SOUTH LAKE

Boundary Definition: protected area/bushland boundary (at times open water mapped as bushland)

SECTION 1: LOCATION INFORMATION

Bush Forever Site no. 254
Area (ha): bushland 34.5 (Site also includes open water.)
Map no. 58
Map sheet series ref. no. 2033–I NW
Other Names: part of Beeliar Regional Park
Local Authorities (Suburb): City of Cockburn (Bibra Lake)
System 6 (1983): Part M93 Part System area bushland, only bushland described

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS
Bassendean Dunes
Bassendean Sands (Qpb: S8)
Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)
Wetlands (within the Spearwood/Bassendean Dune interface)
Holocene Swamp Deposits (Qhw: Mps)

VEGETATION AND FLORA
Vegetation Complexes
Bassendean Dunes
Bassendean Complex — Central and South (at interface of Bassendean Complex — Central and South and Karrakatta Complex — Central and South)
Spearwood Dunes
Karrakatta Complex — Central and South (interface)
Wetlands
Herdsman Complex
Floristic Community Types: *not sampled, types inferred
Supergroup 2: Seasonal Wetlands
*11 Wet forests and woodlands
*12 *Melaleuca teretifolia* and/or *Astartea* aff. *fascicularis* shrublands
Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau AND/OR
Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes

WETLANDS
Wetland Types: sumpland
Natural Wetland Groups
Spearwood—Bassendean interface
Bibra (S/B.1)
Wetland Management Objectives: Resource Enhancement
Swan Coastal Plain Lakes EPP: 22.2 ha

THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: open water, vegetated wetland, vegetated uplands
Vegetation and Flora: limited survey (DEP 1999, EPA and WAWA 1990, Keighery, BJ, 1996a, Newman 1976, Weston 1993)
Structural Units: mapping (EPA and WAWA 1990, Newman 1976)
Uplands: *Eucalyptus marginata* and *E. calophylla* Open Forest; *Banksia attenuata* and *B. menziesii* Low Open Forest, with *Eucalyptus marginata*
Wetlands: *Eucalyptus rudis* Low Closed Forest; *Eucalyptus rudis* Low Forest over *Melaleuca rhaphiophylla* Low Forest to Woodland; *Eucalyptus rudis* and *Melaleuca preissiana* Open Forest, with *Acacia saligna* and *Melaleuca teretifolia* Tall Scrub; *Acacia saligna* Low Woodland; Mixed Closed Sedgeland
Scattered Native Plants: not assessed
Vegetation Condition: >50% Good to Very Good, with areas of severe localised disturbance (mapping, Weston 1993)
Total Flora: not known
Significant Flora: none recorded
Fauna: not known

Linkage: adjacent bushland to the west; part of Greenways 75, 90 (Tingay, Alan & Associates 1998a), part of a regionally significant contiguous bushland/wetland linkage (Part A, Map 7)
Other Special Attributes: included in Beeliar Regional Park Proposal (DPUD 1992a)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Entered in the Interim List of the Register of the National Estate; subject to protection under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

Criteria: Representation of ecological communities, General criteria for the protection of wetland, streamline and estuarine fringing vegetation and coastal vegetation
Recommendation: Site with Some Existing Protection; the care, control and management of this Site for conservation purposes within Beeliar Regional Park is endorsed (see Table 3, Volume 1).

SOUTH LAKE

Boundary Definition: protected area/bushland boundary (at times open water mapped as bushland)

SECTION 1: CADASTRAL INFORMATION

(Lots, locations and derived information to be updated in the public submission period)

Bushplan Site no. 254 **Map no.** 67 **Map sheet series ref. no.** 2033–I NW

System 6 (1983): Part M93 Part System area bushland, only bushland described

Other Names: not known

Area (ha): total 42.5 (includes open water); bushland 34.5

Local Authorities (Suburb)
City of Cockburn (Bibra Lake)

Zoning
MRS: Parks and Recreation, Important Regional Roads
TPS: Landscape

Ownership Categories
State Government, Local Government

Lot/Location/Reserve numbers (Purpose), Street name
0, 304 North Lake Rd; 21 Forrest Rd

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS

Bassendean Dunes
Bassendean Sands (Qpb: S8)

Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)

Wetlands (within the Spearwood/Bassendean Dune interface)
Holocene Swamp Deposits (Qhw: Mps)

VEGETATION AND FLORA

Vegetation Complexes

Bassendean Dunes
Bassendean Complex — Central and South (at interface of Bassendean Complex — Central and South and Karrakatta Complex — Central and South)

Spearwood Dunes
Karrakatta Complex — Central and South (interface)

Wetlands
Herdsman Complex

Floristic Community Types: *not sampled, types inferred

Supergroup 2: Seasonal Wetlands
*11 Wet forests and woodlands
*12 *Melaleuca teretifolia* and/or *Astartea* aff. *fascicularis* shrublands

Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau AND/OR
Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes

WETLANDS

Wetland Types: sumpland

Natural Wetland Groups

Spearwood—Bassendean interface
Bibra (S/B.1)

Wetland Management Objectives: Resource Enhancement

Swan Coastal Plain Lakes EPP: 22.2 ha

THREATENED ECOLOGICAL COMMUNITIES

Not assessed

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: open water, vegetated wetland, vegetated uplands

Vegetation and Flora: limited survey (EPA and WAWA 1990, Keighery, BJ, 1996a, Newman 1976, Weston 1993)

Structural Units: mapping (EPA and WAWA 1990, Newman 1976)
Uplands: *Eucalyptus marginata* and *E. calophylla* Open Forest; *Banksia attenuata* and *B. menziesii* Low Open Forest, with *Eucalyptus marginata*
Wetlands: *Eucalyptus rudis* Low Closed Forest; *Eucalyptus rudis* and *Melaleuca preissiana* Open Forest, with *Acacia saligna* and *Melaleuca teretifolia* Tall Scrub; *Melaleuca* sp. Low Open Forest to Low Woodland; *Acacia saligna* Low Woodland; Mixed Closed Sedgeland

Scattered Native Plants: not assessed

Vegetation Condition: >50% Good to Very Good, with areas of severe localised disturbance (mapping, Weston 1993)

Total Flora: not known

Significant Flora: none recorded

Fauna: no known information

Linkage: no adjacent bushland; part of proposed Greenway 103 (Tingay, Alan & Associates 1997a); part of a regionally significant contiguous bushland/wetland linkage (Volume 2A, Map 8)

Other Special Attributes: included in Beeliar Regional Park Proposal (DPUD 1992a)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Interim list of the Register of the National Estate

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

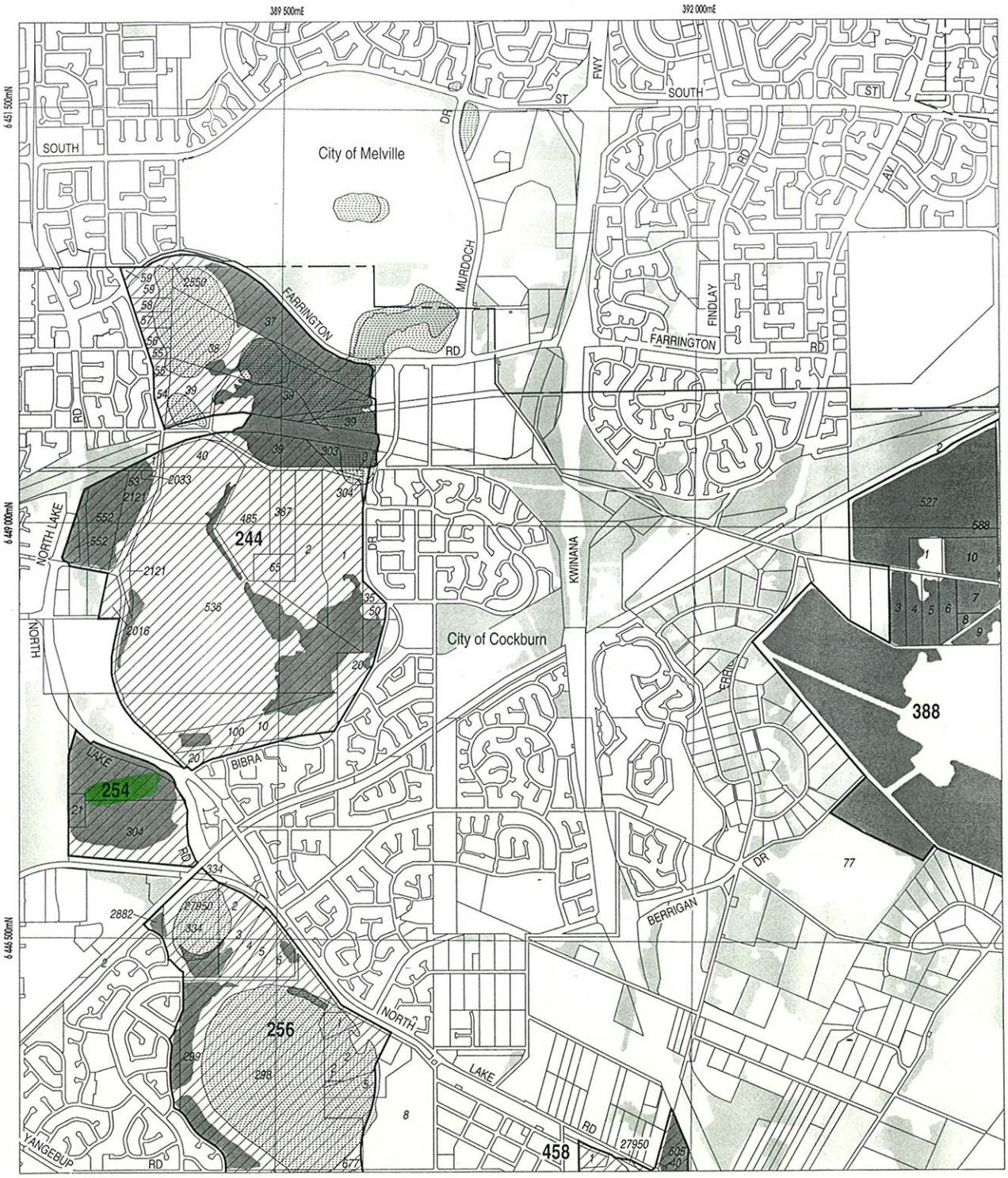
Criteria: Representation of ecological communities, General criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation

Opportunities and/or Constraints

Opportunities: Bushplan Site/part Bushplan Site subject to Swan Coastal Plain Lakes EPP; under MRS Parks and Recreation Reservation and TPS Landscape Zoning

Constraints: under MRD regional road requirements

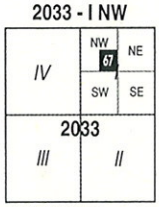
Recommendation: The care, control and management of this Bushplan Site for conservation purposes within Beeliar Regional Park is endorsed.



LEGEND

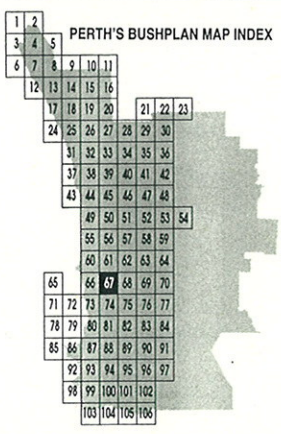
- 472 — Bushplan Sites With Regionally Significant Bushland
- Other Native Vegetation
- Conservation Category Wetlands
- Bushplan Sites With Some Existing Protection
- 696 — Lot Number, Location Number
- Channel Wetlands
- Local Government Boundary

2033 - I NW



1 : 25 000 AMG Reference Grid showing Perth's Bushplan Map Sheet Breakdown

PERTH'S BUSHPLAN MAP INDEX



N

SCALE

0 500 1000

Metres

Produced by Project Mapping Section
Land Information Branch, Ministry for Planning, Perth W.A. November 1998

ntw-map18//environ/bushplan//bushv2_67.dgn

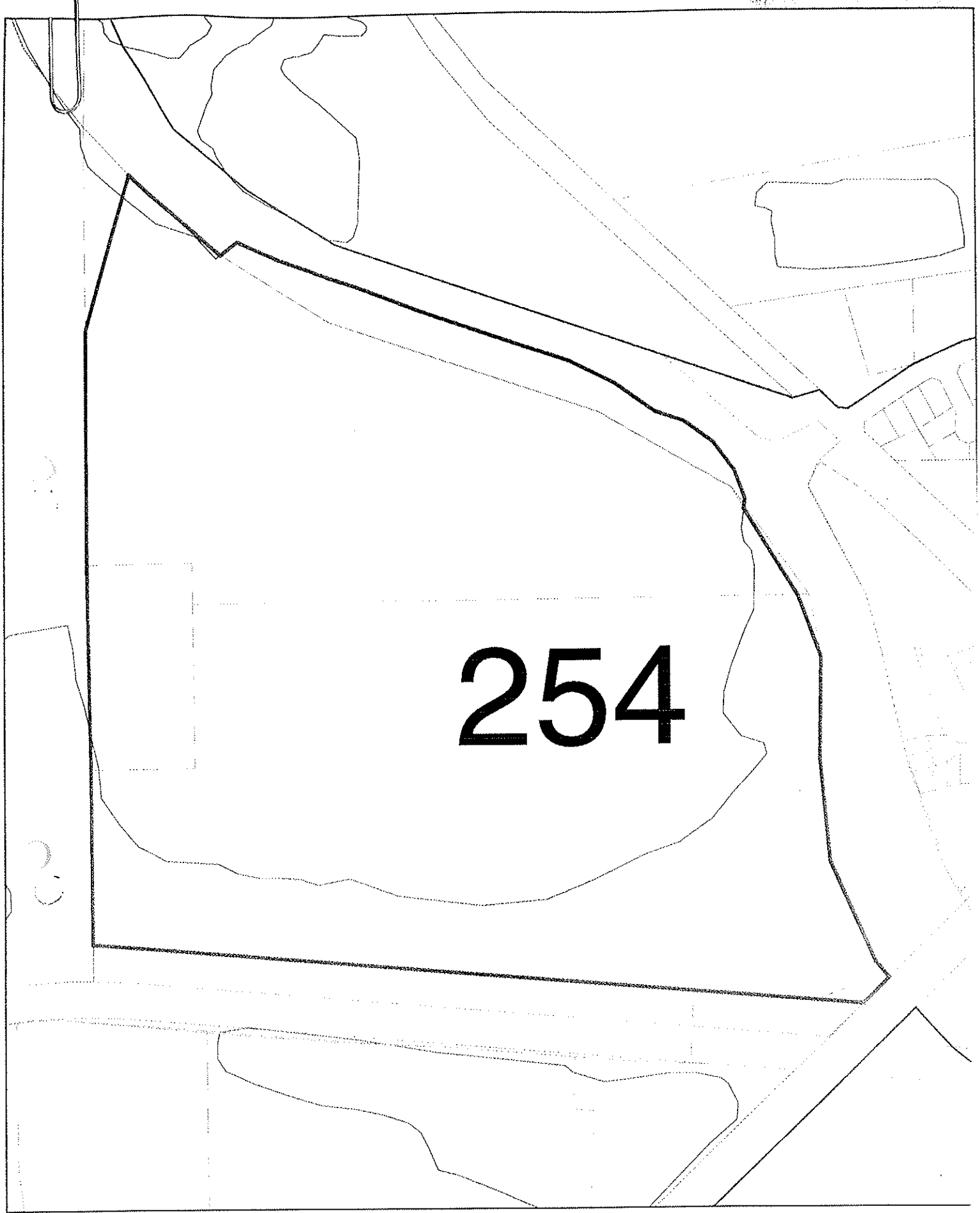
Cadastral Data supplied by Department of Land Administration, W.A.

Wetlands Data supplied by Water and Rivers Commission

Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map

Map 67



BUSHPLAN SITES CORRECTED

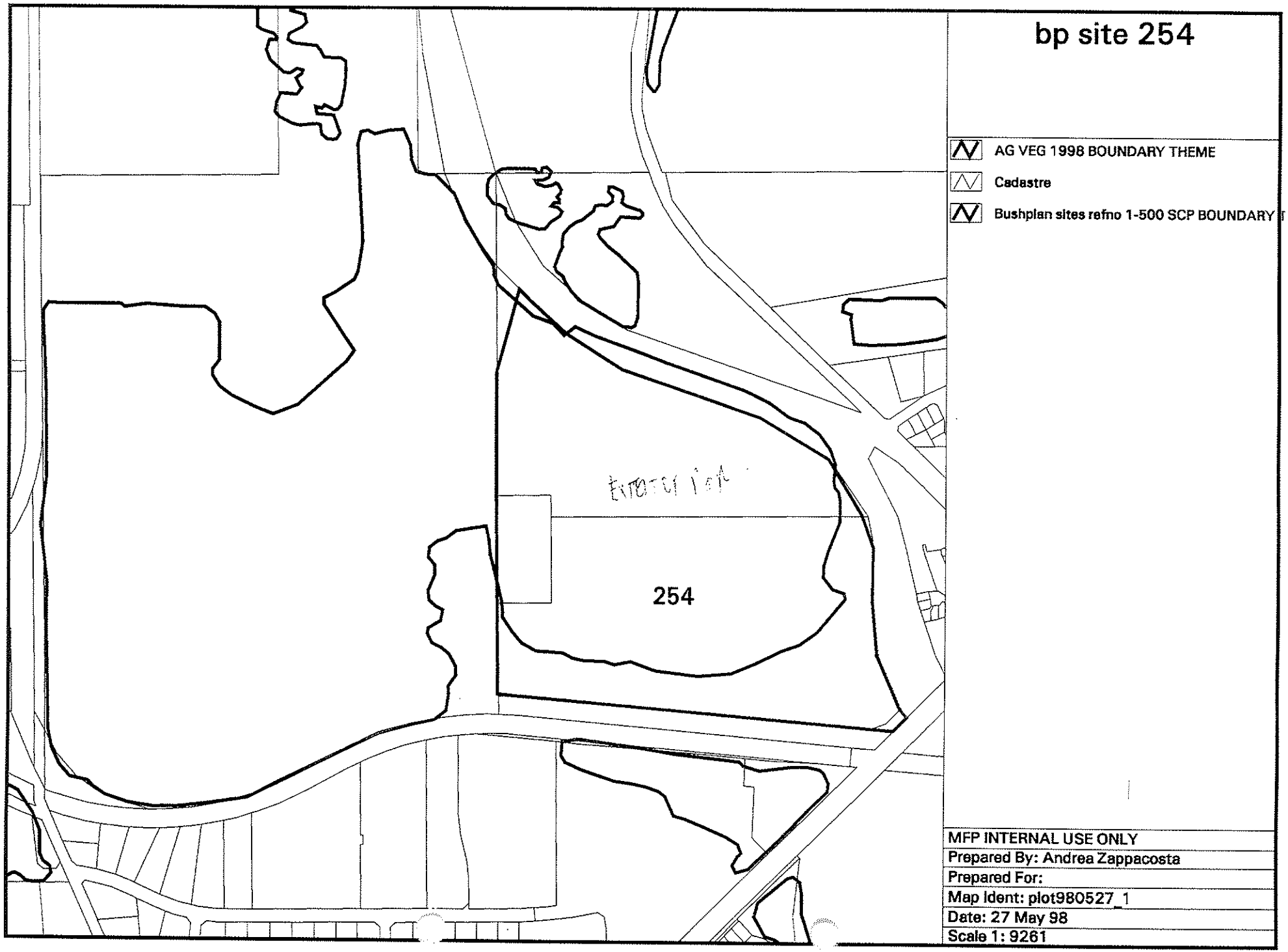
WESTERN AUSTRALIAN PLANNING COMMISSION

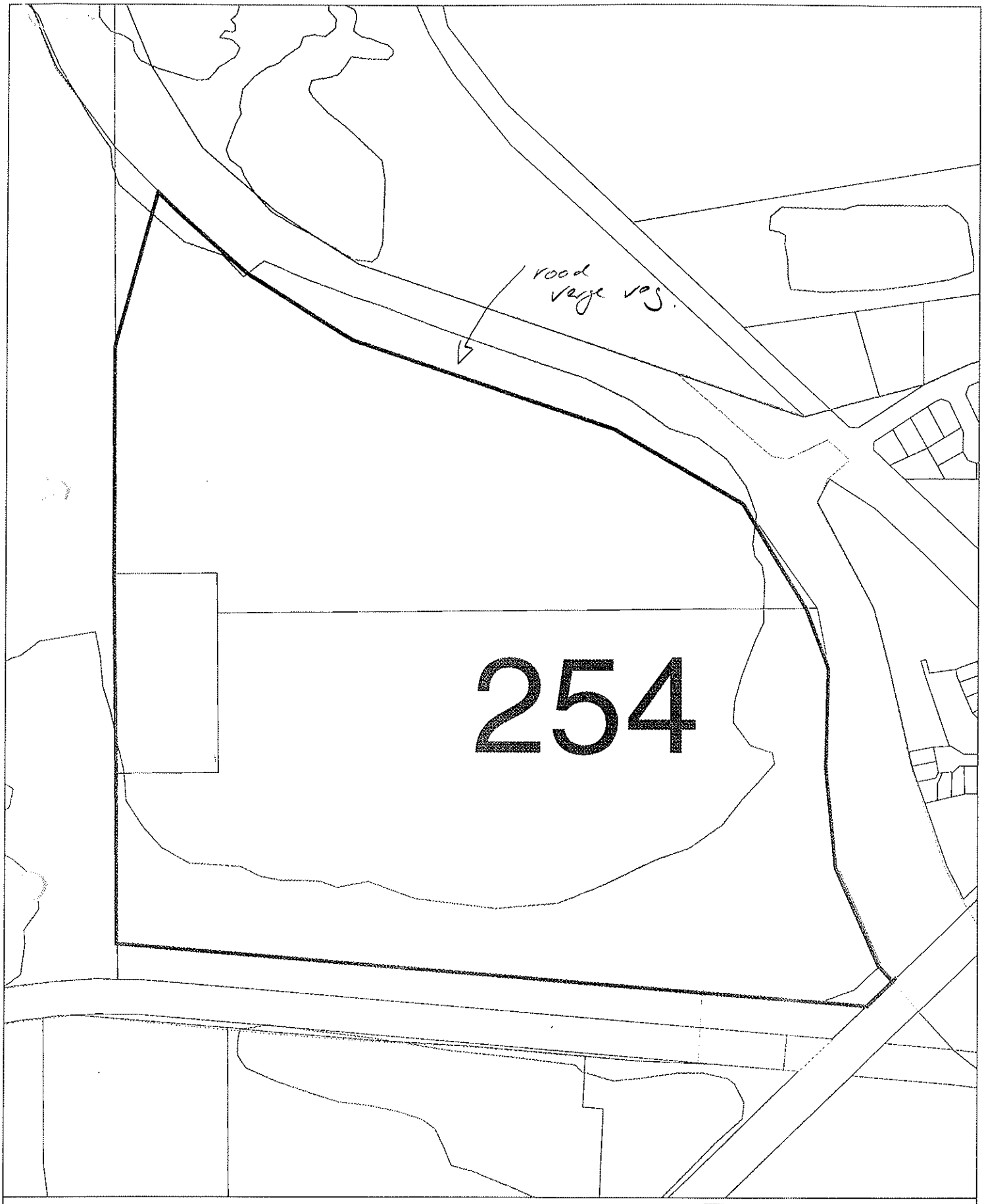
CUSTOMER FOCUS WESTERN AUSTRALIA

JNT 15/9

b CK 28/9/16

N


bp site 254
AG VEG 1998 BOUNDARY THEME
Cadastre
Bushplan sites refno 1-500 SCP BOUNDARY
254
MFP INTERNAL USE ONLY
Prepared By: Andrea Zappacosta
Prepared For:
Map Ident: plot980527_1
Date: 27 May 98
Scale 1: 9261



BUSHPLAN SITES CORRECTED

THE GOVERNMENT OF WESTERN AUSTRALIA

WESTERN AUSTRALIAN PLANNING COMMISSION

CUSTOMER FOCUS WESTERN AUSTRALIA

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SCALE 1:2500

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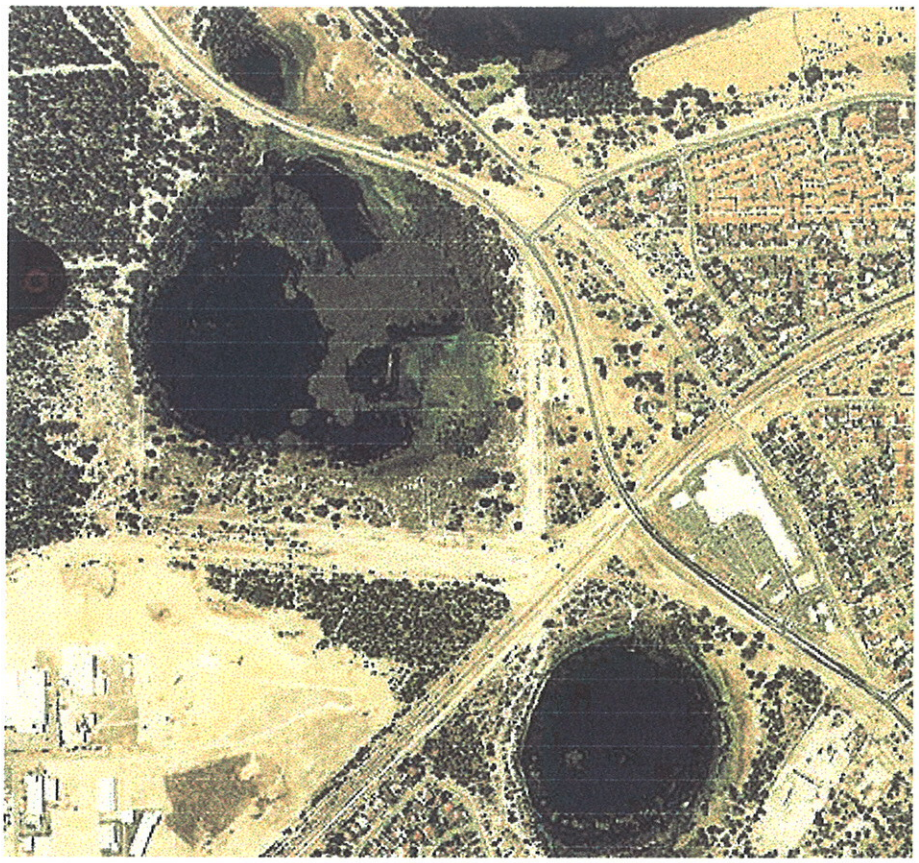
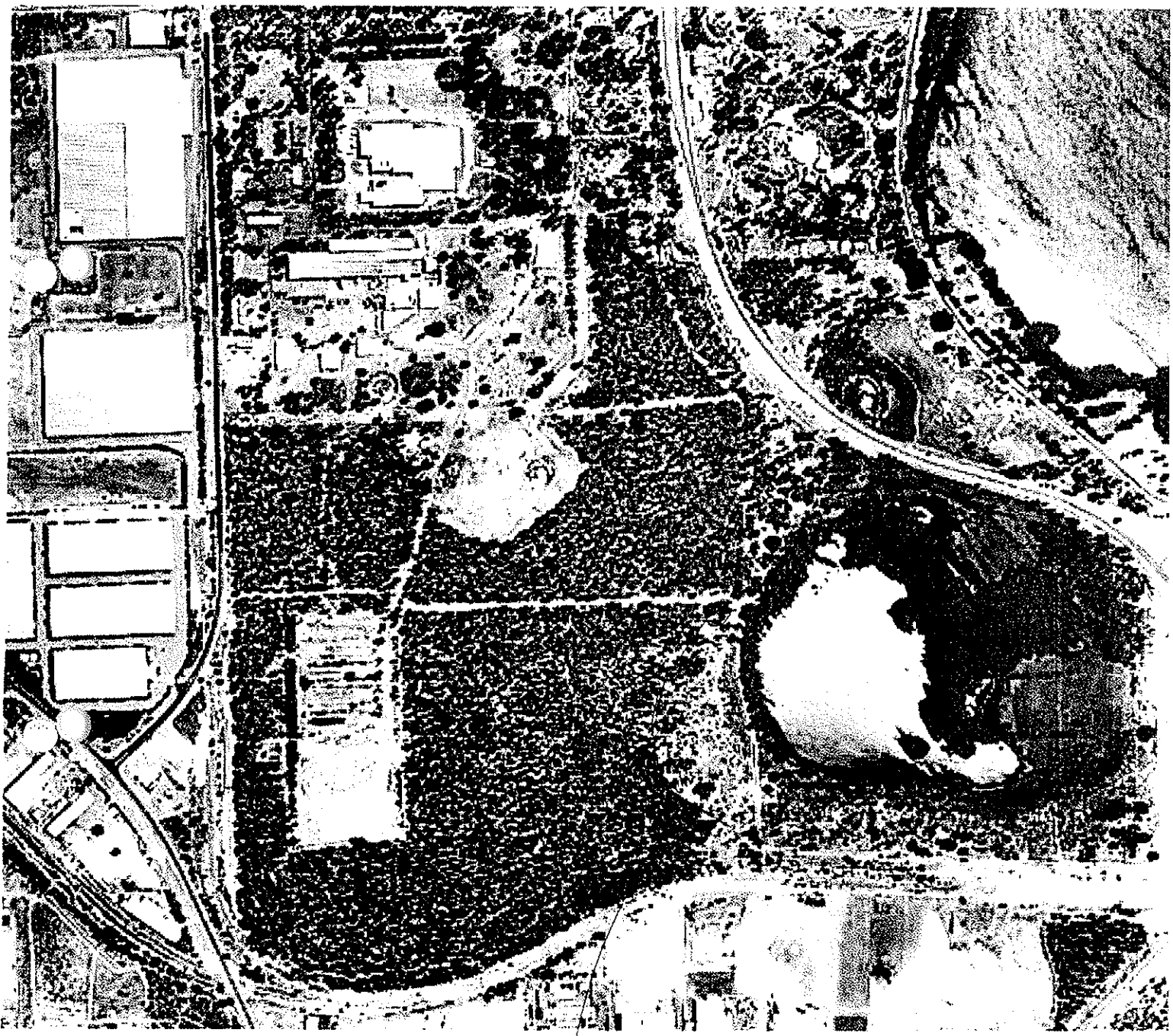


BS 254

1997 Panorama – note areas of open water and vegetation

BS 254 1998



BS254 1998

Flooded Gums + Manni

PBO81 97

This submission deals mainly with the large sites for bushland preservation but there are many small pockets of quality bushland which will be overlooked. When developers move on these, community dissension will arise. To help remediate this problem, and in recognition of the great loss of urban bushland in the Perth Metropolitan area over the past few decades, I suggest that the Town Planning regulations in relation to preserving portions of land for parks and recreation be amended.

Generally land required for residential development involves the setting aside of 10% for public open space or parks and recreation. I suggest that this is now an inadequate proportion and it should be increased to a range of 15% to 20% at the discretion of MFP (and Councils). Such an arrangement should incorporate a requirement that the best pockets of bush on these parcels should be retained as nature reserves. Perhaps a 50:50 recreation/preservation mix might be achieved.

Higher development densities maybe granted to the landowner or developer to compensate for the higher ratio of parks and recreation. Regardless, landowners of potential residential development sites have benefited greatly in terms of capital appreciation over recent years because of the higher densities e.g. R20:30, compared to previous R.12.5 - R.15 in the early 1980's.

I suggest that this recommendation of a higher proportion of parks and recreation space from such smaller pockets of bushland not covered by Bushplan sites, should be part of the final recommendations of the Bushplan study.

BUSHPLAN RECOMMENDATIONS:-

My attention is primarily concentrated on my local geographic area, south of the Swan River where I have a long term, close knowledge of many sites and potential bushland sites. My recommendations are as under:-

Bushplan Site [redacted] - Hamilton Hill:

This site does not include enough of the limestone ridges/bushland extending to the south to the railway line. These hills are a distinctive character feature of the Fremantle/Cockburn area and are one of the last sizeable bird habitats. I recommend expansion of Site 247 to include more of the vegetated ridge.

Site [redacted] Southlake:-

This site is only restricted to the actual wetland and some of its periphery. However, there is an excellent stand of bushland adjoining to the west and extending through to Sudlow Road. Currently the land is owned by Amcor which has a papermill on part of the land. Approximately 20 hectares of diverse bushland dominated by Marri with considerable Hybertia is located towards the Sudlow Road/Miguel Road side.

