

Forrestdale Lake Nature Reserve

Draft Management Plan

2003



 Conservation
Commission
WESTERN AUSTRALIA



DEPARTMENT OF
Conservation
AND LAND MANAGEMENT
Conserving the nature of WA

FORRESTDALE LAKE NATURE RESERVE

Draft Management Plan 2003

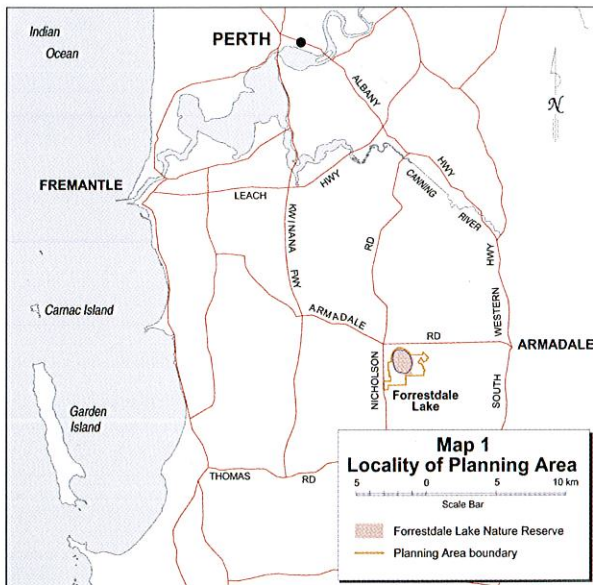
PART A INTRODUCTION

Forrestdale Lake Nature Reserve (Forrestdale Lake) is a Class A reserve of 245 hectares, gazetted for the Conservation of Flora and Fauna. It is located approximately 25 kilometres south east of Perth, in the City of Armadale (Map 1).

Situated on the Swan Coastal Plain and in the Swan Coastal Plain bioregion, the reserve is one of the most important conservation areas in south-western Australia (Department of Conservation and Land Management 1987). It is internationally important as a habitat and refuge for water birds, and in 1990, along with Thomsons Lake, was included on the List of Wetlands of International Importance known as the Convention on Wetlands (Ramsar, Iran, 1971).

It is also included in the *Directory of Important Wetlands in Australia* (2001), and, due to its significance for flora and fauna conservation and recreation, was added to the Register of the National Estate in March 1978.

Map 1 Locality



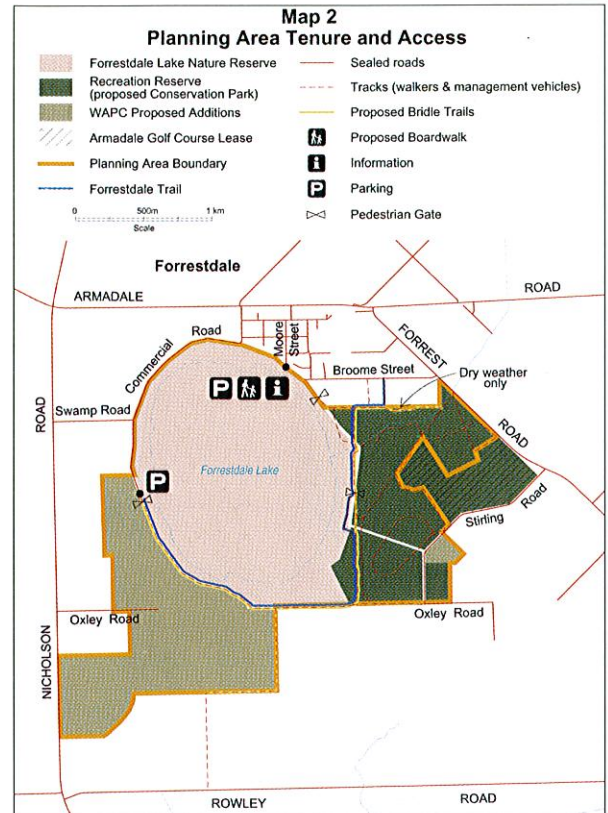
PLANNING AREA

This management plan also incorporates the adjoining Recreation Reserve number 27165, excluding the current golf course lease, and adjoining land that is owned by the WA Planning Commission (WAPC). The Bush Forever report (State of Western Australia 2000) recommends that this WAPC land be

added to the Nature Reserve (Map 2), which has been addressed in this management plan.

Therefore, throughout the plan any reference to Forrestdale Lake Nature Reserve should be read as including Reserve number 27165 and the adjoining WAPC land, as shown in Map 2.

Map 2 Planning Area Tenure and Access



KEY VALUES OF THE PLANNING AREA

The outstanding key values of the reserve are those that contribute to its Ramsar listing. In its joint listing with Thomsons Lake, Forrestdale Lake satisfies three criteria for nomination to the Ramsar list.

- It is an internationally significant waterbird habitat which regularly supports more than 1 per cent of the individuals of the known Australian population of the long-toed stint.
- It is of special value for maintaining the genetic and ecological diversity of the region because of the qualities and peculiarities of its flora and fauna.

- It is a particularly good representative of a natural or near-natural wetland, characteristic of those that were once widespread on the Swan Coastal Plain.

(Environment Australia 2001)

Other key values are:

- rich Aboriginal heritage;
- its significance for the protection of Rare, Threatened and Priority flora and fauna, and Threatened Ecological Communities (TECs);
- plant communities representative of the eastern side of the Swan Coastal Plain; and
- natural and cultural values close to urban centres that provide opportunities for nature appreciation and education.

The main aim of this management plan is to protect these key values, by setting objectives and developing strategies to meet such objectives (Table 1).

LAND TENURE

Forrestdale Lake is a Class A Nature Reserve (number 24781), gazetted in 1988 for the Conservation of Flora and Fauna. It is vested with the Conservation Commission of WA (Conservation Commission). The adjoining reserve (number 27165) is vested in the City of Armadale for the purpose of Recreation, and is reserved for 'Parks and Recreation' in the Metropolitan Region Scheme (MRS). It contains Declared Rare Flora (DRF) and Priority flora species and two TECs.

This management plan proposes that the vesting of the recreation reserve, excluding the golf course, be transferred to the Conservation Commission and that it be managed by the Department of Conservation and Land Management (the Department) as a conservation park. Negotiations to this effect are underway between the Department and the City of Armadale. It is proposed that upon release of this management plan, the Department will begin managing the portion of the reserve outside the existing golf course lease, consistent with the management of the nature reserve (Map 2).

The Department will continue negotiations with the City of Armadale regarding the transfer and management of part or all of the land occupied by the nine-hole golf course once the City's new course is developed and the Forrestdale course is no longer required. Any portion of the golf course managed by the Department will be rehabilitated in the long term and managed for conservation purposes.

Once agreement between the Department and the City of Armadale has been reached regarding the transfer of the golf course lands, the entire recreation reserve will be formally transferred to, and vested in, the Conservation Commission as conservation park. This tenure will enable continued access to the horse riding trails designated in this plan (Map 2).

The Department for Planning and Infrastructure (DPI) have been acquiring land under the MRS scheme consistent with the Bush Forever recommendations (Map 2), with the intention of adding them to the nature reserve. Negotiations are continuing between the Department and the DPI to have these lands added to the nature reserve and vested in the Conservation Commission. This is with the exception of the bridle trails designated in this plan, which will be Conservation Park.

There are also a number of road reserves in the planning area which are currently managed by the City of Armadale, and which are used as bridle trails by horseriders (see Map 2). This management plan proposes that these be closed and that the vesting of them be transferred to the Conservation Commission, for management by the Department.

REGIONAL SIGNIFICANCE

Forrestdale Lake Nature Reserve is located on the southern fringes of Perth's metropolitan area. It is one of the few remaining examples of the lakes and vegetation originally found on the Swan Coastal Plain, and is included in the *State Government Environmental Protection (Swan Coastal Plain Lakes) Policy (1992)* as a wetland having conservation value.

The Statement of Significance for Forrestdale Lake on the Register of the National Estate states that the lake is of regional importance in terms of bird numbers, being in the top one per cent of wetlands in the south west of WA for numbers of individual birds of 20 different bird species. It is one of 12 Ramsar sites in WA and one of four in the Swan Coastal Plain bioregion.

Adjacent land-uses at Forrestdale Lake include residential development (Forrestdale township), a primary school and rural-living blocks.

Significant conservation areas, namely the Jandakot Regional Park and the Wungong Brook, lie close to the planning area and are connected by existing vegetation or proposed re-vegetation sites, thus considerably extending regional wildlife corridors and habitat.

The planning area is part of Bush Forever site 345 'Forrestdale Lake and Adjacent Bushland, Forrestdale', which also includes adjoining lands and Conservation Category Wetlands that the Bush Forever report recommends be added to the nature reserve (State of Western Australia 2000).

