THE VEGETATION AND FLORA OF THE NORTH BALINGUP RESERVES

RESERVES 21695, 16004,10830
Shire of Donnybrook/Balingup

by
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Bushcare

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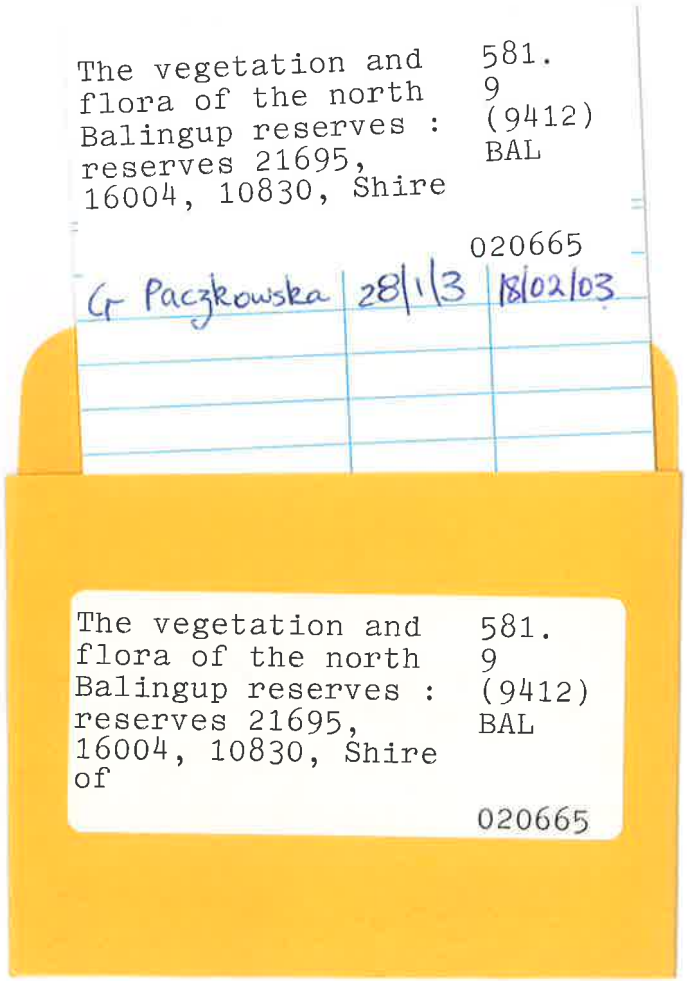

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CONTENTS

SUMMARY

- The survey has helped to achieve the purposes of educating the community about bushland, with 33 volunteers participating in field work and 6 volunteers helping in post survey work.

- 281 species from 62 families were recorded in the North Balingup Reserves.

- Two priority species were recorded during this survey - *Euchiton collinus* P3 and *Tetratheca parvifolia* P3

- Three species were found outside or at the limit of their known range, *Tetratheca parvifolia* P3, *Ozothamnus cordatus* and *Wahlenbergia littoricola*

- 66 introduced species were recorded in the reserves though most of these were restricted to the clearing associated with the racecourse, borrow pits and tracks. The weeds considered of most threat to the reserves bio-diversity are **Watsonia* species, **Rubus fruiticosa* sensu lat, **Leptospermum laevigatum*, **Acacia longifolia*, **Ehrharta calycina* and **Briza maxima.*

- A field herbarium containing most of the species recorded in the reserves will be presented to the Balingup Friends of the Forests Inc.

- 13 permanent 10x10m quadrats have been established in the North Balingup Reserves.

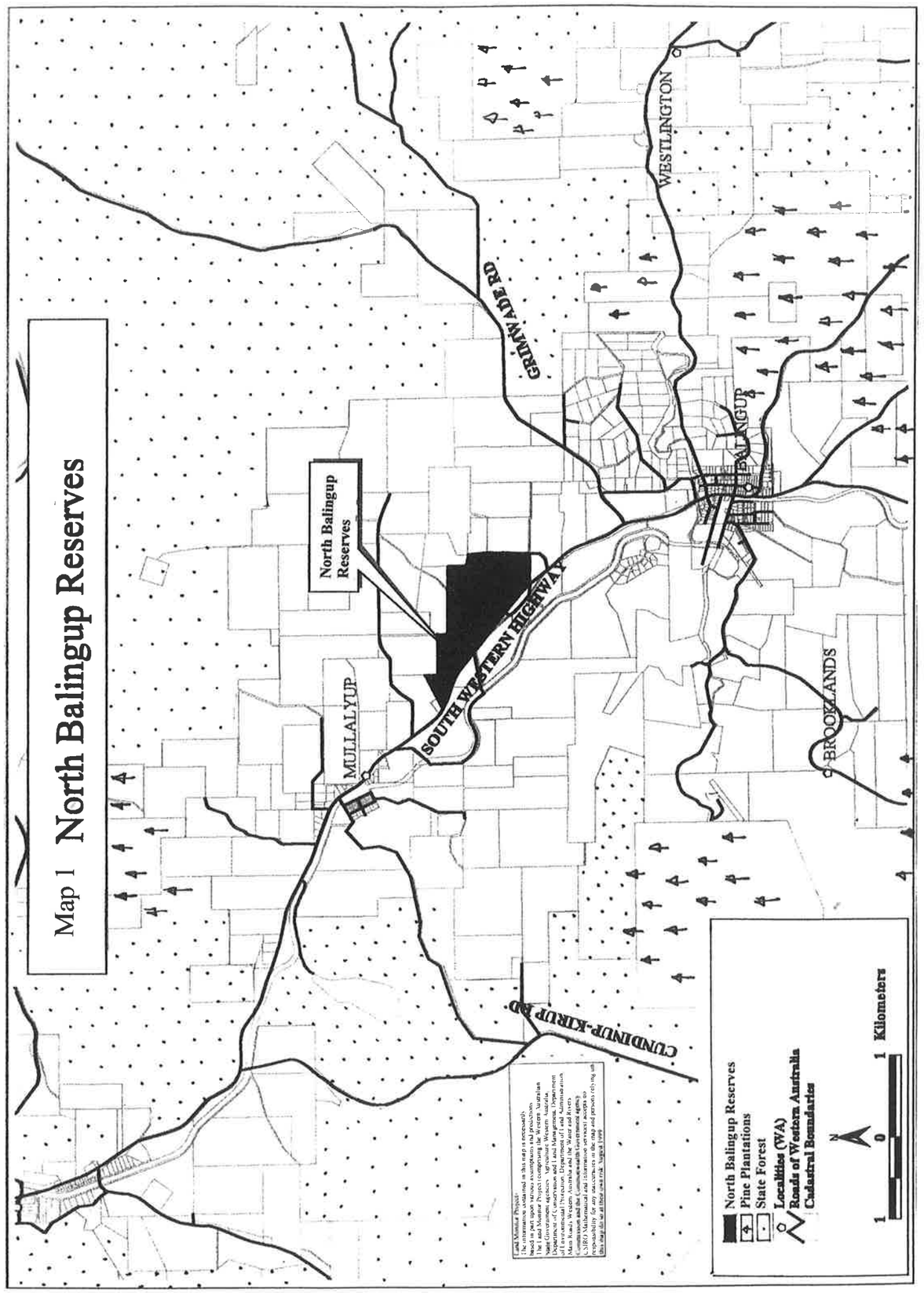
- Four vegetation communities have been recognised for the reserves.

- Most of the vegetation in the reserves is in excellent condition and the reserves appear to be free of dieback disease.

- The reserves have a high conservation value, containing a range of vegetation communities including a vegetation community poorly represented in conservation reserves (Community 1 - Jarrah/Marri Open Woodland over Woody Pear Low Open Woodland)

- No other conservation reserves within the Natural Resource Zone 12 (existing or RFA proposed) have a similar underlying geology and it appears none have a similar range of vegetation.

- Important issues in the future management of the park include maintaining a disease free status, implementing appropriate fire regimes and limiting weed spread.



INTRODUCTION

The Wildflower Society's Bushland Plants Survey Project is a community project that has been in existence since 1988. It has the combined objectives of learning through involvement and bushland conservation. It aims to help community groups and individual land holders know and conserve their bushland by providing training and help to survey, document and monitor vegetation and flora. This understanding can then be utilised in the management and conservation of the bushland. The program is designed to involve the local communities where the surveys take place. It was agreed that this survey would provide community members with a species list, vegetation map, field herbarium, and report on conservation status of the reserves in a local and regional context.

This report covers three adjacent reserves of approximately 108 ha, 2 to 3km north west of Balingup on the South West Highway, referred to as the North Balingup Reserves in this report (Map 1). These reserves were nominated for survey by the Balingup Friends of the Forest Inc and supported by the Balingup Districts Tourism Association. The reserves had previously been identified as one of thirteen sites proposed by Balingup residents as part of a Balingup Ward Green Belt and being of significance in relation to their ecological, recreational, social cultural and visual amenity value (B. Churchward pers comm).

