AUSTRALIAN CAPITAL TERRITORY

LAND (PLANNING AND ENVIRONMENT) ACT 1991

APPROVAL OF PLAN OF MANAGEMENT

JERRABOMBERRA WETLANDS NATURE RESERVE

No. 117 of 1994

Pursuant to paragraph 204(a) of the *Land (Planning and Environment) Act 1991* I **APPROVE** the Plan of Management for Jerrabomberra Wetlands Nature Reserve as set out in Attachment A of this instrument.

B.L.Wood

Bill Wood
Minister for the Environment,
Land and Planning

Dated this 2 day of Aug 1994

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MINISTERIAL FOREWORD

This management plan has been prepared by the ACT Parks and Conservation Service, and describes how Jerrabomberra Wetlands Nature Reserve is to be managed to enhance its conservation, educational and recreational values.

The Wetlands are a significant landscape component of our city, and contain habitat of international importance in the conservation of migratory species of waterbirds. Regionally the Wetlands are important in providing food, shelter and breeding sites for many of the species of waterbirds that frequent the Southern Highlands. The Service will continue to maintain and enhance the conservation values of the Wetlands, so they may be enjoyed and appreciated by the people of the ACT and its visitors.

Situated at the eastern end of Lake Burley Griffin, the Wetlands are close to the urban and business centres of Canberra and have enormous potential as an educational, recreational and tourist resource. Unfortunately in the past, wetlands were commonly viewed as wasteland rather than as the rich and varied ecosystems we now know them to be. Many of Australia's wetlands have disappeared or are under threat. At Jerrabomberra Wetlands, the ACT has a great opportunity to promote wetlands as a valuable and necessary part of our natural heritage.

The preparation of this management plan has involved extensive community consultation. Where possible the Service has incorporated the comments it received in this process into the management framework for Jerrabomberra Wetlands. The resulting plan therefore reflects broader community aspirations for the nature reserve.

In accordance with the provisions of section 204 of the *Land (Planning and Environment) Act 1991* I hereby approve this Plan of Management for Jerrabomberra Wetlands Nature Reserve.

Bill Wood
Minister for the Environment, Land and Planning

2 August 1994

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Jerrabomberra Wetlands Nature Reserve

Plan of Management

ACT Parks and Conservation Service

Authorised by the parliamentary counsel and printed by authority of the ACT Government

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PREFACE

Statutory Processes

Jerrabomberra Wetlands Nature Reserve was gazetted as a reserved area under Section 51 of the *Nature Conservation Act 1980* on 19 September 1990. A previous plan of management was prepared and released for public comment in accordance with the provisions (now repealed) of that Act.

This current plan satisfies requirements of the *Land (Planning and Environment) Act 1991* (Subdivision D of Division 5) for the preparation of plans of management for land identified as Public Land in the Territory Plan.

Jerrabomberra Wetlands is specified as a Designated Area in the National Capital Plan (NCPA 1990). As such, the National Capital Planning Authority (NCPA) retains planning and development control over the area. This current Plan of Management was endorsed by the National Capital Planning Authority on 17 January 1994.

Community Consultation

A draft management plan for Jerrabomberra Wetlands was released for community comment in December 1988. Subsequently, self-government was introduced to the ACT and the administrative and legislative environment for the management of lands changed significantly. A second draft management plan for Jerrabomberra Wetlands Nature Reserve was released in November 1991. This Plan of Management has been reviewed in the light of comment received on those drafts.

Responsible Agency

This plan was prepared by the ACT Parks and Conservation Service (ACTPCS), which is part of the Department of the Environment, Land and Planning. Jerrabomberra Wetlands Nature reserve is managed as part of Canberra Nature Park, one of five parks managed by the ACTPCS.

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SUMMARY

Jerrabomberra Wetlands lie at the eastern end of Lake Burley Griffin within the city of Canberra (Map 1). It has high conservation values and great potential as a resource for education and tourism. These characteristics have been recognised by the ACT Government, and Jerrabomberra Wetlands Nature Reserve is classed as Public Land (Nature Reserve) in the Territory Plan.

This management plan for the Jerrabomberra Wetlands Nature Reserve provides for the management of an area classed as Public Land (Nature Reserve) in the Territory Plan (Map 2) and adjacent lands, and their development and management as a wetlands education centre. In so doing the plan fulfils the Services obligations under the Land (Planning and Environment) Act1991 to prepare a management plan for any area classed as Public Land (Nature Reserve).

The plan:

* recognises and protects the high conservation value of Jerrabomberra Wetlands, including its status as one of the most important areas of wetland habitat in the ACT, and its role in the conservation of Latham's snipe, a migratory wader subject to treaties between Australia and both Japan and China;

* provides guidelines for the provision of public facilities including a visitor centre, pedestrian and cycle paths, bird observation hides and facilities for study and education about aspects of wetlands ecology and management;

* establishes a Refuge Area to protect Latham's snipe, and other sensitive species, from human disturbance;

* retains a significant area for cattle grazing to maintain the open rural character of Dairy Flat; and

* incorporates planning and land-use objectives for Jerrabomberra Wetlands as a significant landscape component of the National Capital.

As a number of urban utilities cross the reserved area, provisions for access and maintenance are addressed in this plan to ensure that restrictive provisions of the *Nature Conservation Act 1980* do not impinge unreasonably upon the needs of other authorities (see section 3.10).

Map 7 provides a visual summary of the main management proposals.

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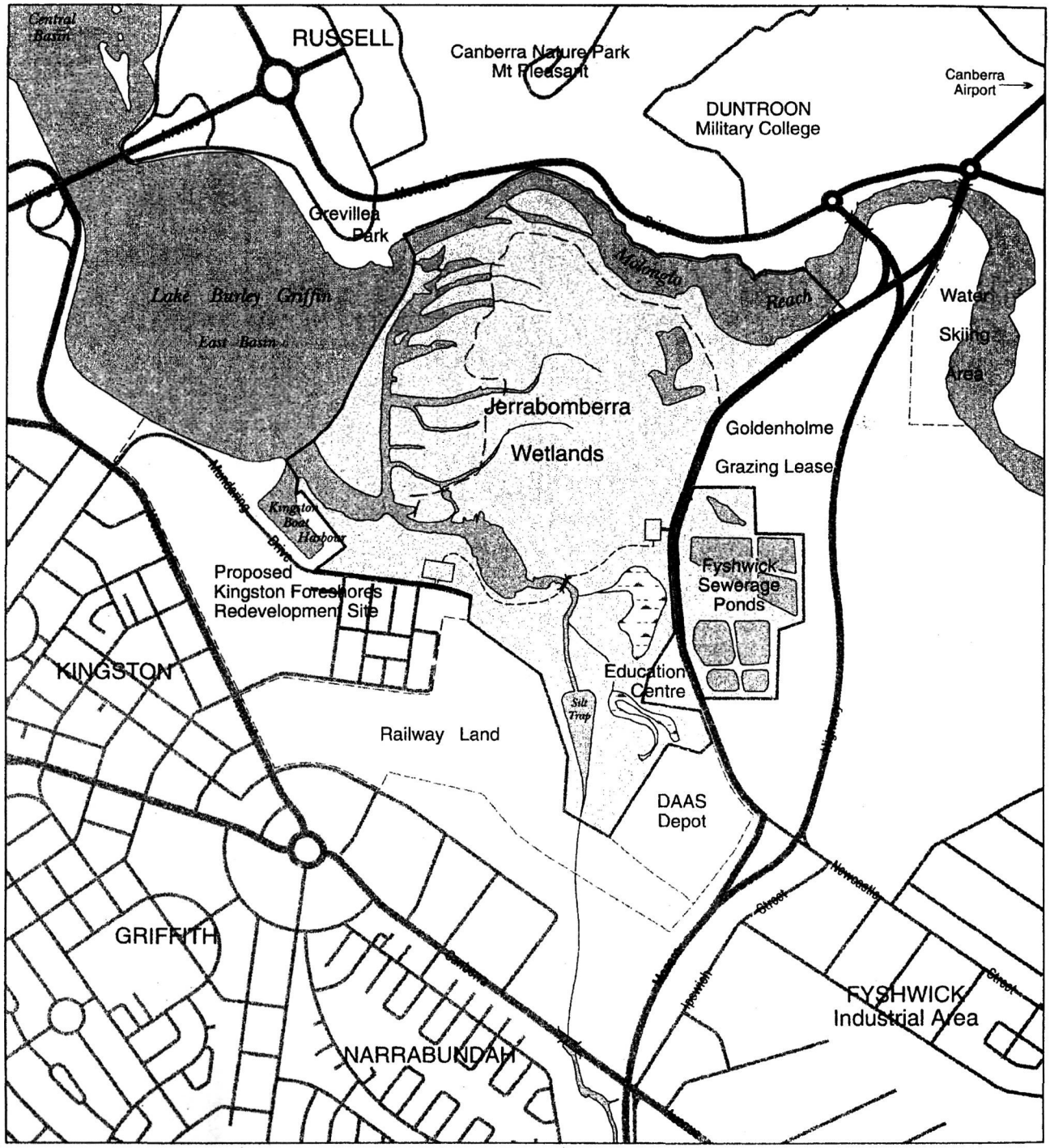
MAP 1 - Jerrabomberra Wetlands location and surrounding land uses



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1. INTRODUCTION

1.1 THE PURPOSE OF THE MANAGEMENT PLAN

Jerrabomberra Wetlands is shown at Map 1. The purpose of this document is to provide management guidelines for the area generally, and to satisfy statutory requirements for the preparation of a management plan for the Jerrabomberra Wetlands Nature Reserve.

Management planning is primarily concerned with identifying methods to avoid and minimise conflicting activities and practices, and to ensure management conditions are kept to specified guidelines. This plan concentrates on management systems and policies. More detailed management prescriptions will be covered in action plans on themes such as management of education programs and interpretation (Table 1).

Community participation is an essential part of the process and has been achieved primarily through the release of this plan as a draft for public comment in 1988 and 1991. The plan has been reviewed in the light of comment received.

During preparation of the plan the Service also sought the advice of the ACT Parks and Conservation Consultative Committee (now the ACT Environment and Conservation Consultative Committee).

A sub-committee of the Consultative Committee, the Jerrabomberra Advisory Group, provided detailed input throughout the preparation of the plan.

The Jerrabomberra Advisory Group was chaired by a member of the Consultative Committee, Ken Shepherd, from the Australian National University Department of Forestry. The following organisations and groups were represented:

* ACT Schools Authority
* Australian National University - Faculty of Science
* Birrigai Recreation Centre (ACT Schools Authority)
* Canberra Ornithologists Group Inc.
* Commonwealth Scientific and Industrial Research Organisation: Division of Wildlife and Ecology
* Conservation Council of Canberra and the South East Region
* Dairy Flat Education Centre (ACT Schools Authority)
* Murray's Australia (ACT based bus company)
* the former National Capital Development Commission

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1.2 SIGNIFICANCE AND VALUE OF JERRABOMBERRA WETLANDS

Jerrabomberra Wetlands is described in *The Ecological Resources of the ACT* (NCDC 1984) as "one of the most valuable wetland habitat areas in the ACT, increasing the biological diversity of Lake Burley Griffin and Canberra City." Jerrabomberra Wetlands provides a series of wetland habitats which support a rich and diverse bird fauna, including most of the wetland species occurring in southern Australia (Appendix 1). Many terrestrial bird species also occur there as well as numbers of platypus and water rats and other wildlife including invertebrates, amphibians, reptiles and fish.

The wetlands provide a variety of habitats which are interrelated and which as a whole account for the abundance and diversity of waterbirds and other wildlife occurring there. For example, birds which roost in one part of the wetlands often feed in another and without both areas these species would not be present. The Fyshwick Sewage Treatment Ponds are an adjunct to the wetland system in that they provide feeding and refuge areas for a number of bird species which would otherwise occur only rarely in the area. However, the ponds are not part of the Jerrabomberra Wetlands Designated Area under the National Capital Plan (see section 2.2).

Parts of Jerrabomberra Wetlands are used as a stopover by migratory waders, including species which are the subject of agreements between Australia and both Japan and China. The agreements encourage the signatory nations to protect the habitats of species listed, as well as to conserve the bird species themselves. A number of these species have been observed at Jerrabomberra Wetlands. One of them, Latham's snipe, is a regular visitor in spring and summer.

The importance of Jerrabomberra Wetlands as waterbird habitat is explained in more detail in section 3.2.1.

Most of Jerrabomberra Wetlands is part of the Dairy Flat flood plain of the Molonglo River. Traces of former river channels and levee banks are visible on the surface of the flood plain. Rosengren (1985) identified a sequential pattern in eight groups of ancient channels. Such features are uncommon in the ACT (section 3.9) and may be a useful educational and interpretative resource.

The fertile flood plain, and the river which formed it, have probably been used intensively by humans for tens of thousands of years. Accounts by early European settlers and an abundance of stone tools indicate its importance to the local Aboriginal people (section 3.8). European settlers were quick to take advantage of its well watered grasslands and continue to graze cattle on it (section 3.2.3).

Much of Jerrabomberra Wetlands is artificial in origin. The waterbodies are essentially parts of Lake Burley Griffin. The introduced grasses are the result of a formerly irrigated dairy and the trees are introduced species; some are part of the city landscaping. There is considerable potential for further modification of the area to increase the number of Australian native species and to increase the value of the area as a resource for the people of Canberra.

Jerrabomberra Wetlands is part of the national capital - a city of over 290,000 people. Its position confers enormous potential for the development of a centre for environmental education, particularly in relation to wetlands, to allow students, local people and tourists to enjoy and learn about wetlands and their ecology and thereby contribute to the conservation of wetlands generally.

The values and significance of Jerrabomberra Wetlands are such that in addition to its reservation under the *Nature Conservation Act* and its inclusion in the ACT's Interim Heritage Places Register, it is believed also to warrant listing in the Register of the National Estate. The Service will review this proposal following preparation of a register of conservation values (further discussed at section 3.2.3).

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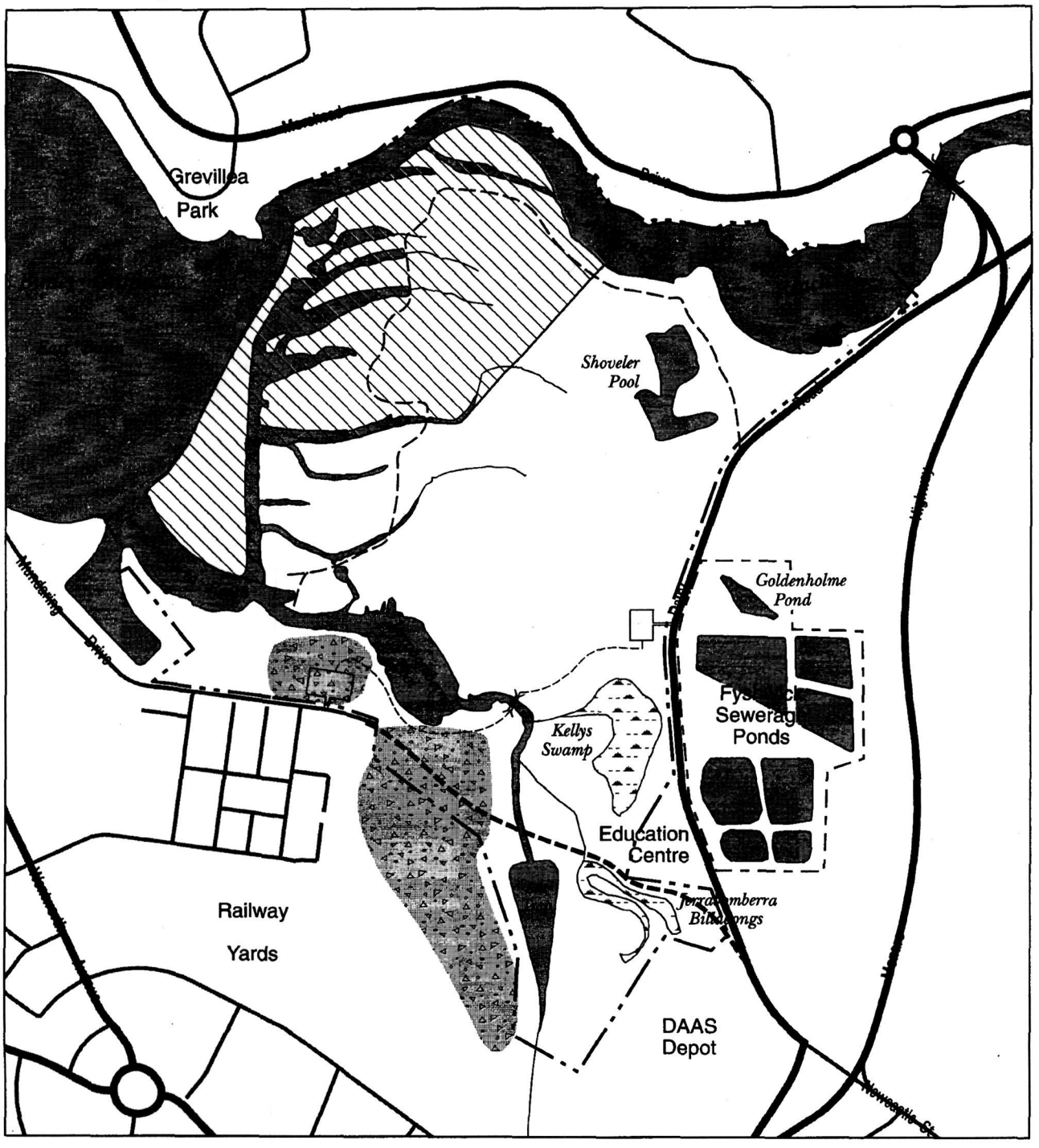
MAP 2 - Principal land units and place names



Cormorant breeding site

Indicative alignment for Newcastle Street extension

Service road to powerlines

Landfill area

Refuge area

Jerrabomberra Wetlands Nature Reserve

Additional area to be managed under seperate arrangements with ACTEW

0 100 200 300 400
Metres

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2. PLANNING AND MANAGEMENT CONTEXT

2.1 NATIONAL, INTERNATIONAL AND REGIONAL CONTEXT

Jerrabomberra Wetlands is one of the most important wetland areas in the ACT (sections 3.2.1 and 1.2). It also provides a safe refuge for the waterbirds of Lake Burley Griffin and provides breeding opportunities for some species.