PB081

City of Cockburn Submission - Proposed Addition 1 - Bushland to the east of South Lake (BS 254) owned by AMCOR.

Vegetation as observed during the on ground inspections on 28/6/99.

See Map 1 for the following units.

1. Margin of Wetland (within BS254): *Eucalyptus rudis* Low Forest *over Melaleuca rhaphiophylla* Low Forest to Woodland. Condition Very Good (fenced from AMCOR land).
2. Gentle rise to east (in AMCOR land). This area has been cleared in the past and is completely degraded. *Eucalyptus rudis, Eucalyptus calophylla and Melaleuca preissii* trees occur in this area. The presence of these species indicate that this area is influenced by the high water table and are part of the 'damp' edge of the wetland.

3. Dune (in AMCOR land): This area is principally *Banksia attenuata* Low Woodland over *Hibbertia hypericoides* and *Xanthorrhoea preissii* Open Low Heath in Good to Very Good condition. Other trees occur as a layer over the Low Woodland or scattered to co-dominants with the *Banksia attenuata*. Co-dominants are - *Eucalyptus marginata, Allocasuarina fraseriana, Banksia menziesii and Banksia grandis* (3a), *Eucalyptus calophylla* (3b) and *E. gomphocephala* (3c) occur as scattered to Low Woodland. There is one area of Degraded Woodland where the trees are regenerating well (3d). This vegetation is typical of the Spearwood Dunes and is inferred to be floristic community type 28 and is typical of the Karrakatta Central and South complex.

Discussion

- The vegetation in the proposed addition to BS254 is consistent with the majority of upland vegetation in the remainder of the Beeliar Regional Park uplands.
- South Lake contains no buffer to the west.
- The City of Cockburn's rationale that the proposed addition would provide for a buffer, landscape protection and vegetation protection is supported. However, it is not direct Bushplan issue except for the addition of an area of Karrakatta Central and South (most of this complex in Bushplan is in a Good to Very Good Condition).

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3. Dune (in AMCOR land): This area is principally *Banksia attenuata* Low Woodland over Hibbertia hypericoides and *Xanthorrhoea preissii* Open Low Heath in Good to Very Good condition. Other trees occur as a layer over the Low Woodland or scattered to co-dominants with the Banksia attenuata. Co-dominants are - Eucalyptus marginata, *Allocasuarina fraseriana*, *Banksia menziesii and Banksia grandis* (3a), *Eucalyptus calophylla* (3b) and *E. gomphocephala* (3c) occur as scattered to Low Woodland. There is one area of Degraded Woodland where the trees are regenerating well (3d). This vegetation is typical of the Spearwood Dunes and is inferred to be floristic community type 28 and is typical of the Karrakatta Central and South complex.

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italics

City of Cockburn Submission – Proposed Addition 1 – Bushland to the east of South Lake (LS 254) owned by AMCOR.

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See Map 1 for the following units.

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BS254 1998

Map showing veg units – see text

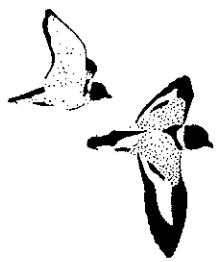
BFS # 254 (adjacent)
PR021

The Vertebrate Fauna of Lot 502 (Amcor Bushland), Cockburn

Supplementary report on the protection of fauna

Prepared for: Landcorp.
Level 3, Wesfarmers House
40 The Esplanade,
Perth.

Prepared by: M.J. & A.R. Bamford,
CONSULTING ECOLOGISTS.
23 Plover Way,
Kingsley, WA, 6026



04/12/'01

CONTENTS

INTRODUCTION

Lot 502, on the corner of North Lake and Phoenix Roads, Bibra Lake, has an area of 89 ha and is proposed for sub-division for industrial use. It is adjacent to South Lake, which is part of Beeliar Regional Park and Bushplan site No. 254, and currently supports native vegetation except where clearing has occurred alongside South Lake, and where the vegetation has been degraded by waste from the Amcor Paper Mill.

A report on the fauna of the site was prepared as part of an environmental impact assessment carried out in 2000 (M.J. and A.R. Bamford Consulting Ecologists 2000a), with that assessment carried out at the Environmental Protection Statement (EPS) level. Subsequently and in response to the submission of public appeals, the Minister for the Environment found that the proposal required a higher level of assessment and therefore a Public Environmental Review (PER) is being prepared. As part of this new assessment, we have been commissioned to fulfil the Environmental Protection Authority (EPA) requirements for additional information on fauna, particularly with respect to fauna protection. Specifically, the EPA requires the following:

- Additional information on the vertebrate fauna of the region to put fauna and fauna habitats of the proposal area into local and regional perspectives. This is to include the effects of fragmentation and other forms of disturbance upon the fauna of Lot 502, and the linkage value of bushland in Lot 502 for fauna.
- Preparation of a map showing important fauna habitats within the proposal area.
- Consideration of the conservation of significant fauna that may use the proposal area.

e.g. Bush Forever sig^t birds

To achieve these aims, this report has the following components:

- A list of vertebrate fauna observed or expected to utilise the site.
- The identification of significant fauna within that list, including species recognised as threatened under state (WA Wildlife conservation Act) or Federal (Environmental Protection and Biodiversity Conservation Act) legislation, species included on CALM's Priority Fauna register and species with locally or regionally restricted distributions.
- Descriptions of fauna habitat types and their condition, both within and immediately adjacent to Lot 502. Descriptions of habitats include an assessment of the their importance for different species of significant fauna.
- Map of fauna habitat types, including their importance for conservation.
- The degree of representation of these habitat types at three levels: within Beeliar Regional Park, within the City of Cockburn and adjacent municipalities, and regionally within the metropolitan area.
- A discussion of the impacts of the proposed sub-division on fauna, and especially significant fauna, including the effects of: loss of habitat; fragmentation of habitat, noise during construction and operation of the industrial park; and rehabilitation of vegetation in a buffer area around South Lake. Impacts are considered to be local when they affect fauna populations of the project area and adjacent sites, including South and Bibra Lakes. Regional impacts affect fauna populations over a broad area, encompassing the City of Cockburn and adjacent municipalities.
- Strategies for the minimisation of detrimental impacts.

METHODS

As part of the initial assessment of the site conducted for the earlier report (Bamford Consulting Ecologists 2000a), the site was visited on the 6th of June 2000 by Mr W. Bancroft, Mr R. Davis, Ms J. Wilcox and Dr M. Bamford of Bamford Consulting Ecologists. Because of the small size of the site, it was possible to walk along all the boundary and the main internal tracks, as well as walk through much of the main bush area. This inspection made it possible to become familiar with the habitats present, while bird species were recorded, tracks and diggings of reptiles and mammals were noted, and searches for amphibians and reptiles were undertaken by raking through leaf-litter, turning over logs and looking under the bark of dead trees. In addition, each member of the team carried out a 20 minute, 2 ha bird survey to get some measure of the abundance of the most common bird species. All team members also spent approximately 1 hour spotlighting for nocturnal fauna on the evening of the 6th of June. While fauna observations were made during this site inspection, the main purpose of visiting the site was to familiarise the consultant with the fauna habitats of the proposal area so that information on fauna in the Perth region could be placed into the perspective of the site. The site was not formally re-visited for the purposes of this supplementary report.

In addition to fauna observations made during the site inspection, lists of vertebrate fauna likely to occur on the site were developed on the basis of published and unpublished records, including extensive personal records accumulated while working as a zoologists in the Perth region since the late 1970s. Because the site is in a region well-studied for fauna, such predictions can be made with a considerable degree of confidence. Sources of information included WA Museum specimen records from the general region, personal observations from previous studies carried out in the area, observations on birds in the Perth area from Van Delft (1997), observations on reptiles in the Perth area from Bush *et al.* (1995), and the results of a number of studies on the vertebrate fauna of bushland remnants in the Perth region (eg. Storr *et al.* 1978, Wykes 1991, How 1998, Turpin 1990, Storr and Johnstone 1988, and How and Dell 1994, Dell and How 1995 and Johnstone and Storr 1998).

The fauna lists are for vertebrate species known to occur in remnant bushland on the Swan Coastal Plain of the Perth region, and virtually any of these species could be recorded at the site given a long enough sampling period. Therefore, the purpose of this study is to indicate those species observed or expected to use the site regularly. The indicated species are therefore those for which the site is important. Taxonomic orders and names used in this report generally follow Tyler *et al.* (1984) for amphibians, Storr *et al.* (1983, 1986, 1990 and 1999) for reptiles, Strahan (1995) for mammals and Christidis and Boles (1994) for birds. Where recent taxonomic revisions have occurred, earlier names are given in parenthesis. Where used, common names are taken from various sources, including Bush *et al.* (1995) for amphibians and reptiles, and Christidis and Boles (1994) for birds.

For the determination of conservation significant fauna of the site, the conservation status of fauna species is assessed under Federal and State Acts such as the Commonwealth Environmental Protection and Biodiversity Conservation Act (EPBC Act) and the WA Wildlife Conservation Act. These use levels of significance recommended by the International Union for the Conservation of Nature and Natural

Resources (IUCN) and reviewed by Mace and Stuart (1994), although the WA Act also has a category of "Other Specially Protected Fauna" that has no equivalent IUCN level. These categories are described in Appendix One. In addition, Environment Australia has supported the publication of reports on the conservation status of reptiles (Cogger *et al.* 1993) and birds (Garnett and Crowley 2000), while the Threatened Species and Communities Section of Environment Australia has produced a list of Threatened Australian Fauna (Environment Australia 1999), although this list is effectively a precursor to list produced under the EPBC Act. These publications also use the IUCN categories, although those used by Cogger e*t al.* (1993) differ in some respects as this report pre-dates Mace and Stuart's review.

In Western Australia, the Department of Conservation and Land Management has produced a supplementary list of Priority Fauna, being species that are not considered Threatened under the IUCN categories but which the Department feels there is cause for concern. Levels of Priority are described in Appendix One.

In addition to the assessment of fauna under CALM's Priority list and the IUCN categories, some fauna are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA) and the Japan Australia Migratory Bird Agreement (JAMBA). Species listed under these agreements are mostly migrants that spend part of the year in each country, although some of the species are non-migrants but occur in both countries.

Fauna species included under conservation acts and/or agreements, or listed as Priority Species, can be considered to be of National Conservation Significance. Species that are not listed under any of the above categories can be considered of Regional Conservation Significance if they are at the limit of their distribution or are common but within a very restricted range. The assessment of regional significance is largely a personal judgement based on familiarity with the species concerned and available information on patterns of distribution.

Assessments of fauna habits within the study area and in nearby sites were based upon the site inspection, information provided by Dr E. Bennett (botanist working on the project) and documentation presented in reports prepared for the Bush Forever project(Government of Western Australia 2000).

Impacts of habitat loss and fragmentation upon fauna have been fairly well documented, although the issue of fauna conservation in fragmented landscapes is subject to considerable debate (eg. Saunders *et al.* 1987). The topic has been studied in some detail in the Perth region (How and Dell 1993, Recher and Serventy 1991) and with available information and personal experience, species that vary in their ability to persist in the face of the sort of development proposed for the study area have been indicated. Species that are unlikely to persist or will decline dramatically on the site as a result of the development are considered to be of Local Conservation Significance. Note that a species of National Conservation Significance may not be of local significance if it is unaffected by the development, while a very abundant and widespread species will be of Local Conservation Significance if severely impacted by the development.

THE PROPOSED DEVELOPMENT

The proposed development is a general industrial area (possibly including mixed business, corporate office or service commercial depending upon a feasibility study and final sub-division planning) across the bulk of the site, with a buffer retained around South Lake. Work on the development is planned to be sequential, starting from the north-eastern corner of the property, and will involve the clearing of vegetation in areas to be developed, and some earthworks to achieve workable contours. It may be possible to retain some trees and to leave the spoil surface undisturbed in some locations, while the sequential process will allow some displacement of fauna. The establishment of gardens and rehabilitation of the buffer will create some alternative fauna habitat and compensate somewhat for the clearing of developed areas.

VERTEBRATE FAUNA OF THE PROJECT AREA

Vertebrate species observed or expected on the site are indicated on Tables 1, 2 and 3. Note that expected species have only been included if there appears to be suitable habitat for them and they are known to occur in the region; species for which there appears to be no suitable habitat, or that are believed to be extinct in the Perth region, have been excluded. The site may support 8 species of frogs, 38 species of reptiles, 80 species of birds and 15 species of mammals (10 native and 5 introduced).

In the following sections, each fauna group (frogs, reptiles, birds and mammals) is discussed in terms of the species present, species of conservation significance, important habitats, impacts of the development and impact minimization. Tables 1, 2 and 3 classify each species according to their National, Regional and Local Conservation Significance (see Methods for descriptions of these). Information on threatened fauna, habitats, impacts and impact minimization are drawn together for all groups in the Discussion (see below).

Frogs

Although only three frog species were recorded, on the basis of patterns of distribution and the habitats present all eight species of frogs known from the Swan Coastal Plain south of the Swan River almost certainly occur on the site (Table 1). This reflects the juxtaposition of South Lake. The Turtle Frog is an entirely terrestrial species that may occur on the site throughout its life cycle (Roberts 1981), while the Moaning Frog, Pobblebonk and to some extent Guenther's Toadlet have aquatic larvae but terrestrial adults that live up to several kilometres away from wetlands (Bush *et al.* 1995, Bamford 1992). These four species therefore depend upon terrestrial habitats and disappear when urban development surrounds wetlands (M. Bamford pers. obs). The Moaning Frog is also dependent upon natural seasonal fluctuations in the water level of wetlands where it breeds. The remaining species will utilize terrestrial habitats but the bulk of their populations remain close to aquatic environments and they survive around urban wetlands where natural fringing vegetation is retained. The fringing vegetation of South Lake is therefore important for frogs.

Across the bushland, the most important areas for frogs are likely to be those closest to South Lake, although the Turtle Frog, Moaning Frog and Pobblebonk are likely to be found throughout the woodland habitat. The cleared area adjacent to the lake is unlikely to be of value to the frogs, but such cleared areas do not present a barrier to their movement (Bamford 1997). In woodland areas, frogs appear to be tolerant of a considerable degree of degradation and weed invasion (M. Bamford pers. obs.).

None of the frogs is of National Conservation Significance but the Turtle Frog, Moaning Frog, Pobblebonk and Guenther's Toadlet can be considered of Local Conservation Significance because they depend in part upon the woodland environment proposed for development. All will decline in abundance due to loss of habitat caused by the development, but rehabilitation of the buffer around South Lake should create some alternative habitat for them. Assessing the level of impact on these four species is difficult because information on their biology, particularly in developed and rehabilitated landscapes, is lacking. However, it can be concluded that of these four species, Gunther's Toadlet will be least affected as it relies less on woodland habitats than the other three species, while the Moaning Frog and Pobblebonk are also known to survive in urban gardens so may be able to exist in gardens within the development (M. Bamford pers. obs.).
Those frog species that make least use of the upland habitats should be unaffected by the development, as long as the existing fringing vegetation, shoreline and seasonal fluctuations of water level in South Lake are retained. Protection of these features of South Lake is also important for Guenther's Toadlet, the Moaning Frog and the Pobblebonk. The Moaning Frog in particular may be adversely affected if the seasonal pattern of water level changes in South Lake is altered by the development. Successful breeding by this species requires a predictable rise in water level in early winter.

Reptiles

From the perspective of reptiles the site lacks some habitats, such as heathland and banksia woodland, with the result that not all species known to persist in the region (see How and Dell 1994) are likely to be present. Despite this, the site may support 38 species (Table 1), of which five were observed during the site inspection. The 38 species expected may not all be present, but are those known from the local area in the sorts of habitats represented on the site, and that are known to persist in remnants of native vegetation within an urban landscape (see Methods).

One reptile species, the Long-necked Tortoise, is aquatic and would visit the site only to lay eggs, while the South-West Cool Skink, Mourning Skink and Tiger Snake are closely associated with riparian habitats around wetlands and might therefore be little affected by development of the site. The tortoise readily lays eggs in urban gardens around wetlands. All remaining species depend upon the woodlands of the site. It is not possible to identify particular areas within the bushland that are more important for reptiles than others as, apart from degradation around the margins of the site, the woodland is remarkably uniform.

Small areas of remnant native vegetation in the Perth region, even when degraded, retain a substantially intact reptile fauna (How and Dell 1994). Despite this, the

majority of reptile species are sensitive to habitat loss associated with development and only a few species, such as the two geckoes, Fence Skink, Two-toed Earless Skink, Dwarf Skink and the three species of *Lerista,* are known to maintain viable populations in urban areas in the absence of native vegetation. Even these species, however, may decline dramatically because of clearing and earthworks. This means that species that can survive in urban landscapes will have to colonise gardens subsequent to development.

Because of the extent of habitat loss associated with development, the majority of reptile species (27 of the 38 species expected) can be considered to be of Local Conservation Significance since their populations will decline dramatically if the site is developed. Most or all of these species may be able to persist in the rehabilitated buffer around South Lake, but their populations will be reduced in size more or less in proportion to the decline in area of habitat. Thus, species of Local Conservation Significance can be expected to suffer population declines in the order of 90% within the site, if it is assumed that the rehabilitated buffer will provide adequate habitat for them. This reduction in population size would make the species more vulnerable to local extinction due to factors such as predation by domestic cats and individuals being killed on roads. Large predatory species, such as the Gould's Goanna, may be particularly vulnerable to the impact of small population size, as they naturally occur at low population densities.

Some species are considered of Regional Conservation Significance because they are at the limit of their distribution in the area (see Table 1). The Sandhill Dragon, Black-headed Tree Goanna, Worm Lerista, Western Bluetongue, Narrow-banded Snake and Half-ringed Snake are at the southern limit of their range just south of the Swan River, while Rosenberg's Goanna, the Perth Lined Lerista and Crowned Snake are at the northern limit of their range. The Worm Lerista and Perth Lined Lerista may persist despite the development, as they are known to survive in gardens, but the other species will suffer population declines. Furthermore, the tree goanna, bluetongue and three snake species occur at low population densities so may not have viable population sizes around the margin of South Lake and in the rehabilitated buffer zone.

Two species are of National Conservation Significance: the Perth Lined Lerista is listed as Rare or Insufficiently Known and the Black-striped Snake is listed as Endangered by Cogger *et al.* (1993). Neither is recognised under Conservation Acts or by CALM, however, probably because both are secure in reserves outside the metropolitan area. Note that the Lined Lerista is one of those species known to persist in suburban gardens. It has a distribution largely limited to the southern suburbs of Perth, but is also present on Rottnest and Garden Islands.

Birds

Because of the mobility of birds, over a hundred species could probably be recorded at the site, but it is considered that only 80 species may make regular use of it and 34 species were observed during the site inspection (Table 2). Not included among species expected to make regular use of the site are waterbirds such as the Australian Pelican *Pelecanus conspicillatus* and Silver Gulls *Larus novaehollandiae*, observed flying over the bushland during the site inspection. However, the list includes waterbirds that may nest in trees within the site (some ducks and the White-faced Heron) and waterbirds that may visit the effluent ponds. For example, during the site inspection, a flock of 25 Australian White Ibis was observed feeding in damp areas where sprinklers had recently been discharging effluent. Several other bird species might be attracted to the site because of these disturbed areas, but most of those listed are likely to depend upon the woodland habitat. Note that several bird species known from the general region of the site have been included on Table 2 but are not expected to utilise the site as there appears to be no suitable habitat for them, such as heathland.

Nearly half (37 of 80 species) of the bird species expected on the site are considered to be of Local Conservation Significance, indicating that their local populations would be severely affected by development of the site, with population declines within the site roughly proportional to the amount of habitat lost. Most of the species predicted to decline may persist in the rehabilitated buffer around South Lake, particularly because this buffer will be adjacent to Beeliar Regional Park. The juxtaposition of the buffer and the park means that the area of woodland to be rehabilitated around South Lake should be more effective at retaining bird species than if it were in isolation. However, the remaining habitat may not be sufficient for a number of species, including the Brown Goshawk, Painted Button-quail, all four species of cuckoos, the Varied Sittella and the Golden Whistler. Furthermore, reduced population sizes may make some species prone to local extinction. For example, bushfires in small reserves can lead to the local extinction of species such as the Splendid Fairy-wren and the thornbills (Dell and How 1995).

The species of Local Conservation Significance are species that are either resident and depend upon the native vegetation of the site, such as the thornbills, Weebill and Splendid Fairy-wren, or species that are regular visitors that only utilise the site because of the native vegetation, such as the two pardalotes and the Western Gerygone. The resident species are of special significance as if they disappear from the site, they will only be able to colonise rehabilitated areas and gardens if they are able to persist in the nearby Beeliar Regional Park. In contrast, species that are regular visitors to the site can be expected to discover suitable habitat when it develops.

Those birds not of Local Conservation Significance include species that survive and even thrive in urban landscapes, such as most honeyeater species, Magpies and Ravens, and those that can utilise the open areas of lawns and gardens, such as the Magpie Lark, some birds of prey and the Willie Wagtail. The White-faced Heron may nest in trees around South Lake and nesting trees are probably within the buffer, so this species is likely to be unaffected by the development.

The only bird species that can be considered of Regional Conservation Significance is the Golden Whistler. This was once a regular seasonal visitor to the Coastal Plain from the forests of the Darling Scarp, but it is now an infrequent visitor (Serventy and Whittell 1976). It has not been observed in the study area but has been seen in woodland around North Lake (M. Bamford pers. obs.).

Only three bird species of National Conservation Significance are expected to use the site: the Square-tailed Kite (Priority 4 according to CALM but listed as Least Concern by Garnett and Crowley 2000 and not listed under the EPBC Act), Peregrine Falcon (Other Specially Protected Fauna of the WA Wildlife Conservation Act, not listed by Garnett and Crowley 2000 or under the EPBC Act) and Short-billed Black-Cockatoo (Schedule 1 (Endangered) of the WA Wildlife Conservation Act, also Endangered under the EPBC Act and according to Garnett and Crowley 2000). Of these, the Kite and Falcon are not given high levels of significance and are likely to be infrequent visitors, although the site could be part of the range of a pair of Falcons and therefore important for them. The Short-billed Black-Cockatoo, however, relies on patches of native vegetation and pine plantations to maintain its presence in the Perth region. Within the study area, it may be a regular visitor to forage on the seeds of Banksias.

During the site inspection, it was noted that the highest densities of birds were seen in the narrow area of degraded bushland between the Amcor Plant and North Lake Road. This appeared to be because of the presence of several Tuart trees in this area, especially attractive to Weebills, and flowering Firewood Banksias and Marri, attractive to several honeyeater species and the Silvereye. There were also scattered low bushes in this area being used by Splendid Fairy-wrens. The Weebills and Splendid Fairy-wrens were found elsewhere on the site, but may always be abundant in this northern section, but the honeyeaters probably move around as the availability of flowers varies seasonally. This area of the site, with its high density of Banksias, may also be favoured by the Short-billed Black-Cockatoo.

Only 10 species were recorded during the censussing carried out in the centre of the bushland, and the densities (/ha) of these species were as follows:

Weebill:	0.25;
Western Gerygone:	0.62;
Red Wattlebird:	0.12;
Brown Honeyeater:	0.37;
Rufous Whistler:	0.25;
Grey Fantail:	0.75;
Grey Butcherbird:	0.12;
Australian Raven:	0.25;
Welcome Swallow:	0.50;
Tree Martin:	1.00.

This suggests a total density of 4.2 birds/ha, slightly under half (1.87 birds/ha) consisting of birds that will decline and could disappear if the site is developed. Densities in the northern area were much higher than this but were due largely to honeyeaters and Silvereyes.

Mammals

The extant mammal fauna of the site is likely to be poor with only 10 native and 5 introduced species (Table 3), compared with as many as 16 mammal species that may be locally extinct (listed in Bamford and Bamford 2000). This high level of extinction has been attributed to changes in fire regime, habitat loss and fragmentation, and predation by Foxes and Cats (Burbidge and McKenzie 1989, Paton 1991).

Because of the level of species loss of mammals, virtually all native species can be considered of Local Conservation Significance except the White-striped Bat, which seems to readily roost in artificial structures and to forage over suburban areas. However, it probably has to be accepted that species such as the Echidna, which may still be present and does occasionally turn up in urban bushland, probably cannot persist even in the existing area of habitat at the site. The Brush Wallaby is another species that may not survive even if the bushland area is retained, and the record of this species at the site is based on a weathered skeleton of a mature specimen. It is possible that this was the last specimen present and the species no longer occurs in the area. Bamford and Bamford (1999) found a population density of Brush Wallabies in Whiteman Park of 0.16 animals/ha, so the project area would be able to support fewer than 10 animals; not a viable population even in the medium term. Like the Brush Wallaby, the Grey Kangaroo has probably recently disappeared from the site, as skeletal remains have been found in woodland just to the north (M. Bamford pers. obs.). The Kangaroo has therefore been excluded from the expected species list, although it is possible that vagrants may still occur in the area.

Of the remaining native mammals, the characteristic diggings of the Quenda were found at the northern end of the bushland and in the central area, while tracks of the Brush-tailed Possum were seen in the central area and one was observed in a tree just over the boundary fence near South Lake. For both these species, the bushland probably supports populations that range around the nearby lakes, and development of the area would reduce the size of these populations. At least for the Quenda, there is considerable suitable habitat around Bibra Lake so the species would persist in the area, although the additional habitat in upland areas is important. However the Brush-tailed Possum, population in the South and Bibra Lakes area would decline due to development of the project area.

The rehabilitated buffer would have the potential to provide some replacement habitat for these two species, but their requirements are different. The Quenda favours low, dense vegetation that can be established within a timeframe of a few years using direct seeding techniques. In contrast, the Brush-tailed Possum requires large, hollow-bearing trees for shelter as well as native trees and shrubs for foraging. The translocation of large, hollow-bearing trees from areas to be cleared would benefit the Possum.

The five species of bats that are considered to be of Local Conservation Significance roost in tree hollows and under loose bark. Their status in the Perth region is unclear (Wykes 1991) so the significance of the project area for them cannot really be determined. A nearby housing development has retained many mature native trees and may still provide them with suitable roosting sites. The retention or translocation

of scattered old trees within the development, even if dead, will provide roosting sites for bats, but it is not known to what extent they will be able to successfully forage in the absence of native woodland.

No mammal species can be considered of Regional Conservation Significance, while two species present or likely to be present are of National Conservation Significance: the Quenda (listed as Priority 4 and Conservation Dependent by CALM) and the Rakali or Water-Rat (Priority 4). As noted above, the woodland of the study area may represent additional habitat utilised by a population of the Quenda centred around Bibra and South Lakes. The Rakali, however, is a semi-aquatic species that may be widespread in local wetlands but is unlikely to occur in the woodland of the project area.

DISCUSSION

Threatened Species

The project area may be utilised by 7 species of threatened fauna that are of National Conservation Significance: the Perth Lined Lerista, Black-striped Snake, Square-tailed Kite, Peregrine Falcon, Short-billed (Carnaby's) Black-Cockatoo, Quenda and Rakali. Of these species, however, only the Short-billed Black-Cockatoo rates a high level of significance. It may also rely on the woodland for foraging. Of the remaining species, the Perth Lined Lerista is known to persist in urban areas so may be able to survive on the site despite development, while the Square-tailed Kite and Rakali are unlikely to use the woodland areas regularly. The Black-striped Snake would be severely impacted by development if present, and the Peregrine Falcon would also be severely impacted if it used the site for nesting, although this does not appear to be the case.

Fauna Habitats; description and quality

From the perspective of fauna, the main vegetation and landform features of the site were:

- The site is essentially a high, sandy ridge in the north and west, sloping down to South Lake to the south-east.
- The vegetation consists mainly of a woodland of Jarrah *Eucalyptus marginata* and Marri *Corymbia calophylla,* with some Tuart *Eucalyptus gomphocephala* and a few specimens of Flooded Gum *Eucalyptus rudis* in the east. Other notable trees and large bushes were Firewood Banksias *Banksia menziesii*, especially in the narrow tongue of the site between the Amcor Plant and North Lake Road, small numbers of Bull Banksias *B. grandis* scattered throughout the woodland, and *Hakea prostrata* that appeared to be concentrated in regenerating areas adjacent to South Lake. There were also some small areas of pine plantation. The bulk of the woodland can be classed as Karrakatta Complex South-Central, with detailed descriptions of vegetation communities over the site prepared by Bennett Environmental Consulting.
- Much of the woodland appears to consist of regrowth, with few large trees present. In addition, the understorey along the western and eastern margins of

the bushland is heavily invaded with exotic grasses and regrowth *Xanthorrhoea* sp.. The bushland between the Amcor Plant and North Lake Road is particularly degraded, in places consisting of scattered trees with an entirely weedy understorey. In bushland away from these margins, the understorey is largely intact, with the most prominent shrub species being *Hibbertia hypericoides*.

- There are cleared areas immediately south of the Amcor Plant, in the vicinity of effluent ponds and a landfill area in the west of the site and adjacent to South Lake. The cleared areas south of the Amcor Plant support a dense growth of grasses (couch *Dactylon* sp. and Kikuyu *Pennisetum clandestinum*). The margins of South Lake are also largely cleared and appear to have been used for the agistment of horses in the past.
- There are badly degraded areas of vegetation along much of the boundary of the Amcor Plant where some sort of effluent is being sprayed from large sprinklers. This effluent coats vegetation and the ground with a material resembling papier mache.

The bushland of the project area is not uniform as fauna habitat and while it requires intensive field work to establish local patterns of distribution of fauna, some patterns were evident from the site inspection or can be surmised from knowledge of the species present. Figure 1 presents an attempt to map the fauna habitats and to classify them according to their importance for fauna.

Observations on birds and mammals in particular suggest that the most important parts of the project area for fauna are the somewhat degraded areas of woodland in the east and north-east of the site. This can be attributed to two factors. These areas are close to South and Bibra Lakes, and therefore movement of species such as some birds and the Quenda is likely to occur between the lakes and the eastern fringe of the woodland. The quality of vegetation is not necessarily a good guide to its importance for fauna. In addition, the vegetation along the east and north-east of the site is structurally complex, with shrubs such as *Hakea prostrata* and small trees such as *Banksia menziesii* in addition to large eucalypts. During the site inspection, birds favoured this area and while some species were probably seasonal visitors foraging on nectar, others were residents favoured by the range of vegetation heights available.

Areas of the project area that are of low value for fauna are those that have been highly disturbed, including cleared areas near South Lake and waste disposal areas associated with the Amcor Plant. Note that the woodland fringing the cleared area near South Lake is of high value for fauna because it is close to the lake, has more structurally complex vegetation than some other areas of woodland and because such transitional regions are favoured by some species. For example, some birds forage along the transition between dense vegetation and open areas.

Fauna Habitats; regional representation

The study area is adjacent to Beeliar Regional Park that lies to the east and there is some native vegetation around low density housing to the north, but the site is not closely associated with native vegetation to the west or south. To the north-east, the site is weakly linked to Bibra Lake via remnant vegetation in a recreational complex (Adventure World). Within the adjacent sector of Beeliar Regional Park, there is little similar upland woodland, so this woodland area is effectively isolated from similar woodland. Within Beeliar Regional Park, a similar area of Karrakatta Complex South-Central is present 3 km to the north-east at North Lake (Bush Forever Site 244), while a larger area of woodland 4 km to the south, around Thomson's Lake (Bush Forever Sites 391 and 392, and privately-owned areas), includes both Karrakatta Complex South-Central and Herdsman Complex (Bush Forever 2000).

Animals do not make fine distinctions between vegetation complexes but a range of parameters may determine their distribution. Therefore, in terms of regional representation of fauna habitat, it may be most appropriate to talk of upland woodland, dominated by eucalypts and Banksias growing on sandy soil, as a broad habitat type. With reference to Bush Forever (2000), Bush Forever Site 244 (east of North Lake) has an area of 128 ha of bushland compared with the 55 ha in the project area (omitting completely degraded areas), with the project area representing almost half of all upland woodland in the South Lake to North Lake sector of the City of Cockburn. In contrast, Bush Forever Sites 391 and 392 have areas of 367 ha and 272 ha respectively and, although not all of this total area is woodland comparable as fauna habitat to the woodland in the project area, this suggests that the total area of woodland within Beeliar Regional Park is in the order of 600 ha. It can therefore be concluded that the project area contains approximately 10% of woodland fauna habitat in the City of Cockburn and adjacent areas.