The reserves include

Reserve 21695 (8.25 ha) vested with the Donnybrook/Balingup Shire as a gravel reserve but currently not in use

Reserve 16004 (55.61 ha) an unvested Timber Reserve currently under control of DOLA but under negotiation to be vested with the Donnybrook/Balingup Shire for the purposes of Recreation, Eco-tourism, Conservation of Flora and Fauna

Reserve 10830 (44.51 ha) the old Balingup Racecourse vested with the Donnybrook/Balingup Shire

The reserves straddle the Mullalyup Brook/Balingup Brook divide and are underlain by the Kirup Conglomerate, a geological formation uncommon in the region.

Whilst vegetation is just one part of the whole ecosystem, and a reflection of many factors, including soils, climate, landform and drainage, vegetation surveys are ideal in providing an understanding of the bio-diversity of an area as plants are: diverse, reflect high levels of endemism, respond to narrow environmental gradients, are easily sampled, taxonomically known and easy to monitor. Thus vegetation surveys are an effective means of assessing the conservation value of bushland.

THE STUDY AREA

The North Balingup Reserves are located in the Donnybrook/Balingup Shire in the middle catchment area of the Blackwood River and fall within the sub-catchment of both the Balingup Brook and Mullalyup Brook. The reserves are dominated by a broad ridge dissecting the site in a north east/south west direction with two broad valleys running west and south east, the latter forming a permanently wet drainage line in the south east of the reserves (see Map 2). The reserves are surrounded by farms and a golf course and effectively forms an island of remnant vegetation separated by 2-9km of cleared land or pine plantations from areas of State Forest (see Map 1).

The climate is Mediterranean with cool winters and hot dry summers. The nearest meteorological records are from Bridgetown 26km to the south east, where the average rainfall is 834mm/year with 63% falling in the months May - August inclusive. The average maximum temperatures range from 29.7 C in January to 15.7. C in July with average minimum temperatures from 12.1 C in January and 4.4 C in July.

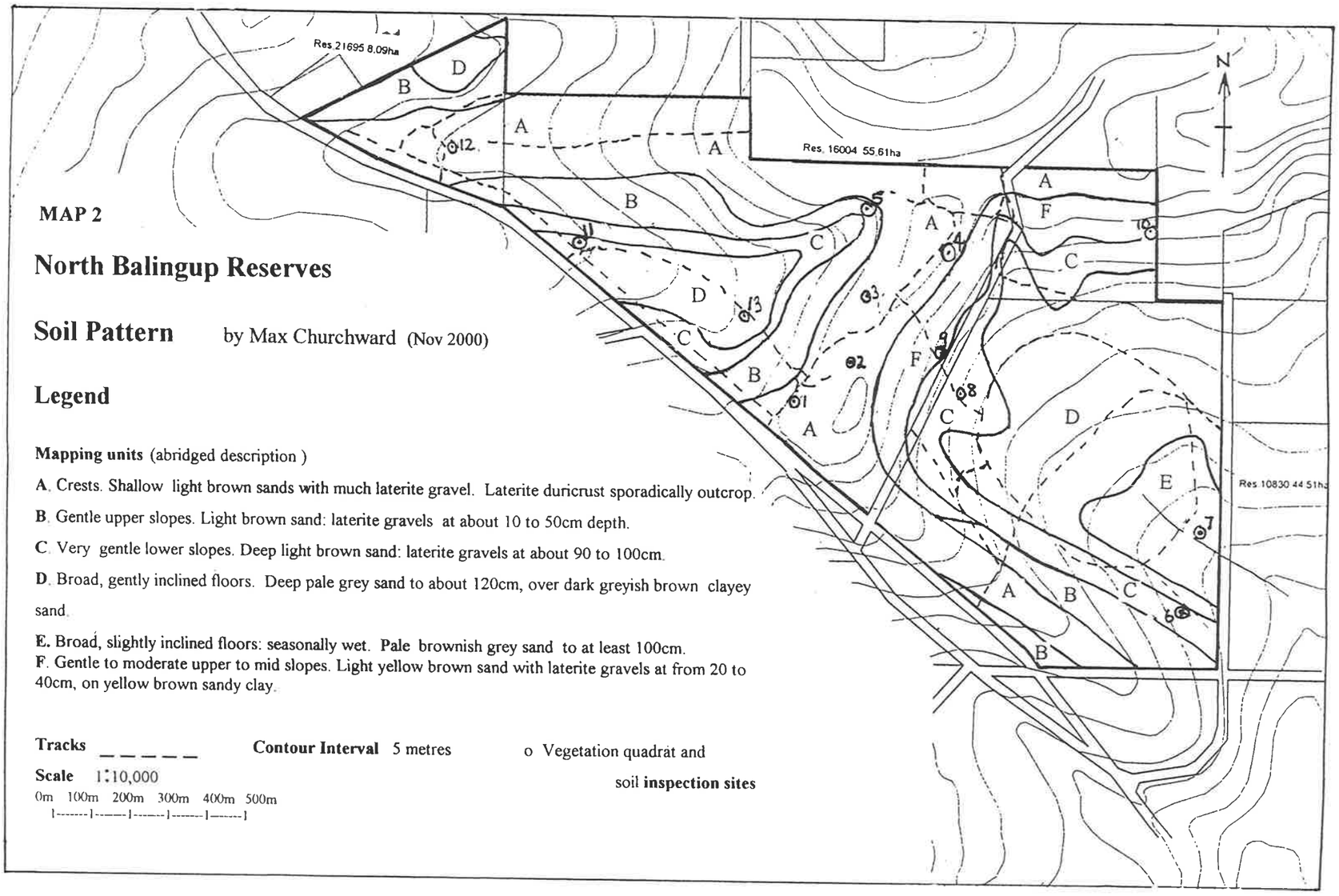
Soils

The soils of the reserves have been mapped and described for this survey by Max Churchward (pers. comm.), who has provided the following geological descriptions of the reserves(see Map 2).

"A broad geological picture would show this area as being in the Balingup-Greenbushes metamorphic belt, an integral part of the Yilgarn shield an ancient mass of igneous (eg. volcanic) and metamorphic (ie. altered) rocks that occupies most of central and southern Western Australia. At the reserves these very ancient rocks are overlain by a sandy clay sediment containing smoothly rounded cobbles. This is the Kirup Conglomerate, the ultimate parent material of the soils of the reserves. Areas of this rock are scattered throughout the southwest in particular from Kirup to Balingup and between Bridgetown and Boyup Brook. These remnants of a once much more extensive occurrence are generally elevated above the present streams which have developed since the conglomerate was deposited. Thus the North Balingup Reserves occupy a gently undulating upland tract at about 200m above sea level, drainage southward to the Balingup Brook and northward to the Mullalyup Brook.

The soils of the reserves are more sandy than surrounding areas, which is related to the sandy nature of the Kirup Conglomerate. In addition these rocks along with other rocks in the region, have been deeply weathered so that many of the soils have been deeply leached of plant nutrients. Because of the sandy nature of the Kirup Conglomerate this applies even more so to the soils at the reserves. Slight erosion has exposed a crust (commonly referred to as laterite duricrust), a product of the weathering, and the sands and gravels so released have been deposited down slope and upon these the soils have developed. Most of the soils comprise a range of sands over sandy clay at less than 100cm depth and commonly contain various amounts of ironstone gravel, while the upper parts of the clay can harden to form a crust to 1m thick "

Additionally Max Churchward has provided detailed soil profiles for all quadrats (survey sites) within the reserves and these are illustrated at the end of Appendix 4 to enable the relationship between soil type and vegetation type to be seen. (Full descriptions are provided in Appendix 5).



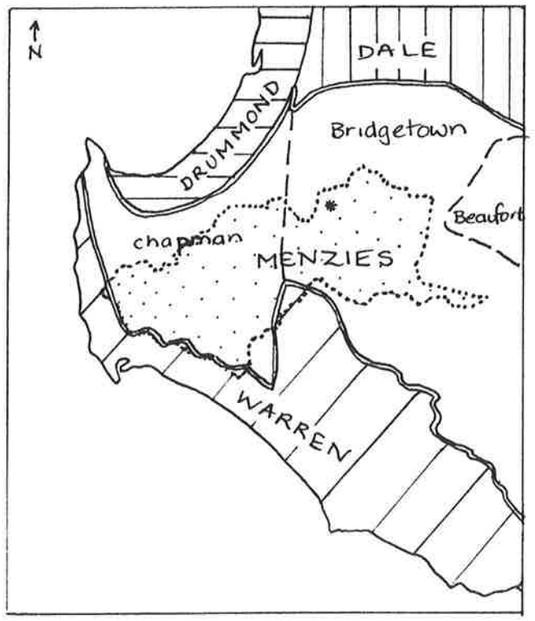
Vegetation

Standard vegetation descriptions in Western Australia have relied on the work of Beard (1981) who divided the State into several provinces, districts, sub districts and systems according to physiographic, geological and soil and climatic characteristics. The North Balingup Reserves are within the Darling Botanical District in the South-West Botanical Province, and within the Bridgetown Vegetation system of the Menzies Subdistrict, commonly called the Southern Jarrah Forests (see Map 3). A vegetation system is a particular series of plant communities occurring within a defined area.