Jerrabomberra Wetlands is also important regionally. During extended dry periods when the principal lakes of the region, Lake Bathurst and Lake George, dry up, Lake Burley Griffin and to a lesser extent Lake Ginninderra provide the only suitable wetland habitat (map 3). At these times the numbers of some species such as pelicans, cormorants and coots increase many times over.

Nationally and internationally Jerrabomberra Wetlands is important because it is used by several species which migrate to Australia during the northern hemisphere's winter. Of particular importance in this regard is Latham's snipe which is subject to agreements between Australia and both Japan and China. These agreements, respectively known as the Japanese and Australian Migratory Bird Agreement (JAMBA) and the Chinese and Australian Migratory Bird Agreement (CAMBA), provide for the reciprocal protection of migratory species and their habitat. The ACT's participation in these agreements is provided for in section 3.2.3. However, Jerrabomberra Wetlands does not meet the criteria for inclusion on the Convention on Wetlands of International Importance.

The major significance of Jerrabomberra Wetlands Nature Reserve is the potential for it to be developed and managed as an environmental education centre with an emphasis on wetlands ecology. It is within a region of over 300,000 people which includes a range of educational and research institutions and is within the precincts of the national capital elements of Canberra including the Parliament House, the War Memorial and the National Gallery. The Nature Reserve can be used to contribute significantly to the conservation of wetlands generally through education, while its location gives it the potential to contribute to tourism and the economy of the region.

Relationship to other parks and reserves

Canberra Nature Park is the name given to a system of twenty-two urban and peri-urban nature reserves. Jerrabomberra Wetlands Nature Reserve is managed as one of the units of Canberra Nature Park. Mt Pleasant, the nearest other unit, is only a few hundred metres away.

Aspects of Jerrabomberra Wetlands Nature Reserve common to other units of Canberra Nature Park include its emphasis on nature conservation, its urban location, the pressures on it, the relationship it has to the national elements of Canberra, and the extent to which its resources have been modified by a century of management alien to the present purpose.

Jerrabomberra Wetlands Nature Reserve is an important focal point of Canberra Nature Park. Its location also provides a prime opportunity to illustrate the role of the Service in environmental management in the ACT.

Jerrabomberra Wetlands Nature Reserve also has something in common with Tidbinbilla Nature Reserve. The emphasis on the role of education in the protection of wildlife is common to both, and in recent years the waterbird area at Tidbinbilla has become one of its most popular wildlife displays as well as its most time consuming management commitment.

This plan leaves open the possibility of a display of captive waterbirds (section 3.2.3) and if that eventuates the waterbird breeding facilities and expertise developed at Tidbinbilla Nature Reserve will become an essential resource for Jerrabomberra Wetlands Nature Reserve.

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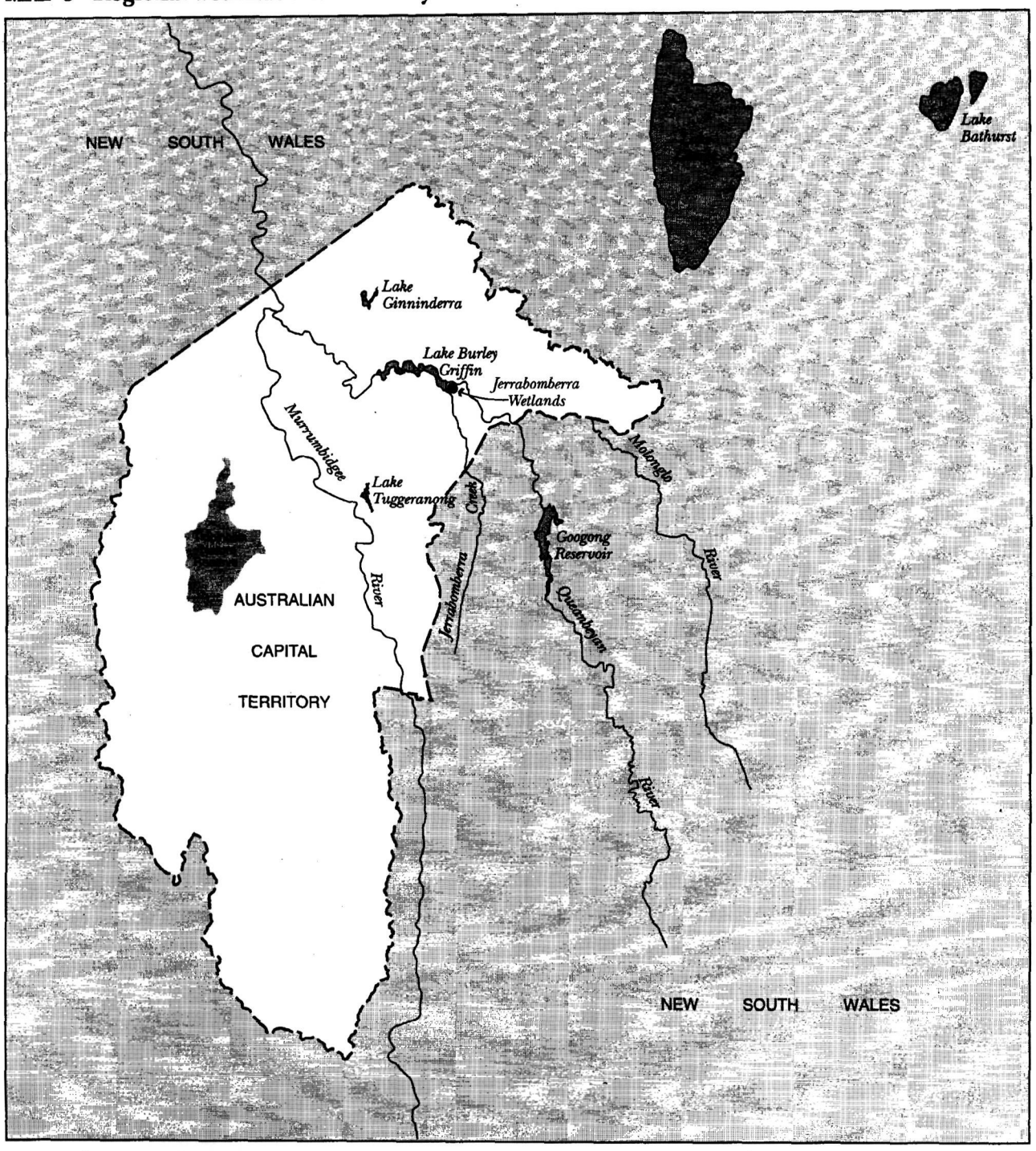
MAP 3 - Regional wetlands and waterways



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National Capital Open Space System

The significance of the natural setting of the National Capital, which originated in Walter Burley Griffin's Plan, has been recognised in the form of the National Capital Open Space System (NCOSS). NCOSS is a land-use planning concept which covers the inner hills and ridges that surround and frame the urban areas, the major lakes and river corridors, and the distant mountains and bushlands south-west of Canberra. NCOSS protects the landscape setting of the National Capital by preserving the mountain and bushland scenery, protecting the environmental quality of the water catchments, river systems, and important ecological resources of the ACT and provides for the long-term recreational needs of residents and visitors.

While each area in NCOSS has its own use and special character, they are all interrelated as a total landscape open space system. Consequently, what is done in one area has an effect on other areas. This requires open space to be planned, used and managed as an integrated system. Jerrabomberra Wetlands is included in NCOSS by virtue of its location as part of the foreshores of Lake Burley Griffin and because of its important nature conservation values.

2.2 PLANNING AND MANAGEMENT OF LAND IN THE A.C.T.

Prior to the introduction of self-government to the ACT, responsibility for determining land use policies, planning and development throughout the ACT was exercised in consultation with the (then) ACT Administration by the (then) National Capital Development Commission (NCDC).

A Policy Plan and Implementation Plan for Jerrabomberra Wetlands was published in December 1988. The plans relate closely to the Lake Burley Griffin Policy Plan and confirm the value of Jerrabomberra Wetlands as an important component of the National Capital with significant conservation and education resources.

National Capital Plan

With the introduction of self-government to the ACT in 1989, the NCDC was abolished. A new Commonwealth planning body for the ACT, the National Capital Planning Authority (NCPA) was established. The NCPA carries out functions under the *Australian Capital Territory (Planning and Land Management) Act 1988* which amongst other things provides for the preparation of a National Capital Plan. The object of this plan is:

> to ensure that Canberra and the Territory are planned and developed in accordance with their national significance.

In relation to NCOSS, the National Capital Plan (NCPA 1990) seeks to ensure the blending of city and country in a way that symbolises the character of the National Capital and provides a balanced range of uses which reinforce the natural, cultural, scenic and recreational values of the ACT. It includes a number of policies applying generally to NCOSS and specifically to Lake Burley Griffin and Jerrabomberra Wetlands. In particular the National Capital Plan states:

> Jerrabomberra Wetlands will be protected as a wildlife refuge in a National Capital and urban context, with facilities designed to realise the area's potential as a significant conservation and education resource for Canberra residents, tourists and international visitors.

The intent of this and other NCOSS policies in the National Capital Plan are reflected in the objectives and strategies of the Jerrabomberra Wetlands Management Plan.

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The National Capital Plan came into effect on 21 December 1990. It defines the planning principles, policies and standards for giving effect to the Plan, and sets out the general land use policies for the Territory. In Designated Areas, which have the special characteristics of the National Capital, the Plan may set out detailed conditions of planning, design and development. Jerrabomberra Wetlands is specified as a Designated Area.

The implications for management of Jerrabomberra Wetlands as a Designated Area are that the NCPA must approve any plans or works relating to the area as being consistent with the National Capital Plan. This may extend to the NCPA commissioning works in the area on behalf of the Commonwealth. The *Australian Capital Territory (Planning and Land Management) Act 1988* requires that:

> the Commonwealth, a Commonwealth authority, the Territory or a Territory authority shall not do any act that is inconsistent with the Plan.

There was close consultation between the Service, the (former) NCDC and the NCPA during preparation of both the Jerrabomberra Wetlands Policy Plan and Jerrabomberra Wetlands Nature Reserve Plan of Management, which complement each other.

The Jerrabomberra Wetlands Management Plan has been drafted in a manner consistent with the National Capital Plan which effectively continues the previous land use and development polices contained in the (former) NCDC Policy Plans for Lake Burley Griffin and the Jerrabomberra Wetlands. Endorsement of this plan by the NCPA provides the basis on which the Service can proceed to undertake management activities and other works.

The NCPA endorsed the Plan of Management for Jerrabomberra Wetlands Nature Reserve on 17 January 1994.

The NCPA is currently preparing a management plan for Lake Burley Griffin, which is National Land and a Designated Area in the National Capital Plan. This management plan will give attention to the relationship between the wetlands and the lake.

Table 1 identifies the relationship between plans prepared by the NCPA and plans prepared by the Service for Jerrabomberra Wetlands Nature Reserve as a Designated Area.

Table 1 Functions of planning documents for Jerrabomberra Wetlands

Document	Functions
Land use (NCPA) **National Capital Plan**	. defines land use policies . defines planning principles & policies for giving effect to the National Capital Plan . sets out general land use policies throughout the Territory . sets out detailed conditions of planning, design & development in Designated Areas
Management (the Service) **Management Plan**	. defines management objectives & policies . establishes management procedures, standards & performance criteria . outlines management priorities . provides a basis for NCPA authorisation of works in a Designated Area

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Action or Precinct Plan (eg fire, soil conservation, interpretation, site & precinct management)	. defines detailed management prescriptions & priorities . defines a timetable & budget for specific works & operations . defines detailed programs of operations &/or maintenance

2.3 HISTORY OF PLANNING AND MANAGEMENT

The area now known as Jerrabomberra Wetlands Nature Reserve has been used for agriculture (mainly cropping and dairying) for over a century. Early maps named it the "Thistle Paddock".

Today there are still remnants of infrastructure that was built soon after Canberra was selected as the site for the nation's capital. Walter Burley Griffin, the original architect of Canberra, had a railway built across the Molonglo River near what is now the western end of Jerrabomberra Wetlands. Stumps on the north bank of Molonglo Reach may be the remains of the bridge which was demolished by a flood, thereby ending the short life of the railway line. Griffin also planned a causeway across the flood plain at this point, to create a secondary lake upstream of the main one, but this plan was never fulfilled.

In 1964, Jerrabomberra Wetlands were formed by the damming of the Molonglo River to create of Lake Burley Griffin, which resulted in the expansion of existing natural wetland areas. As local awareness of the values of wetlands increased, especially as a result of growing concern at the destruction of such areas in other parts of Australia, greater interest was shown in Jerrabomberra Wetlands.

In 1977 an ecological study group was established to advise on protection and development of the area. It consisted of representatives from the Department of Territories, National Capital Development Commission, Canberra Ornithologists Group, CSIRO Wildlife and Rangelands Research and the Department of Transport (Aviation). This group reported its findings in 1982.

The importance of the Wetlands as an ecological resource located near the heart of the nation's capital was emphasised by Professor George Seddon in his report on an open space system for Canberra (1977), the ACT Legislative Assembly in a report from its Standing Committee on City Management (1978) and also in *The Ecological Resources of the ACT* (NCDC 1984).

During the 1970's and 1980's the natural and recreational values of Jerrabomberra Wetlands were threatened by several planning proposals including those for major arterial roads, sand and gravel mining, onshore facilities for sand and gravel extraction from East Basin and a cycle path through Jerrabomberra Backwaters.

A range of urban service facilities have also been located in the area. Power lines have resulted in reduced landscape values and a hazard to flying birds. Sewerage rising mains from the Fyshwick Sewage Treatment Works and the Googong bulk supply water main traverse the area. These services have access and maintenance requirements which impose management constraints upon the ACTPCS. These are discussed further at 3.10.

The Jerrabomberra Advisory Group was established in 1986 as an expert sub-committee of the ACT Parks and Conservation Consultative Committee. Its purpose was to review the conservation values of Jerrabomberra Wetlands and determine their management requirements. The group met eight times and this management plan reflects its deliberations.

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The first draft management plan for Jerrabomberra Wetlands was released in December 1988. However, due to the legislative changes that occurred as a result of the ACT achieving self-government in March 1989, the plan had to be revised and a second draft was released in November 1991. Two important reasons that necessitated the preparation of this second draft were that in 1990 Jerrabomberra Wetlands was included as a Designated Area in the National Capital Plan, and was also gazetted as a Nature Reserve under the provisions of the *Nature Conservation Act 1980* (NCA).

In October 1993 the Territory Plan was adopted, defining the area of Jerrabomberra Wetlands Nature Reserve as Public Land (Nature Reserve). The area defined includes additional areas to that gazetted under the NCA.

Map 2 shows the reserved area and the associated lands referred to in this plan.

2.4 STATUTORY RESPONSIBILITIES

The *Land (Planning and Environment) Act 1991* is the instrument under which Jerrabomberra Wetlands Nature Reserve is reserved, and it prescribes the management objectives and the management planning process. Management authority for areas reserved as Public Land (Nature Reserve) under the *Land Act* is vested in the Conservator of Wildlife and the ACT Parks and Conservation Service.

In its management of Jerrabomberra Wetlands the Service is required to meet or enforce the provisions of the following legislation:

Commonwealth Legislation

* *Australian Heritage Commission Act 1975*
* *Environment Protection (Impact of Proposals) Act 1974*
* *Australian Capital Territory (Planning and Land Management) Act 1988*
* *Lakes Ordinance 1976*

ACT Legislation

* *Air Pollution Act 1984* and Regulations
* *ACT Bushfire Act 1936* and Regulations
* *Dog Control Act 1975*
* *Fishing Act 1967*
* *Heritage Objects Act 1991*
* *Interim Planning Act 1990*
* *Lakes Act 1976*
* *Land (Planning and Environment) Act 1991*
* *Litter Act 1977*
* *Motor Traffic Act 1936*
* *Nature Conservation Act 1980* and Regulations
* *Noxious Weeds Act 1921*
* *Pesticides Act 1989*
* *Pounds Act 1928*
* *Protection of Lands Act 1937*
* *Public Baths and Public Bathing Act 1956*
* *Public Parks Act 1928* and Regulations
* *Rabbit Destruction Act 1919* and Regulations
* *Roads and Public Places Act 1937* and Regulations
* *Soil Conservation Act 1960*
* *Stock Act 1991*
* *Stock Diseases Act 1933*
* *Trespass on Territory Lands Act 1932*
* *Water Pollution Act 1984* and Regulations

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* *Weapons Act 1991*

2.5 LAND USE AND DEVELOPMENT PROPOSALS IN AND AROUND JERRABOMBERRA WETLANDS

Flooding

Jerrabomberra Wetlands is part of the Dairy Flat flood plain of the Molonglo River and most of it lies below the 1 in 100 year flood level, the accepted limit for building construction in Canberra (Map 6). Susceptibility to flooding is one reason that this prime land near the centre of Canberra has not been built upon.

Powerlines which cross Jerrabomberra Wetlands have mounds around the poles to protect them from flooding. Structures such as these or tree plantations influence flood drainage and have the potential to redirect flows and change the 1 in 100 year flood level.

Land on the southern and south western side of Jerrabomberra Wetlands is generally above the 1 in 100 year flood level, including areas near Kelly's Swamp, the Dairy Flat Education Centre, Fyshwick Sewage Treatment Ponds and lands on the south west bank of Jerrabomberra Creek. Map 2 identifies these places.

It is on these more elevated areas that the major Nature Reserve developments discussed in this plan would be located. Some of the other developments proposed would necessarily be partly below the 1 in 100 year flood level, including pedestrian access paths, bird observation hides and footbridges.

Kingston foreshores development

To the south-west of Jerrabomberra Wetlands is the Kingston Boat Harbour. The area around the boat harbour (Map 1) bounded by Wentworth Avenue and Cunningham Street has been identified as one of four "development nodes" around Lake Burley Griffin identified in the National Capital Plan (NCPA 1990). Part of the area is declared National Land and as such is under Commonwealth control.

Depending on planning outcomes, the Refuge Area of Jerrabomberra Wetlands could share a common boundary with possible redevelopment in the Kingston foreshores area. The Refuge Area is discussed at section 3.2.3 and will provide maximum protection to the most sensitive part of the Nature Reserve.

Careful design will be necessary to ensure the Refuge Area is afforded adequate protection. There is also potential for complementary development with resultant benefits for the whole area.

East Basin

To the west of Jerrabomberra Wetlands is the East Basin of Lake Burley Griffin. This large area of shallow open water acts as an alternative to more popular parts of the Lake for some watersports, particularly sailboarding, which continues to increase in popularity in this area. On peak days this area receives over 300 visitors (NCDC 1988b).