PART B MANAGEMENT DIRECTIONS AND PURPOSE

VISION

The vision for Forrestdale Lake Nature Reserve is:

... to be recognised by the community for its international significance as a wetland providing refuge for both migratory waders and local waterbirds, and where natural, cultural (Indigenous and other Australian) and aesthetic values are appreciated and protected. Natural systems and processes will be able to function and evolve, and flora, fauna and habitats will be maintained in the same or better condition as they are today. The reserve will be managed in partnership with the community, as a refuge for wildlife and a safe place to be enjoyed by visitors, now and in the future.

LEGISLATIVE FRAMEWORK

Legislation

Management and planning for Forrestdale Lake Nature Reserve is influenced by the following legislation:

The Conservation and Land Management Act 1984 (CALM Act) which governs the declaration and management of protected areas, and in the process, imposes certain obligations relating to management planning of these areas.

The Wildlife Conservation Act 1950 (Wildlife Conservation Act) which governs the specific protection of native flora and fauna on all lands and waters within the State.

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The presence of the migratory birds protected under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA) means the site is given additional protection under the Commonwealth EPBC Act. Migratory species are listed as one of six matters of national environmental significance that trigger this Act, which means that any actions likely to have a significant impact on the migratory species must first be subject to environmental assessment and approval.

Ramsar wetlands are protected under the EPBC Act, which requires environmental assessments and approvals regimes for actions that have, or are likely to have, a significant impact on the wetlands. The Act also establishes standards for managing Ramsar wetlands through the Australian Ramsar Management Principles, which are stated as regulations under the Act (Environment Australia 2001).

Nature reserves are declared under the *Land Administration Act 1997*, vested in the Conservation Commission, and managed by the Department of Conservation and Land Management in accordance with the legislative specifications of the CALM Act, the Wildlife Conservation Act, and the policies of both the

Department and the Conservation Commission. The Department's primary objective in the management of nature reserves, as defined in section 56 of the CALM Act, is to:

"Maintain and restore the natural environment and to protect, care for, and promote the study of indigenous flora and fauna, and to preserve any feature of archaeological, historic or scientific interest."

The Department's decision making, and subsequent management, is further guided by the principles of its Corporate Plan (2002-2005) which state:

- the diversity and health of ecological communities and indigenous species throughout WA will be maintained and restored; and
- where there are threats of serious or irreversible damage, the lack of full scientific certainty shall not be used as a reason for postponing measures which seek to prevent loss of biodiversity.

OBLIGATIONS AND AGREEMENTS

Australia is a participant of, and signatory to, a number of important international conservation agreements. Many of these affect management of conservation estate, including:

Convention on Wetlands of International Importance (Ramsar Convention)

Australia became a signatory to the Ramsar Convention in 1974. This Convention obliges contracting parties to formulate and implement management plans to promote the conservation of wetlands included in the List of Wetlands of International Importance.

Forrestdale Lake, together with Thomsons Lake, is included on this list.

Japan-Australia Migratory Bird Agreement (JAMBA)/China-Australia Migratory Bird Agreement (CAMBA)

Australia has signed treaties with Japan and China to protect migratory birds. The JAMBA and CAMBA treaties provide for co-operation between the respective governments to protect migratory species and their habitats. Nearly 80 bird species are listed under these Agreements, 21 of which have been recorded at Forrestdale Lake (Burbidge 2002).

Wetlands Conservation Policy for Western Australia 1997

The Wetlands Conservation Policy for Western Australia is the result of the Government's recognition of the fundamental importance of conserving and managing wetlands in a sustainable manner. It outlines the Government's commitment to identifying, maintaining and managing the State's wetland resources, as well as the agencies involved and their responsibilities. Under this policy, a Wetlands Coordinating Committee chaired by the Department of Conservation and Land Management was established to coordinate the implementation of the policy.

PERFORMANCE ASSESSMENT

The Conservation Commission will measure the success of this plan by using the Key Performance Indicators (KPIs) identified in Table 1. The KPIs will also enable the Commission to gauge the success of this plan in protecting the key values identified previously, and how they have contributed to meeting the relevant strategies in the Department's Corporate Plan 2002-2005, viz.:

- Expand and improve the marine and terrestrial conservation reserve system to achieve world's best standards, by identifying and acquiring new conservation reserves.
- Recover threatened flora, fauna and ecological communities.
- Protect biodiversity from threatening processes, agents and activities, including feral animals, weeds, dieback and other exotic diseases, salinity and inappropriate fire regimes.
- Improve community knowledge of biodiversity conservation issues and awareness, understanding and support for the Department's activities, services and policies.
- Partner with other agencies and groups with similar interests.

The Department is responsible for providing periodic reports to the Conservation Commission to allow it to assess the success of its management in meeting the KPIs. The frequency of these reports will depend upon the requirements of each KPI, the satisfactory establishment of baseline information against which to audit, and any unforeseen changes to the environmental conditions. If the Commission determines that, based on the KPIs, values of the planning area are being degraded, they may instruct the Department to:

- alter its management to better address threats,
- change the objective in this management plan where it is considered unrealistic, or
- change the KPI where it is considered unrealistic.

The Department will invite public comment on any proposed amendments to its management of the planning area, where it is contrary to this management plan.

PART C MANAGING THE NATURAL ENVIRONMENT

BIOGEOGRAPHY

The Interim Biogeographic Regionalisation for Australia (IBRA) provides a framework for conservation planning for a comprehensive, adequate and representative system of protected areas to conserve Australia's terrestrial biodiversity. IBRA version 5 was developed by Environment Australia (2000), identifying 85 bioregions, based on lithology, geology, landform and vegetation, and each reflecting a unifying set of major environmental influences which shape the occurrence of flora and fauna and their interaction with the physical environment. Twenty-six bioregions occur in WA.

Forrestdale Lake Nature Reserve is in the Swan Coastal Plain bioregion, a low lying coastal plain, mainly covered with woodlands, which is dominated by banksia or tuart (*Eucalyptus gomphocephala*) on sandy soils, swamp sheoak (*Casuarina obesa*) on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland while the outwash plains, once dominated by *C. obesa* – marri woodlands and *Melaleuca* shrublands, are extensive only in the south (Environment Australia 2000).

About 15.3 per cent of the Swan Coastal Plain bioregion is currently vested in the Conservation Commission. Under the draft Forest Management Plan (Conservation Commission of WA 2002) it is proposed that this will increase to 17 percent, of which 0.03 percent will be represented in the planning area.

Forrestdale Lake is one of four internationally important and 29 nationally important wetlands in the Swan Coastal Plain bioregion (Environment Australia 2001).

GEOLOGY, LANDFORM AND SOILS

Forrestdale Lake is situated in the Perth Basin, on the eastern edge of the gently undulating Bassendean Dunes, which are predominantly leached grey-white siliceous sands. The lake is a deflation basin rimmed by low sand ridges up to five metres, and lakebed sediments that comprise sand to sandy organic mud overlying soft marly limestone and clayey sand (ANCA 1996). On the north-eastern margin of the lake, a rocky outcrop of lithified sandstone is present (Department of Conservation and Land Management 1987). Lake deposits up to two metres thick underlie Forrestdale Lake and include silt, clay, peat, diatomite, marl and freshwater limestone (ERM Mitchell McCotter 2000).

The geomorphology of the lake indicates that it began developing 5000 to 6000 years ago, and it is thought to have been part of an ancient river system (Giblett 1993).

Potential threats to the landform and soils of the planning area include erosion from uncontrolled horseriding and trail bikes. Such threats need to be ameliorated with appropriate strategies in this management plan.

CATCHMENT AND WATER PROTECTION

Hydrology

Forrestdale Lake is a surface expression of groundwater, with an area of open water covering up to 221 hectares, or 90 per cent of the total nature reserve. The ability of the lake to support waterbird populations depends on the presence and quality of water, both of which are directly affected by surrounding land use practices and groundwater management.

Forrestdale Lake is situated on the eastern margin of the Jandakot Groundwater Mound (JGM) where the mound intersects the Perth Groundwater Area. The mound is a region of elevated groundwater table beneath the Swan Coastal Plain. Groundwater discharges from the mound into low lying depressions that support groundwater dependent vegetation and extensive wetland systems, the most notable of which are Forrestdale and Thomsons Lakes. The water level of Forrestdale Lake responds to events that cause variations in the quantity of groundwater supply, evidence that the lake is strongly controlled by the local hydrology (ERM Mitchell McCotter 2000). The water regimes are affected both by natural processes such as rainfall, and as a result of modified land uses within catchments (such as groundwater extraction and urban development). In order to protect the wetland ecosystem, the impacts of existing and proposed land uses within its catchment need to be understood and managed.