The characteristic units of the Bridgetown Vegetation System are:

Jarrah/Marri Forest on the laterite crests and slopes
Blackbutt (*Eucalyptus patens*) on the valley flats with or without Jarrah and/or Marri
Bullich (*Eucalyptus megacarpa*) on semi swampy valleys
River Gum (*Eucalyptus rudis*) fringing the riverbanks with *Melaleuca rhaphiophylla*.

Map 3 Beards Vegetation Mapping (Beard 1981)



KEY

* North Balingup Reserves

MENZIES Subdistrict

Boundary of Vegetation Systems
: Chapman, Bridgetown, Beaufort

DALE Subdistrict

DRUMMOND Subdistrict

WARREN Subdistrict

Boundary Natural Resource Zone 12.

The Bridgetown Vegetation System is similar to the Darling Vegetation System (commonly called the Northern Jarrah Forest) to the north. This similarity is reflected on Regional Forest Agreement (RFA) maps where the vegetation of the North Balingup Reserves is listed as Jarrah Forest North West, which extends to north of Perth (RFA 1998).

On a 1:250 000 scale, Mattiske and Havel (1998) have mapped three vegetation complexes within the reserve, the boundaries of which follow the soil landscape subsystems boundaries of Tille (1996) (see Map 4a). These complexes are:

Kirup: Open Forest to woodland of *Eucalyptus marginata/Corymbia calophylla/Banksia attenuata/Xylomelum occidentale* on sandy slopes
Hester: Tall Open Forest to Open Forest *Eucalyptus marginata/Corymbia calophylla* on lateritic uplands
Balingup: Open Forest of *Eucalyptus marginata/Corymbia calophylla* on slopes and woodland of *E. rudis* on valley floors.

Natural Resource Zones

The reserves lie within the Zone 12 of the Natural Resource Zones of the South West Land Division developed by Allison, Brandenburg and Beeston (1993) (see Map 3). This zoning system was developed to provide natural boundaries of the landscape as opposed to the artificial shire boundaries from which issues relating to land use and conservation could be addressed. Each zone is considered to represent a unique set of biological and physical characteristics and was determined by Beards phytogeographic regions, catchment and drainage divisions and rainfall isohyets. Zone 12 corresponds to Menzies Subdistrict within the Middle Blackwood Catchment area with an annual rainfall of 700-1200 mm.

SURVEY METHODS

Community members and volunteers of the Wildflower Society Bushland Plant Survey Program conducted most of the survey work on the 26/9/00 and 27/9/00 (see Figure 1). Some additional survey work occurred on 7/11/00 and 8 /11 00 to enable identification of late flowering orchids, annuals and grasses.

Thirteen permanent 10mX10m quadrats were established throughout the reserves, their locations chosen to sample the range of vegetation associations present in the reserves and to sample different topographical positions. The boundaries of these quadrats are permanently marked by four star pickets, enabling community members to monitor them in the future. For each quadrat the following data was collected: all vascular plant species, vegetation structure, dominant species, physical features of the site such as slope, soil, topography, environmental aspects such as age since fire, vegetation conditions, weeds and disease presence. Descriptions of vegetation were then made using a modified Muirs classification as outlined in Table 1 (Keighery 1994). Vegetation condition categories are listed in Table 2.

The survey techniques used are outlined in Bushland Plant Survey, A Guide to Plant Community Survey for the Community (Keighery 1994) and have proved successful for use by community members with little or no botanical experience. The technique enables a systematic method of data collection within a defined area. It focuses attention on sampling all plants, not just the obvious plants and provides a basis for describing the vegetation. Copies of quadrat data sheets and photos have been provided to the Friends of the Balingup Forests. Opportunistic collections (ie. those outside quadrats) were also made during the site visits.

Initial plant identifications were made by the volunteers using a preliminary field herbarium and by the survey coordinator. All plant identifications were checked against specimens in the WA Herbarium with expert taxonomists verifying several species. Species nomenclature follows Paczkowska and Chapman (2000) and current usage at Western Australian Herbarium except for Marri, which the Wildflower Society of WA recognises as *Eucalyptus calophylla*, not *Corymbia calophylla*. An asterisk preceding a plant name indicates the species is introduced (a weed). A field herbarium has been compiled and will be presented to the Balingup Friends of the Forest. Approximately 50 species will be lodged in the Western Australian Herbarium with duplicates in the Bridgetown Regional Herbarium. Most of these species are not currently represented in the regional herbarium.

Mapping of vegetation was achieved using the results of quadrat surveys, soil maps and aerial photo interpretation.

Some limitations of the survey include:

- The survey being conducted over one flowering season only and a full compliment of species has not been recorded. It is estimated over 85% of species in the reserves have been recorded.
- Estimates of crown cover and vegetation condition rating may not be consistent as different people estimated these attributes.
- Vouchers were not collected for all specimens, however all specimens collected were matched against Herbarium specimens or verified by relevant experts.
- Not all vegetation boundaries as determined above were checked on the ground and use of aerial photos was limited due to the similarity of the overstorey.

Table 1 Structural Classification Keighery (1994)

Life form/Height Class	Canopy Cover			
	100-70	70-30	30-10	2-10
Trees over 30m	Tall Closed Forest	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 Wodland
Tree 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 ShrubMallee
Shrubs over 2m	Closed Tall Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland
Shrub 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
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

Table 2 Vegetation Condition Scale

1= Pristine
Pristine or nearly so, no obvious signs of disturbance

2 = Excellent
Vegetation structure intact disturbance affecting individual species and weeds are non-aggressive species For example damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.

3 = Very Good
Vegetation structure altered, obvious signs of disturbance
For example disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

4 = Good
Vegetation structure significantly altered by very obvious sings of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

5 = Degraded
Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

6 = Completely Degraded
The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as "parkland cleared" with the flora composing weed of crop species with isolated native trees or shrubs.

FLORA

Two hundred and eighty one species from 62 families were identified from the quadrat and opportunistic surveys which included 224 native and 66 introduced species (see Appendix 1 and 2). Of these, 200 species were recorded during the quadrat surveys (including species adjacent to quadrats and recorded as part of the survey process). Of the remaining 81 species recorded opportunistically, 43 were introduced species and 39 native species many of which included annuals or orchids and included the two priority species *Tetratheca parvifolia* and *Euchiton collinus*, highlighting the usefulness of both quadrat and opportunistic surveys. Several introduced *Eucalyptus* species have been planted near the entrance of the racecourse but have not been identified. The introduced species have a limited distribution primarily around the former racecourse and along tracks and the highway with only 16 of these species recorded in quadrats (see Introduced Species).

Families with the most species include Papilionaceae or pea flowered plants with 30 species (22 native and 8 introduced), Poaceae - grasses 24, (9:15), Orchidaceae - orchids 23, (22:1), Asteraceae - daisies 21, (12:9), Proteaceae - Banksia family, 11, (11:0), and Mimosaceae – wattles 10, (7:3). The most diverse genera included *Acacia* –wattles 10 (7 native), *Lomandra* -mat rushes 9, *Caladenia* -orchids 6, *Gompholobium* -peas 6, *Leucopogon* – beardheaths 5, *Stylidium* - triggerplants 5, *Tetratheca* 4, *Hibbertia* – guinea flowers 4 and *Drosera* - sundews 4.

Two priority species were found during the survey, *Tetratheca parvifolia* (P3) and *Euchiton collinus* (P3) and three species were found on the boundary of, or outside known distribution ranges (see Species of Special Interest).

A number of species collected during the quadrat surveys were difficult to identify due either to insufficient flowering material or immature specimens. These species were identified to family or generic level and in most cases probably represent taxa already recorded eg *Pterostylis* sp. is likely to be either *Pterostylis vittata*, *P. recurva* or *P.* aff *nana*.

Species identified to family or generic level only include: *Pterostylis* sp. - vegetative material only, *Caladenia* sp. - vegetative material only, *Lepidosperma* sp aff *squamatum,* - this genus is very difficult to identify and specimens lacked adequate flowering material, **Asteraceae* sp. - immature vegetative sample, **Conyza* sp. - immature vegetative sample and *Synaphaea* sp. – vegetative sample only.

Whilst specimens of both **Hypocheris glabra* and **Hypochaeris radicata* were collected, these species are known to intergrade (Marchant *et al* 1987) and have been recorded as **H. glabra* in the quadrat surveys.

Two species *Hibbertia amplexicaulis* and *Xanthosia huegelii* showed marked differences in form and both forms have been included the field herbarium. *Hibbertia amplexicaulis* has either small narrow leaves with lobes extending but not joining around the stem or has large leaves which completely encircled the stem. The latter form is often confused with *Hibbertia perfoliata,* a species restricted to fresh water soaks or swamps. *Xanthosia huegelii* is a small herb with small and large leaf varieties.

Rare and Endangered Species

No Rare and Endangered species have been recorded from the reserve previously or were found during the survey.