The Commonwealth's *Lakes Ordinance 1976* prohibits the use of power boats on the Lake without authorisation. In recent years it has been the practice to issue permits for use of power boats on specific areas including East Basin on a few occasions each year. Conditions can be placed on such permits and this affords a means of controlling any potentially harmful impact on the Nature Reserve. Water skiing on the Lake is administered on behalf of the Commonwealth by the ACT Government Service.

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Cruise boats cross East Basin on their way to and from Kingston Boat Harbour and Molonglo Reach. These tours provide an introduction for many people to the values of Jerrabomberra Wetlands.

Water-skiing

Upstream of Jerrabomberra Wetlands, Molonglo Reach is used for water-skiing, subject to the conditions of the *Lakes Act 1976* (ACT), and provides an opportunity for international standard competitive events. In 1985 an average of 85 cars were parked there on Sunday afternoons (NCDC 1988b). Following the completion of the final stage of the Eastern Parkway, access to the water-skiing area will continue to be via Dairy Road with a pass under the Parkway on the south bank of Molonglo Reach.

Goldenholme lease

Land to the east of Jerrabomberra Wetlands Nature Reserve (across Dairy Road) is also part of the Dairy Flat flood plain. Much of it is occupied by the Goldenholme lease, the last dairy in the ACT. The planning policy for this area is to retain its intensive agricultural landscape character.

Canberra Airport

Three kilometres to the east of Jerrabomberra Wetlands is Canberra Airport which is used by commercial, private and military aircraft. Its location is of considerable significance to the management of the Nature Reserve because it restricts activities or developments likely to encourage birds considered hazardous to aircraft (section 3.2.3).

Dairy Flat Education Centre

The former Kelly's Farm is managed by the ACT Department of Education and Training as an education centre which provides specialist education opportunities for visiting students from ACT schools. A cooperative relationship is developing between the managers of Jerrabomberra Wetlands Nature Reserve and the Department of Education - a potentially valuable benefit to both authorities.

Eastern Parkway, Dairy Road and Mundaring Drive

Construction of the Eastern Parkway (Monaro Highway extension) commenced in 1987 (Map 2). The first stage linked the Monaro Highway to Newcastle Street at Fyshwick. Stage 2 linked Newcastle Street to Morshead Drive. Eventually it will provide in combination with other roads, a link between Gungahlin, the city and Tuggeranong.

The Eastern Parkway passes to the east of the Fyshwick Sewage Treatment Ponds. Ultimately it is intended to construct a dual carriageway on this alignment, which will result in Dairy Road becoming a cul-de-sac accessible from the south. The now completed first stage of construction comprises only one new carriageway and Dairy Road operates in place of the other.

This construction program has important implications for the planning of access and the provision of visitor facilities at Jerrabomberra Wetlands Nature Reserve. The main implication is that when the Eastern Parkway is completed, Mundaring Drive rather than Dairy Road will become the main public access route to the Reserve. However, it is anticipated that Dairy Road will continue to serve as a main thoroughfare for the next five years. When design work commences for the major facilities proposed in this plan, an assessment of access will be made using the best available information at the time.

Mundaring Drive/Newcastle Street extension

The city plan shows a gazetted road easement from the eastern end of Mundaring Drive running in a south easterly direction to Dairy Road/Newcastle Street, near the Dairy Flat Education Centre.

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The National Capital Plan (NCPA 1990), in its conditions for Jerrabomberra Wetlands, proposes that a new reservation for the possible extension of Newcastle Street to Mundaring Drive be identified south of the existing gazetted route.

The outcome of plans for the Mundaring Drive/Newcastle Street extension is of considerable interest to the managers of Jerrabomberra Wetlands Nature Reserve, not only for its effect on access to the Reserve but also because the area concerned has significant conservation values.

In addition, the resolution of the Mundaring Drive/Newcastle Street alignment has implications for several urban infrastructure services; see below (Service Easements).

Morshead Drive duplication

Duplication of Morshead Drive adjacent to the northern boundary of Jerrabomberra Wetlands Nature Reserve is programmed. Engineering requirements for this, and the proposed Lake Burley Griffin cycle path which follows a similar alignment, may have implications for the northern boundary of the Reserve.

Service easements

An additional 132 kV powerline linking the Causeway to Gilmore was completed in 1990 (Map 6). Its alignment borders the southern boundary of the Nature Reserve to the south of Mundaring Drive. Additional lines along the same corridor including possible relocation of other existing power lines are planned (section 3.10).

A new sewerage rising main, from the existing pumping station at the northernmost pond of Fyshwick Treatment Works, is proposed to run southeast along Dairy Road, thence following the proposed Mundaring Drive/Newcastle Street corridor to the Causeway. Part of the existing rising main that runs under the Jerrabomberra Wetlands will be relocated to share the same easement (Map 6).

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3. MANAGEMENT STRATEGIES AND PROGRAMS

3.1 MANAGEMENT PHILOSOPHY AND OBJECTIVES

3.1.1 Management philosophy for Jerrabomberra Wetlands Nature Reserve

The ACT Parks and Conservation Service places a high priority on the protection of Jerrabomberra Wetlands, in particular because they provide opportunities for people to appreciate wetlands and learn about the ecological processes taking place in them. The Service believes that realisation of the opportunities requires not only protection, but also enhancement of habitats, as well as development of aids for education and recreation.

The management philosophy for Jerrabomberra Wetlands recognises its partly artificial origin, its nature conservation value, and the advantages conferred by its location, especially its potential for development for both local people and tourists as a centre for environmental education with an emphasis on wetlands ecology and processes.

3.1.2 Objectives

The identification of appropriate objectives is an essential step in developing management programs. Objectives are derived from the management philosophy, planning opportunities and constraints, the particular characteristics of the site, and internationally accepted standards for management of nature reserves.

This section sets out the management objectives for the Jerrabomberra Wetlands Nature Reserve. The priority to be placed on different objectives varies between different parts of the Reserve, from season to season, and from one management program to another. Additional objectives specific to particular management programs are listed in the corresponding sections of the plan.

Some of the objectives are in conflict with others. For example it is not always possible to protect natural processes and provide opportunities for use at the same site. In choosing a balance between conflicting objectives, the Service will have regard to the management philosophy and to the full range of objectives and procedures expressed within this plan.

The primary objectives of management for Jerrabomberra Wetlands Nature Reserve are to:

* conserve native wildlife and enhance habitat conditions;
* provide wetland environments which can be used for education and to develop appreciation and understanding of wetlands;
* contribute to the fulfilment of international agreements protecting migratory bird species;
* promote awareness, appreciation and understanding of natural systems and wetland resources generally, and Jerrabomberra Wetlands in particular, through education and interpretation;
* provide facilities and access for the community to a range of education and recreation opportunities;
* maintain and protect the distinctive rural and flood plain landscape of the wetlands as part of the diversity of landscapes of the Lake and its foreshores, and conserve any significant historic, geological or geomorphological sites;

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* avoid creating circumstances likely to compromise the safety of aircraft using Canberra Airport; and

* allow for the provision and maintenance of agreed urban infrastructure services.

Uses and actions proposed for the Nature Reserve will be assessed by the extent to which they assist the achievement of the objectives. In addition, proposed uses or actions would be assessed as to whether they:

* compromise nature reserve values;

* could reasonably be conducted elsewhere in the region;

* take account of the effects of likely flooding of the Dairy Flat flood plain, and the effect of the predicted 1 in 100 year flood for Canberra;

* compromise control over water quality, or over weeds or pest animals in Lake Burley Griffin and other surrounding areas.

3.2 MANAGEMENT OF HABITAT AND WILDLIFE

3.2.1 Introduction

This section of the plan is concerned with the management of the significant biological resources of Jerrabomberra Wetlands Nature Reserve, and with measures to enhance its biological value for nature conservation and in order to provide a resource for environmental education, particularly in relation to wetland values.

The wildlife (including flora) and wildlife habitats of Jerrabomberra Wetlands have been described in *Jerrabomberra Wetlands: An Ecological Basis for Planning and Development* (NCDC 1982) and their significance has been reported in *The Ecological Resources of the ACT* (NCDC 1984).

The main habitat value lies in the variety of aquatic and semi-aquatic habitats which in turn support a diverse biological community. A synopsis of the description of habitat types given in *Jerrabomberra Wetlands: An Ecological Basis for Planning and Development* (NCDC 1982) is provided in Table 2, with additions and modifications to account for changes since 1982.

Terrestrial habitats of Jerrabomberra Wetlands are dominated by grasslands. The original plant communities, probably meadow grasses (*Poa* and *Danthonia* species) and kangaroo grass (*Themeda triandra*) have been replaced over most of the area and the remaining areas have been strongly modified. The legacy of cropping and pasture improvement on fertile river terraces is an extensive, exotic pasture growth and proliferation of weed species.

Existing tree vegetation is mainly limited to semi-aquatic sites and consists of introduced deciduous species such as willows (*Salix* spp). These provide important protection for the banks of the Molonglo Reach and Jerrabomberra Creek and create habitats for a variety of wildlife, notably birds, aquatic mammals and fish. Australian native species planted in recent years on the landfill area south of Jerrabomberra Reach and near Kelly's Swamp will provide a significant contrast to existing vegetation when they mature, and may well result in additions to the already impressive list of bird species recorded in the area (Appendix 1).

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Table 2 Aquatic and semi-aquatic habitats of Jerrabomberra Wetlands

Habitat Type	Location (examples)	Characteristics
Open permanent water	Jerrabomberra Backwaters, Molonglo Reach	Production of aquatic invertebrates. Submerged logs etc. as fish (breeding) habitat. Used by fish-hunting birds including cormorants, darters, pelicans, herons, egrets; also surface feeders & diving birds.
Margins of open permanent water	Jerrabomberra Backwaters, Molonglo Reach	Emergent reeds provide refuge, shelter, nesting & feeding areas for some waterbirds, eg, swamp hens. Reed-free banks provide resting areas (see also below).
Reed Beds	Kelly's Swamp, Jerrabomberra Pool, Jerrabomberra Backwaters	Extensive reed beds are important to some elusive species, swamp hens, reed warblers & little grassbirds for security, shelter, nesting &/or feeding.
Marshlands	Abandoned meander channels, ephemeral pools or boggy areas on peninsula bordering East Basin	Variable extent & condition depending on lake level, rainfall, evaporation & intensity of grazing. Attract some of the more seasonal & obscure species such as waders (including Latham's snipe), ibis, & herons.
Wet grasslands	Abandoned meander channels, parts of Jerrabomberra Backwaters & peninsula bordering East Basin	Extent & condition vary as above but requirement for both short wet grasslands (for feeding) & long wet grasslands (feeding & cover) depends on grazing intensity. Used by snipe, ibis, herons, lapwings.
Drowned grasslands	Shoveler Pool, parts of Jerrabomberra Backwaters, any grassy area in flood conditions	Ephemeral, but when available one of the best habitats for waterbirds. Utilised by a wide variety including dabblers, filter feeders & large waders such as herons, ibis & spoonbills.
Mudflats	Jerrabomberra Billabongs, Kelly's Swamp, ephemeral pools	Restricted & temporary. Extent depends on management of water flows & lake levels. Attracts migratory waders & marshland species.

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Nutrient rich waters	Fyshwick Sewage Treatment Ponds	Attracts some waterbirds uncommon elsewhere on the wetlands. Used by filter feeders (pink-eared duck, Australasian shoveler) & divers (hardhead, grebes, blue-billed duck)
Sand or gravel beaches	Kelly's Swamp (very small area)	Used by small plover.
Short grassy banks	Mown or heavily grazed edges of waterbodies	May provide feeding areas for grazing ducks, principally maned ducks. Valuable as secure resting areas for dabbling ducks.
Emergent dead trees or logs	Kelly's Swamp (artificial) & old fence posts	Provides perching & resting areas, especially for herons, egrets & spoonbills.

In addition to the avifauna values of Jerrabomberra Wetlands, the aquatic and terrestrial habitats are of considerable value for the conservation of wildlife generally. There is potential for further enhancement with landscaped revegetation works already undertaken and the possibility of reintroducing native grasses to pasture areas.

The avifauna of Jerrabomberra Wetlands has been recorded by the Canberra Ornithologists Group Inc. (COG 1974 to 1988, COG 1987a, COG 1987b) and the Service . COG 1987a is based on data gathered as part of an ACT-wide survey and uses objective criteria to identify "key sites" and "important sites" for each species. Jerrabomberra Wetlands is a key site for fourteen species and an important site for an additional twelve species. This analysis gives it a much higher rating than any other area in the ACT.

The ornithological significance of Jerrabomberra Wetlands is not only site-specific. Birds move between Jerrabomberra Wetlands and other areas, and many of the birds seen on the Lake depend on Jerrabomberra Wetlands. In dry periods inland (especially when Lake George and Lake Bathurst are also dry) Jerrabomberra Wetlands may be used by birds from quite distant areas.

The movement of some species of birds to or from Jerrabomberra Wetlands poses a potential threat to aircraft using Canberra Airport, especially if movement is frequent or involves soaring. A number of species such as cormorants, pelicans and silver gulls often fly to heights where they could encounter aircraft approaching or leaving the airport.

The requirement to safeguard the lives of people using Canberra Airport overrides the desire to maximise the value of Jerrabomberra Wetlands as a significant waterbird area.

3.2.2 Objectives

The objectives relating to habitat and wildlife are as follows:

* to conserve native wildlife and enhance habitat conditions;

* to provide wetland environments which can be used for education and to promote appreciation and understanding of wetlands;

* to contribute to the fulfilment of Australia's international agreements protecting migratory bird species;

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* to avoid creating circumstances likely to compromise the safety of aircraft using Canberra Airport.

3.2.3 Management programs and activities

Protection and enhancement of significant habitat values

The Service will develop:

* a register of important attributes and conservation values of Jerrabomberra Wetlands, its wildlife and significant sites; and

* options for the enhancement of such attributes and values, and the creation of new desired attributes.

These will be based on the following criteria which will also be used to determine priorities for programs to manage or enhance natural values:

* whether the site / species / community has potential value for education or research;

* whether the site / species / community is subject to international treaty;

* whether the species or community is endangered, rare, restricted or near the limit of its range;

* whether the site / species occurrence / community is the only one of its type in the ACT, the most significant in the ACT, or one of a small number of such sites / occurrences / communities; and

* whether the site / community serves a crucial habitat role.

While there will tend to be an emphasis on aquatic species and birdlife, it is recognised that habitat management and enhancement requires an holistic view of the ecological integrity of the wetlands. The natural range of aquatic and terrestrial biota and ecological processes require conservation if target species are to be managed effectively. Management programs will be designed accordingly.

Works planned will be evaluated for possible adverse environmental effects. The appropriate level of assessment and documentation of the expected impact will be carried out. In particular, proposals must meet the requirement that the poisonous heavy metals derived from former mines at Captains Flat, and now trapped in sediments from the Molonglo River, must not be re-distributed by streamflow to uncontaminated areas including, presumably, the water of Jerrabomberra Creek and Jerrabomberra Backwaters. In some cases the expertise required to plan such works or evaluate such impacts will be obtained in part from outside the Service.

Potential enhancement of wetlands in relation to aircraft safety

The future of Jerrabomberra Wetlands would be radically different if Canberra Airport was located much further away. At first sight Jerrabomberra Wetlands is an ideal site for the creation of an excellent and extensive range of waterbird habitats by means of shallow banks, dams and other minor earthworks to alter the drainage pattern particularly in the extensive grazing area. The resulting area would be expected to attract a large number of birds of a wide variety, including ducks, swans, rails, cormorants, pelicans, ibis and spoonbills. However, both the Civil Aviation Authority (CAA) and the Royal Australian Air Force (RAAF) have expressed concern about the increased risk of collisions between birds and aircraft, which could result from expanding or developing wetland habitat in the vicinity of the Canberra Airport.

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The CAA has maintained a computer record of reported bird strikes at Canberra Airport since 1969. A total of 149 strikes were recorded between 1969 and 1987, involving predominantly birds which occur at the Airport (see Appendix 2). Potential problems associated with large flocks of silver gulls have diminished considerably since rubbish tips in the area were closed.

However, some of the larger waterbirds, particularly pelicans, cormorants and ibis can often be seen in summer spiralling to high levels over the eastern end of Lake Burley Griffin, occasionally in the vicinity of aircraft flight paths. The movement of birds between Lake Burley Griffin, Lake George and Googong Dam also presents a hazard to aircraft. Bird strike from a heavy bodied, spiralling species (Appendix 3) may damage an aircraft or in the worst case scenario cause it to crash.

The policy agreed to by the CAA, the RAAF, the (former) NCDC and the Service aimed to ensure that the existing conditions at the airport did not deteriorate as a result of changes initiated in the management of the Wetlands. In particular large, high flying species were not to be encouraged and the number of birds of individual species which may be a hazard to aircraft were not to be increased.

It should be recognised that bird numbers fluctuate strongly in response to wider factors such as habitat condition in western NSW and other inland areas. The number of a particular species has been known to fluctuate on Lake Burley Griffin from very low to thousands.

The management strategy at Jerrabomberra Wetlands for protecting aircraft safety is to provide opportunities for people to observe the birds that occur there already and to modify the area so as to attract, in small numbers, species which may be of interest but do not often occur, and to avoid attracting those species which are a threat to aircraft safety. The aim is to increase the diversity of species rather than to increase the number of birds.

It is impossible to quantify bird strike risk for the waterbirds at Jerrabomberra Wetlands. It is difficult even to establish factors responsible for fluctuations in numbers of birds around the wetlands. However some management actions undoubtedly influence bird numbers (and by analogy, bird strike risk). The Service will continue its monitoring program for bird numbers and species in order to provide a baseline for evaluating management proposals and their effects in the future.

Sand and gravel mining

Surveys of Jerrabomberra Wetlands have shown that significant areas of it contain valuable deposits of sand and gravel (Goldsmith and Pettifer 1977).

When a proposal to exploit these deposits was considered in the early 1980's, air safety factors weighed heavily against the proposal because the ponds required for the operation would attract types of waterbirds considered hazardous to aircraft (Appendix 3).

The Service will manage sand and gravel deposits at Jerrabomberra Wetlands in accordance with the National Capital Plan. This prohibits sand and gravel extraction except to maintain stream channel and flood plain stability, or to protect aquatic habitats and recreation areas and to control flooding.