Groundwater levels are controlled in the long term by climatic conditions. As Perth's climate has become increasingly drier since the 1970s, groundwater levels on the Jandakot Mound have progressively decreased. Other factors contributing to pressures on groundwater include water abstractions, which are now at management limits, and the influence of drainage on the wetlands.

Wetlands in the south west of WA are influenced greatly by the Mediterranean climate, and it is a normal occurrence that water levels rise during the wetter winter months and decrease dramatically in summer. This seasonal hydrological cycle creates biological chemical and physical characteristics unique to the Swan Coastal Plain wetlands.

Management of water resources on the JGM is the responsibility of the Department of Environment (DoE) which, as WA's primary water resources manager, is responsible for the conservation, protection and management of water resources within and surrounding the planning area. However, as the Department of Conservation and Land Management is the managing authority for the nature reserve, there are overlapping responsibilities with DoE for the management of Forrestdale Lake.

The Water Corporation is responsible for the management of the Forrestdale Main Drain, an overflow drain which runs from the lake's eastern side in a northerly direction. It has not flowed now for a number of years and is not currently an issue for management.

As part of the *Wetlands Conservation Policy for Western Australia 1997*, a Wetlands Coordinating Committee was established, with representatives from various agencies and community conservation groups. This Committee is chaired by the Department of Conservation and Land Management and will act as a forum for information exchange regarding management of Forrestdale Lake, in particular water level regimes and water quality.

Water levels

Groundwater, and subsequently, wetland levels, on the JGM have been under considerable pressure over recent years due to a combination of decreasing annual rainfall over the last 25 years, groundwater abstractions reaching management limits, and the influence of drainage on the wetlands (Water and Rivers Commission 2001). Lake water levels respond to events that cause variations to the quantity of groundwater supply. To ensure that waterbird habitat is protected, it is important that the lake's water level continues to be monitored, and that management strategies are implemented to maintain suitable water levels.

Environmental Water Provisions (EWP), including the preferred minimum water level and an absolute minimum level, have been set for Forrestdale Lake to ensure its habitat value for migratory birds and rare, threatened and priority flora and fauna is maintained. The statutory preferred minimum water level of Forrestdale Lake is 21.2 - 21.6m Australian Height Datum (AHD), with an absolute minimum of 21.1m AHD.

Water levels of Forrestdale Lake have been monitored by DoE since 1996, and since that time, the minimum levels have been breached several times. Despite this, most of the environmental values protected by these EWPs, including the wetland vegetation, do not appear to have been significantly impacted (Water and Rivers Commission 2001).

In 1992 EWPs were set for a number of wetlands across the JGM, under section 46 of the *Environmental Protection Act 1986*. These Ministerial conditions are currently under review, following breaches at a number of sites including Forrestdale Lake. The breaches mainly occurred as a result of water extractions being too excessive for the declining water levels that have resulted from the drier climatic conditions. In an attempt to resolve these issues and prevent future breaches, DoE requested that the Minister for the Environment review the existing conditions. Stage II of the review is currently under way and includes an audit of environmental criteria, climate variability, long-term groundwater level behaviour and abstraction management. The review will propose revised environmental conditions for the groundwater mound and Forrestdale Lake, with which this management plan will be consistent.

Low water levels over recent years have contributed to the spread of *Typha orientalis* and its encroachment onto the lakebed, which is an issue for management (see Environmental Weeds).

Water quality

The water quality of Forrestdale Lake is influenced predominantly by groundwater discharge, which, during dry years in particular, contributes about 99 per cent of the nutrient load into the lake. During periods of rainfall, drain discharges into the lake can also be a source of nutrient input. However, during dry years when drain flow is either minimal or non-existent, groundwater effectively provides the entire nutrient load to the lake (ERM Mitchell McCotter 2000).

ERM Mitchell McCotter (2000) conducted a baseline nutrient study at Forrestdale Lake and found that groundwater containing nutrients discharges into the lake predominantly from the west. James Drain on the west side of the lake along with Skeet Drain to the north also contribute nutrients into the lake. James Drain originates from adjacent farmlands and Skeet Drain from nearby Skeet Oval. The nutrients they carry originate from a variety of point and diffuse sources associated with rural land use, including intensive animal feedlots and pens, and fertilised crops and gardens. Groundwater impacted by nutrients from residential land use in the Forrestdale Township also discharges into the lake (ERM Mitchell McCotter 2000).

With the exception of rainfall, there are generally no natural surface water inflows to the lake. There are three nearby roadway drains (Weld, Fisher and Moore), however these discharge into the groundwater and thus surface water from them does not directly enter the lake (ERM Mitchell McCotter 2000).

Water quality monitoring of Forrestdale Lake is undertaken annually by the Department, with the assistance of the Friends of Forrestdale, and in consultation with DoE. Nutrient levels in the lake need to be maintained within a range that will ensure no adverse effects on waterbirds.

The control of diffuse sources of pollution is one of the major issues of wetland management. Mechanisms to ensure that water quality is not adversely impacted by existing and future landuse practices on adjoining land needs to be considered on a regional level. This could possibly be done under the umbrella of the existing Armadale Gosnells Landcare Group Inc. (AGLG) or via a formalised arrangement between this group and the Nutrient Study Group*, whereby community education may be useful in reducing nutrient runoff catchment-wide. The AGLG, together with the Department of Agriculture, have offered property management courses for landholders in the Forrestdale area, which include managing properties to reduce nutrient loss and hence input into the drainage system.

* The Nutrient Study Group was established by the Department in accordance with a recommendation in the management plan of 1987, to guide the preparation and implementation of a nutrient study and water quality monitoring program for Forrestdale Lake. The group, which is chaired by the Department, meets annually to review monitoring results, and has representatives from DoE and the Friends of Forrestdale.

The Environmental Protection Authority (EPA) has developed guidelines to ensure that any proposed changes to land within the catchment of an important wetland will not impact on the water quality or hydrology of the wetland. Groundwater Environmental Management Areas (EMAs) have been identified to assist with future planning in the catchments of significant wetlands such as Forrestdale Lake which have their hydrology dominated by groundwater. The groundwater catchment of Forrestdale Lake is called an EMA Category A, due to the lakes' international significance. As a consequence, new proposals within the lake's groundwater catchment have to be designed and managed to prevent deterioration in groundwater flowing into the lake (WAPC 2001).

NATIVE PLANTS AND PLANT COMMUNITIES

Keighery *et al.* (2001) surveyed the vascular flora of Forrestdale Lake Nature Reserve and identified 351 taxa. Of these, 252 are native and 99 are introduced.

Gibson *et al.* (1994) conducted a floristic survey of the Swan Coastal Plain, and identified 30 community types, six of which are represented in the planning area:

- Community Type 4 *Melaleuca preissiana* damplands;
- Community Type 8 Herb-rich shrublands in claypans;
- Community Type 10a Shrublands on dry clay flats;
- Community Type 12 *M. teretifolia* and/or *Astartea* aff. *fascicularis* shrublands;
- Community Type 21a Central *Banksia attenuata* – *Eucalyptus marginata* woodlands; and
- Community Type 21c Low-lying *B. attenuata* woodlands or shrublands.

(State of Western Australia 2000)

Within the planning area there are two 'Declared Rare Flora' species; Purdie's donkey orchid (*Diuris purdiei*) and the glossy-leaved hammer orchid (*Drakaea elastica*), and two TECs (see page 14). There is also five Priority taxa; one Priority 1 (*Acacia lasitocarpa* subsp. *bracteolata*), and four Priority 4 species (*Villarsia submersa*, *Drosera occidentalis*, *Verticordia lindleyi* subsp. *lindleyi* and *Anthotium junciforme*) (State of Western Australia 2000).

In addition to these there are five species that are significant for a variety of reasons: *Pimelea imbricata* var. *major* (significant populations), *Villarsia violifolia* (significant populations, and considered to be poorly reserved), *Burchardia bairdiae* (significant populations, and populations at the northern or southern limit of their known geographic range), *Leptocarpus* sp. Forrestdale Lake (significant populations) and *Myriocephalus helichrysoides* (taxa endemic to the Swan Coastal Plain) (State of Western Australia 2000).

The floristic values of the planning area are vulnerable to potential threats from surrounding landuses, such as agriculture and urban development. Most of the lake has only

a very narrow strip of fringing vegetation that provides very little buffer to such threats, which include run-off and drainage and the introduction of pest plants. It is essential that any new development proposals on nearby land are assessed by the Department under both the *Environmental Protection Act 1986* and the *Town Planning and Development Act 1928* to ensure they will have minimal impacts on the planning area's biodiversity values.

THREATENED ECOLOGICAL COMMUNITIES

There are currently 68 TECs listed in WA, two of which are recorded in the planning area. One community is known as type 8 - 'Herb-rich shrublands in clay pans', and the other as type 10a - 'Shrublands on dry clay flats'.