Priority Species

CALM has designated five Priority categories excluding Declared Rare and Endangered Species according to their conservation status (see Appendix 3 for descriptions). Two priority species were recorded during this survey - *Euchiton collinus* P3 and *Tetratheca parvifolia* P3

Euchiton collinus **P3**
One specimen of this small perennial or annual herb was found adjacent the middle track in an area that had previously been graded and is dominated by small annual weed species – **Trifolium* species, **Galium divaricatum* and **Filago gallica*. It has previously been recorded scattered throughout the south west region from Albany to Manjimup and near Margaret River and Boddington.

Tetratheca parvifolia **P3** (See Figure 2, p 27).
This small perennial shrub was found in two locations adjacent the middle track. It has previously been found in the vicinity of Donnybrook, Upper Capel, Lowden and somewhere near the "Blackwood River" thus its occurrence in the reserves is near or extends the eastern boundary of its distribution (Thompson 1976 & WA Herbarium).

Range Extensions

Tetratheca parvifolia **P3** See above.

Ozothamnus cordatus This perennial low shrub is common on calcareous soils along the south and west coast and has previously been recorded inland only near Manjimup.

Wahlenbergia littoricola. This perennial herb is distinguished from the more common *Wahlenbergia multicaulis* which is also present in the reserves, by the shape of the style and presence of papillae on the style. (Smith 1992) It has previously been recorded from the Donnelly River to Tone Bridge, the Porongorups and Albany.

Introduced Species

Sixty six introduced species have been recorded for the study area, representing 22 % of the flora (see Appendix 2). However most of these species are restricted to the clearings associated with the old racecourse, adjacent to the highway or vehicle tracks within the reserves or around the borrow pits. Sixteen introduced species were recorded in the quadrat surveys though only 2 of these, **Briza maxim*a and **Hypochaeris glabra,* were common, with neither of these appearing to be aggressively invading the bushland. Most of the vegetation within the reserves is in excellent condition indicating the presence of none or only of few non-aggressive weeds.

The major introduced species in the clearings associated with the old racecourse include **Avena barbata* (Bearded Oat), **Bromus diandrus* (Great Brome),* *Ornithopus compressus* (Yellow Serradella), **Lupinus angustfolia* (Narrowleaf Lupin), **Acetellosa vulgaris* (Sorrel), **Trifolium* species (Clovers), **Vulpia bromoides* (Squirrel tail Fescue), **Hypochaeris glabra*

(Smooth Catsear), **Aira praecox* (Early Hairgrass), **Eragrostis curvula* (African Lovegrass), **Ehrhrarta calycina* (Perennial Lovegrass) and **Briza maxima* (Blowfly Grass). Whilst common introduced species along the highway and tracks include **Watsonia* species (Watsonia) and small annuals such as **Ursinia anthemoides* (Ursinia), **Cotula turbinata* and **Petrorhagia velutina* (Velvet Pink).

The National Weed Strategy (NWS 1997) defines a weed as "a plant which has, or has the potential to have, a detrimental effect on economic, social and conservation values". Plants falling in the latter category are called environmental weeds and their impact on native ecosystems may include: resource competition, prevention of seedling recruitment, changes to soil status, alteration of fire regimes, changes to geomorphological and hydrological cycles, changes in abundance of indigenous fauna and genetic changes (EWSWA 1999). Thus weed presence is not only a result of environmental change but an agent of environmental change.

Important strategies for dealing with environmental weeds and protecting the integrity of bushland remnants include:

- The early identification of weed problems and early intervention, as many weed species establish only slowly and do not become a problem until some suitable event such as a fire or soil disturbance. Often by the time a problem has arisen the cost of eradication or control is high.

- Protecting areas of high conservation from weed species that adversely affect the integrity and bio-diversity of the bushland, working from areas of least disturbance first, thus maintaining or enhancing bio-diversity. Thus removing weeds from areas of bushland in very good to excellent condition is of higher priority than removing weeds from the clearings of the racecourse.

- Protecting threatened vegetation or endangered species on a local and regional scale. Whilst the two populations of *Tetrathca parvifolia* (P3) found in the reserves are adjacent the middle track, weed invasion does not appear to currently pose a threat whilst the only specimen of *Euchiton collinus* (P3) was found in an area that had previously been graded and is dominated by small introduced annual such as **Galium divaricatum, *Trifolium* species and **Filago gallica.*

The vegetation communities most vulnerable to weed invasion in the North Balingup Reserves are those on the sandier soils, Community1, and those with high moisture content, Community 4.

Major Weed Species

Whilst a thorough assessment of the weed hazards in this reserves is outside the scope of this survey, several species are discussed below having been identified as the main potential weed threats to the reserves bio-diversity. Fortunately most of these species are currently present in very low numbers or are presently restricted in distribution. A further guide to the potential of weed species to cause environmental damage within the reserves is provided by a weed rating, determined by EWSWA(1999) and listed in Appendix 2. It must be stressed however that weeds with a low rating may cause significant problems on any one site, similarly species of high rating may not pose a threat under local conditions, thus monitoring of all weeds on a local scale is important.

***Watsonia* species - Watsonia**

Both **Watsonia meriana* sub sp *bulbifera* and **Watsonia versfeldii* appear to be invading natural bush adjacent the highway and along parts of the middle track. These species have caused significant weed problems throughout the south west of Western Australia and can result in complete exclusion of native species in some conditions.

***Rubus fruiticosa* sensu lat – Blackberry**

Rubus fruiticosa sensu lat is a broad grouping of a number of blackberry species all of which are either Declared Plants or Pest Plants under the Agricultural and Related Resources Protection Act administered by AgWA. The species present within the reserves present along the drainage line in the south-east corner of the racecourse has not been identified. Blackberry has the potential to smother the understorey of Community 4 which could lead to a decrease in the reserves bio-diversity as nearly half of the species present in this association are not found elsewhere in the reserves (see Vegetation Communities).

***Leptospermum laevigatum* - Coastal Teatree**

Although present in very low numbers this native shrub from the eastern states has the potential to invade habitats on sandy soils such as Community 1 and become a dominant shrub. **L laevigatum* is a major environmental weed species on sandy soils in southern WA.

***Acacia longifolia* - Sydney Golden Wattle**

Although only recorded once within the reserves this species, like **Leptospermum laevigatum,* has the potential to become a dominant shrub species in vegetation communities on sandy soils such as Community 1. Once established this species can spread rapidly as a result of high germination rates following fires and seed dispersal by birds as has occurred in the Albany area in the past ten years.

***Ehrharta calycina* - Perennial Veldt Grass**

Whilst only recorded in the race course clearing, this species is considered to be one of WA's worst environmental weeds, capable of smothering native species and creating a fire hazard. It has the potential to be a major weed species on the sandy soils of Community 1.

***Briza maxima* - Blowfly Grass**

This species is the most widespread weed in the reserves, recorded in 7 of the quadrats. Currently this grass is not aggressively invading the bush. Specimens found in the quadrats had few leaves and only one or two flowering spikelets per inflorescence, suggesting less than ideal growing conditions. However its widespread distribution indicates potential for rapid spread following favourable disturbance.

Weed control, restoration and revegetation

Control methods for weeds vary according to the life cycles of plants, the extent of distribution and location of weeds and may include manual, chemical and or biological control. Paramount to any weed control is the replacement with appropriate native species as any removal of a weed species creates a gap that may be recolonised by the same or other weed species.

In areas where the vegetation is in good to excellent condition, the vegetation should have the capacity to regenerate naturally, and weed management should focus upon the removal of weed species with minimal disturbance to allow such natural regeneration to occur. This restoration process is the most appropriate approach to weed management for most of the North Balingup Reserves.

Revegetation, either through direct seeding or planting of seedlings, should only be considered for areas denuded of vegetation or where vegetation is degraded and lost it ability to regenerate all components naturally (eg. the area between the racecourse proper and entrance where only tree species remain). Revegetation cannot reproduce the complexities of the natural vegetation but by careful selection of species and use of local propagating material the biological integrity of the area can be maintained. Suitable species for revegetation include common species to the vegetation community expected to be present at that site and should include components from all levels of that community eg grasses, sedges, herbs, shrubs and trees. This information can found in the quadrat data (Appendix 4 and 5) and in the vegetation and soil maps (Map 2 & 4). Seed and propagating material should be collected locally, with care taken not to over harvest or create disturbances.

Useful references for weed identification, management and control include Hussey *et al* (1997) Moore and Moore (2001), ENSWA (1999) and EWAN -Environmental Weed Action Network, (Website: www.omen.net.au/~ewan).

Field Herbarium

A field herbarium will be given to the Balingup Friends of the Forest Inc. and provides an excellent identification tool. It contains pressed and dried specimens of species recorded during the survey. The specimens have been mounted on A4 cardboard sheets held in lever arch files.

Arrangement of field herbariums is always problematic when the skill of the user varies. To encourage easy use and identification of similar plants, the specimens have been grouped initially into life forms and recognisable groups:

Ferns, Cycads, Grasstrees, Grasses, Sedges and Rushes
Orchids and Grass like herbs - monocotyledons
Herbs - dicotyledons
Trees, Shrubs and Vines
Introduced Species

Within each group the plants are arranged alphabetically in plant families except in a few instances where species of the same genera have been kept on the same sheet, or where similar species are placed side by side to assist in identification. It is hoped this grouping will provide an easy method of locating plants whilst encouraging the novice to see similarities between different plants and gain some understanding of plant classification.