The appropriate level of assessment and documentation specified by the *Environmental Assessment (Impact of Proposals) Act 1974* (Commonwealth) and/or the *Land (Planning and Environment) Act 1991* (ACT) as appropriate, will be carried out prior to any decision to allow sand and gravel to be extracted.

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Refuge Area

The Service will establish a Refuge Area on the western part of Jerrabomberra Wetlands to provide a high degree of protection for significant nature conservation values in that area. Public access will be restricted.

The Refuge Area is required:

* to minimise disturbance to small groups of Latham's snipe which concentrate on the peninsula bordering East Basin. (Latham's snipe is a migratory visitor to Australia and is subject to international treaties. This species has been found to be sensitive to human disturbance);

* to provide an area for species, or individual birds, which are sensitive to disturbance; and

* to provide an area to which waterbirds may retreat when they are flushed from other areas.

The most suitable area for these purposes is around the Jerrabomberra Backwaters. Map 4 illustrates the proposed Refuge Area on Jerrabomberra Backwaters.

Access to the Refuge Area will be restricted to seasons, times, parties, and activities which do not threaten the objectives of the refuge (the guidelines for deciding restrictions are listed below.) Unauthorised access will be deterred by existing water barriers, fencing and the creation or deepening of water channels.

The limits on size, number and season of parties entering the refuge should remain flexible allowing for likely improvements in knowledge about human impacts on the area resulting from management experience. The following guidelines will apply:

* Latham's snipe can be found throughout the wetlands but favour the peninsula adjoining East Basin (Refuge Area part one). They are most frequently seen from August to October, but continue in lower numbers as late as March. Counts conducted from 1984/85 to 1986/87 indicate that one person walking through the area to count them markedly reduced the numbers counted next day (Lintermans 1987). Unless further monitoring indicates otherwise, access to this peninsula during the period August to October will be strictly limited. Authorised access will be only for essential management tasks or research which cannot be conducted elsewhere, or at other times and will be conducted as far as possible to minimise disturbance to Latham's snipe. Emergency access is an exception.

* During the remainder of the year (November to July), entry to the peninsula will be subject to permission from the Manager of Jerrabomberra Wetlands Nature Reserve (see note below about permission to enter Jerrabomberra Backwaters). In some years conditions applying for the August-October period may be extended.

* Jerrabomberra Backwaters (Refuge Area part two). The most sensitive period in the life cycle of most waterbirds is the breeding season. For nearly all waterbird species in most years this falls within the period July to December inclusive. Although Jerrabomberra Backwaters is not the principal local breeding area for many species, it is the least disturbed area of high quality waterbird habitat associated with Lake Burley Griffin. It is a potential refuge and breeding area particularly for shy or sensitive species which are by their nature difficult to monitor.

* Disturbance will be minimised in Refuge Area part two especially between July and January. Access for scientific or educational purposes will require permission from the Manager of Jerrabomberra Wetlands Nature Reserve. A record will be kept of number and size of parties entering the area.

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* Permission will be granted for access in the presence of a person approved by the Manager (for example, a ranger or recognised authority) for a pre-determined maximum size and number of parties in any period. This will be on the provisos that activities permitted in the Refuge Area are ones not feasible elsewhere at Jerrabomberra Wetlands, or on Canberra's urban lakes, and will be carried with a minimum of disturbance to waterbirds.

* Personnel of authorities requiring access to the Refuge Area (for example ACTEW) will be kept informed of management requirements and seasonal factors, and will be required to notify in advance their intention to carry out any activities of a potentially disturbing nature.

* Emergency access for authorities such as the Police and ACTEW is not to be restricted.

* Access by water from East Basin onto the peninsula at the western edge of Jerrabomberra Wetlands will be discouraged to protect Latham's snipe and the Refuge Area. The Lake Burley Griffin Plan of Management will support the management of a 10 metre buffer of water from the shoreline in sympathy with this plan and in cooperation with the Service. Signs will be erected if necessary along the shoreline to inform people that landing is not permitted.

* Boat or canoe access along the Jerrabomberra Backwaters into the Refuge Area will be discouraged by signs and if necessary a boom or other barrier (see also section 3.4.3).

Controlled pedestrian access on the north side of Jerrabomberra Reach

Restricted access may be provided to an area on the north side of Jerrabomberra Reach (Map 4). This would provide opportunities for the public to experience a different part of the Wetlands, to allow views into the Refuge Area, and (for school classes) to carry out limnological studies. Access could be provided by a bridge across Jerrabomberra Reach or by walking trail from Kelly's Swamp.

A drawback to the proposal is that, in addition to the potential to affect bird refuge needs, it could reduce bird viewing opportunities from the southern side of Jerrabomberra Creek, and any bridging of the creek could provide an access point for predators such as cats, dogs and foxes. Therefore the provision of access to the north side of Jerrabomberra Reach will not be addressed until after the assessment of the effects of other visitor facilities on bird viewing opportunities and wildlife conservation requirements around Jerrabomberra Pool.

Any pedestrian route which may be developed between the controlled access area and the Kelly's Swamp area (thereby reducing the degree of access control compared to access via a bridge) will be located or designed to avoid diminishing the viewing opportunities from the environs of the southern side of Jerrabomberra Creek.

Prior to the provision of controlled access into the area (or if access is not provided) the area will be managed as part of the Refuge Area (see above).

Because of the sensitivity of some aspects of the management of the adjoining Refuge Area (e.g. breeding behaviours, Latham's snipe), access to the area on the north bank of Jerrabomberra Reach will be controlled. The following principles will apply:

* The effect on the values of Jerrabomberra Wetlands of providing access into the area will be monitored and reviewed. The nature and extent of access provision will be conditional on maintenance of those values. In particular, the Latham's snipe using the peninsula bordering East Basin are to be protected from disturbance.

* Size and number of groups will be regulated.

* Groups entering the area will be adequately supervised.

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* In general, access through the area will be restricted to paths.

Management of grazing

Grazing will be continued as part of the management of Jerrabomberra Wetlands Nature Reserve. It will assist in achieving management objectives in the following way:

* by preventing the pasture from maturing in summer to a condition where it might burn in a grassfire;

* by maintaining short and open pasture, which is attractive habitat for many species of birds;

* by deterring public entry direct from Dairy Road to the Refuge Area;

* by trampling and eating cumbungi bulrush (*Typha australis*) which would otherwise occupy most or all areas of shallow open water;

* by trampling water margins and maintaining bare muddy areas free of water couch (*Paspalum distichium*);

* by demonstrating that some nature conservation objectives can be achieved in cooperation with controlled agricultural activities; and

* by maintaining the open rural character of the Dairy Flat flood plain.

The following specific policies will apply.

* A licence arrangement to graze cattle (rather than lease) will be maintained to provide flexibility. The Service will liaise with the licensee about stocking rates in different areas of the wetlands to achieve desired effects, and to minimise undesirable effects such as the impact of excessive amounts of cattle faeces on water quality. Fences may be removed, upgraded or constructed by the Service to control cattle movement.

* Grazing will be continued on the area between Dairy Road and the Refuge Area.

* Only cattle will be grazed. Pasture manipulation or improvement will not be undertaken to improve grazing unless such action serves other wetland management purposes. A long term objective of reintroducing native grasses as the dominant grassland species will be protected.

* Grazing exclosures will be established at selected points to provide a better basis for assessment of grazing effects and to provide a greater diversity of habitats.

* Grazing will be withdrawn from areas open for general public access although grazing may be used from time to time in such areas as a management tool.

* The timing and intensity of grazing on the peninsula bordering East Basin and the Refuge Area generally may be varied experimentally and to achieve desired effects.

In addition to the main grazing licence over most of the Nature Reserve, which is referred to above, another grazing licence has been granted to the ACT Department of Education for an area between the Education Centre, Jerrabomberra Silt Trap, the Department of Administrative Services depot and Newcastle Street.

The Service will liaise with the Department of Education to ensure a balance is struck between education needs, conservation and future requirements for public access to Jerrabomberra Billabongs.

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Management of Fyshwick Sewage Treatment Ponds

The management authority for the Fyshwick Sewage Treatment Ponds, which are outside of the declared reserve area, is the ACT Electricity and Water Authority (ACTEW). ACTEW is in the process of revising plans for the operation of the Fyshwick ponds. When put into effect the new plans may result in changes to the way the ponds are managed, including greater fluctuations in pond levels.

The partially treated effluent from Fyshwick Sewage Treatment Ponds is pumped to the Lower Molonglo Water Quality Control Centre which treats all sewage from Canberra. The Fyshwick ponds could ultimately become redundant for sewage treatment but must be kept operating for the present to cope with peak flows.

In their operating condition, the Fyshwick ponds are a valuable part of the wetlands system that provide feeding and refuge areas for species such as hardhead, pink-eared duck and freckled duck which are seen infrequently in other parts of Jerrabomberra Wetlands.

The management of the ponds after they become redundant for sewage treatment is outside the scope of this plan. However in developing and managing Jerrabomberra Wetlands the Service will have regard to the long term changes expected at the ponds and to the possibility of using the ponds for purposes of wetlands education.

The Service is discussing with ACTEW the provision of general public pedestrian access to the pond area on the basis of the the following principles:

* The ponds will continue to operate entirely for the function of treating and handling effluent.

* The Service will meet the cost of fencing, signs and any other works required to make the area safe for general public access.

* ACTEW and the Service will cooperate to produce interpretation material for the pond area. The material will explain that the area is an operational sewage treatment works, and provides benefits for birds.

Goldenholme Pond

One small but significant adjunct to Jerrabomberra Wetlands is the pond just north of the Fyshwick Sewage Treatment Ponds. At the time of publication, this pond and a small area of land surrounding it are the subject of an agistment licence similar to the one applying on most of Jerrabomberra Wetlands (see above).

A management strategy will be recorded for the pond in the form of a precinct plan.

Ultimately the pond may be opened to public access which would require a reduction in the area grazed but at present, continuation of the current management is the most appropriate course of action.

Cormorant breeding site and Shoveler Pool

Sections of the south bank of Molonglo Reach are the only breeding sites in the ACT for great cormorants, little pied cormorants and darters. They are also used for roosting by these species and rufous night herons. There are more important breeding sites elsewhere in the range of the species, and local population levels are probably affected only slightly by the success of breeding at the Molonglo Reach site. The breeding site is valuable principally because it is of local interest. Any behavioural changes (such as movement to a new site), and any variations in breeding success, may also prove to be a helpful indicator of environmental changes.

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Shoveler Pool is an ephemeral water feature which attracts a variety of waterbird species and is in the same general area as the cormorant breeding site. Both these features require sensitive management and can provide valuable waterbird viewing opportunities.

The cormorant breeding area will be protected from human interference and disturbance. Provision of a bird observation hide and screening is an appropriate measure to enable appreciation of the breeding colony without disturbance.

Public access may also be provided to viewing points over Shoveler Pool if this is warranted. Access to the south bank of Molonglo Reach is provided at present along a powerline access road from Dairy Road. Public (pedestrian) access along the powerline road will be terminated in the vicinity of Shoveler Pool to prevent access to the Refuge Area.

The junction between the powerline road and Dairy Road was convenient for the requirements of powerline construction (now complete). Location of access tracks and carparking near the south bank of Molonglo Reach will be re-examined with a view to meeting reserve management objectives more appropriately (Map 2).

Management of aquatic plants

Putting the management philosophy and objectives for Jerrabomberra Wetlands Nature Reserve into practice requires the manipulation of habitats to increase both the diversity of species and the opportunities for visitors to learn and appreciate the value of wetlands. Open shallow waters are valuable waterbird feeding areas but active management is required to prevent such areas becoming covered by cumbungi bulrush (*Typha australis*). This rapidly growing plant plays an important role in the life cycle of many wetland animals. However, at Jerrabomberra Wetlands it would soon occupy all shallow waterbodies if it is not subject to controlling influences such as cattle grazing and trampling, cutting, burning or poisoning.

Control of cumbungi has been a regular management activity at Kelly's Swamp since the first bird viewing shelters were erected and cattle grazing removed. Without this work the only views from the bird observation points would be of reeds. Cumbungi is also associated with the filling of waterbodies by sediment. The rapid filling of Jerrabomberra Pool by sediment is an example. (This aspect is dealt with in section 3.6.6).

There is no ideal method for removing cumbungi. In areas where the water can be drained (at Kelly's Swamp this is a possibility), the preferred method is mechanical cutting and removal. Other methods used with some success in the Murrumbidgee Irrigation Area, Lake Burley Griffin or Jerrabomberra Wetlands include:

* creation of deep channels to isolate emergent clumps, preventing them expanding by root action since experience in the ACT has shown that cumbungi is reluctant to invade areas more than 1.5 m deep);
* grazing and trampling by cattle in shallow areas immediately adjacent to the bank;
* use of a weed cutting barge;
* hand operated rope saw with weights, however this will only cut a few stems at a time;
* use of a swamp dozer in shallow areas;
* mechanical removal with backhoe or dragline; and

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* poisoning with herbicides, provided a permit is obtained from the Registrar of Pesticides for the use of herbicides over water. Once the cumbumgi has died it would either be cut, left to rot or burnt. Section 3.6.4 identifies restrictions on, and states a policy for, the use of herbicides and the burning of reeds.

Of these methods, those that may be considered for cumbungi control at Jerrabomberra Wetlands will depend upon the individual requirements of specific sites. The Service will also investigate the feasibility of controlling cumbungi by developing some kind of mechanised underwater cutting device. A record of all treatments and results will be maintained to assist efficient management in future. Due caution will be exercised with any earthmoving equipment to avoid creating steep edges which would be subject to erosion by wave action.

The growth of other aquatic plant species, such as water couch (*Paspalum distichlum*), will be manipulated if necessary by methods such as grazing or harvesting.

Periodic blooms of the water fern (*Azolla sp.*), in the Jerrabomberra Backwaters are a source of food and shelter for wetlands organisms. When the water surface is thickly covered, *Azolla* deters waterbirds. In areas where the display of waterbirds is an objective, such as in front of bird hides, mechanical harvesting may be carried out.

The algal blooms which occur in Molonglo Reach are related to penetration of sunlight, nutrient levels in sediments and nutrient levels in water entering the ACT. Thus they are subject to the effects of water flows released from Googong Reservoir. Algal blooms in Molonglo Reach appear unlikely to be a concern of the managers of Jerrabomberra Wetlands, nor is it likely that they could be affected by the management of Jerrabomberra Wetlands. There is a possibility that algal blooms may develop in still and shallow water bodies within the wetlands. If blue-green algae are the cause of such blooms the Service will follow the protocols established in the ACT Algal Management Plan.

The management of pest plants is dealt with in section 3.6.2.

Use of captive waterbirds: preamble

The display of captive (that is, wing-clipped or pinioned) waterbirds enables people to observe them at a certain place throughout the year, and throughout most of the day, without being dependent on wild birds, which are more erratic and unpredictable in their occurrence. The display of captive waterbirds is a possible management strategy to cater for those visitors with least predisposition to observe birds, and people whose opportunity to view wild birds is limited by time schedules or other factors including disability. However the keeping of captive waterbirds can offend some of the more dedicated birdwatchers or at least diminish their enthusiasm.

Visitor facilities and interpretation programs based on captive birds are justified in terms of their potential positive impact on the visitor with only a passing interest, rather than in terms of their impact on the enthusiast. A wetland, apparently without waterbirds, and especially viewing points overlooking a pool without waterbirds, may provide little satisfaction for tourists and other casual visitors. Holding and display of birds at Jerrabomberra Wetlands Nature Reserve can be justified on these grounds, although they would not be acceptable in a conservation reserve where ecological characteristics were based on more natural origins.

However, there are a number of objections to the use of captive waterbirds at Jerrabomberra Wetlands, and there are constraints on their potential use. These include:

* Many visitors may have objections in principle to the keeping of animals in captivity. This plan will not attempt to debate this issue except to state that the Service has no objection to a properly managed display of captive waterbirds.

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* The maintenance and level of staff commitment required for captive waterbirds is high. In Canberra's climate captive birds depend heavily on daily feeding and different species require different diets.

* Large numbers of wild birds, especially silver gulls and black ducks, are likely to compete for the food. (Water rats, black rats, currawongs and Australian ravens are other likely competitors). Techniques for getting food to the captive birds in preference to their wild competitors are not well developed. Feeding of captive waterbirds at Jerrabomberra Wetlands could attract other birds in such numbers as to increase the risk of bird strike on aircraft.

* Wing-clipped or pinioned birds are subject to most causes of mortality affecting wild birds as well as some causes applying particularly to captive birds, especially increased predation by birds of prey, water rats, dogs, foxes and cats. Successful maintenance of a group of captive waterbirds at Jerrabomberra Wetlands Nature Reserve would depend on both the elimination of dogs, foxes and cats from within a fenced enclosure and also on the breeding of replacements for birds lost from other causes.

Captive waterbirds: policy

The Service is not committed to the introduction of captive waterbirds at Jerrabomberra Wetlands. However, the option will be kept open. Consideration of proceeding with such a proposal will require a demonstrated demand from education or tourism clients and be subject to a comprehensive cost/benefit analysis. This should include a more detailed appreciation of development proposals and commitments in the Kingston foreshores area, and the effectiveness of alternative educational, interpretation and promotional strategies to achieve the management objectives for use of the reserve.

When considering the establishment of captive waterbirds at Jerrabomberra Wetlands an assessment will be made of the following issues:

* development work required (fences, floodgates, visitor facilities etc);

* cost/difficulty of removing feral predators;

* maintenance cost and staff expertise and availability;

* potential effect on air safety of wild birds attracted to the feeding sites, and contingency plans for scaling down feeding arrangements if necessary;

* source of initial stocks of waterbirds;

* competition with similar enterprises;

* affects on other species and species behaviour;

* the educational benefits of the resulting display;

* selection of species (for example, those that breed locally versus Australia-wide);

* experience with and assessment of less intensive bird display schemes such as feeding wild waterbirds; and

* the effect on the migratory habits of birds, particularly those covered by JAMBA and CAMBA.

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Feeding of waterbirds by the Service

Some of the arguments for and against displaying captive waterbirds also apply to feeding wild waterbirds. The level of resource commitment is less and predation is not such an important management issue; but the quality of the display would be more limited. The concern about the potential to affect air safety remains, as well as potential problems with attracting other species, developing dependence relationships and offending some visitors seeking a natural experience.

On this basis, the policy applying to use of captive waterbirds at Jerrabomberra Wetlands will also apply to the feeding of wild waterbirds (see above).

