to maintain values at a low risk of impact (Froend *et al.* 2004b).

The inherent complexity and dynamic nature of wetland ecosystems, generates numerous challenges to managing the threats posed by anthropogenic alterations to groundwater regimes and processes, and any adverse ecosystem responses to these. For practical reasons, management responses will focus on identifying the key elements of ecosystem function, and seek to maintain those attributes of the groundwater regimes and processes that are most critical to maintaining these key elements. An approach along these lines which focuses on a number of key wetland elements has been incorporated into a study of the ecological water requirements of GDEs of the Gnangara Mound undertaken by Froend *et al*. (2004c) – and which included consideration of all the

---

planning areas (ie 'Conservation' and 'Resource Enhancement') recognise their value in supporting a high or substantial level of ecological attributes and functions.

[9] Wetlands within the planning area have been monitored for varying lengths of time –monitoring has been occurring since at least late 1998.

[10] e.g. at Lake Wilgarup and Nowergup Lake.

[11] e.g. at Lake Wigarup.

[12] e.g. at Lake Yonderup, Lake Wilgarup and Lake Nowergup

wetlands in the planning area (except Beonaddy Swamp). This work has drawn on existing knowledge to describe the water regimes required to maintain features such as vegetation, waterbirds, macroinvertebrates, vertebrates and sediment processes. However, ecological water requirements will also be considered in the context of other (e.g. social and economic) groundwater demands.

Water Quality

The water quality of the wetlands in the planning area is variable, and is generally reflective of previous uses. Lake Nowergup, Pipidinny Swamp and Beonaddy Swamp for example have a relatively recent history of horticultural use and/or stock grazing and are therefore significantly nutrient enriched in comparison to Loch McNess, Lake Yonderup and Lake Wilgarup which have been managed for conservation for considerably longer.

Water quality monitoring has been undertaken at Loch McNess, Lake Yonderup, Lake Wilgarup, Pipidinny Swamp and Lake Nowergup since approximately 1995 as part of the broader inter-agency investigations and monitoring of the Gnangara Mound. Monitoring of these wetlands will continue to be undertaken through the Department of Water as part of broader monitoring program of GDEs of the Gnangara Mound.

Wetlands of the Planning Area

Key threats to the wetland values in the planning area, which are often interrelated, include: alterations to the natural groundwater regimes and processes; reduction in water quality; introduced plants and animals; inappropriate fire regimes; and acid sulphate soils – sulphidic, rich, peaty sediments that underlie groundwater dependent wetlands on the Swan Coastal Plain have the potential to become 'acid sulphate soils' and are prone to acidification if sediments are disturbed or exposed.

There are several wetlands within the planning area:

- The Loch McNess wetland system comprises a northern section with relatively little open water and which is subject to seasonal drying, and a permanently inundated basin in the southern section. The wetland has linkages to subterranean waterways and cave lakes, a feature which is uncommon amongst wetlands in the bioregion. The Loch McNess wetland system is identified as being of national importance in the *Directory of Important Wetlands in Australia*. It was assessed as meeting 3 of the 6 criteria for identifying nationally important wetlands. Hill *et al.* (1996) found Loch McNess was the best example of a lake within the 'Yanchep Suite' of wetlands. Loch McNess provides important faunal habitat, and is particularly important for species that require permanent water (e.g. fish, wetland invertebrates, frogs, turtles and waterbirds). There has been a decline in water levels in the lake since 1998 (DoE 2004).
- Lake Yonderup is a relatively undisturbed permanently inundated freshwater wetland with very good water quality[13]. It plays a valuable role as a drought refuge and in supporting rich macroinvertebrate and other species dependent on permanent water (Water Authority of WA 1995, Sommer and Horwitz 1999, Benier and Horwitz 2003). The lake has largely intact vegetation and provides a range of habitat types (DoE 2005a).
- Lake Wilgarup is a seasonal wetland (sumpland) with a shallow, broad basin (Water Authority of WA 1995) with extensive coverage of undisturbed vegetation (Hill *et al.* 1996), although the vegetation has been adversely impacted by declining groundwater levels in recent years. Hill *et al.* (1996) noted it as the best example of a sumpland within the 'Yanchep Suite'.
- Whilst Hill *et al* (1996) describe Pipidinny Swamp as a sumpland, Froend *et al.* (2004b) refer to it as a permanently inundated wetland, which may become a seasonally inundated sumpland or a seasonally waterlogged dampland as a result of declining groundwater level. The occurrence of this wetland on the boundary of the Quindalup and Spearwood Dune Systems is an uncommon situation on the Swan Coastal Plain and is considered particularly significant (Keighery *et al.* 2002). The wetland provides an important refuge for a variety of waterbird species and a population of long-necked turtle (*Chelodina oblonga*) and other groundwater dependant vertebrates and significant aquatic invertebrates (Froend *et al.* 2004b). The wetland has been highly modified having been previously used for market gardening, stock grazing, and mining for diatomaceous earth and marl. The area has also been considerably impacted by damaging and unauthorised vehicle use (e.g. trail bikes and 4WD vehicles). As a legacy of its previous uses the swamp has a number of artificial sumps and channels. Ironically, these have created isolated aquatic habitats that now support a diverse, rich and unique range of macro-invertebrates. There is considerable variability in the water quality and invertebrate richness of these separated habitats (Benier and Horwitz 2003) and

[13] Benier and Horwitz (2003) found that it had the best water quality of all the Swan Coastal Plain wetlands they assessed.

Froend *et al.* (2004b) refer to an increase in conductivity in recent years, which is possibly suggestive of salt-water intrusion associated with surrounding groundwater decline.

- Beonaddy Swamp is a sumpland and although it has a history of clearing and other extensive modification for agricultural uses, it has some conservation value.
- Lake Nowergup within Neerabup Nature Reserve is a permanent, deep lake (Froend *et al.* 2004b). The lake provides key fauna habitat including habitat for species such as the Swan River Goby (*Pseudogobius olorum*), the native water rat (*Hydromys chrysogaster*), several species of frog and waterbirds/waderbirds (Burbidge *pers. comm.*, Froend *et al.* 2004b). It is also a regionally significant wetland for aquatic macroinvertebrate family and species richness (Horwitz and Rogan 2003 cited in DoE 2005a), and supports a species of water flea (*Leydigia ciliate*) unique to the lake (Davis *et al.* 1993 cited in DoE 2005a). The lake is nutrient enriched through previous and/or nearby land use (e.g. piggery, market gardens, cattle grazing) (Wrigley *et al.*1991), although areas of sedgeland on the eastern shore minimise impacts of nutrient enrichment on aquatic fauna (Froend *et al.* 2004b). Since 1989, to maintain lake water levels the lake has been artificially supplemented with water from the Leederville aquifer in an attempt to retain its faunal habitat values (Benier and Horwitz 2003, Loomes *et al.* 2003, McHugh and Bourke 2008). The artificial supplementation has been useful in reducing impacts on sediments and macroinvertebrates, but is not considered to have been adequately successful in preventing impacts on fringing vegetation (Loomes *et al.* 2003), or to have sufficiently inundated macroinvertebrate habitats (Benier and Horwitz 2003). Water quality changes at Lake Nowergup, including an increase in pH range and decreased conductivity, nutrient levels and chlorophyll 'a'[14] values (Benier and Horwitz 2003), are considered to be mostly attributable to supplementation of water from the Leederville aquifer.

16 – Hydrology and Catchment Protection

The objective is to conserve and protect the quality and quantity of water, particularly the wetland systems.

This will be achieved by:

1. engaging with relevant government agencies or landholders as necessary and appropriate to safeguard the hydrological values and processes required to support ecosystems;
2. encouraging sustainable abstraction of groundwater by Department of Water to supplement lake Nowergup;
3. preventing groundwater contamination and minimising water use by applying ecologically appropriate waste management, low water usage and water recycling technologies;
4. managing threatening processes such as weeds, introduced animals, fire and disease and reducing the impacts of these on aquifer ecosystems;
5. managing, as far as possible, to avoid human disturbance and rehabilitating disturbed areas;
6. minimising the impacts of acid sulphate soils on hydrological values and the biota that depend on these;
7. undertaking a hydrological study of Loch McNess to determine future options for protection such as encouraging artificial watering of Loch McNess by the Department of Water;
8. monitoring wetlands to assess any changes in GDEs;
9. undertaking and/or supporting research to improve the understanding of the ecological water requirements of, and hydrological values and processes supporting, GDEs in the planning area, in consultation with other government agencies as appropriate; and
10. planning and implementing land and water-based activities in the planning area to minimise the risks to public health.

17. NATIVE PLANTS AND PLANT COMMUNITIES

At a State level, the Department has the statutory responsibility under the Wildlife Conservation Act for flora conservation, and all flora native to Western Australia is protected under this Act.

[14] Chlorophyll 'a' is an indicator of algal activity.

Native Plants

This management plan draws largely from the work of Beard (1979), Heddle *et al.* (1980), Gibson *et al.* (1994), Keighery *et al.* (1996) and the Department of Environmental Protection (2000) to describe the vegetation and flora of the planning area. Table 4 presents a summary of the total vascular flora recorded for the planning area.

Table 4: Total Vascular Flora Summary

	Yanchep National Park	Neerabup National Park	Ridges
Native Vascular Taxa	462	315	294
Weed Taxa	135	66	32
Weed Taxa as % of Total Flora	22	17	10
Total Vascular Flora	597	381	326

Note: Data based on Bush Forever Sites 288, 381 and 383, and therefore extend beyond the existing planning area/reserve boundaries slightly.

Flora of Conservation Significance

Threatened and Declared rare Flora

Yanchep National Park and Ridges contain one species declared as rare flora under the Wildlife Conservation Act and also listed as vulnerable under the Commonwealth EPBC Act –Wabling Hill or Yanchep mallee (*Eucalyptus argutifolia*).

Priority Species

Priority 2, 3 and 4 species are known to be present in the planning area. These are species that may be rare but there is insufficient survey data available to accurately determine their true status, or which are rare but not currently listed as threatened as DRF and hence are being monitored. Although priority species do not have the same level of legislative protection as rare flora, the priority flora list is maintained as a mechanism to highlight flora of special conservation interest and encourage appropriate management activities in areas such as weed control (see section 20 Environmental Weeds), fire management (see section 23Fire) and site development.

Endemic Species

Yanchep National Park contains a number of moss species that may be endemic to the park (see also *Cryptogams* below): *Buellia epigaea*; *Lecania sylvestris*; *Lecania turicensis*; *Placynthium nigrum*; and *Rinodina bischoffii*. The planning area also contains species that may be endemic to the Perth Metropolitan Area or endemic to the Swan Coastal Plain biogeographic sub-region.

Disjunct Species

The planning area is known to include at least three species believed to be disjunct from their other known geographic ranges; *Leucopogon striatus*, slender myoporum (*Myoporum caprarioides*) (Hearn *et al.* 2003) and Chinese brake (*Pteris vittata*) (DEP 2000).

Relictual Species

The planning area is known to contain at least five native plant species considered to be relictual (Hearn *et al.* 2003): black kangaroo paw (*Macropidia fuliginosa*), *Quinetia urvillei*, *Leptoceras menziesii* and Christmas tree (*Nuytsia floribunda*).

Range End Species

The planning area includes a number of plant species that are at or near the southern end of their known range: *Baeckea robusta*, *Jacksonia calcicola*, *Persoonia comata*, tangling melaleuca (*Melaleuca cardiophylla*) (DEP 2000), *Conostylis pauciflora* subsp. *euryrhipis*, and Yanchep rose (*Diplolaena angustifolia*) (Gibson *et al.* 1994). Range-end species may serve as indicators of climate change.

Tuart

Neerabup and Yanchep National Parks contain some of the most extensive stands of tuart (*Eucalyptus gomphocephala*) that have the highest canopy density and relatively no disturbance on the Swan Coastal Plain (Government of Western Australia 2003b).

The conservation significance of tuart is outlined in a Government of Western Australia (2003b) report. However, tuart is in decline through much of the Swan Coastal Plan. Research findings to date of the Tuart Response Group indicate that there may be a range of complex inter-related factors contributing to tuart decline (e.g. climate variability, hydrological factors, altered fire regimes, altered nutrient cycles, increased understorey competition, insect attack and fungal pathogens).

Specific attention will be required to monitor and protect tuart trees associated with Threatened Ecological Communities, particularly those tuart trees supporting or with the potential to support aquatic root mat communities, and trees within the *Melaleuca huegelii - Melaleuca acerosa* shrublands on limestone ridges.

Cryptograms

Cryptograms[15] provide essential (although poorly recognised and understood) ecosystem functions, including soil stabilisation, decomposition of organic matter, nutrient recycling and the formation of important mutually beneficial associations with vascular plants (Scott *et al.* 1997). Yanchep National Park is known to include a number of mosses that are thought to be endemic to the park.

Flora Values of the 'Ridges' Area

The Ridges proposed addition contains massive limestone ridges and soil associations which support several significant flora species that are not, or not well, represented in the existing parks and reserves, or in conservation reserves generally. Specific information on the flora values of this area can be found in various reports (Department of Conservation and Environment 1978, Department of Conservation and Environment 1981, Weston and Gibson 1997 and DEP 2000).

Plant Communities

This management plan draws largely from the work of Beard (1979), Heddle *et al.* (1980), Gibson *et al.* (1994), Keighery *et al.* (1996) and the Department of Environmental Protection (2000) to describe the vegetation and flora of the planning area (see Appendix 1). However, the information on vegetation associations presented in this plan uses that provided from the floristic survey of the southern Swan Coastal Plain[16].

Floristic survey of the southern Swan Coastal Plain has led to the definition of four 'supergroups' reflecting landscape scale patterns in vegetation, and 66 floristic community types. Three of the supergroups and 12 of the floristic community types are represented within the planning area (see Appendix 2). Of the floristic community types, five have distributions that are confined or predominantly confined to the Perth Metropolitan Region, two are rare in the Perth Metropolitan Region and one represents the southern-most location in the Perth Metropolitan Region. Floristic Community Types 19b and 26a have been identified as Threatened Ecological Communities, and Floristic Community Type 14 identified as a Priority Ecological Community (see Section 19 *Ecological Communities*).

Groundwater Dependent Terrestrial Vegetation

Changes in groundwater attributes (e.g. water level, flux or quality) beyond usual seasonal fluctuations pose a potential threat to terrestrial vegetation dependent on this resource (Sinclair Knight Merz Pty Ltd 2001). The capacity of groundwater dependant vegetation to withstand and adapt to extraordinary changes in groundwater attributes varies in accordance with the extent of groundwater dependency (Heddle 1980; Sinclair Knight Merz Pty Ltd 2001).

Monitoring of a limited number of vegetation transects within the planning area indicates that declining groundwater levels has led to changes in vegetation density, health or vigour in some patches (DoE 2005a).

17 – Native Plants and Plant Communities

The objective is to protect and conserve native plants and plant communities.

[15] Cryptogams are a group of organisms that include non-vascular flora such as mosses, liverworts and other biota such as fungi, algae and lichen.
[16] Primarily by Gibson *et al.* 1994 and then subsequently as part of process to identify regionally significant bushland – see Department of Environmental Protection 2000.

This will be achieved by:

1. listing declared rare flora under the Wildlife Conservation Act and/or EPBC Act;
2. managing native plants and plant communities according to Department Policies;
3. identifying native plants and plant communities that may require special protection and implementing appropriate strategies to minimise the impacts from threatening processes such as climate change, environmental weeds, pest and problem animals, inappropriate fire regimes and inappropriate recreation development;
4. assessing proposed operations and developments, such as road construction and maintenance, facility development and prescribed burns, for potential impacts on declared rare and priority species;
5. ensuring this management plan gives effect to recovery plans and that the strategies in recovery plans and this management plan are complementary;
6. liaising with agencies and neighbouring land managers as necessary and appropriate to prevent or minimise adverse impacts on native plants and plant communities (in particular those of special conservation significance) in the planning area and promote compatible management on adjoining lands;
7. using fire to maintain and enhance flora biodiversity as required, and adapting fire for flora biodiversity management measures as necessary in the light of new knowledge;
8. undertaking and/or supporting research and monitoring of native plants and plant communities such as ecological water requirements of groundwater dependent vegetation and the condition of tuart communities and trees supporting aquatic root mat communities in caves, and adapting management accordingly; and
9. providing appropriate information, interpretation and/or education opportunities for visitors to increase their knowledge, appreciation and understanding of native plants and plant communities in the planning area and their vulnerability to impact.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
17.1 Cover and condition of threatened, priority or otherwise significant flora species or communities.	17.1 No decrease in cover and condition of threatened, priority or otherwise significant flora species or communities over the life of this plan.	Every 5 years, or as per recovery plans if applicable.

18. NATIVE ANIMALS AND HABITATS

The planning area, which provides diverse and high quality habitats for a wide variety of native fauna, is of particular regional conservation importance given the extensive loss and degradation of faunal habitat in the region from urban and other development, as well as current and potential impacts from declining water levels in the Gnangara Mound (see Section 16 *Hydrology and Catchment Protection*).

Native Fauna

The planning area contains a diverse selection of native fauna, which is usually uncommon in such close proximity to the metropolitan area. Native fauna in the planning area include:

- 17 species of mammals;
- over 112 species of birds;
- 45 species of reptiles and amphibians;
- two species of fish; and
- terrestrial and aquatic invertebrates.

(Burbidge 2003b, WA Museum 2003)

Mammals

There are at least 17 species of native mammals within the planning area, even though only Yanchep National Park has been systematically surveyed for mammals. This includes:

- two kangaroos and wallabies (Western grey kangaroo and western brush wallaby);
- three possums (Brushtail possum, western pygmy-possum and honey possum);
- three carnivorous marsupials (Echidna, chuditch and quenda);

- three mice and rats (Water-rat, western bush rat and ash-grey mouse); and
- six bats (Gould's wattle bat, chocolate wattle bat, lesser long-eared bat, greater long-eared bat, white-striped freetail bat and Southern forest bat).

The planning area has a relatively high diversity of mammals compared with other conservation reserves in the Perth Metropolitan area and Swan Coastal Plain, such as Yellagonga Regional Park (six species), Yalgorup National Park (nine species), Thompsons Lake and Nature Reserve (five species) (Burbidge 2003b).

The most significant threats to mammals in the planning area are predation by introduced animals (see Section 21 *Introduced and Other Problem Animals*). Many species with quite specific habitat requirements persist in refugial habitats such as densely vegetated thickets in river, stream and wetland systems, which also provide corridors for migration.

Birds

Over 112 native species of birds have been recorded within the planning area (Burbidge 2003b, WA Museum 2003). At least 110 species have been recorded for Yanchep National Park, which has been the most thoroughly surveyed reserve for birds within the planning area. About 62 species have been recorded at Neerabup National Park and 56 species from Neerabup Nature Reserve. This relatively high diversity of birds emphasises the significance of the planning area for birds, particularly across the Swan Coastal Plain where important woodland and wetland habitats have been fragmented and depleted.

The planning area provides important habitat for a number of waterbird species dependant on permanent wetlands (e.g. ducks, herons and ibis, crakes and rails, grebes, pelicans and cormorants), Loch McNess and Lake Nowergup in particular provide important drought refuge over the summer months when many other wetlands have dried out. A number of birds are resident to the wetlands of the planning area and some are migratory breeders and waders. Sometimes migratory shorebirds utilise the margins of these wetlands as water levels fall, although do so at a lesser extent because they require shallower water and mud flats (Gough and Shimmon 1994, Birds Australia 2005) (Table 5).

Table 5: Wetland bird species of the planning area

Common Name	Scientific Name
Resident wetland birds	
Pacific black duck	*Anas superciliosa*
Grey teal	*Anas gracilis*
Nankeen night heron	*Nycticorax caledonicus*
Purple swamp hen	*Porphyrio porphyrio*
Dusky moorhen	*Gallinula tenebrosa*
Eurasian coot	*Fulica atra*
Little pied cormorant	*Phalacrocorax melanoleucos*
Little black cormorant	*Phalacrocorax sulcirostris*
Little grassbird	*Megalurus gramineus*
Migratory breeders in wetlands	
Musk duck	*Biziura lobata*
Australian shelduck	*Tadorna tadornoides*
Australian wood duck	*Chenonetta jubata*
Yellow-billed spoonbill	*Platelea flavipes*
Australasian grebe	*Tachybaptus novaehollandiae*
Great crested grebe	*Podiceps cristatus*
Migratory Waders and shorebirds	
Black-winged stilt	*Himantopus himantopus*
Red-necked avocet	*Recurvirostra novaehollandiae*
Red-kneed dotterel	*Erythrogonys cinctus*

Groundwater level declines may impact on surface water levels (see Section 16 *Hydrology and Catchment Protection*) and indirectly lead to loss or modification of habitat and feeding areas for waterbirds (Froend *et al.* 2004b).

Reptiles and Amphibians

While there are eight species of frogs and 45 reptiles within the planning area, only Yanchep National Park has been reasonably well surveyed for reptiles and amphibians with six frog and 39 reptile species recorded.

Frogs recorded for the planning area include the slender tree frog (*Litoria adelaidensis*), the motorbike (or bell) frog (*Litoria moorei*), moaning frog (*Heleioporus eyrie*), Western Banjo frog (*Limnodynastes dorsalis*), Glauert's froglet (*Crinia glauerti*), squelching froglet (*Crinia insignifera*), turtle frog (*Myobatrachus gouldii*) and Günther's toadlet (*Pseudophryne guentheri*). All of the frog species are endemic to the south-west of Western Australia (Clayton *et al.* 2006).

Water requirements for frogs of the planning area vary from species to species. Frogs that require a permanent water source, either for breeding, habitat or for their larvae stage, include:

- slender tree frog;
- motorbike frog;
- moaning frog; and
- western banjo frog.

The impacts of declining regional groundwater (see Section 16 *Hydrology and Catchment Protection*) on frogs will vary depending on the water and other ecological requirements of individual species. Species dependent on fringing vegetation may be impacted by significant declines in the condition of this vegetation. Difficulties may also arise if surface water is not sufficiently available for the minimum amount of time required for maturation of tadpoles. Species that breed over summer may be particularly impacted by wetland drying (Froend *et al.* 2004c).

The reptiles of the planning area include the long-necked turtle, two dragon lizards, seven legless lizards, 17 skink lizards, five geckos, goannas, the southern blind snake (*Ramphotyphlops australis*), the carpet python (*Morelia spilota imbricata*), and nine front-fanged snakes.

Only the black-striped snake (*Neelaps calonotus*) has a relatively restricted distribution centred on the Swan Coastal Plain near Perth, and all other reptiles have distributions that are not directly threatened by processes associated with urbanisation (How and Dell 2000). The tiger snake (*Notechis scutatus*) also prefers wetlands where it forages for frogs as well as birds, mammals, lizards, turtles and fish. Snakes appear less able to accommodate habitat fragmentation (How and Dell 1994). Several snakes, such as the yellow-faced whipsnake (*Demansia psammophis*), bardick (*Echiopsis curta*), tiger snake, Gould's hooded snake (*Parasuta gouldii*) and the dugite (*Pseudonaja affinis*), are regarded as potentially dangerous to humans (Bush *et al.* 2007), and visitors should be cautious of snakes, particularly within the natural environment (see Section 32 *Visitor Safety*).

The long-necked turtle is a groundwater dependent species (see Section 16 *Hydrology and Catchment Protection*) that prefers permanent to near permanent water but can survive in wetlands that dry for up to six months of the year (Froend *et al.* 2004b). However, populations can be impacted by wetland drying (see Section 16 *Hydrology and Catchment Protection*).

Fish

There are at least two species of native fish found within the planning area. Lake Nowergup is important habitat for the Swan River goby (*Pseudogobius olorum*) (Froend *et al.* 2004a). Loch McNess is one of the few Swan Coastal Plain wetlands that contain the nightfish (*Bostokia porosa*) (Usback and James 1993, Froend *et al.* 2004a), which occurs in streams and wetlands between Albany and the Moore River (Allen 1982 in Balla 1994). The aquatic root mat community (see Section 19 *Ecological Communities*), which consists mainly of invertebrates, also contains this species (English *et al.* 2003).

Aquatic invertebrates

There is reasonable knowledge about aquatic invertebrates in the planning area from studies on cave ecological communities and as part of the Gnangara Mound Environmental Monitoring Project (GMEMP). Of the wetlands surveyed as part of the GMEMP:

- Loch McNess (south) has the highest cumulative macroinvertebrate family richness (69 families) and is particularly rich in Odonata and Coleoptera species (Froend *et al.* 2004a);
- Pipidinny Swamp has 66 macroinvertebrate families;

- Lake Yonderup has 60 families;
- Lake Nowergup has 52 families (a species of Cladocera, *Leydigia ciliatea* is unique to Lake Nowergup [Froend *et al.* 2004a]); and
- Lake Wilgarup has 30 families.

There is a significant correlation between wetland water levels and aquatic macroinvertebrate family richness at Loch McNess (north), Lake Nowergup and Pipidinny Swamp where 57%, 81% and 63% of the respective variation seen in aquatic macroinvertebrate family richness is attributable to fluctuations in water level (Bernier and Horwitz 2003).

Water level augmentation at Lake Nowergup has been successful in protecting aquatic invertebrates dependent on permanent water, although this wetland is under threat from bulrush (see Section 20 *Environmental Weeds*) and the drying of organic rich sediments (see Section 23 *Fire*). Bulrush monocultures result in a loss of habitat diversity that will result in lower aquatic macroinvertebrate family richness.

Caves in Yanchep National Park support a rich diversity of invertebrates. A total of 127 invertebrate species have been collected from the caves in 2001 (Rob Foulds *pers. comm.* 2008). Cabaret Cave supports an unusually rich cave invertebrate fauna of 41 species present in the shallow groundwater stream (Jasinska *et al.* 1996). Six other caves also support invertebrate fauna, although species composition and relative abundance varies from cave to cave (see Section 19 *Ecological Communities*).

Terrestrial invertebrates

While there is relatively little information about terrestrial invertebrates within the planning area, much can be drawn from the study on ants at Yanchep (Burbidge *et al.* 1992), and on eucalypt and woodland vegetation on the Swan Coastal Plain.

In Australia, ants are widely used as terrestrial invertebrate indicators in land management (Andersen and Majer 2004). In Yanchep National Park, Burbidge *et al.* (1992) showed that slight modifications to ecosystems, such as trampling, weed invasion, altered fire regimes and grazing, result in changes in ant communities, with the more disturbed sites having fewer functional groups.

Managing for invertebrates should also consider aiming to maintain a wide range of successional vegetation stages across the landscape as invertebrate biodiversity is greatest where habitat heterogeneity is maximised (van Heurck and Abbott 2003). Fire plays a key role in maximising habitat heterogeneity (see Section 23 *Fire*).

Fauna of Conservation Significance

Threatened and Other Specially Protected Fauna

At the State level, the Department has the statutory responsibility under the Wildlife Conservation Act for fauna conservation, and all native fauna in WA is protected under this Act. However, the Minister can declare under section 14(2)(ba) of the Wildlife Conservation Act (see *Glossary* for Schedule 1 to 4) fauna species to be specially protected (see Appendix 3) for the following reasons:

- Schedule 1 – fauna that is rare or likely to become extinct – the three species that occur in the planning area are the 'critically endangered' Crystal Cave Crangonyctoid (*Hurleya sp.*) (WAM#642-97), the 'endangered' Carnaby's cockatoo, and the 'vulnerable' chuditch (these three species are also protected under the Commonwealth's EPBC Act);
- Schedule 2 – fauna presumed to be extinct – no species are recorded as previously occurring in the planning area;
- Schedule 3 – birds protected under an international agreement – while no species from this schedule occur in the planning area, there are species that are covered under other international agreements (see below and Section 7 *Legislative Framework*); or
- Schedule 4 – other specially protected fauna – the two species that occur in the planning area are the peregrine falcon (*Falco peregrinus*) and the carpet python (*Morelia spilota imbricata*).

The Department's (Draft) *Policy Statement No. 9 – Conserving Threatened Species and Ecological Communities* (subject to final consultation) provides guidance for the management of threatened fauna. The Department produces recovery plans that identify, justify and schedule the management actions necessary to support the recovery of specific threatened species and communities. Recovery plans have been produced for all three Schedule 1 fauna and recovery teams facilitate their implementation.

Priority Fauna

Species that do not meet criteria for listing as threatened because of insufficient information, as well as species that have been recently removed from the threatened list, or that are near threatened and require monitoring, are placed on the Department's Priority Fauna list. Species on this list are grouped into Priority categories 1 through to 5 (see *Glossary* for definitions of these). There are nine priority species recorded as occurring or likely to occur within the planning area (see Appendix 4).

Migratory Species

At least eight migratory birds (Table 6) that are listed under the JAMBA, CAMBA or ROKAMBA treaties (see Section 5 *Legislative Framework*) have been recorded within the planning area (A Burbidge *pers. comm.* 2003). Permanent wetlands with seasonal variation in depth and shoreline to provide wading zones are particularly important for migratory waders and shorebirds (Froend *et al.* 2004b, Davis *et al.* 2001).

Table 6: Migratory birds in the planning area listed under International treaties.

Common Name	Scientific Name	JAMBA	CAMBA	ROKAMBA
Common greenshank	*Tringa nebularia*	✓	✓	✓
Common sandpiper	*Tringa hypoleucos*	✓	✓	✓
Fork-tailed swift	*Apus pacificus*	✓	✓	✓
Garganey	*Anas querquedula*	✓	✓	✓
Glossy ibis	*Plegadis falcinellus*		✓	
Great egret	*Ardea alba*		✓	
Rainbow bee-eater	*Merops onatus*	✓		
White-winged black tern	*Sterna leucoptera*	✓	✓	✓

The EPBC Act provides statutory protection for migratory birds listed under these agreements, in that all actions likely to impact on such species are subject to environmental assessment and approval, and they may also be specially protected under the proposed Biodiversity Conservation Act (see Section 5 *Legislative Framework*).

Endemic, Relictual and Species at the Limit of their Geographic Range

The planning area is significant for its endemic and relictual fauna, particularly aquatic invertebrates. Of the 100 species of fish and invertebrate fauna that occur in the six caves known of in Yanchep National Park with the root mat community, there are at least six newly discovered crustaceans that are Gondwanan relicts, including five species of amphipods and one species of janirid isopod (English *et al.* 2003).

The Crystal Cave Crangonyctoid crustacean is believed to be endemic to Crystal Cave, and it is also one of the relictual species. There are also other cave fauna that are endemic to these caves.

The cricket *Austrosaga spinifer* may be a species endemic to Neerabup National Park (see above), although there is limited information about this species.

Possible Reintroductions or Translocations of Fauna

The planning area may have once supported many formerly widespread species including critical weight-range mammals and ground-dwelling birds. While there have not been any translocations within the planning area, there is some potential for this to occur, particularly with the addition of the 'Ridges' area to Yanchep National Park, provided appropriate habitats are protected and threatening processes managed.

18 – Native Animals and Habitats

The objective is to protect and conserve native fauna of the planning area and their habitats.

This will be achieved by:

1. protecting fauna and fauna habitats from threatening processes, such as adverse changes to water quality and quantity, the spread of weeds and disease, pest and problem animals, wildfire and human disturbance, with priority given to threatened species;
2. providing statutory protection for specially protected species by listing them under the Wildlife

Conservation Act and/or EPBC Act, subject to satisfaction of the criteria for listing;
3. managing native animals and habitats according to Commonwealth and State legislation and Department Policies;
4. supporting Department programs to develop recovery plans for specially protected species and implement these accordingly;
5. considering the fire requirements of fauna species within the planning area and, where possible, applying fire to promote biodiversity;
6. maintaining the presence of the root mat community for the Crystal Cave Crangonyctoid;
7. maintaining the health of habitat important to Carnaby's cockatoo, including protecting from inappropriate fire regimes and disease;
8. liaising with agencies and neighbouring land managers as necessary and appropriate to prevent or minimise adverse impacts on native animals, particularly specially protected species, including strategies for managing the removal of Gnangara pines;
9. providing appropriate information, interpretation and/or education opportunities for visitors to increase their knowledge, appreciation and understanding of native animals in the planning area, particularly fauna of special conservation significance; and
10. supporting and encouraging further research and surveys to increase knowledge of fauna, particularly groundwater dependent species and specially protected species.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
18.1 Diversity of subterranean fauna.	18.1 Maintain the diversity of subterranean habitats.	After 5 years, or as per recovery plan if applicable.
18.2 Caves that support aquatic subterranean fauna.	18.2 Maintain or increase the number of caves that support aquatic subterranean fauna.	After 5 years, or as per recovery plan if applicable.

19. ECOLOGICAL COMMUNITIES

The planning area contains a range of terrestrial ecological communities, which support a diverse fauna and flora. Knowledge of some communities is limited, although many appear fragile and sensitive to disturbance.

Threatened Ecological Communities

Threatened Ecological Communities are managed in accordance with the Department's draft *Policy Statement No. 9 – Conserving Threatened Species and Ecological Communities* (subject to final consultation). At the time of writing, there are three threatened ecological communities within the planning area (Table 7).

Only one priority ecological community is present within the planning area (Table 7). However, one other priority ecological community, 'Deeper Seasonal Wetlands on Sandy Soils' (SCP14), occurs in the proposed 'Ridges' addition to Yanchep National Park (Gibson *et al*. 1994), but its category of threat has been withdrawn.

Table 7: Threatened and priority ecological communities in the planning area.

Ecological Community	Category of threat in WA[1]	Category of threat under EPBC Act
Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain – SCP01	CR	EN
Woodlands over sedgelands in Holocene dune swales of the Swan Coastal Plain – SCP19b	CR	EN
Melaleuca huegelii - Melaleuca acerosa (currently *M. systena*) shrublands on limestone ridges – SCP26a	EN	
Northern Spearwood shrublands and woodlands – SCP24	P3	
Deeper Seasonal Wetlands on Sandy Soils – SCP 14	Withdrawn	

Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain

Some of the caves within Yanchep National Park that have groundwater fed streams or pools contain tuart root mats which support an exceptionally rich invertebrate cave fauna[17] including a threatened ecological community with endemic and relictual species – this is known as the 'Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain'. This community was assessed as 'Critically Endangered' by the Department in 1996 and 'Endangered' under the Commonwealth EPBC Act in 1999. This community has been recorded in seven caves so far and although two caves have been recently closed due to cave stability, at the time of preparing this plan it cannot be confirmed if this TEC is still present in these caves.

Due to similarities in the animal species and water chemistry, the seven caves are considered to contain one ecological community, however, the faunal assemblages do vary in species composition and relative abundance (Burbidge 2004). Jasinska and Knott (2000) describe this fauna in more detail. The community differs significantly in species composition from root mat communities found within caves on the Leeuwin-Naturaliste Ridge.

Various artificial water supplementation measures have been employed in an attempt to maintain the remaining root mat communities, whilst various measures aimed at improving recharge to the watertable are being investigated or implemented across government. To maintain remaining root mat communities in situ, water levels within the caves must be maintained at a level whereby the majority of the root mats are submerged (English *et al.* 2003).

Protection of the tuart trees supporting the root mat communities is also critical to conservation of this fauna. In addition to ensuring these have access to adequate water supply, these trees will require:

- protection from destructive fires (see Section 23 *Fire*);
- protection from land use or operational activities with potentially adverse impacts; and
- monitoring for significant infestations of pathogens or attack by insect pests (see Section 22 *Diseases*).

Other occurrences of the aquatic root mat community may occur in caves on public or private lands not managed by the Department. Should further occurrences come to light, the Department may seek to purchase areas encompassing these for conservation purposes (e.g. for protection of threatened species or ecosystems) where feasible and appropriate, or alternatively ensure that these are subject to off-reserve conservation measures (e.g. conservation covenants, memoranda of understanding, agreements under section 16 of the CALM Act, referral to the EPA for its consideration to environmental impact assessment of development proposals) where relevant.

Woodlands over sedgelands in Holocene Dune Swales of the Swan Coastal Plain – Swan Coastal Plain Floristic Community Type 19b

One occurrence of this community, which occurs in damplands and occasionally sumplands between Holocene dune swales, has been identified in Yanchep National Park. The community is listed as 'Critically Endangered' on the Department's Threatened Ecological Communities database and under the EPBC Act. Its current distribution is limited, and while there may be multiple occurrences, the total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. An Interim Recovery Plan has been prepared by English *et al.* (2002).

The critical habitat for this community is the system of dunes and swales in which it occurs, the superficial groundwater that provides water to the swale wetlands, and the catchment for this groundwater (English *et al.* 2002). Potential threats include the effects of increasing fragmentation, lack of recruitment, hydrological changes ('un-natural' watertable alterations), changes to groundwater quality, disturbance (e.g. due to recreational use/maintenance activities), inappropriate fire regimes, increased weed invasion, feral animals (rabbits) and pathogens.

Melaleuca huegelii - Melaleuca acerosa (currently *M. systena*) shrublands on Limestone Ridges – Swan Coastal Plain Floristic Community Type SCP26a

The planning area supports a number of occurrences of this 'Endangered' threatened ecological community. An Interim Recovery Plan has been prepared by Luu and English (2005). Whilst there are several occurrences of the threatened ecological community, the total area is small and all or most occurrences are small and/or isolated and

[17] The caves at Yanchep known to contain the threatened aquatic root mat communities support 30-40 species of fauna, whilst 3-6 species tends to be the norm for aquatic caves elsewhere in the world (Jasinksa *et al.* 1996).

very vulnerable to known threatening processes (Luu and English 2005). It is not currently listed under the EPBC Act.

The community is largely restricted to massive limestone ridges. A number of priority species are associated with this TEC, and so recovery actions will also facilitate conservation of these priority species. Key threats include clearing for limestone mining and urbanisation, altered fire regimes, increased weed invasion and grazing (e.g. rabbits, overgrazing by macropods) (Luu and English 2005).