Extending this sort of rough analysis to the greater metropolitan area is difficult because it is hard to define fauna habitat; while all woodlands in a region such as the City of Cockburn may support a similar suite of fauna, this may not be the case in woodland areas in other parts of Perth. The faunal assemblage will vary with distance apart and differences in soil type and plant species making up the woodland. Therefore, to look at the significance of woodland in the project area within the Perth region, it is appropriate to restrict the comparison to the Karrakatta Complex South-Central. Across the Perth Metropolitan Region, 6,275 ha of this complex remain of an original area of 34,532 (Bush Forever 2000). An area of 2,081 ha of this woodland is either reserved or proposed for reservation. The project area contains about 1.4% of Karrakatta South-Central that remains, and about 4.2% of that proposed for reservation.

Impacts of the Proposed Development on Fauna

The project area contains fauna habitat that has some regional representation in reserves and while it doesn't provide linkage to any great extent between areas of high conservation value, it is adjacent to South Lake and therefore provides a habitat continuum from the wetland environment to upland woodland. As fauna habitat, it

complements Beeliar Regional Park. Impacts and associated issues related to the proposed development and fauna are as follows.

- Loss of habitat will be inevitable and a significant proportion of the fauna is dependent upon the woodland environment. For example, the majority of reptile species and approximately half the bird species would be expected to decline in abundance. Furthermore, the reduction in population sizes would make species vulnerable to local extinction due to factors such as mortality on roads and predation by domestic pets. Species likely to persist are those that can survive either in riparian vegetation on the fringes of South Lake or in the post-development landscape. The retention of a buffer will be of some value, but the reduction in habitat area will have a great impact.
- The impact of population declines of species within the site upon the populations of these species locally (including nearby parts of Beeliar Regional Park) and regionally (City of Cockburn and adjacent municipalities) is difficult to assess. As discussed above, however (see section on regional representation of fauna habitats), the project area supports a substantial proportion of woodland habitat locally and even regionally. Of greatest concern are those species that occur at low population densities. In theory, the population decline within the project area could reduce the local and regional populations to unsustainable levels, resulting in local or regional extinction. Species most likely to be so affected include large predatory reptiles, such as the three goanna species, sedentary birds, such as fairy-wrens and thornbills, and the Brush-tailed Possum.
- Because the proposed development does not lie between conservation areas, but is effectively an outlier of a conservation area, the impact of fragmentation upon fauna will not be great. The project area may, however, be used by mobile fauna species, such as some birds, to move between Beeliar Regional Park and the low density urban development north of the site. The development can restrict this sort of movement.
- Probably of more concern than such fragmentation will be the loss of upland woodland to fauna present in Beeliar Regional Park. The woodland may provide seasonal food sources for mobile species such as some birds and probably mammals like the Quenda and Brush-tailed Possum. The woodland may also provide nesting sites for waterbirds such as some ducks that nest in tree hollows. Therefore, there could be impacts on populations of fauna within Beeliar Regional Park.
- Construction impacts will be direct in terms of habitat loss and mortality of fauna, particularly as the development process typically involves clearing and earthworks for subdivision and therefore the total loss of vegetation in most areas. The sequential nature of the development may, however, give time for fauna to move, although displaced individuals of many species can only survive if there is space within neighbouring populations for them. The sequential nature of the development will allow for some recolonisation for species that can occupy habitats in the created, light industrial landscape.
- There may be some potential impacts of the operation of the industrial area upon wildlife in adjacent sites. For example, roads and fences may present barriers for Long-necked Tortoises leaving South Lake to lay eggs. The impact of noise and lights on wildlife are difficult to predict but personal observations made around Perth suggest that the majority of species are

tolerant of these factors. Drainage systems will presumably be established to remove the possibility of hazardous materials entering South Lake.

Strategies for the Minimisation of Detrimental Impacts upon Fauna

The principle strategies for the minimisation of detrimental impacts of the proposed development upon fauna are based upon the retention and rehabilitation of a buffer around South Lake, and the protection and development of habitat within the industrial estate. These strategies were originally discussed by Bamford Consulting Ecologists (2000b) in response to a request by Landcorp, and are summarised as follows.

The proposed buffer around South Lake is 150 m wide and incorporates the margins of the main area of woodland, although the bulk of the area is badly degraded, having been cleared and probably grazed by horses. The boundaries of this buffer have yet to be finalised, but inclusion of a strip of vegetation along North Lake Road towards Bibra Lake would be of benefit, as this would improve linkage between habitat around South and Bibra Lakes. Landcorp plans to rehabilitate the buffer zone to return it to native vegetation. This rehabilitation could use seed and mulch collected from areas of the bushland to be cleared for development. While this is a very ambitious plan, there is considerable rehabilitation expertise developed by mining companies and Main Roads WA. These techniques include seed-collection, harvesting and mulching of vegetation, collection and immediate use of topsoil, translocation of plants such as Balga *Xanthorrhoea* sp. and the translocation of whole, live or dead trees.

The rehabilitation of this area prior to development would create habitat into which displaced fauna could disperse. Because of the sequential development proposed, there should be time to create habitat in the buffer before habitat in development areas is lost. It is not considered that active translocation of fauna away from the project area is likely to be successful unless alternative sites can be found that are known to have supported particular species in the past, and to which those species could be returned by translocating specimens from the site.

The rehabilitated buffer would not provide the same area of habitat as would be lost due to development of the site, but if effective could represent about 10% of the current woodland area.
In addition to developing effective fauna habitat in the buffer, there is potential to develop fauna habitat within the development estate. For example, harvested topsoil and mulch could be applied preferentially in areas destined to be road verges, gardens and the like within the future industrial estate, thus encouraging the rehabilitation of such areas into a simplified form of the native bushland that existed previously. Small patches of native vegetation and even single trees could also be retained in locations where clearing and earthworks are not required. This sort of approach to landscaping, instead of lawns, exotic plants such as palms and eastern states eucalypts, would create gardens that could be of importance for wildlife. Such gardens would allow the populations of wildlife to be larger and therefore less likely to suffer from local extinction than could be supported by the buffer zone alone, and would allow wildlife to move through the industrial area, providing linkage to bushland along road verges and in suburban areas to the north.

The creation of such gardens would be of considerable conservation value. The sequential development would mean that by the time the last of the original bushland

was being cleared, the gardens within the oldest parts of the industrial estate would probably be sufficiently developed to support many of these species.

This approach to the creation of a "conservation landscape" through the industrial estate would have the advantage of not having the costs associated with maintaining lawns, but there would still be maintenance costs, such as weed suppression. Furthermore, there may be a perception that native plants are "scruffy", meaning that tenants may need to be informed of why the gardens have been designed in a certain way. Regulations concerning what sorts of plants can be used in the estate may need to be put into place, much as there will need to be regulations concerning building height and design. There could also be problems where the vegetation may be considered to obstruct views of commercial premises. Despite these sorts of problems, the integration of what would effectively be a form of habitat rehabilitation within the industrial estate would significantly reduce the adverse impacts of the development upon the fauna of the site. The project could also help to alter the sorts of perceptions that may lead to problems with acceptance of this sort of integration.

TABLE 1. Frog and reptile species known from the Swan Coastal Plain of the Perth region (south of the Swan River) and which were either observed (*) or are expected (+) on the site. Species for which no suitable habitat is available, or that are extinct in the region, are not included. The significance columns indicate species of National Conservation Significance (NCS – listed under conservation acts and/or agreements), those of Regional Conservation Significance (RCS – species with locally or regionally restricted distributions) and those of Local Conservation Significance (LCS – species likely to be severely impacted by the proposed development).

Species		Status	Significance		
			NCS	RCS	LCS
Myobatrachidae (ground frogs)					
Glauert's Froglet	*Crinia (Ranidella) glauerti*	*			
Sandplain Froglet	*Crinia (Ranidella) insignifera*	*			
Moaning Frog	*Heleioporus eyrei*	+			+
Pobblebonk	*Limnodynastes dorsalis*	+			+
Turtle Frog	*Myobatrachus gouldii*	+			+
Guenther's Toadlet	*Pseudophryne guentheri*	+			+
Hylidae (tree frogs)					
Slender Tree Frog	*Litoria adelaidensis*	+			
Motorbike Frog	*Litoria moorei*	*			
Chelidae (side-neck tortoises)					
South-West Long-necked Tortoise	*Chelodina oblonga*	+			
Gekkonidae (geckoes)					
Southern Spiny-tailed Gecko	*Diplodactylus spinigerus*	+			
Marbled Gecko	*Phyllodactylus marmoratus*	+			
Pygopodidae (legless lizards)					
Sand-Plain Worm-Lizard	*Aprasia repens*	+			+
Fraser's Legless Lizard	*Delma fraseri*	+			+
Burton's Legless Lizard	*Lialis burtonis*	+			+
Common Scaleyfoot	*Pygopus lepidopodus*	+			+
Agamidae (dragon lizards)					
Western Bearded Dragon	*Pogona minor*	+			+
Sandhill or Heath Dragon	*Tympanocryptis adelaidensis*	+		+	+
Varanidae (monitors or goannas)					
Gould's Sand Goanna	*Varanus gouldii*	*			+
Rosenberg's Goanna	*Varanus rosenbergi*	+		+	+
Black-headed Tree Goanna	*Varanus tristis*	+		+	+
Scincidae (skink lizards)					
South-West Cool Skink	*Acritoscincus (Bassiana) trilineatum*	+			
Fence Skink	*Cryptoblepharus plagiocephalus*	*			
West Coast Ctenotus	*Ctenotus fallens*	+			+
	Ctenotus impar	+			+
Western Limestone Ctenotus	*Ctenotus australis (lesueurii)*	+			+
King's Skink	*Egernia kingii*	+			+
Mourning Skink	*Egernia luctuosa*	+			
Salmon-bellied Skink	*Egernia napoleonis*	+			+
Two-toed Earless Skink	*Hemiergis quadrilineata*	*			
West Coast Four-toed Lerista	*Lerista elegans*	+			
Perth Lined Lerista	*Lerista lineata*	+		+	

Table 1 (cont.)

Species		Status	Significance		
			NCS	RCS	LCS
Worm Lerista	*Lerista praepedita*	+		+	
Dwarf Skink	*Menetia greyii*	*			
West Coast Morethia	*Morethia lineoocellata*	+			+
Dusky Morethia	*Morethia obscura*	+			+
Western Bluetongue	*Tiliqua occipitalis*	+		+	+
Bobtail	*Tiliqua rugosa*	*			+
Typhlopidae (blind snakes)					
	Ramphotyphlops australis	+			+
Elapidae (front-fanged snakes)					
Crowned Snake	*Drysdalia coronata*	+		+	+
Black-naped Snake	*Neelaps (Vermicella) bimaculatus*	+			+
Black-striped Snake	*Neelaps (Vermicella) calonotus*	+	+		+
Western Tiger Snake	*Notechis scutatus*	+			
Dugite	*Pseudonaja affinis*	*			+
Gould's Snake	*Suta (Rhinoplocephalus) gouldii*	+			+
Jan's Bandy-Bandy	*Simoselaps (Vermicella) bertholdi*	+			+
Narrow-banded Snake	*Simoselaps (Vermicella) fasciolata*	+			+
Half-ringed Snake	*Simoselaps (Vermicella) semifasciatus*	+			+
Number of species observed or expected:					
Frogs:	8				
Reptiles:	38				

TABLE 2. Bird species known from the Swan Coastal Plain of the Perth region (south of the Swan River) and which were either observed (*) or expected (+) on the site. Species for which no suitable habitat is available, such as many waterbirds, or that are extinct in the region, are not included. The significance columns indicate species of National Conservation Significance (NCS – listed under conservation acts and/or agreements), those of Regional Conservation Significance (RCS – species with locally or regionally restricted distributions) and those of Local Conservation Significance (LCS – species likely to be severely impacted by the proposed development). Introduced species (Int) are noted in the status column.

Species		Status	Significance		
			NCS	RCS	LCS
Phasianidae (pheasants and quails)					
Stubble Quail	*Coturnix pectoralis*	+			
Anatidae (ducks, geese and swans)					
Australian Shelduck	*Tadorna tadornoides*	+			+
Pacific Black Duck	*Anas superciliosus*	+			
Grey Teal	*Anas gibberifrons*	+			
Australian Wood Duck	*Chenonetta jubata*	*			+
Ardeidae (herons and egrets)					
White-faced Heron	*Egretta novaehollandiae*	+			
Plataleidae (ibis and spoonbills)					
Australian White Ibis	*Threskiornis molucca*	*			+
Accipitridae (kites, hawks and eagles)					
Black-shouldered Kite	*Elanus notatus*	+			
Square-tailed Kite	*Lophoictinia isura*	+	+		
Whistling Kite	*Haliastur sphenurus*	+			+
Brown Goshawk	*Accipiter fasciatus*	+			+
Collared Sparrowhawk	*Accipiter cirrhocephalus*	+			
Wedge-tailed Eagle	*Aquila audax*	+			
Little Eagle	*Hieraaetus morphnoides*	*			+
Falconidae (falcons)					
Peregrine Falcon	*Falco peregrinus*	+	+		+
Australian Hobby	*Falco longipennis*	*			+
Nankeen Kestrel	*Falco cenchroides*	+			
Turnicidae (button-quails)					
Painted Button-quail	*Turnix varia*	+			+
Scolopacidae (sandpipers)					
Common Sandpiper	*Tringa hypoleucos*	+			
Charadriidae (plovers and lapwings)					
Black-fronted Dotterel	*Elseyornis melanops*	+			
Columbidae (pigeons and doves)					
Rock Dove (feral pigeon)	*Columba livia*	+ Int.			
Spotted Turtle-Dove	*Streptopelia chinensis*	* Int			
Laughing Turtle-Dove	*Streptopelia senegalensis*	* Int			
Common Bronzewing	*Phaps chalcoptera*	+			+
Cacatuidae (cockatoos)					
Short-billed Black-Cockatoo	*Calyptorhynchus latirostris*	+	+		+
Corella	*Cacatua* spp.	+ Int			
Galah	*Cacatua roseicapilla*	*			

Table 2 (cont.)

Species		Status	Significance		
			NCS	RCS	LCS
Psittacidae (lorikeets and parrots)					
Rainbow Lorikeet	*Trichoglossus haematodus*	* Int			
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*	+			+
Red-capped Parrot	*Purpureicephalus spurius*	*			+
Australian Ringneck (twenty-eight)	*Barnardius zonarius*	*			
Elegant Parrot	*Neophema elegans*	+			+
Cuculidae (cuckoos)					
Pallid Cuckoo	*Cuculus pallidus*	+			+
Fan-tailed Cuckoo	*Cuculus pyrrhophanus*	+			+
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*	+			+
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*	+			+
Strigidae (hawk-owls)					
Southern Boobook Owl	*Ninox novaeseelandiae*	+			+
Tytonidae (barn owls)					
Barn Owl	*Tyto alba*	+			+
Podargidae (frogmouths)					
Tawny Frogmouth	*Podargus strigoides*	+			+
Apodidae (swifts)					
Fork-tailed Swift	*Apus pacificus*	+			
Halcyonidae (forest kingfishers)					
Laughing Kookaburra	*Dacelo novaeguineae*	* Int			
Sacred Kingfisher	*Todiramphus sanctus*	+			
Meropidae (bee-eaters)					
Rainbow Bee-eater	*Merops ornatus*	+			
Maluridae (fairy-wrens)					
Splendid Fairy-wren	*Malurus splendens*	*			+
Pardalotidae (pardalotes)					
Spotted Pardalote	*Pardalotus punctatus*	*			+
Striated Pardalote	*Pardalotus striatus*	*			+
White-browed Scrubwren	*Sericornis frontalis*	+			
Weebill	*Smicrornis brevirostris*	*			+
Western Gerygone	*Gerygone fusca*	*			+
Inland Thornbill	*Acanthiza apicalis*	*			+
Western Thornbill	*Acanthiza inornata*	+			+
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	*			+
Meliphagidae (honeyeaters)					
Red Wattlebird	*Anthochaera carunculata*	*			
Little Wattlebird	*Anthochaera chrysoptera*	+			
Yellow-throated Miner	*Manorina flavigula*	+			
Singing Honeyeater	*Lichenostomus virescens*	*			
Brown Honeyeater	*Lichmera indistincta*	*			
New Holland Honeyeater	*Phylidonyris novaehollandiae*	*			
White-cheeked Honeyeater	*Phylidonyris nigra*	*			
Tawny-crowned Honeyeater	*Phylidonyris melanops*	+			
Western Spinebill	*Acanthorhynchus superciliosus*	+			+
Petroicidae (Australian robins)					
Scarlet Robin	*Petroica multicolor*	+			+

Table 2 (cont.)

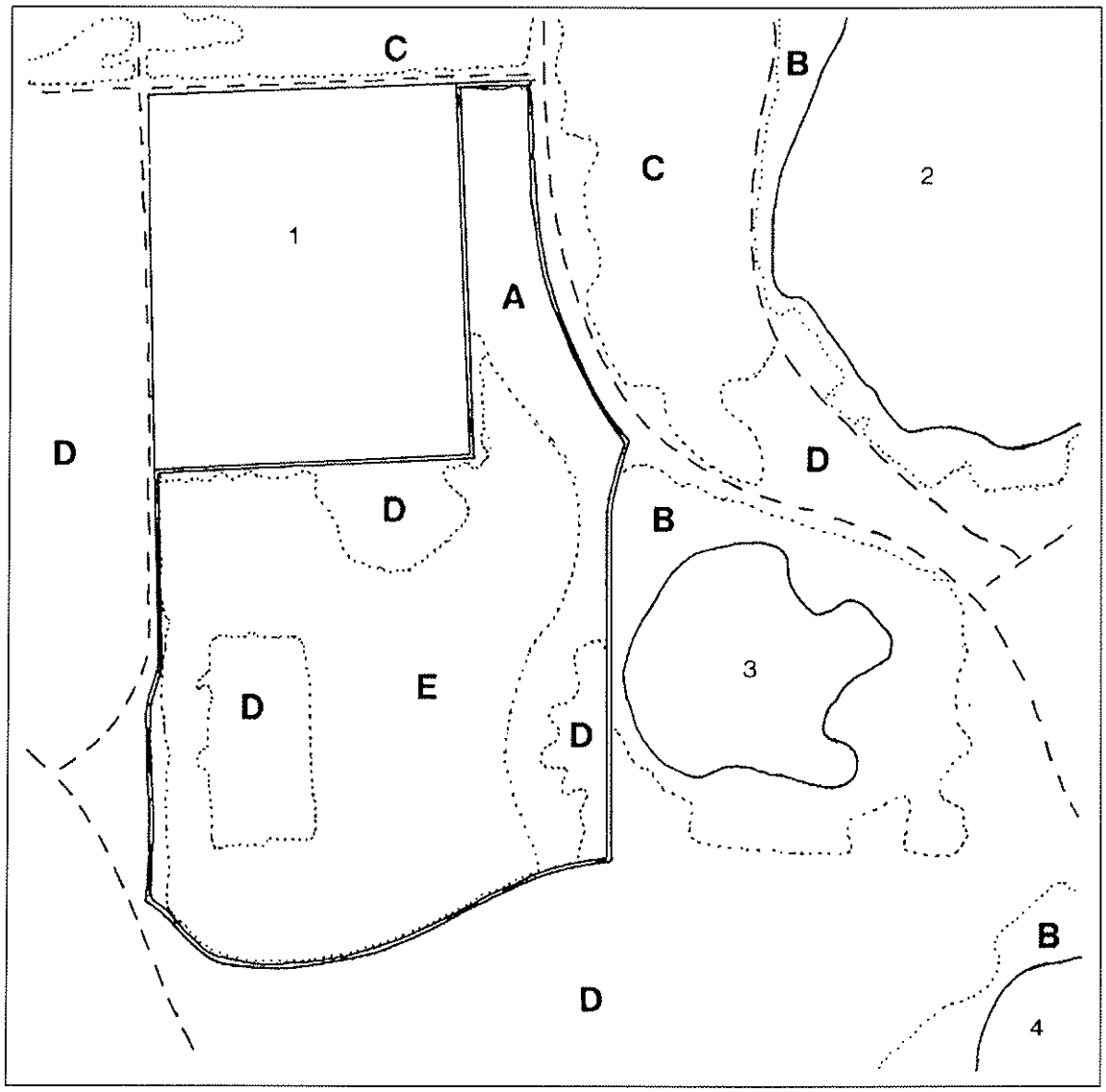
Species		Status	Significance		
			NCS	RCS	LCS
Neosittidae (sittellas)					
Varied Sittella	*Daphoenositta chrysoptera*	*			+
Pachycephalidae (whistlers)					
Rufous Whistler	*Pachycephala rufiventris*	*			+
Golden Whistler	" *pectoralis*	+		+	+
Grey Shrike-thrush	*Colluricincla harmonica*	+			
Dicruridae (flycatchers)					
Magpie-lark	*Grallina cyanoleuca*	*			
Grey Fantail	*Rhipidura fuliginosa*	*			+
Willie Wagtail	*Rhipidura leucophrys*	*			
Campephagidae (cuckoo-shrikes)					
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	+			
White-winged Triller	*Lalage sueurii*	+			
Artamidae (woodswallows)					
Black-faced Woodswallow	*Artamus cinereus*	+			
Grey Butcherbird	*Cracticus torquatus*	*			+
Australian Magpie	*Gymnorhina tibicen*	*			
Corvidae (ravens and crows)					
Australian Raven	*Corvus coronoides*	*			
Motacillidae (pipits and true wagtails)					
Richard's Pipit	*Anthus novaeseelandiae*	+			
Dicaeidae (flower-peckers)					
Mistletoebird	*Dicaeum hirundinaceum*	+			+
Hirundinidae (swallows)					
White-backed Swallow	*Cheramoeca leucosternus*	+			
Welcome Swallow	*Hirundo neoxena*	*			
Tree Martin	*Hirundo nigricans*	*			
Zosteropidae (white-eyes)					
Silvereye	*Zosterops lateralis*	*			
Number of species	observed:	34			
	observed or expected:	80			
	Local Conservation Significance:	37			
	Regional Conservation Significance:	1			
	National Conservation Significance:	3			

TABLE 3. Mammal species known from the Swan Coastal Plain of the Perth region and which were either observed (*) or expected (+) on the site. Species for which no suitable habitat is available, or that are extinct in the region, are not included. The significance columns indicate species of National Conservation Significance (NCS – listed under conservation acts and/or agreements), those of Regional Conservation Significance (RCS – species with locally or regionally restricted distributions) and those of Local Conservation Significance (LCS – species likely to be severely impacted by the proposed development). Introduced species (Int) are noted in the status column.

Species		Status	Significance		
			NCS	RCS	LCS
Tachyglossidae (echidnas)					
Echidna	*Tachyglossus aculeatus*	+			+
Peramelidae (bandicoots)					
Quenda or Southern Brown Bandicoot	*Isoodon obesulus*	*	+		+
Tarsipedidae (honey possum)					
Honey Possum	*Tarsipes rostratus*				
Phalangeridae (possums)					
Brush-tailed Possum	*Trichosurus vulpecula*	*			+
Macropodidae (kangaroos and wallabies)					
Brush Wallaby	*Macropus irma*	(*)	+		
Mollosidae (mastiff bats)					
White-striped Bat	*Nyctinemus (Tadarida) australis*	+			
Vespertilionidae (vesper bats)					
Gould's Wattled Bat	*Chalinolobus gouldii*	+			+
Chocolate Wattled Bat	*Chalinolobus morio*	+			+
	Vespedalus (Eptesicus) regulus	+			+
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	+			+
Gould's Long-eared Bat	*Nyctophilus gouldii*	+			+
Greater Long-eared Bat	*Nyctophilus major*	+			+
Muridae (rats and mice)					
Rakali or Water-Rat	*Hydromys chrysogaster*	+	+		
House Mouse	*Mus musculus*	* Int			
Black Rat	*Rattus rattus*	+ Int			
Leporidae (rabbits and hares)					
Rabbit	*Oryctolagus cuniculus*	* Int			
Canidae (foxes and dogs)					
European Red Fox	*Vulpes vulpes*	* Int			
Felidae (cats)					
Feral Cat	*Felis catus*	* Int			
Number of species	observed or expected:	16			
	introduced:	5			

Figure 1. Map of the project area, indicating main features and fauna habitats. The project area is indicated by a double solid line, roads by broken lines and boundaries between main habitat types by dotted lines.
Key.

1. Amcor Packaging Plant. 2. Bibra Lake. 3. South Lake. 4. Little Rush Lake.
A. High value fauna habitat along eastern margin of project area.
B. Riparian vegetation along edges of wetlands within Beeliar Regional Park.
C. Degraded upland woodland in urban and recreational areas.
D. Cleared and severely degraded habitat, including existing suburbs and industry.
E. Main upland woodland of project area.



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APPENDIX ONE. Categories used in the assessment of conservation status.

Environmental Protection and Biodiversity Conservation Act and the WA Wildlife Conservation Act (categories mainly from IUCN, based on review by Mace and Stuart 1994).

Extinct. Taxa not definitely located in the wild during the past 50 years.

Extinct in the Wild. Taxa known to survive only in captivity.

Critically Endangered. Taxa facing an extremely high risk of extinction in the wild in the immediate future.

Endangered. Taxa facing a very high risk of extinction in the wild in the near future.

Vulnerable. Taxa facing a high risk of extinction in the wild in the medium-term future.

Near Threatened. Taxa that risk becoming Vulnerable in the wild.

Conservation Dependent. Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.

Other Specially Protected Fauna (WA Act only).

Data Deficient (Insufficiently Known). Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.

Least Concern. Taxa that are not Threatened.

WA Department of Conservation and Land Management Priority species (species not listed under the Conservation Act, but for which there is some concern).

Priority 1. Taxa with few, poorly known populations on threatened lands.

Priority 2. Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.

Priority 3. Taxa with several, poorly known populations, some on conservation lands.

Priority 4. Taxa in need of monitoring.

(081) Bibra Lake BF254 adjacent

ENTERED ON GIS

Name: Vegetation Survey of Lot 502 North Lake Road Bibra Lake
Date: 18/05/2006
Capture Author: Thomas Leong

Comments:
Polygon
Created to match documented study area with high level of accuracy

Accuracy Levels:

- High = Document contained visual and or described spatial references easily copied, resulting in little or no polygon boundary errors
- Acceptable = Document contained visual and or described spatial references with complex boundaries, resulting in minor boundary errors
- Low = Document contained little or no visual and or described spatial references, resulting in polygon boundary errors

Attributes
Report Info – Captured without problems
Custodial/Contact – Captured without problems
Content – Captured without problems

VEGETATION SURVEY
of
LOT 502 NORTH LAKE ROAD
BIBRA LAKE

Prepared for: Landcorp
Level 3, Wesfarmers House
40 The Esplanade
PERTH 6000

Prepared by: Bennett Environmental Consulting Pty Ltd
21 Currawong Drive
GOOSEBERRY HILL 6076

2nd November 2001

CONTENTS

APPENDICES

SUMMARY

The Amcor site (Lot 502 North Lake Road) is included in the Karrakatta Central and South Vegetation Complex of which it is estimated that 8% of the 18% remaining of this vegetation complex is conserved (Government of Western Australia, 2000). With the publication of Bush Forever (Government of Western Australia, 2000) it is intended to conserve at least 10% of each vegetation complex. This requires an additional 863.2ha of the Karrakatta Central and South Vegetation Complex to be conserved to meet the 10% level. The Amcor site is not listed as a Bush Forever site and is not included in the additional list (Government of Western Australia, 2000).

The northern half of the Amcor site is degraded through infrastructure development and the dumping of paper pulp but the southern section is in much better condition and could be considered as worthy of conservation.

Two Floristic Community Types, 11 and 28 were recorded from the Amcor site. Both are well reserved and considered not to be threatened (Gibson *et al,* 1994). Two vegetation units were recorded for Floristic Community Type 28 and one for Floristic Community Type 11, making a total of 3 vegetation units. The nearby Bush Forever sites, 234, 256, 391 and 244 recorded 6,9,7 and 5 vegetation units respectively. These sites also included vegetation associated with a lake.

No Endangered Ecological Community as defined by the Department of Conservation and Land Management (English, 2001) or Declared Rare or Priority Flora were identified at the Amcor site.

The Amcor site links directly with South Lake on its eastern side, so it is important that as much bushland as is possible be retained. South Lake links by North Lake Road to Bibra Lake and southwards through Little Rush Lake and Yangebup Lake to Thomson's Lake and then to Harry Waring Reserve, resulting in nearly 11km of bushland linkage. South Lake, and the Amcor site, are included as part of Greenways 75 and 90 and part of a regionally signficant bushland/wetland linkage (Government of Western Australia, 2000).

The dense bushland would provide shelter for smaller mammals, and the large dead trees, nesting sites for many parrots, but there was no evidence of kangaroos, the only animal evident was the rabbit. The regular watering of the paper pulp has encouraged several bird species into the area, in particular ibis and crows.

Some of the degraded areas are so degraded that it would be a very large task to attempt to restore them to their original condition. By watering the paper pulp areas large number of native plants have killed and the area then invaded by weed taxa. Generally the paper pulp areas recorded a diverse list of weed taxa. However most of the natural and relatively undisturbed vegetation has the potential for long term viability.

1 INTRODUCTION

Western Australian Land Authority (LandCorp) proposes to subdivide 89ha of land for industrial use in Lot 502, North Lake Road. This area is currently zoned Industrial under the Perth Metropolitan Scheme and General Industry under the City of Cockburn District Zoning Scheme No 2. The land is immediately west of South Lake (Bush Forever Site 254), which is included in the Beeliar Regional Park and subject to the provisions of the Environmental Protection (Swan Coastal Plain Lakes) Policy.

Bennett Environmental Consulting Pty Ltd was commissioned by Landcorp to undertake a flora and vegetation survey of Lot 502 North Lake Road, Bibra Lake. Lot 502 North Lake Road, is in the town of Bibra Lake within the City of Cockburn. It borders:

- North Lake Road and South Lake (Bush Forever Site 254) on the east:
- Phoenix Road on the north;
- Sudlow Road on the west; and
- an industrial site to the south.

2 BACKGROUND INFORMATION

Lot 502 North Lake Road, here after called the Amcor site, occurs in the Southwest Botanical Province within the Drummond Botanical Subdistrict and the Swan Coastal Plain Subregion, Swan Coastal Plain (Beard, 1990). The whole of the site is indicated in Government of Western Australia (2000) Bush Forever Vol 1, Map 2 as occurring in the Spearwood Dune system and the Karrakatta Complex – Central and South Vegetation Complex. There is 8% of this vegetation complex conserved within reserves although 18% remains vegetated. The aim of the Government of Western Australia (2000) is to conserve at least 10% of each vegetation complex within the Perth Metropolitan area. Originally there was 34,532 ha of Karrakatta Complex – Central and South of which 6,276ha (18%) remains vegetated. To achieve this total in conservation an additional 863.2ha needs to be added as Bush Forever sites.

The Amcor site is not included as a Bush Forever site (Government of Western Australia, 2000) but does abut Bush Forever Site 254 on the eastern side. Bush Forever Site 254 includes open water and vegetated wetland not present at the surveyed area.

There are three Bush Forever Sites that are relatively close to Lot 502. These are Bush Forever Site 254 abutting the Amcor site on the southeast, Bush Forever Site 244 to the north and Bush Forever Site 256 to the south. All the sites include vegetation representative of the Karrakatta Complex – Central and South. In addition

- Site 254 also includes vegetation representative of the Bassendean Complex, Central and South and Spearwood – Bassendean interface.
- Site 256, also includes vegetation representative of the Bassendean Complex Central interface and Herdsman Complex.
- Site 244, records vegetation representative of the Karrakatta Complex – Central and South, Bassendean Complex Central and South and Herdsman Complex.

2.1 Landforms and Soils

The area is more or less level to gently undulating Spearwood Dunes uplands, which has 3° to 10° slopes in the central and eastern parts (Weston, 2000). The soils are pale yellowish-brown sand derived from Tamala Limestone, except for a small area west of South Lake, which is peaty silt swamp deposits.