Terrestrial bird feeding area

A terrestrial bird feeding area has been proposed near a visitor centre site between Jerrabomberra Pool and Mundaring Drive (Mitchell and Clouston 1987). Similar bird feeding programs are carried out during the colder months of the year at Tidbinbilla Nature Reserve and the Australian National Botanic Gardens where they attract a variety of native bird species, especially crimson rosellas, galahs, king parrots, white-winged choughs and sulphur-crested cockatoos.

The purpose of such an area at Jerrabomberra Wetlands would be to demonstrate and interpret the relationship between birds and native vegetation especially for food, shelter and breeding sites. A decision on whether to establish such an area would be made by the Service on the basis of experience with management of Jerrabomberra Wetlands, and would take account of:

* management costs and benefits;
* the possibility of attracting large numbers of avian pest species and ways to avoid this;
* the need to ensure that no threat to air safety resulted from the activity; and
* the interpretation theme of the site, interpretation methods to be used and the relationship of the theme to the objectives for Jerrabomberra Wetlands Nature Reserve.

Selection of plant species

All future plantings of trees and shrubs at Jerrabomberra Wetlands will be of local native species with the exception noted below.

Existing exotic trees

Mature exotic trees must be managed in the context of their place in the wider landscape of the surrounds of Lake Burley Griffin. In general they will be retained. The removal of any such trees to fulfil other objectives will be preceded by an environmental impact assessment which addresses the issue of the lakeshore landscape.

Willows (*Salix* spp.) are well established at Jerrabomberra Wetlands, and provide bird nesting sites, feeding and roosting areas and, by casting shade or when fallen, provide habitat for fish. However in small areas where a special effect is required (for example, a view, or establishment of other plant species) they will be removed.

The spread of seedlings or suckers from willows and other exotic species such as poplars (*Populus* species) will be treated as weed invasion and will be subject to control measures. The criteria for control of pest plants is further discussed at section 3.6.2.

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Terrestrial grasslands management

Although the original terrestrial grasslands of Jerrabomberra Wetlands have been largely lost, the reintroduction of those species and communities which would have naturally occurred will be favoured. A study will be undertaken to determine appropriate species, the effectiveness and suitability of available technology for such revegetation and the resource programming options and implications. It is anticipated that any reintroduction program initiated as a result of the study, will be long term and involve a degree of experimentation.

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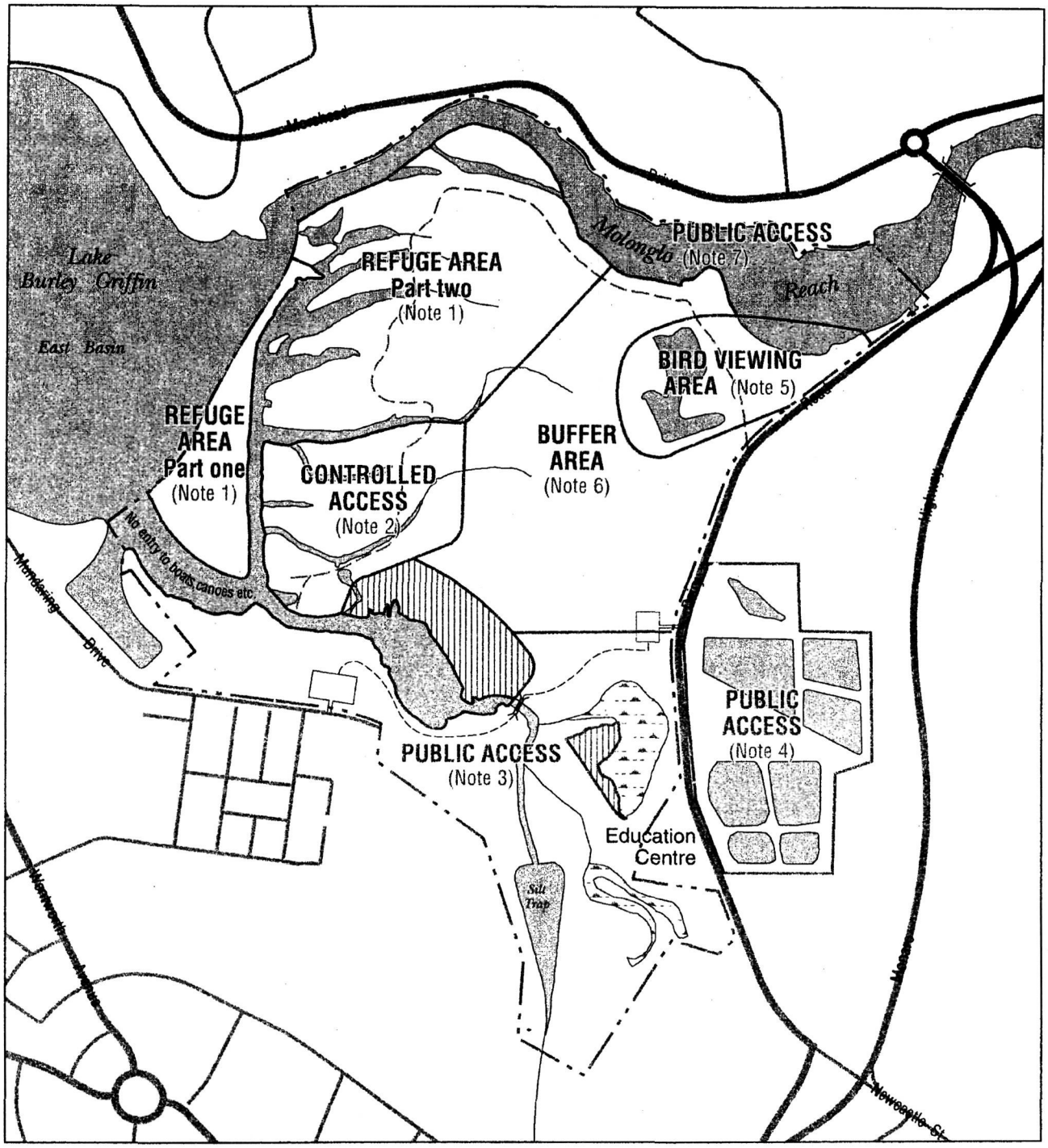
MAP 4 - Access zoning



	Access discouraged to protect bird viewing opportunities
Note 1	Refuge area with controlled grazing. Section 3.2.3. Restricted access
Note 2	Controlled access to protect values of refuge area. Section 3.2.3
Note 3	Public access facilities to be developed
Note 4	Public access to be provided. Section 3.2.3. Subject to public health risk assesment
Note 5	Bird hides and path provided subject to demand and environmental constraints
Note 6	Buffer area grazed by cattle. Access not encouraged
Note 7	Open access to developed picnic and BBQ areas and Molonglo Reach
- - -	Jerrabomberra Wetlands Nature Reserve

0 100 200 300 400
Metres

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3.3 EDUCATION AND INTERPRETATION:

3.3.1 Introduction

As described in sections 1.2 and 3.2, Jerrabomberra Wetlands has high ecological and conservation value. Its location near the centre of Canberra places it in close proximity to a wide variety of educational institutions, which are likely to make use of educational programs provided by the Service. Opportunities for educational programs include the presentation of a range of geomorphic features on flood plains, variations in water quality and their effects on plants and animals, and the range of habitats used by a variety of species, particularly birds. Management strategies implemented to protect and enhance these values form useful education and interpretation subjects in themselves. The Service intends to manage the area to optimise its education value.

3.3.2 Objectives

In defining its intentions for Jerrabomberra Wetlands Nature Reserve, the Service accepts the principles of environmental education outlined by UNEP and UNESCO (1977), and reaffirms the philosophical statements from the National Conservation Strategy for Australia (DASETT 1985) (see Appendix 4).

Accordingly, the objectives for education at Jerrabomberra Wetlands Nature Reserve are to:

* encourage a sensitivity to the values of wetlands generally, that will be reflected in future behaviour;
* encourage people to appreciate and understand the natural environment, particularly wetland resources and processes affecting them, and to raise public awareness of the need to protect fragile environments such as wetlands;
* encourage the appreciation of, and support for, sound environmental management;
* attract visitors from a wide variety of ages and backgrounds; and
* promote community involvement in conservation programs.

3.3.3 Management programs and activities

To function as a wetland education centre the Nature Reserve must meet the varied needs of organised groups such as school groups, and more casual visitors such as family groups and tourists. Works and developments discussed in this section represent preferred options to achieve management objectives to a high degree. There is no commitment to their implementation other than an investigation of the place they would play in management programs and the priority attached to them. They will be further addressed in an interpretation plan to be developed for Jerrabomberra Wetlands (see later in this section).

Organised groups

The main requirements of groups visiting Jerrabomberra Wetlands, particularly those with a specific education theme are:

* availability of expertise on-site;
* presence of general facilities such as toilets, classroom and paths;
* availability of relevant information and teaching aids such as excursion guides;

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* opportunities to undertake investigative activities and to have hands-on learning experiences.

On-site expertise. At present the ACT Parks and Conservation Service does not have staff based on site at the Wetlands, and its interpretation staff can only devote a limited amount of their time to the area. The use of volunteers to assist with visitor programs would help alleviate this shortfall in resources, as well as provide sources of specific expertise and an opportunity for the community to be involved in the management of the Wetlands. The Service will also investigate the possibility of cooperative arrangements with alternative sources of expertise, such as the Dairy Flat Education Centre (run by the ACT Department of Education), the Canberra Ornithologists Group Inc. and commercial enterprises.

Presence of general facilities. A first step in developing Jerrabomberra Wetlands for both educational and general public uses is the provision of access facilities such as paths, gateways and creek crossings.

To this end a pedestrian bridge has been provided across Jerrabomberra Creek near Jerrabomberra Pool so that groups can easily make use of access on both sides of the creek in one visit. Bird-hides and pathways are also in place.

A classroom with fixtures and facilities suitable to the range of topics which can be studied at Jerrabomberra Wetlands is an important adjunct to any organised educational use of the area. Given that the pursuit of school curicula objectives could form a majority use, it is appropriate that, were a classroom to be constructed, the ACT Department of Education and Training should be involved in its establishment and management.

Information and teaching material. Excursion guides and other information and teaching material are being produced (and used) independently of the development of built facilities referred to above. Interpretive and directional signs are being erected on site, and bird identification information will be provided in the hides. An educational kit will be developed for use in educational programs. In-service programs for teachers and regular liaison with teaching staff will be undertaken on an ad hoc basis to enhance teacher contribution to school use of the wetlands and related school curriculum development.

Learning experiences. Organised groups will be provided with opportunities for experimental and hands-on learning experiences. Provision of some opportunities may be dependent on a classroom facility but outdoor facilities such as hides and static displays, are also intended. Organised groups may be permitted to conduct the following types of activities given prior approval:

* water quality monitoring, including the WaterACT community monitoring program;
* installation and recovery of devices used to assess populations of aquatic organisms;
* dip netting; and
* collection of small samples of algae, aquatic plants and bottom sediment.

These activities will be monitored by the Service to ensure that they are sustainable, and that they do not threaten the character or ecology of the resource.

Areas suitable for such activities include:

* Jerrabomberra Silt Trap;
* Jerrabomberra Billabongs;
* Jerrabomberra Creek immediately downstream of the Silt Trap as far as the junction of the channel from Jerrabomberra Billabongs; and

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* Fyshwick Sewage Treatment Ponds, adjacent to Jerrabomberra Wetlands (subject to public health and safety risk assessment).

Education for other visitors

Many "first time" visitors need help to experience what Jerrabomberra Wetlands have to offer. To achieve the education objectives (3.3.2) the following needs must be met:

* orientation, including a theme and context for the wetlands and the variety of experiences they offer;

* development of interest, enthusiasm and awareness; and

* provision of learning opportunities including hands-on experience wherever possible.

A traditional way to satisfy these needs is the provision of a visitor centre, and this option is considered later in this section. Although visitor centres are resource intensive and need to be of a high standard in both design and operation, they can be very effective in providing a first-time or unguided visitor with essential orientation and educational information. A visitor centre also enables the use of more sophisticated displays and audio-visual aids which actively encourage visitor participation and understanding.

Alternatives to a visitor centre are compact visitor information displays located at critical points on the access network. These displays would complement a visitor centre and would be particularly useful in the early stages of implementation of visitor management strategies.

Interpretation plan

The attributes of Jerrabomberra Wetlands provide outstanding opportunities for education and interpretation to a wide range of visitors from organised education groups to tourists and local day visitors and also to people from a range of different backgrounds.

The Service will develop an interpretation plan for Jerrabomberra Wetlands which provides a strategy and program for meeting objectives, and which will be revised when necessary. The following list indicates a range of interpretation formats and activities which will be considered for Jerrabomberra Wetlands subject to limitations set by funding, staff availability and legal requirements relating to the use of volunteers:

* audio-visual programs;

* interactive computer packages;

* cassette tape 'walk and talk'

* signs - interpretative as well as directional;

* orientation/directional leaflet;

* interpretative literature, excursion guides, education kits;

* displays - in bird hides, classroom, visitor centre;

* visitor information stations;

* coordination with tourist promotion centres/operations;

* holiday programs - advertised to attract tourists as well as residents;

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* special events, for example promoted field days;
* variety of guided tours/classes - some arranged to suit tourists as well as locals, for example, some not requiring bookings, some at same time every week;
* booked group activities;
* promotion, for example, brochures distributed from tourist outlets, hotels/motels and transport nodes, and advertising;
* use of mass media, for example, regular talks on radio/articles in papers; and
* visitor centre/classroom.

Visitor Centre

A possible visitor centre site has been selected on the south west (Mundaring Drive) side of the Nature Reserve (see Map 5). Functions of a visitor centre would include:

* to orientate the visitor and provide information on management programs
* to relate displays in the visitor centre to processes and experiences in the Wetlands;
* to encourage an awareness of the management objectives and strategies for Jerrabomberra Wetlands Nature Reserve;
* to relate Jerrabomberra Wetlands to other wetlands; and
* to provide an insight to aspects of wetlands not readily apparent to visitors (for example, limnology).

Personnel to carry out interpretive activities may be drawn from a variety of sources. Volunteers and contractors may be used as well as Service staff and staff of the ACT Department of Education and Training.

The provision of classroom facilities in a visitor centre has attractions in terms of rationalising building requirements and providing additional educational services and opportunities. The role of the Dairy Flat Education Centre is relevant here and the ACT Dept of Education and Training will be consulted on the potential for a joint project in any classroom development proposal.

3.4 MANAGEMENT OF VISITOR USE

3.4.1 Introduction

The landscape and natural values of Jerrabomberra Wetlands contribute directly to its value for recreational use. Other contributing factors include:

* its location within a jurisdiction of over 290,000 people;
* its rural character contrasting with the surrounding city;
* the treeless nature of parts of it, contrasting with the many areas of woodland in and around Canberra;
* an abundance of waterbirds and other wetland fauna; and

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* contrast between the recreational settings offered along the tree lined Molonglo Reach with those on the rest of Lake Burley Griffin.

Most of Jerrabomberra Wetlands are suitable for recreation activities which involve little physical exertion other than walking. Little of it will be developed for more arduous activities. A proposed cycle path is an exception - although cycling in the nature reserve will be managed in sympathy with other recreation activities.

Some principles for management of recreation at Jerrabomberra Wetlands include:

* recreation opportunities available should contribute to the diversity of opportunities available regionally;

* sites within the Nature Reserve will only be developed for recreation where the Jerrabomberra Wetlands site is the most suitable in the region;

* resolution of conflict between recreation and other uses, and between different recreation uses, will be resolved on a regional basis rather than simply within the boundaries of the Jerrabomberra Wetlands Nature Reserve;

* where providing access or facilities for recreational activities, the Service, where possible, will do so in such a way that the requirements of disadvantaged and disabled people are also met; and

* recreational activities will be managed in sympathy with the wildlife conservation objectives for Jerrabomberra Wetlands.

3.4.2 Objectives for Visitor Use Management

The following objectives apply to management of recreation in addition to the overall objectives contained in section 3.1:

* to contribute to the diversity of recreation opportunities available to residents of the ACT;

* to minimise conflict between different recreation uses and users;

* to encourage forms of recreation use which are compatible with the protection of other values of the Nature Reserve, and to control incompatible use;

* to develop and maintain recreation site conditions which are sympathetic to all other management objectives; and

* to influence recreation choices so that use pressures occur at the sites with the most capacity to cater for the uses in question.

3.4.3 Recreation activities

Decisions about activities to be permitted will be based on the objectives for Jerrabomberra Wetlands stated throughout this plan. The following specific policies will be applied:

* Vehicular use of Jerrabomberra Wetlands Nature Reserve by the public will not be permitted, except in special circumstances and subject to permission from the manager of the reserve.

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* Pedestrian access will be permitted throughout the Wetlands with the exceptions specified elsewhere in this plan (section 3.2.3, 3.4.4 and map 4). Fences, signs and water barriers will be used to restrict access from areas such as those in front of bird observation hides. The provision of a path system should meet all legitimate pedestrian access requirements.

* Recreational use of horses will not be permitted. Use of horses other than for stock management purposes is incompatible with the protection of wetland values at Jerrabomberra Wetlands, and conflicts with other recreational activities.

* Camping is not permitted around Lake Burley Griffin, and will not be permitted at Jerrabomberra Wetlands as it would compromise the natural values of the reserve.

* Swimming will not be allowed in areas where there are significant health risks or where it would conflict with objectives for conservation or interpretation.

A proposed cycle path through Jerrabomberra Wetlands is discussed at section 3.4.4. When it is constructed it will provide an extension of the opportunity for recreational cycling afforded by the cycle path circuit around Lake Burley Griffin.

Entry fees for Jerrabomberra Wetlands, and fees for provision of services by the Service, generally are not precluded but will be subject to wider Service and ACT Government policy, including a cost/benefit analysis.

Picnicking and lighting of fires

Picnics will be encouraged by provision of mown grass and in some cases seats or tables, principally on the north bank of Molonglo Reach. The north bank already has picnic tables, barbecues and mown grass, as do other areas around Lake Burley Griffin.

Barbecues will be permitted only where facilities have been provided (electric or gas barbecues or wood burning fireplaces) and are subject to the *Bushfire Act 1936*. Any new facilities will be provided only in the area marked on Map 7 on the northern bank of Molonglo Reach, and part of the southern bank near the bridge over Molonglo Reach. Visitors wishing to picnic will be encouraged to use the developed barbecue areas.