Occurrences of the community within Yanchep and Neerabup national parks comprise the total extent currently represented within the conservation reserve system. Massive limestone ridges in the Ridges area support significant occurrences of the community in good condition. The community includes significant representation of taxa endemic to the Quindalup and Spearwood Dune Systems (Weston and Gibson 1997). The present reservation of small patches elsewhere in the planning area is not considered to represent adequate reservation (Weston and Gibson 1997). Securing conservation purpose and tenure of the Ridges area will improve representation of the threatened ecological community within the conservation reserve system and significantly contribute to its recovery.

Reserve 25253 One Tree Hill, which is proposed for addition to Neerabup National Park, also supports this community. Whilst part of the original extent has been historically quarried and cleared for road development, the remaining area is in good condition (Luu and English 2005).

Northern Spearwood shrublands and woodlands' (SCP24)

The 'Northern Spearwood shrublands and woodlands' priority ecological community is restricted to three locations within the planning area: two within Neerabup National Park and one within Neerabup Nature Reserve. This community is comprised of heaths with scattered tuart occurring on deeper soils north from Woodman Point. Most sites occur on the Cottesloe unit of the Spearwood system. The heathlands in this community typically include parrot bush (*Banksia sessilis*), one-sided bottlebrush (*Calothamnus quadrifidus*) and large flowered bogrush (*Schoenus grandiflorus*).

Deeper Seasonal Wetlands on Sandy Soils – Swan Coastal Plain Floristic Community Type 14

The 'Deeper Seasonal Wetlands on Sandy Soils' ecological community occurs in the proposed 'Ridges' addition to Yanchep National Park (Gibson *et al*. 1994), and has an outstanding mature woodland of moonah (*Melaleuca preissiana*) (CALM 1989a). This community type has (to date) only been recorded from two sites on the Swan Coastal Plain – the other being further south near Lake Joondalup. However, the two occurrences of this community identified through the Swan Coastal Plain survey are likely to be at the southern end of their range, and it is likely to be more extensive to the north. Therefore, the community is not considered to meet criteria as a priority ecological community and has been withdrawn from the PEC database.

19 – Ecological Communities

The objective is to maintain threatened ecological communities and decrease threatening processes and/or their vulnerability to these.

This will be achieved by:

1. identifying and protecting potential threatened ecological communities and ecosystems at risk in the planning area by listing them under appropriate legislation;
2. maintaining and where possible increasing, through additions to the conservation estate, the extent of known threatened ecological communities within the conservation reserve system, such as the addition of the Ridges area;
3. consulting the recovery team for the Aquatic Root Mat Community of the Swan Coastal Plain before undertaking any operational activities and land-use changes within the planning area so that they do not adversely impact upon threatened ecological communities;
4. ensuring this management plan gives effect to recovery plans and that the strategies in recovery plans and this management plan are complementary;
5. installing exclusion devices such as fencing to protect threatened flora communities if necessary from grazing or to discourage unauthorised access;
6. liaising with agencies and neighbouring land managers as necessary and appropriate to prevent or minimise adverse impacts on ecological communities (in particular those of special conservation significance) in the planning area, and promote compatible management on adjoining lands;

7. undertaking, encouraging and/or supporting research and monitoring of important ecological communities such as the ecological requirements of threatened ecological communities, and adapting management accordingly;
8. identifying native plants and plant communities that may require special protection, and implementing appropriate strategies to minimise the impacts from threatening processes, such as climate change, environmental weeds, pest and problem animals, inappropriate fire regimes and recreation development;
9. maintaining, as necessary, those tuart trees supporting the Aquatic Root Mat Community of the Swan Coastal Plain in good condition, such as protection from disease and fire, and continuing artificial water supplementation measures;
10. continuing to implement a monitoring program that enables adequate assessment of the condition of threatened ecological communities and timely evaluation of the status of threats; and
11. providing appropriate information, interpretation and/or education opportunities for visitors to increase their knowledge, appreciation and understanding of ecological communities within the planning area, particularly threatened and priority ecological communities.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
19.1 The flora species that comprise floristic threatened ecological communities.	19.1 No loss of, or adverse impact on, flora species that comprise floristic threatened ecological communities.	After 5 years, or as per recovery plan if applicable.
19.2 The fauna species that comprise the Aquatic Root Mat Community of the Swan Coastal Plain.	19.2 No loss of, or adverse impact on, fauna species that comprise the Aquatic Root Mat Community of Yanchep over the life of this plan.	After 5 years, or as per recovery plan if applicable.

20. ENVIRONMENTAL WEEDS

Environmental Weeds within the Planning Area

Approximately 135 environmental weed species have been recorded in the planning area (see Appendix 5). Forty-three plant families are represented, with the largest numbers of species belonging to *Poaceae* (28 species), followed by *Asteraceae* (19 species) and *Papilionaceae* (nine species). Over 70% of the weeds in the planning area are herbaceous plants or grasses.

The number of environmental weeds in the planning area in each category of rating under the *Environmental Weed Strategy* are:

- High – 17 species;
- Moderate – 49 species;
- Mild – nine species;
- Low – 35 species;
- To be advised – 12 species; and
- Not listed – 13 species.

Eradication and even control of environmental weeds is not always feasible. In order to allocate resources to most efficiently accomplish the ultimate goal of protecting biodiversity from weeds, a prioritised weed control plan for each introduced plant is required.

Those species that are current local priorities for control are listed in Appendix 5, although local priorities for control may change over the life of the plan.

Major weed infestations are located in the Loch McNess recreation area, Boomerang Gorge, bushland close to developments and in wetland areas. There are also weeds present in areas that are less frequented; including the koala feed plantations, along firebreaks, roads, old rubbish sites and other areas of disturbance and clearings.

The planning area is increasingly susceptible to the invasion of weeds because of its proximity to the expanding metropolitan area and the surrounding farming and urban areas. Wetlands, areas of disturbance and areas that are frequently burnt and are low fuel zones close to boundaries and roads are most vulnerable to weed invasion. These sites should be monitored for new and emerging weed infestations.

Declared Weeds

Fifteen weed species listed as 'declared' species under the ARRP Act occur in the planning area and, of these, seven species are local priorities for control (see Appendix 5) including Cape tulip (*Moraea flaccida*), arum lily (*Zantedeschia aethiopica*), saffron thistle (*Carthamus lanatus*), Apple of Sodom (*Solanum linnaeanum*), Patterson's curse (*Echium plantagineum*) and variegated thistle (*Silybum marianum*).

Non-indigenous and ornamental trees

There are many non-indigenous trees located within the planning area (Appendix 6), which have ornamental (see Section 30 *Recreational Activities and Use*) or cultural (see Section 26 *Non-Indigenous Cultural Heritage*) value.

Notwithstanding their heritage, koala feed and scenic value, the presence of non-indigenous tree species can be regarded as incompatible with the purpose and philosophy of a national park and may also be impacting on the natural environment. For example, lemon-scented gums are encroaching into the bushland along Wanneroo Road, and larger trees may also be drawing upon groundwater resources (see Section 16 *Hydrology and Catchment Protection* and Section 17 *Native Plants and Plant Communities*). Some non-indigenous trees are also suffering from damage by the threatened Carnaby's cockatoo (see Section 18 *Native Animals and Habitats,* Section 30.1 *Day Use – McNess Recreation Area* and Section 26 *Non-Indigenous Cultural Heritage*). In this regard, non-indigenous trees that are not serving any specific and useful aesthetic, feed or cultural value, and which have the potential to become environmental weeds, should be progressively removed from the planning area and replaced/rehabilitated with appropriate local native species (see Section 24 *Ecosystem Rehabilitation* and Section 26 *Non-Indigenous Cultural Heritage*).

While over the life of the plan the major access roads may be excised from the planning area into specific road reserves vested with other bodies (see Section 29 *Visitor Access*), the avenue of lemon-scented gums along Wanneroo Road still requires on-going maintenance to protect adjacent bushland (see above).

The koalas at Yanchep National Park (see Section 21 *Introduced and Other Problem Animals*) require a specialised diet of eucalypt leaves. This diet is supplied from a range of native and non-indigenous feed trees (see Appendix 6) previously planted in small plantations scattered within the park (including areas adjacent to the three wetlands and around the golf course) and outside the park in nearby State forest. The koala feed trees, of which flooded gum (*Eucalyptus rudis*) is the most common, provide variety in the diet of the koalas. A strategy of the previous management plan was to progressively remove all plantations from the park (except at the golf course), with a priority for removal of those in the vicinity of the wetlands (CALM 1989a). However, given that the non-indigenous koala feed trees are not posing any significant invasive or environmental impact and that there are few sources of koala feed within close proximity to the park, these plantations of non-indigenous trees should remain for the life of the plan or until koalas are no longer kept at the park, whichever is sooner.

Many of the original trees planted for koala feed have been neglected over the years and are now present as large, dominant trees, which cannot be utilized for koala feed. These trees should be progressively converted into koala food sources by cutting them down and promoting coppice which, if kept in this vegetative state will produce koala feed and may also reduce the potential for the trees to act as weeds (ie. continual use for koala feed may reduce the ability of the trees to produce seeds).

20 – Environmental Weeds

The objective is to minimise the impacts of environmental weeds on key values.

This will be achieved by:

1. considering the *Environmental Weed Strategy for Western Australia* and local knowledge to assess invasiveness, distribution and environmental impact;
2. managing environmental weeds according to relevant legislation and Department policies;
3. maintaining information on weeds including a register of weeds, details of distribution, relevant

biological information and history of control;
4. developing and implementing a weed control plan that considers:
   - prioritising weeds by species and location;
   - impacts on key values including biodiversity and threatened species;
   - controlling weeds by appropriate mechanical, chemical or biological methods; and
   - eradicating new and emerging weeds before they become established;
5. monitoring and evaluating environmental weeds in accordance with the control plan;
6. limiting the opportunity for weeds to be introduced and established by:
   - applying appropriate hygiene practices as required to machinery entering the planning area;
   - minimising disturbance of soil while carrying out management activities, particularly in areas within or adjacent to sources of weeds; and
   - restricting the importation of soil into the planning area to only those sources with strict soil quarantine;
7. undertaking weed surveying and mapping as resources allow, with a priority on areas with values of particular conservation significance (e.g. threatened ecological communities);
8. liaising with relevant agencies and neighbouring land managers to facilitate effective, coordinated weed management in the planning area and surrounding areas;
9. providing appropriate information, interpretation and/or education opportunities for visitors to increase their knowledge, appreciation and understanding of the adverse impacts of environmental weeds on key values;
10. undertaking, supporting and encouraging research and monitoring of environmental weeds, such as the impact of bulrush on wetlands, and adapting management accordingly;
11. ensuring that the ecological functions now performed by bulrush are taken into consideration in the control of bulrush;
12. progressively removing non-indigenous trees that are not serving any specific and useful aesthetic, koala feed or cultural value, and have the potential to become environmental weeds, and replacing/rehabilitating with appropriate local native species; and
13. converting large, dominant non-indigenous koala feed trees into food sources that can be used for koalas by cutting them down and promoting coppice.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
20.1 The extent of environmental weed species at priority locations and rated as a 'high' or local priority.	20.1 Decrease in the extent of weed species rated as 'high' or local priority.	After 5 years.

21. INTRODUCED AND OTHER PROBLEM ANIMALS

Introduced and problem animal species in the planning area are listed in Table 8. The Department's proposed *Management of Pest Animals on CALM-Managed Lands* policy statement (subject to final consultation) guides state-wide approaches and priority setting for the control of problem animals on Department-managed lands and waters. Management of problem animals in the planning area should be cognisant of and consistent with regional approaches. The Department also has responsibilities for control of declared animals on the lands it manages under sections 39-41 of the *Agriculture and Related Resources Protection Act 1976* and will be accountable for declared animal control under the *Biosecurity and Agriculture Management Act 2007* when the supporting regulations are put in place.

A number of introduced species (e.g. fox, cat, rabbit and feral goat) and the processes (e.g. predation, competition and land degradation) by which they impact on biodiversity, are recognised as nation-wide problems and are listed as key threatening processes under the Commonwealth's EPBC Act. Threat abatement plans for these threatening processes provide national coordination to manage the impacts on biodiversity, with the emphasis on local control programs to ensure recovery of endangered species.

The many introduced and problem animals in the planning area (Table 8) mean that eradication and even control are not always feasible. Therefore, the control of introduced and problem animals in the planning area requires a planned and prioritised approach.

A number of techniques can be used to control pest animals including shooting, trapping, baiting (or chemical control) and biological control. However, the use of particular control measures often needs to be tailored to the particular introduced species, area and circumstances. Control measures may also be conditional on a number of other restrictions that consider the protection of the environment and the safety of other visitors.

Particularly significant problem animals within the planning area that are a priority for control include the fox, cat, rabbit and goat.

Table 8: Introduced animals in the planning area.

Common Name	Scientific Name
Mammals	
Fox[1]	*Vulpes vulpes*
Cat	*Felis catus*
Rabbit[1]	*Oryctolagus cuniculus*
House mouse	*Mus musculus*
Black rat	*Rattus rattus*
Domestic dog[1]	*Canis familiaris familiaris*
Feral Goat[1]	*Capra hircus*
Birds	
Mallard & hybrid[18]	*Anas platyrhynchos*
Rock dove	*Columba livia*
Laughing turtle-dove	*Streptopelia senegalensis*
Spotted turtle-dove	*Streptopelia chinensis*
Eastern long-billed corella	*Cacatua tenuirostrisr*
Little corella[1]	*Cacatua sanguinea*
Rainbow lorikeet[1, 2]	*Trichoglossus haematodus*
Laughing kookaburra[2]	*Dacelo novaeguineae*
European goldfinch	*Carduelis carduelis*
Fish	
Mosquito fish	*Gambusia holbrooki*
Goldfish	*Carrasius auratus*
Carp	*Cyprinus Carpio*
Invertebrates	
Feral honeybee	*Apis mellifera*
Yabby	*Cheerax destructor*
European house borer	*Hylotrupes bajulus Linnaeus*

[1] Declared animal under the ARRP Act (as of December 2007).
[2] Considered 'acclimatised' and protected under the Wildlife Conservation Act 1950.

Red Fox and Feral Cat

Both the fox and feral cat occur in the planning area, the latter particularly associated with recreation areas. Currently within the planning area there are no formal programs to control the numbers of foxes and cats.

Throughout the South-west the Department has successfully controlled foxes on conservation reserves using 1080 poison baiting under the *Western Shield* program. 1080 baiting has not been used at Yanchep National Park and Neerabup National Park mainly due to the proximity to urban areas and the possible effects upon the pets of neighbours or visitors. However, baiting with 1080 may be worth trialling in limited areas (subject to appropriate signage and community notice) (Jackson *et al.* 2007). Alternatively, some other current control methods for foxes include destruction of dens, trapping or constructing exclusion fencing.

Cats are more difficult to control, as they are very shy towards traps. Some possible control methods could include measuring the effects of establishing a cat-free zone in which cat numbers are monitored using radio-tracking devices to determine their activity and how far they move, with the aim of investigating the feasibility of introducing a cat-free zone for urban areas near the planning area. The Department would support such an initiative if it were to occur in the nearby town sites.

[18] A mallard duck and Pacific black duck can cross to produce hybrids.

Should other alternative and safe fox and cat control methods suitable for use in the planning area be developed over the life of this plan, the Department will trial the use in the planning area.

Rabbits

Rabbit numbers in the planning area seem to correspond to the periodic impact of *Myxomatosis* and, more recently, *Calicivirus*. This, together with occasional wildfire events that has temporarily reduced populations, have been effective means of control within the planning area and, to date, specific control by the Department has not been necessary. However, controlled baiting, trapping or fencing options may be employed where specific conservation values are threatened (e.g. TECs).

Goats

Feral goats can cause serious damage to the environment by competing with native animals for shelter, water and food, threatening the survival of native flora through their feeding habits and destroying vegetation, which can lead to soil erosion (Environment Australia 2008). Shooting and trapping, as well as monitoring of occurrence, may be suitable options for control.

Invertebrates

Feral honeybees impact on the values of the planning area by competing with native fauna for tree hollows, floral resources such as pollen and nectar and also increasing seed-set in some weeds. The feasibility of completely removing feral honeybees is low, as localised eradication would probably be followed by re-colonisation from new swarms invading the area (Gross 2001). Until an effective means of control is found for feral honeybees, management should focus on controlling the distribution and density of managed hives in areas of highest conservation value or around recreation sites (see Section 40 *Beekeeping*).

It is believed that yabbies have been introduced into Loch McNess and are a threat to marron and other invertebrates because they are a prolific breeder, compete with or prey upon other fauna in the community, may alter riverine habitats through their burrowing activities, carry diseases such as the freshwater crayfish infection *Thelohania* (see Section 24 *Diseases*) and could also potentially impact on root mat communities (see Section 20 *Native Animals and Habitats* and Section 21 *Ecological Communities*) (English *et al.* 2003).

Crystal Cave at Yanchep National Park has not had groundwater streams in it since 2000 and the rewatering project of this cave poses a threat of introducing stygofauna which can replace Gondwanan relicts and also impact threatened root mat communities (see Section 21 *Ecological Communities*). Because of this risk, any artificial recharge of Crystal cave (and any other caves) should be sampled for stygofauna, and risks of faunal invasion and/or genetic dilution should be assessed before recharging of the cave stream commences (Knott and Storey 2004).

21 – Introduced and Other Problem Animals

The objective is to minimise the impacts of introduced and other problem animals on key values.

This will be achieved by:

1. managing introduced and other problem animals according to relevant legislation, Department policies and operational guidelines;
2. maintaining information on introduced and other problem animals including a register of animals, details of distribution, relevant biological information and history of control;
3. developing and implementing an introduced and other problem animals control plan that includes:
   - priority animals by species and location;
   - impacts on key values including threatened species;
   - controlling animals by appropriate methods including trapping, shooting and/or baiting; and
   - preventing the establishment of new populations;
4. monitoring and evaluating introduced and other problem animals in accordance with the control plan, including the monitoring of cave stream ecosystems and artificial recharge for introduced species that may pose a threat to subterranean cave fauna;
5. undertaking surveying and mapping of introduced and other problem animals as resources allow;
6. using fencing and other exclusion control measures for particularly susceptible high conservation value sites such as TECs and PECs;

7. liaising with relevant agencies and neighbouring land managers to facilitate effective, coordinated management of introduced and other problem animals in the planning area and surrounding areas, particularly on goats;
8. providing appropriate information and interpretation on the adverse impacts of introduced and other problem animals and their impacts on key values to promote awareness, appreciation and understanding;
9. encouraging visitors to report introduced and other problem animals; and
10. applying, supporting or encouraging research and monitoring of introduced and other problem animals, and adapting management accordingly.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
21.1 Number or number of populations of goats.	21.1 No increase in the number or number of populations of goats.	After 5 years.

22. DISEASES

Plant Diseases

Phytophthora dieback

A significant threat to biodiversity within the planning area is the epidemic of plant disease known as 'dieback' caused by a microscopic pathogen, the water mould; *Phytophthora cinnamomi.* It is thought that this pathogen was introduced during European settlement of WA by hosting on plants brought over for cultivation and in the soil around their roots. Once infested, susceptible plants are killed and in many cases are eliminated from the site leading to dramatic and permanent changes to native plant communities and their dependent fauna. At worst, mass collapse of ecosystems occurs along with significant interference to important ecological processes.

Effects

The planning area is within a zone vulnerable to the establishment and persistence of *P. cinnamomi*, and it has been recorded at several locations including in the vicinity of the golf course, the wildflower garden (where it is probable that it was brought in with soil) and the eastern end of Old Yanchep Road. *P. cinnamomi* may be present across a significant amount of the planning area, particularly in association with unsealed vehicle tracks. *Banksia* woodlands, in particular, would be highly impacted by the disease.

P. cinnamomi can also have a major impact on faunal habitats (Table 9). Species such as the honey possum are dependent on plant communities such as the *Banksia* woodlands, which are highly susceptible to diseases caused by *P. cinnamomi*. Such dependent species will be reduced in number or disappear as the autonomous spread of *P. cinnamomi* continues to modify critical habitats. Impacts may be accelerated if the vectoring of the pathogen by humans into uninfested areas in the planning area is not minimised. Table 9 shows some effects that a pathogen can have on fauna.

Management

Management for P. cinnamomi is described in the Department Policy No. 3 – Management of Phytophthora and Disease caused by it and the accompanying Best practice guidelines for the management of Phytophthora cinnamomi (CALM 1998b), and the Department's Manual (CALM 2003b). Dieback disease caused by P. cinnamomi is listed as a key threatening process under the EPBC Act and a threat abatement plan has been prepared (Environment Australia 2001).

A 'Phytophthora Dieback Management Plan' will be developed for the planning area that undertakes risk assessment and response planning to (i) develop priorities based on the natural and cultural values of 'protectable areas', and (ii) reduce both the rate of vectored spread and the incidence of initiation of new centres of infestation.

Using strategic mapping of the disease across the planning area, a broad range of tactics may be deployed in the planning area including:

- identifying 'protectable areas' for priority protection;

- more intensive work will be planned and implemented for 'protectable areas' on a priority basis including the analysis of values, more detailed mapping of infested/uninfested areas, and the planning and implementation of risk mitigation and, where appropriate, recovery actions;
- planning and implementing hygiene regimes for all works or activities within uninfested areas;
- minimising and/or prohibiting access into uninfested areas under certain conditions, such as clean on entry and entry at times when soil movement is unlikely (see Section 29 *Visitor Access*);
- applying phosphite (see below); and
- reducing vectoring by feral animals by taking action to reduce populations.

Particular attention needs to be directed to prevention of disease threats to special conservation values, such as *Banksia* woodlands, tuart trees and TECs.

Table 9: Possible effects on fauna due to the presence of a plant pathogen in a vegetation community

Effects on Vegetation	Effects on Fauna
Loss of susceptible plants in the understorey and midstorey	Direct loss of food sources such as seeds, nectar, pollen
	Indirect loss of food sources such as invertebrates
Decline in plant species richness and diversity	Loss of food for species that prefer floristically rich vegetation
	Loss of seasonal food
Decrease in plant cover, increase in bare ground, erosion	Loss of habitat for species dependant on thick ground cover
	Increased predation risk
	Changes to microclimate
Decrease in canopy cover	Loss of food for arboreal species
	Loss of habitat for arboreal species
Decrease in litter fall	Decline in litter invertebrates
	Decline in invertebrate food sources for insectivores
Post infection increase in frequency of resistant species	Change of food resources

Source: based on Wilson *et al.* (1994).

Other Plant Diseases

There are eight species of *Phytophthora* in Western Australia and, while *P. cinnamomi*, is the most damaging often causing major permanent change in ecosystems it infects, the other species (e.g. *P. megasperma*, *P. citricola*, *P. drechsleri* and *P. cryptogea*) generally cause only very localised and minor damage in native vegetation, which often recovers fully.

Rusts are the second most frequent pathogens encountered on native plant taxa in south-western Australia (Shearer 1994), and the gall rust *Uromycladium tepperianum* commonly affects *Acacia* species producing galls in the planning area.

Large populations of Armillaria root rot (or honey fungus) *Armillaria luteobubalina* occur on tuart trees around Yanchep National Park, particularly areas east of Loch McNess (Brad Johnson *pers. comm.*2008). Many species that resist infection by *P. cinnamomi* are susceptible to armillaria root rot. The fungus can act as a primary pathogen, a stress-induced secondary invader, and as a saprophyte[19]. Symptoms of the disease include dieback of the limbs and branches, yellowing of foliage, splits in the trunk, poor vigour, the leaking of sap from the trunk, scars on the trunk and darkening of larger roots. Factors that stress trees, such as drought, flooding and the compaction of soil, weaken their defence systems and increase the chances of the disease developing. While prevention is the best treatment, hygiene is essential for ensuring the disease is not spread from infested sites to uninfected sites.

Botryosphaeria ribis and *Cryptodiaporthe melanocraspeda* appear to be two of the most common aerially dispersed canker-causing fungi, and infect plant hosts mainly from the *Proteaceae* and *Myrtaceae* families (Shearer 1994).

[19] An organism dependent for nutrition on the reduction of organic matter from the dead tissues of other organisms.

Animal Diseases

The possibility that pathogens may be transported with animals and trapping equipment or transferred direct to other species, need to be considered in planning captive breeding, fauna trapping and translocations programs, and in future research.

Mammals

Chlamydia, a bacterium, can infect multiple species of native mammals (CALM 2002), and the Park's koala populations are susceptible to this disease but have been disease free since 1992.

Kangaroos in the planning area are susceptible to chorio-retinitus or kangaroo viral blindness and Ross River virus, although only occasional cases of these diseases have been recorded. They are also susceptible to lumpy jaw and fungal dermatitis.

Birds

Psittacine circoviral (beak and feather) disease is endemic in wild Australian parrot species and is known to affect more than 20 species (Brown 1997). While this disease naturally occurs in wild populations, it has little adverse impact on most species, and has not been confirmed in the threatened Carnaby's cockatoo. The disease is firmly established in the rainbow lorikeet population in the Perth area.

Migratory birds occupy parts of the planning area for periods of the year (see Section 18 *Native Animals and Habitats*). As such there is the potential, although limited, for bird flu to be introduced into the area. Signs of avian influenza depend on the species of bird affected, age, sex, environmental factors and the virulence of the virus. Often there is sudden death, with no obvious signs or lesions. In less acute infections signs can include mild to severe coughing and sneezing, depression, lack of eating, diarrhoea, oedema and cyanosis of the head, combs, wattles and legs, and lesions. Avian influenza is a notifiable disease.

Amphibians

Chytridiomycosis is an infectious disease, affecting amphibians worldwide and caused by the amphibian chytrid fungus *Batrachochytrium dendrobatidis*. A broad geographic zone of infestation occurs from just north of Geraldton, south to Augusta and east to Esperance, however this does not imply that all frog populations are infected within this zone (Aplin and Kirkpatrick 2000). While the infection has been reported in many South-west frog species, five species of frogs (motorbike frog, slender tree frog, moaning frog, Western banjo frog, and clicking froglet) are infected more frequently than most other species (Aplin and Kirkpatrick 2000), and all occur within the planning area. Populations of these frogs should be monitored to detect any significant decline in numbers.

Invertebrates

The freshwater crayfish parasite *Thelohania* is present in some yabbies. *Thelohania* is a microscopic parasite that invades the muscle tissue, and may eventually cause the death, of freshwater crayfish (DoF 2001). Currently there are no treatments available. It is spread when healthy individuals feed on an infected one. This disease may pose a threat to the smooth marron if yabbies are introduced or spread into the area.

22 – Diseases

The objective is to prevent the introduction and minimise the spread of plant and animal diseases.

This will be achieved by:

1. managing plant and animal diseases according to legislation, Department policies and operational guidelines;
2. maintaining information on plant and animal diseases including a register, details of distribution, relevant biological information and history of control;
3. developing a plant and animal diseases control plan that addresses:
   - prioritisation of diseases by species and location;
   - impacts on key values including threatened species; and
   - control of diseases by appropriate methods;
4. controlling plant and animal diseases in accordance with the control plan;

5. identifying protectable or quarantine areas for priority protection from *Phytophthora cinnamomi*;
6. developing, where necessary and implementing appropriate hygiene measures such as developing specific hygiene plans prior to commencing any operation that requires soil or plant material movement such as the construction of recreation facilities, roads, firebreaks and tracks;
7. identifying, evaluating and, where practical, implementing effective and efficient measures for the maintenance and/or restoration of significantly infested areas, including:
   - treating priority sites of threatened plant populations, threatened ecological communities and habitats of threatened native animals with phosphite; and
   - trialling the reconstruction of ecosystems by rehabilitating badly affected areas using local dieback resistant species appropriate to the soil and climate characteristics of the area;
8. liaising with relevant agencies and neighbouring land managers to facilitate effective, coordinated management of plant and animal diseases in the planning area and surrounding areas;
9. providing appropriate information, interpretation and/or education opportunities for visitors to increase their knowledge, appreciation and understanding of the adverse impacts of plant and animal diseases on key values, particularly for *Phytophthora cinnamomi*;
10. undertaking, supporting or encouraging research and monitoring of plant and animal diseases, and adapting management accordingly; and
11. documenting any outbreaks of new plant and animal diseases, and implementing management responses as appropriate.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
22.1 The identification and establishment of protectable areas that are a priority for protection.	22.1 Protectable areas that are a priority for protection have been identified and established.	After 5 years.

23. FIRE

The Department's management of fire, including the use of fire, fire suppression and wildfire prevention, is regulated by legislation (e.g. *Bush Fires Act 1954*, CALM Act and precedents established under Common Law). It is also guided by the Department's *Policy Statement No. 19 – Fire Management Policy* (DEC 2007b), which includes a number of scientific principles (Burrows *et al.* 1998, Fire Ecology Working Group 1999).

This management plan presents an adaptive management approach to fire where management policies and practices are continually improved by learning from the outcomes of operational programs, scientific research (e.g. on fire ecology) and monitoring. This acknowledges a level of uncertainty about what policy and practices are best, but consistent with adaptive management, this plan utilises best available knowledge to implement programs aimed at meeting specific management objectives. Monitoring, regular review, analysis of management outcomes and ongoing research are critical if fire management in the region is to continuously improve.

Fire History

Prescribed burning under controlled conditions was widely adopted after severe wildfires burnt throughout much of the south-west in 1961 (Armstrong 2004). The regular use of low intensity prescribed fire to reduce fuel loads, and consequently reduce wildfire severity, has occurred in Yanchep National Park. In 2007/2008, prescribed burning has been undertaken in Neerabup National Park and Neerabup Nature Reserve. There have been several large and damaging wildfires in Yanchep National Park (1977 wildfire burnt 500 ha, 1983 wildfire burnt 800 ha, 2005 burnt 1,500 ha and 2009 north east wildfire burnt 1,493 ha). The 2005 wildfire at Yanchep National Park damaged some park infrastructure as well as significantly affecting wetland vegetation and soils. However, prescribed burning has generally been effective in reducing the occurrence and severity of large, damaging wildfires, which can have severe impacts on some components of the biota and fire sensitive values.

Wildfires are likely to continue to periodically occur due to the coincidence of lightning strikes with severe fire weather conditions and areas with fuel accumulation (McCaw *et al*. 1992, McCaw and Hanstrum 2003), and the accidental or deliberately lit (arson) fires. The high number of deliberately lit illegal fires is of particular concern, and the Department will continue to liaise with agencies responsible for public education and law

enforcement, such as FESA and the WA Police, to promote education about the effects of fire on the natural environment and key values and the need to prevent wildfires.

Fire Ecology

Fire ecology is the study of the interaction of fire, the biota (plant and animals species), and the habitats in which they live. Knowledge of the impacts of this interaction is integral in protecting biodiversity, but also life and community assets. While numerous studies report on the changing species assemblages, species diversity, vegetation composition and structure, and habitat characteristics in response to time since last fire, fire season, fire interval, and fire intensity, and on the ways in which fire can influence ecosystem processes, not enough is known about local fire ecology. Therefore, fire management will continue to evolve with this accumulated knowledge and management experience (Burrows 2004).

In determining appropriate ecological fire regimes for the planning area, understanding of the vital attributes of native plants and animals is useful. Knowledge of the vital attributes of plants has helped to define fire regimes, especially minimum and maximum intervals between fires. For most faunal groups, it appears fire response is more variable and unpredictable (Burbidge 2003a, Bamford 1992). The immediate impact of fire on fauna and their recovery rate is directly proportional to the scale, intensity, and patchiness of the fire and the interval between fires (Friend 1995, Burrows *et al.* 1998, Friend 1999, Burbidge 2003a, Friend *et al.* 2003). Maintaining a diversity of post-fire fuel ages, seral stages or habitats through space and time is also fundamentally important for ecosystem health and enhancing biodiversity. The process of post-fire vegetation change is continuous, and the rate of change will depend on the severity of the fire, and local soil and climatic conditions.

Managing Fire to Conserve Biodiversity

This management plan proposes to manage biodiversity across the planning area by adopting an adaptive approach to fire management, which, in the long-term, seeks to devise, implement and monitor a range of fire regimes based on:

- vital attributes of threatened species and ecological communities;
- vital attributes of key fire response species;
- creating and maintaining diverse post-fire (seral) stages, or functional habitat types;
- managing fire to protect ecologically sensitive areas and niches; and
- fuel accumulation rates.

One or a combination of these fire regimes is likely to apply to appropriate parts of the planning area. In some cases there may also be the need to avoid fire for biodiversity reasons and the Department will not apply fire to several parts of the planning area (ie. Fire Exclusion Reference Areas, see *Fire Research*). Certain parts of the landscape, such as wetlands, will be protected from fire. As there are gaps in current knowledge, management for biodiversity conservation will initially focus on the protection of threatened species, threatened ecological communities and significant habitats that require specific atypical fire regimes. As information on the vital attributes of species becomes available this will be incorporated into the prescribed burning program. Fire regimes that have been developed to protect life and community assets (see *Managing Fire to Protect Life and Community Assets*) will complement ecological fire regimes where possible. Fire regimes for biodiversity may also achieve a protection benefit. In some cases there may also be the need to avoid fire for biodiversity reasons and the Department will not apply fire to several parts of the planning area (i.e. Fire Exclusion Reference Areas, see *Fire Research*).

In a Logical Burn Unit, there will be a variety of interlocking ecosystem components or habitats with different fire response patterns. For each Logical Burn Unit, a standard ecological fire regime (Figure 5) based on vital attributes of key fire response species is devised for the most fire-prone (least fire sensitive) components and to protect the least fire-prone (most fire sensitive) components.

This typically requires consideration of two landscape components, although this may vary depending on the fire response of flora and fauna species in the area:

- the drier, more flammable fire regime tolerant habitats, which generally contain flora species that are mostly resprouters and have relatively short juvenile periods and fauna that do not require mature or medium to late successional state vegetation; and

- fire regime specific habitats (e.g. granite outcrops and valley floors) will generally contain flora that are fire sensitive with relatively long juvenile periods and fauna that prefer mature, medium to late successional stages of vegetation.

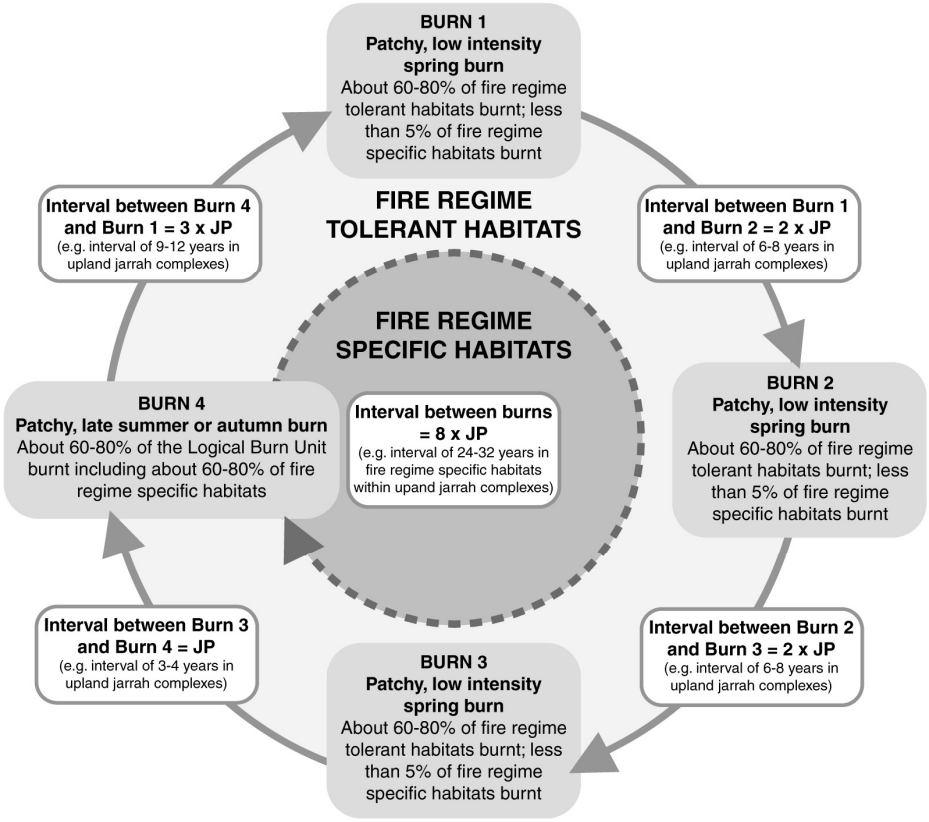


Figure 5: Example of an ecological fire regime for managing ecosystems based on vital attributes

(Adapted from Burrows *et al.* 1998, and Burrows 2008).
[1] = the juvenile period of the slowest maturing fire sensitive understorey species.

Managing Fire Based on the Vital Attributes of Threatened Species and Ecological Communities

Threatened flora and fauna species and threatened ecological communities are protected by State and Commonwealth legislation, which imposes requirements in relation to how fire management activities are conducted. In many cases, it is appropriate to devise and implement fire regimes specific to these taxa to ensure their persistence (where the fire ecology of threatened species is well understood). Alternatively, threatened species and ecological communities will be protected from inappropriate fire regimes, such as frequent lethal or infrequent intense fires, which are known to or are likely to cause the decline of these species and communities.

A Priority mammal species from the planning area, the quenda, may be particularly susceptible to increased predation by foxes and/or cats in early post-fire conditions. Given the quenda's need for dense vegetation and the threat of fox predation, Friend (1997) considers that for this species, frequency of fire in their wetland habitat should be relatively low or include unburnt areas to maintain the protection provided by vegetation.