Community type 8 consists of clay pan communities that can be dominated by *Viminaria juncea*, *Melaleuca viminea*, *M. lateritia* or *M. uncinata* but occasionally by *Eucalyptus wandoo*. Aquatic annuals are also common (Gibson *et al.* 1994). Community type 8 is listed in WA as 'vulnerable'.

Community type 10a forms on the most rapidly drying of the clay flats. It contains aquatic annuals and geophytes such as *Schoenus natans*, *Crassula natans* and *Amphibromus neesii* (Gibson *et al.* 1994). Community type 10a is listed in WA as 'endangered'.

The TECs that occur in the planning area will be managed for conservation. In particular, this will involve control of threatening processes acting upon the communities, especially regional impacts from horses, inappropriate fire regimes, dieback disease caused by the plant pathogen *Phytophthora cinnamomi*, altered groundwater levels or quality, weed invasion and off-road vehicles.

The WA Threatened Species and Communities Unit within the Department of Conservation and Land Management coordinates, assists and promotes the conservation of threatened species and ecological communities on private and public land in WA.

NATIVE ANIMALS AND HABITATS

Forrestdale Lake is especially important as a wetland habitat, regularly supporting more than 10,000 waterbirds. In total, 147 bird species have been recorded within the planning area, including 66 species of waterbirds, 21 of which are protected under the Japan-Australia and China-Australia Migratory Bird Agreements, and 81 species of terrestrial birds (Burbidge 2002). The highest number of waterbirds counted at the lake was 21,083 in February 1987, ranking it ninth in the region (ANCA 1996).

The lake is an important feeding area for an exceptionally wide variety of waterbirds, and provides habitat for 16 habitat specialists with a reduced distribution on the Swan Coastal Plain (birds) and nine wide-ranging bird species that have reduced populations on the Swan Coastal Plain (State of Western Australia 2000).

The planning area supports two species listed on the Department's Priority Fauna List: the quenda (*Isoodon obesulus fusciventer*), a Priority 4 species, and a native bee (*Leioproctus contrarius*), a Priority 3 species. Also occurring within the planning area are two species of native bee and one bird species that are listed as Threatened under Schedule 1 of the Wildlife Conservation Act (Fauna which is Rare or likely to become Extinct): *Leioproctus douglasiellus* and *Neopasiphae simplicior*, and Carnaby's cockatoo (*Calyptorhynchus latirostris*) (Threatened and Priority Fauna Database 2003).

The peregrine falcon (*Falco peregrinus*), listed as Specially Protected under Schedule 4 of the Wildlife Conservation Act (Fauna which is Otherwise Specially Protected), has been recorded in many parts of the metropolitan area and may occur in the planning area (Threatened and Priority Fauna Database 2003).

The planning area also contains seven species of frogs and 15 reptile species. Three of the 15 reptile species are significant because they are scarce or rare in the area and have relatively localised distributions: the swamp skink (*Acritoscincus trilineatum*), lined skink (*Lerista lineata*) and crowned snake (*Notechis coronatus*) (State of Western Australia 2000).

Migratory waders

Forrestdale Lake has international importance as habitat for 21 species of migratory waders that use the lake on a seasonal basis. The most abundant of these species (with their maximum numbers recorded shown in brackets) are the red-necked stint (3000), curlew sandpiper (2000) and sharp-tailed sandpiper (700). The next most abundant species are the long-toed stint (80), the marsh sandpiper (60) and the wood sandpiper (32) (Burbidge 2002). Between 1981 and 1985, 14 species cited in the JAMBA treaty were recorded at the lake (Jaensch *et al.* 1988). Forrestdale Lake is one of the few sites in WA where little ringed plover (*Charadrius dubius*) and little stint (*Calidris minuta*) have each been recorded more than once, and is the only WA locality for white-rumped sandpiper (*C. fuscicollis*) (ANCA 1996).

Exposed mudflats around the lake are essential habitat and feeding ground for migratory waders. To ensure the continued presence of such birds at Forrestdale Lake, it is essential that the amount of both *Typha orientalis* and, where appropriate, native emergent rushes and sedges be controlled to prevent encroachment too far onto the lakebed. This will ensure that exposed mudflats remain available for utilisation by wading birds.

Macroinvertebrates

Macroinvertebrates are an essential component of wetland food webs, comprising much of the diet of waterbirds and waders. In addition to this, they may act as indicators for the assessment of wetland health (Davis *et al.* 1993). A total of 27 invertebrate taxa were collected from Forrestdale Lake over the 2001-2003 sampling period. They comprised one mollusc, eight crustaceans, 3 arachnids and fifteen insect species (Wild *et al.* 2003).

ENVIRONMENTAL WEEDS

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

An integrated approach to environmental weed management was developed in the *Environmental Weed Strategy for Western Australia* (Department of Conservation and Land Management 1999), and further supported by the Department's *Policy Statement 14 – Weeds on CALM Land*. As the inter-relationship between soil disturbance, weed invasion and native plants is complex, weed control should be undertaken in a strategic and integrated manner with guidance from the Environmental Weed Strategy. Rehabilitation of areas from which extensive patches of weeds have been removed is important.

Ninety nine exotic plant species have been identified in the reserve (Keighery *et al.* 2001). As rated in the Environmental Weed Strategy for WA, there are 14 High impact species, 52 Moderate, 13 Mild, 17 Low, and three species that are either unlisted or not rated. Introduced bulrush (*Typha orientalis*), pampas grass (*Cortaderia selloana*), bridal creeper (*Asparagus asparagoides*) and arum lily (*Zantedeschia aethiopica*) are four that have a High rating, and which pose the most threat to native vegetation in the planning area. Work has been undertaken in the past to remove pampas grass, bridal creeper and arum lilies. Weed issues are greater on the western side of the lake as a result of past land clearing and grazing practices.

Introduced bulrush, an aggressive colonizer in disturbed environments, has the potential to further reduce the area of open water and exposed mudflats, and is a major management issue at Forrestdale Lake. Furthermore, in summer, as the lake dries, the bulrush dries off presenting a significant fire hazard. Colonisation and spread of *Typha orientalis* around Forrestdale Lake has the potential to significantly displace and change fringing vegetation and hence alter waterbird habitat. It does however, provide shelter, nesting sites and a food source for birds and other wildlife, and acts as a buffer to nutrient input,

and so its complete removal needs to be carefully considered and integrated with revegetation strategies.

As stated previously, exposed mudflats around the lake are essential habitat and feeding ground for migratory waders. To ensure the continued presence of such birds at Forrestdale Lake, it is essential that the amount of *T. orientalis* be controlled to prevent encroachment too far onto the lakebed, to ensure that exposed mudflats remain available for utilisation by wading birds.

Strategies for the continued management of *T. orientalis* in Forrestdale Lake Nature Reserve have been identified in this management plan (Table 1).

INTRODUCED AND OTHER PROBLEM ANIMALS

Problem animals are those species, both native and introduced, that have become established as wild or naturalised populations, and which have potential for serious impact on natural systems through direct effects such as predation, habitat destruction, competition for food and territory, introduction of disease, and through environmental degradation by selective grazing. A primary operational objective of the Department is to achieve the systematic and safe control or eradication of introduced and other problem animals according to an agreed priority dependant on:

1. the impact of the animals;
2. the efficiency and effectiveness of control measures;
3. participation of other stakeholders; and
4. the capacity for long term monitoring of the population.

The Department also has responsibilities for control of problem animals on the lands it manages under sections 39–41 of the *Agriculture and Related Resources Protection Act 1976* (ARRP Act): "A Government Department shall control declared plants and declared animals on or in relation to public land under its control."

Foxes and cats are present in the planning area, however the extent of their impact is currently unknown. In recent drier years, foxes have been seen within the nature reserve preying on young cygnets (D. James, pers. comm. 2002). The only effective broadscale method of fox control is baiting using 1080, a poison of the highest order, which is not appropriate at Forrestdale Lake due to its close proximity to urban areas. Shooting may be an alternative option, but only in the south-west corner of the planning area, away from neighbouring houses.

No feral cat control is currently undertaken or proposed to be undertaken in the planning area. The City of Armadale is currently undertaking trials in regard to the possibility of introducing cat controls. The trials are assessing the effects of a cat free zone, measuring cat density and radio tracking cats to determine their activity and how far they move, to investigate the feasibility of introducing a cat curfew for some areas of the City. Should this initiative occur in the Forrestdale Township, the Department should support it.