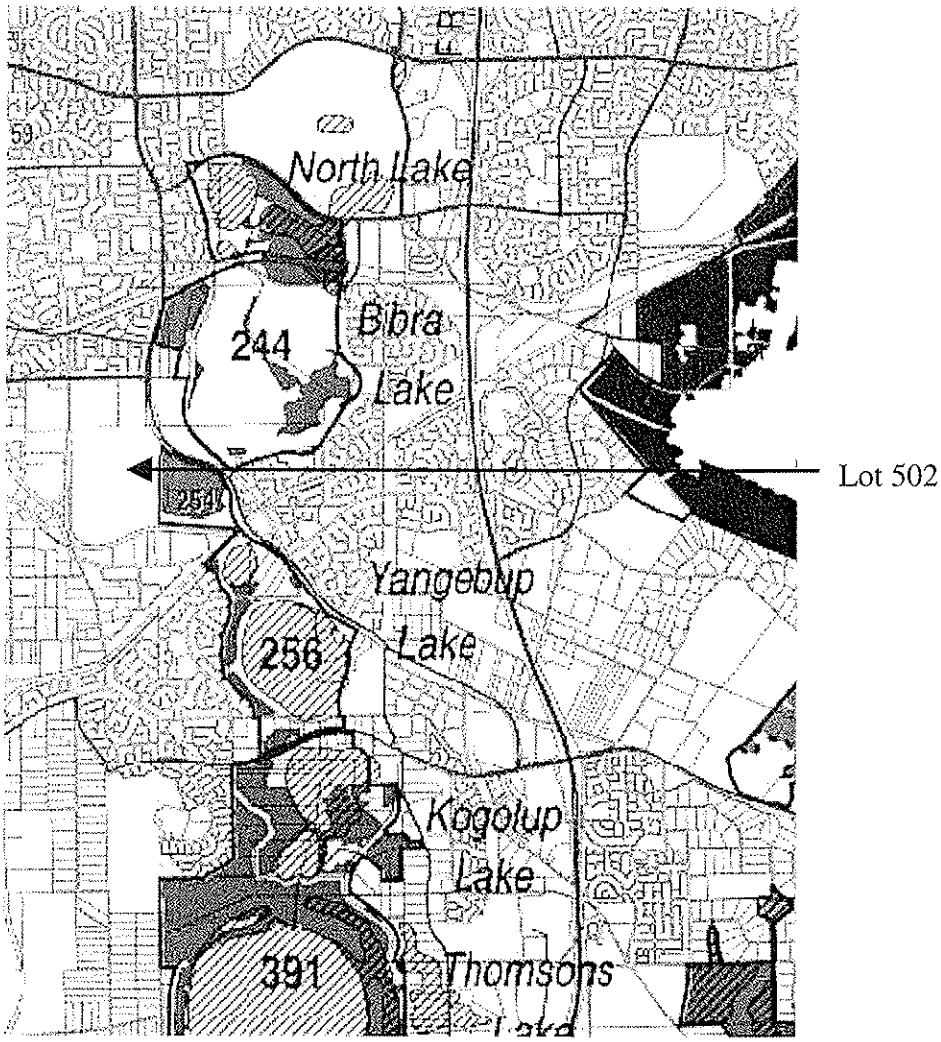


Figure 1. Location of Bush Forever Sites in relation to the Amcor area from Bush Forever Map 1 Implementation Plan

2.2 Vegetation Complexes

The vegetation complexes (Heddle *et al*, 1980) associated with the Bassendean and Spearwood Dune systems in the area near the Amcor site are:

- **Bassendean Complex – Central and South**: Vegetation ranges from woodland of *Eucalyptus marginata – Allocasuarina fraseriana – Banksia* spp. to low woodland of *Melaleuca* taxa and sedgelands on the moister sites. This

area includes the transition of *E. marginata* to *E. todtiana* in the vicinity of Perth.

- **Karrakatta Complex – Central and South**: Predominantly open woodland of *Eucalyptus gomphocephala – E. marginata – Corymbia calophylla* and woodland of *E. marginata – Banksia* species.

Gibson *et al* (1994) established 509, 10m x 10m plots when they undertook a floristic survey of the Swan Coastal Plain. From the information gathered they established four supergroups, which broadly reflected the major geographical elements of the Swan Coastal Plain. The first major group is centered on the Foothills/Pinjarra Plain, the second is the seasonal wetland, the third major group is centered on the Bassendean Dune System but with significant occurrences on the Spearwood Dune System, and the fourth major group is almost exclusively a Spearwood and Quindalup Dune System group. These supergroups were then divided into Floristic Community Types.

The Bush Forever sites closest to the Amcor site all include open water, vegetated wetland and upland vegetation. These are South Lake, Yangebup Lake, North Lake and Bibra Lake.

At Bush Forever Site 254, South Lake, no detailed vegetation survey has been undertaken. The landscape features open water, vegetated wetland and vegetated uplands. Supergroups 2, 3 and 4 are represented. Inferring from the information presented in Bush Forever (Government of Western Australia, 2000) there appears to be one upland Floristic Community Type (Gibson *et al*, 1994):

- Floristic Community Type 28 – Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* woodlands (Spearwood Dunes).

At Bush Forever Site 256, Yangebup Lake, no detailed vegetation survey has been undertaken. Supergroups 2, 3 and 4 are represented but from the information presented in Bush Forever (Government of Western Australia, 2000) it appears there could be two upland Floristic Community Types (Gibson *et al*, 1994):

- Floristic Community Type 28 – Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* woodlands (Spearwood Dunes) and possibly
- Floristic Community Type 23a – Central *Banksia attenuata – Banksia menziesii* woodlands (Bassendean Dunes).

At Bush Forever Site 244 the recorded upland Floristic Community Types (Gibson *et al.*, 1994) are:

- Floristic Community Type 23a – Central *Banksia attenuata – Banksia menziesii* woodlands (Bassendean Dunes); and
- Floristic Community Type 28 – Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* woodlands (Spearwood Dunes).

3 OBJECTIVES

The objectives of the current survey at the Amcor site were to:

- describe and map the vegetation floristic units present;
- indicate the condition of the vegetation;
- identify and map any Threatened Ecological Communities;
- identify and map any Declared Rare or Priority Flora;
- address regionally significant bushland criteria as in Bush Forever (Government of Western Australia, 2000); and
- prepare a report covering all the above.

4 SURVEY METHODOLOGY

Fieldwork was undertaken on 1st October 2001. All accessible tracks were driven to determine the different vegetation units present and their condition. As required by the Department of Environmental Protection four (4) 10m x 10m permanent quadrats were placed within the three vegetation units. Two of these were in the dominant vegetation unit.

In addition a detailed survey of each vegetation unit identified was undertaken both in the quadrats and surrounding areas to increase the number of taxa recorded. The vegetation was sampled by traversing the area on foot. Plants unknown in the field were collected and identified using available keys. The scientific name was checked using the database MAX (Western Australian Herbarium, 2001a)

Arthur Weston (1999, and 2000) undertook searches of the Conservation and Land Management Database for Rare and Priority Flora. This identified two Declared Rare Flora, two Priority 1 flora, three Priority 3 flora and three Priority 4 flora previously recorded from the wider area (Appendix A). No Rare or Priority Flora were located during the 1999 and 2000 Amcor site surveys.

4.1 Vegetation

The vegetation of the area was defined for the whole unit, not just for the quadrat. The quadrat was placed in a characteristic section of the community but often it was not possible to include all tree taxa within the 10m x 10m quadrat. Where tree taxa occurred outside of the quadrat these taxa were recorded separately and built into the vegetation classification. The descriptions were prepared using the vegetation layers as listed in Table 1.

Changes in vegetation structure included variation in the:

tree layer, eg. Tuarts, Banksia spp, Jarrah;
shrub layer, eg. Myrtaceae sp., Papilionaceae species; and
understorey layer, eg. sedges, herbs, grasses.

Table 1. Vegetation layers. Adapted from: Bush Forever (Government of Western Australian, 2000)

Life Form/ Height Class	Canopy Cover			
	100-70%	70-30%	30-10%	10-2%
Trees over 30m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland
Trees under 10m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland
Tree mallee/Mallee	Closed Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Shrub mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs over 2m	Closed Tall Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland
Shrubs 1-2m	Closed Heath	Open Heath	Shrubland	Open Shrubland
Shrubs under 1m	Closed Low Heath	Open Low Heath	Low Shrubland	Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

4.2 Taxa Present

For each quadrat all taxa were recorded, together, where applicable, with their flower colour, average height and percentage cover. Time was spent locating additional taxa within the same vegetation unit but outside of the quadrat. Where the same vegetation unit occurred in different areas these were also searched to increase the taxa list for the unit. Taxa were recorded in the field, but where the identity was unknown or uncertain these were collected and pressed, then later identified using keys and by comparison with the specimens housed at the Western Australian Herbarium. Current nomenclature was checked using FloraBase (Western Australian Herbarium, 2001b) and MAX (Western Australian Herbarium, 2001a).

4.3 Vegetation Condition

The vegetation condition of each quadrat and the vegetation community as a whole was recorded using the 6-scale condition rating as appeared in Bush Forever Vol 2, p. 48 (Government of Western Australian, 2000).

Table 2: Condition rating scale (Bush Forever 2000)

Rating	Description	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual taxa and weeds are non-aggressive taxa.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native taxa.

5 RESULTS

5.1 Flora

A total of 172 vascular plant taxa, 136 genera and 49 families were collected from the area. This included 67 weed taxa, representing 42% of the total number of taxa recorded. The dominant plant families and the number of genera and taxa recorded is given in Table 3. These seven plant families represent 46% of the total number of taxa recorded during the survey.

Table 3. Dominant vascular plant families

FAMILY	No. of Genera	No of Native Taxa	No. of Weeds	Total Taxa
PAPILIONACEAE	13	10	8	18
ASTERACEAE	14	6	9	15
POACEAE	12	1	13	14
PROTEACEAE	7	11	0	11
MYRTACEAE	7	6	3	9
ANTHERICACEAE	6	6	0	6
EUPHORBIACEAE	5	3	3	6
TOTAL	**64**	**43**	**36**	**79**

5.2 Vegetation

There were three vegetation units recognised. These are described using the vegetation structural classes listed in Bush Forever (Government of Western Australia, 2000) and their distribution shown in Appendix C Map 1. A list of taxa recorded for each vegetation unit is set out in Appendix B and mapped in Appendix C. The information collected for each quadrat, including a photograph is set out in Appendix D.

- **Closed Forest to Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* with occasional to dense *Corymbia calophylla* over an Open Heath dominated by *Xanthorrhoea preissii* or *Hibbertia hypericoides*.** (Quadrats 2 and 3)

  Dominant trees: *Allocasuarina fraseriana, Banksia attenuata, B. menziesii, Corymbia calophylla, Eucalyptus gomphocephala, E.marginata* subsp. *marginata*
  Dominant shrubs 1-2m tall: *Acacia pulchella* var. *pulchella, A. saligna, Hakea prostrata, Macrozamia riedlei, Xanthorrhoea preissii*
  Dominant shrubs <1m tall: *Daviesia divaricata, Hardenbergia comptoniana, Hibbertia hypericoides, H. racemosa, Macrozamia riedlei, Petrophile linearis, Phyllanthus calycinus, Pimelea rosea, Stirlingia latifolia, Xanthorrhoea brunonis*
  Dominant sedges: *Dasypogon bromeliifolius, Desmocladus flexuosus, Lepidosperma squamatum, Lyginia barbata*
  Dominant herbs: *Burchardia umbellata, Conostylis aculeata* subsp. *aculeata, Phlebocarya ciliata, Sowerbaea laxiflora*

Dominant weeds: *Briza maxima, Ehrharta calycina, E. longiflora, Gladiolus caryophyllaceus, Hypochaeris glabra, Petrorhagia velutina, Stellaria media, Trifolium dubium*

A few, tall *Eucalyptus gomphocephala* were located in the south west corner of the Amcor site. In the central section of the southern area there were several *Xylomelum occidentale* trees.

- **Tall Open Scrub to Tall Shrubland of *Hakea prostrata, Jacksonia furcellata* and *Kunzea glabrescens* over a Low Open Shrubland over a Grassland dominated by *Briza maxima.** (Quadrat 1)

Dominant shrubs >2m tall: *Hakea prostrata, Jacksonia furcellata, Kunzea glabrescens*
Dominant shrubs 1-2m tall: *Persoonia sacculata*
Dominant shrubs <1m tall: *Acacia huegelii, Calytrix angulata, Daviesia divaricata, Gompholobium tomentosum, Hardenbergia comptoniana,*
Dominant sedges: *Lyginia barbata, Mesomelaena pseudostygia*
Dominant herbs: *Anigozanthos manglesii, Drosera glanduligera, Poranthera microphylla, Thysanotus manglesii, Trachymene pilosa,*
Dominant weeds: *Aira caryophyllea, Arctotheca calendula, Briza maxima, Carpobrotus edulis, Ehrharta calycina, Hypochaeris glabra, Trifolium campestre, Zaluzianskya divaricata*

This vegetation community was located in the north east section of the Amcor site.

Both these communities are representative of Floristic Community Type 28 (Gibson *et al*, 1994).

- **Open Woodland of *Eucalyptus rudis* and *Banksia grandis* over an Open Shrubland of *Hakea prostrata* over a Herbland of weeds.** (Quadrat 4)

Dominant trees: *Banksia attenuata, B. grandis, Eucalyptus rudis*
Dominant shrubs 1-2m tall: *Hakea prostrata, Jacksonia furcellata*
Dominant shrubs <1m tall: *Macrozamia riedlei, *Olea europea, Xanthorrhoea brunonis*
Dominant herbs: *Caladenia flava, Conostylis aculeata* subsp. *aculeata, Gnephosis angianthoides*
Dominant weeds: *Aira caryophyllea, Briza maxima, Carpobrotus edulis, Ehrharta calycina, Erodium botrys, Gladiolus caryophyllaceus, Lagurus ovatus, Pelargonium capitatum, Petrorhagia velutina, Stellaria media, Vigna sativa*

This community was only a remnant of a previously much larger area, which continued down to the western shore of South Lake. The remnant was dominant along the south eastern side of the Amcor site, but the understorey was completely replaced by weeds with large open areas of **Carpobrotus edulis* and **Ehrharta calycina*. This community

is on the interzone between Floristic Community Type 28 and Floristic Community Type 11.

Relating the Gibson *et al* (1994) Floristic Community Types with Heddle *et al* (1980) Vegetation Complexes, Floristic Community Types 11 and 28 recorded at the Amcor site can be compared as follows. Floristic Community Type 28 was recorded from the Pinjarra Plain; Bassendean Dune – Bassendean North, Bassendean Central and South; Spearwood Dune – Karrakatta North, Karrakatta Central and South, Cottesloe North, Cottesloe Central and South; and the Whicher Scarp. Floristic Community Type 11 was recorded from Pinjarra Plain; Bassendean Dune – Bassendean Central and South; Spearwood Dune – Karrakatta Central and South, Herdsman; and Vasse Complex. This indicates that the Floristic Community Types recorded from the Amcor site are not restricted to the Karrakatta Central and South Complex but are recorded from several different Heddle *et al* (1980) Vegetation Complexes.

5.3 Rare and Priority Flora

No Rare or Priority Flora were recorded during the survey. Weston (2000) refers to locating a small sedge which could be *Schoneus latitans*. This same sedge was common throughout the Closed Forest to Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* with occasional to dense *Corymbia calophylla* but was not in flower. Checking with FloraBase (Western Australian Herbarium, 2001b) *Schoenus latitans* has been collected from near Geraldton whereas *S. clandestinus* has been collected from Eneabba southwards to south of Perth including several collections from the metropolitan area. Both taxa flower in March so a collection at that time of year would determine the correct classification. However *S. clandestinus* is expected to be the correct classification.

The Declared Rare Flora, *Caladenia huegelii* was listed but only *Caladenia flava, C. latifolia* and *Caladenia longicauda* subsp. *calcigenia* were recorded. Similarly the Declared Rare Flora, *Diuris micrantha* was also listed but *D. corymbosa* was the only taxa recorded. *Phlebocarya ciliata* was recorded in the Closed Forest to Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* with occasional to dense *Corymbia calophylla* but not the Priority Three Flora, *Phlebocarya pilossisima* subsp. *pilossisima*.

5.4 Conservation Category Wetlands

Although the Amcor site abuts South Lake there were no wetlands present. All the land is uplands of the Spearwood Dune system, which form a very important and essential component of South Lake, as it would increase the ecological diversity of this Bush Forever site.

Bush Forever (Government of Western Australia, 2000) list the following for retaining vegetation associated with lakes:

- provides a wildlife corridor connecting the areas of bushland;
- could possibly be a feeding or breeding habitat for native birds;

- conservation category wetlands include the fringing vegetation as well as the associated upland vegetation; and
- increases the ecological diversity of the current wetland reserve.

South Lake does include an area of Floristic Community Type 28 but this is in poor condition as illustrated in Photograph 1, equivalent to Condition 5-6. The condition of the vegetation at the Amcor site abutting South Lake is Condition 6, then progressing into Condition 5 and then into Condition 3-4, the best quality vegetation recorded at the Amcor site.

In addition the Amcor site is:

- included as part of Greenways 75 and 90; and
- is part of a regionally significant bushland/wetland linkage.

The cleared area between the lake edge (currently the proposed 150m buffer) and the woodland could be readily rehabilitated as is currently occurring on the west side of South Lake. This would provide cover through a vegetated corridor for animals to move between the lake and the dense vegetation associated with the woodland. If development proceeds consideration could be given to direct translocation of some of the vegetation into this degraded buffer area together with plantings of dominant upper storey plants. In addition, if the area is developed within the vicinity of the lake, there will need to be strict guidelines for runoff from carparks etc to ensure the integrity of the lake is maintained. Contaminants entering the lake would severely impinge on the lake's integrity.

5.5 Weeds

A total of 59 weeds were recorded during the survey representing 37.6% of the total plant taxa recorded. Most have been determined as environmental weeds by the Department of Conservation and Land Management (1999) and the Western Australian Herbarium (2001a) and their rating is given below in Table 4. The rating allocated to each weed by CALM is based on three criteria:

- **Invasiveness** – ability to invade natural bushland in good to excellent condition or ability to invade waterways.
- **Distribution** – wide current or potential distribution including consideration of known history of wide spread distribution elsewhere in the world.
- **Environmental impacts** – Ability to change the structure, composition and function of ecosystems. In particular an ability to form a monoculture in a vegetation community.

Ratings indicate the following;

- **High** indicates this weed is prioritised for control and/or research ie prioritising funding to it.
- **Moderate** indicates control or research effort should be directed to it if funds are available, however it should be monitored (possibly a reasonably high level of monitoring).
- **Mild** indicates monitoring of the weed and control where appropriate.
- **Low** indicates that this taxa would require a low level of monitoring.

Table 4. Weeds recorded during the survey classified according to CALM (1999)

Scientific Name	Common Name	CALM Category		
		Rating	Invasiveness	Impact
**Brassica tournefortii*	Wild turnip	High		
**Bromus diandrus*	Great brome	High		
**Ehrharta calycina*	Perennial veldt grass	High		
**Eragrostis curvula*	African love grass	High		
**Euphorbia terracina*	Geraldton carnation weed	High		
**Freesia* hybrid	Freesia	High		
**Lagurus ovatus*	Hares tail grass	High		
**Leptospermum laevigatum*	Victorian tea tree	High		
**Lupinus consentinii*	Blue lupin	High		
**Moraea flaccida*	One-leaf cape tulip	High		
**Pelargonium capitatum*	Rose pelargonium	High		
**Romulea rosea*	Guildford grass	High		
**Zantedeschia aethiopica*	Arum lily	High		
**Aira caryophyllea*	Silvery hairgrass	Moderate		
**Anagallis arvensis*	Pimpernel	Moderate		
**Arctotheca calendula*	Cape weed	Moderate		
**Avena barbata*	Bearded oat	Moderate		
**Briza maxima*	Blowfly grass	Moderate		
**Briza minor*	Shivery grass	Moderate		
**Carpobrotus edulis*	Hotentot fig	Moderate		
**Cynodon dactylon*	Couch	Moderate		
**Ehrharta longiflora*	Annual veldt grass	Moderate		
**Euphorbia peplus*	Petty spurge	Moderate		
**Galium murale*	Bedstraw	Moderate		
**Gladiolus caryophyllaceus*	Pink galdiolus	Moderate		
**Heliophila pusilla*		Moderate		
**Hypochaeris glabra*	Flatweed	Moderate		
**Juncus capitatus*		Moderate		
**Lactuca serriola*	Prickly lettuce	Moderate		
**Lotus suaveolens*	Hairy birdsfoot trefoil	Moderate		
**Pinus pinaster*	Monterey pine	Moderate		
**Solanum americanum*	Glossy nightshade	Moderate		
**Solanum nigrum*	Blackberry nightshade	Moderate		
**Sonchus asper*	Prickly sowthistle	Moderate		
**Sonchus oleraceus*	Sowthistle	Moderate		
**Trifolium arvense*	Hares foot clover	Moderate		
**Trifolium dubium*	Suckling clover	Moderate		
**Urospermum picroides*	False hawkbit	Moderate		
**Ursinia anthemoides*	Ursinia	Moderate		
**Vulpia myuros* var. *myuros*	Silver grass	Moderate		
**Acacia dealbata*	Sydney silver wattle	Mild		
**Fumaria capreolata*	White fumitory	Mild		
**Hedypnois rhagadioloides*	Cretan weed	Mild		
**Nicotiana glauca*	Tree tobacco	Mild		

Scientific Name	Common Name	CALM Category		
		Rating	Invasiveness	Impact
**Oxalis pes-caprae*	Soursob	Mild		
**Pennisetum setaceum*	Fountain grass	Mild		
**Petrorhagia velutina*	Velvet pink	Mild		
**Phytolacca octandra*	Ink weed	Mild		
**Raphanus raphanistrum*		Mild		
**Trachyandra divaricata*	Strapweed	Mild		
**Acetosella vulgaris*	Sorrel	Low		
**Cicendia filiformis*		Low		
**Conyza bonariensis*	Flaxleaf fleabane	Low		
**Erodium botrys*	Corkscrews	Low		
**Gamochaeta falcata*	Cudweed	Low		
**Geranium molle*	Cranes bill	Low		
**Oxalis purpurea*	Four o'clock	Low		
**Polycarpon tetraphyllum*	Four leaf allseed	Low		
**Ricinus communis*	Castor oil	Low		
**Silene gallica*	French catchfly	Low		
**Stellaria media*	Common chickweed	Low		
**Vicia hirsuta*	Hairy vetch	Low		
**Zaluzianskya divaricata*	Zedweed	Low		
**Chamelaucium uncinatum+*	Geraldton wax	Not listed		
**Eucalyptus camaldulensis+*	River red gum	Not listed		
**Schinus teberinthifolia*	Japanese pepper tree	TBA		
**Vicia sativa*	Common vetch	TBA		

TBA = To be assessed
+ Taxa native to elsewhere in Australia.

Twelve of the weed taxa are recorded as High, indicating that these are the weeds that are major environmental weeds. Those weeds associated with the degraded areas, mainly from the paper pulp are listed in Appendix B and indicated by *. *Moraea flaccida*, rated High in the above table, is also listed by Agriculture WA as a Declared Plant. "Declared Plants" are those taxa which have been categorised as potential or current agricultural pests. **Moraea flaccida* is classified as Category P1 – Plants which cannot be introduced or spread. Most Declared Plants are in this category.

The suite of weeds dominant at different areas within the bushland are illustrated in Appendix C, Map 3. The percentage of dominance and often the weed taxa varied across the Amcor site.

5.6 Vegetation Condition

The condition of the vegetation was recorded using the scale in Bush Forever as indicated in Table 5 and in Appendix C, Map 2.

Table 5. Vegetation condition categories

Rating	Description	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual taxa and weeds are non-aggressive taxa.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native taxa.

By referring to Appendix C, Map 2 it can be interpreted that 40% of the site is Condition 6 – Completely Degraded; 17% is Condition 5 (5-6) – Degraded; 20% is Condition 4 (4-5) – Good and 23% is Condition 3 (3-4) Very Good. None of the vegetation surveyed recorded a Rating of 1 – Pristine or 2 – Excellent, as all areas included several to dense weeds in the understorey. Generally the condition of the vegetation was rated lower along roads and firebreaks. The paper pulp dumped throughout areas of the bushland and the subsequent watering, has increased the number of weeds and caused the deaths of trees within the radius of the sprinklers Large areas have been laid waste due to the paper pulp and "rivers" of the paper pulp have penetrated some distance into the bushland.

There has been little dumping by the public throughout the bushland but there was one short track in the centre of the southern section where household rubbish had been dumped. One old car body was recorded on the southern perimeter. Although the area is fenced with warning signs on the fence the southern boundary fence has been cut in several places allowing vehicles to enter. During the survey a vehicle was passed on the southern firebreak, and the driver was sure he was driving on land administered by the Department of Conservation and Land Management.

5.7 Representation of Ecological Communities

Two Floristic Community Types have been recorded for the site surveyed. These are Floristic Community Types 11 and 28 as discussed in 5.2. In Gibson *et al* (1994) each of community types described has the following recorded.

Reservation status:

Well reserved – known from two or more A class National Parks or Nature Reserves.

Poorly reserved – known from a single A class National Park or Nature Reserve.

Unreserved - not known to occur in any A class National Park or Nature Reserve.

Conservation status:

Presumed destroyed – A community that is totally destroyed or so extensively modified that it is unlikely to re-establish ecosystem processes in the foreseeable future.

Critical - A community with most or all of its known occurrences facing severe modification or destruction in the immediate future.

Endangered - A community in danger of severe modification or destruction throughout its range, if causal factors continue operating.

Vulnerable – A community likely to move into the endangered category in the near future if the causal factors continue operating.

Susceptible - A community of concern because there is evidence that it can be modified or destroyed by human activities, or would be vulnerable to new threatening processes.

Low risk - A community that does not qualify for one of the above categories.

Insufficiently known – A community for which there is inadequate data to assign to one of the above categories.

Table 6. Reservation and Conservation Status of Floristic Community Types

Floristic Community Type	Reservation Status	Conservation Status
11	Well reserved	Low risk
28	Well reserved	Low risk

Both Floristic Community Types recorded from the Amcor site are well reserved and of low risk (Gibson, *et al,* 1994) as shwon in Table 6.

5.8 Threatened Ecological Community

The Department of Conservation and Land Management (English, 2001) lists none of the vegetation types at the Amcor site as a Threatened Ecological Community.

5.9 Diversity

By referring to Appendix B the total number of taxa recorded for each structural unit is summarised below.

- Closed Forest to Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* with occasional to dense *Corymbia calophylla* over an Open Heath dominated by *Xanthorrhoea preissii* or *Hibbertia hypericoides* – 131 taxa including 43 weeds.
- Tall Open Scrub to Tall Shrubland of *Hakea prostrata, Jacksonia furcellata* and *Kunzea glabrescens* over a Low Open Shrubland over a Grassland dominated by **Briza maxima* – 56 taxa including 18 weeds.
- Open Woodland of *Eucalyptus rudis* and *Banksia grandis* – 44 taxa including 24 weeds.

Although the number of weeds recorded for each of the vegetation units is relatively high, 33% or greater, within the Closed Forest to Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* with occasional to dense *Corymbia calophylla* the weeds were mainly confined to the edges of tracks and around infrastructures or where the paper pulp had penetrated into the bushland.

The dominant vegetation unit was less disturbed than the other which were small in size and significantly disturbed. The Tall Open Scrub to Tall Shrubland of *Hakea prostrata, Jacksonia furcellata* and *Kunzea glabrescens* had large open spaces between the dense patches of vegetation, allowing weeds to grow. As mentioned earlier in the text the remnant of the Tall Open Scrub to Tall Shrubland of *Hakea prostrata, Jacksonia*

furcellata and *Kunzea glabrescens* was highly degraded and would account for over 50% of the taxa recorded being weeds.

Bush Forever sites are selected where there is a diversity of plant communities and floristic diversity. There were three vegetation units recorded from the Amcor site, representing two Floristic Community Types, 28 and an interzone between 28 and 11. Floristic Community Type 28 was dominant and widespread through the Amcor site. The other vegetation units were highly degraded and could not be considered as representative of a Floristic Community Type. From old glass found above the lake during the field work, it would appear there had been a residence and presumably grazing or even a market garden on the site many years ago. However this is the vegetation between Floristic Community Type 28 and the lake side vegetation Floristic Community Type 11.

Floristic Community Type 28 varied considerably in vegetation condition between the different locations across the total Amcor site. It varied from degraded to very good, the location of good condition sections occurring in the southern area is set out in Appendix C Map 2. The northern sections of this Floristic Community Type had extensive areas of paper mulch deposited, which had dissipated into the bushland. Also much of the northern area was developed for offices and other infrastructures.

The number of taxa recorded in this survey was not particularly diverse with a total of 114 native taxa being recorded. Two nearby Bush Forever sites where the vegetation has been mapped and the taxa listed are Bush Forever Site 256, Yangebup and Little Rush Lakes, an area of 27.7ha and Bush Forever Site 391, Thomsons Lake Nature Reserve, an area of 366.7ha. Both these Bush Forever Sites include wetlands and therefore much more varied vegetation units, recorded 140 native taxa and 199 native taxa respectively.

The Amcor site recorded three vegetation units. By referring to Table 7 this number was less than the vegetation units recorded from Bush Forever Sites 244, 254, 256 and 391 which recorded 5,6,9 and 7 vegetation units respectively. Therefore the diversity in the vegetation units recorded from the Amcor site is less than the four nearby, Bush Forever sites included in the Beeliar Regional Park. However as mentioned earlier all these sites included wetland and lake plus upland vegetation, whereas the Amcor site included only upland vegetation.

Table 7. Vegetation Units Recorded at Bush Forever Sites 244, 254, 56 and 391

Bush Forever Site	Vegetation Units	Total Number of Vegetation Units
254 – South Lake	*Eucalyptus marginata, Corymbia calophylla* Open Forest; *Banksia attenuata, B. menziesii* Low Open Forest; *Eucalyptus rudis* Low Closed Forest; *Eucalyptus rudis* and *Melaleuca preissiana* Open Forest; *Acacia saligna* Low Woodland; Mixed Closed Sedgeland.	6
256 – Yangebup and Little Rush Lakes	*Eucalyptus gomphocephala,. E.marginata, Corymbia calophylla* Woodland; *Eucalyptus marginata* Woodland; *Banksia attenuata, B. menziesii* Low Woodland; *Eucalyptus rudis* Open Forest; *Melaleuca rhaphiophylla and Eucalyptus rudis* Woodland; *Melaleuca preissiana, Banksia ilicifolia* Low Woodland; *Melaleuca teretifolia* Low Woodland; *Acacia saligna* Tall Shrubland; Sedgelands to Closed sedgeland.	9
391 – Thomsons Lake Nature Reserve	*Eucalyptus marginata* Low Open Forest;*Banksia attenuata, B. menziesii* Low Open Forest; mixed low heath; *Eucalyptus rudis, Melaleuca preissiana, M. rhaphiophylla* Open Forest; *Eucalyptus todtiana, Melaleuca preissiana* Low Open Forest; *Acacia* sp. Closed to Open Tall Scrub; *Melaleuca teretifolia* Low Open Forest; *Baumea articulata, Typha* sp. Closed Sedgeland.	7
244 – North Lake and Bibra Lake	*Eucalyptus marginata* Open Forest; *Banksia attenuata, B. menziesii, Allocasuarina fraseriana* Low forest; *Eucalyptus rudis, Melaleuca preissiana, M. rhaphiophylla, B. ilicifolia* Forest to Woodland; *Melaleuca teretifolia* Tall Shrubland; *Baumea articulata, Typha orientalis* Sedgelands	5

5.10 Regional Assessment

The Bush Forever Sites that are close to the Amcor site are Bibra Lake and North Lake (Site 244); South Lake (Site 254) and Yangebup Lake (Site 256). These are all included in the Beeliar Regional Park. All these Bush Forever Sites were visited but no detailed survey was undertaken. They all included representation of Floristic Community Type 28, Spearwood *Banksia attenuata* or *B. attenuata – Eucalyptus* woodland but in varying condition.

Floristic Community Type 28 at South Lake, which abuts Lot 502, is in a degraded condition with only a small remnant remaining. The inclusion of additional area of this Community Type within the reserve would greatly enhance its conservation value and that of the Beeliar Regional Park.