Carnaby's Cockatoo breed in Eucalypt woodland with large tree hollows (created by fire). Excessively frequent destructive wildfires are a threat to hollow abundance. Sufficient and suitable hollow habitats need to be considered in fire management regimes.

Fire effects on reptiles and amphibians are often complex and less predictable. Some micro-habitats of reptiles and amphibians, such as leaf litter and bark, are more susceptible to fire. The frequency and area of wildfires are important factors in the protection of reptiles and amphibians.

Generally, overall faunal biodiversity is likely to be maximised by avoiding widespread intense wildfires and maintaining a diversity of post-fire vegetation successional stages to provide habitat diversity. The fire responses of native biota will also vary depending on the extent of, and interaction of fire with, habitat fragmentation and other ecological disturbances (e.g. impacts of weeds, disease, introduced animals).

Banksia woodlands are relatively widespread throughout the planning area. *Banksia* species that resprout from lignotubers are generally less sensitive to frequent fire regimes than those that regenerate only from seed (particularly those with only canopy-stored seed) and which often require longer minimum inter-fire periods to allow sufficient viable seed for population replacement (Lamont and Markey 1995, Hopkins and Griffin 1989). Hobbs and Atkins (1990) indicate a fire rotation of > 5 years may be needed to maximise conservation values in *Banksia* woodland, although they note that this may not always be consistent with fuel reduction burning for community/asset protection objectives.

Tuart woodlands are also significantly represented within the planning area. Tuart is thought to rely predominantly on fire for recruitment of seedlings, although mature trees are killed if fire breaches the bark (Ruthrof *et al.* 2002). Tuart does not form lignotubers, however trees not killed by fire resprout from buds on their stems or branches (Longman and Keighery 2002). After fire, seeds are released in large quantities from the canopy, and a mass recruitment of seedlings follows (Ruthrof *et al.* 2002)[20]. The exact post-fire period for sufficient seed to be produced to recruit seedlings is not known, although it is thought to be a minimum of 4-9 years (Ruthrof *et al.* 2002). Beyond a decade post-fire, a considerable part of the tuart population may not be reproductive (Ruthrof *et al.* 2002). Seed production and supply may vary considerably in conjunction with variations in between flowering seasons (e.g. there have been reports of mass flowering every 5 to 8 years) (Ruthrof *et al.* 2002). Destructive or significantly damaging fire in areas where tuart trees have roots in caves is a major threat to associated subterranean fauna and ecological communities, such as aquatic root mat communities (see Section 19 *Ecological Communities*). Therefore, it is important that fire management protects these trees from destructive or significantly damaging fires.

The 'vulnerable' Wabling hill mallee (*Eucalyptus argutifolia*) (see Section 17 *Native Plants and Plant Communities*) is known to regenerate from a woody underground rootstock after fire, producing its first buds within 3-4 years (CALM 1998b). There are also several threatened species and communities of the planning area that are prone to modification by fire either directly (e.g. Swan Coastal Plain Floristic Community Type SCP26a) or indirectly (e.g. Swan Coastal Plain Floristic Community Type SCP01) (see Section 19 *Ecological Communities*). However, there is generally little information regarding the fire response of species and communities of conservation significance occurring in the planning area. Therefore, further investigation into such species and communities (including vital attributes, fire history, and interactions with other threatening processes) will be important to identify and provide for their optimal fire regimes.

Managing Fire to Protect Ecological Sensitive Areas and Niches

In the previous management plan for Yanchep National Park, specific regimes were identified for (i) fuel reduction, (ii) vegetation management, and (iii) no planned burn (CALM 1989a), which applied to specific areas within the national park. However, these areas will no longer apply for the management plan, so that strategic and operational fire management flexibility can be maintained to adapt to prescribed burning, the occurrence of wildfire and new information.

There are a number of factors to be taken into consideration with respect to the fire response of wetland ecosystems within the planning area. These include:

- wetlands may be more likely to support species with fewer fire adaptive traits and restricted or specialised habitats (e.g. some birds, frogs which are dependent on permanent or seasonal water);
- some of the wetland habitats are significant for the conservation of Threatened Ecological Communities and a number of priority species (e.g. Swan Coastal Plain Floristic Community Types 14 and 19, quenda, snakes, black bitterns and little bitterns);
- the implications of declining groundwater levels and associated wetland drying, including issues of increased susceptibility to fire, acid sulphate soils, peat fires, spread of and increased fire risks from wetland weeds such as bulrush;
- cumulative impacts of multiple simultaneous pressures/disturbance factors on wetlands;
- water quality impacts (e.g. impacts of increases in turbidity or disturbance of acid sulphate soils/loss of or change in soil profiles); and

[20] Seeds are also normally released slowly throughout the year, and particularly over summer.

- mechanical fuel reduction methods as an alternative or adjunct to the use of fire to reduce fuel loads in wetlands.

Climate change and drying of wetlands in the planning area renders them more susceptible to ignition, and fire susceptibility of Gnangara Mound wetlands with organic sediments, peatlands, rushes and reed beds is increasing. Lake Wilgarup has a deep (approximately 1m depth) organic/peat sediment profile that has been dry for several years. The 2005 wildfire at Yanchep National Park severely reduced vegetation cover and disturbed soil structure at several wetlands (e.g. Loch McNess, Lake Wilgarup, Lake Yonderup and Pipidinny Swamp), and consumed organic soils at Lake Wilgarup (Clark and Horwitz 2005 in DoW 2007). The burning of organic sediments leads to subsequent changes in wetland physio-chemistry and functioning, and poses a serious health threat to local residents. In recent years, long-burning peat fires have been problematic at Lake Nowergup.

The Department has developed fire management guidelines for organic-rich soils (peatlands) and watercourses with reeds and rushes.

Fires within karst and cave environments may alter the dynamics of these systems through changes in the surface-subsurface interrelationships. Fire associated changes may include alterations to movements of air, water and nutrient movement through karst through increased sediment loads (e.g. ash) into the system, and re-routing or channelling of water drainage through loss of overlying vegetation (see Section 15 *Geology, Landforms and Soils*).

Fire damage to tuart trees with roots in caves has significant implications for associated subterranean ecological communities (see below, Section 15 *Geology, Landforms and Soils* and Section 19 *Ecological Communities*).

Karst environments also have safety implications for fire management because of the risk to the safety of fire fighters (and machines) operating within these environments (see Section 32 *Visitor Safety*).

Managing Fire to Protect Life and Community Assets

The existence of urban areas, farmland and other developments, as well as the increasing use of natural areas for recreation, requires that the protection of life and community assets be considered in fire management for the planning area.

Identifying fire vulnerable community assets within the planning area, and determining the risk, likelihood and consequences of wildfire impact on those assets will assist in managing the threat posed by wildfires. The Department's 'wildfire threat analysis'[21] provides a strategic framework for this to occur and the basis for a more detailed analysis and evaluation of susceptible areas and specific management tactics. This process will also assist in developing strategies to mitigate the threat to biodiversity values. The wildfire threat analysis process aims to:

- provide a framework to analyse the best available information on all factors contributing to the wildfire threat, and allow evaluation of alternative responses;
- provide a standard and repeatable process for decision-making;
- permit objective comparisons between different areas with different problems;
- support the clear and explicit explanation of the rationale behind fire management decisions; and
- provide a rational basis for discussion and conflict resolution in the preparation of plans.

To achieve this, the wildfire threat analysis process considers:

- the likelihood of an ignition occurring (past fire history);
- the potential behaviour of fire following that ignition (fuel, landform, weather);
- the capacity to mount an effective suppression response (detection, travel time and access for suppression forces and the quantum of those resources); and
- the potential consequence on social, economic and environmental values impacted before suppression is achieved.

[21] The wildfire threat analysis is consistent with the accepted framework under which risk assessments are implemented in Australia – the *Australian/New Zealand Standard AS/NZS 4360:2004 – Risk Management*. Variables in the analysis procedure, such as fuel age, may change over time and hence the analysis only provides an assessment of risk at the time of analysis. Consequently, the analysis process is used as a guide and Department expertise and experience is necessary to formulate long-term risk mitigation strategies.

Strategies for Wildfire Mitigation

The Department proposes the following strategies for wildfire mitigation in the planning area:

- providing 'asset protection' around key community assets;
- providing 'strategic protection' to prevent wildfire runs;
- using mechanical fuel management where appropriate;
- maintaining, and if possible improving, the Department's fire response capability;
- liaising with local government authorities, FESA and local fire brigades;
- educating and communicating with the community; and
- managing public access (see Section 29 *Visitor Access*) and maintaining access for fire management purposes.

Asset Protection

Asset protection is strategically located immediately around key community assets, such as the McNess Recreation Area and golf course, and will be managed with a priority for the protection of human life and particular assets. The full range of options for wildfire mitigation described above may be employed in these areas. A key component of management will be regular prescribed burning and the use of mechanical fuel management techniques (see below). As a whole, the management objective for these areas is to maintain a reduced fuel level and fire response capacity appropriate to protect the asset.

It is appropriate that an Asset Protection Plan be developed for the planning area, given:

- the high numbers of visitors to Yanchep National Park;
- the likelihood of wildfire occurring;
- the consequences of wildfire; and
- the likelihood of an expanding population with increased access within close proximity to the planning area in the medium term.

Mechanical Fuel Management

Mechanical fuel management includes the use of slash breaks[22]. Slash breaks can be applied to restrict a wildfire and/or enable access for fire-fighting machinery and are most often applied in asset and strategic protection areas. The visual impacts of slashed breaks will be minimised wherever possible using landscape management techniques (e.g. retaining selected trees round ridgelines, manipulating shrub height or alternating their alignment). Should other forms of mechanical fuel management become available in the future they will be investigated for their application and use within the planning area.

Education, Liaison and Community Involvement

Engaging with the public is vital if their understanding of the role and effects of fire, the application of planned fire and fire suppression operations are to be understood.

To aid community awareness and engagement the Department will continue to provide appropriate community education and involvement opportunities.

The planning area adjoins State forest, private lands and settlements, which may have an indirect impact on fire management within the planning area. It is therefore important to the successful management of fire, and many other land management issues, to foster 'good neighbour' relations with adjoining landowners, particularly to ensure complementary fire management on adjoining lands (see Section 40 *Community Involvement and Support*). In particular, local government authorities have a dual responsibility with the Department to mitigate the impacts of wildfire.

Managing Access

The Department maintains a strategic fire access network within the planning area that comprises both 'public' and 'management access only' roads/tracks (see Section 29 *Visitor Access*). This network may be maintained to ensure safe access for fire fighting vehicles and to permit effective fire management. An annual road/track maintenance program will be developed based on fire management requirements and available funding, and will be planned to consider potential impacts on natural, cultural and recreation values.

[22] Slash breaks are areas of reduced fuel where vegetative cover is temporarily reduced to ground cover and root stock. Slashed breaks will generally be in the range of 10 to 30m in width.

Where appropriate, fires may be contained within Logical Burn Units defined by existing roads, in preference to constructing new firelines around the perimeter of the fire. However, where temporary roads or firelines are constructed during fire suppression activities, these should be rehabilitated after the fire event (see Section 24 *Ecosystem Rehabilitation*) to minimise the threat of soil erosion, weeds or spread of disease and unauthorised use of the access.

In the case of a wildfire, the Director General of the Department has the authority to close an area to reduce or remove the threat to visitor safety under the CALM Regulations (see Section 29 *Visitor Access*).

Given the high visitor numbers to Yanchep National Park, an evacuation plan will be considered for inclusion in the Asset Protection Plan.

Fire Research

Fire management and the development of ecologically-based fire regimes within the planning area should take into account all available knowledge and should adapt to new knowledge gained through research, monitoring and experience, including unforeseen events such as wildfires. However, it is recognised that the knowledge about the science of fire and its interaction with the biota is incomplete. The Department is improving this knowledge through the planned use of fire to deliver specific research outcomes. In particular, the Department is investigating the burning of *Banksia* woodlands to increase water recharge to the Gnangara Mound (see Section 16 *Hydrology and Catchment Protection*).

Other areas identified for research, or in which fire may be conditionally applied or excluded, are classified as 'Conditional Burning Areas'. Of particular importance to research is the establishment of Fire Exclusion Reference Areas (FERAs) across the landscape, where fire is excluded to allow for a comparison to fire regimes under prescribed conditions. There is one FERA in the planning area located in the north of Yanchep National Park.

In addition, the Department may initiate specific fire research/monitoring projects as opportunities arise, including pre and post-burn monitoring. Consistent with principles of adaptive management, fire management will be reviewed and, if necessary, adjusted in response to ongoing research and monitoring results.

23 – Fire

The objective is to conserve biodiversity and natural values and to protect life and community assets.

This will be achieved by:

1. managing fire in the planning area through the Master Burn Plan process and according to relevant legislation, Department policies, principles, guidelines and available knowledge;
2. implementing, with the advice of the Conservation Commission, specific fire management guidelines for protecting and conserving significant habitats of the planning area, such as wetlands, karst, organic-rich soils and tuart and *Banksia* woodlands;
3. maintaining a diversity of post-fire (seral) stages by approximating the fuel age distribution in Figure 9, and using fire management guidelines and other available knowledge to determine the appropriate fuel age distribution for fire sensitive/atypical habitats where known;
4. maintaining roads and tracks used for fire management according to Department standards;
5. identifying further areas where it may be desirable to exclude fire and reviewing Fire Exclusion Reference Areas in the planning area;
6. developing an asset protection plan for the planning area;
7. facilitating, supporting, participating or undertaking Department research and monitoring into fire management, such as organic-rich soils, caves and tuart root mats, and adapting management accordingly;
8. liaising with relevant agencies, local Bushfire Brigades and neighbouring land managers to facilitate effective, coordinated management of fire in the planning area and surrounding areas by encouraging cooperative arrangements and ensuring community protection from fire is at an appropriate level;
9. monitoring the impacts of fire on key values;
10. providing appropriate information, interpretation and/or education opportunities for visitors to increase their knowledge, appreciation and understanding of (i) the Department's fire planning and management, (ii) the effects of fire on the natural environment and key values of the planning area,

(iii) the need to prevent wildfires, and (iv) the safety and survival of people and property;
11. providing opportunity for the public to have input into burn programs; and
12. ensuring the ecological requirements of fire-sensitive wetland species and communities, and fire risks associated with organic-rich wetland sediments are taken into consideration in fire planning.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
23.1 The impact of fire on human life or significant community assets.	23.1 No loss of human life or significant community assets, or serious injury attributable to the Department's fire management.	Annually.
23.2 The extent of fire diversity measured by the diversity and scale of post-fire fuel ages.	23.2 The distribution of post-fire fuel ages (time since fire) approximates the fuel age distribution in Figure 5.	Annually.
23.3 The extent to which fire management guidelines for significant habitats requiring specific fire regimes are addressed in burn objectives.	23.3 Burn objectives are met for significant habitats requiring specific fire regimes.	After 5 years.

24. ECOSYSTEM REHABILITATION

Rehabilitation may be required for all components or just one component (e.g. planting native flora) in an ecosystem. It often takes place where new areas are added to a reserve, or following disturbance to natural areas caused through gravel pit working, mining, road works, previous silviculture activities, track closure, recreation site closure or redevelopment, or activities associated with fire suppression. Volunteers and school groups undertake most of the ecosystem rehabilitation at Yanchep National Park (see Section 40 *Community Involvement and Support*).

Where other agencies/organisations have been responsible for disturbance within the planning area, it is that agency's responsibility to rehabilitate those areas to a suitable ecological standard. In such cases, the cost of ecosystem rehabilitation should also be borne by that agency.

The main ecosystem rehabilitation issues for the planning area are restricted to degraded areas around old houses that are scattered around the main recreation areas.

24 – Ecosystem Rehabilitation

The objective is to rehabilitate disturbed ecosystems to a stable condition that resembles as close as possible the natural ecosystem structure, function and/or processes, thereby improving resilience to future disturbances.

This will be achieved by:
1. ensuring that activities are carried out in accordance with relevant Departmental policies and guidelines;
2. developing ecosystem rehabilitation working plans for different parts of the planning area including allocating priorities for works based on:
   - type and extent of the disturbance;
   - likelihood of natural regeneration;
   - existing and potential impacts on natural and visual landscape values;
   - availability of knowledge and resources;
   - level of participation of stakeholders; and
   - the capacity for long-term monitoring.
3. undertaking appropriate rehabilitation following disturbance events, such as gravel pits and after wildfire;
4. rehabilitating, closing or relocating roads and tracks that have the potential to erode or impact on visual amenity of the planning area;

5. ensuring local and native key ecological species and/or communities are used in ecosystem rehabilitation schemes wherever possible and allowing for natural regeneration, where possible, in areas that have been disturbed;
6. enhancing wildlife movement corridors (links between habitat remnants) and other significant habitats that provide for the ecological requirements of native fauna;
7. protecting ecosystem rehabilitation areas from threatening processes (e.g. inappropriate fire regimes, environmental weeds, spread of pathogens, grazing and recreation impacts);
8. promoting best practice ecosystem rehabilitation techniques and complementary management within the broader landscape (including liaison with adjacent property owners and other key stakeholders);
9. actively involving volunteers, community groups and traditional custodians in ecosystem rehabilitation programs;
10. ensuring the cost of ecosystem rehabilitation is borne by those responsible for the disturbance; and
11. monitoring, evaluating and recording progress and achievements of ecosystem rehabilitation programs/projects.

PART D. MANAGING OUR CULTURAL HERITAGE

Management and protection of Australia's heritage was strengthened in 2004 by the introduction of a new heritage system under the Commonwealth EPBC Act. This system includes the World Heritage, National Heritage List, and Commonwealth Heritage List.

Policy Statement No. 18 – Recreation, Tourism and Visitor Services (DEC 2006b) provides guidance for managing Indigenous and non-Indigenous cultural heritage. The policy recognises the importance of Indigenous heritage and identifies opportunities for Indigenous involvement in the care of Department-managed lands. This may include such activities as interpretation of cultural history, and anthropological and archaeological survey and site assessment. It also recognises the need for liaison with appropriate Aboriginal Elders about management plans, public works, site management and heritage protection measures.

In addition to complying with legislative requirements, management of Indigenous cultural heritage and non-Indigenous cultural heritage within the park is guided by:

- protection of places and objects of Indigenous heritage significance;
- continuation, as much as is possible, of the relationship between Indigenous people and their heritage places;
- recognition that Indigenous people are the primary source of important information on the value of, and how to best conserve their heritage;
- provision for Indigenous people to have a primary and active role in heritage management;
- recognition that Indigenous people must control intellectual property and other information relating specifically to their heritage;
- protection of culturally restricted information;
- maintain and/or restore Gloucester Lodge, Yanchep Inn, McNess House and culturally significant introduced plants in the planning area according to recommendations made in the Heritage Conservation Plan; and
- retain the koala viewing enclosure in Yanchep National Park as a recreational experience that have become a part of visitor expectation.

25. INDIGENOUS HERITAGE

The reserves, and in particular the wetlands within them (along with many others on the Swan Coastal Plain), played an important role in the seasonal[23] migrations that were part of traditional Aboriginal society prior to the arrival of Europeans (O'Connor *et al.* 1989). These migrations were spiritually important and involved ceremony and the telling of stories along the way. The migrations enabled Indigenous groups to take advantage of a greater diversity and abundance of food and other resources produced by the varying environmental conditions along the route. As inland water supplies dried up in summer, Indigenous people would gather in large groups around the various bodies of water on the coastal plain (O'Connor *et al.* 1989). Later in autumn and early winter the groups would move inland along the various drainage lines of the plain, gradually separating into smaller family groups (O'Connor *et al.* 1989). These small family groups would then amalgamate with others in late spring to move back onto the coastal plain for summer (O'Connor *et al.* 1989).

Wetlands are considered to have particular meanings and significance to many local Indigenous people because the Rainbow Serpent or 'Waugal'[24] created them during *Nyitting*[25]. The travels of the 'Waugal' created streams and rivers, caves and groundwater streams where it burrowed underground and wetlands and lakes in areas where it emerged from under the ground (DoE 2005b).

Yanchep National Park's Loch McNess and the surrounding area are culturally significant to Indigenous people. Traditionally, Yuat people would migrate south from the Moore River and Nyoongar people would migrate north from the Swan River to Loch McNess to meet, hold ceremonies and rituals, and to obtain food and water (O'Connor *et al.* 1989). The spring feeding into the lake is particularly important in Aboriginal mythology and is

[23] 'Seasonal' in this case meaning the six Nyoongar seasons.
[24] A spiritual being associated with water and creation.
[25] Also known as The Dreaming or Cold Time and denotes the time of creation.

known as Wagardu (Hallam 2002). Loch McNess is also considered to be the home of a 'Waugal'. Other wetlands significant to Indigenous cultural heritage include Pipidinny Swamp in Yanchep National Park and Lake Nowergup in Neerabup Nature Reserve.

Providing visitors with information on Indigenous history and culture through interpretative/educational materials and activities can be an effective way of enhancing visitor appreciation and understanding of Indigenous cultural heritage, which in turn can assist with promoting culturally appropriate behaviour. As discussed in Section 7 *Management Arrangements with Indigenous People*, education and interpretative activities relating to Indigenous culture are, and will continue to be the focus for visitors to Yanchep National Park.

25 – Indigenous Heritage

The objective is to conserve Indigenous cultural heritage and cultural resources in consultation with Indigenous people.

This will be achieved by:

1. complying with Commonwealth and State legislation and Departmental policies prior to commencing operations that have the potential to impact on cultural heritage;
2. protecting and maintaining cultural heritage according to the Burra Charter and any heritage conservation management plan;
3. consulting and involving local Elders and custodians and relevant organisations (such as the South West Land and Sea Council), and referring to the State Aboriginal Site Register and other relevant registers, to improve the protection and conservation of Indigenous cultural heritage;
4. managing threatening processes (such as fire, introduced plants and animals) and visitors activities to ensure Indigenous cultural heritage is not adversely impacted;
5. providing culturally appropriate information and interpretation on Indigenous cultural heritage to promote awareness, appreciation and understanding;
6. encouraging training, employment and economic development through cooperative or joint management arrangements; and
7. fostering connection to country by allowing cultural activities based on traditional occupation and use.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
25.1 Protection of known or identifiable Indigenous heritage sites.	25.1 No disturbance without formal approval and consultation with Elders and custodians.	After 5 years.

26. NON-INDIGENOUS CULTURAL HERITAGE

The reserves of the planning area have been used for a wide variety of activities since European settlement including cave exploration, 'health and pleasure resort'[26], stock grazing and transport, war time defence, and limestone extraction and processing (see Appendix 7) (Heritage Council of Western Australia 2006).

The cultural heritage significance[27] of several sites within the planning area has been formally recognised by registration[28] on Commonwealth, State, or other Registers of heritage buildings and places. These sites include historic buildings; gardens; remnants of army bunkers, lime kilns, and sheep dips. The *McNess Recreation Area – Yanchep National Park Non-Indigenous Cultural Heritage Conservation Plan* (CALM 2003b) (Heritage Conservation Plan) was prepared Hocking and Blackwell and provides information on several of the buildings.

MRA Non-Indigenous Cultural Heritage Conservation Plan

The Heritage Conservation Plan assessed the cultural heritage of the landscape of MRA within Yanchep National Park. This Heritage Conservation Plan recommended:

[26] Land that now comprises Yanchep National Park was reserved for 'protection and preservation of caves and flora, and for a 'health and pleasure resort' in 1905.
[27] Cultural significance, here and throughout the 'Managing Cultural Heritage' section of the plan, means: aesthetic, historic, scientific or social value for past, present or future generations.
[28] Registration as used here includes interim listings (ie. those that have not yet achieved permanent listing).

- that the mix of indigenous, native and introduced flora species, collectively, contribute to the cultural significance of the area, and hence should be perpetuated in the landscape;
- that the current usage of Yanchep Inn, Gloucester Lodge, the Administration building and McNess House are compatible with management of cultural significance, and in most cases the current usage is also the preferred usage; and
- reviews of various heritage conservation plans for the buildings are required prior to major works.

Ultimately, it is essential for the sake of preserving European history that maintenance of "the historic buildings (ie. McNess House, Administration building and the Yanchep Inn) for existing or other uses are compatible with heritage conservation" (CALM 2003b).

Gloucester Lodge

In 2005 the City of Wanneroo decided not to renew the lease for the Heritage listed Gloucester Lodge for use as a Museum (see Section 31 *Commercial Tourism Operations*). In 2009, a new lease was issued (see section 30.8 *Overnight Stays*). According to the Heritage Conservation Plan, it is important "to maintain Gloucester Lodge and provide for 'new' heritage conservation compatible uses involving:

- commissioning works as necessary and appropriate to maintain the structural integrity and heritage values of the building; and
- investigating options for utilising the building for community use and park office space."

It was also recommended by the Heritage Conservation Plan that new uses of the Lodge should reinforce lost elements of significance and to exploit the existing assets such as the dining room and the poolside loggia.

Yanchep Inn

The Heritage Conservation Plan for the Heritage listed Yanchep Inn recommends that:

- the Yanchep Inn's current eastern entrance should remain;
- the relationship of the open court east of the Inn and the building should be retained without the intrusion of further car parks or structures within the open area or the adjoining eastern façade;
- the fountain and layout within the open court east of the Inn should be conserved and enhanced; and
- visual and physical links between the Yanchep Inn and Loch McNess should be retained, and where possible, re-enforced.

It was also recommended that the Department liaise with the Yanchep Inn lessee to implement improvements consistent with heritage conservation objectives for this building as outlined in the Heritage Conservation Plan.

McNess House

The Heritage listed McNess House has a Heritage Conservation Plan initially prepared in 1990 by Pidgeon. Hocking & Blackwell in CALM (2003b) reviewed the Heritage Conservation Plan and recommended that:

- McNess House continue to be used as the visitor centre for Yanchep National Park;
- the conservation plan for McNess House should be revised and upgraded within two years or earlier if major works or a change of use are proposed; and
- the visual link known as the 'ski-run' between McNess House and Loch McNess should be retained and may be reinforced by plantings.

Introduced Plants in the McNess Recreation Area

The Lakeside Precinct and other parts of Yanchep National Park contain numerous introduced tree species that were established during the 1930s. These introduced tree species were placed on the lakefront 'to beautify the place' and many still remain.

Although introduced plant species are not usually compatible with the philosophy of a "national park", the Heritage Conservation Plan (CALM 2003b) states that a "mix of plantings is recommended to be continued and reinforced in order to retain the character of the place". The Heritage Conservation Plan (CALM 2003b) also includes lists of preferred tree species to be used in a tree replacement program to combat the reduced visual quality of the damaged trees as well as lists that indicate the significance of certain tree species in the planning area.

Carnaby's cockatoos have been damaging many of these trees, particularly in the Lakeside Precinct with devastating results (see Section 18 *Native Animals and Habitats* and Section 30.1 *Day Use – McNess Recreation Area*). The Heritage Conservation Plan made several recommendations in regard to the management of introduced plants in the McNess Recreation Area.

Cultural activity other than built structure

Since the 1930s, koalas have been on display at Yanchep National Park and for many years, it was the only place in Western Australia where these animals could be viewed (see Section 30.4 *Wildlife Viewing and Interaction*). Because of the long-standing history of viewing koalas in the park, the presence of these animals has social and historical value.

A new enclosure for the koalas was built in 2005 and the permanent entry on the Register of Heritage Places concluded that the enclosure is of "little significance". However, this register also states that Yanchep National Park "has provided a recreation experience for many Western Australians since its official opening in 1931, and many have a feeling of proprietary interest over the park, similar to that felt for Kings Park, the caves at Yallingup and Rottnest". A key aspect of this "recreational experience" has been the viewing of the koalas and that form a part of visitor expectations[29] of Yanchep National Park. Therefore, it is recommended that the enclosure and the koalas remain.

The enclosure has the capacity to accommodate a sustainable population of around 12 koalas without the provision of feed becoming difficult and the population is managed through exchange breeding programmes (see Section 30.4 *Wildlife Viewing and Interaction*).

26 – Non-Indigenous Cultural Heritage

The objective is to conserve the non-Indigenous cultural heritage and cultural resources.

This will be achieved by:

1. complying with Commonwealth and State legislation and Departmental policies prior to commencing operations that have the potential to impact on cultural heritage;
2. protecting, managing and maintaining cultural heritage according to the Burra Charter;
3. managing places of significant cultural heritage within the reserves with guidance from the Heritage Conservation Plan (CALM 2003b);
4. ensuring that any leases containing cultural heritage assets specify compliance with conservation requirements for the ongoing maintenance of the place (and in accordance with the Heritage Conservation Plan);
5. providing for interpretation of historic cultural heritage to visitors;
6. managing and regularly monitoring threatening processes (such as fire, introduced plants and animals) and visitor activities to ensure cultural heritage is not adversely impacted;
7. consulting and involving the local community and relevant organisations, such as the Register of Heritage Places and other relevant registers, to improve the protection and conservation of cultural heritage;
8. ensuring the safety of visitors by opportunistically removing ornamental trees from the main recreation area if they are damaged by cockatoos or pose a risk; and
9. retaining koalas at Yanchep National Park because they are a part of "recreational experience" and visitor expectations.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
26.1 Protection of known or identifiable non-Indigenous heritage sites.	26.1 No disturbance to heritage listed places without formal approval and consultation of Heritage Council.	After 5 years.

[29] Of the 230,000 visitors to Yanchep National Park in 2006/07, 6% stated koalas as their reason for visiting (DEC 2007).

PART E. MANAGING VISITOR USE

The provision of visitor services, facilities and experiences in the planning area is guided by the Department's *Policy Statement No. 18 – Recreation, tourism and visitor services* (DEC 2006b), which outlines the Department's principles, operational guidelines, procedures and administrative controls in relation to facilitating recreation and tourism on the public conservation estate.

This part of the management plan addresses issues such as increased visitation to the planning area and at the same time ensures that the visitors gain an awareness of the area's values that should, in turn, foster an appreciation and understanding of conservation. In the planning area, the major foci for managing visitor use are:

- maintaining existing recreational values/assets and opportunities in the planning area (see Section 30 *Recreational Activities and Use*);
- build upon recreation facilities and services within the planning area and maintain the McNess Recreation Area as the key focus for recreational use (see Section 30 *Recreational Activities and Use*);
- maintain a focus on low key, passive and nature appreciation recreation activities in the less developed Neerabup National Park and Neerabup Nature Reserve (see Section 30 *Recreational Activities and Use*);
- rationalising leases for Gloucester Lodge and the Golf Course (see Section 30 *Commercial Tourism Operations*);
- monitoring increases in population in nearby suburbs and adapting management as appropriate and necessary (see Section 29 *Visitor Access* and Section 30 *Recreational Activities and Use*); and
- ensuring appropriate vehicle, pedestrian and bicycle access to Yanchep National Park and improving traffic flow in and around McNess Recreation Area (see Section 29 *Visitor Access*).

27. VISITOR USE PLANNING

Recreation Planning Framework

Managing the way people use the planning area involves the management of recreation, commercial activities, public safety, visitor education, interpretation and information. Recreation and tourism planning considers a range of factors including visitor risk, environmental impacts, social benefit, equity, public demand and potential economic benefit (see Appendix 8). The recreation planning framework adopted in this plan uses both visitor management settings and a classification of recreation sites according to an established site hierarchy. It also draws upon information presented in other planning documents developed for the planning area.

The provision of visitor services, facilities and experiences in the planning area should also consider the range of opportunities that are or may become available within the local region over the next 10-15 years.

Visitor Management Settings

The visitor management settings presented in Map 5 identify a 'Highly Modified' setting for a significant proportion of the planning area, the reasons for this are the urban context of the reserves, the long-linear shape of Neerabup National Park and the impacts these have on any attempts to effectively provide for recreation at the more remote end of the Recreation Opportunity Spectrum (ROS). The size of the reserves is inadequate to provide sufficient buffering of remote recreation management settings. Despite this, this management plan distinguishes between the levels of development that is considered appropriate for the McNess Recreation Area (MRA) of Yanchep National Park compared to other parts of the planning area – identifying the MRA as 'Highly Modified'. More specifically, it is appropriate that on conservation grounds, recreational 'development' of the planning area outside of the MRA be limited, with a focus on primarily passive recreational uses. Visitors specifically seeking such an experience would be better directed to other conservation reserves.

The primary management benefit provided in identifying visitor management settings for the planning area, is to identify areas of the reserves where visitors would be able to have the most 'natural' recreation experience possible under the urban constraints.

Prior to the development of recreation sites, the Department uses a detailed process of planning and design to assess the potential visitor impacts on recreation sites. Proposed developments are assessed using a variety of environmental, social and cultural factors. The environmental factors include geological, topographic, soil condition and type, water (surface and groundwater) quantity and quality, vegetative cover condition and significance, other biota (such as flora and fauna and their significance) and visual quality as outlined in *Policy Statement No. 34 – Visual Resource Management of Lands and Waters Managed by CALM* (CALM 1989b). The social factors are determined using questions relating to the condition of recreation sites found in the Department's Visitor Satisfaction Survey, which are distributed to visitors at major recreation sites within the planning area. The cultural factors include Indigenous and non-Indigenous heritage sites, artefacts and records.

27 – Visitor Use Planning

The objective is to provide visitors with a range of nature-based experiences whilst ensuring the impacts on key values are minimised.

This will be achieved by:

1. ensuring future recreation and tourism developments and visitor use and activities are consistent with policy and visitor management settings as shown on Map 5;
2. referring any future recreational developments or non-conforming use that will be inconsistent with the visitor management setting to the Conservation Commission for approval; and
3. assessing and minimising the environmental, cultural and social impacts of recreation and tourism developments and visitor activities and ensuring these are consistent with visitor management settings for the area.

28. VISITOR OPPORTUNITIES

Managing the way people use the planning area involves the management of recreation, commercial activities, public safety and visitor education, interpretation and information.

Visitor Profile

Visitor Numbers and Trends

Information on visitors to Neerabup National Park and Neerabup Nature Reserve is not formally recorded. Incidental observations by staff suggest that local residents use the reserves for passive recreational activities including walking, wildlife viewing and photography. It is anticipated that the demand for such uses will increase as the suburban population around the reserves increases. Some illegal and unauthorised recreational activities (e.g. off-road vehicle use and dog walking) occur in the planning area and education and information needs to be provided on the impacts that these activities can have on the natural environment and visitor enjoyment.

The Department formally records visitation to Yanchep National Park via staffed entry and the use of road counters. Over the past 5 years (2003-2008), an average of 235,754 people visited the Park per annum and these numbers indicate that Yanchep National Park is the most highly visited National Park in the Department's Swan Region and amongst the most heavily visited reserves in the State. However, this visitation is seasonal and notably linked to holiday periods (e.g. Easter and summer holidays) with weekends throughout spring and summer being characteristically busy. Irrespective of season, the weekdays are generally quieter.

Visitor feedback forms and other records show that visitors to Yanchep National Park include:

- independent visitors (including visitors from overseas, interstate, elsewhere in WA and the local area)[30];
- coach tour groups (with visitors from Western Australia, interstate or overseas)[31]; and
- organised groups (e.g. school groups or clubs)[32].

[30] Between 2003 and 2008, independent visitors have accounted for around 81% of total visitors to the park.
[31] Between 2003 and 2008, coach passengers have accounted for around 12% of total visitors to the park.
[32] Between 2003 and 2008, organised groups (e.g. school groups) have accounted for around 7% of total visitors to the park.

It is also apparent that a significant proportion of visitation to Yanchep National Park is in pursuit of a general leisure experience rather than for a specific purpose. Of those that are visiting the Park for a specific purpose, the main attractions are the picnic and barbeque areas, caves, Yanchep Inn, koala viewing and the golf course.

Organised group activities at Yanchep National Park are also popular, and in particular the demand for interactive school activity programs that will continue to be provided since a scheduled program was initiated in 2000.

Given population projections of continued growth in the northwest corridor of Perth (WAPC 2005), it is anticipated that visitation to the planning area will increase. It is also likely that there would be an increase in visitation to Yanchep National Park should the time taken for day-trippers to travel from Perth to the Pinnacles (and beyond) be significantly reduced through proposed coastal road developments[33] (see Section 29 *Visitor Access*). This development is currently going ahead and once finished, day-trippers (and one day coach passengers in particular) will be provided with improved opportunity to visit the Park en-route to other destinations, and to engage in park activities that they might not otherwise have had time for.

28 – Visitor Opportunities

The objective is to provide visitors with a range of nature-based educational, recreation and tourism opportunities that facilitate their enjoyment, understanding and appreciation of the key values.

This will be achieved by:

1. liaising with other government agencies, commercial tour operators and recreation providers in the region to encourage complementary opportunities and appropriate regional recreational links between the reserves and surrounding areas;
2. recording visitor numbers using a variety of methods and monitoring visitor satisfaction across a range of activities and sites in the planning area as part of the Department's Visitor Satisfaction Survey;
3. undertaking social research to assist in recreation planning and development including projects nominated through the Department's Nature Based Tourism Research Reference Group; and
4. using data collected from visitor numbers and satisfaction surveys to improve management and minimise environmental, social and economic impacts across a range of sites in the planning area.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
28.1 Visitor satisfaction levels of nature-based experiences.	28.1 Visitor satisfaction levels of nature-based experiences are maintained or increased from over the life of this plan.	After 5 years.

29. VISITOR ACCESS

Most lands and waters entrusted to the Department are available for public use where this use is consistent with the primary purpose of the reserve and conserving its natural values and biodiversity. In addition all types of access need to be carefully managed in consultation with visitors to the planning area and according to the proposed visitor management settings.