Midges

Midges (*Chironomids*) inhabit the wetlands of the Swan Coastal Plain, and have been the subject of complaints by local residents at Forrestdale Lake for many years. Research shows that while midges are a natural component of aquatic ecosystems in Perth wetlands, nutrient enrichment promotes higher densities of midge larvae. Hence, midge problems are partly a symptom of a disturbed system and a consequence of poor water quality (Pinder *et al.* 1991). The problem has been exacerbated at Forrestdale Lake, as there is very little buffer between the lake and adjacent residential areas, as buffers can assist in reducing the impact of pest insects (Bowen *et al.* 2002). There have however, been few problems from midges over the past few years as a result of the low rainfall in the Perth region, that has resulted in the lake drying out early in summer before major midge swarms develop.

The City of Armadale began aerial spraying of the lake in 1975 to control the number of midge larvae. Since that time, the lake has been treated on an as-needs basis, as often as two or three times a year during spring and summer, using a granulated organo-phosphate known as Temphos. Currently, the Department undertakes and manages the aerial treatment of the lake as necessary, under a joint funding arrangement with the City of Armadale.

To help address the midge problems occurring at Forrestdale Lake, a monitoring program conducted by Murdoch University commenced in 1987, and a District Control Plan for treatment was put in place in 1991. The control plan includes long term management solutions based on research and monitoring as well as short-term abatement methods. Monitoring needs to continue to guide how and when treatments occur.

There is some concern, however, about the impact of Temphos, both on macro-invertebrates and the entire food chain. As a precaution, and to ensure waterbirds do not ingest Temphos granules, the lake is not treated if the water level is less than 30cm in depth.

DISEASE

Disease caused by Phytophthora

The most significant disease threat to plants within the reserve is the disease known as 'dieback', caused by the microscopic pathogen *Phytophthora cinnamomi*. It is thought that this pathogen was introduced during European settlement of WA through the soil around roots of plants brought over for cultivation. There are now known to be eight species of *Phytophthora* occurring within the native plant communities of WA, of which, *P. cinnamomi* is recognised as the most damaging. Once infected, susceptible plants are killed and, in many cases, eliminated from the site. This could lead to dramatic and permanent changes to native plant communities and their dependent fauna.

The south-east section of the nature reserve is infected with *P. cinnamomi*. However, at the time of writing this plan, a comprehensive survey has not been conducted of the entire planning area, an issue that needs to be addressed through this planning process.

P. cinnamomi could have an impact on revegetation programs if the species used are susceptible to the disease. The risk of impact from the disease can be reduced by modifying activities that spread the pathogen, and by controlling access to highly susceptible areas. Strategies to prevent the introduction of *P. cinnamomi* into uninfected areas, and minimise spread in and from already infected areas, are key management issues

FIRE

Wildfire is a significant threat both to adjoining properties and to the natural and cultural values of the planning area. Large infestations of introduced bulrush (*Typha orientalis*) constitute a fire hazard as fires in bulrush are difficult to control and can cause damage to fringing vegetation. Frequent wildfire in wetland areas will prevent the establishment of paperbark vegetation and will lead to an even greater domination of non-local bulrush.

Forrestdale Lake Nature Reserve is situated within the Gazetted Fire District, and as such, fire suppression is the responsibility of the Fire and Emergency Services Authority (FESA). In the instance of a fire within the planning area, the Department plays a support role, through the provision of an environmental officer and information on significant flora species and communities, and may assist FESA on incident control teams. The Department is also responsible for pre and post-suppression works.

The Department is preparing a Fire Response Plan in conjunction with the City of Armadale and FESA, to help ensure effective response to unplanned fire by the responsible agencies. The plan will outline practices such as:

- fire control actions and strategies to protect environmentally sensitive areas from unplanned fire;
- undertaking pre-suppression activities including reducing fuel loads by mowing or slashing;
- maintaining a fire record system of all fires within the reserve; and
- ensuring an effective network of firebreaks is maintained.

It is also essential that Fire Management Guidelines be completed and implemented, in the form of an MOU between the Department, FESA and the City of Armadale, to ensure a coordinated approach to fire management within the planning area. Any such plan needs to incorporate the FESA guidelines for fire management, and should be reviewed and updated annually, prior to each fire season.

Selective prescribed burning may be considered for the protection of values or to enhance biodiversity provided there is

no significant impact from fire on the flora and fauna of the planning area. It could also be undertaken for the protection of life and property, in conjunction with biodiversity maintenance.

PART D MANAGING OUR CULTURAL HERITAGE

INDIGENOUS HERITAGE

According to Nyungar tradition, wetlands, waterways and lakes, including Forrestdale Lake, are said to be the home of the powerful water serpent figure, the Waugal. The Waugal is spiritually and mythologically important to Aboriginal people who believe that it created rivers and lakes, and maintains the flow of waters that feed its resting places. According to Nyungar beliefs, these places are described as *wimatch*, (a place of great religious significance) and consequently require the highest respect and reverence in the way they are considered used and valued.

It is critical to note that in relation to Nyungar cultural values, this respect and reverence goes beyond the spiritual, and is linked inextricably with environmental integrity. According to Nyungar tradition, the respect and reverence required by a place such as Forrestdale Lake requires a level of awareness and acknowledgement of responsibility from visitors and other users that ensures the ongoing protection and good health of the system (G. Kelly, *pers. comm.*).

As well as its mythological status, the lake was a source of tortoise for people from Pinjarra, Mandurah and Armadale. Seasonal camps were usually established under the shelter of surrounding melaleuca scrub in the lake's north-western edge, and some groups set up semi-permanent camps for extended periods on their way from the Darling Plateau to the coast. (O'Conner *et al.* 1989; Gray 1994). Thus, the lake has significance both as a tortoise hunting site, and for these campsites at the lake.

The conservation of Indigenous heritage is important in maintaining the identity, health and well being of Indigenous people (Australian Heritage Commission 2002). In WA, the *Aboriginal Heritage Act 1972* (Aboriginal Heritage Act) protects places and objects customarily used by, or traditional to, the original inhabitants of Australia. A register of such places and objects is maintained under the Act, however, all sites are protected under the Act whether they have been entered on the register or not.

There is one site within the planning area that has been recorded on the Department of Indigenous Affairs' Register of Aboriginal Sites, which is also protected under the Aboriginal Heritage Act: Site S2213, a mythological site.

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

NON- INDIGENOUS HERITAGE

The first non-Aboriginal settlement at Forrestdale Lake (then known as Lake Jandakot) occurred in 1885, when William and Alfred Skeet were granted a 'Special Occupation' licence for 100 acres adjoining the lake, as well as licences to cut and sell timber. The area at this time has been described by Popham (1980) as:

'... rich swamplands ... closely covered by huge paperbark trees, many thirty feet high with a diameter of some three feet, the undergrowth beneath them dense with rough scrub and tanglewood creepers'.

Early settlers in the Forrestdale Lake area commenced farming in 1893 on the edge of Commercial Road. Large areas of land were soon utilised for farming around Taylor Road, where the water table is close to the surface. Other settlers soon followed and the Lake Jandakot settlers cleared their land, experimented with crops and ran dairy cattle and poultry as viable commercial ventures (Popham 1980).

By 1898, the area surrounding the Lake had been set aside as a Townsite Reserve and recommendations made regarding subdivision. The Jandakot region soon became a thriving community, producing vegetables, apiary products and in later years, dairy produce for the Fremantle markets. The prosperity of the region encouraged the construction of a railway between Fremantle and Jandakot, which in July 1907 was extended to Armadale for the purpose of transporting goods to the Fremantle Markets (Department of Conservation and Land Management 1987).

From the 1920s intensive agriculture gave way to sheep and cattle grazing, which continued over the next 50 years. During the 1940s the west side of Forrestdale Lake was heavily grazed by sheep and cattle, particularly during the drier summers when land owners used the fringing vegetation to supplement feed from their paddocks. As a result, the west side of the Lake is devoid of most natural understorey species and is infested with weeds and other introduced plants particularly arum lilies.

In 1957 interest developed in creating a Class A reserve around and including Forrestdale Lake, with the intention that the reserve be used for recreation, particularly sailing. Thus the reserve was gazetted for the 'Protection of Flora and Fauna and Recreation' (Department of Conservation and Land Management 1987).

The population in the Forrestdale area rapidly increased in the latter half of the 1960s as the townsite blocks to the north-west of the Lake were taken up. Since that time, the population has slowly increased to its current figure of approximately 1350.

PART E MANAGING VISITORS

VISITOR OPPORTUNITIES

Nature reserves are gazetted to provide for the conservation and restoration of the natural environment, the protection, care and study of indigenous flora and fauna, and the preservation of any feature of archaeological, historic or scientific interest. The Department's *Draft Policy Statement 18 – Recreation, Tourism and Visitor Services* outlines the Department's principles, operational guidelines, procedures and administrative controls in relation to facilitating recreation and tourism on Departmental managed lands and waters. This management plan follows the policies outlined in *Draft Policy Statement 18* where applicable. As such, only low-impact recreation is permitted, and then only when it does not adversely affect the natural values and ecosystems of the reserve.