Photograph 1. Floristic Community Type 28 at South Lake. The tree stratum is open and the understorey predominantly replaced by weeds.

Bibra Lake and North Lake included Floristic Community Type 28 in Excellent to Good condition and rehabilitation work on this area is well advanced particularly near the Wetlands Centre. At Yangebup Lake Floristic Community Type 28 is also represented but due to people pressure is only in a Good condition with many weeds throughout the bushland. The last two sites also included bushland with *Eucalyptus gomphocephala*, a few trees only of which were recorded from the Amcor site.

In Bush Forever (Government of Western Australia, 2000) the vegetation condition at Bibra Lake and North Lake is recorded as >20% Good to Very Good, 80% Degraded; at South Lake as >50% Good to Very Good and at Yangebup Lake <20% Excellent to Very Good, >80% Degraded to Completely Degraded. All three recorded areas of severe localised disturbance.

All of the nearby Bush Forever sites included Floristic Community Type11 – Wet forests and woodlands where the common tree was *Eucalyptus rudis*. This tree was also recorded in a remnant vegetation unit on the eastern side of the Amcor site abutting South Lake but the vegetation unit was so degraded that it could not be considered representative of the community. However it may be possible with considerable effort to restore this community between the lake and this area.

From the above, the dominant Floristic Community Type 28 recorded from The Amcor site is represented in close by Bush Forever Sites. The other Floristic Community Type recorded from the Amcor site is in a degraded condition and is of a small, difficult to rehabilitate size, unless combined as suggested above as a project with South Lake.

5.11 Linkage to Other Bushland Areas

The Amcor site links directly with South Lake on its eastern side. South Lake links across a road (North Lake Road) to Bibra Lake and across the railway line to Little Rush Lake and Yangebup Lake. Yangebup Lake links south, across a road, with Thomson's Lake, which links with Harry Waring Reserve, resulting in nearly 11km of continuous or near continuous and conserved bushland. All this conserved area is included in the Beeliar Regional Park.

South Lake, and the eastern edge of the Amcor site, is part of Greenways 75 and 90 (Tingay, 1998) and part of a regionally significant bushland/wetland linkage (Government of Western Australia, 2000). The eastern side of the Amcor site therefore is important as part of the Greenways and regionally signficiant bushland/wetland linkages. Consideration should therefore be given to maintaining this area as bushland and combining it with the Beeliar Regional Park.

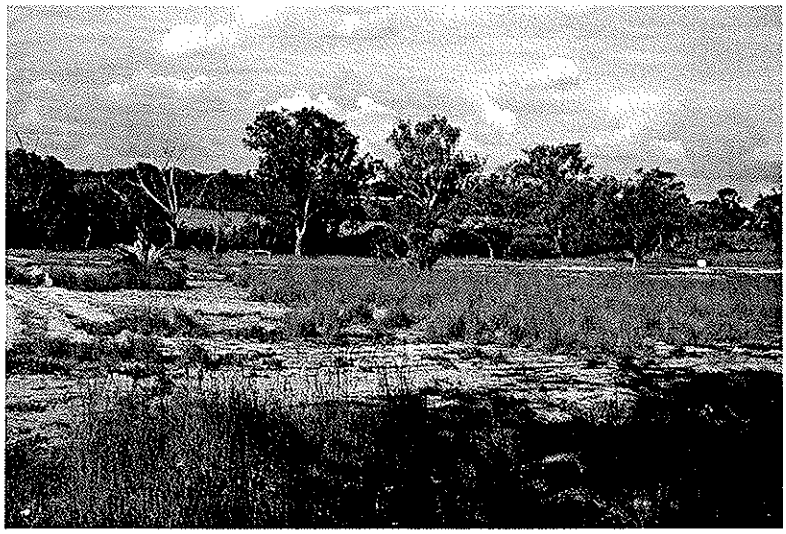
5.12 Vegetation Community Viability

Most of Floristic Community Type 28 sampled at the Amcor site has the potential for long term viability. The southern section of this bushland was in Very Good to Good condition although there were areas that were highly degraded, mainly due to paper pulp being spread on the surface. To attempt to rehabilitate these paper pulp areas would be a very difficult task as in many cases all the native taxa have been removed and replaced by weeds. Some sections could be rehabilitated, as is being undertaken at the Cockburn Wetland Education Centre, and it would be of benefit to do this if some of the degraded land in the northern section of the Amcor site is retained as a part of the Beeliar Regional Park.

Flagged pegs indicate on the eastern side of the Amcor site "100m from Lake Edge". If the area between these pegs and South Lake is to be included in the Beeliar Regional Park a large rehabilitation program will need to be undertaken. This area is highly degraded with **Carpobrotus edulis* and ***Ehrharta calycina*** being the dominant weeds. Both of these are readily controlled by hand pulling (**Carpobrotus*) and with a selective herbicide (**Ehrharta*) with follow up treatments in subsequent years as seedlings germinate.

All seed to be used for rehabilitation should be collected from the surrounding shrubs and trees. Care should be taken to ensure that the taxa collected are appropriate and representative of the particular vegetation unit. As some pea taxa are now commencing to mature seed collection should be undertaken from late October through to February. Seed collected must not be stored in plastic bags but in cardboard boxes, paper or cloth bags.

The collected seed can either be used for the propagation of seedlings for planting in early winter or for sowing directly at the break of the winter season. Rehabilitation work has already commenced on the South Lake side of the fence as evidenced by the green protectors around planted seedlings.

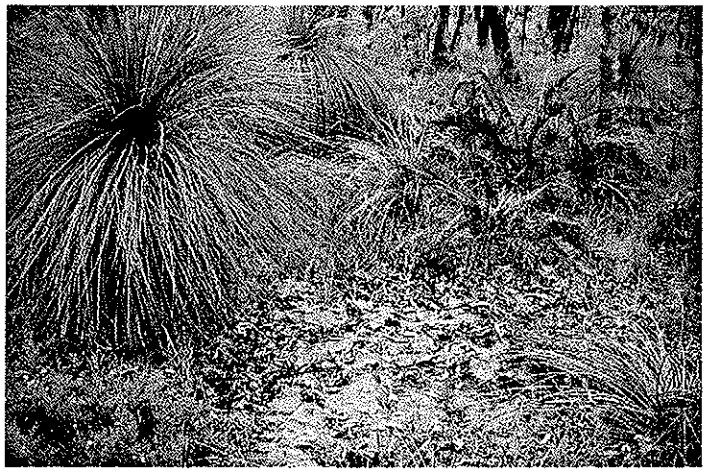


Photograph 2, from near a 100m peg showing the degraded vegetation between the peg and the fringing vegetation of South Lake.

By conserving 100-150m from the Lake shore, none of Floristic Community Type 28 from the Amcor site will be included in the Beeliar Regional Park. Consideration should be given to extending the distance from the lake for reservation to include some area(s) of Floristic Community Type 28. This Floristic Community Type is represented at Bibra and Yangebup Lakes but it would be ideal to include some of this Floristic Community Type from the Amcor site in the Regional Park.

The main threatening processes to the area are the paper pulp, weeds, fire, and to a limited extent trail bike riders, 4-wheel drive vehicles and the dumping of rubbish. The dumping of the paper mulch and the "rivers" of this material that then flow into the bushland have had a devasting effect on the bushland. At the main dump areas all native vegetation has been removed, where it has spread into the bushland by "rivers" several native taxa have managed to survive, particularly where the paper layer is not thick. The main dumps are then watered, presumably to stabilise the area, resulting in many weeds surviving and thriving. The ibis and crows were abundant in these areas, as the watering attracts a ready food source. However the combination of paper pulp and watering has killed many native trees including jarrah, marri and banksias.

Photograph 3, showing dense area of paper pulp which is watered encouraging a diverse weed flora and trees that are dead or dying



Photograph 3, paper pulp river through good quality bushland

There were many different weeds recorded from the Amcor site (Table 2) most from the paper mulch areas. However some sections of the bushland, mainly those close to roads, tracks and paper mulch areas had a large percentage of the understorey being replaced with weeds. Fire was evidenced in the bushland although it is several years since a large fire went through the area.

Children on trail bikes ride the tracks quite often, and occasionally, it was observed from their tracks, take off into the bushland. This will destroy that bushland and open up an additional track which provides the opportunity for invasion by weeds. There was no evidence of timber being cut and as mentioned earlier, there was limited dumping of rubbish.

The majority of *Eucalyptus marginata* subsp. *marginata* trees were looking very unhealthy at the time of the survey. On close examination it was found that the jarrah leaf miner was causing this destruction. The leaves were blistered and turning reddish-brown in colour. This disease is cyclical and the trees recover.

6 DISCUSSION

Bush Forever (Government of Western Australia, 2000) is a 10-year plan that attempts where possible to retain at least 10% of the original 26 vegetation complexes in the Swan Coastal Plain. Seven vegetation complexes (Heddel *et al*, 1980) fall below the 10% level one of which is Karrakatta Central and South, the vegetation complex of the Amcor site. It is estimated there is 18% of this vegetation complex remaining of which currently 8% is conserved (Government of Western Australia, 2000).

When selecting areas for inclusion as Bush Forever sites, public land was selected over privately owned land. The Amcor site is not listed as a Bush Forever site and is not included in the additional list (Government of Western Australia, 2000).

The Amcor site of 89ha is a considerable size however the northern half is degraded through infrastructure development and the dumping of paper pulp. As a result the associated bushland is degraded. However the southern section is in much better condition and could be considered as worthy of conservation. This section is also compact in shape and of a large enough size to be able to maintain its very good condition. The southern remnant of the Amcor site recorded a vegetation condition score of 3-4, Very Good to Good with areas of vegetation condition 5 - Degraded, mainly along the tracks. This condition score is not unusual in the sandy soils of Perth metropolitan area.

Two Floristic Community Types, 11 and 28 were recorded from the Amcor site. Both are well reserved and considered not to be threatened (Gibson *et al,* 1994). Floristic Community Type 28 included two vegetation units (Closed Forest to Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* with occasional to dense *Corymbia calophylla* and Tall Open Scrub to Tall Shrubland of *Hakea prostrata, Jacksonia furcellata* and *Kunzea glabrescens*) and Floristic Community Type 11, one vegetation unit (Open Woodland of *Eucalyptus rudis* and *Banksia grandis*) making a total of three for the Amcor site. The nearby Bush Forever sites, 234, 256, 391 and 244 recorded 6,9,7 and 5 vegetation units. These sites also included vegetation associated with a lake.

No Endangered Ecological Community as defined by the Department of Conservation and Land Management (English, 2001) or Declared Rare or Priority Flora were identified at the Amcor site.

Most of the Amcor site is vegetation unit Closed Forest to Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* with occasional to dense *Corymbia calophylla* which recorded 132 taxa including 43 weeds. Both the other two vegetation units were very small by comparison. They are Tall Open Scrub to Tall Shrubland of *Hakea prostrata, Jacksonia furcellata* and *Kunzea glabrescens* recording 57 taxa including 18 weeds and Open Woodland of *Eucalyptus rudis* and *Banksia grandis* recording 44 taxa including 24 weeds.

The Amcor site links directly with South Lake on its eastern side. South Lake links by North Lake Road to Bibra Lake and southwards through Little Rush Lake and Yangebup Lake to Thomson's Lake and then to Harry Waring Reserve, resulting in nearly 11km of bushland linkage. South Lake, and the Amcor site, are part of Greenways 75 and 90 and part of a regionally signficant bushland/wetland linkage (Government of Western Australia, 2000). If development is to be considered for this site this bushland linkage provided by the Amcor site should be retained.

As the Amcor site is adjacent to the Bush Forever Site 254, South Lake it is important that as much bushland as is possible be retained. Although not a fauna specialist, no evidence of kangaroos through the bushland was seen, the only animal evident was the rabbit. However the dense bushland would provide shelter for smaller mammals, and the large dead trees, nesting sites for many parrots. The regular watering of the paper pulp has encouraged several bird species into the area, in particular ibis and crows.

Some of the degraded areas are so degraded that it would be a very large task to attempt to restore them to their original condition. By watering the paper pulp areas large number of native plants have killed and the area then invaded by weed taxa. Generally the paper pulp areas recorded a diverse list of weed taxa. However most of the natural and relatively undisturbed vegetation has the potential for long term viability.

Generally the Amcor site is in the Karakatta Central and South Vegetation Complex (Heddle *et al*, 1980) of which less than 10% is reserved. The dominant Floristic Vegetation Type 28 is well reserved and not considered to be under threat. No Rare or Priority Flora were recorded from the site. The southern portion of the Amcor site was in Very Good to Good condition but the northern section outside the developed infrastructure predominantly was Degraded to Completely Degraded due to paper pulp being dumped in the area and rivers of this paper pulp penetrating into the bushland.

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APPENDIX A

List of Rare, Priority and Significant Plant Taxa that may occur in the area (From Weston, 2000)

Taxon Name	Code	Flowers	Habit	Habitat
Caladenia huegelii	DRF	Aug-Oct	Orchid	Deep sandy lower slopes
Diuris micrantha	DRF	Aug-Sep	Orchid	Winter-wet sedge flats
Acacia lasiocarpa var. *bracteolata* long peduncle	P1	May-Sep	Shrub	Winter-wet sandy to clay soil
Trupterococcus paniculatus	P1	Nov-Dec	Herb	Sandy winter-wet flats
Aotus cordifolia	P3	Aug-Dec	Shrub	Winter-wet thickets
Jacksonia sericea	P3	Dec-Feb	Prostrate shrub	Sand
Phlebocarya pilosissima subsp. *pilosissima*	P3	Aug-Sep	Grass-like	Sand often with lateritic gravel
Anthotium junciflorme	P4	Dec-Mar	Grass-like	Winter-wet, lowlying flats
Dodonaea hackettiana	P4	Jul-Oct	Shrub, small tree	Sand, or with limestone
Microtis media subsp. *quadrata*	P4	Dec-Jan	Orchid	Clayey winter-wet swamps
Lysinema elegans	p,s,e	Oct-Nov	Shrub	Sand
Villarsia violifolia	p,s	Nov-Feb	Prostrate herb	Winter-wet depressions

EXPLANATION OF CODES

Code	Code Declared Rare and Priority Flora Categories
R	DRF (Declared Rare Flora) -Extant Taxa. Taxa, which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection.
X	DRF (Declared Rare Flora) -Presumed Extinct Taxa. Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently.
1	Priority One -Poorly Known Taxa. Taxa, which are known from one or a few (generally <5) populations, which are under threat.
2	Priority Two -Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat.
3	Priority Three -Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under immediate threat.
4	Priority Four -Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.
p	Taxa considered to be poorly reserved
s	Significant populations
e	Taxa endemic to the Swan Coastal Plain

APPENDIX B

List of Plant Taxa in the Different Vegetation Units

Abbreviation	Vegetation Unit
Em,Ba	Closed Forest to Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* with occasional to dense *Corymbia calophylla* over an Open Heath dominated by *Xanthorrhoea preissii* or *Hibbertia hypericoides*
Hp,Jf,Kg	Tall Open Scrub to Tall Shrubland of *Hakea prostrata, Jacksonia furcellata* and *Kunzea glabrescens* over a Low Open Shrubland over a Grassland dominated by **Briza maxima*
Er,Bg	Open Woodland of *Eucalyptus rudis* and *Banksia grandis* over an Open Shrubland of *Hakea prostrata* over a Herbland of weeds
Degraded	Vegetation could not be assessed

NOTE: * indicates the plant is an introduced "weed" species

FAMILY	TAXA	VEGETATION COMMUNITY			
		Degraded	Er,Bg	Em,Ba	Hp,Jf,Kg
AIZOACEAE	**Carpobrotus edulis*	+	+	+	+
AMARANTHACEAE	*Ptilotus polystachyus*			+	
ANACARDIACEAE	**Schinus teberinthifolia*	+			
ANTHERICACEAE	*Caesia parviflora*			+	
	Chamaescilla corymbosa			+	
	Dichopogon preissii			+	
	Laxmannia squarrosa			+	+
	Sowerbaea multiflora			+	
	Thysanotus manglesii			+	+
APIACEAE	*Eryngium rostratum*			+	
	Hydrocotyle callicarpa	+			
	Trachymene pilosa		+	+	+
	Xanthosia huegelii			+	
ARACEAE	**Zantedeschia aethiopica*			+	+
ASPHODELACEAE	**Trachyandra divaricata*	+		+	
ASTERACEAE	**Arctotheca calendula*	+	+	+	+
	**Conyza bonariensis*			+	
	Cotula australis	+			
	**Gamochaeta falcata*			+	
	Gnephosis angianthoides		+		
	**Hypochaeris glabra*	+	+	+	+
	**Lactuca serriola*	+			
	Podolepis gracilis			+	
	Podotheca angustifolia			+	+
	Quinetia urvillei			+	+
	Siloxerus humifusus			+	
	**Sonchus asper*	+			+
	**Sonchus oleraceus*	+		+	
	**Urospermum picroides*			+	
	**Ursinia anthemoides*	+		+	+
BRASSICACEAE	**Brassica tournefortii*			+	
	**Heliophila pusilla*			+	+
	**Raphanus raphanistrum*			+	
CARYOPHYLLACEAE	**Petrorhagia velutina*	+		+	+
	**Polycarpon tetraphyllum*	+		+	
	**Silene gallica*	+		+	+
	**Stellaria media*		+	+	
CASUARINACEAE	*Allocasuarina fraseriana*		+	+	
CENTROLEPIDACEAE	*Centrolepis drummondiana*		+	+	
COLCHICACEAE	*Burchardia umbellata*			+	
CRASSULACEAE	*Crassula colorata*	+	+	+	+
	**Crassula decumbens*	+	+	+	
CYPERACEAE	*Isolepis marginata*			+	
	Lepidopserma squamatum			+	
	**Leptospermum laevigatum*				+

FAMILY	TAXA	VEGETATION COMMUNITY			
		Degraded	Er,Bg	Em,Ba	Hp,Jf,Kg
CYPERACEAE (cont.)	*Mesomelaena pseudostygia*			+	+
	Schoenus clandestinus			+	
	Tetraria octandra			+	
DASYPOGONACEAE	*Acanthocarpus preissii*			+	
	Dasypogon bromeliifolius			+	
	Lomandra caespitosa			+	
DILLENIACEAE	*Hibbertia huegelii*			+	
	Hibbertia hypericoides			+	
	Hibbertia racemosa			+	
DROSERACEAE	*Drosera erythrorhiza*			+	
	Drosera glanduligera		+	+	+
	Drosera macrantha			+	
	Drosera pallida			+	
	Drosera stolonifera			+	
EPACRIDACEAE	*Astroloma pallidum*			+	
	Conostephium pendulum			+	
	Leucopogon propinquus			+	+
EUPHORBIACEAE	**Euphorbia peplus*	+	+	+	
	**Euphorbia terracina*			+	
	Phyllanthus calycinus			+	
	Poranthera microphylla		+	+	+
	**Ricinus communis*	+		+	
FUMARIACEAE	*Fumaria capreolata*	+		+	
GENTIANACEAE	**Cicendia filiformis*	+			
GERANIACEAE	**Erodium botrys*	+	+		
	**Geranium molle*		+		
	**Pelargonium capitatum*	+	+	+	+
GOODENIACEAE	*Scaevola canescens*			+	+
HAEMODORACEAE	*Anigozanthos humilis*			+	
	Anigozanthos manglesii			+	+
	Conostylis aculeata subsp. *aculeata*			+	+
	Phlebocarya ciliata			+	
IRIDACEAE	**Freesia* hybrid			+	
	**Gladiolus caryophyllaceus*	+		+	+
	**Moraea flaccida*		+	+	
	Patersonia occidentalis			+	+
	**Romulea rosea*	+		+	
JUNCACEAE	**Juncus capitatus*	+			
	Juncus pallidus	+			
	Luzula meridionalis			+	
MIMOSACEAE	*Acacia cyclops*		+		+
	**Acacia dealbata*	+			
	Acacia huegelii				+
	Acacia pulchella var. *pulchella*			+	+
	Acacia saligna			+	+
MYRTACEAE	*Calytrix angulata*				+

FAMILY	TAXA	VEGETATION COMMUNITY			
		Degraded	Er,Bg	Em,Ba	Hp,Jf,Kg
MYRTACEAE (cont.)	**Chamelaucium uncinatum*			+	
	Corymbia calophylla			+	
	**Eucalyptus camaldulensis*	+			
	Eucalyptus gomphocephala			+	
	Eucalyptus marginata subsp. *marginata*			+	
	Eucalyptus rudis		+		
	Hypocalymma robustum			+	+
	Kunzea glabrescens				+
OLEACEAE	**Olea europaea*		+		
ORCHIDACEAE	*Caladenia flava*		+	+	
	Caladenia latifolia		+	+	
	Caladenia longicauda subsp. *calcigena*			+	+
	Diuris corymbosa			+	
	Pterostylis vittata			+	
OXALIDACEAE	**Oxalis pes-caprae*	+		+	
	**Oxalis purpurea*			+	
PAPILIONACEAE	*Bossiaea eriocarpa*			+	
	Daviesia divaricata		+	+	+
	Daviesia nudiflora			+	
	Gompholobium tomentosum			+	+
	Hardenbergia comptoniana			+	+
	Isotropis cuneiformis			+	
	Jacksonia furcellata		+		+
	Jacksonia sternbergiana			+	
	Kennedia prostrata			+	+
	**Lotus suaveolens*	+			
	**Lupinus consentinii*			+	
	**Meliotus indicus*	+			
	Nemcia capitata			+	+
	**Trifolium arvense*	+	+		
	**Trifolium campestre*		+	+	+
	**Trifolium dubium*	+		+	
	**Vicia hirsuta*	+			
	**Vicia sativa*	+	+	+	
PHORMIACEAE	*Dianella revoluta*		+	+	+
PHYTOLACCACEAE	**Phytolacca octandra*	+			
PINACEAE	**Pinus pinaster*	+			
POACEAE	**Aira caryophyllea*		+	+	+
	Austrodanthonia occidentalis			+	
	**Avena barbata*	+	+	+	
	**Briza maxima*	+		+	+
	**Briza minor*				+
	**Bromus diandrus*	+	+	+	
	**Cynodon dactylon*	+			

FAMILY	TAXA	VEGETATION COMMUNITY			
		Degraded	Er,Bg	Em,Ba	Hp,Jf,Kg
POACEAE	**Ehrharta calycina*	+	+	+	+
	**Ehrharta longiflora*		+	+	
	**Eragrostis curvula*	+		+	
	**Lagurus ovatus*	+	+	+	+
	**Pennisetum setaceum*	+			
	**Triticum aestivum*	+			
	**Vulpia myuros* var. *myuros*	+	+	+	+
POLYGONACEAE	**Acetosella vulgaris*		+		
PORTULACEAE	*Calandrinia granulifera*		+	+	
PRIMULACEAE	**Anagallis arvensis*	+	+	+	
PROTEACEAE	*Banksia attenuata*		+	+	
	Banksia grandis		+	+	
	Banksia ilicifolia			+	
	Banksia menziesii			+	
	Hakea prostrata		+	+	+
	Persoonia sacculata				+
	Petrophile linearis			+	
	Petrophile macrostachya			+	
	Stirlingia latifolia			+	
	Synaphea spinulosa				+
	Xylomelum occidentale			+	
RESTIONACEAE	*Desmocladus flexuosus*			+	
	Lyginia barbata			+	+
RUBIACEAE	**Galium murale*	+	+	+	+
RUTACEAE	*Philotheca spicata*			+	
SCROPHULARIACEAE	**Zaluzianskya divaricata*				+
SOLANACEAE	**Nicotiana glauca*	+			
	**Solanum americanum*	+			
	**Solanum nigrum*	+			
STYLIDIACEAE	*Stylidium brunonis*				+
	Stylidium piliferum			+	+
	Stylidium schoenoides			+	
THYMELAEACEAE	*Pimelea rosea*			+	
XANTHORRHOEACEAE	*Xanthorrhoea brunonis*		+	+	
	Xanthorrhoea preissii			+	
ZAMIACEAE	*Macrozamia riedlei*		+	+	
	Grand Total	**52**	**44**	**131**	**56**

APPENDIX C

Maps of Vegetation Units and Vegetation Condition

Map 1: Vegetation Units

Abbreviations used in the map.

Abbreviation	Floristic Community Type	Vegetation Community
EmBa	28	Closed Forest to Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* with occasional to dense *Corymbia calophylla* over an Open Heath dominated by *Xanthorrhoea preissii* or *Hibbertia hypericoides*
HpJfKg	28	Tall Open Scrub to Tall Shrubland of *Hakea prostrata*, *Jacksonia furcellata* and *Kunzea glabrescens* over a Low Open Shrubland over a Grassland dominated by **Briza maxima*
ErBg	Interzone 11-28	Open Woodland of *Eucalyptus rudis* and *Banksia grandis* over an Open Shrubland of *Hakea prostrata* over a Herbland of weeds


SCALE: 1cm = 68.3m
HpJsKg
Quad 1
Buildings, planted trees or native trees with an understorey of weeds
EmBa
Quad 2
Developed area
ErBg
EmBa
Quad 3
Quad 4
Tall tuarts in this area

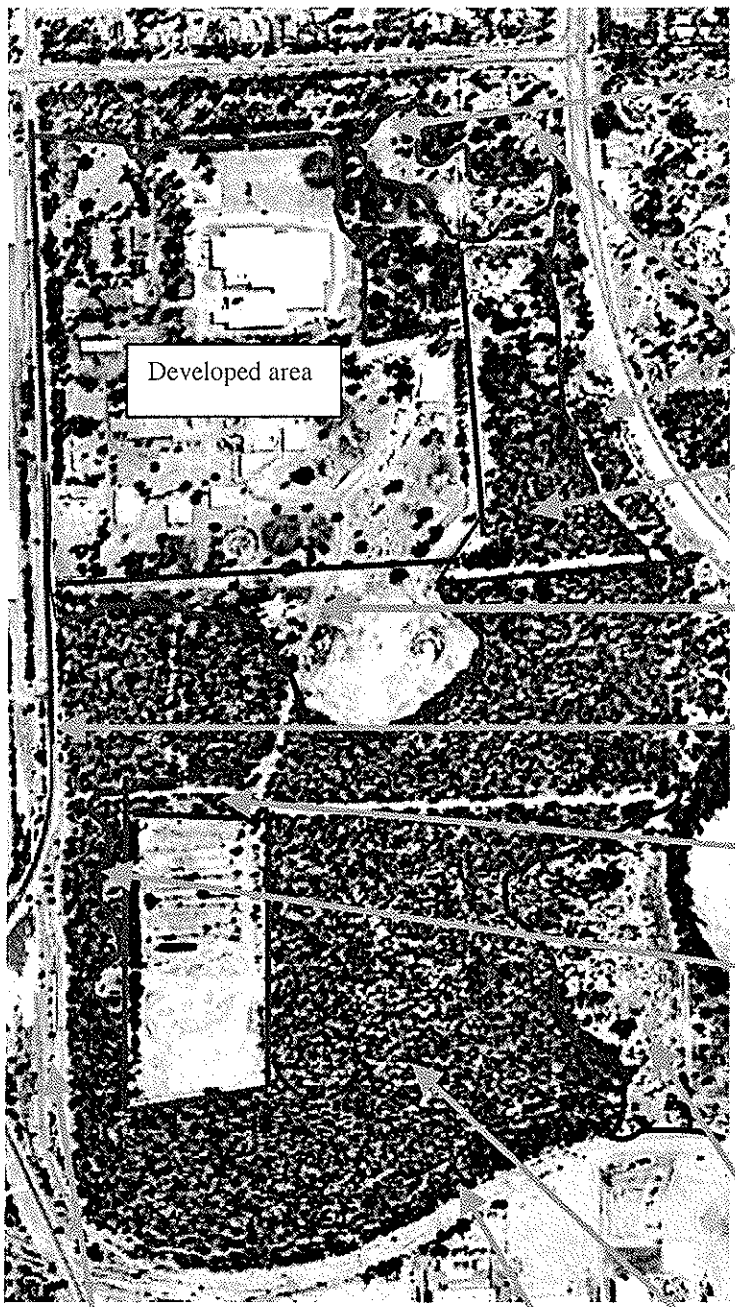
Map 2: Vegetation Condition

Vegetation condition categories

Rating	Description	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual taxa and weeds are non-aggressive taxa.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native taxa.