The field herbarium is designed to be added to, or improved, eg non-flowering specimens replaced with flowering ones or fruiting material added. Information regarding family and generic identification may be added to assist in identification.

Field herbariums can be constructed in different ways and the booklet "How to Create a Local Herbarium (Patrick 1997) outlines how to prepare specimens and care for the herbarium. Insect damage can destroy specimens and the best way to avoid this is to freeze dry specimens in the freezer for 24 hours if any evidence of damage occurs.

VEGETATION

Plant Communities

Vegetation classification based on the floristics (the type of plants present) as compared with those based on structure alone, have been found to be the more appropriate method of describing vegetation in areas of high species richness which includes the SW of Western Australia (Gibson *et al* 1994). Thus, the vegetation of this study site has been based on primarily on floristic similarity as determined by the quadrat surveys, with communities being described using the most common structural forms of those units.

Four vegetation units have been recognised for the reserves and are referred to as communities. These communities were determined by the quadrat surveys (Appendix 4) and have been broadly mapped (Map 4). Site information for all quadrats is provided in Appendix 5. It should be noted that not all boundaries were checked on the ground and aerial photography does not clearly differentiate between the different communities, particularly communities 2 and 3, due to the similarity of the overstorey. No quadrats were conducted in community 2 west of the main ridge.

One unit -Community 3 has been divided into two associations on the basis of distinct structural differences, although there is little floristic difference. Association 3b has a distinct Tall Shrub or Small Tree layer of Bull Banksia -*Banksia grandis*. These two associations have been mapped together as there is no discernible difference between them on the aerial photographs.

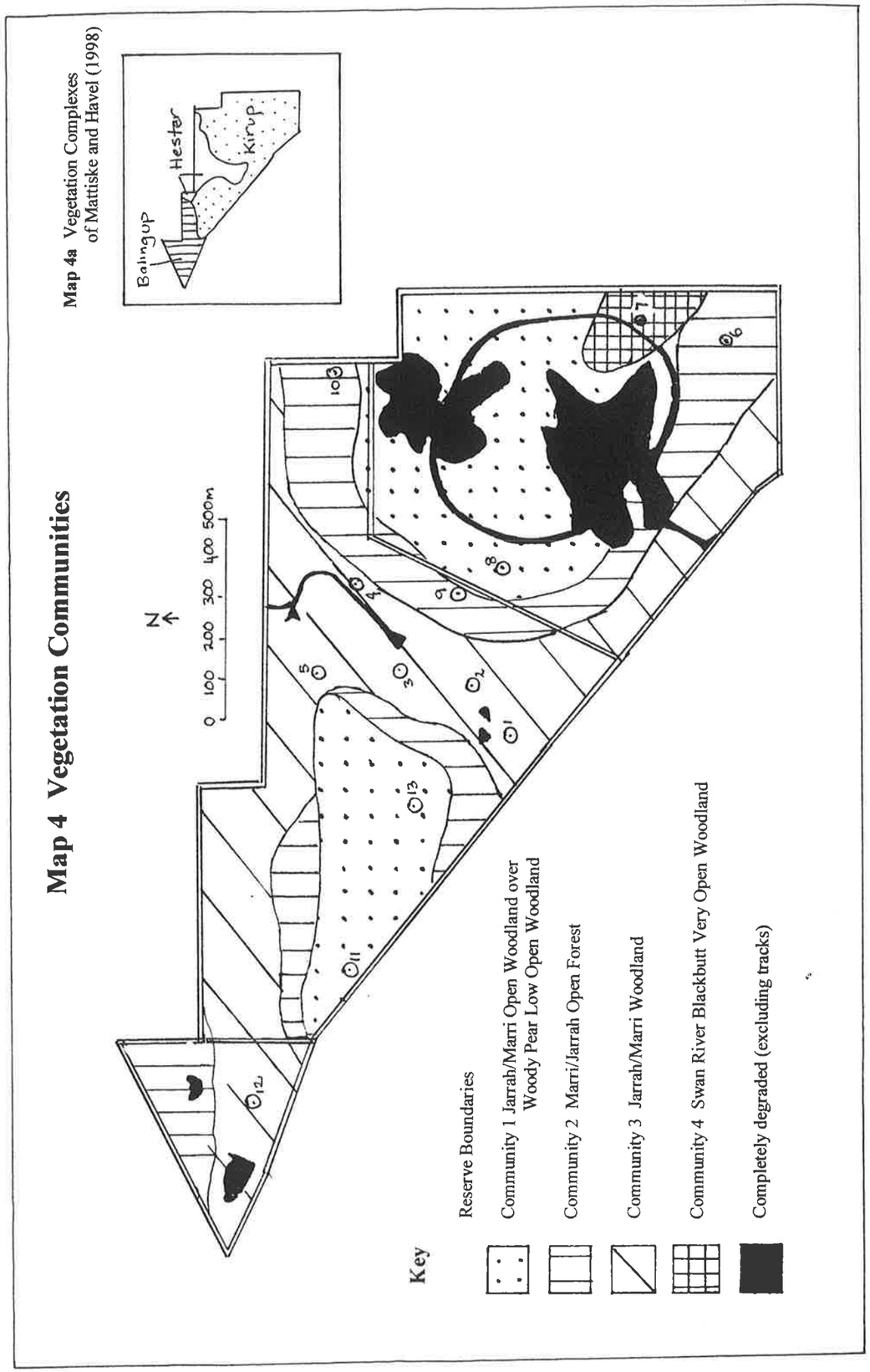
The similarity between most of the communities can be gauged by the high number of species found in most of the quadrats, with 32 species found in 8 or more quadrats (see Appendix 4).

1 Jarrah(*Eucalyptus marginata*)/Marri (*Eucalyptus calophylla*) Open Woodland over Woody Pear (*Xylomelum occidentale*) Low Open Woodland, Mixed Shrubland and *Phlebocarya ciliata* Herbland.
Quadrats 8, 11 and 13, Figure 3 and 4.

This community occurs on the gentle mid to lower slopes where grey or pale yellow brown sands occur to a depth of a metre or more (see page 51). The presence of a distinctive Low Woodland of Woody Pear - *Xylomelum occidentale*, dominance of *Bossiaea linophylla* and *Acacia extensa* in the shrub layer, dominance of *Phlebocarya ciliata* and presence of *Loxocarya cinerea* and *Hypolaena exsulca* in the sedgeland are distinguishing features of this community. Other common species include *Pteridium esculentum, Macrozamia riedlei, Hibbertia hypericoides, Xanthorrhoea preissii, Dampiera linearis, Patersonia umbrosa* var *xanthina, Drosera pallida, Lagenophora huegelii, Platysace filiformis, Conostylis serrulata* and *Burchardia umbellata*.

Species largely restricted to this community include *Thysanotus manglesianus, Stylidium violaceum, Stylidium schoenoides, Lomandra caespitosa, Gompholobium capitatum* and *Philotheca spicata.*

Marri, *Eucalyptus calophylla,* is usually sub dominant in the overstorey and a high number of annuals are present compared with other communities, including *Poranthera microphylla, Millotia tenuifolia, Trachymene pilosa* and *Wahlenbergia preissii*. Similarly a high number of orchids were recorded with 15 of the 23 orchids recorded in this community. The average number of species /quadrat in this community was 55.



2 Marri/Jarrah Tall Open Forest over Mixed Shrubland, Mixed Low Shrubland, Mixed Open Herbland and Mixed Open Sedgeland.
Quadrat 6,9 and 10 Figures 5 and 6.

This community occurs where soils are sandy to a depth of 1m, with gravel occurring at 35 cm or greater (see page 51). It is found on mid to lower slopes. This community has the most diverse flora, with 58, 59 and 71 native species recorded for the three quadrats. It also contains the most native grasses with 7 of the 9 native grasses present. Many species present are also common in community 1,3a and 3b.

Characteristic species largely restricted to this association include *Anigozanthus manglesii, Clematis pubescens, Asrtoloma ciliatum, Dianella revoluta, Microlaena stipoides, Kennedia carinata* and *Conostylis aculeata.*

Other characteristic species of the shrub layers include *Persoonia longifolia, Bossiaea linophylla, Acacia extensa, Hibbertia hypericoides, Macrozamia riedlii, Gompholobium preissii, Sphaerolobium medium, Leucopogon capitellatus, Monotaxis occidentalis, Hibbertia commutata Hibbertia amplexicaulis, Hovea chorizemifolia* and *Scaevola calliptera.* Common herbs include *Drosera pallida, Logania serpyllifolia, Lagenophora huegelii, Xanthosia huegelii, Opercularia apiciflora, Dampiera linearis* and *Patersonia umbrosa* var. *xanthina.* Common sedges and grasses include *Tetraria capillaris, Tetraria octandra, Tetrarrhena laevis, Deyeuxia quadriseta* and *Austrostipa campylachne.*

3a Jarrah/Marri Woodland over *Acacia extensa/Acacia pulchella* Shrubland, *Hibbertia hypericoides/Bossiaea ornata/Sphaerolobium medium* Low Open Shrubland *Patersonia umbrosa* var. *xanthina* Open Herbland and *Tetraria capillaris/Tetraria octandra* Very Open Sedgeland. (Mapped as one unit with 3b)
Quadrats 1,2,4,12, Figure 7 and 8.