The location of Forrestdale Lake in a developing urban environment makes it a valuable place for the local community to undertake passive recreation in a natural setting. The natural values of the reserve provide opportunities for nature appreciation, bird watching, bushwalking and environmental education. As such, visitation to the nature reserve is predominantly for the purpose of birdwatching and walking. In addition, an external trail that runs around some of the perimeter of the reserve, as well as trails on the adjoining reserve, are frequently used by horse-riders.

VISITOR USE

Birdwatching

Given the importance of Forrestdale Lake as waterbird habitat, it is not surprising that it is a popular destination for birdwatchers. As such, birdwatching is one of the main recreational pursuits in the reserve. To facilitate this, a boardwalk out into the lake was constructed in 1994. However, this was destroyed by fire in March 2003. The Department's Swan Coastal District is currently investigating structure options and funding opportunities for its replacement. Should a replacement structure be built, its design is to be determined in consultation with the community, and should link up to the existing cycleway to provide wheelchair access.

The boardwalk also contained a number of interpretation signs. The signs have recently been cleaned up but are weathered and the information needs updating.

Bushwalking

Another visitor use at Forrestdale Lake is bushwalking. Walkers use the Forrestdale Trail that is located around the outside of the nature reserve (Map 2). It is a multi-purpose trail mainly used by locals for walking, horseriding and mountain bike riding, which could raise issues of visitor safety (R. Giblett, pers. comm. 2003). The trail is included in a brochure produced by the City of Armadale, and there is one interpretive sign, at the

end of Moore Street, but no signs on the trail itself.

Horse riding

Horse riding is an historical use in the Forrestdale area. The trails both around the nature reserve and in the adjoining recreation reserve have long been used by horseriders for both recreation and training. Biological and physical impacts of horse riding can include trampling and grazing of plants, spreading weeds and disease, disturbing native fauna, soil compaction and erosion. The level of impact is dependent on the extent, frequency and intensity of use, topography and soil type.

Horse riding is not permitted within Forrestdale Lake Nature Reserve itself but does occur outside the reserve, directly adjacent to the boundary, on a limestone trail that runs around the reserve's perimeter (the Forrestdale Trail). It also occurs on an ad hoc network of trails throughout the recreation reserve, and on adjoining WAPC land, which is proposed to be transferred to, and vested in, the Conservation Commission (see Land Tenure).

The local community has identified horse riding as a key recreational value of the area. The aim of this plan is to continue to provide opportunities for riding while protecting the TECs and DRF species in the recreation reserve, and minimising the risk of horses spreading dieback and encouraging weed invasion. To achieve such a balance, a network of trails has been proposed, which includes a dry weather access only trail, to be closed to horse traffic in winter months (Map 2).

It is proposed that once the recreation reserve has been transferred to the Department, the tenure will change to become conservation park, which will enable horse riding to continue on the network of trails designated in this plan.

ACCESS

The current level of access for pedestrians is limited, and the trails are relatively unmarked and often inaccessible in winter. The tracks within the planning area are for walkers and horseriders (on designated bridle trails). They also provide access for management and emergency vehicles. At present there is an ad hoc network of tracks, particularly in the recreation reserve. There may be opportunities to rationalise these and close and rehabilitate some over the life of the plan, as they become obsolete.

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

PART F MANAGING SUSTAINABLE RESOURCE USE

SCIENTIFIC AND RESEARCH USE

There are many opportunities for research within the reserve, including studies of the lake's water quality and levels, groundwater interaction, invertebrates, waterbirds, and of terrestrial flora and fauna. Murdoch University has undertaken research at Forrestdale Lake into the invertebrate community structure, which can be used as an indicator of wetland health. Ongoing research by universities and other groups should continue to be encouraged and supported by the Department.

It would be appropriate that research and monitoring programs involve a wide range of people and groups. The involvement of volunteers, educational institutions and individual researchers can reduce the costs of such programs and assist in providing information to both management and the broader community. It is important that all research undertaken in the reserve is coordinated by the Department, to ensure an integrated approach, which avoids duplication and enables prioritising of projects.

REHABILITATION

Rehabilitation is the establishment of a stable, self-regulating ecosystem following disturbance, consistent with the purpose for which the area is managed.

The Department's *Policy Statement No. 10 - Rehabilitation of Disturbed Land* provides guidelines for the rehabilitation of lands managed by the Department based on the following principles:

- and should be managed as far as possible to avoid disturbance;
- rehabilitation should be the last option in a series of management decisions designed to protect environmental values; and
- rehabilitation should aim to restore original values and help to enhance all potential uses provided the priority uses are not adversely affected.

Only local native species that are free of *Phytophthora* should be used for rehabilitation purposes within the planning area. This ensures the greatest degree of success whilst enabling new vegetation to blend into the existing environment and limiting the introduction of exotic (non-local) plants and disease.

PART G INVOLVING THE COMMUNITY

INFORMATION, EDUCATION AND INTERPRETATION

Forrestdale Lake Nature Reserve provides a valuable opportunity for improving community awareness about wetland ecosystems and Ramsar, as well as TECs and DRF species. An effective information, education and interpretation program is vital to achieve the goals and objectives for the management of the reserve. The program will concentrate on raising awareness about the reserve's conservation values, particularly those that contribute to its Ramsar listing, potential human impacts, and the positive action visitors can take to support management of the reserve and of other wetlands.

Existing facilities are limited to some interpretation signs on the boardwalk and an information shelter, which are located at the end of Moore Street (Map 2). Given the importance of the site as waterbird habitat, high priority could be given to upgrading the signs for the purpose of public interpretation and education, thus assisting in achieving conservation objectives. Any such signs should incorporate an explanation of Ramsar.

An information brochure on the reserve does exist, however it is now out of print. It is recommended that, in consultation with the community, the brochure be updated and reprinted.

WORKING WITH THE COMMUNITY

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

Forrestdale Lake Nature Reserve is valued very highly by the local community, who have been involved in preparing this draft management plan by providing written comments on issues within the planning area and through participation in a community meeting. Also, a Community Advisory Committee has provided advice to the planning team throughout the planning process.

At this draft stage of the management plan, opportunity exists for interested community members and organisations to comment on the proposed management of the reserve either by written submission or by making a submission on the Department's webpage (<http://www.naturebase.net/cgi-bin/participate/plancomment.pl>).

Ongoing community support is essential for the successful implementation of this management plan. Community groups are encouraged to take part in volunteer activities such as clean up days, and to help with projects such as waterbird surveys, water monitoring and rehabilitation.

Friends of Forrestdale

The Friends of Forrestdale is a community group dedicated to conserving Forrestdale Lake Nature Reserve and adjoining

reserves. The group was launched in 1990 following a recommendation in the Forrestdale Lake Nature Reserve Management Plan (1987) to enable interested volunteers to become involved in rehabilitation and weed control works. They have, to date, played an active role in the planning and management of the reserve.

PART H MONITORING AND IMPLEMENTING THE PLAN

The effectiveness of this management plan will be reviewed periodically through a formal auditing process. These audits will include reports on the status of the reserve's key values using KPIs (see Performance Assessment) and an assessment of the effectiveness of current management strategies, as well as providing feedback to the Department's District Manager, Swan Coastal District. The KPIs for the Forrestdale Lake Nature Reserve Management Plan are listed in Table 1.

TERM OF THE PLAN

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

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

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Dr Rod Giblett [Friends of Forrestdale]