Public Vehicle Access

Public Vehicle Access in Areas Surrounding the Planning Area

Marmion Avenue was extended in late 2008 and now will link Butler and Yanchep town site. The Mitchell Freeway was extended in late 2008 from Hodges Drive to Burns Beach Road and with further extensions from Burns Beach Road proposed to commence in 2011, the freeway will be located immediately adjacent to the western boundary of Yanchep National Park. In the future, the extended Marmion Avenue and Mitchell Freeway are likely to become the preferred routes for visitors travelling to Yanchep National Park rather than Wanneroo Road. Therefore, access into the park is likely to change within the life of this plan.

[33]The Government is committed to provide a sealed coastal road between Lancelin and Cervantes.

Public Vehicle Access within the Planning Area

Wanneroo Road, Yanchep Beach Road, Old Yanchep Road and Yeal Swamp Road traverse Yanchep National Park and currently are part of the park and vested with the Conservation Commission. Since they are managed by other authorities such as Main Roads WA and City of Wanneroo, they should be excised and roads reserves created under either the *Main Roads Act 1930* or *Local Government Act 1995* as appropriate.

There are plans to progressively upgrade Wanneroo Road to a dual carriageway to cater for increasing traffic and a more direct route to Lancelin. However, any plans to upgrade or widen Wanneroo Road through the park will require careful planning, appropriate approvals and consideration of all alternatives such as the effect of Marmion Avenue and Mitchell Freeway upgrades.

Yanchep Beach Road traverses Yanchep National Park and is a part of the park and vested with the Conservation Commission. However this section of road is currently maintained by the City of Wanneroo and therefore it is more appropriate it should be excised and a road reserve established and vested with the City of Wanneroo. The establishment of a road reserve covering this road and transfer to City of Wanneroo is currently being pursued.

Vehicle Access within Yanchep National Park

The access roads connecting the park and Wanneroo Road or Yanchep Beach Road are in poor condition with narrow sections causing poor sight lines. Since neither road provides an ideal route into the park and given future changes to public vehicle access outside the park, an investigation of alternative routes into the park will need to be undertaken during the life of this plan.

The single, primary internal road services the many recreation areas within the Park including McNess Recreation Area, Cabaret and Crystal caves, the golf course and the ovals. No upgrading of this road is proposed during the life of this plan although some improved signage and minor improvements may be required.

Pedestrian and Cycle Access

Currently there is low level pedestrian access to the parks and reserves of the planning area along overnight walk trails. However, future residential development in areas adjacent and west of the parks is likely to result in an increase in pedestrian access to the parks. Although this is not likely to occur within the life of this plan, it still needs to be considered in any future planning for the parks. A similar situation occurs with cycle access.

Management Access

Management access in the planning area for fire management, controlling feral animals and weeds, water monitoring, and maintenance purposes is not likely to dramatically change from that existing at present.

Unauthorised Access

The planning area has a long history of disturbance associated with factors such as illegal dumping (e.g. rubbish, vehicles), vandalism, unauthorised firewood or wildflower collection, unauthorised cave access, and deliberately lit wildfires. With the improvement in main arterial roads and the planned residential development in the area, the level of illegal access could potentially increase. Therefore, unauthorised access will require ongoing monitoring and action to reduce this impact as necessary such as improved interagency liaison and cooperative management, fencing and gating, use of legislative penalties and adaptive management.

Access for Visitors with Disabilities

The Department is committed to improving access to its services, information and facilities for people with disabilities as outlined in the *Disability Access and Inclusion Plan 2007 - 2010* (DEC 2007c).

29 – Visitor Access

The objective is to provide for safe, effective access that facilitates visitor appreciation of the key values of the planning area without having significant adverse impacts on those values.

This will be achieved by:

1. providing access as shown in Map 6, consistent with Departmental policies and the appropriate visitor management setting, and in consultation with visitors and relevant stakeholders;

2. ensuring 'management vehicle' tracks are effectively closed to the public except with the approval of the District Manager;
3. liaising with Main Roads WA and local Government to ensure the appropriate management and maintenance of regional roads and road development to and through the planning area;
4. continuing to prohibit vehicles driving off dedicated roads[34], CALM Act roads and tracks[35], except with the approval of the District Manager;
5. ensuring public roads serving the planning area are vested and managed by the appropriate authority;
6. providing advice to road managing authorities on any road improvements in the area (e.g. Marmion Avenue, Mitchell Freeway, Wanneroo Road, Yanchep Beach Road) that will impact on the key values of the planning area;
7. investigating options for an alternative primary access route into Yanchep National Park and developing when demand requires;
8. planning for pedestrian and cycle access from areas outside the planning area as nearby residential developments affect the planning area;
9. providing information to visitors on different types and locations of safe and appropriate access;
10. consistent with the Department's *Disability Services and Inclusion Plan* (DEC 2007c) and where appropriate, improving access, facilities and services for disabled visitors; and
11. as required, installing and maintaining fences and gates to deter unauthorised and illegal access and protect key values.

30. RECREATIONAL ACTIVITIES AND USE

30.1 – Day Use – McNess Recreation Area

In Yanchep National Park, day use is restricted to the McNess Recreation Area (MRA). The MRA has been divided into precincts to aid description and clarity. Upgrades and/or new development of sites are proposed for certain areas of the MRA to provide diverse but complementary alternatives to those already provided within the Lakeside precinct (see Figure 6 and Table 12).

Provision of activities such as golfing, viewing koalas and visiting a historic Inn are not readily reconciled with modern day concepts of appropriate recreation in a national park. Despite this, retention of opportunities and activities such as these within the MRA is supported over the term of this management plan given that:

- they are not incompatible within the highly modified historic landscape of the MRA;
- many Western Australians have developed a strong emotional attachment to the site and experiences it has traditionally provided;
- concentration of visitation to the MRA helps to alleviate the pressures of visitation on the rest of the planning area;
- they do not present an unmanageable threat to key values overall; and
- similar opportunities are either not provided or uncommon elsewhere in close proximity to the planning area.

Expansion of recreational opportunities within the MRA

The Lake-view area at the southern end of the Lakeside Precinct is a key focus for visitors to the MRA, as it provides direct views of the lake and easy access to parking for picnics and barbeques. The demand for use of this area is often beyond its capacity at peak visitation times[36], consequently interfering with the quality of the recreation experience. Therefore, picnic areas on the northern end of the lake to promote dispersal of crowds during peak visitation times could be developed.

[34] 'Dedicated' roads are defined under the *Road Traffic Act 1974* (any highway, road or street open to, or used by the public), Land Administration Act (reserved, declared or otherwise dedicated as a road, street or thoroughfare) and *Local Government Act 1995* (public thoroughfare dedicated for public use). Usually, where dedicated roads pass through land managed by the Department, the road remains Crown land road reserve.

[35] Roads constructed and maintained on Department-managed lands and which are open to the public are best described as 'CALM Act roads'. Parts of these roads or tracks may be closed to the public by signage or barriers.

[36] Peak visitation times are during school holiday, especially weekends, during public holidays and father's and mother's days.

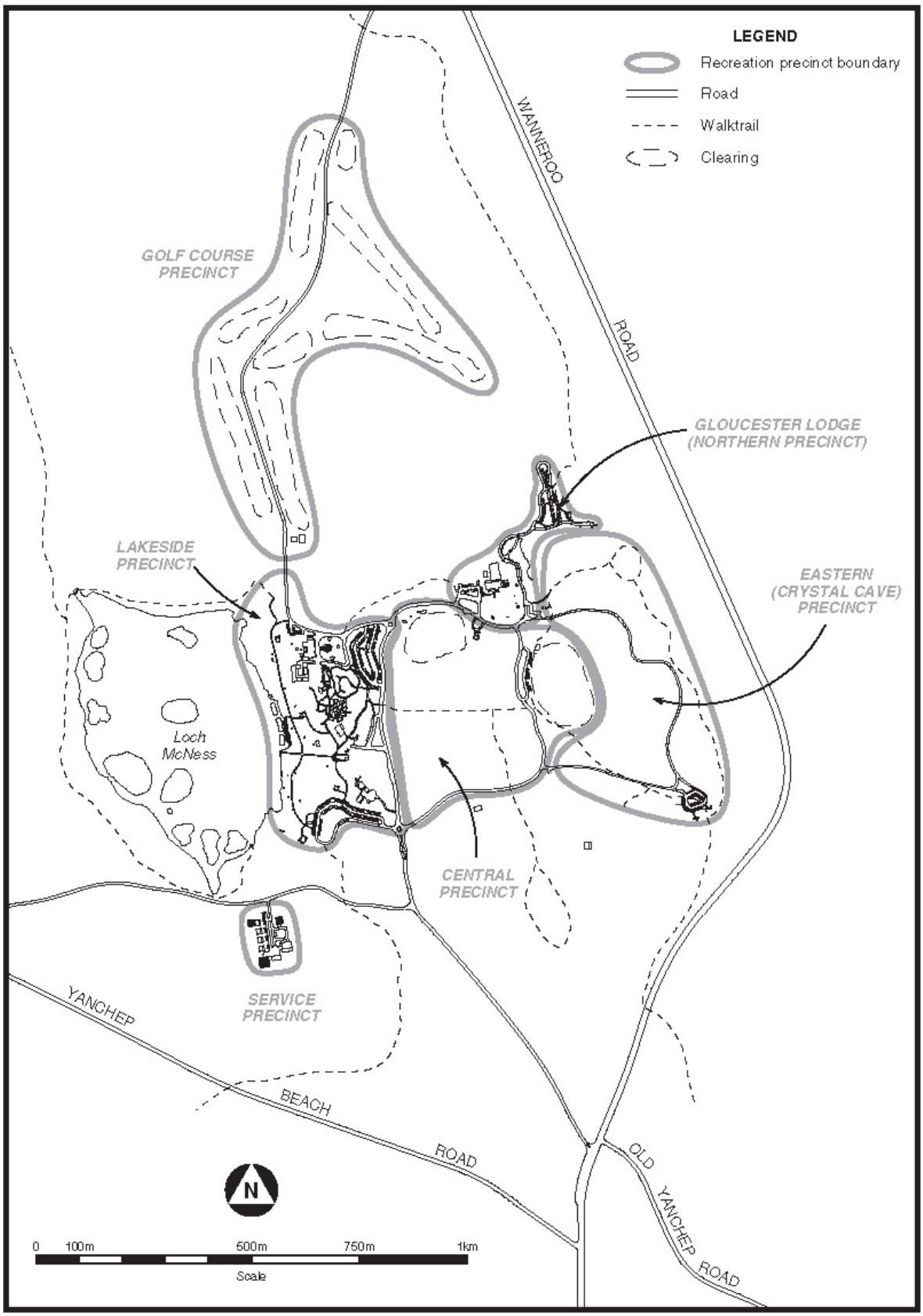


Figure 6: Precincts in Yanchep National Park

Table 10: McNess Recreation Area Proposals

Precinct Management Objectives and Proposals	
All Precincts	❖ Provide universal visitor access wherever possible. ❖ Progressively upgrade, replace or remove toilet facilities. ❖ Provide/modify facilities and services as necessary to facilitate comprehensive and integrated interpretation of natural, cultural and historic features. ❖ Continue to maintain and upgrade signage as necessary. ❖ Undertake modifications as appropriate to improve visitor 'sense of arrival' and orientation. ❖ Undertake works as necessary for conservation of historic buildings.
Lakeside Precinct Objective: To maintain existing facilities and develop facilities that will disperse crowds on the lakefront.	❖ Develop and implement an ongoing native tree replacement program and provide shade alternatives as appropriate to combat cockatoo damage. ❖ Implement measures to maintain or enhance the aesthetics of the historic buildings as appropriate (e.g. restore or establish gardens to complement buildings). ❖ Remove the current park staff office building if no longer required, or use plantings or other appropriate landscaping to screen this building. ❖ Disperse visitors on the lake front by providing additional picnic areas in other areas of Yanchep National Park.
Gloucester Lodge (Northern Precinct) Objective: To attract more visitors to the precinct by improving, or adding to existing facilities, and services.	❖ Develop Gloucester Lodge as necessary and appropriate for heritage conservation compatible use. ❖ Develop and implement plans for increasing visitor use and improve facilities and services. ❖ Improve the amenity of the swimming pool and ornamental pools area.
Eastern (Crystal Cave) Precinct Objective: To improve existing facilities to enhance visitors experience whilst ensuring ecological values are protected.	❖ Upgrade the entrance to Crystal Cave to improve aesthetics and functionality. ❖ Upgrade the publicly accessible areas inside Crystal Cave (e.g. improving lighting, walkways and handrails).
Golf Course Precinct Objective: To maintain the existing use of the precinct until such time that it is required for alternative uses or rehabilitated for conservation purposes.	❖ Seek an EOI for the management of the clubhouse and golf course and/or upgrade some or all facilities based on cost recovery or external funding/sponsorship opportunities.
Central Precinct Objective: To maintain or improve the condition of the indigenous vegetation and utilise the area as picnic space and/or sports ground.	❖ Retain one oval as large open space. ❖ Investigate alternative landscape solutions for Henry White or Bull Banksia Ovals and/or reduce the area by revegetating with indigenous flora. ❖ Upgrade existing picnic areas as appropriate or necessary.
Service Precinct Objective: To maintain a separate service precinct to support management of the park.	❖ Implement planting or other landscaping to screen the service area from public view.

Recreation outside of the McNess Recreation Area

The focus of recreation management outside of the MRA but within the planning area will be to provide a comparatively much lower level of recreation development with a greater focus on passive and nature appreciation activities. This is because within the Perth Metropolitan Area, the planning area incorporates

relatively large and undisturbed areas of remnant vegetation of conservation importance and the fact that there are other areas nearby where more intensive recreational activities are provided.

30.1 – Day Use – McNess Recreation Area

The objective is to provide a range of quality day use opportunities to enhance the enjoyment of visitors and their appreciation of key values.

This will be achieved by:

1. developing day-use areas in accordance with Department policies;
2. designing, constructing and maintaining day use sites according to established planning procedures, design standards and site environmental capability;
3. monitoring the impacts of day use activities for environmental degradation and visitor safety reasons and, in liaison with users and if the activity is environmentally unacceptable, modifying or restricting access (temporarily or permanently);
4. providing information to visitors about day-use opportunities;
5. implementing development proposals in MRA as indicated in Table 10 to address the contemporary MRA management issues discussed above;
6. providing recreational opportunities within the planning area as indicated throughout this plan; and
7. monitoring visitor numbers, use patterns and satisfaction levels to improve understanding of day use of the planning area and inform future management.

30.2 – Golf

The objective of a national park is to fulfil so much of the demand for recreation as is consistent with the proper maintenance and restoration of the natural environment, the protection of indigenous flora and fauna, and the preservation of any features of archaeological, historic or scientific interest (see Section 9 *Land Tenure and Classification*). Whilst golfing can be considered a recreational activity, it is an unusual activity within a national park because it is the only one of its kind located in Western Australia. It has been used by locals ever since its official opening in 1962 and therefore has historical and social values attached to it.

The golf course is primarily used by members of the public in the surrounding suburbs. Over the past five years, although club memberships[37] have declined there are still a small number of individuals, clubs (RSL) and corporate events utilising the golf course. Popularity may increase in future as the population around the planning area increases and for this reason, closure of the golf course is not recommended. However, the cost of managing the golf course over several years has also exceeded revenue, mainly because users often do not pay[38]. Because of this, it is proposed that current management of the golf course and clubhouse is outsourced following an EOI process (see Section 31 *Commercial Tourism Operations*). The lease duration will be determined through negotiation with the lessee and the capital investment being proposed. The lease term of the golf course will be accompanied by a set of conditions including water use (see Section 35 *Water Resources*) and the need to be run on a cost recovery basis. Should no suitable EOI be received or conditions are not adhered to, then the golf course will continue to be managed by the Department on a cost recovery basis and the option of rehabilitation will be reviewed in the next management plan.

This draft management plan seeks specific comment from the public regarding the future management of the golf course.

30.2 – Golf

The objective is to continue to provide a golf course at Yanchep National Park on a sustainable and cost recovery basis.

This will be achieved by:

1. advertising an EOI and outsourcing the costs and maintenance associated with the golf course and the lease duration with be set by negotiation with the lessee and the capital investment being proposed;
2. attaching conditions such as appropriate water use to the lease; and

[37] 140 members in 2003/04 compared to 100 in 2007/08.
[38] The Yanchep National Park golf course is the cheapest courses in the vicinity of Yanchep.

3. considering the closure the golf course if no EOI is received or membership continue to decline and revenue is not sufficient to cover the operating costs and future capital investment.

Key Performance Indicators:

Performance Measure	Target	Reporting Requirements
30.2.1 Revenue levels.	30.2.1 Revenue levels match the cost of management.	After 5 years.

30.3 – Caving

For the purposes of this management plan the term 'caving' will be used to refer to a spectrum of activities, from tours in developed, artificially lit and guided caves, through to guided and challenging exploration of wild and semi-wild caves.

Allowing well-managed caving in the planning area can have a number of conservation and social benefits. At a regional level, the ability to visit caves at Yanchep National Park is particularly important given that the park has the only caves in the metropolitan region that are open to visitors. The opportunity to view caves also helps foster increased community appreciation and understanding of the value of the local karst system, which in turn can lead to greater support for conservation efforts.

Caving Visitor Impact Management Program

Caving can potentially have a number of adverse effects on cave environments, which in turn can impact upon the biota they support. Potential impacts include:

- erosion and compaction of sediments;
- alterations to cave atmosphere (e.g. increased carbon dioxide and temperature)[39];
- speleothem breakage and discolouration;
- de-vegetation around cave entrances; and
- the growth of lampenflora (ie. growth of algae and other non-vascular plants as a result of artificial illumination in tourist caves).

Various management measures are employed to mitigate such impacts. A program to address impacts is being developed and implemented in consultation with karst management and/or other relevant specialists and will include (but not necessarily be limited to):

- the installation of trail markers to caves, pathways or other protective measures to minimise visitor impacts on caves[40];
- adoption and promotion of a caving codes of conduct[41] and interpretation/education to assist visitors in minimising impacts;
- purpose-designed cave lighting systems to minimise occurrence of lampenflora in artificially lit caves[42];
- visitor impact monitoring to facilitate assessment of the relevant KPIs in this plan; and
- review and adaptation of management (including rehabilitation) as necessary to protect cave values.

Cave Access

Currently access between vehicle tracks and cave entrances (and/or between nearby caves) is generally via informal walking tracks through the vegetation. The lack of well-defined trails to cave entrances can lead to the development of multiple indiscriminate tracks and impact on the vegetation. On the other hand, more formalised walk trails can also unintentionally aid unauthorised cave access and vandalism. The provision of subtle trail indicators and use of the permit system to convey information could be used to minimise environmental impacts.

[39] This can lead (for example) to alterations in the rate of speleothem formation and affect the suitability of the cave environment for fauna.

[40] Members of Western Australian Speleological Group and the Speleological Research Group of Western Australia have assisted the Department in placing and maintaining small, unobtrusive markers in several of the planning area caves. These guide cavers along routes aimed at minimising impact and maximising visitor safety.

[41] The Australian Speleological Federation have a number of caving codes and guidelines that can be modified if/as necessary to suit local circumstances. See Appendix 9 for the guidelines that have been adapted for the planning area.

[42] Lampenflora is currently managed by periodic 'clean-up' efforts by volunteers and staff. The installation of modern sensor controlled low lighting systems (in consultation with speleological and lighting experts) can significantly improve the control of lampenflora as well as providing more sophisticated presentation of key features of interest.

Caving in the planning area

In the Yanchep area, Crystal Cave is the only guided tour cave open for visitors although many other caves have been discovered and explored. The option of opening additional tour caves to broaden the visitors experience and knowledge of caves and karst systems should be considered.

Yonderup was previously an adventure cave that has the potential to become a tour cave and is currently open to visitors at certain times (e.g. Water Conservation week). The use of Yonderup cave as a tour cave to educate visitors that Yanchep National Park has more than one cave has the support of the Yanchep National Park Caves Advisory Committee. This cave can also be used as an adventure cave and has the potential to foster greater understanding of karst systems in the area.

This draft management plan seeks specific comments on the proposal of opening a second tour cave and the encouragement of adventure caving in the planning area.

Cave Guiding Standards

In order to maintain cave values and visitor safety it is important that cave tours in the planning area are undertaken by suitably trained and experienced guides (see Appendix 9). Minimum requirements for training and experience will need to be reviewed as necessary in response to new knowledge and experience, and in the pursuit of best practice. Currently, all persons guiding cave tours in the planning area (including Department staff and experienced speleologists) must have 'Trip Leader' status with a speleological group that is a corporate member of the Australian Speleological Federation and/or have completed an accredited cave leader course conducted by the Department.

There are no commercial tour operators licensed to conduct caving tours in the planning area. Should this change over the life of this plan, operators would need to meet the same minimum training standards required of other cave tour leaders.

30.3 – Caving

The objective is to allow caving for recreational, scientific and training purposes while ensuring protection of karst and associated values.

This will be achieved by:

1. continuing to provide a range of caving opportunities within the planning area as appropriate;
2. continuing to classify and manage caves in the planning area in accordance with the Cave Management Classification System identified in Appendix 8, or any substitute management arrangements identified in consultation with karst management and/or other relevant specialists;
3. ensuring that visitors to all caves are:
   - subject to prior authorisation either by payment of a fee on entry, or by registering trips; and
   - are registered and caves closed as necessary once visitation limits have been reached;
4. ensuring the Department's minimum training and experience requirements for cave tour guides are applied; and
5. periodically assessing risks (e.g. undertaking geotechnical inspections, evaluating carbon dioxide levels) in all caves open to visitation as necessary to maximise visitor safety (see Section 32 *Visitor Safety*).

Key Performance Indicators:

Performance Measure	Target	Reporting Requirements
30.3.1 Presence of lampenflora in Crystal Cave.	30.3.1 Decrease, or no increase in the presence of lampenflora in Crystal Cave over the life of this plan.	After 5 years.
30.3.2 Visitor Satisfaction levels.	30.3.2 Maintenance or increase in visitor satisfaction levels.	After 5 years.

30.4 – Wildlife Viewing and Interaction

Wildlife viewing and interaction activities provide valuable opportunities to raise public awareness of wildlife conservation issues within the planning area and beyond. The most commonly targeted wildlife in the planning

area includes kangaroos, koalas and birds (e.g. swamphen and Carnaby's cockatoos). Potential adverse impacts associated with wildlife viewing and interaction includes disruption of activities (e.g. feeding, breeding), direct injury (e.g. road kills) and habitat alteration leading to significant increases or decreases in population size (Green and Higginbottom 2001).

Visitors to the MRA will often feed ducks. The deliberate feeding of wildlife has the potential to adversely affect the wellbeing of both humans and animals and is prohibited in the planning area. Since many people are accustomed to feeding ducks and other waterbirds in urban wetlands, management of this issue should focus on information/education to alter visitor behaviour.

Viewing of koalas at Yanchep National Park has been a long-standing tradition. Koalas were originally introduced to the park in 1936 when due to a lack of food availability at Perth Zoo an alternative location with access to appropriate food was required. The original colony died out in 1940 and was re-introduced in 1944. The colony is maintained because it is an expected part of the tourist experience at Yanchep and visitors to the park have an emotional attachment to these animals (see Section 26 *Non-Indigenous Cultural Heritage*).

While Yanchep National Park was for many years the only place in WA where koalas could be viewed, they are now kept at several locations around Perth including Perth Zoo, Caversham Wildlife Park and Cohunu Koala Park. Koalas at Yanchep:

- compete with other venues around Perth to present koalas to the public;
- require ongoing specialised care and diet (Muir 1983) (see Section 20 *Environmental Weeds* and Section 26 *Non-Indigenous Cultural Heritage*); and
- pose a philosophical question of compatibility of keeping an introduced species in captivity with the purpose of a national park (CALM 1989a).

However, the keeping of koalas at Yanchep has important:

- cultural value – for preserving the historic link with the past use of the park (see Section 26 *Non-Indigenous Cultural Heritage*);
- recreation value – as one of the main attractions for visitors to the park (see Section 30 *Recreational Activities and Use*); and
- natural value – as another genetic source or destination for translocations.

Therefore, while there is some debate about the retention of koalas at Yanchep, they will be retained for the life of this plan.

30.4 – Wildlife Viewing and Interaction

The objective is to provide opportunities for sustainable wildlife viewing and interaction consistent with the protection of key values.

This will be achieved by:

1. continuing to facilitate opportunities for wildlife viewing and interaction as appropriate;
2. ensuring visitors to the planning area have access to information that will enhance wildlife viewing and interaction activities and promote appropriate behaviour that minimises disturbance of wildlife; and
3. retaining a sustainable population of koalas for genetic variability.

30.5 – Recreational Boating

Recreational boating adds to the diversity of recreational opportunities available in the planning area and region and enables visitors to further appreciate wetland and other values. By hiring rowboats and/or partaking in Wagardu Boat Tours, visitors can experience and appreciate Loch McNess.

Rowboats

The use of rowboats on the lake is a long-standing tradition dating back to the 1930s when it represented a significant part of the area's attractions. This remains a popular activity, particularly in warm weather where it is

often necessary to queue for a boat to become available[43]. Over the past two years (2007/2008), declines in water levels have resulted in row boats being unavailable. It is possible that the length of time that row boats cannot be used on the lake due to low water levels may increase and that row boats may not be available for hire on a permanent basis during the life of this plan.

Boat Tours

From November 2001 to January 2008 a boat tour that accommodated up to 20 passengers was utilised at Lock McNess to conduct guided boat tours (Wagardu Boat Tours)[44]. This tour was guided by Department staff and provided visitors with another means of enjoying and learning more about the wetland environment. Declining water levels in 2005 and 2006 resulted in a decrease in passenger capacity or inability to run tours at all until January 2008 when the launch was withdrawn from the water and has not returned. In the event that the motorised launch does not resume tours, it is recommended that this tour be replaced with an activity that is similar to the interpretive theme that was presented on this tour (i.e. a guided or self-guided interpretive walk around the edge of the wetland) (see Section 39 *Information, Interpretation and Education*).

Monitoring of Loch McNess undertaken to date has not revealed any significant ongoing impacts on water quality associated with the current level of boating activity on the lake (see Section 16 *Hydrology and Catchment Protection*). The use of private vessels within the planning area wetlands is restricted.

30.5 – Recreational Boating

The objective is to continue to provide opportunities for visitors to enjoy boat based activities on Loch McNess that do not have significant adverse impacts on the ecological values of Loch McNess.

This will be achieved by:

1. discontinuing Wagardu Boat tours and rowboats if water levels continue to decline; and
2. considering a number of options to replace the boating activity with a similar interpretive wetland experience (e.g. a guided or self-guided interpretive walk around the edge of the wetland).

30.6 – Bushwalking

In the planning area, bushwalking is one of the main recreational opportunities provided for visitors and is a valuable means of increasing awareness and appreciation of the area's natural, recreational and cultural values and their management. Whilst the use of existing walk trails within the planning area is already popular, it is anticipated that use will increase as the population of surrounding suburbs continues to grow.

A range of short walks and long-distance walks are available (see Map 6 and Table 11). These feature both natural and cultural points of interest. Currently, all existing walk trails in the planning area are restricted to walkers and are not available for use by cyclists.

The impact of bushwalking on the physical environment, while generally low compared to other recreation activities, can vary depending on soil conditions, landform, vegetation type and intensity of use. Where use levels are high, bushwalking has the potential to lead to:

- degradation or loss of vegetation or special habitat areas;
- soil compaction and erosion;
- introduction and spread of weeds and pathogens;
- cave collapse; and
- disturbance of wildlife.

Usually these problems can be effectively minimised through appropriate design and construction and visitor information.

[43] An average of 2,400 boats have been hired per annum for the past five years (2003-2008). There are currently 16 rowboats available for hire.

[44] Between 2003 and 2008, an average of 2,000 visitors each year purchased tickets for the Wagardu Boat tour.

Table 11: Walk trails within the planning area

Trail name	Management Setting	Length	Class (1-6)
Yanchep National Park			
Coastal Plains Walk Trail	Highly Modified / Recreation	55 km	2 – 3
Yaberoo Budjara	Highly Modified / Recreation	28 km	2 – 3
Cockatoo	Highly Modified	17.5 km	2
Yanchep Rose	Highly Modified / Recreation	14 km	2 – 3
Ghost House	Highly Modified / Recreation	9.2 km	2 – 3
Caves	Highly Modified	4.5 km	2
Woodlands	Highly Modified	2.6 km	2
Wetlands	Highly Modified	2 km	2
Yanchep Heritage	Highly Modified	various	2
Dwerta Mia	Highly Modified	0.5 km	2
Koala Boardwalk	Highly Modified	0.25 km	2
Neerabup National Park			
Yaberoo Budjara Heritage trail	Highly Modified / Recreation	28 km	2 – 3
10th Light Memorial Horse trail	Highly Modified	1.3 km	2

Future Walk Trail Developments

It is anticipated that the network of existing walk-trails within the planning area will be sufficient to meet needs over the life of the plan. However, there is significant scope for enhancing recreation experience and accessibility through improvements to existing trails and providing dual use on some trails (see Section 30.7 *Cycling*). One long distance walk traversing the planning area, the Yaberoo Budjara Heritage Trail, has been upgraded recently but is likely to require further upgrading in the future in response to a changing local context, and to ensure visitor safety and experience are maintained over the life of the plan. Specific management considerations include:

- integrated and cooperative ongoing management – the trail traverses through land of various tenure;
- safety and amenity – urbanisation west of the reserves will see an increase in the number of roads and in the amount of traffic intersecting this trail, which has the potential to impact on visitor safety and satisfaction;
- car parking facilities at Neerabup National Park to provide for visitors using the trail from beyond the local area (see Section 29 *Visitor Access*); and
- opportunities for adding value through improved interpretive and other facilities or services.

30.6 – Bushwalking

The objective is to provide a range of high quality bushwalking opportunities that do not have significant adverse impacts on key values.

This will be achieved by:

1. maintaining bushwalking tracks according to the established standards (Table 10 and Map 6);
2. undertaking risk assessment to identify and manage hazards associated with bushwalking;
3. providing information to visitors about bushwalking opportunities that provides:
   - a walk that best suites the needs and abilities of visitors;
   - the degree of difficulty;
   - safety guidelines include party size and registration;
   - camping and campfire policy; and
   - the code of conduct;
4. consulting with visitors and relevant stakeholders about bushwalking opportunities;
5. developing bushwalking tracks in accordance with Departmental policies and design classes and site capability;
6. providing a range of bushwalking opportunities consistent with appropriate visitor management settings and as resources permit;
7. designing, constructing and maintaining walk tracks according to the classes as required; and
8. managing long distance/overnight bushwalking including a registration system, re-alignment or closure of trails (temporarily or permanently) for reasons of visitor safety, protection of threatened species, rehabilitation or impacts from fire.

30.7 – Cycling

Cycling can be undertaken within the planning area for recreation or competition on all public roads (unless specifically prohibited).

Cycling brings about considerable health benefits for users, enables closer interaction with the environment than is the case with motorised vehicles, and provides a relatively inexpensive means of accessing and exploring park and forest areas. The impacts of cycling on the natural environment are generally minimal, providing this activity is confined to roads and trails that are appropriately located, designed, managed for disease control and maintained. However, conflicts can arise between other trail users and bicycles, particularly mountain bikes on pedestrian and shared access trails. Careful attention to the planning and design of appropriate trails will ensure that such conflicts are minimised. The sandy soils and rough limestone ridges of the planning area can be problematic in the development of cycle trails, as the level of maintenance required will often be impracticable.

There is currently no formal provision for off-road bicycle access to and in the planning areas. Demand for this may increase in future due to the encroaching urban development near the planning area. If required, it is recommended that most off-road cycle trails developed in the planning area will be graded from 'easiest' to 'difficult'. Current roads within the planning area could be widened to accommodate cycle paths. In addition, City of Wanneroo could be encouraged to widen roads used to access the planning area to accommodate cyclists.

'Easy' or 'difficult' trails could be developed along some of the existing walk trails in the planning area and in turn reduce the need to construct facilities (e.g. toilets). These trails could be utilised by mountain bikers seeking a challenging trail to traverse and most walk trails in the planning areas have opportunities for down hill descents (along limestone ridges), which are very popular, but could also lead to soil erosion and conflict with bushwalkers if not managed appropriately.

Other cycle trails planned for use by families could be shared trails or classified as 'easiest', which utilise existing roads and surfaced walk trails within the planning area. It would be beneficial to encourage visitors to cycle to points of interest (e.g. Crystal Cave) rather than drive. Existing roads may need to be widened or marked as dual use to accommodate bicycle and vehicle traffic. Cycle trails based on dual-use or multi-use need careful design and management to prevent conflict.

This management plan, whilst not proposing the development of specific cycle trail/s, does not preclude the development of trails for this purpose providing there is sufficient interest/demand and impacts on the values of the planning area can be adequately managed. However, it is important to ensure that recreational opportunities in the broader region have been considered prior to developing cycle trails in the planning area. Cycle trails that provide links to or complement other trails in the region, rather than circuits within the planning area are preferred.

Cycle paths within the planning area could also link to adjacent urban cycle trails along main roads so as to provide access for future urban developments on the fringes of the planning area. The development of shared use trails over the life of the plan will only be considered if these can be effectively designed and managed to simultaneously provide for the safety and enjoyment of all groups and protection of the values of the planning area.

30.7 – Cycling

The objective is to allow for the development of quality recreational cycling opportunities that do not have significant adverse impacts on key values.

This will be achieved by:

1. developing cycling trails in accordance with Departmental policies;
2. providing a range of cycling opportunities consistent with appropriate visitor management settings and as resources permit;
3. designing, constructing and maintaining cycle trails according to established planning procedures, design class standards and site environmental capability;
4. liaising with local authorities to explore (and where appropriate taking advantage of) opportunities to complement and link in with other trails and recreation opportunities within or near the planning area when considering the development of cycle trails; and

5. ensuring any shared use cycle trails developed over the life of the plan are designed and managed to prevent conflict between user groups.

30.8 – Overnight Stays

Many people stay overnight in attractive surroundings on lands managed by the Department. Overnight stays may be catered for by built accommodation or through the provision of camping facilities, some of which attract fees.

Built Accommodation

The Yanchep Inn is an important historical element of Yanchep National Park and continues to function as a licensed hotel offering meals and accommodation. A heritage conservation assessment of the Yanchep Inn recommended that the preferred use of the Inn is its original and existing use (CALM 2003b). As part of the Yanchep Inn concession agreement (see Section 31 *Commercial Tourism Operations*), 14 new motel units were built in 2007.

Accommodation is also provided at Gloucester Lodge (see Section 31 *Commercial Tourism Operations*).

Camping

There are two areas along walk trails designated for camping; Shapcott's Campsite is located north west of Yanchep National Park, and Ridges Campsite is located near the eastern boundary of the proposed Ridges addition to the park (see Map 6). Both these campsites provide basic facilities including a shelter, toilets, campfire rings and rainwater tanks. Firewood is provided outside of the fire season.

There is a small but regular demand for visitors to be able to stay overnight within Yanchep National Park and it is not uncommon for illegal camping to occur in the car parks of the MRA. The Department may consider the establishment of a caravan park and/or camping ground in the park or in the surrounding local government area should the need be identified for such a facility in the future.

Therefore camping facilities provided by the Department in the planning area over the life of the plan will be limited to the existing walk-in campsites developed in association with long-distance walk trails.

30.8 – Overnight Stays

The objective is to provide opportunities for visitors to stay overnight in appropriately designed built accommodation and campsites, and that facilitate visitor enjoyment, appreciation and understanding of the key values whilst minimising environmental and other impacts.

This will be achieved by:

1. maintaining walk-in campsites in association with long distance walk trails as appropriate (see Section 30.6 *Bushwalking*); and
2. prohibiting campfires for visitors camping on walk trails overnight during the fire season.

31. COMMERCIAL TOURISM OPERATIONS

A commercial concession is a right granted, in consultation with the Conservation Commission by way of commercial lease or licence for occupation or access and use (respectively) of an area of land or water managed by the Department. Commercial concessions must be consistent with the purposes of the conservation reserve, the protection of its key values and with the objectives of this plan.

Leases

There are currently three leases operating in the planning area, all of which are located in Yanchep National Park (Table 12). The Yanchep Inn [including a restaurant, bar and hotel accommodation and the Chawn Mia Tearooms (café also known as Chocolate Drops)] are leased to Yanchep Inn Nominees Pty Ltd. Under the lease agreement, the lessee of these premises has exclusive use of areas of the Park described as the 'Zone of Operation' (referred to as the McNess Recreation Area in Section 30 *Recreational Activities and Use*) for any

commercial activities conducted over the term of the lease. The golf clubhouse is leased to the Yanchep Golf Club Inc.

A lease has been issued to Yanchep Inn Nominees Pty Ltd for the use of Gloucester Lodge to provide group accommodation and recreational activities.

Table 12: Leases in the planning area

Lease Number	Lessee	Premise(s)	Expiry
2100/100	Yanchep Inn Nominees Pty Ltd.	Yanchep Inn and Chawn Mia Tearooms	24/12/2020
2260/100	Yanchep Inn Nominees Pty Ltd.	Gloucester Lodge	18/10/2014
2089/100	Yanchep Golf Club Inc.	Golf Clubhouse	30/06/2013[45]

The Yanchep Golf Club lease is for land only and is currently operated by the Yanchep Golf Club Inc and its lease is being negotiated at the time of writing with expiry date of 30 June 2013. The golf course is managed by the Department and is used by people from the local community[46]. Whilst it is likely that this lease will continue to be available over the life of this plan, the continued operation of the golf course within Yanchep National Park over the long-term is problematic because:

- there are currently several fully serviced golf courses in the City of Wanneroo, including one at the Sun City Country Club adjacent to Yanchep National Park;
- the golf course at Yanchep National Park is only a 9 hole golf course and is maintained to minimum levels in order to protect wetlands within the park (that is, only the greens and tees are watered);
- the cost of operation exceeds revenue[47]; and
- club memberships are declining and many users avoid payment of course fees.