SCALE: 1cm = 68.3m
4-5
5-6
6
5
4
5
6
Condition 6
5
3-4
4-5
3-4
6
4-5
3
5
Condition
6
3-4
6
5
4-5
5-6

MAP 3: Weed Suites



Briza maxima 20-30%; *Ehrharta calycina* 20-30%; *Sonchus asper* 5%; *Euphorbia terracina* 5%; *Cynodon dactylon* 10-20%; *Trachyandra divaricata* 3%

Ehrharta calycina 20-60%; *Briza maxima* 20-60%; *Gladiolus caryophyllaceus* 5%; *Hypochaeris glabra* 5%

Briza maxima 90%; *Ehrharta calycina* 5-10%; *Gladiolus caryophyllaceus* 1%; *Moraea flaccida* 1%; *Hypochaeris glabra* 1%

Sonchus asper 20-30%; *Briza maxima* 20-30%; *Cynodon dactylon* 30-40%; *Avena barbata* 5%

Oxalis pes-caprae 30%; *Arctotheca calendula* 2%; *Briza maxima* 3%; *Ehrharta calycina* 2%

Hypochaeris glabra 80%; *Ehrharta calycina* 15%; *Arctotheca calendula* 5%; *Bromus diandrus* 5%; *Moraea flaccida* 5%

Ehrharta calycina 40%; *Eragrostis curvula* 40%; *Ricinus communis* 30%; *Bromus diandrus* 20%; *Ehrharta longiflora* 15%

Carpobrotus edulis 50-70%; *Ehrharta calycina* 10-20%

Euphorbia terracina 15%; *Gladiolus caryophyllaceus* 5%; *Oxalis pes-caprae* 15%; *Chamelaucium uncinatum* 5%; *Nicotiana glauca* 15%; *Lupinus consentinii* 20%

Hypochaeris glabra 200%; *Briza maxima* 15%; *Vulpia myuros* 5-10%; *Ehrharta calycina* 1%; *Gladiolus caryophyllaceus* 1%

Edge of tracks – *Ehrharta calycina* 20-40%; *Briza maxima* 30-50%; *Gladiolus caryophyllaceus* 5%; *Hypochaeris glabra* 5-10%

SCALE: 1cm = 100m

APPENDIX D

Photographic Record
and
Data Collected for Quadrats

FLORA DATA SHEETS

Project: Landcorp	Date: 1st October 2001	Surveyors: EB &JB
Location: Northern section of the area. About 50m from fenceline on west and east **Aerial Photograph:N/A**		
DATUM: Quadrat 1	Easting **50 387 998**	Northing **6448169**
Soil type: Sand :silt : clay Colour Greyish white	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves 5 % Twigs **5** %; Logs %	**Topography:** Br; R; US; MS; LS; DL; MIC; MAC **Aspect: Downward side of S sloping dune**	**Film No:** **Photo No. 3**
Percentage cover of strata (for quadrat) Trees 0 %; Shrubs >2m 70 %; Shrubs 1-2m 0 %; Shrubs <1m 2 %; Herbs 5 %; Grasses/sedges 90 %; Bare Ground 10 %		
Vegetation Description: **Dense shrubland of *Kunzea glabrescens, Jacksonia furcellata* and *Hakea prostrata***		
Condition: **Vegetation condition 4** **Lot of paper pulp nearby where condition is 6 as full of weeds.** **Rare or Priority Flora:** **Other Notes:**		

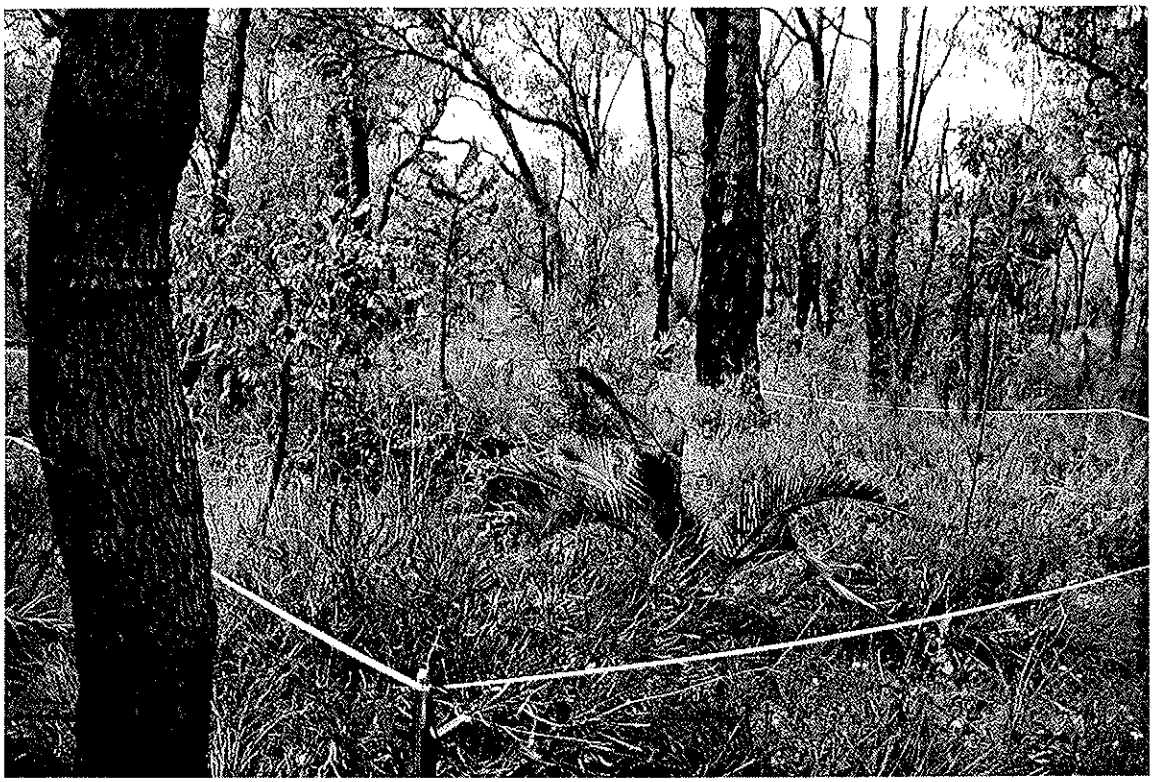
TAXA	Fl colour	Ht (cm)	%Cover
Acacia pulchella var. *pulchella*		seedling	<1
**Briza maxima*	green	45	70
**Briza minor*	green	30	2
Caladenia longicauda subsp. *calcigena*	white	30	<1
Conostylis aculeata subsp. *aculeata*	yellow	20	2
Dianella revoluta		120	3
**Ehrharta calycina*	pink	10	20
**Erodium bortys*	pink	40	15
**Gladiolus caryophyllaceus*	pink	100	1
Gompholobium tomentosum	yellow	50	1
Hakea prostrata	white	650	30
**Hypochaeris glabra*	yellow	15	70
Jacksonia furcellata		500	10
Kunzea angulata	cream	450	30
Leucopogon propinquus		35	1
Monotaxia grandiflora	white	5	<1
Patersonia occidentalis		40	1
**Pelargonium capitatum*		30	<1
Podotheca angustifolia	yellow	5	1
Quinetia urvillei	pink-green	15	<1
**Silene gallica*	white	15	<1
**Sonchus asper*	yellow	15	<1
Thysanotus manglesii	purple	T	<1
Trachymene pilosa	white	5	<1
**Ursinia anthemoides*	cream	10	<1
**Vulpia myuros*	green	10	1
**Zaluzianskya divaricata*	yellow	5	2

Quadrat 1

FLORA DATA SHEETS

Project: Landcorp	**Date:** 1st October 2001	**Surveyors:** EB &JB
Location: Northern section of the area. **Aerial Photograph:N/A**		
Quadrat 2	Easting **50 388 080**	Northing **6447903**
Soil type: Sand :silt : clay Colour Grey	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves **5** % Twigs **1** %; Logs %	**Topography:** Br; R; US; MS; LS; DL; MIC; MAC **Aspect: Downward side of S sloping dune**	**Film No:** **Photo No. 3**
Percentage cover of strata (for quadrat) Trees 10 %; Shrubs >2m 70 %; Shrubs 1-2m 80 %; Shrubs <1m 5 %; Herbs 5 %; Grasses/sedges 90 %; Bare Ground 10 %		
Vegetation Description: **Woodland of Jarrah and Marri with *Banksia attenuata* over shrubs often dominated by *Xanthorrhoea preissii***		
~~**Condition:**~~ **Vegetation condition 3** **Rare or Priority Flora:** **Other Notes:**		

TAXA	Fl colour	Ht (cm)	%Cover
Acacia saligna	yellow	200	3
Anagallis arvensis	blue	20	1
Banksia attenuata		150	1
Banksia grandis		130	1
Briza maxima	green	30	60
Burchardia umbellata	white	40	1
Caesia parviflora	white	60	1
Caladenia flava	yellow	10	<1
Conostylis aculeata subsp. *aculeata*	yellow	30	5
Corymbia calophylla		1400	5
Desmocladus flexuosus	green	30	<1
Dianella revoluta		50	1
Drosera stolonifera		15	<1
Ehrharta calycina	pink	120	20
Eryngium rostratum	white	20	<1
Eucalyptus marginata subsp. *marginata*	white	800	2
Euphorbia peplus	green	10	1
Gladiolus caryophyllaceus	pink	120	<1
Gompholobium tomentosum	yellow	50	2
Hardenbergia comptoniana	purple	T	2
Hibbertia racemosa	yellow	30	1
Hypocalymma robustum	pink	30	2
Hypochaeris glabra	yellow	5	10
Leucopogon propinquus		50	1
Macrozamia riedlei		120	3
Nemcia capitata	orange	40	1
Patersonia occidentalis		30	1
Phlebocarya ciliata		50	8
Phyllanthus calycinus	white	100	20
Pimelea rosea	pink	100	1
Scaevola canescens	white	20	<1
Sowerbaea multiflora	purple	40	1
Stirlingia latifolia	yellow	130	50
Tetraria octandra	brown	50	1
Thysanotus manglesii	purple	T	<1
Trachymene pilosa	white	5	1
Trifolium campestre	yellow	20	3
Vicia sativa	pink	t	<1
Xanthorrhoea brunonis		50	5



Quadrat 2

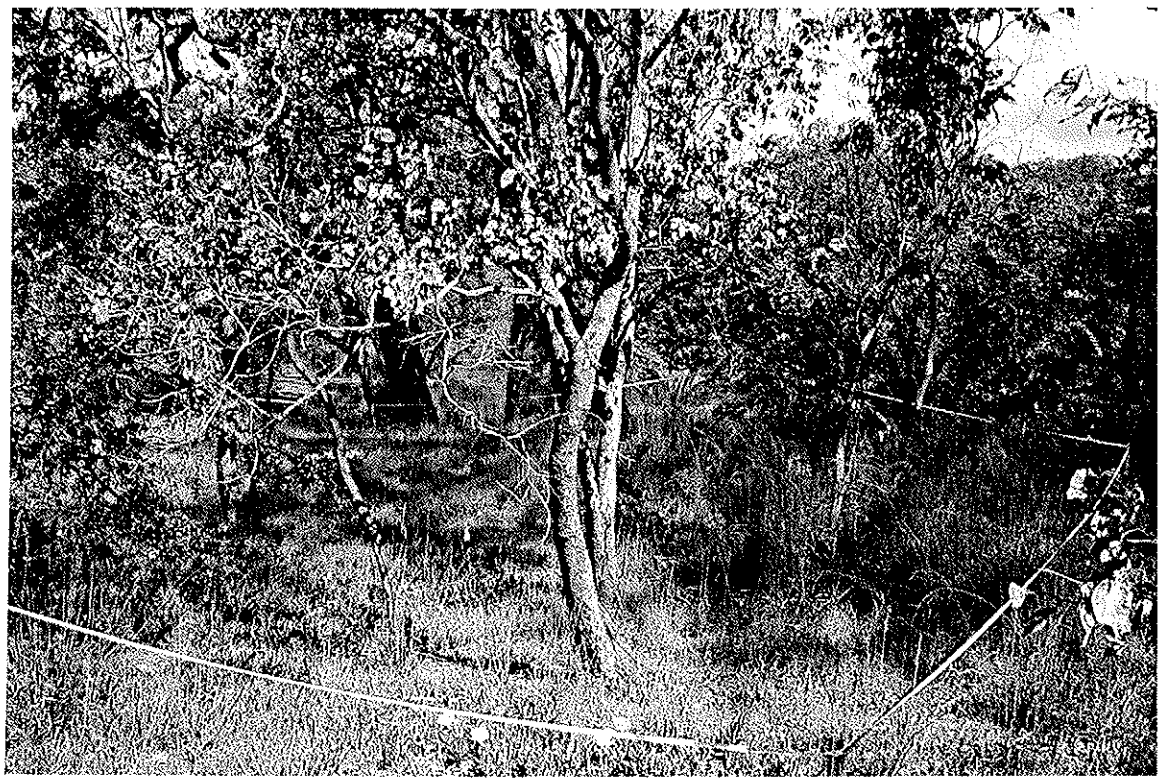
FLORA DATA SHEETS

Project: Landcorp	**Date:** 1st October 2001	**Surveyors:** EB &JB
Location: Centre of southern section **Aerial Photograph:N/A**		
DATUM: Quadrat 3	Easting **50 387946**	Northing **6447064**
Soil type: Sand :silt : clay Colour Greyish yellow	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves 5 % Twigs **5** %; Logs %	**Topography:** Br; R; US; MS; LS; DL; MIC; MAC **Aspect: SE slope from the highest point on the land**	**Film No:** **Photo No.**
Percentage cover of strata (for quadrat) Trees 50 %; Shrubs >2m 70 %; Shrubs 1-2m 0 %; Shrubs <1m 2 %; Herbs 5 %; Grasses/sedges 90 %; Bare Ground 10 %		
Vegetation Description: **Dense Woodland of jarrah with occasional marri and *Allocasuarina fraseriana* and *Banksia attenuata* over *Xanthorrhoea preissii* and *Hibbertia hypericoides*** ~~**Condition:**~~ **Vegetation condition 3** **Most of the jarrah is regrowth but many years ago.** **Rare or Priority Flora:** **Other Notes:**		

TAXA	Fl colour	Ht (cm)	%Cover
Acacia pulchella var. *pulchella*		70	1
Aira caryophyllea		15	3
Astroloma pallidum		5	<1
Austrodanthonia occidentalis		40	<1
Bossiaea eriocarpa		30	15
Briza maxima		40	20
Burchardia umbellata		50	1
Caesia parviflora		40	1
Caladenia flava		15	<1
Carpobrotus edulis		5	1
Conostylis aculeata subsp. *aculeata*		30	3
Crassula colorata		5	<1
Desmocladus flexuosus		30	1
Dianella revoluta		50	<1
Drosera macrantha		T	<1
Drosera stolonifera		15	1
Ehrharta calycina		120	1
Eryngium rostratum		70	1
Eucalyptus marginata subsp. *marginata*		1000	50
Gladiolus caryophyllaceus		120	1
Hardenbergia comptoniana		T	1
Hibbertia hypericoides		80	30
Hypochaeris glabra		5	8
Lagenifera huegelii		30	<1
Leucopogon propinquus		20	<1
Lomandra caespitosa		40	1
Luzula meridionalis		40	3
Macrozamia riedlei		130	2
Petrorhagia velutina		15	1
Pterostylis vittata		50	<1
Romulea rosea		30	<1
Sonchus oleraceus		5	<1
Sowerbaea multiflora		50	2
Stellaria media		20	2
Tetraria octandra		50	3
Thysanotus manglesii		T	<1
Trachymene pilosa		5	1
Trifolium campestre		5	2
Trifolium dubium		30	2
Urospermum picroides		5	<1
Xanthorrhoea brunonis		80	3
Xanthorrhoea preissii		150	20

Quadrat 3

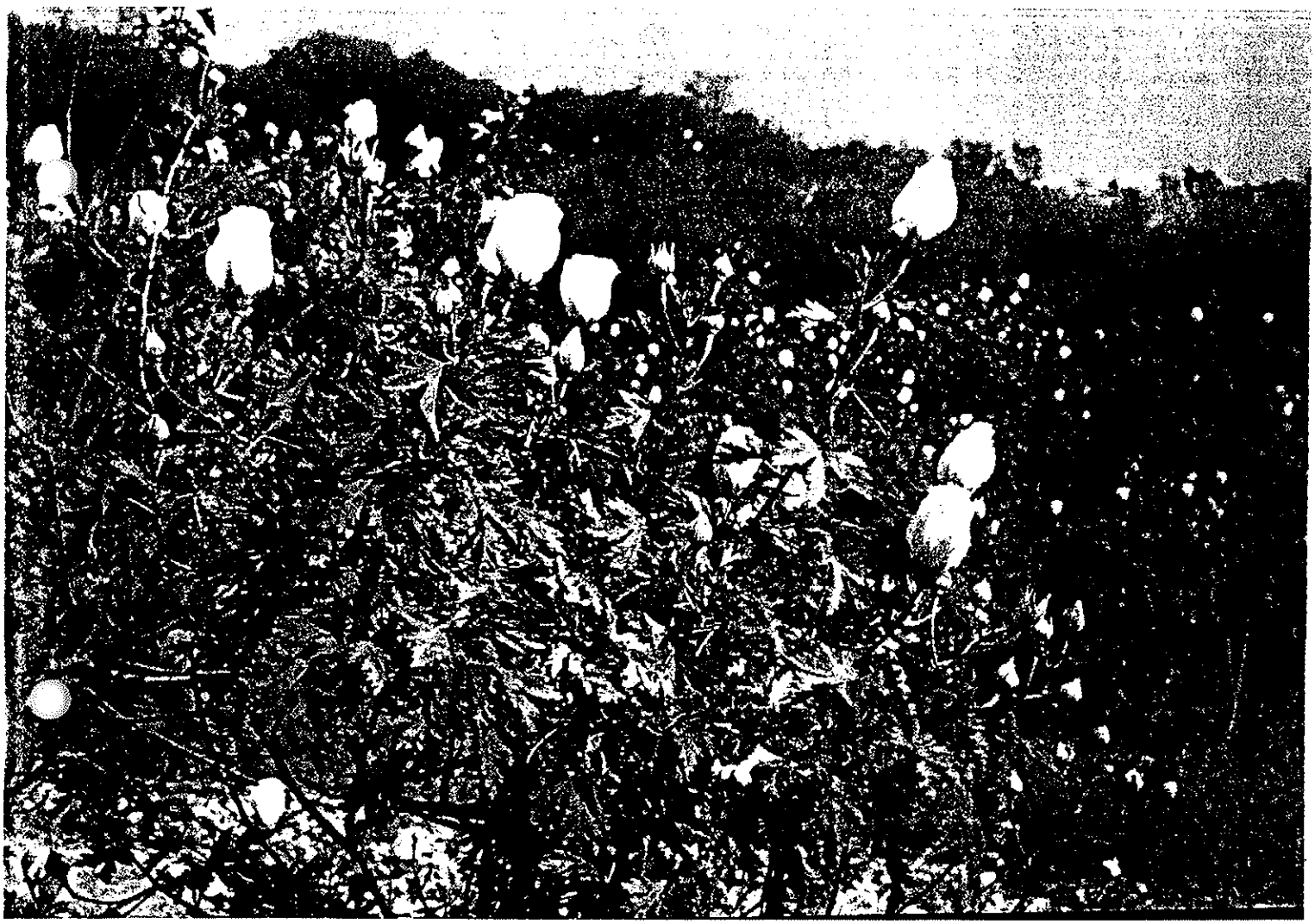
TAXA	Fl colour	Ht (cm)	%Cover
Acacia cyclops		45	<1
Anagallis arvensis	blue	20	3
Arctotheca calendula	yellow	15	<1
Avena barbata	green	30	1
Bromus diandrus	green	15	2
Carpobrotus edulis	pink/yellow	5	25
Crassula colorata	white	5	1
Crassula decumbens	white	5	1
Ehrharta calycina	pink	130	15
Ehrharta longiflora	green	20	40
Eucalyptus rudis	cream	700	10
Euphorbia peplus	green	15	5
Geranium molle	pink	20	60
Hakea prostrata	cream	400	8
Hypochaeris glabra	yellow	5	1
Olea europea		35	<1
Vicia sativa	pink	T	<1



Quadrat 4

Part Report:
Value identification
not objection
assessment section
(Contact Heritage
Commission, Melinda
Brown for complete
report) 13/5/96

Objection Assessment of the values of the vegetation and flora of the Beeliar Wetlands



Alogyne huegelii var. *glabrescens* to the west of Manning Lake

Prepared for the Australian Heritage Commission

by Bronwen Keighery, Consultant Botanist
November 1995 and February 1996

Table 2: Bushland Areas listed on the National Estate or being considered for listing.

Bushland Areas listed/interim listed on the National Estate

Bushland Area	Area (ha)	Native Flora	Flor. Com[10].	Veg. Assoc#.	Veg. Comp.[18]
Hepburn Heights/Pinnaroo	90	230*[1]	3*	19[11].	3
Trigg/Karrinyup Reserves	120	175[2]	4		2
Banksia Road Nature Reserve	33	150[3]	3		1
Marangaroo (Res 20091)	30*	130 *[4]	1		1
Neerabup National Park	1,111	242[5]	2		?2
Star Swamp	100	191[6]	3	13[11].	?2
Woodvale Nature Reserve	44	170[7]	1		1
Beeliar Wetlands	2700	406[22]	7	31[18]	4
Thompsons Lake NR	509	199[14]		15[14] 12[18]	3
Baganup Lake	254	279[15]	4	10[15]	3
Murdoch University	?	200[13]		5[13]	2
Yangebup Lake	103*	140[16]		5[16] 7[18]	2
Piney Lake	68	96[10]		6[10]	1
Booragoon Lake	13	34[12]		3[12]	1
Market Garden Lake	38	21[17]		7[17]	1

Unlisted areas subject to current nominations

Kings Park	400	290[20]	1	5[20]	1
Bold Park	221	221[21]	4		3
M91	56	86[23]	2		1

\# these are not directly compatible as they are based on variety of approaches to describing vegetation associations

* estimate of area, flora or floristic community types

1 estimate based on Keighery (1991), Tingay (1991), Foulds (1988) and AHC Listing Document

2+ G. Keighery pers. comm.

3+ G. Keighery pers. comm.

4 estimate from knowledge of the area

5+ G. Keighery pers. comm.

6 Bell *et al.* (1984)

7 Keighery and Langley (1994)

8 Gibson et al.(1994) and System 6 Update

9 Tingay (1991)

10 Rodda (1986)

11 Weston and Clay (1980)

12 Smith (1985)

13 Dell and Bennett (1986)

14 Crook and Evans (1981)

15 Clay (1986)

16 Ecoscape (1994)

17 Ecoscape (1995)

18 Newman *et al.* (1976)

19 Heddle *et al.* (1980)

20 Bennet in Kings Park Bushland Draft Management Plan (1993)

21 Keighery, Harvey and Keighery (1991)

22 Appendix Flora

23 Keighery and Keighery 1993

\+ Reserve flora lists for bushland areas on the Swan Coastal Plain are being compiled by G.J. Keighery with assistance from B.J. Keighery and N. Gibson to establish a better knowledge of the flora of these areas and to address species conservation status for the Swan Coastal Plain.

Table 3: Floristic Community Types found in the study area
Each site is located Map 1. Study site codes refer to the following areas:
Thom - Thomson Lake Nature Reserve (Gibson *et al.* 1994)
Harry - Banganup Lake and adjacent bushland, Harry Waring Marsupial Reserve or Jandakot Research Station (Gibson *et al.* 1994)
MTB - Lakes Mount Brown and Brownman Swamps and adjacent bushland (Gibson *et al.* 1994)
NAVB - M 91 (Gibson *et al.* 1994)
Beel - 1 & 2 North Lake and adjacent bushland (System 6 Update 1995)
- 3 Murdoch University

Floristic Community Type (site)	Generalised Description	Predominant Landform Type (after Churchward and McArthur 1980)
Wetland Super Group		
5 (Map 2a) Harry 3	Mixed shrub damplands Mean species richness per site: 38.4 Av.Cond: 2.1, Cons status: Low risk	Bassendean/Pinjarra
11 (Map 2a) Harry 6 Beel 3	Wet forests and woodlands Mean species richness per site: 27.2 Av.Cond: 2.7, Cons status: Low risk	Bassendean/Pinjarra
16 (Map 2a) *NAVB 1	Highly saline seasonal wetlands Mean species richness per site: 13.5 Av.Cond: 2.9, Cons status: Vulnerable	coastal and esturine
17 (Map 2a) MTB 05	*Melaleuca rhaphiophylla - Ghania trifida* seasonal wetlands Mean species richness per site: 13.6 Av.Cond: 2.3, Cons status: Low risk	Quindalup/ Spearwood
Bassendean Dune Super Group		
21a (Map 2b) Harry 05	Central *Banksia attenuata - E. marginata* woodlands Mean species richness per site: 54.6 Av.Cond: 2.5, Cons status: Low risk	Bassendean/ Spearwood
23a Map 2b) Harry 04 #Beel 02	Central *Banksia attenuata - B.menziesii* woodlands Mean species richness per site: 62.8 Av.Cond: 2, Cons status: Low risk	Bassendean
Spearwood/Quindalup Dune Super Group		
24 (Map 2b) Thom 02 MTB 1, 2, 3 & 4 *NAVB3 &4	Northern Spearwood shrublands and woodlands Mean species richness per site: 41.8 Av.Cond: 3, Cons status: Susceptible	Spearwood
28 (Map 2b) #Beel 1 Harry 1 & 2	Spearwood *Banksia attenuata* or *Banksia attenuata - Eucalyptus* woodlands Mean species richness per site: 55.2 Av.Cond: 2.5, Cons status: Low risk	Spearwood
29a (Map 2b) *NAVB 2	Coastal shrublands on shallow sands Mean species richness per site: 40.7 Av.Cond: 2.3, Cons status: Susceptible	Quindalup

Appendix 1

This list was compiled from a series of published and unpublished lists for the study area. The principle references are cited in the key to column 4. Records were also extracted from the text of Environmental Science Murdoch University (1986) and Newman et al (1980). As most of these lists date from the 1980's there was a need to update the nomenclature.

Some additions have also been made from field visits in October and November 1995 for this study.

Key

Column 1: Taxon
Taxa are listed alphabetically in family, genera and species. Nomenclature is after Gibson *et al.* (1994). A * preceding a the genus name indicate a non-native taxon, these may be naturalised taxa or planted taxa.

Column 2: Priority Code (Department of Conservation and Land Management 1995)

Column 3: Gegraphical Range/Significant Taxa
N = Populations at the northern limit of their known range
S = Populations at the southern limit of their known range
W = Populations at the western limit of their known range
Geographic Limit - Location of limits as defined above.
= Significant taxa (see Sections 3.3.1 and 3.4.1.2 for details of significance)

Column 4: Areas

P	Piney Lake Reserve (Rodda 1986)
Ba	Banganup Lake (Weston and Clay 1980)
Bo	Booragoon (Lake Smith 1985)
M	Murdoch University (Dell and Bennett 1986)
T	Thompson's Lake Nature Reserve (Crook and Evans 1981)
S	The Spectacles (Clay 1986)
Y	Yangebup Lake (Ecoscape 1994)
Ma	Manning Lake (this report)
MG	Market Garden Swamps (Ecoscape 1995)
MB	Floristic Database for Swan Coastal Plain (Gibson *et al.*1994) and System 6 Update
F	Floristic Database for Swan Coastal Plain (Gibson *et al.*1994) and System 6 Update.
91	System 6 area M91 (Keighery and Keighery 1993)

Taxon	Prio Code	Geographic Range	Recorded Areas
Aizoaceae			
*Carpobrotus aquilaterale			P, Ba, T, S
*Carpobrotus edulis			Ba, Bo, M, T, Y, F, 91
Carpobrotus virescens			91
Carpobrotus virescens X edulis			91
*Tetragonia decumbens			F, 91
Amaranthaceae			
Ptilotus drummondii			Ba, T, Y, 91
Ptilotus ?manglesii			P
Ptilotus polystachyus			M, Y
Anredaceae			
*Anredera cordifolia			MG
Anthericaceae			
Arnocrinum preissii			Ba, T, Y
Caesia micrantha			Ba, M, T
Caesia occidentalis			F
Chamaescilla corymbosa			Ba, M, T, S, F
Corynotheca micrantha			Ba, M, T, S, Y
Dichopogon capillipes			Ba, T, Y, F
Laxmannia ramosa			Ba
Laxmannia squarrosa			P, Ba, T, M, F
Sowerbaea laxiflora			P, Ba, M, T, S, Y, F
Thysanotus arenarius			Y
Thysanotus asper			M
Thysanotus manglesianus/patersonii complex			P, Ba, T, Y,F, 91
Thysanotus multiflorus			M
Thysanotus sparteus			Ba, T, Y, F
Thysanotus thyrsoideus			F
Thysanotus triandrus			Ba, M, Y, F
Tricoryne elatior			Ba, Bo, M, T, S, Y
Tricoryne tenella			F
Amaryllidaceae			
*Narcissus tazetta			
Apiaceae			
Apium annuum			F, 91
Apium prostratum			F
Centella cordifolia			Ba, Bo, M, T, S, Y
Daucus glochidiatus			F, 91

Taxon	Prio Code	Geographic Range	Recorded Areas
Eryngium pinnatifidum subsp. pinnatifidum			Ba, M, T, Y, F
*Foeniculum vulgare			T, Y, Mg, Ma, 91
Homalosciadium homalocarpum			Ba, Y, F
Hydrocotyle diantha			F
Hydrocotyle scutellifera			F
Platysace compressa			Ba, M, T, F
Trachymene pilosa			M, Y, F
Xanthosia huegelii			Ba, M, , S, Y, F
Araceae			
*Zantedeschia aethiopica			S, Y, H, MG, F
Asclepidaceae			
*Gomphocarpus fruticosus			MG
Asparagaceae			
*Myrsiphyllum asparagoides			Ma
Asphodelaceae			
*Asphodelus fistulosus			Ba, M, T, 91
*Trachyandra divaricata			91
Asteraceae			
*Arctotheca calendula			Ba, T, S, Y, 91
*Aster subulatus			Ba, T, F
Asteridea pulverulenta			Ba, Y
Brachyscome iberidifolia			Ba, M
*Carduus pycnocephalus			Ba
*Centaurea melitensis			Ba, F, 91
*Cirsium vulgare			Ba, MG, 91
*Conyza albida			F, 91
*Conyza bonariensis			Bo, F, 91
Cotula coronopifolia			Ma
*Dittrichia graveolens			MG, 91
*Helianthus annua			MG
Helichrysum cordatum			M, 91
Hyalosperma cotula			Ba, T, F, 91
*Hypochaeris glabra			Ba, Bo, S, Y, MG, F, 9
Ixiolaena viscosa	N	North Lake	Bi, N, F
*Lactuca serriola			Y, F
Lagenifera huegelii			Ba, S, Y, F
Millotia myosotidifolia			Ba, M, t
Millotia tenuifolia			F

Taxon	Prio Code	Geographic Range	Recorded Areas
Olearia axillaris			Ba, M, T, F, 91
Olearia elaeophila			Y
Pithocarpa corymbulosa			Y
Podolepis canescens			Ba, T
Podolepis gracilis			Ba, M, T, Y, F
Podotheca angustifolia			Y, F
Podotheca chrysantha			Ba, M, T, F
Podotheca gnaphalioides			P
Pseudognaphalium luteoalbum			Ba, F
Quinetia urvillei			Y, F
Senecio hispidulus			Ba, T
Senecio lautus			Ba, M, T, Y, F, 91
Siloxerus humifusus			Ba, M, F
*Solidago canadensis			MG
*Sonchus asper			Ba, M, F, 91
Sonchus hydrophilus			F, 91
*Sonchus oleraceus			F, 91
*Taraxacum officinale			MG
*Urospermum picroides			F, 91
*Ursinia anthemoides			Ba, S, Y, F
*Vellereophyton dealbatum			Ba, T, F, 91
Waitzia citrina			T, F
Waitzia suaveolens			F
Azollaceae			
Azolla filiculoides			Y, H
Brassicaceae			
*Brassica oxyrrhina			Y
*Brassica tournefortii			Ba, MG, F, 91
*Heliophila pusilla			Ba, F, 91
*Lobularia maritima			MG
*Sisymbrium orientale			MG
*Raphanus raphanistrum			BO, MG
*Rorippa naturtium-aquaticm			Ba, T
Callitrichaceae			
*Callitriche stagnalis			Ba
Campanulaceae			
*Wahlenbergia capensis			Ba, Y
Wahlenbergia preissii			Ba, F

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Cannaceae			
	*Canna generalis			MG
	*Canna ochnoides			MG
	Caryophyllaceae			
	*Arenaria serpyllifolia			F
	*Cerastium glomeratum			Ba, F
	*Minuartia hybrida			F, 91
	*Petrorhagia velutina			Ba, T, Y, 91
	*Sagina apetala			Ba, F
	*Sagina maritima			F, 91
	*Silene gallica			Ba, T, Y, F, 91
	*Stellaria media			Ba, F, 91
	Casuarinaceae			
	Allocasuarina fraseriana			P, Ba, M,, T, S, Y, F
	Allocasuarina humilis			P, Ba, M,, T, S, F, 91
	Centrolepidaceae			
	Centrolepis aristata			Ba
	Centrolepis drummondiana			Ba, T, Y, F
	Chenopodiaceae			
	Atriplex cinerea			F, 91
	Atriplex hypoleuca			Ma
	*Atriplex prostrata			T
	*Chenopodium album			MG
	*Chenopodium ambrosioides			Ba, T
	*Chenopodium murale			91
	Chenopodium pumilio	N	Balangup L	Ba
	Rhagodia baccata			F
	Rhagodia baccata subsp. baccata			91
#	Rhagodia baccata subsp. dioica			91
	Sarcocornia quinqueflora			MG, Ma, F, 91
	Suaeda australis			MG, 91
	Threlkeldia diffusa			F, 91
	Colchicaceae			
	Burchardia congesta			P, Ba, Bo, M,, T, S, Y,F
	Commelinaceae			
	Cartonema philydroides			Ba, M, T
	*Tradescantia fluminense			Bo

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Convolvulaceae			
#	Wilsonia backhousei			91
#	Wilsonia humilis			91
	Crassulaceae			
	Crassula colorata			P, Ba, Y, F, 91
	Crassula exserta			F, 91
	*Crassula glomerata			Ma, F, 91
	Crassula pedicellosa			F
	Cucurbutaceae			
	*Citrullus lanatus			MG
	*Cucumus myriocarpus			S, MG
	Cuscutaceae			
	*Cuscuta epithymum			Ba
	Cyperaceae			
	Baumea arthrophylla			Ba, T
	Baumea articulata			P, Ba, M, T, S, F
	Baumea juncea			T, Y ,F
	Baumea preissi			Ba, T
	Baumea riparia			Ba, T
	Baumea rubigenosa			Ba, T
	Bolboschoenus caldwellii			Ba, T, MG
	Carex preissii			F
*	Cyperus congestus			Ba, T, S, Y, MG
*	Cyperus eragrostis			Y
	Cyperus polystachyos			Ba, T
	*Cyperus rotundus			Bo, MG
	*Cyperus tenellus			P
	*Cyperus tenuiflora			Bo, M
#	Eleocharis sphacelata			K
#	Fimbristylis vilata			M, S
	Gahnia trifida			Ma, MG, F, MB
	Isolepis cernua			F, 91
	Isolepis marginata			Ba, T, F
	Lepidosperma angustatum			M, S, Y, F, 91
	Lepidosperma costale			Ba, T
	Lepidosperma drummondii			M
#	Lepidosperma gracile			M
	Lepidosperma longitudinale			Ba, Bo, M, T, S, F