This community is found on the broad ridges and upper slopes where soils are very shallow and laterite capping occurs near the surface, or where there is high proportion of ironstone gravel in the soil (see page 51). Jarrah is the dominant tree species with Marri a subdominant species. The structure varies from Open Woodland to Open Forest

Characteristic species largely restricted to this community or to the similar association 3b, include: *Bossiaea ornata, Astroloma pallidum, Austrodanthonia occidentale, Lomandra preissii, Banksia grandis, Acacia pulchella, Xanthosia atkinsonia, Xanthosia candida, Xanthorrhoea gracilis, Patersonia babianoides, Goodenia eatoniana* and *Amphipogon amphipogonoides.*

Other common species include *Acacia extensa, Sphaerolobium medium, Hibbertia hypericoides, Xanthorrhoea gracilis, Leucopogon capitellatus, Scaevola calliptera, Goodenia eatoniana, Hibbertia commutata, Lomandra sericea, Tetratheca setigera, Thysanotus multiflorus, Hovea chorizemifolia, Eriochilus dilatatus, Pterostylis vittata, Xanthosia huegelii, Opercularia apiciflora, Austrostipa campylachne, Damperia linearis, Leucopogon capitellatus,* and *Persoonia longifolia.* Most of these species are common to community 2 and 3b.

It appears that *Bossiaea ornata, Astroloma pallidum* and *Xanthorrhoea gracilis* replace *Bossiaea linophylla, Astroloma ciliatum* and *Xanthorrhoea preissii* of community 1 and 2.

The average number of species per quadrat is 55.

3b Jarrah Marri Tall Woodland over *Banksia grandis* Tall Open Shrubland, *Bossiaea ornata/Sphaerolobium medium/Hibbertia hypericoides* Shrubland, *Patersonia umbrosa* var. *xanthina* Herbland and Mixed Open Sedgeland. (Mapped as one unit with 3a)
Quadrats 3,5, Figure 9 and 10

This community is found scattered throughout the range of 3a and is distinguished by the presence of a distinct Tall Shrub or Low Tree layer of Bull Banksia -*Banksia grandis*. There do not appear to be other major differences in floristics, soils or topographical position although *Acacia extensa* is not as dominant in the shrub layer compared to 3a in the quadrats surveyed. The average number of species per quadrat is 50.

4 Swan River Blackbutt (*Eucalyptus patens*) Very Open Woodland over *Acacia saligna/Acacia extensa/Callistachys lanceolata* Tall Open Scrub *Acacia pulchella/Agonis linearifolia* Open Heath, Mixed Open Herbland *Tetrarrhena laevis/Microlaena stipoides* Very Open Grassland and *Lepidosperma* sp./*Baumea juncea* Sedgeland
Quadrat 7 Figure 11

This community is found along the drainage line in the east of the reserve where soils are deep grey to light brown sands and remain wet throughout most of the year. The abundance of the *Acacias* would be expected to decline with increasing age since the last fire which occurred in 1994. This is the only community to have a significant native grass cover, with *Tetrarrhaena laevis* and *Microlaena stipoides* dominant. Other characteristic species include *Callistachys lanceolata, Agonis linearifolia, Thomasia pauciflora, Tremandra diffusa, Caesia micrantha, Baumea juncea* and *Lomandra pauciflora.* Twenty of the 41 species present were recorded only in this community.

Vegetation Condition

Most of the reserve is in excellent condition, exhibiting a diverse flora and varied structure. Ten quadrats scored an excellent rating whilst B5 and B8 scored very good to excellent and B6 - very good. Sixteen introduced species were recorded in the quadrats and none of these were aggressively invading the bushland. No evidence of disease was observed (see Dieback) and whilst larger trees and shrubs showed evidence of the hot fire 6 years ago all but some smaller saplings have recovered vegetatively (see Fire).

Areas of high degradation occur within the reserves and are associated with the clearings around the racecourse, borrow pits (north of the racecourse and in the western end of the reserve) and track sides (see Map 4). Within the race track approximately two thirds of the remaining native vegetation is in good to very good condition exhibiting a reduced diversity and complexity whilst the remaining one third in the eastern portion is in very good to excellent condition.

The number of species found in each 10x10 quadrat varied from 41 in B7 to 74 in B 6 with an average of 56 species/quadrat. Higher species /quadrat does not necessarily indicate any greater conservation value as different vegetation communities are characterised by different species diversity. Few comparable studies are available for the Jarrah forests, though studies in the Northern Jarrah Forest found an average of 60 species / 20mx20m quadrats with a range from 40 –80 species. (McDougall pers. comm.), whilst Gibson *et al* (1994) found an average of 67.8 species/ 10mx10m quadrat on the Swan Coastal Plain in *Eucalyptus calophylla /E. marginata* Woodland/Forest with similar understorey species to those found in Community 2.

Dieback

Dieback caused by the fungus *Phytophthora cinnamomi* and related species is rife in the Jarrah forests of southern Western Australia, resulting in a decrease in plant diversity in the short term and a change in plant composition in the long term (McDougall 1997). Susceptible plant species die as the pathogen invades the roots and rots the tissue, thus inhibiting the ability of the plant to take up water. Not all plant species are susceptible to dieback but once present there is no way of eradicating the disease although spraying with phosphite can confer some immunity to susceptible plants species if applied regularly. The pathogen may spread by mobile spores through water – hence infections usually move down slopes, or by resting spores transported in soil eg on car tyres.

No sampling for dieback presence was conducted during this survey, however no symptoms of dieback were evident (ie dead or dying plants). Comparisons with recent studies in the Northern Jarrah Forests particularly near Dandalup indicate the reserves are free of dieback McDougall (pers. comm). McDougall found that whilst most species could be present in small numbers on dieback sites, regardless of how susceptible they are, the rarity of the following species were the best indicators of dieback presence in Jarrah forest: *Agrostocrinum scabrum, Banksia grandis, Comesperma virgatum, Daviesia preissii, Dianella revoluta, Hibbertia amplexicaulis, Leucopogon verticillatus, Patersonia babionoides, Persoonia longifolia, Styphelia tenuifolia* and *Tetratheca hirsuta* (McDougall pers comm). With the exception of *Styphelia tenuifolia,* which was not recorded on the reserve, all of these species are present and frequently very common (See Appendix 4)

Additionally, McDougall (1997) found that *Bossiaea ornata, Hibbertia commutata, Hovea chorizemifolia Labichea punctata, Leptomeria cunninghamii, Leucopogon capitellatus, Logania serpyllifolia, Scaevola calliptera, Stylidium amoenum, Stylidium schoenoides, Tetrarrhena laevis,* and *Trichocline spathulata,* along with eight other species not recorded during this survey, were species that became rarer on dieback sites though were still found in low numbers. These species are common and often dominant in the shrub and herb layers within the North Balingup Reserves.

Given the topography of the reserves, dieback disease has the potential to spread rapidly down slopes if introduced along the central track on the main ridge.

Fire

All of the North Balingup Reserves were burnt by a very hot fire 6 years ago in the spring of 1994. The proliferation of *Acacia* species in the understorey reflects this recent firing and the species dominance is expected to change with time. Most trees have recovered vegetatively though some smaller saplings have not recovered.

Many of the dominant structural components of the vegetation present, especially the *Acacias* and many Papilionaceae species are obligate seed regenerators and their ability to recover following fire relies on having adequate seed source which may take 7 to 10 years or more to develop. This seed source may be stored in the soil as in *Acacias,* on the plants as in *Banksias* or be transported in by wind or animal etc. Other plants may regenerate vegetatively, either from buds protected by bark or from underground storage organs. Some species are referred to as fire ephemerals and appear abundantly immediately following fire, declining markedly in number between fires. Fire initiates flowering in some species such as certain orchids and sundews whilst others like grasstrees flower more frequently following fire.

Fire is a natural part of the environment and the effects of fire on flora in the south west of Western Australia is variable and dependent upon the fire regime – a combination of the interval of time between fire, the intensity of fire, the season and size of fire (Burrows 1990). The varying responses of different plant species to fire, indicate no particular fire regime will suit all plant species. Thus to maintain diversity, fires should be infrequent to enable a seed bank to develop and preferably not burn the entire bushland remnant to ensure both a recruitment base for regeneration and habitat for fauna.