Although rehabilitation of the golf course may be desirable in the long term and could be completed over time through a number of stages and at different levels of rehabilitation, this option will be reviewed in the next management plan (see Section 30.2 *Golf*).

It is proposed to establish a lease for the golf course following a formal 'Expression of Interest' process. This lease will have certain conditions attached to it to minimise environmental impacts, which a commercially operated golf course could usually incur, such as excessive water use and fertiliser runoff.

This management plan is seeking comments on outsourcing the operation of the golf course business in conjunction with the clubhouse.

Other Leases

Henry White first discovered Cabaret Cave, in Yanchep National Park, in 1902. It was converted to an underground function centre in the 1930s, with some major modifications to its structure, including a concrete floor, doors and wall seating. During 2006, Cabaret Cave received significant upgrades such as formalised parking facilities, improved pedestrian access, toilet facilities and access to water and improved power within the cave.

The management of this cave lies with the Department and the venue is regularly hired by Yanchep Inn Nominees Pty Ltd to facilitate functions and catering for bookings conducted at Cabaret Cave[48].

Licences

Guidance for the general conditions for tour operators on Department-managed land is provided for in the Department's *Tour Operator Handbook – Terrestrial* (DEC 2008).

The Department issues two types of licences:

[45] Lease renewal being negotiated at time of writing.
[46] 25,030 golf cards purchased over past 5 years (2003-2008).
[47] In 2007/08 the management of the golf course cost approximately $31,000 and revenue was approximately $25,000.
[48] Yanchep Inn Nominees Pty Ltd has sole catering rights for Cabaret Cave due to its location within the 'Zone of Operation'.

- T Class licences (issued for periods of one, three and five years) of which currently 112 commercial tour operators (CTOs) can visit the National Parks within the planning area[49]; and
- E Class licence (issued for periods of up to five years) of which there are currently none issued for the planning area.

It may be considered advantageous, over the life of this plan, to licence commercial tour operators to conduct guided cave tours in the planning area. Given the nature of this activity, licence conditions should include minimum training and experience standards (see Section 30.3 *Caving*). Consultation with the Caves Advisory Committee should also be undertaken.

Commercial tourism activities will be monitored to determine their environmental impacts. Operating conditions will be regularly reviewed and modified to address specific problems. If necessary, licences can be cancelled. Close liaison and training should be facilitated to improve the understanding by commercial operators of the area's key values and address management issues.

31 – Commercial Tourism Operations

The objective is to ensure that commercial tourism activities are compatible with other management objectives and to extend the range of services, facilities and experiences available through the involvement of private enterprise.

This will be achieved by:

1. considering tourism concessions that:
   - are consistent with this management plan;
   - facilitate management of the planning area; and
   - provide a service or facility to visitors that the Department would not otherwise be able to provide;
2. maintaining existing lease arrangements for the Yanchep Inn hotel premises and Chawn Mia Tearooms (Chocolate Drops);
3. enabling a trial lease for Gloucester Lodge for 5 years;
4. ensuring lease duration for the golf course are set by negotiation with the lessee and the capital investment being proposed;
5. ensuring that any licences allowing CTOs to conduct guided cave tours in the planning area may be E Class licenses, subject to formal 'Expression of Interest' processes and have minimum training and experience standards;
6. encouraging licence holders to undertake tourism industry accreditation appropriate to their activities;
7. ensuring any commercial recreation and tourism operations are at least cost-neutral to the Department;
8. working with Indigenous people to promote their participation in commercial activities; and
9. providing advice, resources and training for the tourism industry in interpreting the Department's role and the planning area's natural, recreational and cultural values.

32. VISITOR SAFETY

It is essential to encourage visitors to exercise appropriate behaviour whilst undertaking recreational activities that involve risk. Caving is one of the more high-risk recreational activities in which visitors to the planning area engage. This risk can be reduced through employing measures such as signage, safety guidelines, geotechnical inspections, monitoring for (and where necessary responding to) hazardous cave atmospheric conditions, and minimum training/experience standards (see Section 30.3 *Caving*).

Unauthorised access of caves is an ongoing issue in the planning area (see Section 30.3 *Caving*) which presents significant safety risks both to those illegally accessing these areas and persons involved in associated cave rescue operations. Some caves are gated to deter unauthorised access where other management measures prove ineffective and the threats/hazards warrant this. The use of signage and other forms of communication to inform people of the hazards of unauthorised cave access may also be of assistance in managing this issue.

[49] Not all operators licensed to use the reserves actually do so. The MRA of Yanchep National Park is the focus for the majority of operators that do visit the planning area – coach tour passengers make up approximately 12% of the total number of visitors to the MRA (Based on Yanchep National Park visitation statistics collected between 2003 and 2007).

Long distance walk trails can also present particular visitor safety concerns. These include for example, the hazards of wildfire, severe summer heat, becoming lost or injured, and sinkholes or other potential karst hazards. The risk associated with these can be minimised through walker self-registration systems, effective signage and information programs designed to ensure walkers are adequately informed about and equipped to handle the conditions they will encounter (see Section 30.6 *Bushwalking*).

Falling limbs of trees within the MRA is another specific visitor safety risk that needs to be considered. Trees in this area occasionally drop limbs that could potentially cause serious injury. Therefore trees are regularly checked and obvious hazards removed where necessary.

32 – Visitor Safety

The objective is to take all reasonable and practical actions to minimise risk to public safety while maintaining a range of visitor experiences wherever possible.

This will be achieved by:

1. managing visitor risk in accordance with Department Policies;
2. continuing to review and update the existing Visitor Risk Management Plan that:
   - identifies and assess the risks associated with all recreation sites;
   - implements a risk management program according to priority of risk;
   - maintains recreation sites to minimise visitor risk;
   - monitors and regularly reviews visitor risk;
3. promoting application of caving safety codes of conduct or guidelines (e.g. ASF cave safety guidelines, Minimal Impact Cave Rescue Code, modified to suit the planning area) as appropriate;
4. ensuring geotechnical monitoring and inspections are conducted as necessary to maximise visitor safety (e.g. during caving);
5. ensuring commercial concessionaires are appropriately trained or accredited and carry appropriate insurance when undertaking high risk activities in the planning area;
6. applying industry standards and utilising appropriate expertise and quality of materials in the design, construction and maintenance of facilities and structures;
7. installing wildlife warning signs at appropriate locations where necessary;
8. maintaining and imprioving strategies regarding walker self registration system as described in Section 30.6 *Bushwalking* as required; and
9. enforcing the CALM Regulations to influence appropriate and safe visitor behaviour when necessary.

Key Performance Indicators:

Performance Measure	Target	Reporting Requirements
32.1 Number of visitor injury incidents proportional to total visitors reported to the Department.	32.1 Number of visitor injury incidents proportional to total visitors reported to the Department remains stable or decreases.	Annually.
32.2 Cave stability and geotechnical inspections.	32.2 Cave stability and geotechnical inspections are undertaken regularly.	After 5 years.

PART F. MANAGING RESOURCE USE

This chapter will describe the natural resources available, the threats of resource use to the values of the planning area and strategies proposed by the Department to mitigate the threats. Major foci for managing the planning area's resources and its affects on the natural environment are to:

- reduce the impacts of mineral and basic raw material extraction in the planning area (see Section 34 *Mineral and Petroleum Exploration and Development*); and
- minimise the impact of declining groundwater by reducing water use in the planning area (see Section 35 *Water Resources*).

33. INDIGENOUS CUSTOMARY ACTIVITIES

The hunting and gathering of food by Indigenous people is an important part of their culture, enabling them to re-establish links with the land, share knowledge and partake in traditional practices. Prior to the arrival of Europeans, Indigenous people regularly utilised the planning area for food hunting and gathering. One example of this is described in Hallam (1975), where Indigenous traditional food gathering is referred to in the region, in particular, the use of its lakes and swamps to access food such as freshwater turtles, water fowl, frogs and bulrush (the roots of which were roasted, ground and made into a cake).

The importance of traditional food gathering is acknowledged in State legislation. Under section 23 of the Wildlife Conservation Act, Indigenous people may be exempted from some of the provisions of the Act related to the taking of wildlife. However, it is required that Indigenous people seeking to engage in traditional food gathering in the planning area (including gathering for ceremonial or demonstration purposes), obtain consent from the Department's Director General. Where consent is provided, it will generally be associated with conditions, including for example that:

- nature reserves are to be excluded;
- the use of wildlife is to be sustainable;
- food taken cannot be sold; and
- the activity is consistent with other land management objectives.

General provisions of the CALM Act and Wildlife Conservation Act apply to other Indigenous activities, for instance firearms may not be carried on a reserve, existing access tracks to be used and visitor safety is paramount.

Over the life of this plan the native title rights of Indigenous people may change, including hunting and gathering. The Department will ensure conformity with any future changes to legislation or Government policy relevant to traditional food gathering.

33 – Indigenous Customary Activities

The objective is to enable Indigenous people to collect traditional foods while protecting key values and the safety of other visitors.

This will be achieved by:

1. allowing the traditional custodians of the area or others approved by them to take sufficient food for themselves and their family provided this has been approved by the Director General and is in accordance with Section 23 of the Wildlife Conservation Act and any associated conditions;
2. ensuring that management adapts to and conforms to any legislative or policy changes during the life of this plan; and
3. ensuring that the collection of traditional foods does not impact upon the safety of other visitors.

34. MINERAL AND PETROLEUM EXPLORATION AND DEVELOPMENT

Legislative Framework and Government Policy

Under the Mining Act the specific processes for approval of mining proposals on land managed under the CALM Act are dependent on the classification of the reserves under the Land Administration Act. The granting of a mining tenement is subject to the concurrence of the Minister for Environment and approval of both Houses of Parliament for national parks across the State and class 'A' nature reserves across the State. The issuing of petroleum permits or licences requires the Minister for Environment to make a recommendation to allow access to the conservation reserves. The Department of Mines and Petroleum (DMP) administers the Mining Act.

The document, *Guidelines for Mineral Exploration and Mining within Conservation Reserves and other Environmentally Sensitive Areas* (DMP 1998), outlines the procedures and conditions to be applied to applications for mining tenements.

Mineral and Petroleum Resources and Prospectivity

There have been no mining tenements granted within the current boundaries of the national parks or nature reserve within the planning area.

The Ridges area was initially proposed to be added to Yanchep National Park in the *Northern Forest Region Regional Management Plan 1987 – 1997*. The mining tenement areas[50] contain limestone and are prospective for petroleum however, there are other sources of limestone in the metropolitan area. The Ridges area has high conservation value (see Section 17 *Native Plants and Plant Communities* and Section 19 *Ecological Communities*).

Basic Raw Materials

Neerabup National Park has a long history of disturbance associated with limestone extraction, mostly undertaken from mining tenements that pre-dated the gazettal of the national park, but which are no longer current and have since been rehabilitated. Reserves 25252 and 25253 on the eastern boundary of Neerabup National Park are quarry reserves vested in the City of Wanneroo that are currently subject to negotiations for addition to the Park (see *Proposed Reserves* in Section 10). Whilst the vegetation of Reserve 25253 is in reasonable condition, the historical use of Reserve 25252 for landfill has resulted in it being significantly affected by weeds. The latter, and other similar highly disturbed areas, are a high priority for weed control and rehabilitation due to the threat they pose as a source of new weeds into the national park.

An active mining lease (No. M70/7171) that also incorporates a concrete batching plant is situated outside of the western boundary of Neerabup National Park between Hester Ave/Quinns Road and Hall Road. Access to the mining operation and batching plant is via a pre-existing management track on the western boundary[51], and is fenced off from the national park. The mining and batching plant operations are subject to environmental conditions.

34 – Mineral and Petroleum Exploration and Development

The objective is to minimise the impacts of mineral and petroleum exploration and development, including basic raw material extraction and development activities on the key values.

This will be achieved by:

1. in conjunction with DMP, evaluating the likely impact of proposed mineral and petroleum exploration and development activities within the planning area (and adjacent areas that may impact upon it, e.g. cultural and recreational areas);
2. in conjunction with DMP, monitoring existing mineral and petroleum exploration and development activities that impact directly or indirectly on the planning area and requesting DMP to take any necessary action where conditions are breached;

[50] M70/140 (112 hectares) and M70/142 (120 hectares).
[51] By way of a miscellaneous licence issued under the Mining Act.

3. referring, exploration or mining proposals with the potential to impact upon the planning area to the EPA for their consideration of assessment under the Environmental Protection Act;
4. seeking direct and complementary offsets to counterbalance any adverse environmental impact due to mineral and petroleum exploration and development activities to achieve no net environmental loss or, preferably, a net environmental benefit outcome;
5. in accordance with Department and Conservation Commission policies, permitting access to basic raw materials from the planning area where:
   - the use of material assists in the protection and management of the area;
   - a more environmentally acceptable alternative is not available;
   - the material is used within the boundaries or enclaves of the planning area; and
   - extraction is consistent with this management plan and purpose, class and tenure of the area.
6. ensuring access to basic raw materials by Local Government Authorities and private contractors complies with existing Departmental and Conservation Commission policies and guidelines including Department *Policy Statement No. 34 – Visual resource Management of Lands and Waters Managed by CALM* (CALM 1989b);
7. ensuring that all sites in which mining activity occurs are rehabilitated according to the conditions of the mining lease and Department rehabilitation standards and guidelines (see Section 24 *Ecosystem Rehabilitation*); and
8. ensuring that hydrology and catchment protection and its importance to cave, wetland and other species within Yanchep National Park are considered in mining tenement proposals referred to the Department.

35. WATER RESOURCES

Legislative Framework and Government Policy

The responsibility for the regulation, protection and management of water resources in the planning area rests with the Minister for Water Resources (or delegated authority such as the Department of Water [DoW] and Water Corporation), and the Department.

Water Protection

Sections 33(1)(dc) and (dd) of the CALM Act state that a function of the CEO is to promote the conservation of water (as to both quantity and quality), and develop policies that provide for water to be taken from lands to which the CALM Act applies. Section 33(4) states that these specific functions related to water are to be carried out, where there is a management plan for the relevant land to which the section applies, in accordance with that plan, and without limiting the operation of the *Rights in Water and Irrigation Act 1914* (RIWI Act). The CALM Regulations 2002 provides for a management objective for indigenous State forest and timber reserves for the removal and storage of water. The removal of water from national parks or nature reserves is already provided for.

DoW applies the *Australian Drinking Water Guidelines* (National Health and Medical Research Council and Natural Resource Management Ministerial Council 2004) to protect water supply across the Gnangara mound. The *Metropolitan Water Supply Sewerage and Drainage Act 1909* (MWSSD Act) protects drinking water sources and their catchments by proclaiming areas within the Perth metropolitan and referring to them as Public Drinking Water Source Areas (PDWSAs). Areas that have been proclaimed as PDWSAs may have constraints placed on land use, development, public access and land/water-based activities. The Gnangara Underground Water Pollution Control Area (GUWPC) and the Perth Coastal Underground Water Pollution Control Area (PCUWPC) PDWSA adjoin and cover parts of the planning area.

Water Abstraction in the Planning Area

The planning area lies over the shallower margins of the Gnangara mound within the superficial aquifer, which feeds water into the wetlands and caves of the area. Its flow is recorded in a north-east to west direction and can be subject to variation depending on local influences (see Section 16 *Hydrology and Catchment Protection*). This groundwater system is one of the largest sources of potable water in the southwest of Western Australia and in addition to supplying public water, it also supports extensive horticultural and other industries, household garden bores, parks and recreation areas and a range of ecological systems.

Yanchep National Park is not included in the PDWSA, but is nevertheless an area that aids in recharging the groundwater and needs to be protected from pollution. Nearby Gnangara Park has been named a Priority 1[52], and Ridges and Yanchep National Park are considered acceptable land uses within the vicinity of this type of priority area. A large part of Neerabup National Park is included in the PDWSA as a Priority 3, which means that this area is defined so as to manage the risk of contamination to the water source (MWSSD Act) (Map 3). This type of priority has implication for the developments of new facilities such as toilets, which may have an impact on the groundwater (ie. contamination from leaching of waste water from septic tanks). Should such facilities be considered in Neerabup National Park, then the Department will use toilet systems that do not leach.

DoW regularly monitor bores in the planning area to assess the level of groundwater in the Gnangara mound. It has been recorded that between 1979 and 2005, the Gnangara mound has experienced a significant depletion of around 500 GL to 600 GL of water (DoE 2005a). DoW will require ongoing access for monitoring and maintenance of any of these bores in the planning area.

In addition to DoW monitoring bores, there are also bores located in the planning area that are predominantly used to irrigate lawns and gardens, service buildings, toilet facilities and for fire management at Yanchep National Park (Table 13). Bores were also drilled in 2002 to supplement declining water levels at some of the caves located in the park. Another supplementation bore is located in Neerabup National Park and it is predominantly used to supplement water levels in Lake Nowergup during spring and summer.

Table 13: Bores in the planning area

Bore location	Number of bores	Predominant use
Golf course	2	Irrigation of tees and greens
Lakefront	2	Reticulation of lawns & main park water system
North Oval	1	Back-up bore (previously used to reticulate ovals)
Yanchep Inn	1	Fire Hydrant
Settlement (west)	2	Caves water supplementation
Neerabup*	1	Supplement Lake Nowergup water levels

*Bore located outside of the planning area and is maintained by DoW to supplement water in Lake Nowergup, which is located inside the planning area (DoW 2007).

The grassed areas of Yanchep National Park such as the lakefront and the tees and greens of the golf course are irrigated regularly and trials were undertaken to determine the most efficient irrigation regime. Typically, the grassed areas of Yanchep National Park require around 10mm of water on a regular basis to maintain a good condition, especially in summer due to the high amount of traffic they receive from visitors using these areas for functions, picnics and from vehicles and machinery. Flow meters were installed on bores in late 2008 to assess exactly how much water is used each year and extraction amounts will be monitored and recorded.

A trial water supplementation system was put in place at Yanchep National Park in 2002 to measure the success of pumping water into seven different caves located within the area. This project was undertaken to maintain permanent pools for critically endangered root mat communities (TECs) and the aquatic fauna that also live in the water (see Section 19 *Ecological Communities*). The water supplementation was from two bores located near the settlement, west of Loch McNess and it was estimated that 3.6GL per year was needed to permanently supply the caves with water until at least 2015 (Yesertener 2006) (see Section 16 *Hydrology and Catchment Protection*).

Lake Nowergup has been artificially maintained by DoW since 1989 mainly due to the large abstraction pressures of businesses such as horticulture and market gardens in the proximity and also because of climate change (DoE 2004). Water is supplemented into this wetland to protect TECs and reduce the threat of exotic species such as bulrush encroaching and because the wetland is a refuge for water birds (see Section 19 *Ecological Communities* and Section 16 *Hydrology and Catchment Protection*). The water is maintained at a level to represent its spring peak[53] (DoE 2005a).

[52] Priority 1 are managed to ensure there is no degradation of the drinking water source and it prevents the development of potentially harmful activities in the Gnangara area and it is the most stringent priority classification for drinking water protection.

[53] Spring peak for lake Nowergup is measured at 17m AHD and can only drop to a 16.8m AHD minimum. AHD is defined as Australian height datum; height in meters above mean sea level +0.026m at Fremantle.

35 – Water Resources

The objective is to minimise the impact of water resource use on key values.

This will be achieved by:

1. ensuring all water extracted from the planning area is taken and used in an ecologically sustainable manner;
2. managing public drinking water source protection areas that occur on CALM Act lands to promote the conservation of both the quantity and quality of water;
3. continuing to monitor the water levels of Loch McNess;
4. referring any proposals for significant use of water resources to the EPA for formal assessment where such proposals are likely to adversely affect the key values of the planning area;
5. following an appropriate level of assessment and approval by the Conservation Commission, the Minister for Environment and DoW, issuing a Water Removal Permit under the CALM Act for the extraction (taking) of water from the planning area as required;
6. monitoring flow meters on all bores operating in the planning area;
7. minimising the amount of water required to irrigate areas of Yanchep National Park; and
8. undertaking audits of water use in the planning area and develop water conservation initiatives to reduce water use.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
35.1 Quantity of water abstracted in the planning area for management.	35.1 Maintain water extraction quantity at current levels over the life of this plan.	After 5 years.
35.2 Water levels in Loch McNess.	35.2 Water levels continue to be monitored and recorded.	Annually – dependent on information available from DoW or Water Corporation.

36. BEEKEEPING

Apiarists in Western Australia have traditionally relied on large areas of native vegetation for honey production, and are increasingly dependent on land managed by the Department as other areas are cleared for urban development and agriculture.

All apiary sites on Crown land in WA require a permit from the Department. Beekeepers are also required under the *Beekeepers Act 1963* to register with the Department of Agriculture and Food.

As well as manage risk of bees to visitors, the Department has a responsibility to protect the biodiversity values of the planning area including the functioning of ecological processes such as pollination. Therefore it is necessary to assess the dynamics between the native pollinators (which includes mammals, birds and insects), native flora and native fauna species dependent on that flora, prior to allowing an introduced pollinator to persist within a conservation reserve.

The management of beekeeping on Crown land is guided by the revised Department's Policy Statement No. 41 *Beekeeping on public land* (subject to final consultation). The Department aims to maintain (and renew) current apiary site permits on all classes (tenures) of land, but permit no additional apiary sites on land currently or proposed to be reserved primarily for nature conservation purposes, until a management plan has been prepared. Through the management planning process, the planning area has been categorised as being either (see Appendix 10):

- 'suitable' for apiary sites (new sites are permitted and permits renewed every five years);
- 'suitable, but conditional' (new sites will be permitted, and permits will be renewed on an annual basis subject to conditions such as seasonal restrictions, hive limits, structural modifications to the hives to restrict the queen, increased disease hygiene control and/or regular monitoring of the apiary site); or
- 'highly constrained' (sites will be cancelled and relocated in negotiation with the apiarist).

Within the planning area there are eight apiary sites in Yanchep National Park, three in Neerabup National Park and another five located in the two kilometre buffer of the planning area.

An assessment of the planning area identified three apiary sites as highly constrained, seven suitable but constrained and one site as suitable. One of the apiary sites (no. 564), although it is suitable but conditional in terms of flowering season, it is however located near a recreational site and thus will be highly constrained. This issue is easily rectified by moving the apiary site several hundred metres away from the campsite into a suitable but conditional area. Appendix 11 shows additional conditions that should be placed on each permit.

Further information on beekeeping can be obtained from the Department's website at: *http://www.dec.wa.gov.au/*

36 – Beekeeping

The objective is to protect the natural and recreational values through minimising the environmental and other impacts of commercial honeybees whilst supporting the beekeeping industry.

This will be achieved by:

1. managing apiary sites according to relevant Departmental policies. In keeping with this, the Department will:
   - maintain existing apiary sites throughout the planning area; and
   - manage apiculture by designating access routes, supervising field activities (including applying dieback hygiene principles), sign posting sites and reviewing site management;
2. reviewing every 5 years the apiary analysis for the planning area to determine whether access for beekeeping is either retained at the current level, increased, decreased or phased out based on environmental and management criteria (see Appendix 10);
3. subject to the review of the apiary analysis, renewing apiary permits and considering new sites, transfer of sites, cancellation or relocation of sites in accordance with the assessment criteria;
4. not permitting any new sites within conservation reserves that have no historical use;
5. controlling feral bees within the planning area where possible (see Section 21 *Introduced and other Problem Animals*);
6. liaising with beekeepers, the Beekeeping Consultative Committee, and the Department of Agriculture and Food to ensure the most efficient and sustainable use of sites;
7. supporting research on the impact of beekeeping on biodiversity and adapting management to incorporate new knowledge; and
8. monitoring apiary use within the planning area and any corresponding impacts within the areas identified as suitable but conditional, to aid in the review process.

37. FOREST PRODUCE

The CALM Act definition of forest produce is for the purpose of extraction/utilisation by way of permits, licences and contracts has retained only honey, seed, beeswax, rocks, stone and soil (other than minerals within the meaning of the Mining Act).

The Department is responsible for the conservation and management of all flora on lands managed by the Department under the CALM Act, and throughout the State under the Wildlife Conservation Act. Therefore the Department has the authority to control the commercial harvesting of protected flora in WA on all lands. Under the Wildlife Conservation Act three forms of licenses are issued by the Department to harvest flora, although only the Commercial Purposes Licence (CPL) applies to the sale of protected flora taken from Crown land. Declared rare flora are excluded from this licensed activity.

Section 99A(6) of the CALM Act prevents the taking or removal of forest produce from all lands managed by the Department other than State forest and timber reserves, except in specified circumstances. These specified circumstances on conservation reserves such as national parks and conservation parks include removal of exotic plants, removal for other therapeutic/scientific/horticultural purposes and essential works. Essential works include works that are required to establish or re-establish access to land or to provide a firebreak. Forest produce, including seed, that is taken in connection with essential works can be sold, or used by the Department.

Flora Harvesting

Harvesting of flora can have a number of environmental impacts including reducing the available seed stock and by reducing the numbers of flowers available for cross-pollination and reduce the genetic diversity. Flora harvesting activities can also contribute to the spread of *P. cinnamomi* and trampling of vegetation (see Section 22 *Diseases*).

Koala feed trees are grown in various locations within the planning area and are harvested by Departmental staff daily (see Section 22 *Environmental Weeds*, Section 28 *Non-Indigenous Cultural Heritage* and Section 32.4 *Wildlife Viewing and Interaction*).

The Department may choose to collect seed itself, for use within the parks. Using local seed and the subsequent regeneration of native vegetation is the preferred method of rehabilitation. There are currently no licences for commercial flora harvesting in the planning area, but seed collection has occurred in the planning area as part of a rehabilitation program following the 2005 wildfires that occurred at Yanchep National Park.

37 – Forest Produce

The objective is to prevent the unauthorised removal of forest products from the planning area.

This will be achieved by:

1. permitting the taking or removal of forest produce in accordance with a licence issued by the Chief Executive Officer for:
   - removal of exotic plants;
   - removal for therapeutic/scientific/horticultural purposes; and
   - essential works;
2. removing trees that pose a threat to the public or facilities, or that obstruct designated access tracks;
3. in accordance with section 33(1)(cb) of the CALM Act, using forest produce that becomes available from essential works for the purposes of making improvements to any land to which the CALM Act applies; and
4. issuing licences for non-commercial flora harvesting or bioprospecting in the planning area if appropriate, and ensuring licence conditions are applied and enforced to protect ecological values.

38. POLLUTION AND WASTE MANAGEMENT

There are many potential pollution sources that exist, which could impact on natural values. Atmospheric pollutants are derived from both human activity and natural processes and can have an effect on human health and the wider environment. Potential sources of pollution include:

- atmospheric pollution, for example, industrial and vehicle emissions, carbon dioxide levels;
- land pollution, for example, littering and urban, visitor, industrial and agricultural waste;
- solids and liquid waste generated by visitors who inappropriately dispose of it;
- groundwater pollution, for example, acid sulphate soils (see Section 16 *Hydrology and Catchment Protection* and Section 15 *Geology, Landforms and Soils*), seepage from septics, and nutrients and chemicals from agricultural activities;
- bushfires; and
- noise pollution.

The Department is responsible for pollution control and abatement. DoW is responsible for managing water resources and generally the Water Corporation and/or the local authority is responsible for the disposal of sewage.

Waste can come from a variety of sources within the planning area and can include:

- visitor waste from recreational activities; and
- potential for the dumping of urban, agricultural and industrial waste in the planning area.

Toilets in the MRA are currently connected to septic tanks and not linked to the main sewer. Because some of the toilet's proximity to Loch McNess and the risk of seepage, it would be recommended that over the life of this plan to connect the toilets to the main sewer or alternative non-leaching system (see Section 35 *Water Resources*).

Rubbish generated in the planning area by visitors is disposed of in bins provided throughout the MRA. These bins are emptied on a regular basis and taken away by the City of Wanneroo.

Reserve 25252 has been reported as a possible contaminated site by the City of Wanneroo and has been subject to weed infestations and rubbish dumping in the past. It is likely that reserve 25252 will be subject to further investigation of any possible contamination at the site (see Section 10 *Existing and Proposed Reserves*).

38 – Pollution and Waste Management

The objective is to minimise the production and impacts of waste.

This will be achieved by:

1. complying with relevant legislation and Department policies and guidelines;
2. educating visitors to remove the rubbish and waste generated during their visit to the planning area;
3. managing lands that have been reported as a contaminated site in partnership with the City of Wanneroo (e.g. reserve addition 25252); and
4. ensuring waste disposal systems such as septic tanks do not impact on hydrology.

PART G. INVOLVING THE COMMUNITY

The planning area provides a valuable opportunity for the community to experience and learn about natural communities of plants and animals and landscapes, cultural heritage and karst features. An effective communication program is vital to achieving the vision and objectives of this management plan. It informs the public of the attractions, facilities, opportunities and interpretive services available, and assists in increasing appreciation and understanding of natural and cultural environments. It also fosters a sense of community ownership of the planning area, engenders support for management and encourages appropriate behaviour. Communication is also vital to managing visitor risk so visitors have a safe, enjoyable experience in the planning area.

A range of communication strategies that target different audiences are used, including providing:

- information on the areas facilities, attractions, activities, access, regulations, code of care and costs of entry and activities;
- interpretation in the form of site specific themes appropriate to the planning area;
- education programs including presentations and organised field activities are targeted at specific user groups and facilitate learning and foster greater appreciation and understanding of the area's key values;
- community involvement through volunteer groups and other Government agencies; and
- liaison, consultation and advisory services to stakeholder groups.

39. INFORMATION, INTERPRETATION AND EDUCATION

Information

Information of the area's facilities, attractions, activities, access, regulations, code of care and costs is provided by the Department through park and reserve signage, print media, the Department's website and Department staff. Information is also widely available from many external sources, including tour operators and the tourism industry. The delivery of consistent and accurate information by both internal and external providers is important in achieving effective communication. To this end, the Department provides advice, resources and training to operators and other information providers such as volunteers, to assist them in accurately reinforcing the Department's message to visitors.

Information at Yanchep National Park is provided in print products (e.g. brochures, information sheets, booklets), interpretive signage and by staff. There is little opportunity to provide information at Neerabup National Park, apart from along the Yaberoo Budjara walk trail because of a lack of facilities, access, orientation points or current interest. It is only through the Department's website that visitors are able to obtain any information about Neerabup National Park. Therefore there is a need to provide improved information about this park to the public.

Interpretation

Interpretation is a means of enriching visitor experience and generates an appreciation of a place's natural and cultural values. It is an interactive process involving the visitor, the interpretive medium and the setting. Interpretation is a means of communicating ideas, feelings and information and an opportunity for translating stories of places, wildlife and people in terms that motivate and inspire visitors to greater understanding and care. The interpretation of the key values of the planning area to visitors is integrated with recreation and tourism planning and site developments (see Part E *Managing Visitor Use*).

Detailed communication planning for the park has been undertaken as a part of, and to facilitate, the implementation of this management plan. A key objective of the communication plan is to raise community awareness of, and appreciation for, the planning area's key values (see Section 4 *Key Values*). Communication planning is done in conjunction with recreation site planning and development to identify the best means of

conveying communication messages at individual recreation sites in the context of broader park communication and other management objectives.

Interpretive Themes

'*From caves to coast, the way of water*' is the primary interpretive theme for Yanchep National Park. Following on from this are three supporting themes (see Table 14).

Table 14: Primary interpretive themes at specific sites in the planning area

Supporting Theme	Interpretive Area	Major Sites for Interpretation
Water ❖ Wetlands ❖ Karst features ❖ Tuart trees Water has shaped natural areas.	Lakes	Lake tour, rowboats, sculptures and wetlands walk trail.
	Caves	Crystal cave tours, Cabaret cave, Yonderup cave, adventure caves and Boomerang Gorge.
	Tuart trees on karst features	Tuart root mat communities in Crystal Cave and wildflower garden.
Natural Communities ❖ Cave flora and fauna ❖ Tuart tree communities ❖ Banksia woodlands ❖ Wetland ecosystem Natural areas are dependent on water.	Caves	Flora and fauna in Crystal Cave.
	Woodlands	Woodlands walk trail, Cockatoo walk trail and Yaberoo Budjara walk trail.
	Wetlands	Wetlands walk trail, Ghost House walk trail and Pipidinny Swamp.
People ❖ Nyoongar ❖ Early settlers ❖ Present day visitors ❖ Future visitors People are attracted to water.	Lakefront	Dwerta Mia and Balga Mia.
	Throughout the park	Yanchep Inn, Gloucester Lodge, McNess House, Ghost House walk trail, Barge wrecks on wetlands walk trail, Yaberoo Budjara walk trail, 10th Light horse walk trail and campsite.

Neerabup National Park and Neerabup Nature Reserve do not have developed interpretive themes due to low levels of visitation and a lack of facilities that could communicate the themes. Some signage providing basic information about the 10th Light Horse Memorial Trial does exist near the trailhead and reflects the local history of the area (see Section 30.6 *Bushwalking*). Any other communication facilities developed at Neerabup National Park and Neerabup Nature Reserve should be aligned with the interpretive themes developed at Yanchep National Park so that it is complementary to and not a duplication of themes of other national parks and reserves including regional parks.

Water

Water is a supporting theme for the planning area because water is a sculptor of landscapes, lifeblood of biodiversity and life force for people. Yanchep National Park is a transect of the way of water; from groundwater that flows as subterranean streams that in places have carved out caves in the limestone of past shorelines to stream flow and groundwater seepage into Loch McNess.

The caves within Yanchep National Park are sculpted from the actions of subterranean streams and groundwater seepage that have dissolved the limestone of past shorelines and created cave formations of stalactites, stalagmites, flow stones and straws. The sandy soils and winter rains have made for fast growing cave formations.

A number of natural communities such as tuart forest, *Banksia* woodland, shrub lands and wetlands take up surface and groundwater and provide habitat for a diversity of life. Groundwater that is not taken up by plants or evaporated from lakes and other wetlands ultimately seeps through the sands and into the sea.

Natural communities

'Natural communities' is a supporting theme of the planning area because they depend on water and encompass topics such as caves, woodlands and wetlands.

The caves within Yanchep National Park are home to intriguing troglodytic wildlife, which have a restricted and seemingly tenuous distribution because of declining water levels.

The woodlands of Yanchep National Park contain the most developed assemblage of tuart trees north of Perth. These attract the threatened black cockatoos and provide a home to possums and parrots along with many associated invertebrates. *Banksia* woodland and shrub-land include a diversity of small trees and shrubs as an ecologically viable representative area of the wildlife of the Swan Coastal Plain.

The wetlands of Yanchep National Park, with Loch McNess as the major feature, support migratory, seasonal and resident wetland species of birds and animals. It is a vital link in a chain of wetlands north of Perth.

All of these natural communities are expressions of the relationship of the landscape and soils with the way of water from rainfall, run-off, wetlands and groundwater.

A meeting place for people

A meeting place for people is another supporting theme of the planning area. This theme covers Nyoongar traditional people, their descendant's contemporary connection, the colonial period of exploration and early land use, the twentieth century recreational heritage and Yanchep today in the suburban context.

The availability of water at Yanchep National Park has attracted people from the time of the Nyoongars that were dependent on the local natural resources for food, shelter, tools and medicine. The setting provides the context for cultural expressions through custom and ceremony where people meet to care for country and culture.

The colonial period of the 19th century of exploration and land development for pastoral and agricultural pursuits altered the landscape and its inhabitants.

The 20th century with the establishment of the caves with cave guides saw the growth of recreational pursuits – as a health and pleasure resort within a protected area for nature conservation. It is a fine example of a cluster of 1930s buildings equivalent in value to those on Rottnest Island from an earlier time. It is representative of the Australia-wide 1930s recreational developments in proximity to capital cities. More recently suburban encroachment has contrasted and enhanced the value of this green space as a refuge for nature, wildlife and people.

Today, Yanchep National Park continues to attract people to view and experience the natural, recreational and cultural values, all of which are dependent on the way of water as a sculptor of landscapes, the lifeblood of biodiversity and as a life force for people.

Encompassing the theme of water, tours are provided at various sites. Crystal Cave tours run every day of the year, whilst other tours, such as the Loch McNess boat tour and Indigenous tours are dependent on season and bookings.

Previously, interactive interpretive activities had been predominantly focusing on traditional Indigenous culture. Although this activity is still available at Yanchep National Park, it is currently being delivered by sub-contractors on weekends, public holidays and by speciall arrangement (see Section 30.1 *Day Use – McNess Recreation Area*). Special events such as NAIDOC celebrations have proven to be well attended each year, partly due to the quality and number of activities provided at Yanchep National Park.

The main focus has now shifted more toward interactive interpretive activities that revolve around the natural environment and interpretive themes (see Table 14). In particular, 'Nearer to Nature' is becoming increasingly popular during the school holidays.

Interpretive activities in the planning area are currently based the natural environment and Indigenous culture, but do not include colonial and early 20th century history. In the past, the history of the area was displayed in the Gloucester Lodge museum, which was operated by the City of Wanneroo, but since its closure in 2005, the display is no longer available. Some local history is explained within current interpretive tours such as the boat tour and Crystal Cave tours. A guided interpretive activity that offers an insight into this feature of the park would complement the other activities currently on offer and provide a more holistic understanding of the area.