Taxon	Prio Code	Geographic Range	Recorded Areas
Lepidosperma scabrum			Ba, T, S
Lepidosperma sp. (Coastal terete BJK & NG 231)			F
Lepidosperma tenue			M, S
Lepidosperma squamatum			Y, F
Mesomelaena pseudostygia			P,Ba, M, T, S, Y, F
Mesomelaena tetragona			P
Schoenus aff. laevigatus			F
Schoenus brevisetis			F
Schoenus brevifolius			Ba, T
Schoenus clandestinus			Ba, Y, F
Schoenus curvifolius			Ba, M, T, S, Y, F
Schoenus grandiflorus			Ba, T, S, Y, 91
Schoenus rodwayanus			F
Schoenus subflavus			Ba, T
Tetraria octandra			P, M, Y, F
Dasypogonaceae			
Acanthocarpus preissii			F, 91
Calectasia cyanea			Ba, M, T, S
Dasypogon bromeliifolius			P, Ba, M, T, S, F
Lomandra caespitosa			F
Lomandra hermaphrodita			F
Lomandra integra			M
Lomandra maritima			Ma, F, 91
Lomandra micrantha			Ba
Lomandra nigricans			Ba, T, F
Lomandra preissii			F
Lomandra suaveolens			Ba, M, F
Dennstaedtiaceae			
Pteridium esculentum			Bo, T, S, P, H, N
Dilleniaceae			
Hibbertia acerosa			91
Hibbertia huegelii			Ba, M, T, Y, F
Hibbertia hypericoides			P, Ba, M, T, S, Y, Ma F, 91
Hibbertia racemosa			P, Ba, M, T, S, Y, F, 91
Hibbertia spicata subsp. leptotheca	3	S Yalgorup	F, 91
Hibbertia stellaris			P, M
Hibbertia subvaginata			M, T, F

	Taxon	Prio Code	Geographic Range	Recorded Areas
Droseraceae				
	Drosera erythrorhiza			Ba, M, T, S, Y, F
	Drosera gigantea subsp. gigantea			P
	Drosera glanduligera			Ba, M, T
	Drosera macrantha			Ba, M, T, S, F
	Drosera menziesii subsp. penicillaris			P, Ba, M, T, F
	Drosera paleacea			Ba, M, Y, F
	Drosera pallida			Ba, M, Y, F
	Drosera stolonifera			M, Y, F
Epacridaceae				
	Acrotriche cordata			91
	Astroloma pallidum			Ba, M, T, S, Y, F
	Brachyloma preissii			Ba, M, F
	Conostephium pendulum			P, T, S, Y, F
	Conostephium preissii			Ba, M, T, Y
	Leucopogon australis			P, M, 91
	Leucopogon conostephioides			Ba, M, T, Y
	Leucopogon gracillimus			F
	Leucopogon oxycedrus			Ba
	Leucopogon parviflorus			M, Ma, F
	Leucopogon propinquus			Ba, Bo, M, T, S, Y, F
	Leucopogon racemulosus			M, F
	Lysinema ciliatum			P, Ba, M, T, S
Euphorbiaceae				
*	Euphorbia peplus			Ba, T, Y, Ma, MG, F, 91
*	Euphorbia terracina			Y, Ma, 91
	Monotaxis grandiflora			P, Ba, M
	Monotaxis occidentalis			Ba, Y
	Phyllanthus calycinus			Ba, M, T, S, Ma, F, 91
	Poranthera microphylla			Ba, F
*	Ricinus communis			Y, MG
Fagaceae				
*	Quercus suberus			P
*	Quercus sp.			S
Frankeniaceae				
	Frankenia pauciflora			91
Fumariaceae				
*	Fumaria capreolata			Ba, T

	Taxon	Prio Code	Geographic Range		Recorded Areas
*	Fumaria muralis				Ba, T
Gentianaceae					
*	Centaurium erythraea				F
*	Centaurium spicatum				Ba
Geraniaceae					
*	Erodium botrys				Ba, T
*	Erodium cicutarium				Ba, T, F, 91
*	Geranium molle				Ba, T, F, 91
*	Pelargonium capitatum				P, T, S, Ma, MG, F, 91
*	Pelargonium domesticum				Bo
	Pelargonium littorale				F
Goodeniaceae					
	Dampiera linearis				P, Ba, M, T, S, F
#	Dampiera triloba				M
	Goodenia ?pulchella				Ba, M, T
#	Lechenaultia biloba	W			M
	Lechenaultia expansa				Ba, T
	Lechenaultia floribunda				P, M, S, Y
	Lechenaultia linarioides	S	Spectacle		S
	Scaevola canescens				Ba, M, T, S, Y
	Scaevola crassifolia				91
	Scaevola globulifera				M
	Scaevola repens				M, Y
Haemodoraceae					
	Anigozanthos humilis				P, Ba, M, T, S, Y, F
	Anigozanthos manglesii				P, Ba, M, T, S, Y
	Anigozanthos viridis				T
	Conostylis aculeata				P, Ba, M, T, S, Y, F, 91
	Conostylis candicans				P, M, T, F
	Conostylis setigera				P, Ba, M, T, Y, F
	Haemodorum paniculatum				Ba, M, T, Y
	Haemodorum spicatum				Ba, Bo, T, Y
	Phlebocarya ciliata				P, Ba, M, T, S, F
	Tribonanthes ?uniflora				P
Gyrostemonaceae					
	Tersonia cyathiflora				MB
Haloragaceae					
	Glischrocaryon aureum				Ba

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Gonocarpus cordiger			Ba
	Gonocarpus pithyoides			F
	Myriophyllum crispatum			Ba
	Myriophyllum integrifolia			Ba
Iridaceae				
*	Chasmanthe floribunda			S
*	Gladiolus caryophyllaceus			P, Ba, M, T, S, Y, F, 91
*	Homeria flaccida			Ba, Y, F, 91
*	Ixia paniculata			Ba
	Patersonia occidentalis			P, Ba, M, T, S, Y, F
	Patersonia occidentalis (swamp form)			N
*	Romulea rosea			Ba, M, T, S, Y, F, 91
*	Tritonia sp.			B
Juncaceae				
*	Juncus acutus			MG, C
*	Juncus articulatus			Ba
*	Juncus bufonius			Ba
	Juncus caespiticius			Ba
	Juncus kraussii			MG, Ma
	Juncus pallidus			P, Bo, M, T, S,Y
	Luzula meridionalis			Ba, T
Juncaginaceae				
	Triglochin calcitrapum			91
	Triglochin procerum			Ba, M, T, F
Lamiaceae				
#	Hemigenia sericea			MB
	Hemiandra pungens			P, Ba, M, T
*	Stachys arvensis			Ba
Lauraceae				
	Cassytha flava			F, 91
	Cassytha glabella			M
	Cassytha pubescens			91
	Cassytha racemosa			Ba, M, T, F, 91
Lemnaceae				
	Lemna disperma			Ba
Lobeliaceae				
	Lobelia alata			F
	Lobelia tenuior			F

	Taxon	Prio Code	Geographic Range	Recorded Areas
Loganiaceae				
	Mitrasacme paradoxa			Ba
Loranthaceae				
	Nuytsia floribunda			P, Ba, Bo, M, T
Lythraceae				
*	Lythrum hyssopifolia			Ba
Malvaceae				
	Allogyne huegelii var. glabrescens	S	Manning L.	Ma
*	Lavatera plebeia		in Metro area in Yalgorup	MG, 91
	Lawrencia spicata			91
*	Malva parviflora			MG
Menyanthaceae				
	Villarsia albiflora			Ba
	Villarsia ?capitata			Ba, T
Mimosaceae				
	Acacia cochlearis			Ba, T, Y, F
	Acacia cyclops			Ba, M, T, Y, MG, 91
	Acacia huegelii			Ba, M, T, Y, MG, 91
	Acacia lasiocarpa var. lasiocarpa			F, 91
*	Acacia longifolia			Y, Bl
	Acacia pulchella			P, Ba, Bo, M, T, Y, MG, F, 91
	Acacia rostellifera			T, Ma, F, 91
	Acacia saligna			P, Ba, Bo, M, T, Y, MG, Ma, F, 91
	Acacia stenoptera			Ba, M, T, S, Y, F
	Acacia truncata			Ma, 91
	Acacia willdenowiana			P, M, T, Y
Molluginaceae				
	Macarthuria australis			Ba, T
Moraceae				
*	Ficus carica			MG, H, Ma
*	Morus nigra			MG, Ma, S
Myoporaceae				
	Eremophila glabra			F, 91
	Myoporum insulare			91
Myrtaceae				
	Agonis linearifolia			M, N, H
	Astartea aff. fascicularis			Ba, Bo, M, T, S, Y, F
	Baeckea camphorosmae			Ba, T, S

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Beaufortia elegans			M
	Calothamnus lateralis			P
	Calothamnus quadrifidus			Ma, 91
	Calytrix angulata			Ba, T, S
	Calytrix flavescens			Ba, M, T, F
	Calytrix fraseri			Ba, M, T, F
*	**Chamelaucium uncinatum**	**S**	**Bold Park**	**P, M, Ma, Y**
	Eremaea ?asterocarpa			Ba, T
	Eremaea pauciflora			Ba, M, T
	Eucalyptus calophylla			P, Ba, M, S, Y, F
*	Eucalyptus citriodora			P
	Eucalyptus decipiens			Ma, MB, 91
	Eucalyptus gomphocephala			Ba, M, T, S, Y, Ma, MG, MB, Ma, F
	Eucalyptus marginata			P, Ba, M, T, S, Y, F
	Eucalyptus rudis			P, Ba, Bo, M, T, S, Y, F
	Eucalyptus todtiana			Ba, T, Y, F
	Hypocalymma angustifolium			P, Ba, M, T, F
	Hypocalymma robustum			P,Ba, M, T, S, Y, F
	Kunzea ericifolia			Ba, M, T, S, Y, F
*	Leptospermum laevigatum			P, M, S, Y, MG
	Melaleuca acerosa			Ma, F, 91
	Melaleuca cuticularis			Co, MG
	Melaleuca huegelii			Ma, MB, 91
	Melaleuca incana			S
*	Melaleuca lanceolata			Ma
	Melaleuca lateritia			P, M, Ro, S, F
	Melaueca preissiana			Ba,Bo, M, T, S, Y, F
	Melaleuca rhaphiophylla			P, Bo, M, S, Y, Ma, MG, Co, Ma, F
	Melaleuca seriata			Ba, M
	Melaleuca teretifolia			P,Ba, Bo, M, T, S,MG, F
	Melaleuca thymoides			P,Ba, M, T, F
	Melaleuca viminea			MG
	Pericalymma ellipticum			P, Ba, M, F
	Regelia inops			M
	Scholtzia involucrata			Ba, M, T,S, F
	Verticordia drummondii			Ba, T
Oleaceae				
*	Olea europea			MG

	Taxon	Prio Code	Geographic Range	Recorded Areas
Onagraceae				
	Epilobium billardierianum			Ba, F
	Epilobium hirtigerum			Ba, F
*	Oenothera stricta			MG
Orchidaceae				
	Caladenia deformis			Ba, T, S, Y
	Caladenia denticulata			Ba, T
	Caladenia discoidea			Ba, T
	Caladenia flava			P, Ba, T, S, Y, F
	Caladenia gemmata			Ba, T
	Caladenia latifolia			Ba, T, Y, F, 91
	Caladenia longicauda			Ba, M, T
	Caladenia ?paludosa			Ba, M, T
	Diuris emarginata			Ba, T
	Diuris longifolia			P, Ba,M, T, F
	Elythranthera brunonis			P, Ba, M, T, F
	Elythranthera emarginata			M
#	Epiblema grandiflorum			Ba
	Leporella fimbriata			M
	Lyperanthus nigricans			Ba, M, Y
	Microtis media			Ba, M, T, Y, F
*	Monadenia bracteata			F, 91
	Prasophyllum fimbria			Ba
	Prasophyllum ovale			Ba, T
	Prasophyllum parvifolium			Ba
	Pterostylis aff. nana			M, T
	Pterostylis recurva			Ba
	Pterostylis scabra var. robusta			M
	Pterostylis vittata			M, S, Y
	Thelymitra benthamiana			F
	Thelymitra campanulata			Ba, M, T
	Thelymitra crinita			M
Orobanchaceae				
*	Orobanche minor			Ba, M, Y
Oxalidaceae				
*	Oxalis pes-caprae			Ba, T
*	Oxalis purpurea			Ba, T

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Papilionaceae			
	Aotus cordifolia			P, Ba, M
	Aotus gracillima			P, Ba, M, T
	Aotus procumbens			M, Y
	Bossiaea eriocarpa			P, Ba, M, , S, YTF
	?Callistachys lanceolata			P
*	Cystus prolifera			M
	Daviesia decurrens			Ba, M, T, Y
	Daviesia divaricata			P, M, Y, F
	Daviesia nudiflora			Ba, M, T, Y
	Daviesia physodes			P, BL, Ba, M, T, S
	Daviesia triflora			P, Ba, M, T, S, Y, F
	Eutaxia virgata			E, Ba, M
	Gompholobium confertum			M
	Gompholobium tomentosum			P, Ba, M, T, S, Y, F
	Hardenbergia comptoniana			P, Ba, Bo, M, T, S, Y, MG, , 91F
	Hovea pungens			P, Ba, M, T, S, F
	Hovea trisperma			Ba, M, T, S, F
	Isotropis cuneifolia			Ba, M, T, S, Y, F
	Jacksonia aff. sericea (swamp form)	eP		N
	Jacksonia furcellata			P, Ba, Bo, M, T, S, Y, 91
	Jacksonia sternbergiana			P, Ba, Bo, M, T, S, Y, F
	Kennedia coccinea			91
	Kennedia prostrata			P, Ba, Bo, M, T, S, Y, F
	Latrobea tenella			Ba, M
*	Lupinus angustissimus			Y, MG
*	Lupinus cosentinii			Ba, T, S, Y, MG
*	Medicago polymorpha			Ba, T
*	Melilotus indicus			Ba, T, MG, F, 91
	Nemcia capitata			P, Ba, M, T, S, Y, F
	Nemcia reticulata			F, 91
*	Ornithopus sativus			Ba
	Oxylobium lineare			P, M
	Pultenaea ochreata			Ba, M, T, S
	Pultenaea reticulata			P, Ba, T, S, F
	Sphaerolobium vimineum			Ba, M, F
	Templetonia retusa			Ma, MG
*	Trifolium angustifolium			Ba

Taxon	Prio Code	Geographic Range	Recorded Areas
* Trifolium arvense			MG
* Trifolium campestre			Ba, T, Y, F, 91
* Trifolium cernuum			Ba, F, 91
* Trifolium dubium			Ba, T
* Trifolium glomeratum			Ba
* Trifolium pratense			Ba, t
* Vicia hirsuta			Ba, T
* Vicia sativa			P, Ba, M, T, M, F
Viminaria juncea			Ba, M, T, S
Phytolaccaceae			
* Phytolacca octandra			91
Phormiaceae			
Dianella revoluta			P, Ba, Bo, M, T, S, Y, MG, 91
Pinaceae			
* Pinus pinaster			P, Ma
Pittosporaceae			
Pittosporum phylliraeoides			MG
Pronaya fraseri			Ba, M
Sollya heterophylla			MG
Plantaginaceae			
* Plantago lanceolata			MG
Poaceae			
* Aira caryophyllea			Ba, Y, F, 91
* Aira cupaniana			Ba
* Aira praecox			Ba
Amphipogon laguroides			Ba, M, T, F
Amphipogon turbinatus			Ba, M, T, F
* Arundo donax			Y, MG
* Avellinia michelii			F
* Avena barbata			P, Ba, T, F, 91
* Avena fatua			Y, MG, F
* Briza maxima			P, Ba, T, S, Y, F, 91
* Briza minor			P, Ba, T, S, Y, MG, F, 91
* Bromus diandrus			F, 91
* Bromus hordeaceus			F, 91
* Catapodium rigidum			91
* Cortaderia selloana			T
Cynodon dactylon			Bo, T, S, Y, MG

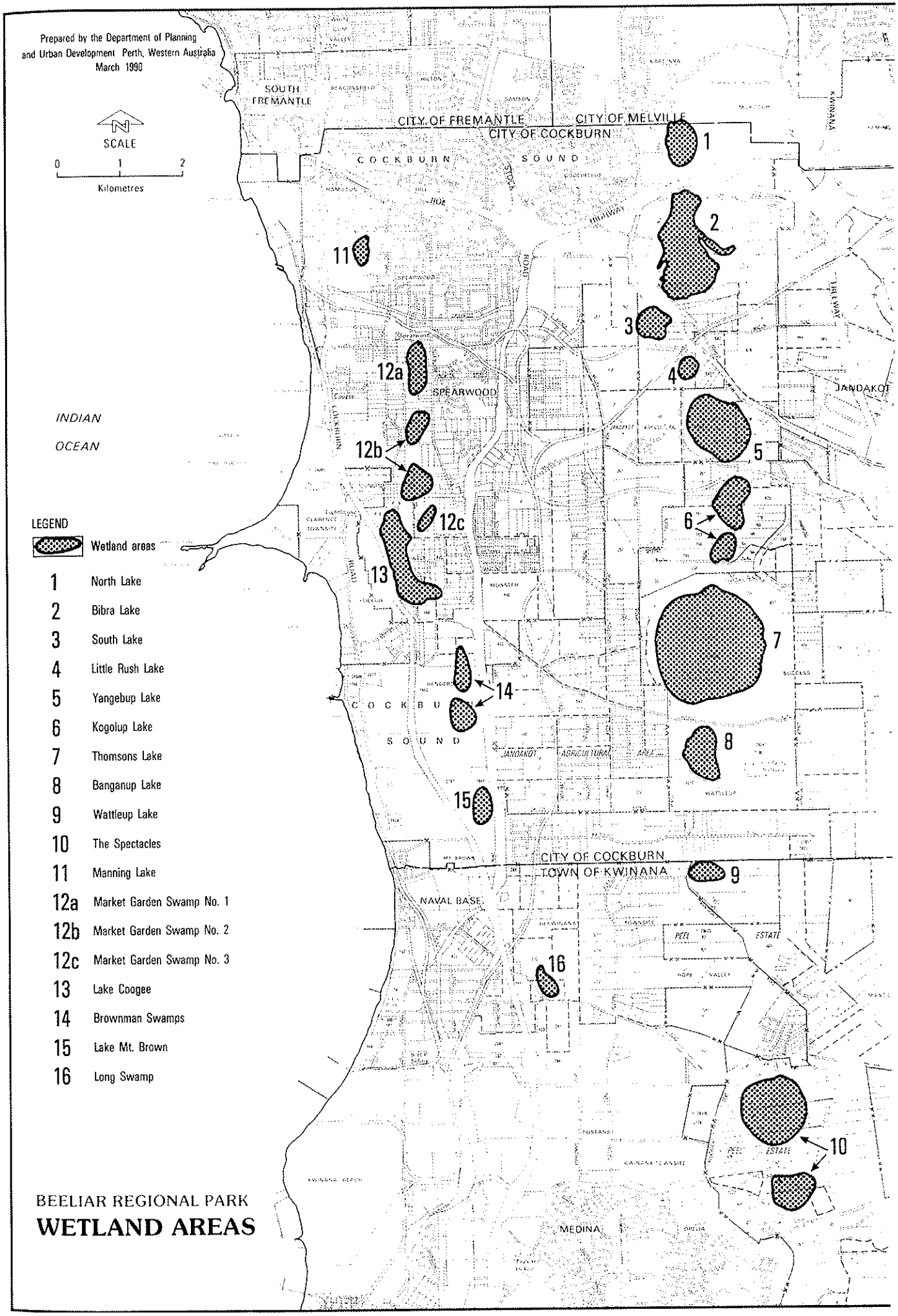
	Taxon	Prio Code	Geographic Range	Recorded Areas
	Danthonia occidentalis			Ba, T, F, 91
	Deyeuxia quadriseta			Ba, T, F
*	Diandrus gussonii			Ba, T
	Dichelachne crinita			F
*	Digitaria sanguinalis			Ba
*	Echinochloa crus-galli			MG
*	Ehrharta calycina			P, Ba, Bo, T, S, Y, MG, F, 91
*	Ehrharta longiflora			Ba, T, Y, F
	Hemarthria uncinata			Ba, T
*	Holcus setiger			F
*	Hordeum leporinum			Y
*	Lagurus ovatus			Ba, T, Y, MG, F, 91
*	Lolium multiflorum			91
*	Lolium perenne			Ba, T
*	Lolium rigidum			Y, F
	Microlaena stipoides			Ba, T, F
*	Paspalum dilatatum			MG
*	Paspalum distichum			Y, MG
*	Paspalum vaginatum			Ba, T, Y
*	Pennisetum clandestinum			Bo, S, Y, MG, Ma
*	Phalaris minor			91
*	Poa annua			F
	Poa drummondiana			Ba, T, 91
	Poa poiformis/porphyroclados			Ba, F, 91
*	Polypogon monspeliensis			Ba, T
*	Rhynchelytrum repens			Y
*	Secale cerale			MG
	Sporobolus virginicus			Y, F, 91
	Spinifex longifolius			91
*	Stenotaphrum secundatum			Ba, Bo, T, MG
	Stipa compressa			Ba, T, Y, F
	Stipa flavescens			Ba, T, Y, 91
	Stipa semibarbata			Ba, T
	Stipa variabilis			Ba, T
*	Vulpia bromoides			Ba, T, F
*	Vulpia myuros			Ba, F, 91
Polygalaceae				
	Comesperma calymega			Ba, M, T, F

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Comesperma confertum			F, 91
	Comesperma flavum			Ba
	Comesperma virgatum			Ba, M, T
Polygonaceae				
*	Emex austrlis			MG, Ma
	Muehlenbeckia polybotrya			Ba, T
*	Polygonum aviculare			MG, Ma
	Polygonum salicifolium			Bl, Bo, T
*	Rumex acetosella			Ba, T
*	Rumex crispus			Ba, T
Portulacaceae				
	Calandrinia calyptrata			F
	Calandrinia corrigioloides			Ba, T, F, 91
	Calandrinia granulifera			Ba
	Calandrinia liniflora			Y
	Portulaca oleracea			MG
Primulaceae				
*	Anagallis arvensis			P, Ba, M, T, S
	Samolus junceus			F, 91
	Samolus repens			F, 91
Proteaceae				
	Adenanthos cygnorum			P, Ba, M, T, S
	Adenanthos obovatus			S
	Banksia attenuata			P, Ba, Bo, M, T, S, Y, F, 91
	Banksia grandis			Ba, M, T, Y
	Banksia ilicifolia			P, Ba, Bo, M, T, Y, F
	Banksia littoralis			P, Ba, Bo, M, T, F
	Banksia menziesii			P, Ba, Bo, M, T, S, Y, F, 91
	Conospermum stoechadis			Ba
	Conospermum triplinervium			Ba, T
	Dryandra nivea			Ba, T, S, Y, Ma, F, 91
	Dryandra sessilis			M, T, Y, Ma, F, 91
	Grevillea preissii			Ma, F, 91
	Grevillea vestita			Ba, Y, 91
	Hakea lissocarpha			Ba, S, 91
	Hakea prostrata			Ba, M, T, Y, Ma, F, 91
	Persoonia saccata			P, Ba, T, S, Y
	Petrophile brevifolia			Y

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Petrophile linearis			P, Ba, M, T, S, Y, F
	Petrophile serruriae			F,91
	Stirlingia latifolia			P, Ba, M, T, S, Y, F
	Synaphea spinulosa			P, Ba, M, T, S, Y
	Xylomelum occidentale			Ba, M
Ranunculaceae				
	Clematis pubescens			Ba, M, T, Ma
*	Ranunculus muricatus			Ba, M, T
Restionaceae				
	Alexgeorgea nitens			Y
#	Empodisma gracillimum			M
	Hypolaena exsulca			Ba, M, T, F
	Leptocarpus aristatus			P, M, Y
	Leptocarpus coangustatus			F
	Leptocarpus scariosus			Ba
	Lepyrodia muirii			Ba, T
	Loxocarya flexuosa			M, S, Y F, 91
	Loxocarya pubescens			Ba, T, S
	Lyginia barbata			P, M, T, S, Y
	Restio stenostachyus			Ba, T
Rhamnaceae				
	Cryptandra mutila			F, 91
	Spyridium globulosum			Ma, 91
Rubiaceae				
*	Galium aparine			F, 91
*	Galium murale			F
	Opercularia hispidula			Ba, F
	Opercularia vaginata			Ba, M, S, Y, F, Ma
Rutaceae				
	Boronia crenulata			Ba, M, T, F
	Boronia ramosa			M
	Eriostemon spicatus			P, Ba, M, T, S, Y, F
Salicaceae				
*	Salix babylonica			Bl, Bo, MG
Santalaceae				
	Dodonaea aptera			Y
	Dodonaea hackettiana	4	eW	Ba, T, S
	Exocarpos sparteus			Ba, Bo, M, T, S

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Leptomeria cunninghamii			F
	Leptomeria empetriformis			Ba, T
	Leptomeria spinosa			Ba
	Santalum acuminatum			Ba, 91
Scrophulariaceae				
*	Bellardia trixago			Ba, F
*	Cymbalaria muralis			Ba
*	Dischisma arenarium			Ba, F
	Gratiola peruviana			Ba
*	Parentucellia latifolia			Ba
*	Parentucellia viscosa			Ba, M, F, 91
*	Verbascum virgatum			M, T, 91
*	Veronica arvensis			F
Solanaceae				
*	Nicotiana glauca			Y, MG, 91
*	Solanum nigrum			Ba, T, S, MG, 91
	Solanum symonii			Y, MG, 91
Stackhousiaceae				
	Stackhousia monogyna			P, Ba, MG
Sterculiaceae				
	Thomasia cognata			F, 91
Stylidiaceae				
	Levenhookia pusilla			F
	Levenhookia stipitata			Ba, M, F
	Stylidium brunonianum			P, Ba, M, T, Y
	Stylidium bulbiferum			F, 91
	Stylidium calcaratum			Ba, M
	Stylidium junceum			P, Ba, T
	Stylidium piliferum			Ba, M, T, S, F
	Stylidium repens			Ba, M, T, F
	Stylidium schoenoides			Ba, M, T, Y, F
Thymelaeaceae				
	Pimelea angustifolia			Ba, M , T
	Pimelea calcicola			Ma, F, 91
	Pimelea rosea			P, Bo, M, T, S, Y, F
	Pimelea sulphurea			M, Y, F
Tropaeolaceae				
*	Tropaeolum majus			Y

Taxon	Prio Code	Geographic Range	Recorded Areas
Tremandraceae			
Platytheca galioides			Ba, M, T
Typhaceae			
Typha domingensis			Ba, T, S
* Typha orientalis			Y, MG
Urticaceae			
Parietaria debilis			91
Verbenaceae			
* Lantana camera			Y
Violaceae			
Hybanthus calycinus			P, Ba, M, T, S, Y, F, 91
Vitaceae			
* Vitus vinifera			MG
Xanthorrhoeaceae			
Xanthorrhoea brunonis			S
Xanthorrhoea preissii			P, Ba, Bo, M, T, S,Ma, MG, F
Zamiaceae			
Macrozamia riedlei			Ba, Bo, M, S, Y, F, 91
Zygophyllaceae			
Zygophyllum fruticulosum	S	Port Kennedy	91
* Tribulus terrestis			MG


Prepared by the Department of Planning
and Urban Development Perth, Western Australia
March 1990
SCALE
0 1 2
Kilometres
SOUTH FREMANTLE
CITY OF FREMANTLE
CITY OF MELVILLE
CITY OF COCKBURN
COCKBURN SOUND
SPEARWOOD
JANDAKOT
INDIAN
OCEAN
CITY OF COCKBURN
TOWN OF KWINANA
NAVAL BASE
MEDINA
LEGEND
Wetland areas
1 North Lake
2 Bibra Lake
3 South Lake
4 Little Rush Lake
5 Yangebup Lake
6 Kogolup Lake
7 Thomsons Lake
8 Banganup Lake
9 Wattleup Lake
10 The Spectacles
11 Manning Lake
12a Market Garden Swamp No. 1
12b Market Garden Swamp No. 2
12c Market Garden Swamp No. 3
13 Lake Coogee
14 Brownman Swamps
15 Lake Mt. Brown
16 Long Swamp
BEELIAR REGIONAL PARK
WETLAND AREAS

Mar

BS 254

30 APR 1999
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Jdl.

Submission
Prepared by the
Housing Industry Association

PERTH'S BUSHPLAN

April 1999

SUBMISSION NO 1895

Table of Contents

Executive Summary

The Housing Industry Association congratulates the Western Australian State Government on the considerable skill with which *Perth's Bushplan* report synthesises an array of environmental and scientific studies into a coherent collection of regional bushland sites.

HIA has significant concerns which it seeks to have addressed prior to final reporting on Perth's Bushplan. Whilst holding reservations with the current propsals, the aims of creating a biodiverse environment for the Perth Metropolitan Region are generally favourably considered.

HIA's submission is primarily concerned with the impacts on our members of implementation of *Perth's Bushplan.* From HIA's perspective, the impacts of *Perth's Bushplan* report relate to:

- Maintenance of an adequate supply of land for urban expansion within the Perth Metropolitan Region
- Uncertainty as to full extent of bushland and wetland conservation areas (including Case Study – City of Cockburn Subdivison Surplus Amcor Land)
- Impact of *Perth's Bushplan* on housing affordability
- Lack of sufficient information regarding implementation mechanisms
- Impact of *Perth's Bushplan* report recommendations on HIA members

Summary of HIA Recommendations:

Throughout this submission, HIA has made a number of recommendations. These are:

That the State Government demonstrate how Perth's population growth will be accomodated, given the land required to meet all of its bushland and wetland conservation proposals.

Prior to a committment to implementing the report, State Government should:

- Consolidate all land conservation requirements for the Perth Metropolitan Region;
- Publish details of these requirements for the Region iin a single document; and
- Assess the requirements and the on-going costs of acquisition and maintenance costs of 'conservation' areas against other values held by Government/community such as housing affordibility, transport costs, etc.

In the interests of the community being kept adequately informed as to the cost and processes of *Perth's Bushplan*, summaries of negotiations over sites made under the Memorandum of Understanding should be made public periodically *(Report Recommendation 4).*

The proposed review of *Perth's Bushplan* should occur every two years with the inclusion of the key stakeholders including housing industry in the review process *(Report Recommendation 5.14).*

SUBMISSION - PERTH'S BUSHPLAN

1. Introduction

HIA welcomes the opportunity to provide a submission in respect of *Perth's Bushplan* report.

HIA is the national peak residential, building and development industry association, with 30,000 members comprising all active areas of the building and development industry. In particular: -

- Large building comapnies in high density development in the capital cities;
- Builder-developers in multi-lot volume and individual residential developments;
- Large, medium and small builders of custom-designed and project homes;
- Smaller builders relying on renovations and additions work;
- Trade contractors across all sectors of building;
- Building material manufacturers and suppliers;
- Legal, architecture, town planning, building and urban design, and other related professions supporting development and building procedures;
- Financial/banking organisations, including forecasting services;
- State and local government representatives.

HIA's **mission** is to promote policies and provide services that enhance members business practices, products and profitability consistent with the highest standards of professional and commercial conduct.

HIA **policy** is formulated through established member service committees at national and state level. This approach is consistent with the move towards a borderless regulatory framework and facilitates a national approach to policy coordination.

HIA provides a **broad range of services** to its members, across areas such as :

- Planning and Development
- Technical Services
- Training and Professional Development
- Industrial Relations/OH&S and Legal Services
- Research and Policy and Export Facilitation.

HIA's submission is primarily concerned with the impacts on our members of implementation of *Perth's Bushplan*. From HIA's perspective, the impacts of *Perth's Bushplan* report relate to:

2. Availibility of adequate land for housing

The impact of proposed reservations, complementary mechanisms and negotiated planning solutions for "off reserve" protection will reduce the availablility of land to meet Perth's future housing needs and limit choice in housing location.

Perth's Bushplan report estimates that of the 19,000 ha of unprotected Bushland Sites, 6,700 is zoned Rural. Of the remaining zoned Urban, Urban Deferred or Industry, approximately a half is privately owned. The loss of the Urban and Urban Deferred Zoned land is of concern to HIA as it will place pressure to spread out new housing areas and add to servicing costs. Whilst consolidating existing urban areas remains an option, State and local Governments have been slow to introduce the necessary supporting framework and policies to pursue this alternative.

In order to accommodate its concerns, **HIA recommends**:
That the State Government demonstrate how Perth's population growth will be accomodated, given the land required to meet all of its bushland and wetland conservation proposals.

3. Uncertainty surrounding the full requiremnts for conservation areas

The full extent of conservation requirements are unclear and environmental initiatives incorporated in *Perth's Bushplan* go beyond the land requirements for conservation of 10% of each of the 26 vegetation complexes.