CONSERVATION STATUS

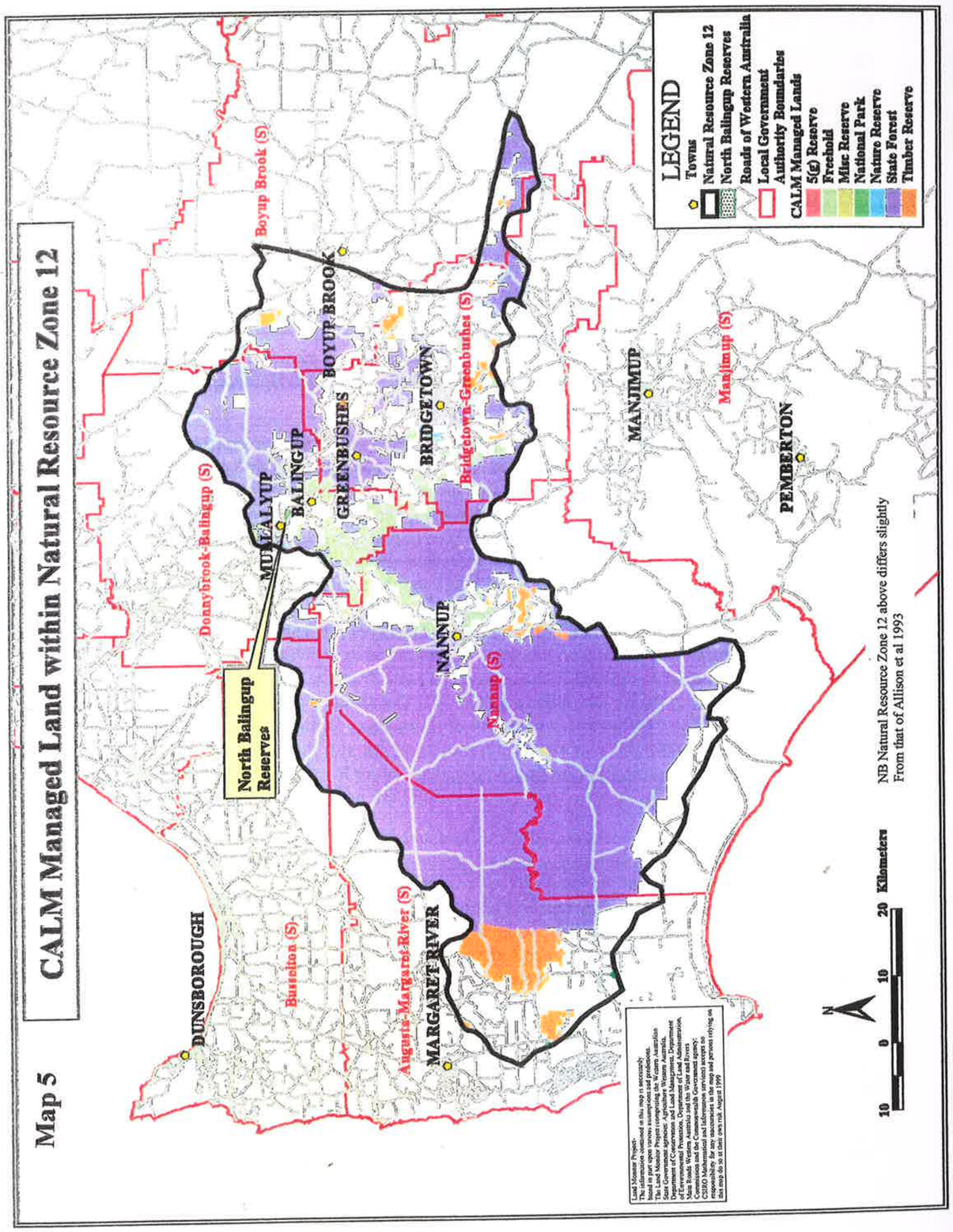
On a regional scale it is appropriate to compare the conservation and vegetation status of the reserves with that of the Natural Resource Zone 12, an area considered to have similar biological, physical and ecological values (Map 3 & 5). Whilst much of this zone is vegetated with bushland, little land is currently vested for the purposes of conservation, with only 500ha in Nature Reserves, 16ha in National Parks (along the south west boundary) and 42ha in 5g reserves (see Map 5) (B.Carr Dept Environmental Protection, pers comm). Implementation of RFA proposals would greatly increase the amount of conservation reserves within this zone, though most of these are in the southern portion and few are near the North Balingup Reserves (Map 6). No conservation reserves in the Zone 12, existing or proposed, have similar underlying geology to those of the North Balingup Reserves.

Vegetation mapping within zone 12 has been conducted by Beard (1981) and Mattiske and Havel (1998) but the absence of comparable quadrat based vegetation data makes regional comparison difficult. Beards mapping is very broad dividing Zone 12 into two systems: Bridgetown and Chapman with a small incursion of a third. The North Balingup Reserves fall within the Bridgetown System (see Map 3).

The lack of detailed descriptions of floristics and structure in the vegetation complexes of Mattiske and Havel (1998) make it difficult to compare the complexes of different areas or to relate them to the vegetation communities of this survey. Never-the-less a strong mapping correlation exists between Community 1 (Jarrah/Marri Open Woodland over Woody Pear Low Open Woodland), and the Kirup Complex (Open Forest to woodland of *Eucalyptus marginata/Corymbia calophylla/Banksia attenuata/Xylomelum occidentale* on sandy slopes) and between Community 3 (Jarrah/Marri Woodland) and the Hester Complex (Tall Open Forest to Open Forest *Eucalyptus marginata/Corymbia calophylla* on lateritic uplands),(Map 4 and 4a). Assuming this correlation holds outside the reserves it is apparent that the largest area of Kirup complex and hence Community 1 in Zone 12 is in the North Balingup Reserves. A few smaller areas exist to the east of the reserves in State Forest and in the proposed Mullalyup Conservation Park of the adjacent Zone 11. The Hester Complex is more widespread within Zone 12, scattered from north of Balingup to Bridgetown. According to Mattiske and Havel (1998), this complex is currently reserved in a Nature Reserve west of Bridgetown and present in the RFA proposed Powlallup Nature Reserve, southern portion of the Mullalyup Conservation Park and in a Conservation Park north of Bridgetown.

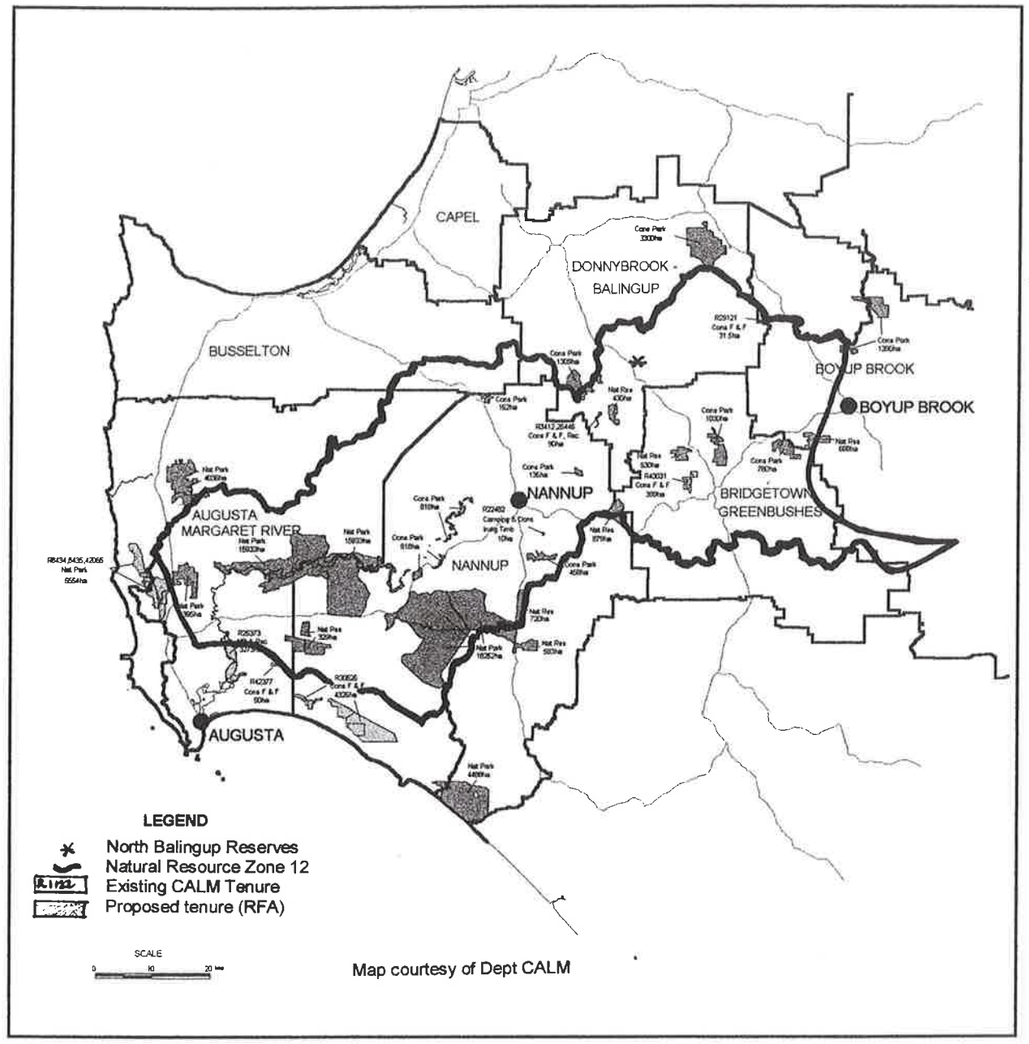
The North Balingup Reserves contain a diverse flora and vegetation in excellent condition and occur on a geological formation that is uncommon in the region. The vegetation contains communities representative of the local and regional area and a community uncommon on regional scale (Community 1). The reserves contain 2 priority species and several species on the limit of their known distribution and as an island of vegetation surrounded by cleared land the reserves may play an important role in bird and animal movements. All these factors indicate the reserves have a high conservation value.