Education

Education is a series of linked learning programs with defined outcomes in mind. Education programs including presentations and organised field activities are targeted at specific user groups and facilitate learning and foster greater appreciation and understanding of the area's key values. The planning area provides a base for a range of opportunities for education programs for schools in the metropolitan region, and the department often liaises and is involved with local schools.

Local schools have helped propagate native plant species in Yanchep National Park's nursery, which they then used to revegetate degraded areas of the park and they have also contributed to clean up days. Other metropolitan schools have also regularly visited Yanchep National Park and been involved in weeding, seed collecting, propagating native plant species and revegetating degraded areas with the plants grown in the nursery. Following the 2005 wildfire that swept through much of the park, many schools took part in the Fire Recovery Programme, which included rehabilitating affected areas and at the same time, learnt about the ability of native flora and fauna to recover after wildfire.

39 – Information, Interpretation and Education

The objective is to promote community awareness, understanding and appreciation of key values and to engender support of management activities.

This will be achieved by:

1. providing information to visitors on key values and issues such as visitor safety, wildlife interactions, the way of water and appropriate activities and behaviour;
2. supporting institutions using the park for educational purposes;
3. ensuring that commercial tour operators have relevant and factual interpretive material to provide a quality service to visitors in interpreting the planning area's values, themes and management messages;
4. liaising with tourism organisations regarding the planning area's communication issues as necessary; and
5. reinforcing interpretive themes and stories including colonial and early 20th century history.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
39.1 Level of visitor satisfaction with education and interpretation opportunities.	39.1 Level of visitor satisfaction with education and interpretation opportunities remains stable or increases.	After 5 years.

40. COMMUNITY INVOLVEMENT AND SUPPORT

Community involvement is an integral part of the Department's operations including the development and implementation of this management plan. A key objective for the Department is to develop community awareness and appreciation of the State's natural environment and biodiversity and promote community involvement in and support for its protection and conservation.

The community have been involved in preparing of this management plan by providing their perspective of the issues within the park via written submissions and consultation meetings. In particular, members of the Yanchep National Park Advisory Committee (YNPAC) and Yanchep Caves Advisory Committee (YCAC) provided advice to the management planning team on many issues addressed during the planning process.

Ongoing community support is essential for the successful implementation of the approved final management plan. The involvement of Indigenous people, neighbours, visitors, tour operators and interest groups is important to the conservation of the planning area's values. Community members are encouraged to take part in volunteer activities in the planning area such as visitor surveys, clean up days and assistance with maintenance, such as weed removal, track maintenance, and data collection on visitors and wildlife. In 2007/08 over 6000 volunteer hours were contributed to management activities within the planning area, including the restoration of Heritage Tram 57, tending to the wildflower garden, installing reticulation and erecting fences in revegetation sites, compiling a herbarium of wildflowers, propagating native species in the nursery and involvement with

NAIDOC. Volunteer activities not only increase the Department's work capabilities and skills base, but also foster communication links and understanding with the community.

The volunteer groups and members of the local community will often take part in yearly activities which include Arbor Day, National Tree Day and Clean up Australia Day to name a few. All of these activities aim at educating people about the natural environment and people's involvement play an integral part in helping improve the natural surroundings.

The Department's *Good Neighbour Policy* (DEC 2007a) assists in delivering its objectives as outlined in the *Corporate Plan 2007-2009* (DEC 2007d). The Policy outlines several principles for effective neighbour relations. The Policy also addresses issues such as fences adjacent to Department-managed lands, fire management, control of weeds and introduced pest animals, stock on Department-managed lands, access to Department-managed lands and others.

Working together with Indigenous people to 'care for country' will assist heritage preservation and conservation of the environment, as well as enrich cross-cultural awareness. The future involvement of Indigenous people in management of the planning area will be considered in light of the Government determining a policy position (see Section 6 *Management Arrangements with Indigenous People*).

Working with other Government agencies can also be beneficial to the planning area in raising awareness about environmental issues such as declining groundwater levels. Sponsorships by agencies and/or the private sector could provide built structures, improve interpretive activities and support the planning area in promoting environmental awareness.

40 – Community Involvement and Support

The objective is to facilitate effective community involvement and support in planning and management of the parks and reserves.

This will be achieved by:

1. continuing to provide and promote opportunities for involvement of interested community members in conservation and land management programs within the planning area;
2. managing community involvement and support and effective neighbour relations in accordance with Department policies;
3. liaising with neighbouring land owners and land managers, local authorities, relevant Government agencies and other stakeholders in the management of cross boundary issues;
4. continuing to support volunteer involvement in Departmental programs, and maintain the Department's volunteer database; and
6. maintaining the Yanchep National Park Advisory Committee and Yanchep Caves Advisory Committee as appropriate.

Key Performance Indicator:

Performance Measure	Target	Reporting Requirements
40.1 The number of registered volunteers and the number of volunteer hours contributed.	40.1 The number of registered volunteers and volunteer hours contributed remains stable or increases over the life of this plan.	Every 5 years.

PART H. RESEARCH AND MONITORING

Knowledge is essential to effectively plan and manage the planning area. Monitoring might be defined as an examination of performance, while research is the acquisition of new knowledge.

Research activities are supported by the Department where they contribute to the understanding of natural and social processes within the planning area, and where research activities do not themselves threaten or disrupt these processes. Research may be undertaken by Department staff or by external organisations and individuals. Research undertaken by people from external organisations such as universities and research centres require a permit issued by the Department's Nature Protection Branch. It is a condition of the permit system that results of studies are forwarded to the Department.

Within the planning area, the focus for monitoring is outlined in the plan's performance assessment process. The protection of key values within the planning area have an associated key performance indicator (KPI) with a performance measure, target and reporting requirement, which guides monitoring with the planning area (see Section 11 *Performance Assessment and Monitoring*).

Research Requirements

There are several ongoing research and monitoring programs occurring in the planning area including regular Carnaby cockatoo surveys (see Section 18 *Native Animals and Habitats*), visitor satisfaction surveys (see Section 28 *Visitor Opportunities*, 30.3 *Caving* and Section 39 *Information, Interpretation and Education*) and water quality monitoring of Loch McNess (see Section 35 *Water Resources*). A cross-government initiative to ensure the sustainable use of groundwater for drinking and commercial purposes and to protect the environment has been part of developing a *Gnangara Sustainability Strategy* since 1995.

In the case of management plans, research and monitoring should assist in meeting the requirements of the KPIs. This will include gaining a better understanding of those values identified as being most at risk and management practices most likely to have adverse ecological and social impacts. Research and monitoring within the planning area which are assessed by KPIs include:

- assessing and monitoring the extent of erosion/degradation in caves directly attributable to anthropogenic causes (see Section 15 *Geology, Landforms and Soils*);
- monitoring the cover and condition of threatened, priority or otherwise significant flora species or communities (see Section 17 *Native Plants and Plant Communities*);
- monitoring the diversity of subterranean fauna (see Section 18 *Native Animals and Habitats*);
- surveying the fauna species that comprise the Aquatic Root Mat Community of the Swan Coastal Plain (see Section 19 *Ecological Communities*);
- assessing and monitoring the extent of environmental weed species at priority locations and rated as 'high' or local priority (see Section 20 *Environmental Weeds*);
- monitoring the number or number of populations of goats (see Section 21 *Introduced and Other Problem Animals*);
- monitoring the stability of caves by conducting regular geotechnical inspections (see Section 32 *Visitor Safety*);
- monitoring the water quality of Loch McNess to ensure it continues to meet Australian Drinking Water Guidelines (see Section 35 *Water Resources*); and
- assessing and monitoring the quantity of water abstracted in the planning area for management (see Section 35 *Water Resources*).

Other research and/or monitoring projects that are recommended in the strategies of this management plan include:

- improving the understanding of the ecological water requirements of, and hydrological values and processes supporting, Groundwater Dependent Ecosystems in the planning area, in consultation with other government agencies as appropriate (see Section 16 *Hydrology*);
- monitoring of plant and animal diseases (see Section 22 *Diseases*); and

- facilitating, supporting, participating or undertaking Department research and monitoring into fire management, such as organic-rich soils, caves and tuart root mats (see Section 23 *Fire*).

Additionally, future research and/or monitoring projects recommended in this management plan that may be undertaken in the planning area include:

- trialling a cat-free zone in future urban areas on the western boundary of the planning area (see Section 21 *Introduced and Other Problem Animals*);
- sampling the artificially recharged water in Crystal cave (and any other cave) for introduced stygofauna (see Section 21 *Introduced and Other Problem Animals*); and
- monitoring populations of frogs to detect any significant decline in numbers due to the amphibian chytrid fungus *Batrachochytrium dendrobatidis* (see Section 22 *Diseases*).

Ideally, it would be appropriate for research and monitoring programs to involve a wide range of people and groups. The involvement of volunteers, educational and other scientific institutions, and individual researchers can reduce the cost of such programs, assist in providing information to both management and the broader community, and assist in fostering a sense of ownership in the planning area.

Research and Monitoring

The objective is to increase knowledge and understanding of natural values and visitor use to provide for better management and to monitor the impacts of implementation of the management strategies in this plan.

This will be achieved by:

1. identifying and initiating integrated research and monitoring programs that:
   - facilitate management of the planning area, as resources permit and according to priority;
   - focus on issues and key values required to successfully implement this management plan; and
   - establish baseline information for future auditing;
2. liaising with relevant Department staff to determine research priorities, and documenting these where relevant;
3. providing information gained through research, monitoring and experience to the district and region where it can be stored in regional and district office libraries, updated when required and used, if necessary, to modify management practices;
4. developing and maintaining a database of historical, current and required research on the planning area;
5. incorporating research and monitoring findings into interpretive and educational material where appropriate;
6. encouraging and supporting, wherever possible, external agencies, institutions, volunteers, individuals and other organisations to carry out research and monitoring projects where this contributes directly to the management of the planning area or the delivery of Department strategies;
7. ensuring that research and monitoring activities do not adversely impact on the values of the planning area; and
8. pursuing external funding sources to assist in achieving research and monitoring objectives.

GLOSSARY

1080	A naturally occurring toxin (sodium fluoroacetate) found in many native Australian plants known as poison peas (*Gastrolobium sp*.).
A Class Reserve	Classification under the Land Administration Act 1997 reflects security of tenure, level of approval required to alter the reserve's area, purpose or classification.
Aeolian	Wind-deposited materials.
Aquifer	A layer of rock which holds and allows water to move through it, and from which water can be extracted.
Biodiversity	The variety of all life forms: the different plants, animals and micro-organisms, the genes they contain and the ecosystems they form; often considered at three levels: genetic diversity, species diversity and ecosystem diversity.
Biogeography	The study of both geography and biology including the relationships between plants, animals, soils, water, climate and humans.
Biotic	Of, or relating to living things; caused or produced by living organisms.
CAR (Comprehensive, Adequate and Representative) Reserve System	The terms comprehensive, adequate and representative together describe the attributes of an ideal reserve system. These terms are defined in the Australian and New Zealand Environment and Conservation Council's *Guidelines for Establishing the National Reserve System* as: ❖ comprehensiveness – inclusion of the full range of ecosystems recognised at an appropriate scale within and across each bioregion; ❖ adequacy – the maintenance of the ecological viability and integrity of populations, species and communities; and ❖ representativeness – the principle that those areas that are selected for inclusion in reserves reasonably reflect the biotic diversity of the ecosystems from which they derive. In addition to using the scientifically-based CAR criteria, special values (e.g. threatened species and ecological communities) spectacular landforms and scenery as well as natural areas of high public use are also commonly included in parks and reserves.
Catchment	The surface area from which water runs off to a river or any other collecting reservoir.
Climate Change	Climate change is a result of global warming, caused by increases in the concentrations of greenhouse gases such as carbon dioxide, methane and nitrous oxide.
Commercial concession	A lease or licence, administered by the Department to conduct commercial operations on lands or waters held by the Conservation Commission or the Marine Parks and Reserves Authority.
Conservation	The protection, maintenance, management, sustainable use, restoration and enhancement of the natural environment.
Critical weight mammals	Mammals weighing between 35 grams and 5.5 kilos.
Cultural Significance	In accordance with the meaning in the Burra Charter, cultural significance means aesthetic, historic, scientific or social value for past, present or future generations.
Culturally Significant Place	The use of the term place in this context has the meaning defined in the Burra Charter, that is, of a site, area, land, landscape, building or other work, group of buildings or other works, and may include components, contents, spaces and views.
Declared species	Either plants that are declared as weeds or animals that are declared as pests. A list of declared species, with their levels of declaration in various areas of the State is published annually in the Government Gazette pursuant to Section 37 of the *Agricultural and Related Resources Protection Act 1976*.
Disjunct	Populations are said to be disjunct when they are geographically separated from the main range.
Ecological community	An integrated assemblage of species that inhabit a particular area.
Ecological Water Requirements (EWR)	The water regimes needed to sustain the ecological values of water dependent ecosystems at a low level of risk. EWR may be expressed in parameters such as water quantity and quality.

Ecosystem	A community or an assemblage of communities of organisms, interacting with one another and the environment in which they live.
Ecotourism	Tourism focused on appreciation of ecological values, such as to see particular biota or to visit national parks and other reserves.
Endemic	Flora or fauna that is naturally restricted to a particular region.
Environmental Water Provisions (EWP)	The actual water abstraction allocation levels made after consideration of the economic and social requirements for the water.
Environmental weed	An unwanted plant species growing in natural ecosystems that modifies natural processes, usually adversely, resulting in the decline of the communities they invade; usually an introduced plant.
Eutrophication	The enrichment of water by nutrients, such as compounds of nitrogen or phosphorus. It causes an accelerated growth of algae and higher forms of plant life. These consume more oxygen often leading to an oxygen deficit, which can have a major detrimental effect on the fish other aquatic organisms.
Exotic	A species occurring in an area outside its historically known natural range as a result intentional or accidental dispersal by human activities.
Fauna	The animals inhabiting an area; including mammals, birds, reptiles, amphibians and invertebrates. Usually restricted to animals occurring naturally and excluding feral or introduced animals.
Feral	A domesticated species that has become wild.
Fire regime	The combination of season, intensity, interval, extent and patchiness of fire in a given area over time.
Flora	The plants growing in an area; including flowering and non flowering plants, ferns, mosses, lichens, algae and fungi (although fungi are strictly speaking not plants). Usually restricted to species occurring naturally and excluding weeds.
Geology	The study the history of the earth and its life especially as recorded in rocks.
Geomorphology	The study of the earth surface features and their formation.
Gondwana	The southern supercontinent Gondwana (originally Gondwanaland) included most of the landmasses which make up today's continents of the southern hemisphere, including Antarctica, South America, Africa, Madagascar, India, Australia-New Guinea, New Zealand, and New Caledonia.
Groundwater	All free water below the surface in the layers of the Earths crust.
Habitat	The place where an animal or plant normally lives and reproduces.
Hydrology	The scientific study of the characteristics of water, especially of its movement in relation to the land.
Indigenous	Native or belonging naturally (to a place).
Introduced species	See Exotic.
Invertebrates	Animals without backbones, for example, insects, worms, spiders and crustaceans.
Karst	Term used to describe landscapes that are commonly characterised by closed depressions, subterranean drainage and caves. Karst landscapes are driven by the hydrological cycle and formed principally by solution of the rock, most commonly limestone (as is the case in the planning area).
Lake	Permanently inundated wetland basin (Hill *et al.* 1996).
Lampenflora	The growth of algae and other non-vascular plants within caves as a result of artificial illumination as in tourist caves.
Landform	All the physical, recognisable, naturally formed features of land having a characteristic shape; includes major forms such as a plain, mountain or plateau, and minor forms such as a hill, valley or alluvial fan.
Landscape	Appearance or visual quality of an area determined by its geology, soils, landforms, vegetation, water features and land use history.
Pathogen	Any organism (bacterium or virus) or factor that causes disease within a host.
Potable	Suitable for drinking.
Priority Flora and Fauna Listings	*Priority 1*: Poorly known species. Species that are known from one or a few collections or sight records (generally less than 5), all on lands not managed for conservation and under threat of destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. *Priority 2*: Poorly known species Species that are known from one or a few collections or sight records (generally less than 5), some of which are on lands not under immediate threat of destruction or

	degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. *Priority 3*: Poorly known species Species that are known from collections or sight records from several localities not under imminent threat, or from few widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. *Priority 4*: Rare, Near Threatened and other species in need of monitoring. Rare. Species are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for 'vulnerable'. Species that have been removed from the list of threatened species during the past 5 years for reasons other than taxonomy. *Priority 5*: Conservation dependant species Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within 5 years.
Rehabilitation	The process necessary to return disturbed land to a predetermined state, in terms of surface, vegetation cover, land-use and/or productivity.
Relictual/relict/relic	A surviving individual, population, community or species that is characteristic of an earlier period in evolutionary history. Also an area to which a once more widespread population, species or community is now confined.
Soil erosion	A combination of processes in which soil is loosened, dissolved, or worn away, and transported from one place to another by climatic, biological or physical agents.
Speleothem	Decorations or deposits in caves caused by the re-crystallisation of dissolved minerals.
Statutory	Enacted or required by law.
Stygofauna	Animals that live in underground waters such as those in caves, most being small invertebrates. Also known as stygobionts.
Sumpland	Seasonally inundated wetland basin (Hill *et al.* 1996).
Taxa	A defined unit (for example, species or genus) in the classification of plants and animals.
Swan Coastal Plain	A geographic feature that lies directly west of the Darling Scarp, and which contains the Swan River as it travels west to the Indian Ocean. It is one of Western Australia's Interim Biogeographic Regionalisations for Australia (IBRA) regions. It is also one of the distinct physiographic provinces of the larger West Australian Shield division.
Temperate	Of mild temperature, the Temperate Zone is the area or region between the tropic of Cancer and the arctic circle in the Northern Hemisphere or between the tropic of Capricorn and the Antarctic circle in the Southern Hemisphere.
Threatened ecological community	Threatened ecological communities are assessed by the Department and endorsed by the Minister for Environment. They are non-statutory (although some protection is afforded under the Acts of the Department of Environment and Conservation and the Department of Planning) unless listed under the Commonwealth EPBC Act. There are four categories of threatened ecological communities: presumed totally destroyed, critically endangered, endangered (may be destroyed within 20 years) and vulnerable (may be destroyed within 50 years). As with flora, there are also possible threatened ecological communities that are allocated Priority 1 to 5 within the Department.
Troglobites	Those organisms what have dependence upon cave environments and are usually eyeless, non-pigmented, with long antennae and limbs.
Vertebrate	Animals that have a spinal column, which includes fish, amphibians, reptiles, birds and mammals.

ACRONYMS

ACKMA	Australasian Cave and Karst Management Association
ANZECC	Australian and New Zealand Environment and Conservation Council
ARRP Act	Agricultural and Related Resources Protection Act
ASF	Australian Speleological Federation
BRM	Basic Raw Materials
CALM	Department of Conservation and Land Management
CAMBA	China Australia Migratory Bird Agreement
CAR	Comprehensive, adequate and representative protected area reserve system. Comprehensive enough that the full range of ecosystems recognised at an appropriate scale are reserved; adequate enough to maintain the ecological viability and integrity of populations, species and communities; and representative enough that the reserves reflect the biotic diversity of the ecosystems.
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTO	Commercial Tour Operator
DEC	Department of Environment and Conservation
DEHWA	Department of Environment Heritage, Water and Arts (Federal)
DIA	Department of Indigenous Affairs
DMP	Department of Mines and Petroleum
DoAF	Department of Agriculture and Food
DoF	Department of Fisheries
DoW	Department of Water
DRF	Declared Rare Flora
EPA	Environment Protection Authority
EPBC Act	Environmental and Biodiversity Conservation Act
EWS	Environmental Weed Strategy for Western Australia
FESA	Fire and Emergency Services Authority
GUWPC	Gnangara Underground Water Pollution Control Area
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for the Conservation of Nature
JAMBA	Japan Australia Migratory Bird Agreement
KPI	Key Performance Indicator
LCU	Landscape Conservation Unit
LCT	Landscape Character Type
MRWA	Main Roads Western Australia
NRM	Natural Resource Management
PCUWPC	Perth Coastal Underground Water Pollution Control Area
PDWSA	Public Drinking Water Source Area
RATIS	Recreation and Tourism Information System
RIWI	Rights in Water and Irrigation
ROKAMBA	Republic of Korea Australia Migratory Bird Agreement
SRG	Speleological Research Group
TEC	Threatened Ecological Community
UCL	Unallocated Crown land
WAM	Western Australian Museum
WAPC	Western Australian Planning Commission
WASG	Western Australian Speleological Group

REFERENCES

Andersen, A.N. and Majer, J.D. (2004) Ants show the way down under: invertebrates as bioindicators in land management. *Front. Ecol. Environ* **2(6)**:291-298.

Apling, K. and Kirkpatrick, P. (2000) Chytridiomycosis in southwest Australia: historical sampling documents the date of introduction, rates of spread and seasonal epidemiology, and sheds new light on chytrid ecology. Proceedings of *Getting the Jump on Amphibian Disease*. Cairns, Australia.

Balla, S. (1994) *Wetlands of the Swan Coastal Plain.* Volume 1 Their Nature and Management. Water Authority of Western Australia and Western Australian Department of Environmental Protection. Perth Western Australia.

Bamford, M.J. (1992) The impact of fire and increasing time after fire upon *Heleioporus eyrie*, *Limnodynastes dorsalis* and *Myobatrachus gouldii* (Anura: Leptodactylidae) in Banksia woodland near Perth, Western Australia. *Wildlife Research* **19**:169-78.

Beard, J.S. (1979) Vegetation Survey of Western Australia. The Vegetation of the Perth Area, Western Australia. 1: 250 000 Series. Vegmap Publications, Applecross.

Benier, J.M. and Horwitz, P. (2003) Annual report for the Wetland Macroinvertebrate Monitoring Program of the Gnangara Mound Environmental Monitoring Project – Spring 2002 to Summer 2003. Report Number 2003/06. A report to the Water and Rivers Commission of Western Australia.

Horwitz, P. and Benier, J. (2003) *The Effect of Artificial Maintenance of Water Levels on the Aquatic Invertebrate Fauna of Lake Nowergup, with Notes on the Water Quality and Sediments.* Unpublished report to the Water and Rivers Commission, Edith Cowan University.

Birds Australia (2005) Wetland birds of Yanchep National Park. Number 62a in a series of Bird Guides of Western Australia. Birds Australia Western Australia.

Burbidge, A.H. (2003a) Birds and fire in the Mediterranean climate of south-west Western Australia. In Abbott, I. and Burrows, N. (ed.) *Fire in ecosystems of the south-west of Western Australia: impacts and management*. Backhuys Publishers, Leiden: 321-347.

Burbidge, A.H. (2003b) *Animals of Yanchep NP, Neerabup NP and Neerabup NR – Notes prepared by Allan Burbidge*, July 2003.

Burbidge, A. (2004) *Threatened Animals of Western Australia*. Department of Conservation and Land Management Western Australia.

Burbidge, A.H., Leicester, K., McDavitt, S. and Majer, J.D. (1992) Ants as indicators of disturbance at Yanchep National Park, Western Australia. *Journal of the Royal Society of Western Australia* **75**: 89-95.

Burrows, N.D. and Friend, G. (1998) Biological indicators of appropriate fire regimes in south west Australian ecosystems. In T. Pruden and L. Brennan (ed.) *Fire in ecosystem management: shifting the paradigm from suppression to prescription.* Tall Timbers Fire Ecology Conference Proceedings, No. 20. Tall Timbers Research Station, Tallahasse.

CALM (1989a) *Yanchep National Park Management Plan 1988-1999.* Department of Conservation and Land Management Western Australia.

CALM (1989b) *Policy Statement No. 34 – Visual Resource Management of Lands and Waters Managed by CALM*. Department of Conservation and Land Management Western Australia.

CALM (1998a) *Gnangara Park – A Preliminary Concept Plan*. Prepared by a Technical Working Group consisting of Department of Conservation and Land Management, Water & Rivers Commission, Water Corporation, Ministry for Planning and Department of Environmental Protection.

CALM (1998b) *Western Australia's Threatened Flora.* Edited by Andrew Brown, Carolyn Thomson-Dans and Neville Marchant. Department of Conservation and Land Management, Como, Western Australia.

CALM (1999a) *Environmental Weed Strategy for Western Australia*. Department of Conservation and Land Management, Perth.

CALM (2002) *Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*. Department of Conservation and Land Management, Western Australia.

CALM (2003a) *Establishment of Comprehensive, Adequate and Representative Terrestrial Conservation Reserve System in Western Australia*. Department of Conservation and Land Management, Perth.

CALM (2003b) *McNess Recreation Area Yanchep National Park Non-Indigenous Cultural Heritage Conservation Plan – Final Report*. Prepared by Hocking Planning & Architecture, Blackwell & Associates, Lucy Williams Historian & Heritage Consultant, Western Australia.

Christensen, P. (1983) Western brush wallaby. In: *The Australian Museum Complete Book of Australian Mammals. The National Photographic Index of Australian Wildlife.* Edited by Ronald Strahan. The Australian Museum. Angus and Robertson Publishers.

Clayton, M, Wombey, J.C., Mason I.J., Chesser R. T. and Wells A. (2006) *CSIRO List of Australian Vertebrates – A Reference with Conservation Status.* CSIRO Publishing, Victoria, Australia.

Cockbain, A. E. (1990) Perth Basin. In: *Geology and Mineral Resources of Western Australia*: Western Australia Geological Survey, Memoir 3, p. 495 – 524.

Commonwealth of Australia (1997) The Wetlands Policy of the Commonwealth Government of Australia. Environment Australia, Canberra ACT.

Davis, J.A., Rolls, S.W. and Wrigley, T.L. (1991) *A survey of the environmental quality of wetlands on the Gnangara Mound, Western Australia*. Water Authority of Western Australia, Perth.

Davis, J.A., Halse, S.A. and Froend, R.H. (2001) Factors influencing biodiversity in coastal plain wetlands of southwestern Australia. In: *Biodiversity in wetlands: assessment, function and conservation.* Volume 2: 89-100 (edited by Gopal, B., Junk, W.J. and Davis, J.A.). Backhuys Publishers, Leiden, The Netherlands.

Department of Conservation and Environment (1978) System 6 Study - Conservation Reserves and National Parks Committee Report.

Department of Conservation and Environment (1981) *The Darling System Western Australia - Proposals for Parks and Reserves*. The System 6 Study Report to the Environmental Protection Authority, Report No 8, Western Australia.

Department of Conservation and Environment (1983) Conservation through reserves for Western Australia as recommended by the Environmental Protection Authority – 1983, Report No. 13. Department of Conservation and Environment, Perth, Western Australia.

DEC (2006a) *100-year Biodiversity Conservation Strategy for Western Australia*. Department of Environment and Conservation, Perth.

DEC (2006b) *Policy Statement No. 18 – Recreation, Tourism and Visitor Services*, Department of Environment and Conservation, Perth.

DEC (2007a) *Good Neighbour Policy*. Department of Environment and Conservation, Perth.

DEC (2007b) *Policy Statement No. 19 – Fire Management Policy.* Department of Environment and Conservation, Perth.

DEC (2007c) *Disability Access and Inclusion Plan 2007 – 2010*. Department of Environment and Conservation, Perth.

DEC (2007d) *Corporate Plan 2007-2009.* Department of Environment and Conservation, Perth.

DEP (2000) *Bush Forever* State of Western Australia.

DMP (1998) *Mining Environmental Management Guidelines*. Department of Mines and Petroleum, Perth.

DoE (2004) *Environmental management of groundwater abstraction from the Gnangara groundwater 2003-2004 annual compliance report to the Environmental Protection Authority*. Department of Environment, Perth.

DoE (2005a) *Section 46 Progress Report – State of the Gnangara Mound*. Department of Environment. Government of Western Australia.

DoE (2005b) Study of Groundwater Related Aboriginal Cultural Values on the Gnangara Mound, Western Australia. Produced by Estill & Associates: McDonald E., Coldrick B. and Villiers L., Western Australia.

DoF (2001) Translocations of freshwater crayfish: contributions from life histories, trophic relations and diseases of three species in Western Australia. Department of Fisheries, Perth.

DoW (2007) *Environmental management of groundwater abstraction from the Gnangara Groundwater Mound 2004-05*. Annual compliance report to the Environmental Protection Authority, July 2004 to June 2005. Department of Water, Perth.

DoW (2009) *Gnangara Sustainability Strategy: Draft for public comment*, Department of Water, http://portal.water.wa.gov.au/portal/page/portal/gss Accessed: 2009

English, V., Blyth, J., Gibson, N., Pember, D., Davis, J., Tucker, J., Jennings, P. and Walker B. (2003) *Interim Recovery Plan No 110 Sedgelands in Holocene Dune Swales – Interim Recovery Plan 2002-2007.* Western Australian Threatened Species and Communities Unit, Department of Conservation and Land Management, Western Australia.

Environment Australia (2001) *Threat abatement plan for Dieback caused by the Root-rot Fungus Phytophthora cinnamomi.* Environment Australia, Canberra.

Environment Australia (2008) *Threat abatement plan for competition and land degradation by feral goats*. Environment Australia, Canberra.

Finlayson, B. and Hamilton-Smith, E. (2003) *Beneath The Surface: A Natural History of Australian Caves*. University of New South Wales Press, Sydney.

Fire Ecology Working Group (1999) *Management of fire for the conservation of biodiversity : workshop proceedings*. Department of Natural Resources and Environment, Melbourne.

Friend, G. (1995) Fire and invertebrates : a review of research methodology and the predictability of post-fire response patterns. In McCaw, W. L., Burrows, N. D., Friend, G. R. and Gill, A. M. (eds) *Landscape fires '93: proceedings of an Australian bushfire conference.* CALMScience Suppl. No. 4, Department of Conservation and Land Management: 165-174.

Friend, T. (1997) Ecology and Management of the Southern Brown Bandicoot or Quenda *Isoodon obesulus.* In: *1997 Fauna Conservation Course, Batalling Field Study Centre, 20-24the October 1997.* Department of Conservation and Land Management, Wildlife Branch of the Nature Conservation Division.

Friend, G. (1999) Fire and faunal response patterns: a summary of research findings. In G. Friend, M. Leonard, A. MacLean and I. Sieler (eds) *Management of fire for the conservation of biodiversity: workshop proceedings.* Fire Ecology Working Group, Department of Natural Resources and Environment, Victoria.

Friend, G. and Wayne, A. (2003) Relationships Between Mammals and Fire in South-west Western Australian Ecosystems. In: *Fire in Ecosystems of south-west Western Australia: Impacts and Management.* Pp 363-380 (Edited by Ian Abbott and Neil Burrows). Backhuys Publishers, Leiden, The Netherlands.

Froend, R., Loomes, R., and Lam, A. (2003) *Gnangara Mound Wetlands – Extra Vegetation Monitoring – Summer 2002/2003*. Unpublished report prepared for the Water and Rivers Commission.

Froend, R., Loomes, R., Horwitz, P., Rogan, R., Lavery, P., How, J., Storey, A., Bamford, M. and Metcalf, B. (2004a) Study of Ecological Water Requirements on the Gnangara and Jandakot Mounds under

Section 46 of the Environmental Protection Act. Task 1: Identification and re-evaluation of ecological values. Prepared for the Water and Rivers Commission.

Froend, R., Loomes, R., Horwitz, P., Bertuch, M., Storey, A. and Bamford, M. (2004b) Study of Ecological Water Requirements on the Gnangara and Jandakot Mounds under Section 46 of the Environmental Protection Act. Task 2: Determination of Ecological Water Requirements. Prepared for the Water and Rivers Commission.

Froend, R., Rogan, R., Loomes, R., Horwitz, P., Bamford, M. and Storey, A. (2004c) Study of Ecological Water Requirements on the Gnangara and Jandakot Mounds under Section 46 of the Environmental Protection Act. Tasks 3 & 5: Parameter identification and monitoring program review. Prepared for the Water and Rivers Commission.

Garnett, S.T. and Crowley, G.M. (2000) *The Action Plan for Australian Birds 2000*. Environment Australia, Canberra.

Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H. and Lyons, M.N. (1994) *A floristic survey of the southern Swan Coastal Plain: report to Heritage Council of W.A. and Australian Heritage Commission.* Department of Conservation and Land Management, 228 p.

Gough, D. and Shimmon, R. (1994) Neerabup National Park. *Landscope* **10(2)**:22-7.

Government of Western Australia (2003b) *A Tuart Atlas: Extent, density and condition of tuart woodlands on the Swan Coastal Plain.*. Prepared by the Department of Conservation and Land Management for the Tuart Response Group.

Green, R. and Higginbottom, K. (2001) The Negative Effects of Wildlife Tourism on Wildlife. *Wildlife Tourism Research Report Series: No. 5. Status Assessment of Wildlife Tourism in Australia Series*. CRC for Sustainable Tourism Pty. Ltd.

Gross C.L. (2001). The effect of introduced honeybees on native bee visitation and fruit-set in *Dillwynia juniperina* (Fabaceae) in a fragmented ecosystem. *Biological Conservation* 102 (1): 89-95.

Hallam, S.J. (1975) *Fire and Hearth: A Study of Aboriginal Usage and European Usurpation in South-western Australia*. Australian Institute of Aboriginal Studies, Canberra.

Hallam, S.J. (2002) *Peopled landscapes in southwestern Australia in the early 1800s: Aboriginal burning off in the light of Western Australian historical documents*. Talk to the Royal Western Australian Historical Society.

Hamilton-Smith, E., Kiernan, K. and Spate, A. (1998) *Karst Management Considerations for the Cape Range Karst Province Western Australia* A Report Prepared for the Department of Environmental Protection, Perth.

Hearn, R., Stoneman, G.L., Keighery, G., Burrows, N., Yates, C. and Hopper, S. (2003) *Management of Significant Flora Values in South-West Forests and Associated Ecosystems.* Unpublished report to the Conservation Commission of Western Australia's Forest Management Plan Steering Committee.

Heddle, E.M. (1980) *Effects of Changes in Soil Moisture on the Native Vegetation of the Northern Swan Coastal Plain, Western Australia*. Bulletin 92, Forests Department of Western Australia.

Heddle, E.M., Lonergan, O.W. and Havel, J.J. (1980) Vegetation of the Darling System Western Australia, Atlas of Natural Resources, Darling System, Western Australia. Department of Conservation and Environment.

Heritage Council of Western Australia (2006) *Register of Permanent Places – Permanent Entry*. Western Australia.

Hill, A.L., Semeniuk, C.A., Semeniuk, V. and Del Marco, A. (1996) *Wetlands of the Swan Coastal Plain, Vol. 2*. Wetland mapping, classification and evaluation. Water and Rivers Commission and Department of Environmental Protection. 146 pages.

Hobbs, R. J. and Atkins, L. (1990) Fire-related Dynamics of a Banksia Woodland in South-western Western Australia. *Australian Journal of Botany* **38**:97-110.

Hopkins, A.J.M. and Griffin, E.A. (1989) Fire in the *Banksia* woodlands of the Swan Coastal Plain. *Journal of the Royal Society of Western Australia* **71 (4)**: 93-94.

Horwitz, P., Judd, S. and Sommer, B. (2003) Fire and organic substrates: soil structure, water quality and biodiversity in far south-west Western Australia In: *Fire in Ecosystems of south-west Western Australia: Impacts and Management*. Pp 381-393 (Edited by Ian Abbott and Neil Burrows). Backhuys Publishers, Leiden, The Netherlands.

Jackson, J., Moro, D., Mawson, P., Lund, M. and Mellican, A. (2007). Bait uptake and caching by red foxes and nontarget species in urban reserves. *Journal of Wildlife Management* 71(4): 1134-1140.

Jasinska, E.J. and Knott, B. (2000) Root-driven faunas in cave waters. In: Ecosystems of the World – Subterranean Ecosystems (Ed in Chief Goodall D.W.; Eds. Wilkens H, Culver D.C. and Humphreys W.F.). Vol 30. Chapter 15: 287-307. Elsevier Science B.V. Amsterdam.

Jasinska, E.J., Knott, B. and McComb, A.J. (1996) Root mats in ground water: a fauna-rich cave habitat. *Journal of the North American Benthological Society* **15(4)**: 508-519.

Keighery, B.J., Keighery, G.J. and Gibson, N. (1996) Part XIII: Floristics of the Neerabup National Park (Part M6). In: *Floristics of Reserves and Bushland Areas in the Perth Region (System 6), Parts XI-XV*. Wildflower Society of WA (Inc), Nedlands.

Keighery, G. (1997) Arum Lily as an Environmental Weed in Western Australia, Overview of Distribution and Threat to Natural Systems. *Arum lily (Zantedeschia aethiopica)s - Proceedings of a Workshop held at HMAS Stirling, Garden Island, Western Australia.* CRC for Weed Management Systems, Adelaide, Australia.

Keighery, B.J., Keighery, G.J. and Shepard, D. (2002) The Distribution and Conservation of Tuart and the Community in which it Lives. In : *Tuart (Eucalyptus gomphocephala) and Tuart Communities.* Wildflower Society of Western Australia (Inc).

Lam, A., Loomes, R.C., Froend, R.H. (2002) *Wetland Vegetation Monitoring 2002 – Survey of the Gnangara Wetlands*. Unpublished report to the Water and Rivers Commission of Western Australia.

Lamont, B.B. and Markey, A. (1995) Biogeography of Fire-killed and resprouting *Banksia* Species in South-western Australia. *Australian Journal of Botany* **43**: 283-303.

Loomes, R., Lam, A. and Froend, R. (2003) *Assessment of the Management of Lake Nowergup*. Unpublished report prepared for the Water and Rivers Commission of Western Australia.