The report includes recommendations regarding future proposals to set aside land for;

- Wetland conservation areas;

- Other wetlands;
- Regionally significant bushland in the east of the Perth Metropolitan Region; and
- Locally significant bushland sites (Report Recommendations 4, 5.12, 5.13, *Perth's Bushplan* Volume 1 pp xvi and xviii).

However, the location, methods of implentation, development controls and costs or value to the community have not been identified in the report.

For example, Section 2.3 of the report refers to "the importance of looking at the regions's bushland as an integrated system", the high priority given to linkage corridors and the Government's commitment to "the improved conservation of Metropolitan Perth's wetlands through a separate wetland protection statement" (*Perth's Bushplan* Volume 1, p 26). Section 1 of the report refers to the Government's commitment to "fulfilling its undertakings under the *Urban Bushland Strategy* to provide support to local governments and communities in preparing local bushland and greenway strategies....and will be the subject of separate reports." (*Perth's Bushplan* Volume 1, pp1-2).

The full impact of additional conservation areas cannot be gauged at this stage. HIA has major concerns:

- That the extent of additional conservation requirements have not been made public; and
- With the cumulative impact of alienating additional land to the Regionally Significant Sites identified in *Perth's Bushplan* report from residential development.

Authoritative consolidated information regarding the full extent of conservation sites is sought and **HIA recommends** prior to the State Government committment to implementing the report, it should:

- Consolidate all land 'conservation' requirements for the Perth Metropolitan Region;
- Publish details of these requirements for the Region; and
- Assess the requirements and the on-going costs of acquisition and maintenance costs of all the conservation areas against other values held by Government/community such as housing affordibility, transport costs, etc.

Case Study City of Cockburn – Subdivision Development of Surplus Amcor Land

An illustration of HIA's concerns with the lack of certainty surrounding *Perth's Bushplan* at the local level is provided by a recent subdivision proposal to develop an industrial-zoned site in the City of Cockburn (refer to Appendix 1 to this submission). The 89 ha site, on the corner of Phoenix Road and North Lake Road, was not identified in *Perth's Bushplan* as having regional signficance. However, Council officers in their report to Council on the subdivision have since sought to add a portion of the site to *Perth's Bushplan* and to reserve it for Parks and Recreation. The uncertainty is delayng development of the site.

4. *Perth's Bushplan* proposal and housing affordability

The adoption of Bushplan Sites will impede the orderly 'frontal' nature of urban expansion and add to infrastructure servicing costs of new development.

Perth's Bushplan report refers to additional bushland and wetlands conservation areas in the Metropolitan Region. When added to Bushplan sites, the total area constrained from urban development could add to the cost of providing transport and utilities to new housing areas.

The extent of *Perth's Bushplan,* related wetland conservation sites and locally significant bushland sites impact on the availability of raw materials used in building construction processes. A number of the Bushplan sites are located on sites used to supply basic raw materials to the Perth housing market. If quarrying is prevented, transort costs could raise the cost of housing in the Perth Metropolitan Region.

5. Implementation mechanisms

Perth's Bushplan proposals have far-reaching impacts for land use planning and urban development in the Perth Metropolitan Region as indicated by the report Recommendations 5.1, 5.2 and 5.15 (*Perth's Bushplan* Volume 1, pp xvi-xviii). HIA

has concerns that there is insufficient information provided on implementation mechanisms, priorities and timetabling.

Of the reservation mechanisms proposed, HIA questions both the WAPC's capacity to acquire and maintain the Bushplan Sites through the Metropolitan Region Improvement Fund, and the sufficiency of the budget indicated for protection of areas recommended in *Perth's Bushplan.* The Report states that an additional $70 million to $100 million from the MRIF over the next 10 years would be required (*Perth's Bushplan*, Volume 1, p 33) with adequate maintenance ossibly doubling the costs. The funding, whilst possibly sufficient to reserve some land, will not allow for proper maintenance of the reserved land, nor will it match the WAPC acquisition program over the last 7 years. If the Government's funding commitment falls short of its goal, either *Perth's Bushplan* will fail to be fully implemented or undue reliance will be placed on complimentary mechanisms for "off-reserve" protection.

6. *Perth's Bushplan* report recommendations

In relation to the report recommendations, HIA raises the following issues

General Comment on the Recommendations (*Perth's Bushplan* Volume 1, ppxv to xviii);

The Ministerial Reference Group's Terms of Reference relate, if not overlap, with several of the report recommendations. Accordingly, HIA seeks clarity as to the weight which may be given by the State Government for the Reference Group's findings when it presents its findings on implementing the report recommendations.

HIA questions why Bushplan Sites should be over and above the usual 10% public open space requirements for subdivisions. The need for and cost of maintaining the additional requirement is questioned given that it may be possible to substitute the 10% contribution with Bushland Sites and there are a variety of recreation pursuits that are compatible with conservation protection. The 10% POS contribution is a standard which should be reviewed to ease the State and local Government maintenance burden of open space management.

Recommendations 1 and 3;

Supported.

Recommendation 4;

In the interests of the community being informed as to the cost and processes of *Perth's Bushplan*, HIA recommends that summaries of negotiations over sites made under the Memorandum of Understanding should be made public.

The Memorandum Of Understanding should incorporate the views of the public and industry as provided through submissions on *Perth's Bushplan*. The coordinating structure should also seek periodic participation from the public to assist in a broad acceptance of *Perth's Bushplan* implentation mechanisms and operations (Note: HIA does not believe that its views are accomodated in Recommendation 5.15).

Further information on the Memorandum of Understanding and Statement of Planning Policy should be supplied, for instance the report refers to complementary implementation mechanisms such as "Applying various incentives such as taxation rebates, grants..." (*Perth's Bushplan* Volume I, p 32) although does not detail these.

A timeframe for development of the MOU is requested, together with details of the responsible Minister/s, an indication as to how will priorities be determined and the transparency of the processes. HIA suggests that the MOU provide the coordinator with the power or authority to negotiate as well as the ability to do so.

Recommendation 5;

A timeframe needs to be placed on the "periodic review"of Perth's Bushplan proposed to provide certainty to industry. It is recommended that the review should occur every two years (Recommendation 5.14).

Appendix 1

City of Cockburn Subdivison Application:

1 Letter to Jones Lang Wootton from Council regarding the site.
(Refer particularly to pp 13 and 14 of letter/council report)

2 Plan of site

3 Aerial Photograh of site.

City of Cockburn

Direct Indial: Allen Blood (Ph: 94113598)
Ref: 1101294 (CDC2/99 - 8.1)
Your Ref:

PO Box 1215, Bibra Lake,
Western Australia 6965

Cnr Rockingham Road and
Coleville Crescent, Spearwood,
Western Australia 6163

Telephone (08) 9411 3444
Facsimile (08) 9411 3416

23 February 1999

Jones Lang Wootton
Level 3
225 St George's Terrace
PERTH WA 6000

ATTENTION: MR RICHARD F PARRY

SUBDIVISION - DEVELOPMENT OF SURPLUS AMCOR LAND

Council at its meeting held on Tuesday 16 February 1999, considered the future subdivision and development potential of the Amcor land recently offered for sale and resolved as follows:-

"(1) endorse the following principles for the subdivision and development of the Amcor land:

1. Retention of upland vegetation around South Lake to maintain its visual and ecological integrity.

2. Retention of mature trees in a landscape strip along North Lake Road and Phoenix Road frontages.

3. Provision of a road system linking North Lake Road with Spearwood Avenue, Sudlow Road and potentially Cocos Drive to the south.

4. No direct lot frontage will be permitted to North Lake or Phoenix Roads.

5. The potential for road access to Phoenix Road needs to be carefully examined before any approval is granted.

6. A service road is to be provided along a portion of the disused railway reserve along the southern boundary of the land.

7. Lots are not to back onto South Lake reserve or Phoenix/North Lake Road.

8. An estate development plan and development guidelines are required.

SUBMISSION NO
Belongs to 1895

9. The discharge of drainage into South Lake or its buffer area will not be permitted and the development will need to be implemented in a manner which will not adversely impact on the water quality or hydrology of the lake.

10. Subdivision requirements will include underground power and high quality estate perimeter fencing.

11. Subdivision of the land into superlots will not be supported except to enable the excision of the lot for the Amcor factory from the balance of the site.

(2) provide a copy of the Agenda report to Amcor, their agent and prospective purchasers of the land;

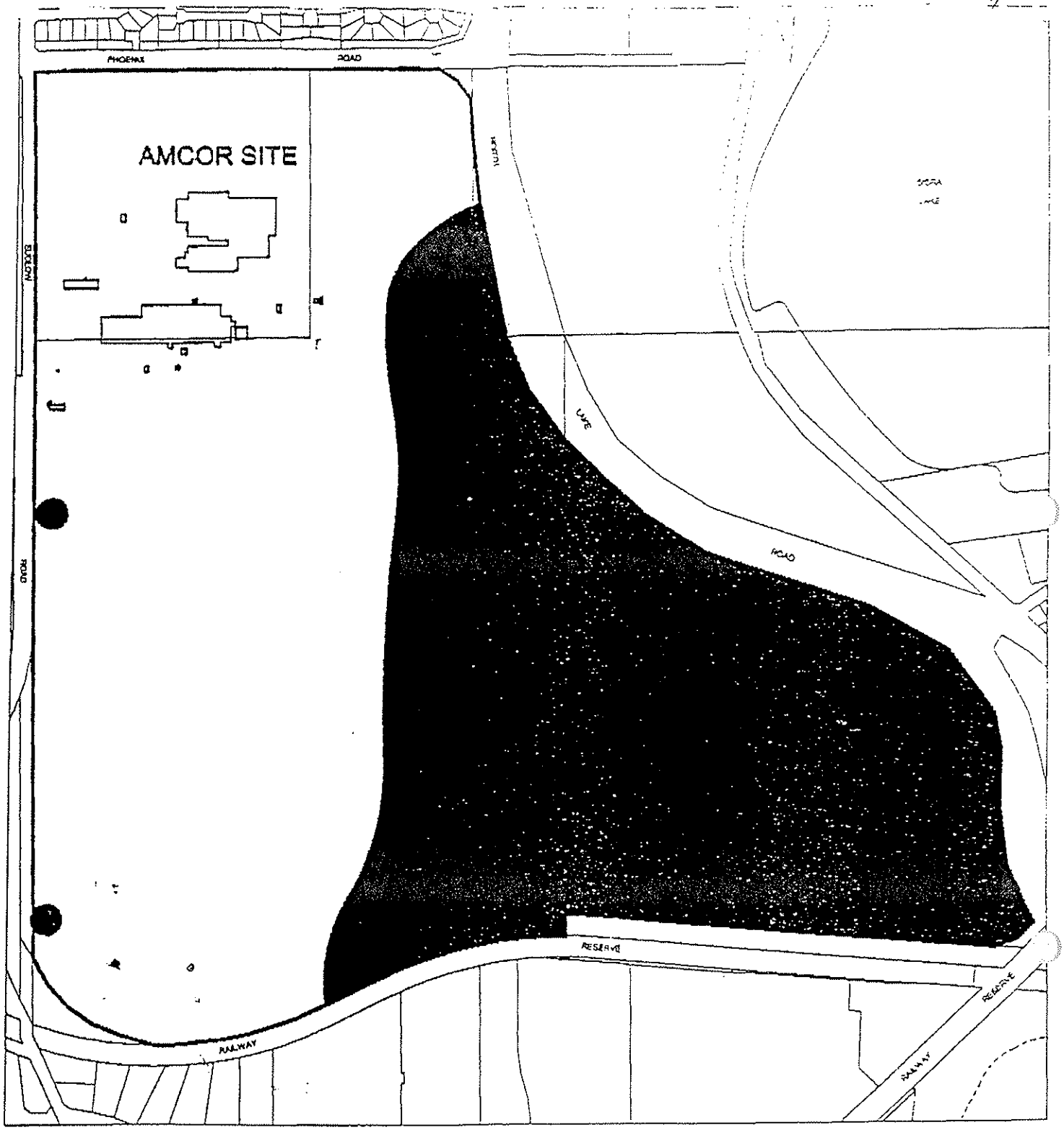
(3) review the principles following advice from the Ministry for Planning regarding the request for the inclusion of part of the land around South Lake in Bush Plan."

Several of the parties interested in purchasing the land liaised closely with Council prior to close of the tender period and would be aware of these requirements. Notwithstanding this, and in the event that the successful tenderer has not previously contacted Council, it would be appreciated if you would provide to them a copy of Council's determination.

Should you wish to discuss any of the matters outlined in Council's determination, please do not hesitate to call Allen Blood on 94113598 or Mr Darren Walsh on 94113441 if it relates to environmental issues.

Allen Blood
STRATEGIC PLANNER

AB:NW



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SCALE

PROPOSAL FOR EXTENSION OF SOUTH LAKE RESERVE

CDC 9/2/99

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5. The potential for road access to Phoenix Road needs to be carefully examined before any approval is granted.

6. A service road is to be provided along a portion of the disused railway reserve along the southern boundary of the land.

7. Lots are not to back onto South Lake reserve or Phoenix/North Lake Road.

8. An estate development plan and development guidelines are required.

9. The discharge of drainage into South Lake or its buffer area will not be permitted and the development will need to be implemented in a manner which will not adversely impact on the water quality or hydrology of the lake.

10. Subdivision requirements will include underground power and high quality estate perimeter fencing.

11. Subdivision of the land into superlots will not be supported **except to enable the excision of the lot for the Amcor factory from the balance of the site.**

(2) provide a copy of the Agenda report to Amcor, their agent and prospective purchasers of the land;

(3) review the principles following advice from the Ministry for Planning regarding the request for the inclusion of part of the land around South Lake in Bush Plan.

CARRIED

Background

ZONING:	MRS:	General Industry
	DZS:	General Industry
LAND USE	Relevant portion of the site is vacant	

The subject land is vacant industrial land and is surplus to the requirements of Amcor. The land has been offered for sale in two parcels comprising approx 77 ha south of the existing paper mill and 12.3 ha at the corner of Phoenix Road and North Lake Road.

While the likely use of the land is based around an industrial subdivision, the size and location of the site provide potential for

alternative uses. One possible use which has been promoted by the Director, Planning and Development is the development of zoological gardens or other tourism based activities

Submission

N/A

Report

In response to the advertising of the subject land for sale there have been a number of inquires regarding Councils requirements for the land.

In view of the importance of this land and the issues relating to its subdivision/development, it is considered appropriate that Council should determine a formal position on development principles that should be incorporated into the subdivision of the land at this time in anticipation of receiving detailed plans from the successful tenderer in due course. A plan showing the area of land that is for sale was included in the Agenda attachments.

The recommended development principles are as follows:

Retention of upland vegetation around South Lake to maintain its visual and ecological integrity

The southern parcel is adjacent to and forms the western and northern back drop to South Lake. The land contains good quality bushland which provides a strong ecological link to South Lake and a vegetated buffer to the wetland.

The land has not been identified for retention in the recently released Bush Plan report despite the fact that previous System 6 report identified the need for improved buffers around the lake. The Manager of Environmental Services has sought urgent advice from the Ministry for Planning as to whether or not a portion of the land around South Lake can be added to Bush Plan and subsequently reserved for Parks and Recreation. The suggested area for inclusion in Bush Plan is that land east of the ridge line that encircles the lake. The extent of the area was shown on a plan included in the Agenda attachments. The reservation of the relevant portion of the land around South Lake as Parks and Recreation is the preferred outcome.

In the event that this request is not supported by the Ministry for Planning, it will be necessary to achieve a satisfactory outcome through the subdivision process. A somewhat reduced buffer may be able to be achieved using in part DEP buffer

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requirements for EPP wetlands (50m) and POS. This would achieve a belt of trees of approximately 30 metres between RL 24 and 26 around the margins of the lake. If land west of the belt of trees was earth worked resulting in the industrial land being lower than RL 26 the impact of the industrial development on the natural setting would be reduced.

Retention of mature trees in a landscape strip along North Lake Road and Phoenix Road frontages.

Retention of mature trees along the major road frontage will help retain the existing high visual quality of the area as has been achieved on the north side of Phoenix Road as part of the St. Pauls Estate. The width of the landscape strip would need to be determined as part of the detailed site analysis.

Provision of a road system linking North Lake Road with Spearwood Avenue, Sudlow Road and potentially Cocos Drive to the south.

The road system should provide for access to North Lake Road with linkages to Spearwood Avenue, Sudlow Road and Cocos Drive (if possible and practicable) to provide adequate access and circulation within the development as well as increased accessibility for the balance of the Bibra Lake Industrial area.

Given the juxtaposition of Bibra Drive and the proposed entry off North Lake Road into the subject land it is considered that additional industrial traffic will not be encouraged through Bibra Lake as would have occurred with the previously proposed extension of Cocos Drive to North Lake Road.

No direct lot frontage permitted to North Lake or Phoenix roads.

The internal road system should provide the required access.

The potential for road access to Phoenix Road to be carefully examined

Part of the land that is for sale is a narrow strip at the corner of North Lake and Phoenix Roads. Accordingly any road access to Phoenix Road will be within 130 metres of the North Lake Road intersection and would require a traffic impact assessment before access could be approved.

In the event that the 2 parcels are sold off individually there will be a need to ensure that the subdivision of the southern parcel includes a road link to the corner parcel so that the corner land

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is not reliant on access from Phoenix Road which may be restricted to left in/ left out if approved at all.

A service road is to be provided along a portion of the disused railway reserve along the southern boundary of the land.

The disused railway is to be developed by Council as part of the east west trail/cycleway system that links the coast to the eastern wetland chain. A service road should be provided along a portion of the lands frontage to the railway reserve to provide a safe exit for users in the case of an emergency.

Lots not to back onto South Lake reserve or Phoenix/North Lake Road.

For visual and maintenance reasons lots should not back or side onto Phoenix/North Lake Roads or the South Lake reserve.

An estate development plan and development guidelines are required.

To ensure a high quality estate the developers should prepare the following for Council adoption:

- Estate development plan locating higher order uses such as showrooms, warehouse, office uses etc along the main roads with general and light uses occupying the internal locations.
- Estate design guidelines covering landscaping, building materials and buildings form, storage of materials etc.

The discharge of drainage into South Lake or its buffer area will not be permitted and the development will need to be implemented in a manner which will not adversely impact on the water quality or hydrology of the lake.

A drainage management plan will be required for the estate given the potential impact that drainage could have on South Lake. Given that South Lake is designated as an EPP Lake, drainage into the lake and its buffer area will not be permitted and care will need to be taken to ensure that development does not result in local ground water contamination or changes to the hydrology of the lake.

Subdivision requirements.

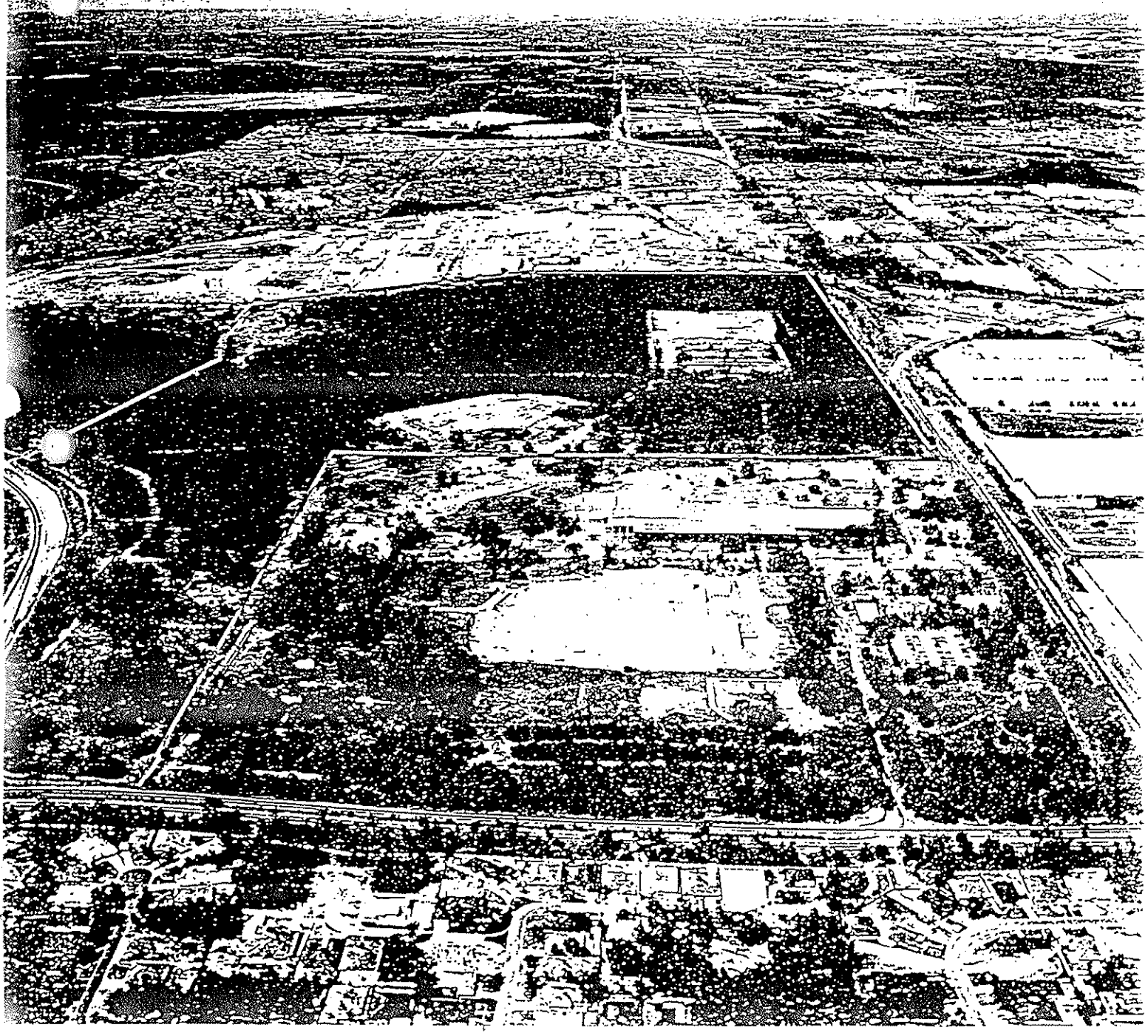
Underground power and high quality estate walling will be required.

SIGNIFICANT INDUSTRIAL LAND HOLDING

FOR SALE BY EXPRESSIONS OF INTEREST

OVER 89 HA (220 ACRES)

CLOSING 5PM (WST) FRIDAY 29TH JANUARY 1999

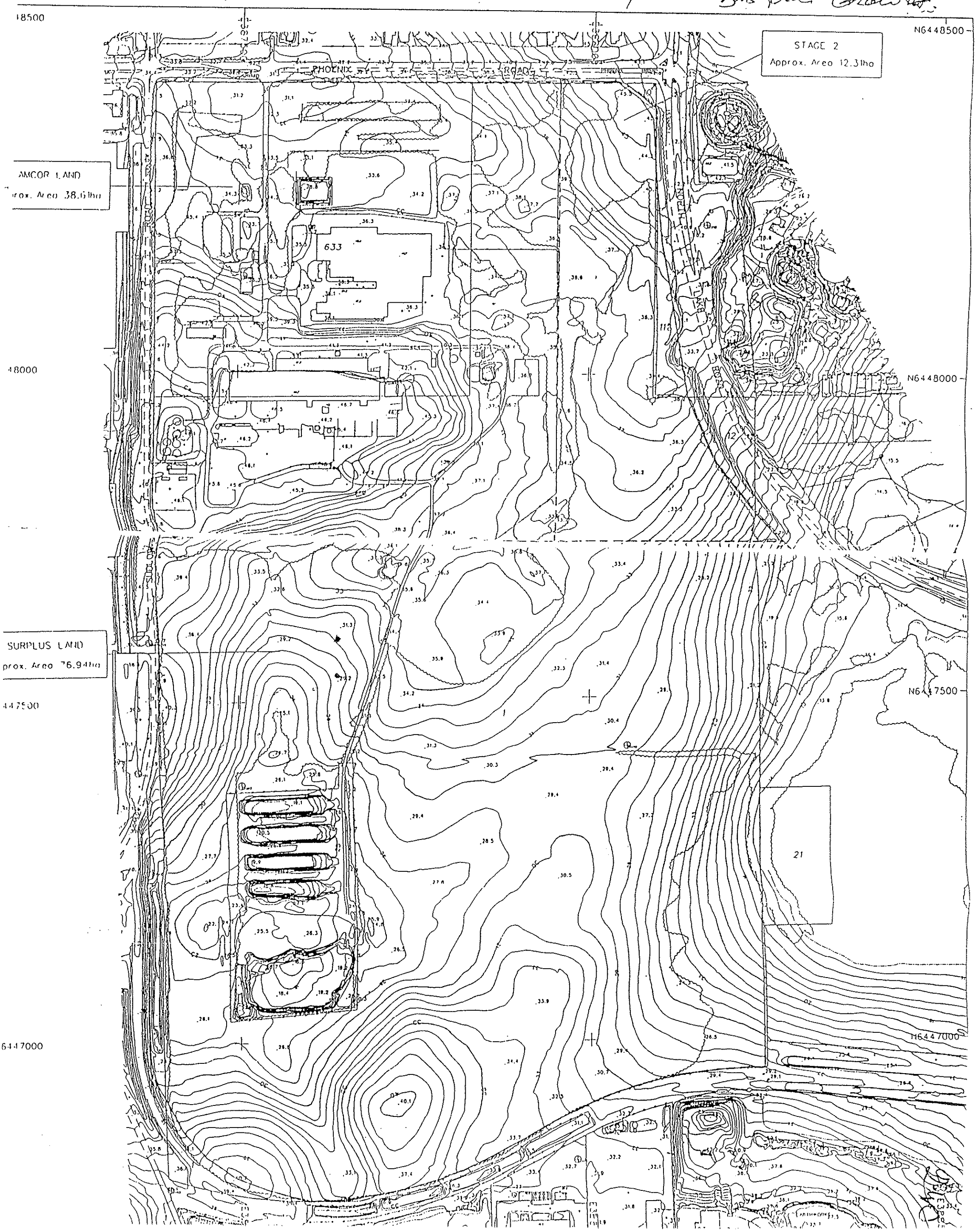


Dev Costs. #55,000 / ac.

Avg Lot 3000m². 85% of Total,

8 yr Selling Dev Period.

Avg Price #65/m² 3% Dev. Growth.



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9.7 SOUTH LAKE AND LITTLE RUSH LAKE

BS254

9.7(a) GENERAL INFORMATION

(i) South Lake

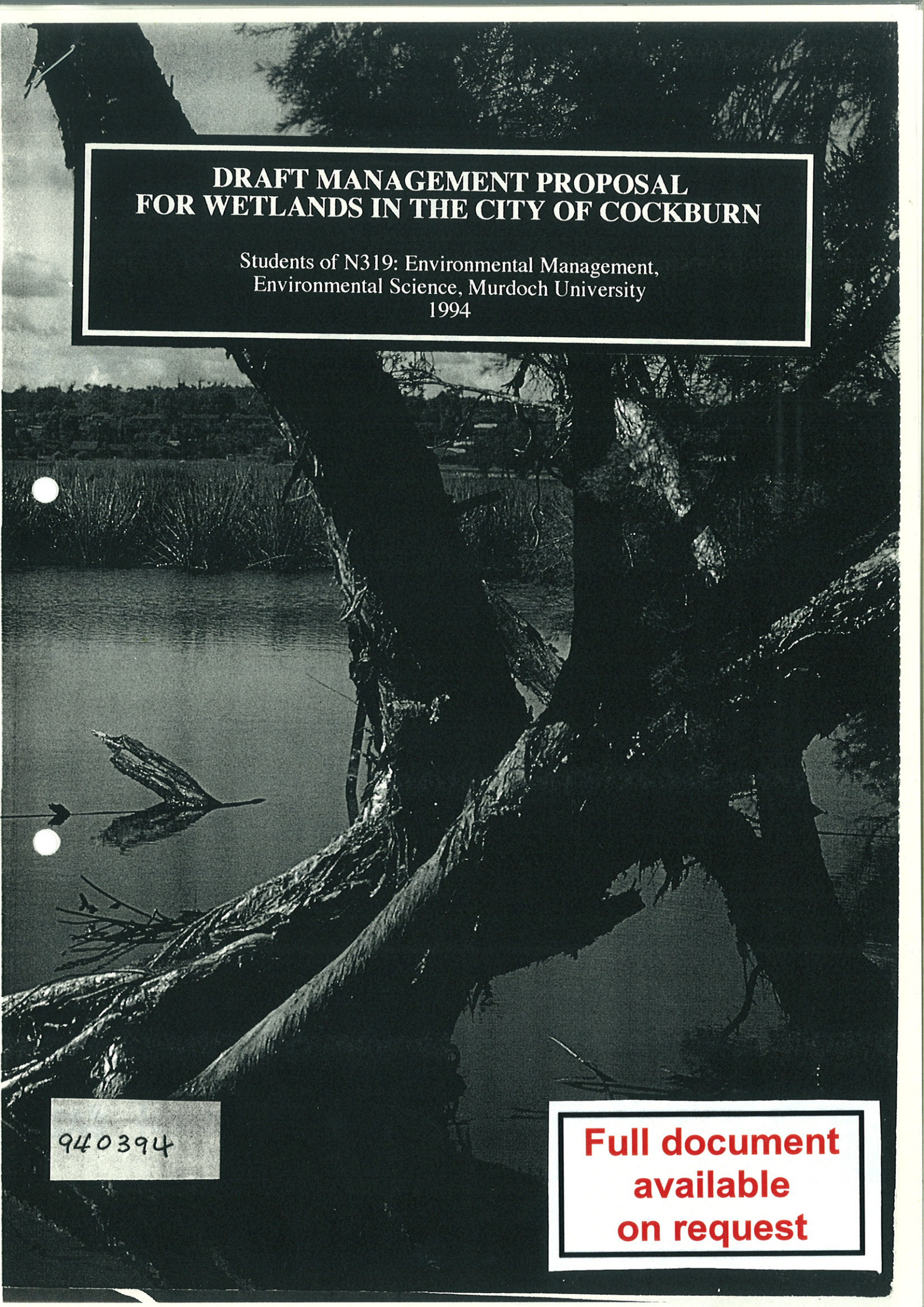
LOCAL AUTHORITY: City of Cockburn
MRS ZONE: Parks and Recreation
MANAGEMENT: State Planning Commission
SYSTEM 6 RECOMMENDATION: M93
WAC CLASSIFICATION: LE.f.sm.s.so.
WATER RESERVE: West of Jandakot Public Water Supply Area

(ii) Little Rush Lake

As per South Lake except : WAC CLASSIFICATION: LE.f.sm.s.c.

9.7(b) AREAS

South Lake Area including surrounding reserve	approx 47 ha
Total wetland	22.8 ha
Paperbark	9.2 ha
Sedgeland	5.5 ha
Open water	3.8 ha
Modified wetland	4.3 ha



DRAFT MANAGEMENT PROPOSAL FOR WETLANDS IN THE CITY OF COCKBURN

Students of N319: Environmental Management,
Environmental Science, Murdoch University
1994

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BASS STH
NTH LAKE

BS 247
SPEAR. S.
MANNING

BS 248
BASS. S.
BIBRA

BS 254
BASS. S.
STH. LK.

BS 256
BASS. S
YANGEB.

BS 261
SPEAR S
L. COOGEE

BS 262
BASS. S
PIARRA

BS 263
BASS. S.
W. GIBBS

BS 269
SPEAR. S.
SPECTACLE

BS 273
+ BS 404
SPEAR S.
CASUARINA

BS 342
BASSEND S.
ANST. KEAN

BS 344
BASS. S
DE YOUNG

BS 346
SPEAR. S.
COOGEE

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WANDI

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BASS. S.
MODONG

BS 353
BASS S
BANKSIA

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SPEAR. S
HARRY WAR

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BS 429
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MARKE

JANDAKOT

Proposals for the

Jandakot Botanic Park

Final

Prepared for the Western Australian Planning Commission
by the Ministry for Planning
Albert Facey House
469 Wellington Street
Perth 6000 Western Australia

Ministry for Planning

March 1995

THE COCKBURN WETLANDS : AN ENVIRONMENTAL STUDY