The National Capital Plan (NCPA 1990) identifies an area on the south bank of Molonglo Reach adjacent to Dairy Road for development of recreation facilities. The Service would encourage such facilities to be developed in a way that would provide an adequate degree of long term protection to Shoveler Pool, the cormorant breeding area and the Refuge Area. The area considered suitable for development of recreation facilities such as barbecues, picnics tables, toilets and areas of mown grass is identified at Map 7.

There is the potential for an undesirable increase in bird numbers or species to occur in areas used for barbecues and picnics as a result of discarded food. The Service will monitor this situation, and if it becomes a problem may consider remedial action such as increased servicing of recreation sites, visitor education and restriction of recreational activities.

Fishing

Parts of Jerrabomberra Wetlands will continue to provide a significant recreation opportunity for fishing. In other areas of Jerrabomberra Wetlands fishing would conflict with management objectives, such as provision of opportunities to observe waterbirds from concealment.

Fishing will be permitted in any areas developed for high intensity recreation (such as the northern bank of Molonglo Reach) but not elsewhere in the wetlands. This represents little or no change from the current situation.

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Canoeing and boating

Canoeing and non-powered boating are minor existing recreation activities within Jerrabomberra Wetlands. Molonglo Reach and Jerrabomberra Reach both offer locally significant opportunities for scenic canoe tours. The Jerrabomberra Backwaters is used by one Canberra school to train rowing crews.

All boating activities potentially conflict with the provision of opportunities to observe waterbirds from concealment, and with the provision of a high degree of security for the Refuge Area (section 3.2.3).

Canoeing and boating will be permitted to continue in Molonglo Reach (and East Basin of the Lake) but not in Jerrabomberra Backwaters or Jerrabomberra Reach, except for approved research or management purposes. Boating activities will be monitored for undesirable impacts, and management strategies reviewed accordingly.

Feeding birds

Feeding birds is a recreation activity with much appeal to some members of the community. It is potentially valuable in a social sense and also as a means of bringing people and wildlife into closer proximity. It does need to be controlled to prevent threats to the health or welfare of the birds or other wildlife and to avoid attracting such numbers or species of birds as to present a threat to aircraft using Canberra Airport.

The degree to which bird feeding by the public is to be restricted or encouraged will be reviewed by the Service on the basis of experience. If feeding is officially condoned it would be allowed only in restricted areas such as near a major entry where recreation rather than education or scientific study was an important use. In general, feeding of wild animals by the public will not be encouraged. (See also sections on bird feeding in 3.2.3.)

Special events and group activities

During the period of this plan organised groups may come to account for a significant proportion of the visitors to Jerrabomberra Wetlands. However, there is the potential for such groups to diminish the values of Jerrabomberra Wetlands especially through conflict with other use or conservation objectives.

Land managers are often asked to grant permission for special events unrelated to the primary use objectives involving either large numbers of people, special privileges, competitions or other potentially disruptive activities. Such events will be accommodated at Jerrabomberra Wetlands only where they are not likely to result in unacceptable effects on other values, or unreasonable conflict with general public use.

The Service will liaise with organisations conducting group activities in order to minimise undesirable effects. A permit is required for most group activities. Permit applications are required to indemnify the Government, to observe a code of conduct and to satisfy the Service of their competence to run the activity. Permit arrangements will clarify the circumstances under which organisations may conduct specific activities within the Wetlands, and will impose conditions designed to limit the total number and frequency of use, to limit impacts on specific natural or cultural resources, or to limit conflict with other users of the Wetlands. Permit holders will be required to supply the Service with data on levels and kinds of use.

The Service policy on the management of commercial activities, (concessions), e.g. use by tour operators, will be applied as relevant.

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Observing wildlife

As indicated previously, Jerrabomberra Wetlands is of considerable ornithological interest and importance. Plans for manipulation of bird habitats at Jerrabomberra Wetlands are intended to increase the value of the area for wildlife, especially birds (section 3.2).

To assist the public to view birds at Jerrabomberra Wetlands, especially shy species, screened observation hides and access paths are being built. The standard designs often include mounding, which helps to screen visitors and reduce noise transmission. Mitchell and Clouston, (1987) identified a possible path system with suggested sites for bird observation hides. A plan showing both existing, and proposed, paths and hides is at Map 5.

In addition to these ground level facilities, there is scope for elevated hides (or towers) to provide views into distant areas, particularly the Refuge Area, which are otherwise inaccessible to the public.

3.4.4 Provision and control of public access

Management of public access must strike a balance between protecting the wetlands from incompatible actions and enabling the public to enjoy and appreciate the area. Control of access is one of the most important determinants of both the quality of recreation experiences and the security of nature conservation values.

Access restrictions are specified in detail in the following parts of the plan and are in summary form at Map 4 and include:

* the Refuge Area, which is generally closed to the public to protect nature conservation values (see section 3.2.3);

* an area of restricted public access adjoining the Refuge Area on the north bank of Jerrabomberra Reach (see section 3.2.3);

* the access requirements for the continuation of grazing management and the interaction between grazing management and public access - (see section 3.2.3);

* restrictions on canoeing and other access by water (see section 3.4.3); and

* the provisions for bicycle access are dealt with below.

In addition, access will be restricted or discouraged in other specified areas for management reasons. Two such areas are shown at Map 4. In these areas the presence of people would disturb birds being observed from hides on the opposite bank.

An indication is given at Map 5 of the type of path system and bird observation facilities that have been already been built as well as those that are planned for the future. Proposed paths, bridges, water bird viewing facilities and guided tours are expected to satisfy all legitimate access requirements within the constraints imposed by potential conflict between different users. Those access facilities that are already in place include:

* a pedestrian bridge across Jerrabomberra Creek to link the southern entrance area with the Kelly's Swamp facilities;

* a path from the Mundaring Drive carpark to bird hides on Jerrabomberra Pool and Kelly's Swamp; and

* a new viewing platform at Kelly's Swamp.

The final lay out of the trail system will be determined by two proposed developments, namely:

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* the Lake Burley Griffin cycle path; and

* the extension to Mundaring Drive.

At the time of publication of this plan, neither of these proposals has been finalised to a stage where their routes are confirmed.

Proposed cycle path

In 1984 the (then) NCDC announced plans to continue the Lake Burley Griffin cycle path around East Basin through the Jerrabomberra Backwaters. Public submissions were made to a hearing of the Parliamentary Joint House Committee on the ACT, which resolved that the proposed alignment would not be approved. The Committee recommended that the NCDC, in consultation with the Service and concerned community groups, develop an alternative alignment away from the western area of the wetlands.

Subsequent discussions reached an agreement on two options to be further investigated, which is reflected in the Jerrabomberra Conditions in the National Capital Plan (NCPA 1990). The main point of discussion was whether the cycle path should link Mundaring Drive and Dairy Road to the east of Kelly's Swamp or follow a less intrusive route to the west of Kelly's Swamp.

Of the two alternatives proposed, the Service believes the more westerly route (indicated at Map 5) is to be preferred on the following grounds:

* minimum disturbance to waterbird viewing areas;

* reduced conflict with pedestrians by cyclists and other travellers; and

* improved bicycle access to Dairy Flat Education Centre.

A pedestrian bridge across Jerrabomberra Creek has been provided to serve visitor and management access requirements between the southern and northern parts of the public access area. It is not intended to provide a through link for travellers, eg runners and cyclists not specifically visiting Jerrabomberra Wetlands Nature Reserve. Consequently, the bridge and its approaches are neither suitable for, nor available as, a link in the final route for the Lake Burley Griffin cycle path.

The bike path will cross the Molonglo River at the new Dairy Flat Bridge and return around the Lake between Morshead Drive and Molonglo Reach. A review of the northern boundary of the Jerrabomberra Wetlands Nature Reserve will be undertaken when an alignment is known. The intention will be to rationalise the boundary if necessary to exclude as far as possible the bike path and any other developments or intensive use areas which do not complement management objectives for the Reserve. Proposed boundary alterations are further discussed at section 2.6.

3.4.5 Visitor facilities

At the time of finalisation of this plan, visitor facilities at Jerrabomberra Wetlands Nature Reserve comprise two carparks, paths, a viewing platform and bird observation hides at Kelly's Swamp and a bridge crossing of Jerrabomberra Creek. Proposals for additional visitor facilities are discussed elsewhere in this plan and include:

* paths (including cycle path) and bridges,

* further screened bird observation points (hides) or towers,

* toilets,

* visitor information centre,

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* entrance control point,
* classroom centre (separate or combined with visitor centre),
* special outdoor education facilities such as bird feeding area, ponds for ornithological studies etc,
* barbecue and picnic facilities, and
* further carparks.

In addition to these facilities the Service considers that subject to the assessment of its commercial viability, a shop and/or food outlet, such as a cafeteria, may be a desirable development in the vicinity of the visitor entry point at the Mundaring Drive entrance to the Wetlands. Such a facility may be leased or licensed to a commercial operator, and could be associated with a visitor centre or entrance control point.

Works proposed are subject to development planning, financial programming and resource allocation, and approval where necessary by the National Capital Planning Authority. They are options to be considered in the context of achieving management objectives for the Nature Reserve and will be assessed on merit and circumstance as management programs are implemented.

Corporate sponsorship of works or activities has the potential to assist with the implementation of management programs and to extend community involvement in the management of Jerrabomberra Wetlands in a positive fashion. Private sector participation in the achievement of objectives for the management and development of Jerrabomberra Wetlands Nature Reserve will be encouraged.

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MAP 5 - Indicative trail system

- Possible visitor centre
- Existing / Proposed observation hide
- Pedestrian path
- Management trail (restricted access)
- Viewing platform
- Carpark access
- Jerrabomberra Wetlands Nature Reserve

0 100 200 300 400
Metres

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3.5 RESEARCH

It is desirable to promote research into management problems relevant to Jerrabomberra Wetlands to ensure early incorporation of research results into management programs, to avoid duplication of monitoring and sampling, and to coordinate research activities.

The following objectives apply to the management of research:

* to provide an information base about physical, biological and cultural resources of the Wetlands;
* to provide an information base about the visitor use characteristics of the Wetlands;
* to promote understanding of the nature and dynamics of wetland communities;
* to focus research effort on management problems of highest priority; and
* to promote efficient and prompt transfer of research results into management practice.

Management practices

The Service will oversee monitoring and research activities carried out by other organisations within Jerrabomberra Wetlands. Such activities will be the subject of written agreement between the Service and the organisation and/or person involved. This will include obtaining any necessary statutory permits if protected native plants or animals are affected.

The Service will promote and/or arrange for surveys to provide useful information about resources, uses, user impacts and the dynamics of wetlands.

3.6 RESOURCE PROTECTION

3.6.1 Control of pest animals

A number of vertebrate species at Jerrabomberra Wetlands are pests or potential pests because they:

* are exotic species which prey on, displace or compete with native species, or in other ways threaten nature conservation values;
* are the subject of regional control programs; or
* limit the achievement of management objectives.

A limiting factor in the control program for some species is that the small size of Jerrabomberra Wetlands will result in the rapid re-colonisation of animals of the target species from surrounding areas. This may be offset in some parts of the Wetlands by water barriers, which isolate some areas from surrounding lands, and make control programs longer lasting in their effects

Priority for control of pest animals will be determined according to:

* their potential to diminish the values of Jerrabomberra Wetlands;
* the ability of the Service to achieve a worthwhile outcome with the resources available; and
* the priority placed on control of the species in the region.

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Current species control priorities for the Wetlands are stray domestic dogs, hares, rabbits and foxes. Domestic water fowl will be controlled as required. Mallard ducks at Jerrabomberra Wetlands are also being controlled as part of an ACT program to reduce their potential impact on populations of native Pacific black ducks.

It is extremely difficult to create cat and fox proof fences. However, there are several opportunities to augment water barriers as deterrents to the entry of terrestrial pests. One opportunity is provided by the peninsula bordering East Basin in the Refuge Area which could be made into an island with relatively little effort. Access to it could be provided with a structure such as a gated bridge or drawbridge which provided a barrier to dogs, foxes, cats, rabbits and hares. A cheaper but less attractive alternative to creating an island would be to erect a fence across the isthmus of the peninsula.

The same principle of creating "islands" protected by water barriers or a combination of water and fences could be employed elsewhere in the wetlands. In particular, a moat has been proposed in association with the proposed cycle path across Jerrabomberra Wetlands. This has potential as a deterrent to the entry of terrestrial pests as well as a barrier for controlling the movement of people.

Works such as creation of water barriers will be subject to the conditions specified elsewhere in this plan (section 3.2.3 "Protection and enhancement of habitat values", and section 3.6.4 "Pollution legislation and Jerrabomberra management").

3.6.2 Control of pest plants

The flora of Jerrabomberra Wetlands has been heavily modified by past land use and is mainly of exotic origin. The recognition of pest plants and priority for control action will be based on the following factors:

* the extent to which the species occurrence is a threat to the values of Jerrabomberra Wetlands or inhibits efforts to achieve management objectives;
* ability to achieve a significant result with the resources available;
* whether the species has been identified by the ACT Weeds Committee as a priority species;
* whether the species is one which has quickly become a problem in other similar wetland areas, and thus has potential to become a problem at Jerrabomberra Wetlands;
* whether the species is detrimental to the health of livestock or agricultural productivity; and
* whether the species hampers desired access to an area.

The highest priority for weed control at present is considered to be control of thistle species in areas where they deter pedestrian access or detract from aesthetic values.

Use of herbicides will inevitably be among the control measures adopted for some weed species. Use of herbicides will be subject to provisions of the *Water Pollution Act 1984* and consideration of the following factors:

* possible residual or non-target effects;
* public health;
* occupational health and safety of management personnel;
* visitor safety;
* protection of aquatic ecosystems; and

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* feasibility of alternative methods of controlling the weed species.

The management of aquatic plants is dealt with in section 3.2.3 because most management action on aquatic plants is regarded as habitat manipulation rather than pest control. Unlike thistles and other pest plants, the main aquatic plant species at Jerrabomberra Wetlands contribute to achievement of the objectives of this plan although they are not necessarily desirable in all areas.

3.6.3 Bushfire management and control

Jerrabomberra Wetlands is less subject to bush or grass fires than other parts of the ACT. In most bushfire seasons much of the pasture at Jerrabomberra Wetlands retains a proportion of green uncured material due to combined effects of the high water table, the pasture type and grazing. The risk of ignition by fires spreading from surrounding areas is comparatively low because of water barriers on all sides except the eastern side which is partly bounded by irrigated or ploughed fields. Risk of ignition from within Jerrabomberra Wetlands is also comparatively low due to restrictions on the type of public access.

The only fire management action warranted at present at Jerrabomberra Wetlands is the slashing around carparks, pedestrian access routes and the education centre. Action is warranted in this case because:

* because the proposed education centre adjoins an area of ungrazed grass which is drier than elsewhere at Jerrabomberra Wetlands; and

* the education centre is a potential source of fires because it is a place where human activity is concentrated.

If ignition of fires at Jerrabomberra Wetlands becomes a problem or threat, other management actions such as creation of ploughed firebreaks or controlled burning of selected dry grass areas will be carried out.

3.6.4 Water and air pollution

The quantity and quality of water passing through Jerrabomberra Wetlands is of fundamental importance to the biology of the wetlands. This section of the plan identifies factors which influence the water supply to Jerrabomberra Wetlands, and ways in which the Service can modify those factors. The section also identifies the influence of water and air pollution legislation on potential Nature Reserve management activities.

The quantity of water entering Jerrabomberra Wetlands will potentially be affected by planning decisions about the broad-scale management of the catchment, much of which is in NSW (Map 3), and by the design and management of in-stream structures such as dams. For example, the urbanisation of the Harman-Symonston area of the ACT will change the pattern of flows in Jerrabomberra Creek. These changes will be modified deliberately by the planners, using methods tried elsewhere, such as in the Tuggeranong Valley.

The quality of water entering Jerrabomberra Wetlands has been or may be affected by a number of factors including:

* heavy metal contamination from mining activities further up the catchment of the Molonglo River in New South Wales;

* management of the sewer main from the Fyshwick Sewage Treatment Ponds through Jerrabomberra Wetlands;

* occasional algal blooms in Lake Burley Griffin;

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* improved treatment of effluent at Queanbeyan Sewerage Treatment Works;
* the connection of Queanbeyan Abattoir to the sewerage system;
* a gross pollution trap for the Gladstone Street part of the Fyshwick Industrial Area;
* management policy for the Jerrabomberra Creek silt trap;
* effects of a flood control structure built as part of the crossing of Jerrabomberra Creek by the re-aligned Hindmarsh Drive;
* a possible international rowing course (that is, an impoundment two kilometres long and a few hundred metres wide) on the upstream side of the Hindmarsh Drive crossing; and
* the proposed redevelopment of the Kingston foreshores of Lake Burley Griffin

Potential pollution of waterways feeding Jerrabomberra Wetlands is controlled by the *Water Pollution Act 1984* and Regulations and by the following NSW laws:

* *Clean Waters Act 1970*
* *Fisheries and Oyster Farms Act 1935*
* *Maritime Services Act 1975 - Navigable Waters (Anti-Pollution)* and regulation
* *Water Act 1912*
* *Clean Air Act 1961*
* *Public Health Act 1902*
* *Local Government Act 1919.*

The Service will liaise with the sections of the ACT Government Service and NSW Government that are responsible for administration of this legislation.

Monitoring

Regular water monitoring is undertaken by NCPA in the Wetlands at site 519, and nearby within Lake Burley Griffin at site 509, which is off Bowen Park. This monitoring provides information about the quality of water flowing through, and out, of Jerrabomberra Wetlands.

Currently students and teachers at the Dairy Flat Education Centre are monitoring water quality at three sites within the Jerrabomberra Wetlands. These activities are part of WaterACT which is funded by the National Waterwatch Program.

The Service will obtain expert advice on the likely cost/value of a monitoring program to identify changes in the quality of water entering Jerrabomberra Wetlands. It will carry out liaison with the proper authorities in the interests of protecting and upgrading the quality of water entering Jerrabomberra Wetlands. Any or all of the following authorities may be involved:

* Office of the Environment (ACTGS)
* Transport and Engineering Division (ACTGS)
* ACT City Services
* NCPA (Commonwealth)

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* ACT Planning Authority
* ACTEW
* ACT Health Surveillance Service
* Yarrowlumla Shire Council
* Queanbeyan City Council
* NSW Department of Planning
* NSW State Pollution Control Commission
* NSW Department of Water Resources.

In most matters the NSW Department of Water Resources acts as a coordinating point for the NSW authorities. The main focus for ACT/NSW liaison on water quality issues is the Water Network on which the Service is represented, as well as the Office of the Environment .