Luu, R., and English V. (2005) Interim Recovery Plan No 193 – Melaleuca huegelii – Melaleuca systena Shrublands of Limestone Ridges (Swan Coastal Plain Community Type 26a) Interim Recovery Plan 2004-2009. Western Australian Threatened Species and Communities Unit, Department of Conservation and Land Management, Western Australia.

McCaw, L. and Hanstrum, B. (2003) Fire environment of Mediterranean south-west Western Australia. In Abbott, I. and Burrows, N. (ed.) *Fire in ecosystems of the south-west of western australia: impacts and management*. Backhuys Publishers, Leiden: 87-106.

McCaw, L., Maher, T. and Gillen, K. (1992) *Wildfires in the Fitzgerald River National park, Western Australia, December 1989*. Technical Report 26, Department of Conservation and Land Management, Western Australia.

McHugh, S.L. and Bourke, S.A. (2008*) Management area review of shallow groundwater systems on Gnangara and Jandakot mounds*. Department of Water, Perth.

Muir, B. A. (1983). *Koalas at Yanchep National Park, Western Australia*. Australian Symposium of Veterinary Medicine.

Natural Resource Management Ministerial Council (2004) *Directions for the National Reserve System – A Partnership Approach.* Australian Government. Department of the Environment and Heritage. Canberra, ACT.

Orell, P. and Morris, K. (1994) *Chuditch recovery plan*. Wildlife Management Program No. 13. Department of Conservation and Land Management, Perth.

Ruthrof, K.X., Yates, C.J. and Lonwergan, W.A. (2002) *The Biology of Tuart*: in Keighery, B.J. and Longman V.M. *Tuart (Eucalyptus gomphocephala) and Tuart Communities*. Wildflower Society of WA Inc.

Scott, G. A.M., Entwisle, T.J., May, T. W. and Stevens, G.N. (1997) *A Conservation Overview of Australian Non-marine Lichens, Bryophytes, Algae and Fungi*, Environment Australia, Canberra.

Seddon, G. (1972) *A sense of place*. University of Western Australia Press, Nedlands, Australia.

Shearer, B.L. (1994) The major plant pathogens occurring in native ecosystems of south-west Australia. In: Plant diseases in ecosystems: Threats and impacts in south-western Australia. *Journal of the Royal Society of Western Australia* **77**: 113-122.

Sinclair Knight Merz (2001) *Environmental water requirements of groundwater dependent ecosystems*. Environment Australia, Canberra

Sommer, B. and Horwitz, P. (1999) Interim monitoring results for Gnangara Mound wetlands with low water levels (Lakes Joondalup, Jandabup, Nowergup, Gnangara and Coogee Springs) – Spring 1998. Report to the Water and Rivers Commission of Western Australia. Joondalup: Centre for Ecosystem Management, Edith Cowan University.

Thackway, R. and Cresswell, I.D. (1995) An Interim Biogeographic Regionalisation of Australia: A Framework for Establishing the National System of Reserves. Version 4.0. Australian Nature Conservation Agency, Canberra.

Usback, S. and James, R., (eds (1993) *A Directory of Important Wetlands in Australia*, Australian Nature Conservation Agency, Canberra.

Van Heurck, P. and Abbott, I. (2003) Fire and terrestrial invertebrates in south-west Western Australia. In: *Fire in Ecosystems of south-west Western Australia: Impacts and Management.* Pp 291-319 (Edited by Ian Abbott and Neil Burrows). Backhuys Publishers, Leiden, The Netherlands.

WA Museum (2003) Fauna species recorded in Yanchep National Park. Western Australian Museum, Perth.

Water Authority of WA (1995) Review of proposed changes to environmental conditions, Gnangara Mound Groundwater Resources, Section 46. Water Authority of Western Australia, Perth.

Western Australian Planning Commission (2005) Population Report No. 6, Western Australia Tomorrow – Population projections for planning regions 2004 to 2031 and local government areas 2004 to 2021. West Australian Planning Commission, Perth.

Weston, A.S. and Gibson, N. (1997) Report on the limestone vegetation of Wabling Hill area, reserves 39411 and 39412 and the Ridges extension to Yanchep National Park. Department of Conservation and Land Management.

Wilson, B.A., Newell, G., Laidlaw, W.S. and Friend, G. (1994) Impact of plant diseases on faunal communities. In: Plant diseases in ecosystems: Threats and impacts in south-western Australia. *Journal of the Royal Society of Western Australia* **77**: 139-143.

Wrigley, T.J., Rolls, S.W. and Davis, J.A. (1991) Limnological Features of Coastal-plain Wetlands on the Gnangara Mound, Perth, Western Australia. In *Australian Journal of Marine and Freshwater Research* 42: 761-73.

Yesertener, C. (2006) *Assessment of The Artificial Maintenance of Groundwater in Yanchep Caves,* Department of Water, Government of Western Australia, Hydrogeological Record Series, Report HG13, Perth WA.

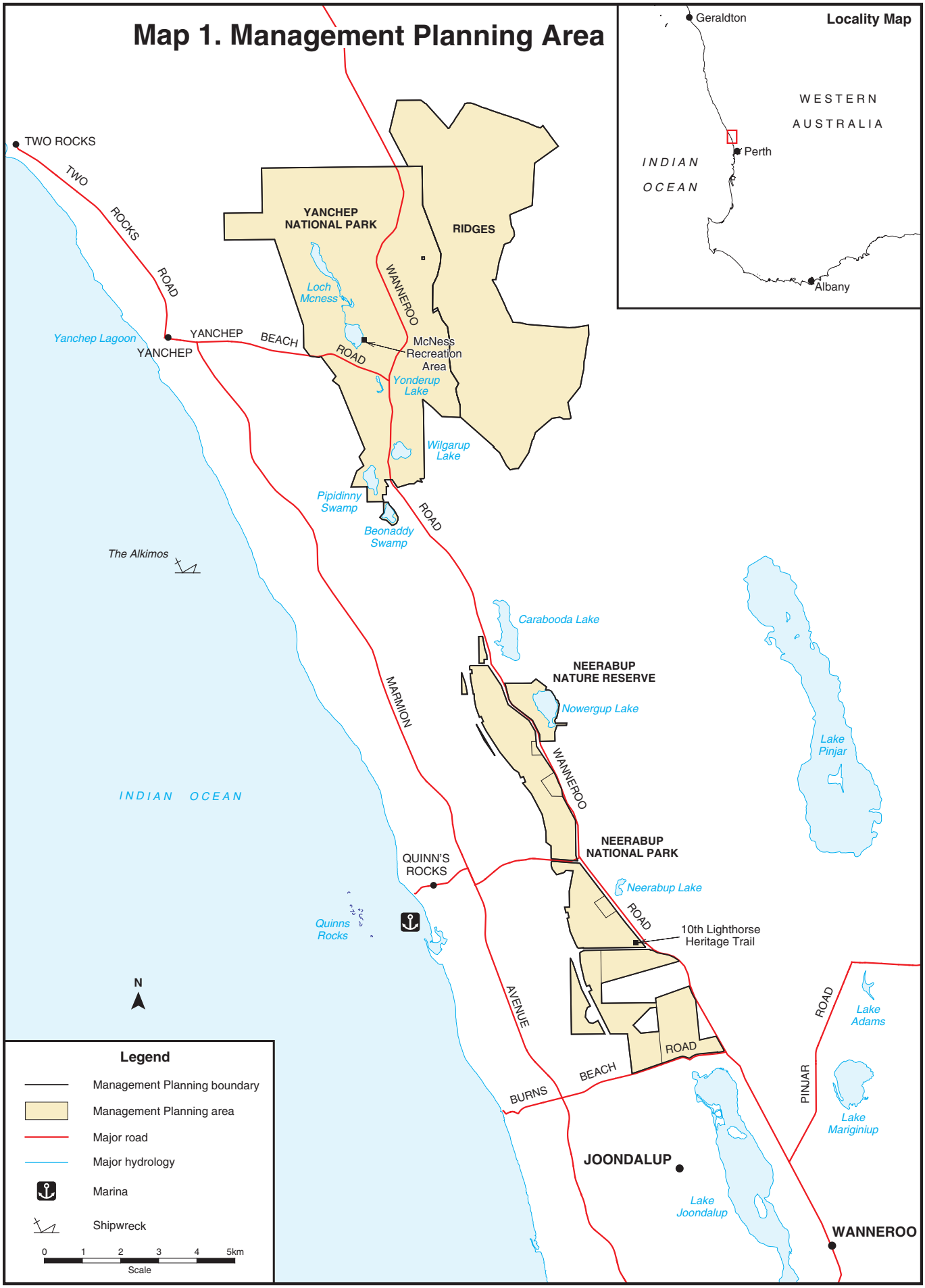
PERSONAL COMMUNICATIONS

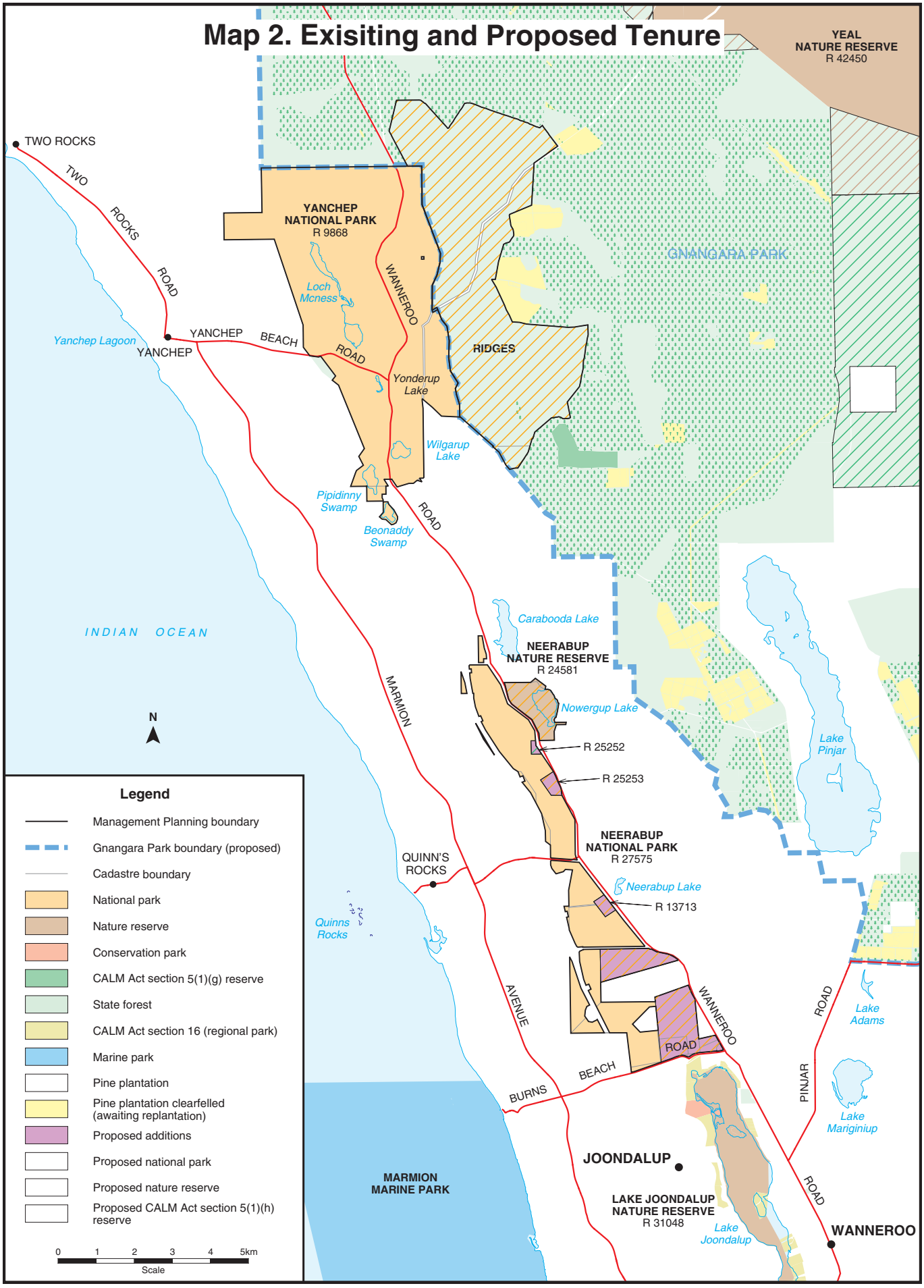
Department of Environment and Conservation

Dr Andrew Burbidge – Research Fellow, Science Division.
Dr Neil Burrows – Director, Science Division.
Brad Johnson – Acting Ranger, Grounds and Facilities, Yanchep National Park.
Dr Peter Mawson – Senior Zoologist, Wildlife Conservation Branch, Nature Conservation Division.
Christie Mahony – Volunteer Coordinator, Yanchep National Park

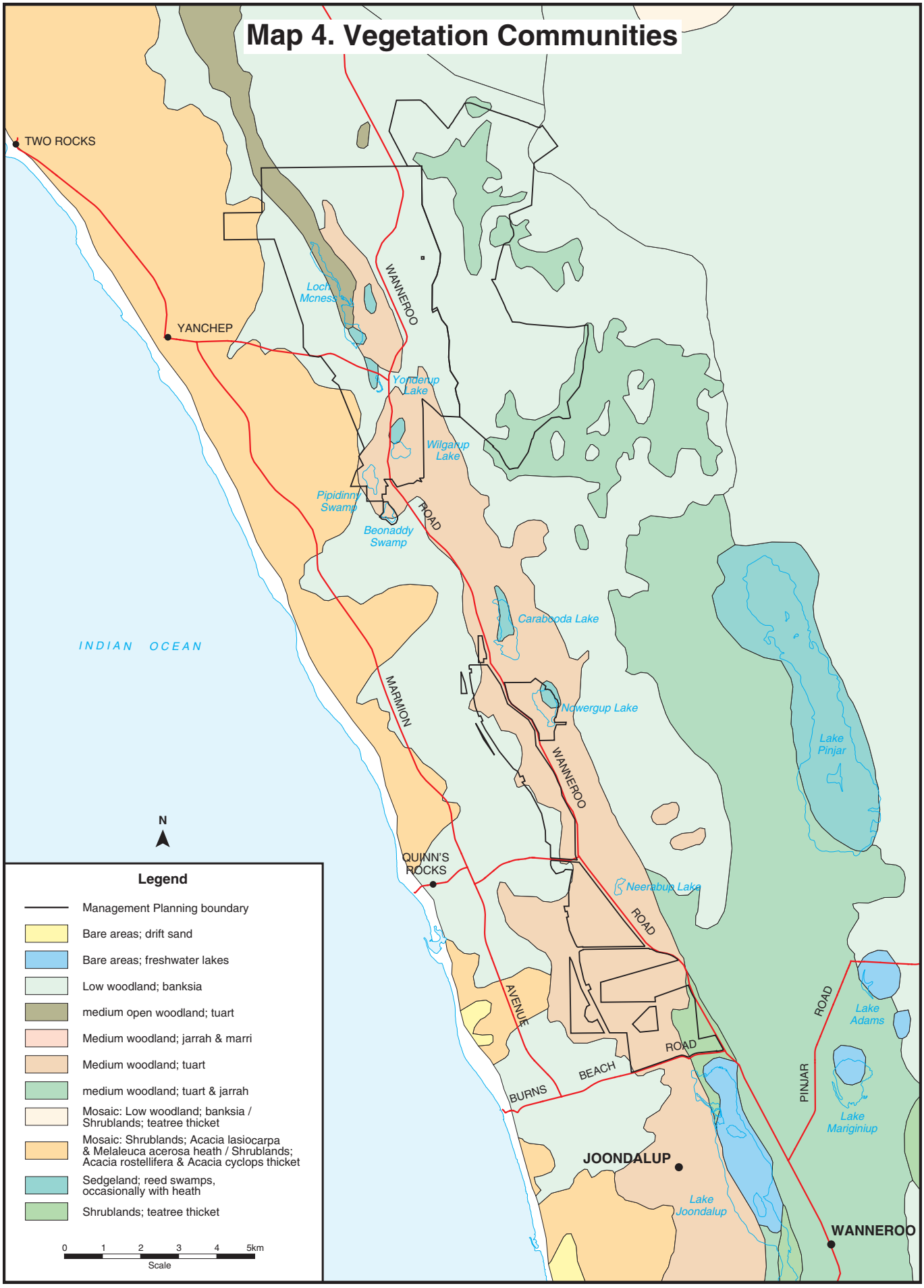
Other

Rob Foulds
Ron Johnstone
Hugo Beckle

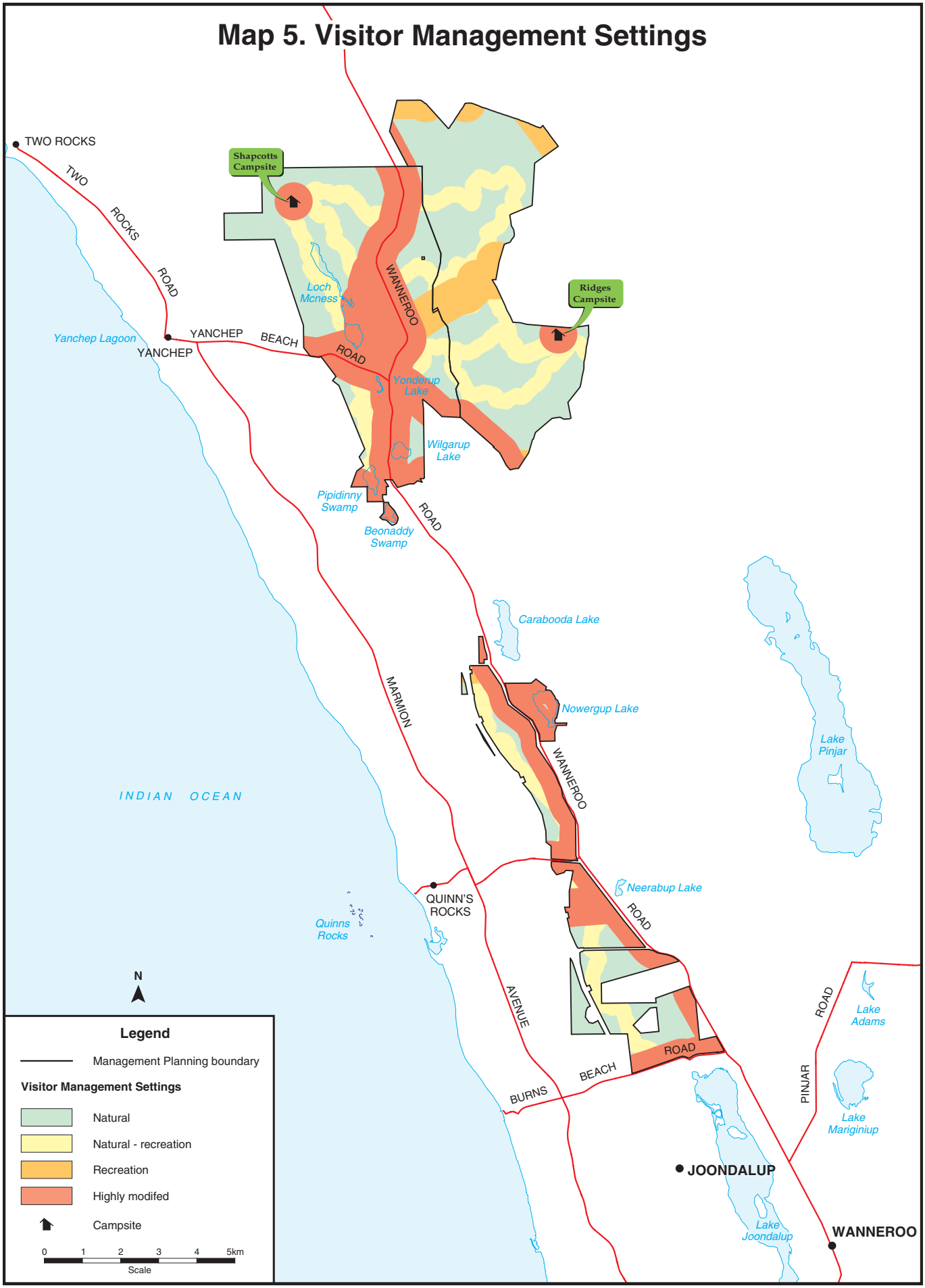

Map 1. Management Planning Area
Locality Map
Geraldton
WESTERN
AUSTRALIA
Perth
INDIAN
OCEAN
Albany
TWO ROCKS
TWO
ROCKS
ROAD
YANCHEP
NATIONAL PARK
RIDGES
Loch
Mcness
WANNEROO
ROAD
Yanchep Lagoon
YANCHEP
YANCHEP
BEACH
ROAD
McNess
Recreation
Area
Yonderup
Lake
Wilgarup
Lake
Pipidinny
Swamp
Beonaddy
Swamp
ROAD
The Alkimos
Carabooda Lake
NEERABUP
NATURE RESERVE
Nowergup Lake
MARMION
WANNEROO
Lake
Pinjar
INDIAN OCEAN
QUINN'S
ROCKS
NEERABUP
NATIONAL PARK
Neerabup Lake
ROAD
10th Lighthorse
Heritage Trail
Quinns
Rocks
N
AVENUE
ROAD
Lake
Adams
ROAD
BEACH
BURNS
PINJAR
Lake
Mariginiup
JOONDALUP
Lake
Joondalup
WANNEROO
Legend
Management Planning boundary
Management Planning area
Major road
Major hydrology
Marina
Shipwreck
0 1 2 3 4 5km
Scale

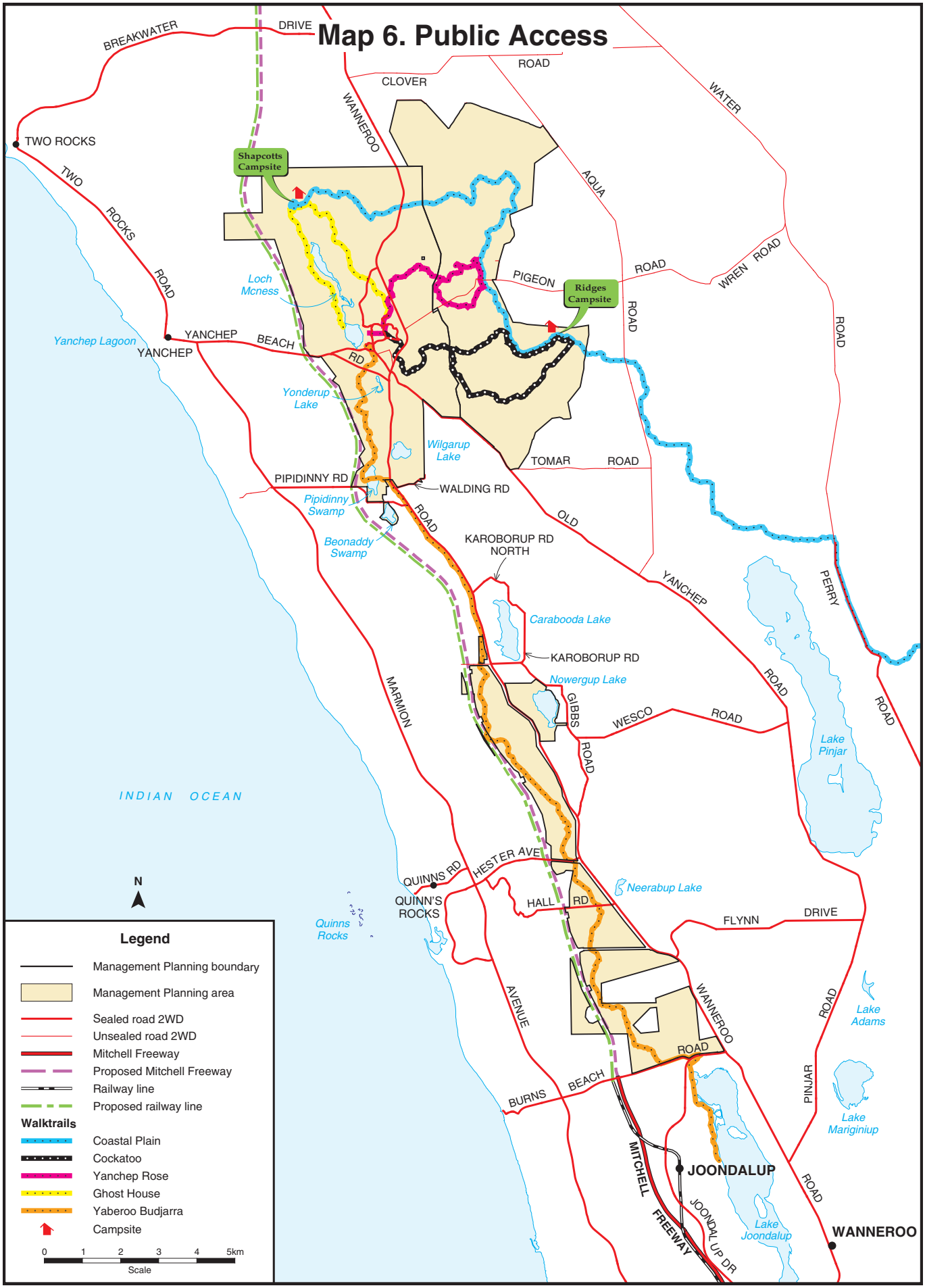

Map 2. Exisiting and Proposed Tenure
YEAL
NATURE RESERVE
R 42450
TWO ROCKS
TWO ROCKS ROAD
YANCHEP
NATIONAL PARK
R 9868
GNANGARA PARK
Loch Mcness
WANNEROO ROAD
Yanchep Lagoon
YANCHEP
YANCHEP BEACH ROAD
RIDGES
Yonderup Lake
Wilgarup Lake
Pipidinny Swamp
Beonaddy Swamp
ROAD
Carabooda Lake
INDIAN OCEAN
NEERABUP
NATURE RESERVE
R 24581
MARMION
Nowergup Lake
R 25252
R 25253
Lake Pinjar
N
NEERABUP
NATIONAL PARK
R 27575
QUINN'S ROCKS
Neerabup Lake
R 13713
Quinns Rocks
AVENUE
WANNEROO ROAD
ROAD
Lake Adams
BEACH
BURNS
PINJAR ROAD
Lake Mariginiup
JOONDALUP
MARMION
MARINE PARK
LAKE JOONDALUP
NATURE RESERVE
R 31048
Lake Joondalup
WANNEROO
Legend
Management Planning boundary
Gnangara Park boundary (proposed)
Cadastre boundary
National park
Nature reserve
Conservation park
CALM Act section 5(1)(g) reserve
State forest
CALM Act section 16 (regional park)
Marine park
Pine plantation
Pine plantation clearfelled (awaiting replantation)
Proposed additions
Proposed national park
Proposed nature reserve
Proposed CALM Act section 5(1)(h) reserve
0 1 2 3 4 5km
Scale


Map 3. Water Sources
TWO ROCKS
TWO ROCKS ROAD
Coastal
YANCHEP NATIONAL PARK
Yanchep Coastal Lakes
Loch Mcness
WANNEROO ROAD
Yanchep Lagoon
YANCHEP
YANCHEP BEACH ROAD
RIDGES
Yonderup Lake
Wilgarup Lake
Pipidinny Swamp
Beonaddy Swamp
ROAD
Lower Swan
MARMION AVENUE
Carabooda Lake
NEERABUP NATURE RESERVE
Nowergup Lake
INDIAN OCEAN
Lake Pinjar
WANNEROO ROAD
N
NEERABUP NATIONAL PARK
QUINN'S ROCKS
Neerabup Lake
Quinns Rocks
ROAD
Wanneroo Coastal Lakes
ROAD
Lake Adams
ROAD
BEACH
BURNS
PINJAR ROAD
Lake Mariginiup
JOONDALUP
Lake Joondalup
Coastal
WANNEROO
Legend
Management Planning boundary
Major road
Major hydrology
Drain
Catchment boundary
Waterbody
Important wetland
Swamp
Area subject to inundation
Reservior protection zone - wellhead
Public Drinking Water Supply Areas
Priority 1
Priority 3
0 1 2 3 4 5km
Scale


Map 4. Vegetation Communities
TWO ROCKS
YANCHEP
Loch Mcness
WANNEROO
Yonderup Lake
Wilgarup Lake
Pipidinny Swamp
Beonaddy Swamp
ROAD
Carabooda Lake
INDIAN OCEAN
MARMION
Nowergup Lake
Lake Pinjar
WANNEROO
N
QUINN'S ROCKS
Neerabup Lake
ROAD
AVENUE
ROAD
BEACH
BURNS
ROAD
PINJAR
Lake Adams
Lake Mariginiup
JOONDALUP
Lake Joondalup
WANNEROO
Legend
Management Planning boundary
Bare areas; drift sand
Bare areas; freshwater lakes
Low woodland; banksia
medium open woodland; tuart
Medium woodland; jarrah & marri
Medium woodland; tuart
medium woodland; tuart & jarrah
Mosaic: Low woodland; banksia / Shrublands; teatree thicket
Mosaic: Shrublands; Acacia lasiocarpa & Melaleuca acerosa heath / Shrublands; Acacia rostellifera & Acacia cyclops thicket
Sedgeland; reed swamps, occasionally with heath
Shrublands; teatree thicket
0 1 2 3 4 5km
Scale

Map 5. Visitor Management Settings




Map 6. Public Access
BREAKWATER
DRIVE
TWO ROCKS
TWO ROCKS ROAD
CLOVER
ROAD
WANNEROO
WATER
AQUA
Shapcotts Campsite
Loch Mcness
PIGEON
ROAD
Ridges Campsite
WREN ROAD
ROAD
ROAD
Yanchep Lagoon
YANCHEP
YANCHEP BEACH RD
Yonderup Lake
Wilgarup Lake
TOMAR ROAD
PIPIDINNY RD
WALDING RD
Pipidinny Swamp
ROAD
OLD
Beonaddy Swamp
KAROBORUP RD NORTH
YANCHEP
PERRY
Carabooda Lake
KAROBORUP RD
Nowergup Lake
MARMION
GIBBS
WESCO
ROAD
ROAD
ROAD
Lake Pinjar
ROAD
INDIAN OCEAN
HESTER AVE
QUINNS RD
QUINN'S ROCKS
Neerabup Lake
HALL RD
FLYNN
DRIVE
Quinns Rocks
AVENUE
WANNEROO
ROAD
ROAD
Lake Adams
BURNS BEACH
PINJAR
Lake Mariginiup
MITCHELL FREEWAY
JOONDALUP
JOONDALUP DR
ROAD
Lake Joondalup
WANNEROO
N
Legend
Management Planning boundary
Management Planning area
Sealed road 2WD
Unsealed road 2WD
Mitchell Freeway
Proposed Mitchell Freeway
Railway line
Proposed railway line
Walktrails
Coastal Plain
Cockatoo
Yanchep Rose
Ghost House
Yaberoo Budjarra
Campsite
0 1 2 3 4 5km
Scale

APPENDICES

APPENDIX 1. Heddle Vegetation Complexes within the Planning Area

Heddle (Heddle *et al.* 1980) Vegetation Complexes within the Planning Area

Vegetation Complex (as per Heddle et al. 1980)	Geomorphological System	Description	% Remaining as Native Vegetation[54]
Quindalup Complex	Quindalup Dune System	Coastal dune complex subdivided mainly into two alliances – a strand and foredune alliance (containing Angianthus cunninghamii, Anthericium divaricatum, Arctotheca nivea, Atriplex isatidea, Cakile maritima, Calocephalus brownii, Carpobrotus virescens, Pelargonium capitatum, Senecio lautus, Sonchus megalocarpus, Spinifex longifolius, Tetragonia implexicoma, T.zeyheri), and the mobile and stable dune alliance (containing Acacia cyclopis, Anthocericis littorea, Lepidosperma gladiatum, Myoporum insulare, Nitraria schoberi, Olearia axillaris, Scaveola crassifolia, S.nitida, Spyridium globulosum, Westringia rigida and Wilsonia backhousei). Local variations include the low closed forest of M. lanceolata-Callitris preissii and closed scrub of Acacia rostellifera.	48
Cottesloe Complex – North	Spearwood Dune System	Predominantly low open forest and low woodland of slender banksia - firewood banksia - Prickly Bark (*Eucalyptus todtiana*). Closed heath occurs on the limestone outcrops.	70
Cottesloe Complex – Central and South	Spearwood Dune System	Mosaic of woodland of tuart and open forest of tuart – jarrah – marri. Closed heath occurs on the limestone outcrops.	36
Herdsman Complex	Wetlands within Spearwood Dune System	Sedgelands and fringing woodland of flooded gum-Melaleuca species.	31
Karrakatta Complex – North	Spearwood Dunes	Predominantly low open forest and low woodland of banksia – pricklybark (E. *todtiana*) species with minor occurrences of open forest of tuart-pricklybark-banksia.	20

Source: Department of Environmental Protection (2000)

Vegetation Associations within Neerabup National Park

Floristic survey of Neerabup National Park by Keighery *et al.* (1996) identified 5 different vegetation associations for that park – these are listed in Appendix 2, including:

- shrublands or heaths dominated by Xanthorrhoea preissii, Hakea trifurcata, Calothamnus quadrifidus, Melaleuca acerosa, Dryandra sessilis, Melaleuca huegelii and Acacia lasiocarpa;
- tuart woodlands;
- jarrah woodlands;
- Banksia woodlands; and
- Jacksonia sternbergiana low forest;

[54] These figure represent the % remaining as native vegetation on the relevant geomorphological system in the Perth Metropolitan Region.

The vegetation of Neerabup National Park is very dependant on the soils; with shrublands or heaths on Tamala limestone ridges and associated soils, and woodlands on the deeper sands Keighery *et al.* (1996). The park contains floristic community types and flora typical of the Spearwood Dunes Tamala Limestone (Keighery *et al.* 1996)

Vegetation Units within Neerabup Nature Reserve

Keighery (2003) lists flora of this reserve using data derived from Keighery (1999). Vegetation units identified in Neerabup Nature Reserve include:

- *Banksia* low woodland;
- jarrah marri woodland;
- bushland upland areas dominated by tuart;
- wetland mosaic areas dominated by Eucalyptus rudis and Melaleuca spp.; and
- lake bed.

294 native plant taxa and 115 weed taxa were recorded for this reserve.

APPENDIX 2. Floristic Community Types within the Planning Area

Supergroup	Floristic Community Type	Yanchep National Park	Neerabup National Park or Neerabup Nature Reserve	Ridges	Comments
Supergroup 2 – Seasonal wetlands	14 Deeper wetlands on sandy soils			Yes	Predominantly in the Perth Metropolitan area. Identified as Priority Ecological Community.
	19b Woodlands over sedgelands in holocene dune swales	Yes			Threatened Ecological Community. Confined to the Perth Metropolitan area.
	S7 Northern woodlands to forests over tall sedges alongside permanent wetlands	Yes	Yes		Predominantly in the Perth Metropolitan area.
Supergroup 3 – Uplands centred on Bassendean Dunes and Dandaragan Plateau	22 Banksia ilicifolia woodland			Yes	Distribution goes well beyond the Perth Metropolitan Region but the Perth Metropolitan Region is central to its distribution.
	23b Northern banksia attenuata-banksia menziesii woodlands			Yes	Distribution goes well beyond the Perth Metropolitan Region. Southern-most location in the Perth Metropolitan Region.
	23c North-eastern banksia attenuata-B. Menziesii woodlands	Yes			Rare in the Perth Metropolitan area.
Supergroup 4 – Uplands centred on Spearwood and Quindalup Dunes (Spearwood Dunes)	24 Northern Spearwood shrublands and woodlands		Yes		Almost completely confined to the Perth Metropolitan area – a single atypical outlier is found to the north of the Perth Metropolitan area. A community of concern because there is evidence that it can be modified or destroyed by human activities, or would be vulnerable to new threatening processes (Gibson *et al.* 1994). Neerabup National Park contains a significant area of this community type, in unusually good condition (Keighery *et al.* 1996). This community type has some of the highest levels of

Supergroup	Floristic Community Type	Yanchep National Park	Neerabup National Park or Neerabup Nature Reserve	Ridges	Comments
					structural diversity of the different community types identified by Gibson *et al.* (1994) having 14 different structural units (Keighery *et al.* 1996). Relationship with 'tuart woodland 'and 'heath' vegetation associations as identified by Keighery *et al.* (1996).
Supergroup 4 – Uplands centred on Spearwood and Quindalup Dunes (Spearwood Dunes)	26a Melaleuca huegelii-melaleuca systena shrublands on limestone ridges	Yes	Yes	Yes	Predominantly in the Perth Metropolitan area. This community type is generally confined to massive limestone ridges (Keighery *et al.* 1996). Generally found on the ridge tops with community type 26a on the ridge slopes with more soil development.
Supergroup 4 – Uplands centred on Spearwood and Quindalup Dunes (Spearwood Dunes)	26b Woodlands and mallees on limestone	Yes	Yes	Yes	Predominantly in the Perth Metropolitan area.
Supergroup 4 – Uplands centred on Spearwood and Quindalup Dunes (Spearwood Dunes)	27 Species-poor mallees and shrublands on limestone	Yes	Yes	Yes	Distribution well beyond the Perth Metropolitan area.
Supergroup 4 – Uplands centred on Spearwood and	28 Spearwood banksia attenuata or banksia attenuata-eucalyptus woodlands.	Yes	Yes	Yes	Distribution well beyond the Perth Metropolitan area. Occurrence at Neerabup National Park is the southern most location in the Perth Metropolitan area.