TABLE 1 FORRESTDALKE LAKE NATUR

KEY POINTS and OBJECTIVES	STRATEGIES and KEY PERFORMANCE INDICATORS	KEY POINTS and OBJECTIVES
<p>LAND TENURE</p> <ul style="list-style-type: none"> • Negotiations are continuing between the Department and the City of Armadale regarding the transfer of the adjoining recreation reserve, excluding the golf course, to the Conservation Commission of WA (CCWA). • Negotiations are also underway with the WAPC regarding the acquisition of adjacent WAPC land for vesting in the CCWA. • There are a number of road reserves within the planning area, currently utilised by horse riders. This plan proposes that these be closed and the vesting be transferred to the CCWA. <p>Objective To ensure all lands that comprise the planning area are created as reserves and transferred to the Conservation Commission of WA, for management by the Department.</p>	<p>Strategies</p> <ol style="list-style-type: none"> 1. Continue negotiations with the City of Armadale to transfer the vesting of Recreation Reserve 27165 (excluding the Armadale Golf Course) to the CCWA, as Conservation Park. 2. When the City of Armadale vacates the existing golf course, transfer that land to the CCWA as Conservation Park. 3. Continue negotiations with the WAPC regarding the transfer of adjacent land to the south-east and Bush Forever site 345, to the CCWA as they become available. 4. Close the existing road reserves within the planning area and transfer their vesting to the CCWA as Conservation Park. <p>Key Performance Indicator: All strategies achieved by 2013.</p>	<p>NATIVE PLANTS AND PLANT COMMUNITIES</p> <ul style="list-style-type: none"> • The planning area supports 252 native plant species, which comprise six regional floristic groups of the Swan Coastal Plain (two of which are TECs), two DRF and five Priority flora species. • Vegetation communities in the planning area are representative of those once widespread on the Swan Coastal Plain that have now been significantly cleared. • The main threats to the vegetation are environmental weeds, dieback, horse riding and fire. <p>Objective To conserve indigenous plant species and communities, particularly threatened or priority species and TEC's.</p>
<p>CATCHMENT AND WATER PROTECTION</p> <p>Water Levels</p> <ul style="list-style-type: none"> • Forrestdale Lake is a surface expression of groundwater and hence, management of its water levels involves management of the regional groundwater system. • Water entering the lake comes mainly from ground water that is rainfall recharge in the catchment to the west. • While the lake is naturally subject to seasonal drying over summer, this is exacerbated in periods of drier climate. • Continued low water levels promote the encroachment of <i>T. orientalis</i> across Forrestdale Lake, which potentially reduces the amount of wading bird habitat. <p>Objective To maintain a water level regime that supports the lake's water dependant ecosystems and meets the needs of the range of waterbirds that use the lake.</p>	<p>Strategies</p> <ol style="list-style-type: none"> 1. Liaise with DoE regarding the monitoring and maintenance of appropriate water levels in the lake. 2. Arrange an annual forum with DoE and the Water Corporation to exchange information relating to water management issues at Forrestdale Lake. 3. Continue to provide input into DoE's Section 46 Review of Environmental Conditions of the Jandakot Mound. <p>Key Performance Indicator: The development of new EWPs for Forrestdale Lake, and these being adhered to over the life of the plan.</p>	<p>NATIVE ANIMALS AND HABITATS</p> <ul style="list-style-type: none"> • The nature reserve is included on the List of Wetlands of International Importance, known as the Convention on Wetlands (Ramsar, Iran, 1971). • Forrestdale Lake is an important breeding ground for local birds, and a summer refuge for 21 migratory bird species protected under JAMBA and/or CAMBA treaties. • The planning area provides valuable habitat for 81 species of terrestrial birds and 66 species of waterbirds, and supports two Priority and four Threatened fauna species. • The main threats to the native fauna and fauna habitats are inappropriate water levels and water quality, environmental weeds, predation by foxes and cats, dieback and inappropriate fire regimes. • The main threats to water birds are inappropriate water levels and quality, and introduced <i>Typha</i>, which decreases the amount of exposed mudflat essential for migratory waders. <p>Objectives</p> <ol style="list-style-type: none"> 1. To conserve indigenous fauna, with an emphasis on threatened and priority species and those protected by international agreements. 2. Conserve and enhance the area as waterbird habitat as per the management requirements for Ramsar listed wetlands.
<p>Water Quality</p> <ul style="list-style-type: none"> • High levels of nutrients are believed to promote an increase in the number of midges, by providing a greater food source as a result of algal blooms. • One of the Department's roles in managing Forrestdale Lake is to support the implementation of policies and strategies of other management authorities, where such strategies benefit the natural values of the planning area. • Levels of total phosphorous greater than 150mgm/L indicate nutrient enrichment of the wetland. • Midges are an indicator of poor water quality in that if numbers of them reach nuisance levels (i.e. exceed 2000 larvae/m2) it is indicative that the wetland is nutrient enriched. <p>Objective To maintain a healthy aquatic ecosystem, thereby ensuring the provision of a feeding ground and refuge for waterbirds and protection of the reserve's ecological values.</p>	<p>Strategies</p> <ol style="list-style-type: none"> 1. In co-operation with DoE, continue to undertake a water-sampling program to monitor nutrient levels and water quality. 2. Work co-operatively with state and local government authorities regarding the management of surface and subsurface drainage. 3. Maintain the Department's role on the Jandakot Water Resources Community Consultative Committee. 4. Support DoE and the City of Armadale in the formation and implementation of an Integrated Catchment Management group for the Forrestdale Lake catchment. 5. Liaise with the Water Corporation to pursue the issue of sewerage the Forrestdale township to reduce nutrient runoff into Forrestdale Lake. 6. Ensure management of Forrestdale Lake is consistent with criteria developed as a result of the current Section 46 Review. <p>Key Performance Indicators:</p> <ol style="list-style-type: none"> 1. No decline in water quality of the lake over the life of the plan, as determined by DoE. 2. The annual maximum level of total phosphorous does not exceed 150mgm/L. 3. Maintaining <i>Polypedilum nubifer</i> larvae levels at less than 2000/m2. 	

RESERVE: MANAGEMENT SUMMARY

STRATEGIES and KEY PERFORMANCE INDICATORS

Strategies

1. Conduct surveys to record the distribution, abundance and other relevant characteristics of the vegetation of the planning area.
2. Identify and conserve vegetation communities and flora species that are rare, threatened or in need of special consideration.
3. Implement management strategies to remove threats to the vegetation, especially that which is rare, threatened or in need of special consideration.
4. Where necessary, rehabilitate vegetation that is degraded.
5. Provide information to visitors about the importance of the reserve's vegetation and potential human impacts on this.
6. Ensure any new development proposals within the groundwater catchment are assessed to ameliorate impacts on Forrestdale Lake.

Key Performance Indicators:

1. No loss in quality or quantity of DRF or Priority species populations, or areas of TEC from 2003 levels.
2. No additional threatening processes acting upon the TECs, DRF or Priority species.

KEY POINTS and OBJECTIVES

ENVIRONMENTAL WEEDS

- 99 weed species have been identified within the planning area. As rated according to the *Environmental Weed Strategy for WA*, there are 14 high, 52 moderate, 13 mild, 17 low and three that are either unlisted or not rated.
- *Typha orientalis* is the most serious weed species threatening reserve values.

Objective

To minimise the impact of environmental weeds on the values of the planning area, using methods compatible with the conservation of the natural environment.

STRATEGIES and KEY PERFORMANCE INDICATORS

Strategies

1. Where weed invasion threatens the reserve's values, implement suitable weed control programs in accordance with the *Environmental Weed Strategy for WA*.
2. Map bushland condition and the distribution of weeds every 5 years.
3. Continue control of *Typha orientalis* and determine acceptable/unacceptable distribution limits and what action is to be taken at what stage of *T. orientalis* growth.
4. Map *T. orientalis* distribution annually, and immediately control new satellite clumps.
5. Remove *T. orientalis* from the lakebed as a priority where it is detrimental to migratory wader habitat.
6. Control *T. orientalis* infestations in parts of James Swamp that lie within the planning area (low priority).

Key Performance Indicators:

1. No increase in the number and cover of species rated High in the *Environmental Weed Strategy for Western Australia*, over the life of the plan.
2. The total area of *Typha orientalis* is reduced to 2000 levels.
3. No decrease in bushland condition during the life of the plan.

Strategies

1. Protect native fauna from introduced predators through appropriate control regimes where possible.
2. Establish and implement an integrated fauna research and monitoring program for the planning area, which includes a formal data review.
3. Regularly monitor the distribution and abundance of bird species, especially migratory birds.
4. Undertake and/or encourage other agencies (e.g. Friends group, tertiary institutions) to undertake specific research and monitoring projects.
5. Seek to maintain wildlife corridor links with nearby conservation areas.
6. Where appropriate, remove sedges and rushes on mudflats to maintain habitat for migratory waders.

Key Performance Indicators:

1. No loss of species diversity or change in species composition of migratory waders in the planning area, over the life of the plan.
2. The total area of *Typha orientalis* is reduced to 2000 levels.