Chemical spills

The accidental spillage of industrial chemicals and other hazardous substances is a potential major threat to the biological integrity of Jerrabomberra Wetlands. The major risk is from any spill in the vicinity of the Eastern Parkway bridges across Molonglo Reach. Other possibilities include spills:

* on Morshead Drive where it runs parallel to Molonglo Reach;
* on Dairy Road especially near Molonglo Reach, Kelly's Swamp or Jerrabomberra Billabongs;
* on Ipswich Street near the Jerrabomberra Creek bridge;
* on the railway lines to the west of the silt trap - billabongs area;
* from the Department of Administrative Services depot on Newcastle Street, or from any facilities constructed in future on the adjoining lands; and
* within Fyshwick that find their way into the catchment of the Wetlands.

Responsibility for management of chemical spills in the urban area lies with the Canberra Fire Brigade and Australian Federal Police. The Office of the Environment has the role of providing advice on measures to be taken for disposal of chemicals.

Installation of sumps, drains, bunds or booms at critical points to contain a spill, redirect it or reduce the quantity released into the environs are means that may be used to minimise the impact of spills.

The Service will liaise with appropriate authorities and make any investigations which may be necessary to establish whether actions should be taken to reduce the threat or risk of chemical spills which may affect Jerrabomberra Wetlands.

Pollution legislation and Jerrabomberra management

Three actions proposed elsewhere in this plan may require permits under either the *Water Pollution Act 1984, the Air Pollution Act 1984* or the *Pesticides Act 1989*. They are:

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* the use of herbicides over water, to kill emergent reeds such as cumbungi bulrush (*Typha australis*);

* the burning of emergent reeds; and

* major earthworks.

The reasons that these activities might be carried out are explained in section 3.2.3 under the headings "Management of aquatic plants" and "Protection and enhancement of habitat values", and section 3.6.6 "Removal and control of sediments within Jerrabomberra Wetlands".

The *Pesticides Act 1989* requires that herbicides used in the ACT be registered for their intended purpose. In addition to meeting this requirement, the Service will, before implementing any management program, and in conjunction with the OOE and the ACT Public and Environmental Health Service, perform a documented assessment of the health, employee safety and environmental implications of the use of any herbicide for control of emergent reeds .

The *Air Pollution Act 1984* provides for the burning of plant matter on unleased land for land clearing and fire hazard reduction purposes. Permits may be issued on behalf of the Pollution Control Authority by the ACT Rural Fire Service. Current policy is to issue permits only for days of moderate atmospheric stability, and when the wind forecast indicates that smoke would be moved away from the built up area.

Any major earthworks that may impact upon water quality are subject to the *Water Pollution Act 1984*, and require a licence. Steps are required to prevent any eroded material or polluted water from leaving the work site.

3.6.5 Dredging of East Basin

The significance of any proposal to carry out dredging operations in East Basin is that any pipelines used to remove sediment could pass through Jerrabomberra Wetlands, because other lands around East Basin are more elevated and generally occupied by suburban or commercial development.

Dredging of part or all of East Basin has been contemplated by relevant authorities during the last two decades, and may be considered again, although the current view appears to be that "macrophyte beds in East Basin may be retained as a means of controlling algae" (NCDC 1988b). Retention of the macrophyte beds entails retention of the sediments in which the plants are embedded.

The reasons for or against any dredging proposal in East Basin are outside the scope of this plan. In so far as any dredging operation would affect Jerrabomberra Wetlands, the appropriate level of assessment and documentation specified by the Commonwealth's *Environmental Assessment (Impact of Proposals) Act* will be carried out.

3.6.6 Removal and control of sediments from within Jerrabomberra Wetlands

The nature of many of the waterbodies comprising Jerrabomberra Wetlands is that they accumulate sediment in a process which eventually transforms waterbodies to swamps, marshes and finally, dry land. Human activity in the catchment of these waterbodies can result in enormous increases in the rate of sediment accumulation. In a few years Jerrabomberra Pool has been transformed by this process to a generally shallow waterbody supporting reeds well out from the shoreline.

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Changes in the catchment of Jerrabomberra Creek could have strong effects on the rate of sediment accumulation at Jerrabomberra Wetlands (for example, changed management of the silt trap, possible suburban development within the immediate catchment at Harman, Symonston or in NSW, and installation of any structures within the bed of Jerrabomberra Creek or its tributaries such as impoundments, road crossings or pollution traps). Changes in the management of the silt trap may be required as it is in poor condition due to the severe erosion to the inlet.

Some features resulting from sediment accumulation have a positive value for nature conservation and in particular for the display of waterbirds. Sedimentation is a natural process in a flood plain environment. However at an increased rate sedimentation can threaten the conservation, education and recreation values of Jerrabomberra Wetlands.

Management policy

Sediment will be removed where necessary to preserve the varied wetland character of Jerrabomberra Wetlands, to protect the potential for display or education and to preserve a diversity of landforms and wildlife habitats.

Management will encourage development of sediment control off-site by environmentally sound catchment management and pollution control. Sediment removal is a destructive process in the short term. The removal of sediment from any particular waterbody will be preceded by an assessment of the environmental impact of the operation and its consequences. If necessary, mitigation measures appropriate to the management objectives for the wetlands will be determined and applied.

Operational management of the Jerrabomberra silt trap may require periodic removal of sediment. The Service will liaise closely with its management authority, the Department of Urban Services, to ensure management objectives for the wetlands receive adequate consideration during such an operation.

3.7 LANDSCAPE MANAGEMENT

Jerrabomberra Wetlands is part of two larger visual units, the Dairy Flat flood plain and the Lake Burley Griffin foreshores, both of which contribute to the setting of the national capital. Its existing landscape character is mostly open and rural, with distant views to the surrounding hills. Deciduous trees dominate the banks of Jerrabomberra Creek and Molonglo Reach and are scattered along the lakeshore. Gaps in the screen of deciduous trees fringing the lakeshore provide glimpses of significant elements in the national capital landscape including Parliament House, Captain Cook Memorial Water Jet and the Carillon. The landfill area on the south bank of Jerrabomberra Reach and the environs of Kelly's Swamp have been planted with native species, which on maturity will provide a backdrop and visual definition to the open rural flood plain, as well as creating a diversity of habitats to encourage birds and other wildlife.

In addition to the internal landscape characteristics of Jerrabomberra Wetlands, it is important to consider the Wetlands in the broader landscape context, especially with respect to views from Lake Burley Griffin and elevated areas such as Mt Pleasant and the Eastern Parkway.

The flood flow regime through Jerrabomberra Wetlands can be affected by tree plantings (and other interruptions to the free movement of water), and is a factor requiring management consideration.

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Management policy

The management of Jerrabomberra Wetlands will be directed at retaining the existing open rural character of the Dairy Flat flood plain, and retaining the existing visual character of the lakeshore landscape with its fringe of exotic trees. (See also section 3.2.3 "Existing exotic trees").

Plantings of native species on the landfill area around Kelly's Swamp, and in limited areas along the northern side of Jerrabomberra Reach, will be designed and managed to enhance biological and visual diversity, and to provide a visual edge to the open flood plain area.

Grazing and other vegetation management strategies will recognise the retention of landscape characteristics as an important objective.

Landscape management will be directed at retaining the following essential features.

* The rural flood plain landscape of open grassland with temporary and permanent water features. Scattered clumps of shrubs and/or trees which do not interfere with its open character may be introduced to complement those existing, to act as screens to otherwise intrusive features or to serve a specified habitat enhancement role. Vegetation which follows former or existing fencelines and other land unit boundaries is not considered essential to this picture and may be removed. The Dairy Road and Eastern Parkway developments intrude on the flood plain vista, but it is not intended to ameliorate this effect by screen plantings. Possible hydraulic effects and an even more intrusive breaking up of the general scene could result. An exception is that part of Dairy Road between Newcastle Street and Kelly's Swamp carpark where some screen plantings have already been undertaken. Subject to hydraulic considerations, the principle of plantings to screen, provide habitat and reinforce other landscape developments will continue to be followed.

* The role of the Wetlands as a component of the landscape of Lake Burley Griffin and its setting in the National Capital. In this context the Lake Burley Griffin and Molonglo Reach boundaries of Jerrabomberra Wetlands are significant landscape features. Vegetation species and their relative distributions and densities contribute to the character of the area and will be managed to maintain the existing visual effect. Special attention will be given to the minimisation of unsympathetic visual intrusions such as contrasting plantings and over-obvious visitor or management facilities.

The raised landfill area to the south of Jerrabomberra Creek is an evolving landscape feature, which together with the Kelly's Swamp area will become more heavily vegetated and contain the majority of developed facilities. Landscape management will be directed towards maintaining a balanced and harmonious visual effect to support and reinforce its role in introducing visitors to Jerrabomberra Wetlands, providing a variety of wildlife habitats and screening sensitive areas from unnecessary disturbance. In addition, a longer term effect will be to form a vegetated backdrop to the flood plain when viewed from the north and west.

Liaison with ACT City Services will be established as part of the planning procedure for landscape development and management, to ensure that factors affecting flood flow regimes receive adequate consideration.

3.8 CULTURAL HERITAGE

The location of Jerrabomberra Wetlands was a site favoured by the local Aboriginal people. Records made by early settlers and the large number of artifacts recovered from market gardens at nearby Pialligo (NCDC 1988c) indicate that the fertile flood plain was well used over a long period. Evidence for such use has been obscured at Jerrabomberra Wetlands by ploughing and other agricultural activities.

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It is likely that considerable numbers of stone tools are buried near the surface and could be exposed by disturbance such as earthworks or scouring by floods.

There is little if any significant archaeological evidence at Jerrabomberra Wetlands from the period of European settlement. Effects of European activities on landscape and vegetation are dealt with elsewhere in the plan.

Management policy

Collection of, or disturbance or damage to any prehistoric or historic artifacts from within the Nature Reserve will not be permitted, except as may be permitted under the *Heritage Objects Act 1991*. Where disturbance or removal of artifacts is justified for research or by risk of loss or damage, such removal will only be carried out by suitably experienced personnel authorised by the Service. Full site recording will precede collection.

All artifacts collected will be recorded and lodged with an authorised repository or other such place as determined under the *Heritage Objects Act*.

A formal cultural resource survey of Jerrabomberra Wetlands Nature Reserve will be conducted, as resources permit, to strengthen the resource data base and guide management policy.

3.9 GEOMORPHOLOGICAL SITES

One geomorphological feature of Jerrabomberra Wetlands which is of local and regional significance is the set of ancient meander channels, or palaeochannels, and levee banks indicating the former flow paths of the Molonglo River. These features are represented by the flooded fingers of water forming Jerrabomberra Backwaters and by the damp depressions which can be followed on foot across the grazing area, or seen clearly from the air, on aerial photographs or from the top of Mt Pleasant.

According to the then NCDC (1988c) the site is the only extensive area of flood plain with palaeochannels in the ACT. As such it is a potentially useful teaching resource.

Section 3.2.3 of this plan refers to the possibility that in the long term the existing drainage pattern could be altered deliberately, thereby flooding some channels or creating islands by linking channels, in order to enhance waterbird habitat. At the time any earthworks which could affect the palaeochannels are considered by the Service, due regard will be given to the value of retaining a representative area of palaeochannels in a recognisable form.

3.10 FACILITIES MANAGED BY OTHER AUTHORITIES

A general description of facilities within Jerrabomberra Wetlands which are managed for the community by authorities other than the Service is at Table 3 and their location is indicated at Map 6. Other facilities could be added in future subject to the *Land (Planning and Environment) Act 1991*. Known proposals are discussed at section 2.5.

The Service will formalise management agreements with other authorities which require access to Jerrabomberra Wetlands for the management of facilities or other operational reasons. These agreements will include provisions designed to ensure that vehicle access and other use or disturbance is minimised and confined to purposes directly related to the organisation's functions. The agreements will require the other authorities to observe the provisions of this plan.

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Table 3 Facilities managed by other authorities

Authority	Facility
ACT Electricity and Water Authority	. Googong bulk supply water main . Fyshwick sewerage rising mains . Duntroon irrigation rising main . Fyshwick Sewage Treatment Plant . powerlines
ACT City Services	. Jerrabomberra silt trap

The ponds comprising part of the Fyshwick Sewage Treatment Plant are outside the Nature Reserve, but have been referred to in section 3.2.3 in order to reflect their relationship to the rest of the wetlands. They are part of a facility managed by the ACT Electricity and Water Authority, albeit one which has nature conservation and recreation value. An agreement has been reached between the Service and ACTEW about public access to the ponds and is reported in section 3.2.3.

The sewerage rising mains located within the Jerrabomberra Wetlands will require regular monitoring for leaks and maintenance requirements.

The twin 132 kV powerline crossing Jerrabomberra Backwaters (Map 6) commenced operating in 1986/87. The standard of the construction access road, put in for the purpose, is excessive for future service access needs, and intrudes unnecessarily on the landscape amenity. The Service will seek the cooperation of ACTEW in downgrading the access road to a standard which will satisfy service access needs but reduce visual impact.

A small housed pump on the Molonglo River (Map 6) supplies irrigation water by underground pipe to the Goldenholme lease east of Dairy Road. The facility will remain for the purpose and an occupancy authority will be granted to the lessee of Goldenholme to satisfy statutory requirements.

3.11 MANAGEMENT FACILITIES

Management infrastructure at Jerrabomberra Wetlands is minimal, although a number of improvements have been provided to assist visitor use of the area. Some management facilities are desirable for efficient operations, and for providing a degree of security to improvements and nature conservation values. Existing improvements which are managed by the Service are included at Map 6.

An option to be further investigated is the provision of staff accommodation with associated plant and equipment storage facilities. The need for an on-site residence for enhanced security and management effectiveness is not necessary at this stage, but is an option that may be considered in the future.

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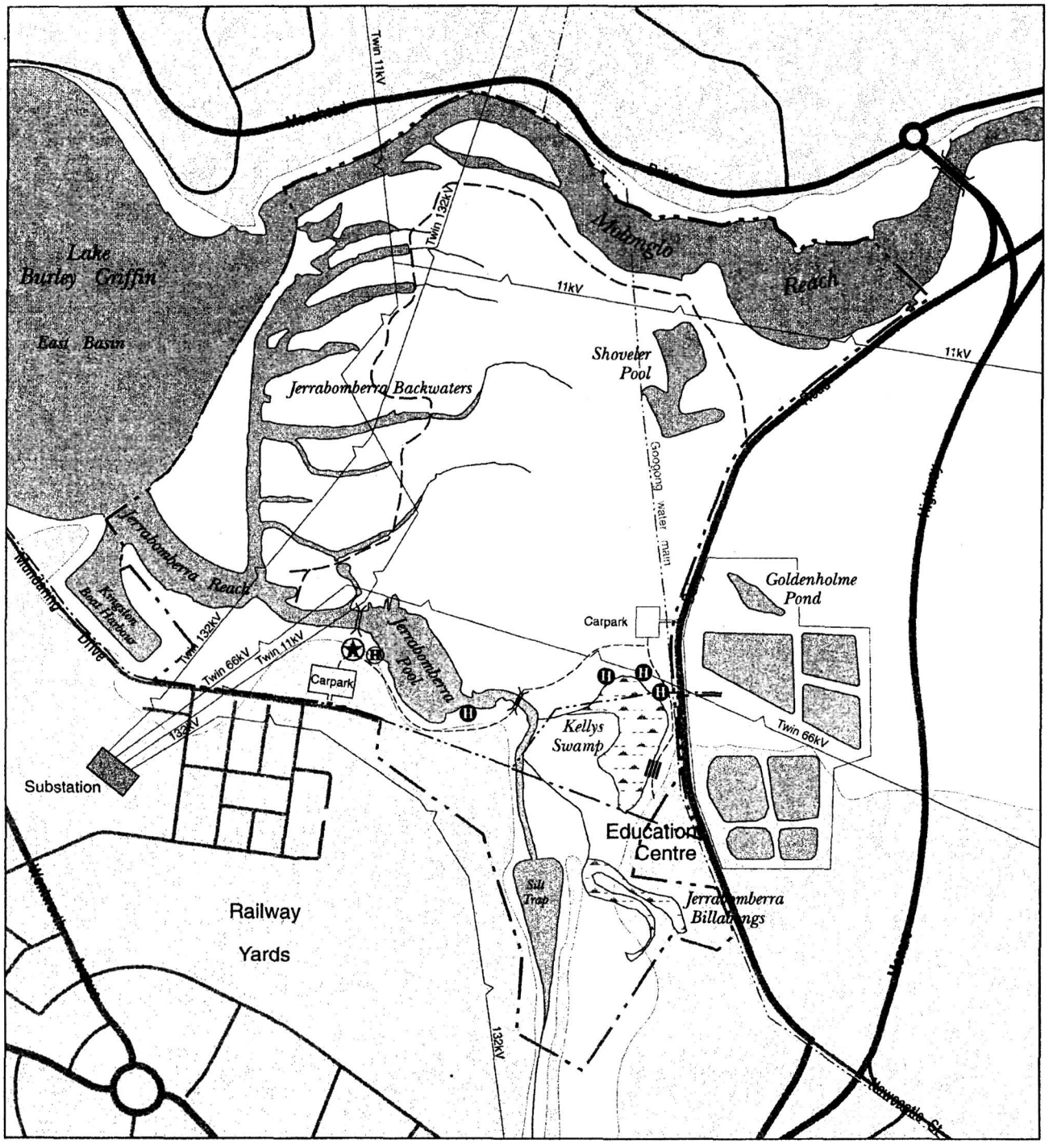
MAP 6 - Services and developments



- Jerrabomberra Wetlands Nature Reserve
- Powerlines
- Service road to powerlines
- 100 year flood level
- Pedestrian path
- Proposed observation hide
- Existing and proposed sewerage mains
- Pumphouse
- Viewing platform

0 100 200 300 400
Metres

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4. MANAGEMENT PRIORITIES SUMMARY

Management proposals for the Wetlands are indicated below according to the priority attached to their implementation. Their timing will be subject to the availability of appropriate resources. Works proposed which involve capital expenditure are subject to development planning, financial programming and resource allocation. They are options to be considered in the context of achieving management objectives for the Nature Reserve and will be assessed on merit and circumstance as management programs are implemented. Sponsorship funds will be actively sought to assist with the development program.

Those actions defined as 'works' in the *Australian Capital Territory (Planning and Land Management) Act 1988* are subject to the National Capital Plan (NCPA 1990) and require the approval of the NCPA.