Supergroup	Floristic Community Type	Yanchep National Park	Neerabup National Park or Neerabup Nature Reserve	Ridges	Comments
Quindalup Dunes (Spearwood Dunes)					Neerabup National Park contains significant areas of this community type, often in association with the more restricted community type 24. This community type has some of the highest levels of structural diversity of the different community types identified by Gibson *et al.* (1994) having 10 different structural units (Keighery *et al.* 1996). Relationship with '*Banksia* woodland', 'jarrah woodland over *Banksia* low woodland and/or open low heath', and '*Jacksonia sternbergiana* low open forest' vegetation associations as identified by Keighery *et al.* (1996)
Supergroup 4 – Uplands centered on Spearwood and Quindalup Dunes (Quindalup Dunes)	30b Quindalup eucalyptus gomocephala and/or agonis flexuosa woodlands	Yes			Rare in the Perth Metropolitan area. It is a community of concern because there is evidence that it can be modified or destroyed by human activities, or would be vulnerable to new threatening processes Gibson et al (1994). Only occurrence in northern part of Swan Coastal Plain.

Source: Keighery *et al* 1996, Department of Environmental Protection (2000)
Note: Italics indicate occurrence is inferred from floristics rather than sampled.

APPENDIX 3. Fauna protected under the Wildlife Conservation Act and the EPBC Act.

Species	Schedule	Values	Habitat	Threats	Issues
Crystal Cave Crangonyctoid *Hurleya sp.* (WAM#642-97) (endangered)	Schedule 1	A crustacean that was found to be a relictual species[55] and also endemic to Crystal Cave. It was only known from a single population comprising of less than 50 mature individuals (English *et al*. 2003).	Cave streams and pools, the tuart trees that have roots in the cave, and the catchment and waters of the Gnangara Mound supplying water for the cave stream.	❖ Declining groundwater; ❖ breakdown of the artificial water supplementation system; ❖ water quality and invasion of foreign stygofauna (see Section 21 *Introduced and Other Problem Animals*); and ❖ decline in habitat or quality of habitat (see Section 19 *Ecological Communities*).	Following drying of pools in the cave, the Crangonyctoid has not been recorded in any other known caves at Yanchep National Park for the past three years and may now be extinct (P. Mawson *pers. comm.* 2008). Should the Crystal Cave Crangonyctoid be found within any cave, consideration should be given to protecting water quality from human influences.
Carnaby's cockatoo (endangered)	Schedule 1	A study on the importance of the pine plantation to the endangered Carnaby's cockatoos is being undertaken as part a specific conservation initiative involving conservation groups, volunteers, and government agencies called the Gnangara Sustainability Strategy.	Endemic to the south west of the State and breeds in high rainfall wheatbelt areas and feeds and breeds in Yanchep National Park and feeds in nearby Gnangara Park. Requires mature eucalypt woodland with large tree hollows (including tuart trees), and nearby access to shrub/heathland feeding areas[56].	❖ Ongoing loss, fragmentation and degradation of breeding and feeding habitat; ❖ competition for nesting hollows from other native or introduced hollow nesting species (e.g. galahs, corellas, feral honey bees and possums); and ❖ illegal poaching.	Carnaby's cockatoos have been reported to cause significant damage to ornamental and introduced native trees (e.g. Lemon-scented gums) through their roosting and feeding in and adjacent to the McNess recreation area (Brad Johnson *pers. comm.*2008).
Chuditch (vulnerable)	Schedule 1	The chuditch is vulnerable to local extinction because of low population	Confined to fewer than 6,000 animals in the southwest of Western Australia, mostly in jarrah forest but also scattered in woodland and	❖ Land clearing; ❖ competition from foxes and feral cats; ❖ road traffic;	Although chuditch sometimes consume fox baits, they are not affected in terms of survival or breeding, and generally increase in

[55] A relictual species has species lineages from when Australia was part of the supercontinent, Gondwana.
[56] Carnaby's cockatoo feeds on the seeds or nectar of a variety of shrubby heathland species, including for example, banksias, hakeas, grevillea and dryandra. It also feeds on associated insects.

Species	Schedule	Values	Habitat	Threats	Issues
		densities and the patchy distribution of populations.	wheatbelt areas (Orell and Morris 1994). Require adequate numbers of suitable den and refuge sites (horizontal, hollow logs or earth burrows) to survive (Orell and Morris 1994).	❖ poisoning (from consuming fox baits); and ❖ accidental trapping.	numbers in areas baited for foxes.
Peregrine falcon *Falco peregrinus*	Schedule 4	The Peregrine falcon feeds on small and medium-sized birds, as well as rabbits and other day-active mammals.	The Peregrine falcon can be found in most habitats, including woodlands near Loch McNess.	❖ Ongoing loss, fragmentation and degradation of breeding and feeding habitat; and ❖ competition from foxes and feral cats.	It has been found that pesticides can thin the eggshells of Peregrine falcons, decreasing their breeding success in some areas.
Carpet python *Morelia spilota imbricata*	Schedule 4	Carpet python are non-venomous and prey on small animals such as rats, mice and birds.	The carpet python is widespread across southern Western Australia occurring in woodlands, forests and dense coastal scrub, on granite and limestone outcrops and along watercourses (Bush *et al.* 2007). It is arboreal, terrestrial, rock dwelling and shelters in burrows made by other animals, hollow tree limbs, rock crevices and hollow logs.	❖ Habitat destruction; ❖ inappropriate fire regimes; and ❖ predation by introduced species.	Carpet pythons lay around 10 to 50 eggs in late spring or summer and can often be found living in the ceiling cavity of houses.

APPENDIX 4. Priority species recorded in the planning area.

Species	Priority	Habitat	Threats
Quenda (Southern brown bandicoot) *Isoodon obesulus fusiventer*	P3	Dense scrubby vegetation and woodlands, and, on the Swan Coastal Plain it is also often associated with wetlands.	Habitat loss and fragmentation, fire in fragmented habitat, and predation by foxes and cats (or dogs near residential areas) (Friend 1997).
Rakali (water rat) *Hydromys chrysogaster*	P4	Dense vegetation associated with wetlands, and is widespread on wetlands in the Wanneroo area (Bamford 2003).	Can be affected by significant declines in wetland water levels.
Kwoora (Western brush wallaby) *Macropus irma*	P4	Open forest or woodland, particularly with seasonally wet flats, low grasses and open scrubby thickets (Christensen 1983).	Loss and fragmentation of habitat, predation of juveniles by foxes, and loss of habitat from inappropriate fire.
Black bittern *Ixobrychus flavicollis australis*	P4	Vegetated wetlands, breeding in trees over water and feeding on wetland aquatic fauna (Garnett and Crowley 2000).	Key threats to these species are wetland/riparian disturbance (Garnett and Crowley 2000), particularly by inappropriate fire regimes.
Little bittern *Ixobrychus minutus*	P4		
Carpet python *Hylaeus globuliferus*	P3	Woodlands, forests and dense coastal scrub, on granite and limestone outcrops and along watercourses (Bush *et al.* 2007). It is arboreal, terrestrial, rock dwelling and shelters in burrows made by other animals, hollow tree limbs, rock crevices and hollow logs.	Habitat destruction, inappropriate fire regimes and predation by introduced species impact on this species.
Black striped snake	P3	Restricted to coastal dunes and sandplains with heath and Banksia between Cataby and Mandurah. Spends most of its time in soil, rotten pulpy wood and leaf litter occasionally moving about on the surface at night (Bush *et al.* 2007).	The biggest threat to this species is likely to be from habitat destruction.
Native bee *Hylaeus globuliferus*	P2	Known from 19 records across the southwest from Jurien to Ravensthorpe, four of which are from within Neerabup National Park with an isolated population north of the Murchison River.	Destruction of slender banksia (*Banksia attenuata*)[57].
Cricket *Austrosaga spinifer*	P2	Known from four records, all found within Neerabup National Park.	Vulnerable to clearing and inappropriate fire regimes (P. Mawson *pers. comm.*2006)
Biting midge *Austroconops mcmillani*	P2	Known from a small number of sites around the Yanchep Golf Course and has not been recorded from any location outside the park (P. Mawson *pers. comm*. 2008).	Insecticide (e.g. spraying on the lake front, golf course and/or Yanchep Inn gardens)

[57] The species is known to feed on the flowers of some *Adenanthos*, *Grevillea* and *Banksia* species, including the slender banksia.

APPENDIX 5. Weeds in the planning area

Scientific Name	Common Name	EWSWA	WON	ARRP	Local Priority
Weeds of National Significance					
Asparagus asparagoides	Bridal creeper	H	WON	YES	H
Ulex europaeus	Gorse	L	WON	YES	
Department of Agriculture and Food Declared Weeds					
Moraea flaccida	One-leaf cape tulip	H		YES	H
Zantedeschia aethiopica	Arum lily	H		YES	H
Carthamus lanatus	Saffron thistle	MO		YES	MO
Myriophyllum aquaticum	Parrots feather (aquatic)	MO		YES	
Solanum linnaeanum	Apple of Sodom	MO		YES	MO
Cirsium arvense var. arvense	Perennial thistle	L		YES	
Cynara cardunculus	Artichoke thistle	L		YES	
Datura stramonium	Common Thornapple	L		YES	
Galium tricornutum	Three-horned Bedstraw	L		YES	
Senecio jacobaea	Ragwort	L		YES	
Silybum marianum	Variegated thistle	L		YES	L
Echium plantagineum	Paterson's Curse	TBA		YES	MILD
Hypericum perforatum var. angustifolium	St. Johns Wort	TBA		YES	
Environmental Weed Strategy High Priority					
Brassica tournefortii	Mediterranean turnip	H			
Bromus diandrus	Great brome	H			
Cortaderia selloana	Pampas grass	H			H
Eragrostis curvula	African Lovegrass	H			
Ehrharta calycina	P. Veld grass	H			H
Euphorbia terracina	Geraldton carnation weed	H			H
Freesia alba x leichtlinii	Freesia	H			H
Leptospermum laevigatum	Victorian tea tree	H			H
Lupinus cosentinii	Sandplain lupin	H			
Passiflora foetida	Passion flower	H			H
Pelargonium capitatum	Rose Pelargonium	H			
Sparaxis bulbifera	Harlequin flower	H			
Typha orientalis	Bulrush	H			H
Watsonia bulbillifera	Watsonia	H			H
Local High Priority					
Avena fatua	Wild oat	MO			H
Ficus carica	Common fig	MO			H
Stenotaphrum secundatum	Buffalo grass	MO			H
Asphodelus fistulosus	Wild onion	MILD			H
Romulia rosea	Guildford grass	NR			H
Environmental Weed Strategy Moderate, Mild, Low and To Be Advised Priority					
Aira cupaniana	Silvery hairgrass	MO			
Briza minor	Shivary grass	MO			
Bromus rubens	Red brome	MO			
Carduus pycnocephalus	Slender thistle	MO			
Carex divisa	Divided sedge	MO			
Carpobrotus edulis	Hottentot fig	MO			
Centaurea melitensis	Maltese cockspur	MO			
Cirsium vulgare	Spear thistle	MO			
Cynodon dactylon	Couch	MO			

Cyperus eragrostis	Umbrella sedge	MO			
Cyperus rotundus	Nut grass	MO			
Dischisma arenarium	Annual herb	MO			
Ehrharta villosa var. villosa	Annual grass/herb	MO			
Erodium cicutarium	Common storksbill	MO			
Gladiolus caryophyllaceus	Wild Gladiolus	MO			MO
Heliophila pusilla	Annual herb	MO			
Holcus lanatus	Yorkshire Fog	MO			
Hordeum glaucum	Northern Barley grass	MO			
Hypochaeris glabra	Smooth catsear	MO			
Lactuca serriola	Prickley lettuce	MO			
Lolium temulentum	Drake	MO			
Orobanche minor	Lesser broomrape	MO			
Parentucellia latifolia	Common bartsia	MO			
Parentucellia viscosa	Sticky bartsia	MO			
Paspalum vaginatum	Salt water couch	MO			
Pennisetum clandestinum	Kikuyu	MO			MO
Phyla nodiflora	Perennial herb - no name	MO			
Physalis peruviana	Cape gooseberry	MO			
Polypogon monspeliensis	Annual beardgrass	MO			
Pseudognaphalium luteoalbum	Jersey cudweed	MO			
Rostraria cristata	Annual grass/herb	MO			
Solanum americanum	Glossy nightshade	MO			
Solanum nigrum	Nightshade	MO			
Trifolium arvense	Hare's foot clover	MO			
Trifolium campestre	Hop clover	MO			
Trifolium campestre var. campestre	Hop clover	MO			
Trifolium glomeratum	Ball clover/cluster clover	MO			
Urochloa mutica	Perennial grass/herb	MO			
Urospermum picroides	False hawkbit	MO			
Ursinia anthemoides	Ursinia	MO			
Vicia sativa	Common vetch	MO			
Vulpia myuros	Rat's tail fescue	MO			
Wahlenbergia capensis	Cape bluebell	MO			
Dittrichia graveolens	Stinkwort	MILD			MILD
Phytolacca octandra	Red ink plant	MILD			
Psoralea pinnata	African scurfpea	MILD			
Rumex crispus	Curled dock	MILD			
Rumex pulcher	Fiddle dock	MILD			
Silene nocturna	Mediterranean catchfly	MILD			
Trachyandra divaricata	Onion weed	MILD			MILD
Trifolium scabrum	Rough clover	MILD			
Arundo donax	Giant reed / Bamboo	L			MO
Asparagus officinalis	Asparagus	L			
Bromus hordeaceus	Soft brome	L			
Centaurium tenuiflorum	Annual herb	L			
Chenopodium album	Fat hen	L			
Cyperus tenuiflorus	Scaley sedge	L			
Emex australis	Doublegee	L			L
Epilobium ciliatum	Glandular willow-herb	L			

Epilobium tetragonum	Square-stalked willowherb	L			
Galinsoga parviflora	Potato weed	L			
Lachenalia bulbifera	Perennial herb	L			
Lolium perenne	Perennial ryegrass	L			
Matthiola incana	Common stock	L			
Mentha x piperita	Perennial herb	L			
Oenothera glazioviana	Evening primrose	L			
Paspalum urvillei	Vasey grass	L			
Passiflora filamentosa	Perennial herb	L			
Petroselinum crispum	Parsley	L			
Polycarpon tetraphyllum	Fourleaf allseed	L			
Ranunculus muricatus	Sharp buttercup	L			
Ricinus communis	Castor oil	L			L
Romneya coulteri	California tree poppy	L			
Sagina apetala	Annual pearlwort	L			
Scabiosa atropurpurea	Purple pincushion	L			
Senecio vulgaris	Common groundsel	L			
Taraxacum officinale	Dandelion	L			
Trifolium spumosum	Bladder clover	L			
Triticum aestivum	Wheat	L			
Ajuga reptans	Wild mint	NR			L
Apium graveolens	Wild celery	NR			L
Avellinia michelii	Annual grass	TBA			
Bartsia trixago	Annual herb	TBA			
Brachychiton acerifolius	Flame trees	NR			L
Brassica barrelieri subsp. oxyrrhina	Smooth stem turnip	TBA			
Callitris preissii	Rottnest I. Pine	NR			L
Cerastium balearicum	Mouse-eared chickweed	NR			
Chamelaucium uncinatum	Geraldton wax	NR			L
Conyza sumatrensis	Annual herb	NR			
Cucumis myriocarpus	Paddy melon	TBA			MILD
Desmazeria rigida	Annual grass/herb	TBA			
Foeniculum vulgare	Fennel	TBA			MILD
Hypochaeris radicata	Flat weed	NR			
Isolepis marginata	Coarse club-rush	NR			
Lythrum hyssopifolia	Lesser loosetrife	TBA			
Oxalis corniculata	Yellow wood sorrel	NR			
Oxalis pes-caprae	Soursob / Sourgrass	TBA			
Petrorhagia dubia	Wild Pink	NR			
Solanum sodumeum	Apple of Sodom	NR			MILD
Vicia sativa subsp. nigra	Narrow leaf vetch	TBA			
Vitis vinifera	Woody climber	TBA			

APPENDIX 6. Non-indigenous tree species in the planning area

Common Name	Scientific Name	Location	Purpose
Norfolk Island pine	*Araucaria heterophylla*	Ghost House ruins	Ornamental
Flame tree	*Brachychiton acerifolium*	Ghost House ruins	Ornamental
Rottnest Island pine	*Callitris preissii*	Ghost House ruins	Ornamental
Lemon tree	*Citrus lemon*	Ghost House ruins	Ornamental
Bangalay gum	*Eucalyptus boytryoides*	Entrance roads	Koala feed tree
Pink flowering marri	*E. calophylla 'rosea'*	Entrance roads	
Lemon-scented gum	*E. citriodora*	Wanneroo Road, Ghost House ruins	Ornamental
Red cap gum	*E. erythrocorys*	Entrance roads	
Flowering gum	*E. ficifolia*	Entrance roads	
Spotted gum	*E. maculata*	Entrance roads, Ghost House ruins	
Brittle gum	*E. mannifera*	Entrance roads	
Yellow box	*E. melliodora*	Entrance roads	
Grey gum	*E. punctata*	Entrance roads, Ghost House ruins	Koala feed tree
Swamp mahogany	*E. robusta*		Koala feed tree
Sydney blue gum	*E. saligna*		Koala feed tree
Forest red gum	*E. tereticornis*		Koala feed tree
Manna gum	*E. viminalis*		Koala feed tree
Fig tree	*Ficus carica*	Ghost House ruins	Ornamental

APPENDIX 7. Heritage Status and listing of places and buildings in the Planning Area

Place	Heritage Council of WA (Permanent Register Entry)	Heritage Council of WA (Interim Register Entry)	Heritage Council of WA (Other places listed on database)	National Trust Classification	Municipal Inventory	Register of National Estate	Heritage Conservation Plan
Administration Building		✓		✓	✓		
Army Bunkers – Radar Installation	✓			✓	✓		
Beach House			✓				
Chauffeur's Room and Garage		✓		✓	✓		
Chawn Mia Tearooms			✓				
Crystal cave					✓		
Ghost House Ruins		✓			✓		
Gloucester Lodge and Pool		✓		✓	✓		✓
Golf course clubhouse			✓				
Koala Enclosure			✓				
Lime Kiln – Lunder (5)			✓				
McNess Guest House		✓		✓	✓	✓	✓
Motel Units (old)			✓				
Park staff office (Ranger's Hut)			✓				

Place	Heritage Council of WA (Permanent Register Entry)	Heritage Council of WA (Interim Register Entry)	Heritage Council of WA (Other places listed on database)	National Trust Classification	Municipal Inventory	Register of National Estate	Heritage Conservation Plan
Recreation Hall site			✓				
Roads and Parking areas			✓				
Sheep Dips			✓				
Tram Cottages		✓		✓	✓		
Wangi Mia			✓				
War Memorial			✓				
Yanchep Inn		✓		✓	✓		✓
Avenue of Trees					✓		
10th Light Hose Campsite			✓				

APPENDIX 8. Visitor management settings criteria

	Natural	Natural -Recreation	Recreation	Highly modified	
				A	B
Principle purposes	Conservation of significant natural and cultural values, with low level recreation.	Conservation of significant natural and cultural values, with low to medium level recreation.	Moderate intensity recreation.	Moderate to high level recreation, education and interpretation. Group activities specifically catered for at many sites.	As per 'A' but with high level recreation, education and interpretation and permanent, commercial structures (e.g. shops, cafes, ecolodges).
Description	Remote areas with conservation significance. Some evidence of previous development in process of rehabilitation, or existing human activity related to management tracks/trails, designated 4WD tracks and walking tracks.	Modified environment but dominated by natural vegetation and landscapes conservation significance. Signs of past use evident.	Modified environment but includes areas with 'natural' landscape values. Exotic plants may be present but rarely dominant, recreation facilities present.	Highly modified environments with a moderate to high level of nature-based developments set in a mostly natural landscape. Signs of human activity are a regular feature.	As per 'A' but with a higher level of development, facilities and services set in a modified natural landscape (e.g. exotic plants present). Includes structures for commercial purposes.
Access (access standards and type of transport used by visitors, resource users and protected area managers)	Vehicles: 4WD only. Walk: AS Walking Track class 4 to 6; tracks generally formed (class 6 tracks not formed). Boats: non-motorised boats only. Cycle: types 4 cycle trail. Horses: no horses permitted. Airstrip: no airstrips permitted.	Vehicles: 4WD, sometimes 2WD seasonal. Walk: AS Walking Track class 3 to 5; tracks formed. Boats: boats, motorised and non-motorised, on designated routes/areas Cycle: types 4 cycle trail. Horses: designated bridle trails possible. Airstrip: natural earth.	Vehicles: 2WD unsealed. Walk: AS Walking Track class 2 to 4; tracks generally formed. Boats: boats, motorised and non-motorised, on designated routes/areas Cycle: types 2 & 3 cycle trails. Horses: designated bridle trails possible. Airstrip: unsealed.	Vehicles: 2WD sealed. Walk: AS Walking Track class 1 & 2; tracks well constructed; universal access provided where appropriate and practical Boats: Areas may be open to all types of boats. Cycle: type 1 cycle trails. Horses: designated bridle trails possible. Airstrip: sealed.	
Site modification (Extent, type and design of infrastructure, facilities, amenities and the style of accommodation provided)	Minimal modification at sites. 'No Facilities' level of development. Overnight Stays: campsites not defined. Day Use: Car parking not defined. Facilities: No facilities provided.	Minor modifications at specific sites. 'Medium' and 'Low' level of development. Overnight Stays: campsites generally defined. Day Use: Car parking generally defined.	Modification of sites evident. 'Medium' level of development. Overnight Stays: campsites generally defined; nature-based built accommodation either single structure (e.g. shack/hut) or semi-permanent multiple structures (e.g. safari camp).	Modification of site clearly evident. 'Medium' to 'high' level of development. Overnight Stays: nature-based built accommodation with multiple structures and a moderate level of facilities and services (safari camp,	Modification of site clearly evident. 'High' level of development. Overnight Stays: built accommodation with a high level of facilities and services (e.g. ecolodge, motel style).

	Natural	Natural -Recreation	Recreation	Highly modified	
				A	B
		Facilities: Basic facilities may be provided such as shade shelters, BBQs, toilets.	Day Use: Car parking area defined. Facilities: Facilities generally provided such as shade and interpretive shelters, gas BBQs, tables, toilets.	ecolodge). Day Use: Defined car parking areas and bays. Facilities: High level of facilities including shade shelters, gas BBQs, tables, toilets, rubbish collection, visitor information in shelter / building.	Day Use: As per 'A'. Facilities: As per 'A' but visitor centres and/or permanent structures for commercial purposes (shops, café's) may be present.
Social interaction (Density of users and degree of social interaction and opportunities for solitude)	Little interaction between users, with small numbers of brief encounters with individuals or small groups only except at campsites.	High likelihood of contact with individuals and small groups along access routes and at campsites.	High level of contact with others at campsites and along access routes. Campsite design allows for group camping.	Constant interaction expected. Group and family activities important part of visitor experience. Interaction with others unavoidable. Natural setting important but in the security of a safe and managed environment.	
Degree of self reliance (level of support services)	Visitors must be totally self-reliant. Support services infrequent or unreliable.	Visitors must still be largely self-reliant. Basic support services provided in specific locations.	Self-reliance requirements are generally low where facilities are provided, but outdoor skills will be important in areas away from roads and tracks.	Minimal self-reliance. High level of support facilities usually present or in close proximity.	
Style of visitor management (level of on-site management, site constraints and regulations)	Infrequent DEC presence. Information principally off-site (e.g. brochures, guides, maps); minimal signs. Low maintenance.	Some management presence including visits by DEC staff and signs. Information may be provided on-site. Permit system may be used to control access; emphasis on establishing appropriate visitor expectations and behaviour.	May be frequent ranger presence. Interpretive material, brochures and track guides available. Moderate on-site management requirements, including signs and barriers; facilities may be common but clustered.	Frequent staff presence, on-site manager. Could be interpretative and education focus. High degree of on-site management including use of physical barriers and on-site staff; vehicle and pedestrian movement heavily controlled.	
Interpretation facilities and services	Signposting may be provided at trailheads; track markers and signs may occur for public health or safety reasons (e.g. at track junctions). Some guided tours may be permitted (see below).	Signposting may be provided where necessary. Interpretive material off-site or at trailheads; guided tours permitted.	Well signposted at trailheads and along track. Interpretive shelters, displays and leaflets, guided tours may be provided. Primary themes may be expressed at recreation sites. Extensive range of opportunities.	Well signposted at trailheads and along track. Interpretive shelters, displays and leaflets, guided tours may be provided; visitor centre may be present. Primary themes may be expressed at recreation sites. Extensive range of opportunities.	

	Natural	Natural -Recreation	Recreation	Highly modified	
				A	B
Commercial uses	CTO licences permitted, but may consider regulating numbers to maintain visitor experiences consistent with setting (E class). Focus on nature-based/cultural activities. Leases generally not permitted, or if allowed then setting revised.	CTO licences permitted with focus on nature-based/cultural activities. Leases permitted in appropriate tenure and subject to strict sustainable conditions.	CTO licences permitted, nature-based/cultural and adventure activities. Leases permitted	CTO licences permitted, nature-based/ cultural and adventure activities. Leases permitted.	
Probable recreation experiences	Opportunities for solitude, independence, closeness to nature, tranquillity and self-reliance in an environment that offers a high degree of challenge. Although the activity may not be based on the use of a motorised vehicle, the influence of vehicles and the safety afforded by them may be significant.	Opportunities for challenging interaction with nature using outdoor skills. Opportunities may have human elements but still high probability that visitors can experience isolation from human influences.	Opportunities to interact with nature while still having access to facilities. Interaction with others expected.	Opportunities for nature appreciation and social interaction in a safe environment. Facilities support group activities. Interaction with others unavoidable.	

APPENDIX 9. Caving in the Planning Area

(A) Caving Code of Practice

Towards Management Authorities and the General Public:

- Where required, cave visitors must have specific permit approval before entering any cave. They will enter only caves authorised by the relevant permit and at the permit specified times. All permit or other entry conditions must be complied with.
- The prevailing procedures regarding nearby camping areas will be followed and care taken to prevent damage to signs, equipment, wildlife or landscape features. In short, leave as found, with particular emphasis on complete removal of all rubbish.
- All cave visitors will be as self-sufficient as possible in terms of water, supplies, assistance required, etc.

Towards caves and karst:

- Caving activity must be conducted in a manner responsible to the cave environment, taking particular care to avoid damage to speleothems, sediments, biota and other natural phenomena.
- The maximum and minimum size of any party will be limited to that authorised by the relevant permit.
- Cave entrances and passages should not be excavated/enlarged, water levels in sumps should not be modified and stream flows should not be diverted without prior consent of DEC.
- Established marked routes must be used: single tracks should be followed and care taken to avoid needless deposition of mud. Mud throwing or modelling is unacceptable.
- All human introduced wastes must be removed from the cave and disposed of properly.
- Cave visitors will not light fires or smoke in any cave.
- Caves must not be disfigured by unnecessary marking (including direction arrows).
- Disturbance should not be caused to any biotic community. No disturbance should be caused to maternity or over wintering roosts of bats. Sampling of wildlife (dead or living), palaeontologic material, or archaeological material will not occur without special permit approval.
- All cave visitors will carry at least one light source (but preferably two or more sources) and wear a "fasten-on" head helmet where practicable when in a cave. Light sources should be adequate for the planned duration of any particular trip. Trip Leaders are responsible for the gear worn by each member of his/her group.
- No person will be coerced to go underground/through squeezes, etc.
- When underground, no trip member will be deprived of any light source (except to aid in emergency).
- Policy guidelines for recreational abseiling (see section 2.3) must be followed in caves and karst features such as dolines that may attract recreational abseiling outside of essential cave access and exploration requirements.

(B) Access Guidelines

Public Access	TOURIST CAVE (Guided or self-guided) e.g. Crystal Cave, Yanchep National Park (YNP), Calgardup Cave, Leeuwin Naturaliste National Park	General public.	❖ Developed and managed for tourist use and/or as an educational resource. ❖ Clearly signposted with access restricted to specified times. ❖ Payment of a fee required for entry. ❖ Infrastructure installed to facilitate access, decrease visitor impacts and improve safety.
	ADVENTURE CAVE - Class 1 e.g. Tunnel Creek, Kimberley.	General public.	❖ May be required to register at the cave entrance and/or pay a fee. ❖ May be some infrastructure and signage to decrease visitor impacts and improve safety.
	ADVENTURE CAVE - Class 2 (horizontal) e.g. Golgotha Cave, Calgardup Window Extension (LNNP) Yonderup Cave, Mambibby Cave (YNP). - Class 3 (Vertical) e.g. Mill Cave (LNNP).	Novice groups (General public) lead by an experienced leader, e.g. school groups and licensed commercial tour operators. Speleologists.	❖ General protection. ❖ Entry permit needed. ❖ DEC approved leader needed. ❖ May be limited infrastructure.

Restricted Access	RESTRICTED ACCESS Note: All caves are in this category unless designated otherwise.	Experienced and responsible speleologists, scientists.	❖ Maximum protection. ❖ Entry permit needed. ❖ DEC approved leader needed. ❖ Speleological club visits. ❖ Research, monitoring or management purposes.

APPENDIX 10. Commercial apiary site assessment

	Suitable	Suitable, but Conditional	Highly Constrained
Approach	Maintain or increase numbers of apiary sites in these areas. Standard permit conditions would apply	Maintain of increase numbers of apiary sites in these areas. Additional permit conditions would apply, such as increased hygiene and seasonal, site location and access restrictions. Research and monitoring at these sites may be required.	Close, and re-locate where possible, any current apiary sites in these areas. Prevent any new apiary sites in these areas
Environmental Criteria			
1. Threatened and other conservation significant flora within a 2 km radius	No rare, priority 1 or 2 flora present that are visited by honeybees	Rare, priority 1 or 2 flora present that are visited by honeybees and impacts are seasonal or undetermined[1]	Rare, priority 1 or 2 flora present that are visited by honeybees and impact is predicted to be year round[1]
	No priority 3 or 4, endemic, disjunct or relictual flora present that are visited by honeybees	Rare or priority 1 or 2 flora present that are visited by honeybees but no predicted impact[2] Priority 3 or 4, endemic, disjunct or relictual flora that are visited by honeybees present[3]	
2. Significant ecological communities within a 2 km radius	No Threatened Ecological Communities (TECs)	TEC present and impacts are seasonal[1] TEC present, but no predicted impact[2]	TEC present and impact is predicted to be year round[1]
3. Threatened fauna and other significant habitats (ie habitats for fauna adversely impacted by honeybees) within a 2 km radius	No old growth forest or other known habitat of hollow nesting threatened fauna present	Old growth forest or other known habitat of hollow nesting threatened fauna is present[4]	
	No fauna watering points at fauna breeding centres and translocation sites present		Fauna watering point at fauna breeding centres and translocation sites present[5]
	No other significant habitats or communities present	Other significant habitats or communities are present that are seasonally impacted[6]	Other significant habitats or communities are present that are impacted year round

	Suitable	Suitable, but Conditional	Highly Constrained
Management Criteria			
1. Previous use	A conservation reserve that has authorised historic use of commercial beekeeping		A conservation reserve that has no authorised historic use of commercial beekeeping
2. Access	Public or suitable management vehicle only access is available		There is no public or suitable management vehicle only access or current access is being closed
	No gazetted wilderness present	'Candidate' wilderness only	Gazetted wilderness present
3. Recreation sites or dwellings within a 500 m radius	No built accommodation/camping/day use site present		Built accommodation/camping/day use site present
4. Tracks and trails within a 200 m radius	No walk trail present (Class 1 or 2)	Walk trail present, but only used infrequently or proposed walk trail (Class 1 or 2)	Walk trail present and used frequently (Class 1 or 2)
5. Disease control	Low risk of *Phytophthora cinnamomi* spread	*P. cinnamomi* present or area identified as protectable from *P. cinnamomi* spread, but there is an existing site[7]	Area identified as protectable from *P. cinnamomi* spread and there are no existing sites[7]
6. Apiary sites within a 3 km radius	No other apiary sites present		Apiary site present
7. Feral honeybee management within 2 km		Feral honeybee control program in place[8]	
8. Weed management within a 2 km radius	No 'High' or 'Moderate' rated environmental weeds present that are considered to have an increased seedset due to honeybees	'High' or 'Moderate' rated environmental weeds that are considered to have an increased seedset due to honeybees, but flower seasonally[9]	'High' or 'Moderate' rated environmental weeds that are considered to have an increased seedset due to honeybees and flower year round[9]
9. Other management concerns	No impact on Department operations or the requirements of other authorities controlling Crown land or Government reserves	An impact on Department operations or the requirements of other authorities controlling Crown land or Government reserves that can be managed	An impact on Department operations or the requirements of other authorities controlling Crown land or Government reserves that can not be managed

Notes:

[1] = Impacts are seasonal or undetermined (see Guidance for Additional Conditions – A). Where impacts are predicted to be year-round, the area will be considered to be highly constrained.

[2] = Visited by honeybees, but no predicted impact. These flora and TECs are still of high conservation significance and a precautionary approach is warranted (see Guidance for Additional Conditions – B).

[3] = As with note 2 above, priority 3 or 4, endemic, disjunct and relictual flora are of conservation significance and a precautionary approach is warranted. In addition, although populations of these species may be widespread and impacts on these populations may not threaten the existence of the species, there still may be some populations that should be afforded higher protection (e.g. the population may be (1) at the species' range end, (2) the largest viable population, or (3) genetically significant) (see Guidance for Additional Conditions – C).

[4] = If there is a current apiary site and there are feral honeybees present, then use can continue year-round. However, old growth forest and other significant habitats for hollow-nesting fauna will be targeted for feral honeybee control (see Guidance for Additional Conditions – D). For new sites within old growth forest see Guidance for Additional Conditions – E.

[5] = Native fauna breeding centres and fauna translocation sites often have watering points. Commercial beekeeping in the vicinity may disturb the animals from drinking.

[6] = To be determined through the planning process. (If no specific habitats are identified through the planning process then the following should be inserted for this note "no other significant habitat or community likely to be impacted by honeybees has been identified during the planning process, however they may be identified during the life of this management plan").

Other significant habitats may be identified due to:

- new research/information;
- changes in threat status of fauna; and/or
- changes in resource availability – for example, directly after a fire when competition between species such as honey possums and honeybees would be at its highest.

[7] = Standard disease control conditions will apply. The soil dryness index may be used to restrict vehicle access to the sites. There should be no new sites established in areas that are protectable from *P. cinnamomi* (or designated Disease Risk Areas).

[8] = There may need to be seasonal restrictions (see Guidance for Additional Conditions – D) when a feral honeybee control program is in place.

[9] = High or moderate rated environmental weeds are a high priority for the Department to control (see Guidance for Additional Conditions – F).

Guidance for additional conditions:

A	Seasonal restriction based on flowering period of flora. Site must be available for a minimum of one month. Placement and number of hives also may be restricted.
B	Placement (at least 100 m from populations) and number of hives may be restricted. Monitoring or representative samples for health of adult populations and seedling recruitment or TEC to ensure there is no decline due to apiary management, taking into account factors such as drought, disease, fire, environmental weeds and other disturbances. If unacceptable impacts are shown or observed later, then treatment will be the same as A.
C	There may be a need to review populations within the planning area to determine whether these populations are significant to the conservation of the species. If deemed significant then treatment will be the same as A.
D	When a feral honeybee control program is in place, then use of the site will be restricted during periods when the queen may swarm, such as spring, or a suitable method to restrict the queen should be implemented.
E	For new sites in old growth forest where there are no feral honeybees present, a condition may be that if during the period of the permit, feral honeybee hives are located within two kilometres of the site, the site will be temporarily restricted until the feral honeybees are controlled.
F	Seasonal restriction is based on the flowering period of environmental weeds but only until the environmental weed has been successfully eradicated.

APPENDIX 11. Assessment of Current Apiary Sites within the Planning Area

Apiary sites within the planning area were assessed against the environmental and management criteria and categorised as suitable, suitable but conditional or highly constrained. The table below shows the result of the assessment and indicates what criteria require additional conditions. Some of these additional conditions have been included as guidance but should be seen as a minimum set.

Apiary Site No.	Environmental Criteria Assessment								Management Criteria Assessment					Conditions
	Rare & Priority 1, 2 Flora Visited			Other Cons. Flora Visited	TEC			Fauna Habitat	Rec. Sites	Class 1 or 2 Walk Trail	Disease Risk	Weed Management		
	Impact Year Round	Impact Seasonal	No Predicted Impact		Impact Year Round	Impact Seasonal	No Predicted Impact					Impact Seasonal	Impact Year-round	
Suitable (1)														
4837														
Suitable but Conditional (7)														
891		X					X		X					A (Jan, Aug-Nov)
2637		X				X	X					X		A (Jan, Aug-Nov), B (Jan, Mar-Dec), F (Aug-Jan)
2677							X					X		F (Aug-Dec)
3131		X												A (Dec-Feb)
3626												X		F (Jul-Dec)
4919												X		F (Aug-Dec)
5594							X					X		F (Aug-Dec)
Highly Constrained (3)														
564									X			X		F (Aug-Dec), near a recreational site
890							X						X	F (Jan-Dec)
4403		X		X		X	X						X	A (May-Sep, Nov-Dec, Feb), B (Jan, Mar-Dec), C, F (Jan-Dec)
Sites within 2 km of Planning Area* (5)														
166#		X										X	X	A (Jan-Dec), F (Jan-Dec)
189#														
190#												X		F (Mar-Dec)
2229		X					X					X		A (Aug-Nov), B, F (Jul-Jan)
5271												X		F (Jul-Dec)

* Sites located within a 2 km radius of the planning area may be subject to an additional assessment. This assessment reflects data obtained specifically for the planning area.

Sites not to be re-issued.