KEY POINTS and OBJECTIVES	STRATEGIES and KEY PERFORMANCE INDICATORS	KEY POINTS and OBJECTIVES
<p>INTRODUCED and OTHER PROBLEM ANIMALS</p> <ul style="list-style-type: none"> Problem animals recorded within the planning area include foxes, feral cats and midges. Excessive numbers of midges have previously been a nuisance to local residents at Forrestdale and have been the subject of numerous studies and reports. Midge control is the joint responsibility of both the Department and the City of Armadale. <p>Objectives</p> <ol style="list-style-type: none"> To prevent, and where possible, negate the impact of introduced and other problem animals on the reserve's values. In cooperation with the City of Armadale, to minimise the effect of midge populations, in a manner that has minimal environmental and social impacts. 	<p>Strategies</p> <ol style="list-style-type: none"> Where impacts on ecological values are found to be significant, implement measures to control introduced species within the planning area. In conjunction with the City of Armadale, undertake monitoring and treatment of the lake as necessary to alleviate midge problems. Monitor lake levels, weather conditions and waterbird and macroinvertebrate populations before, during and after treatments. Continue to seek alternatives to chemical pest control that are compatible with the ecological values of the reserve. Ensure existing vegetation buffers are maintained, both around the lake and around urban developments adjoining the reserve. Annually update the stakeholder contact list for notification of midge treatments. 	<p>ACCESS</p> <ul style="list-style-type: none"> Access to the planning area needs to be provided on designated trails for pedestrians and, where appropriate, horse riders. Access also needs to be provided for management and emergency vehicles. Boat access on the lake is necessary in some instances for scientific research purposes. The current level of access for pedestrians is limited, and the trails are relatively unmarked and often inaccessible in winter. <p>Objective</p> <p>To provide safe and convenient access within the reserve, for visitors and management, that is consistent with reserve values, and where it helps meet the objectives for Visitor Use.</p>
<p>DISEASE</p> <ul style="list-style-type: none"> Dieback (<i>P. cinnamomi</i>) is the most significant pathogen threatening native flora within the planning area. Dieback is only known to occur on the eastern side of Forrestdale Lake Nature Reserve. The adjoining recreation reserve has not yet been assessed for dieback. <p>Objective</p> <p>To negate the impact, and prevent the further spread, of <i>Phytophthora cinnamomi</i>.</p>	<p>Strategies</p> <ol style="list-style-type: none"> Re-survey the planning area for <i>P. cinnamomi</i> infection, and quarantine affected areas. Reduce the risk of introducing and spreading the disease to uninfected areas by limiting access to affected areas, and ensuring appropriate hygiene standards to machinery and vehicles when undertaking works within the planning area. In areas of high conservation value, treat unaffected vegetation around localised dieback infections to limit further spread. Ensure that all operations in the planning area comply with standards set in the Department's <i>P. cinnamomi</i> management guidelines. <p>Key Performance Indicator:</p> <p>No new human-assisted infections or further spread of <i>P. cinnamomi</i> over the life of the plan.</p>	<p>VISITOR USE</p> <ul style="list-style-type: none"> The predominant visitor uses within the Nature Reserve are birdwatching and walking. The local community has identified horse riding as a key recreation value of the area. Riding occurs on an ad-hoc network of trails in the municipal reserve, and on a bridle path on the perimeter of the Nature Reserve. <p>Objective</p> <p>To provide for passive, low impact visitor uses in a manner that is consistent with the reserve's conservation purpose, and which minimises conflict between visitors.</p>
<p>FIRE</p> <ul style="list-style-type: none"> The planning area is in a Gazetted Fire District and hence fire suppression is the responsibility of the Fire and Emergency Services Authority (FESA). In the instance of fire, the Department plays a support role, providing environmental advice, and may assist FESA on Incident Control Teams. To protect the biodiversity of the reserve, as well as people and property, by minimising the impact of wildfire. <p>Objective</p> <p>In the past, frequent fires in the reserve have contributed substantially to degradation of vegetation and invasion of environmental weeds.</p>	<p>Strategies</p> <ol style="list-style-type: none"> Prepare and implement Fire Management Guidelines in the form of a MOU between the Department, FESA and the City of Armadale. Liaise with FESA during preparation of a Fire Response Plan for the planning area. Maintain a system of firebreaks throughout the planning area as per the Fire Management Guidelines and in cooperation with the City of Armadale (until the adjoining reserve becomes vested in the Conservation Commission). Isolate stands of <i>T. orientalis</i> for fire protection purposes by cutting into blocks, and slashing, burning or removing blocks where appropriate. Initiate measures in pre and post suppression works to minimise the spread of plant diseases and weeds. Consider the use of prescribed burning as necessary to conserve biodiversity values and for the protection of life and property. <p>Key Performance Indicator:</p> <p>No loss of TECs or DRF or Priority species as a result of fire.</p>	<p>SCIENTIFIC RESEARCH AND USE</p> <ul style="list-style-type: none"> A number of different studies of the planning area should assess issues such as lake water quality and levels, groundwater interaction, waterbirds, macroinvertebrates and terrestrial flora and fauna. <p>Objectives</p> <ol style="list-style-type: none"> To focus research on issues that assist in the delivery of Departmental strategies as per the Corporate Plan, and the business plans of the Nature Conservation and Parks and Visitor Services Outputs. To assist external researchers where the outcomes are relevant to the Department, and maintain up-to-date knowledge of previous and current research.

STRATEGIES and KEY PERFORMANCE INDICATORS

KEY POINTS and OBJECTIVES

STRATEGIES and KEY PERFORMANCE INDICATORS

Strategies

1. Allow for emergency response within the planning area and ensure all paths enable access by emergency vehicles.
2. Restrict access by horse riders to designated bridle trails only, and fence the existing bridle trail along the currently unfenced edge adjoining the recreation reserve.
3. Prohibit the use of recreational watercraft (including model boats) in the lake, and allow use of watercraft only for education, research and managerial purposes by approved users.

REHABILITATION

- Loss of natural vegetation and degradation has occurred as a result of frequent wildfire, introduction of pest plants and animals, rubbish dumping, uncontrolled access, horse riding and impacts from adjoining land uses.
- There has been an ongoing rehabilitation program in the reserve undertaken by the Department with the support of the Friends of Forrestdale.
- Use of local native species during rehabilitation ensures the greatest degree of success and preserves the biodiversity and landscape of the area.

Objective

To encourage the natural regeneration of indigenous vegetation, and to restore degraded areas to a condition resembling the natural environment.

Strategies

1. Prepare and implement a rehabilitation plan for the planning area, using only plants that have been propagated from seeds and cuttings collected either from within the reserve or from provenance from the Swan Coastal Plain.
2. Co-ordinate rehabilitation works with weed control and fire protection.
3. Encourage members of the local community, schools and the Friends of Forrestdale to participate in rehabilitation works, and to seek external funding for such works.
4. Ensure mulch, soil and plants used in rehabilitation works do not contain unwanted seeds or plant diseases.

Strategies

1. Promote visitor use that is consistent with the protection of the values of the planning area.
2. Provide a network of fenced bridle trails throughout the planning area, as outlined in Map 2, which minimise both the spread of dieback and impacts on DRF and TECs.
3. Install cavalettis at trail entrances allowing horse access to designated trails whilst excluding trail bikes and off road vehicles.
4. Reconstruct the boardwalk using appropriate design and construction method, developed in consultation with the community.
5. Upgrade the wet, low-lying section of bridle trail on the southern boundary between the nature reserve and recreation reserve, with blue metal powder.
6. Monitor bushland condition in the planning area to ensure horse riding is not contributing to degradation or dieback spread.
7. Develop a horse riding Code of Conduct, to be included in the update of the brochure.

INFORMATION, EDUCATION AND INTERPRETATION

- Information, education and interpretation provide targeted communication with the public.
- It is important for the effective implementation of the Management Plan that community understanding and support is fostered for the reserve.
- There is currently very little information available, in particular with reference to Forrestdale Lake's Ramsar listing, and the significance of Ramsar listed wetlands.

Objectives

1. To increase community awareness, appreciation and understanding of the values of the planning area, and to gain support for management practices.
2. To increase community awareness, appreciation and understanding of Forrestdale Lake's listing as a Ramsar site, and the significance of Ramsar listed wetlands.

Strategies

1. Develop and implement an Interpretation Plan for the reserve which focuses on:
 - Interpretation signs, ensuring any new signs incorporate the Ramsar logo and an explanation of Ramsar wetlands.
 - Waterbirds;
 - Priority, rare and threatened flora, fauna and ecological communities.
2. Continue to encourage, promote and support local volunteers and the Friends of Forrestdale, with essential resources to help them carry out their activities.
3. Provide information to visitors on reserve values and issues such as Ramsar, visitor safety, permitted activities and regulations.
4. Provide a written annual update on management for local residents, possibly via the local newsletter, *The Forrestdale Rag*.

Strategies

1. Encourage the participation of volunteers, educational institutions and other organisations in research projects within the planning area, and promote research programs that address the Key Performance Indicator's of this management plan.
2. Support, and where possible, seek grant applications to encourage scientific research and monitoring within the planning area.
3. Encourage and support the Friends of Forrestdale in continuing to undertake regular monitoring of waterbird populations at Forrestdale Lake as part of the Birds Australia program.

WORKING WITH THE COMMUNITY

- Community groups and individuals are encouraged to be involved in the management of the planning area.
- Community support is essential for the successful implementation of this Management Plan.
- The Friends of Forrestdale have been in existence since 1990, and are dedicated to conserving the values of the planning area.

Objective

To facilitate effective community involvement in management of the reserve.

Strategy

1. Involve the community, particularly the Friends of Forrestdale, in the implementation of this management plan.

Key Performance Indicator:

The number of volunteer hours contributed is maintained or increased over the life of the plan.