Action	Priority	Reference
Liaise with relevant authorities about Kingston redevelopment	High	2.5
Refuge Area: . determine current restrictions & implement permit system . monitor effects of access . regularly inform ACTEW of management requirements & seasonal factors	High	3.2.3
Monitor waterbird occurrence & breeding	High	3.2.3
Prepare interpretation plan	High	3.3.3
Investigate possibility of cooperative staffing arrangements with other government & community groups	High	3.3.3
Construct pedestrian network including paths, bridges, board-walks etc.	High	3.3.3
Provide unstaffed interpretation facility	High	3.3.3
Conduct cultural resource survey	High	3.8
Liaise with ACTEW & relevant planning authority about removal of redundant powerlines	High	3.10
Remove causeway to island in Molonglo Reach & modify powerline construction road	High	3.10
Compile register of conservation values, significant wildlife & sites	High	3.2.3
Assess environmental effects of any proposed earthworks & obtain expert advice if necessary, especially with respect to any hydrological effects	High	3.2.3

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Continue to monitor and control pest species and aquatic plants	High	3.2.3 3.6.2
Compile register of options for enhancement of habitat values	Medium	3.2.3
Carry out works necessary to open Fyshwick Sewage Treatment Ponds to the public	Medium	3.2.3
Provide visitor facilities at cormorant breeding area	Medium	3.2.3
Erect signs &/or booms if necessary to control access by water. Monitor water recreation use	Medium	3.2.3
Construct toilets	Medium	3.3.3
Plan the siting of bird hides; partly dependant on observation of bird behaviour	Medium	3.4.3
Expand bird hide facilities	Medium	3.4.3
Obtain expert advice on water quality monitoring	Medium	3.6.4
Liaise & investigate as necessary to reduce threat of chemical spills affecting the Wetlands	Medium	3.6.4
Liaise with ACT City Services for production of silt trap management plan	Medium	3.6.6
Commence provision of management facilities	Medium	3.11
Liaise with graziers about stocking rates	Low	3.2.3
Establish grazing exclosures	Low	3.2.3
Alter fences to improve grazing management to achieve objectives	Low	3.2.3
Conduct feasibility study for introduction of native grasses	Low	3.2.3
Liaise with ACT Department of Education about grazing on Jerrabomberra Billabongs	Low	3.2.3
Establish management strategies for Goldenholme Pond	Low	3.2.3
Assess possible provision of viewing point for Shoveler Pool	Low	3.2.3
Provide outdoor facilities for activities such as limnological studies	Low	3.3.3

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Liaise with water quality authorities about catchment management	Low	3.6.4
Authorise land occupancy associated with Goldenholme irrigation pump	Low	3.10
Determine management infrastructure requirements	Low	3.11

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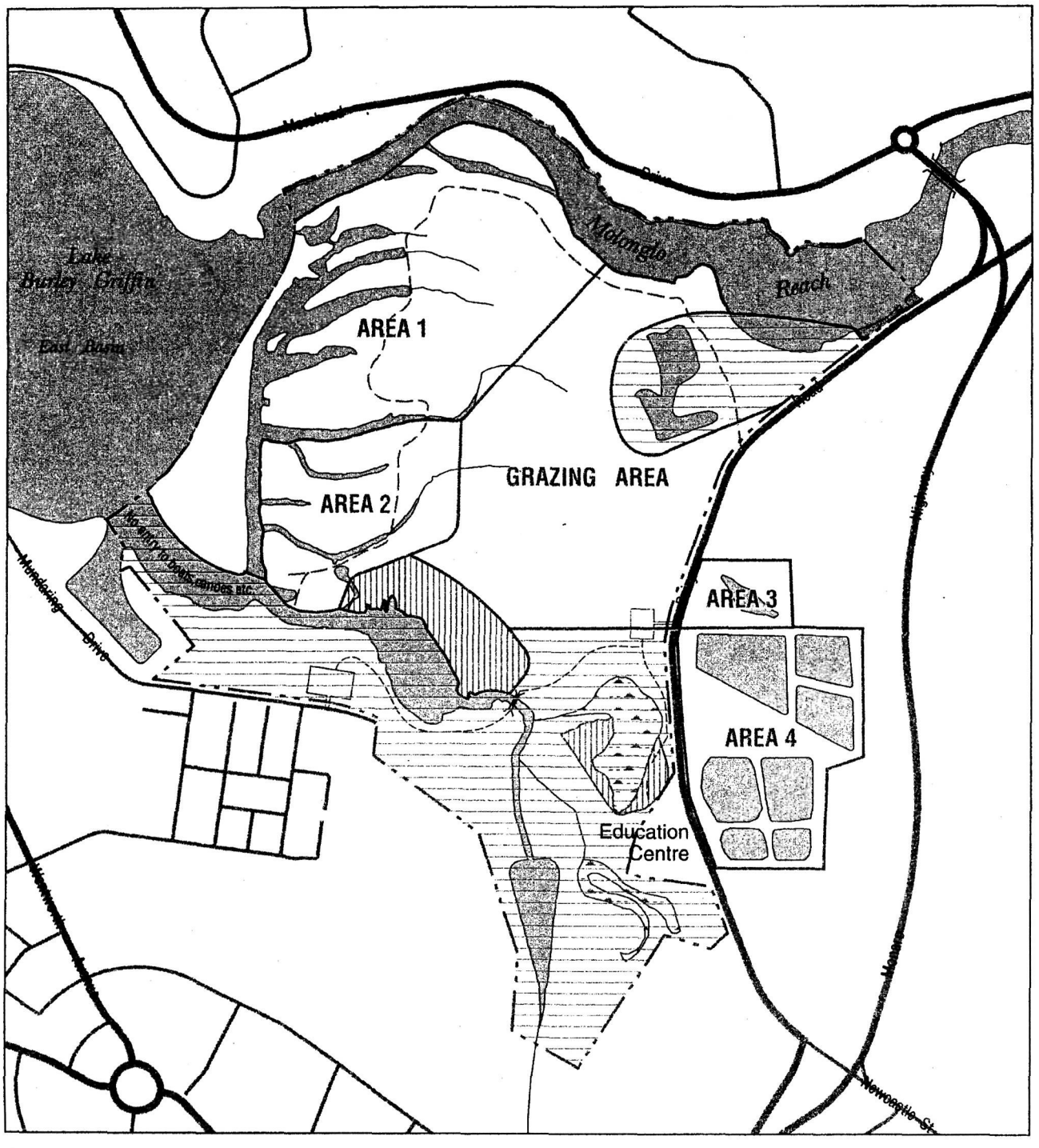
MAP 7 - Summary of management proposals



AREA 1	Refuge area - protection and habitat enhancement. Restricted access
AREA 2	Limited access under controlled conditions
AREA3	Resumed from lease. Bird viewing opportunities developed
AREA 4	Public access to be provided. Bird viewing opportunities developed
	Public access facilities to be developed
	Access discouraged to protect bird viewing opportunities
	Intensive recreation. Barbeques along northern side of Molonglo Reach
	Jerrabomberra Wetlands Nature Reserve

0 100 200 300 400
Metres

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ABBREVIATIONS

ACT	Australian Capital Territory
ACTPCS	ACT Parks and Conservation Service
ACTEW	ACT Electricity and Water Authority
ACTGS	ACT Government Service
DAS	Commonwealth Department of Administrative Services
CAA	Civil Aviation Authority
COG	Canberra Ornithologists Group Inc.
Lake	Lake Burley Griffin
NCA	*Nature Conservation Act 1980*
NCDC	National Capital Development Commission
NCPA	National Capital Planning Authority
NSW	New South Wales
RAAF	Royal Australian Air Force
Service	The ACT Parks and Conservation Service. The Service is part of the ACT Department of the Environment, Land and Planning
ACTPA	ACT Territory Planning Authority
UNEP	United Nations Environment Program
UNESCO	United Nations Education, Scientific and Cultural Organisation

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GLOSSARY

ACT Parks and Conservation Service. The administrative unit of the ACT Government, charged with giving effect to the Minister's responsibility for management of the land within Jerrabomberra Wetlands Nature Reserve. In the event of any change in administrative arrangements this means its successor.

Goldenholme Pond. Name coined for the purpose of this document. Refer map 2 for location.

Jerrabomberra Backwaters. Name coined for the purpose of this document. Refer map 2 for location.

Jerrabomberra Billabongs. Name coined for the purpose of this document. Refer map 2 for location.

Jerrabomberra Reach. Name coined for the purpose of this document. Refer map 2 for location.

Jerrabomberra Wetlands. The area subject to this plan defined at map 2.

Jerrabomberra Wetlands Nature Reserve. That part of Jerrabomberra Wetlands which is declared under the Nature Conservation Act as a reserved area (see map 2).

Management plan. A written statement, approved and adopted by the Minister, of the management objectives, strategies and practices which will be adopted in management of a nature reserve or other defined area of land.

Manager (of Jerrabomberra Wetlands Nature Reserve). An official of the ACT Parks and Conservation Service with the authority to take the action specified. In most cases this means the Conservator of Wildlife appointed under the Nature Conservation Act, or his delegate.

Minister. The ACT Government Minister responsible for administration of the *Nature Conservation Act 1980*.

NCDC. The National Capital Development Commission; established under the *National Capital Development Commission Act 1957* and abolished in 1988 with the advent of self government for the ACT.

NCPA. The National Capital Planning Authority; successor to the NCDC as Commonwealth planning authority for the ACT.

Service. The ACT Parks and Conservation Service. (see above).

Shoveler pool. Name coined for the purpose of this plan. Refer map 2 for location.

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APPENDICES

Appendix 1 Bird species recorded at Jerrabomberra Wetlands

Common names follow the list given by Royal Australian Ornithologists Union (1978).

Key

Abundance		Residence Status		Habitat	
VR	very rare	N	nomadic	A	aquatic plants
R	rare	N*	no set pattern	D	deep water
U	uncommon	R	permanent resident	G	grasslands
C	common	B	breeds in reserve	M	mudflats
S	seasonal, nomadic or sporadic (refers to terrestrial birds only)	S	seasonal	S	shoreline areas
		E	escapee	T	shoreline trees
				P	sewage ponds

Part 1 Waterbirds

Common name	Abundance	Residence Status	Habitat
Grebe, Great Crested	U	N	D
Grebe, Hoary-headed	C	R	ADP
Grebe, Australasian	C	BR	ADP
Pelican, Australian	C	N*	ADMS
Darter	U	B	DT
Cormorant, Great	C	R	ADGMST
Cormorant, Pied	R	N*	DST
Cormorant, Little black	C	BR	DST
Cormorant, Little pied	C	BR	DST
Heron, Pacific	U	S	AGMS
Heron, White-faced	C	R	AGMS
Egret, Cattle	C	S	GM
Egret, Great	U	N	AS
Egret, Little	R	N*	AS
Egret, Intermediate	R	N*	AS
Heron, Rufous Night	U	N*	AGST
Bittern, Little	R	N*	A
Bittern, Australasian	VR	N*	
Stork, Black-necked	VR	N*	
Ibis, Glossy	R	N*	AG
Ibis, Sacred	U	N*	GS
Ibis, Straw-necked	U	N*	G
Spoonbill, Royal	C	S	M
Spoonbill, Yellow-billed	C	S	MS
Duck, Plumed Whistling	VR	N	
Swan, Black	C	BR	ADSP
Duck, Freckled	R	N*	ADP
Goose, Cape Barren	VR	E	GS

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Waterbirds (cont.)

Common name	Abundance	Residence Status	Habitat
Goose, Domestic	U	E	ADS
Shelduck, Australian	U	S	AMS
Duck, Pacific Black	C	BR	ADGMSTP
Teal, Grey	C	BR	ADMSP
Teal, Chestnut	U	R	ADMSP
Shoveler, Australasian	C	S	ADMSP
Duck, Pink-eared	U	N*	DMS
Hardhead	C	R	ADSP
Duck, Maned	C	BR	AGSP
Duck, Blue-billed	R	N	DP
Duck, Musk	U	BR	A
Duck, Domestic & Hybrids	C	R	ASD
Sea-eagle, White-bellied	R		
Harrier, Marsh	R		
Rail, Buff-banded	R	BN	AMS
Rail, Lewins	VR	U	AMS
Crake, Baillons	U	S	ASM
Crake, Australian	U	S	ASM
Crake, Spotless	R	S	ASM
Native-hen, Black-tailed	VR	E	AST
Moorhen, Dusky	C	BR	GASP
Swamphen, Purple	C	B	AGST
Coot, Eurasian	C	B	ASGP
Snipe, Painted	VR	N*	
Plover, Lesser golden	VR	N*	
Dotterel, Red-kneed	C	S	SM
Plover, Double-banded	R		MS
Plover, Red-capped	VR	N*	SM
Plover, Black-fronted	C	BR	SM
Stilt, Black-winged	U	N*	MSP
Avocet, Red-necked	VR	N*	MS
Curlew, Eastern	VR	N*	MS
Sandpiper, Wood	R		MS
Tattler, Grey-tailed	VR	N*	
Sandpiper, Common	VR	N*	
Greenshank	VR	N*	
Sandpiper, Marsh	VR	N*	
Snipe, Latham's	C	S	AGM
Godwit Bar-tailed	R		MS
Sandpiper, Sharp-tailed	U	N*	MS
Sandpiper, Pectoral	R		MS
Stint, Red-necked	R	N*	MS
Sandpiper, Curlew	VR	N*	
Gull, Silver	C	R	AGMSP
Tern, Whiskered	R	N*	DP
Tern, Gull-billed	R		D
Tern, Caspian	R		D
Reed warbler, Clamorous	C	B	ASP
Grass bird, Little	C	B	A

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Part 2 Terrestrial birds (no status or habitat available)

Common Name	Abundance	Common Name	Abundance
Kite, Black-shouldered	C	Robin, Flame	S
Kite, Whistling	N	Robin, Scarlet	S
Goshawk, Brown	C	Jacky Winter	R
Sparrowhawk, Collared	U	Whistler, Golden	U
Goshawk, Grey	R	Whistler, Rufous	C
Eagle, Wedge-tailed	R	Shrike-thrush, Grey	U
Eagle, Little	U	Flycatcher, Satin	R
Harrier, Spotted	R	Flycatcher, Restless	R
Falcon, Black	R	Fantail, Rufous	S
Falcon, Peregrine	U	Fantail, Grey	C
Hobby, Australian	U	Willie Wagtail	C
Falcon, Brown	R	Cisticola, Golden-headed	C
Kestrel, Australian	C	Songlark, Rufous	S
Quail, Stubble	U	Songlark, Brown	R
Quail, Brown	R	Fairy Wren, Superb	C
Lapwing, Masked	C	Scrubwren, White-browed	C
Lapwing, Bonded	R	Gerygone, Western	U
Pigeon, Feral	C	Gerygone, White-throated	U
Dove, Peaceful	R	Thornbill, Brown	R
Pigeon, Crested	R	Thornbill, Yellow-rumped	C
Black-Cockatoo, Yellow-tailed	R	Sitella, Varied	R
Cockatoo, Gang-gang	U	Wattlebird, Red	C
Galah	C	Friarbird, Noisy	S
Cockatoo, Sulphur-crested	C	Honeyeater, Yellow-faced	S
King-parrot, Australian	U	Honeyeater, White-eared	S
Rosella, Crimson	U	Honeyeater, Fuscous	S
Rosella, Eastern	C	Honeyeater, White-plumed	C
Parrot, Red-rumped	C	Honeyeater White-naped	S
Cuckoo, Pallid	S	Spinebill, Eastern	R
Cuckoo, Fan-tailed	S	Chat, White-fronted	U
Bronze-cuckoo, Horsefield	S	Mistletoe bird	R
Bronze-cuckoo, Shining	S	Pardalote, Spotted	C
Owl, Barn	R	Pardalote, Striated	R
Needletail, White-throated	R	Silvereye	C
Kingfisher, Sacred	C	Goldfinch, European	C
Kingfisher, Azure	R	Greenfinch, European	U
Kookaburra, Laughing	C	Sparrow, House	C
Bee-eater, Rainbow	S	Firetail, Red-breasted	C
Dollarbird	S	Finch, Zebra	U
Skylark	C	Starling, Common	C
Swallow, Welcome	C	Myna, Common	C
Martin, Tree	S	Chough, White-winged	C
Martin, Fairy	S	Magpie-lark	C
Pipit, Richards	C	Wood swallow, Dusky	S
Cuckoo-Shrike, Bl. faced	C	Magpie, Australian	C
Triller, White-winged	S	Currawong, Pied	C
Thrush, White's	R	Raven, Australian	C
Blackbird	C	Raven, Little	R

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Appendix 2 Reported birdstrikes at Canberra Airport between 1969 and 1987 (by bird species)

Species	No. of strikes
Galah	55
Magpie	19
Plover	15
Hawk	6
Kestrel	3
Wedge-tailed Eagle	2
Duck	4
Silver Gull	1
Pipit/Skylark	4
Swallow	3
Starling	3
Sparrow	2
Bat	1
Unknown	31
Total	149

Information from the Bird Hazard Investigation Unit, Civil Aviation Authority

Appendix 3 Jerrabomberra Wetland birds considered potentially hazardous to aircraft

Australian Pelican	Royal Spoonbill
Black Swan	Yellow-billed Spoonbill
Darter	Black Duck and other Ducks
Cormorants	White-bellied Sea-eagle
White-faced Heron	Marsh Harrier
Rufous Night-heron	Masked Lapwing
Sacred Ibis	Migratory Waders
Straw-necked Ibis	Silver Gull

Information from: *Jerrabomberra Wetlands: an Ecological Basis for Planning and Development* (NCDC 1982)

Appendix 4 Environmental Educational Principles and Philosophy

UNEP/UNESCO Principles of Environmental Education:

* To defend and improve the environment for present and future generations has become an imperative goal for mankind.

* Education utilising the findings of science and technology should play a leading role in creating an awareness and a better understanding of environmental problems.

* Environmental education should be provided for all ages, at all levels and in both formal and non formal education.

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* Environmental education must look outward to the community. It should involve the individual in an active problem-solving process.

The National Conservation Strategy for Australia:

* The provision of environmental information services at various technical levels is an important strategy as it encourages the motivated and concerned. Without them, responsible public participation in decision-making about the environment would be impossible.

* The purpose of environmental education services is to produce an environmentally literate citizenry who will not only have a basic knowledge of the environment, but a sensitivity to it, a concern for and commitment to sound environmental management and the basic skills of problem-solving and decision-making in relation to the environment.

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