Currently the Donnybrook/Balingup Shire has no reserves vested for the purposes of conservation although reserve 16004 in the North Balingup Reserves is proposed for the purposes of "Recreation, Eco-tourism, Conservation of Flora and Fauna". This proposal is in line with the consideration of their Draft Rural Strategy that a bushland strategy be developed for the Greater Balingup Precinct to protect native flora and fauna and retain current scenic qualities (BSD Consultants Pty Ltd 2001). CALM have recommended this reserve be vested for the purposes of Conservation of Flora and Fauna only (P. Hanly, CALM pers comm).



Map 5

Map 6 Existing and Proposed CALM conservation reserves in Zone 12



Management Considerations

As the reserves have a high conservation value their management should aim to maintain this value, by preserving the flora and vegetation identified by this survey as being both representative and unique to the local and regional area. Implicit in such an aim is the identification of processes that threaten this value, some of which have been identified by this survey (dieback introduction, frequent burning and weed invasion) and implementation of practises that would reduce these threats. The reserves also exhibit prolific spring flowering (see Figure 12), providing both educational and recreational opportunities and these aspects of management along with those already mentioned are best addressed by the preparation of a Management Plan for the reserves.

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Figure 1 Volunteers from the local community and Wildflower Society, recording information for quadrat B2. Working in groups of 4 to 6 everyone is involved in laying out the quadrat, collecting and labelling specimens and recording data.

Figure 2 ***Tetratheca parvifolia*** **P3**, one of two priority plants recorded in the North Balingup Reserves during the survey.

Figure 3 Community 1 Quadrat B11 Jarrah/Marri Open Woodland over Woody Pear (*Xylomelum occidentale*) Low Open Woodland, Mixed Shrubland and *Phlebocarya ciliata* Herbland.

Figure 4 Community 1 Quadrat B8, Woody Pear (*Xylomelum occidentale*) a dominant and characteristic species of this community is in the foreground.

Figure 5 Quadrat B6 Marri/Jarah Tall Open Forest. The prolific flowering of wattles here (*Acacia extensa*) was a feature of the reserves at the time of surveying.

Figure 6 Community 2 Quadrat B10 Marri/Jarrah Tall Open Forest showing the dense 1 to 2 m. shrub layer of *Acacia extensa* and *Bossiaea linophylla* characteristic of this community.

Figure 7 Community 3, Association 3a Quadrat B2 Jarrah/Marri Woodland on the main ridge. The blackened tree trunks are a result of a very hot fire in the spring of 1994.

Figure 8 Community 3, Association 3a Quadrat B4 Jarrah/Marri Open Forest, showing the openness of the understorey and dominance of the small shrubs and herbs characteristic of community 3.

Figure 9 Community 3, Association 3b Quadrat B3. Jarrah/Marri Tall Open Woodland over *Banksia grandis* Tall Open Shrubland, *Bossiaea ornata/Sphaerolobium medium/Hibbertia hypericoides* Shrubland, *Patersonia umbrosa* var. *xanthina* Herbland and Mixed Open Sedgeland.

Figure 10 Community 3, Association 3b Quadrat B5. Apart from the presence of a shrub or small tree layer of Bull Banksia (*Banksia grandis*), this association is similar to Association 3a.

Figure 11 Community 4 Quadrat B7. Swan River Blackbutt Very Open Woodland over *Acacia saligna/Acacia extensa/Callistachys lanceolata* Tall Open Scrub *Acacia pulchella/Agonis linearifolia* Open Heath, Mixed Open Herbland *Tetrarrhena laevis/Microlaena stipoides* Very Open Grassland and *Lepidosperma* sp. */Baumea juncea* Sedgeland.

Comesperma virgatum
Milkwort

Xanthosia atkinsonia

Thysanotus multiflorus
Many Flowered Fringe Lily

Hardenbergia comptoniana
Native Wisteria

Chorizema cordatum
Flame Pea

Pimelea suaveolens
Scented Banjine

Acacia extensa
Wiry wattle

Hakea lissocarpha
Honey Bush

Tetratheca hirsuta

Figure 12: Prolific spring flowering is a feature of the North Balingup Reserves

APPENDIX 1: PLANT SPECIES LIST - NORTH BALINGUP RESERVES

All taxa (species and subspecies) recorded within the reserves during the survey are listed in Appendix 1. The taxa are listed alphabetically by family, and within family, alphabetically by genera.

KEY

Column 1 Plant Family

Column 2 Botanical name

* indicates an introduced species
subsp = sub species
var = variety
sensu lat = broad species grouping

Column 3 Common Name

Common names follow Bennet (1993), and Hussey *et al* (1997) and Willis (1972).

Column 4 Life Form

A **Annual**: a plant which completes its life cycle in less than one year, i.e. germinates from seed, flowers, sets seed and dies in the same year

P **Perennial**: a plant that lives three or more years

P/A Plants with perennial rootstocks (e.g. bulbs and corms) but with above ground parts which die back each year (common in the families Orchidaceae and Iridaceae)

Column 5 Growth form or habit

Tree A woody plant over 2 metres tall with a single stem or branches well above the base

Shrub A woody plant multi stemmed at or close to the base, or if single stemmed under 2m tall

Herb a plant without a persistent above ground woody stem (excluding grasses, sedges and rushes)

Vine a climbing, scrambling or trailing plant, often with special modifications for climbing

Grass members of the family Poaceae

Sedge grass like plants, members of the families Cyperaceae and Centrolepidaceae

Rush grass like plants, members of the families Restionaceae and Juncaceae

Grasstree members of the family Xanthorrhoeaceae

Cycad members of the family Zamiaceae

Fern Member of the Class Filicopsida (True Ferns)

Column 6 Quadrat Number

Column 7 Conservation Code -Rare/Priority (see Appendix 3)

APPENDIX 1 PLANT SPECIES LIST NORTH BALINGUP RESERVES

Family /Taxon	Common Name	Life Form	Growth form	Quadrat	Priority
AIZOACEAE					
*Lampranthus coccinea		P	shrub		
AMARANTHACEAE					
Ptilotus manglesii	Pom Poms	P	herb	6	
ANTHERICACEAE					
Agrostocrinum scabrum	Blue Grass Lily	P	herb	1 3 4 5 10 11 13	
Caesia micrantha	Pale Grass Lily	P	herb	7 10	
Chamaescilla corymbosa var	Blue Squill	P	herb	1 2 4 7 10 13	
corymbosa		P	herb		
Johnsonia lupulina	Hooded Lily	P	herb	9 11	
Sowerbaea laxiflora	Purple Tassel	P	herb		
Thysanotus manglesianus	Fringe Lily	P	herb	6 8 11 13	
Thysanotus multiflorus	Many Flowered Fringe Lily	P	herb	1 2 3 4 5 6 10 12	
Tricoryne humilis		P	herb		
APIACEAE					
Daucus glochidiatus	Australian Carrot	A	herb	9 13	
*Foeniculum vulgare	Fennel	P	herb		
Hydrocotyle callicarpa	Small Pennywort	A	herb	13	
Platysace filiformis		P	herb/shrub	1 4 5 9 10 11 12 13	
Trachymene pilosa	Native Parsnip	A	herb	1 6 8 9 13	
Xanthosia atkinsonia		P	herb	1 2 3 12	
Xanthosia candida		P	herb	2 4 5 6 12	
Xanthosia huegelii		P	herb	1 2 3 8 9 10 11 12	
ASPLENIACEAE					
Asplenium flabellifolium	Necklace Fern	P	fern	11	
ASTERACEAE					
*Arctotheca calendula	Cape Weed	A	herb		
*Conyza sp	Fleabane		herb	7	
*Cotula turbinata	Funnel Weed	A	herb		
Craspedia variabilis		A/P	herb	9	
Euchiton collinus		A/P	herb		P3
*Filago gallica	Slender Cudweed	A	herb		
Hyalosperma cotula		A	herb		

Family /Taxon	Common Name	Life Form	Growth form	Quadrat	Priority
ASTERACEAE cont.					
*Hypochaeris glabra	Smooth Catsear	A/P	herb	1 5 6 7 8 9 10 13	
*Hypochaeris radicata	Flatweed	A/P	herb		
Lagenophora huegelii		P	herb	2 3 4 6 8 9 10 11 12 13	
Millotia tenuifolia var tenuifolia	Soft Millotia	A	herb	1 8 13	
Ozothamnus cordatus		P	shrub		
Podolepis gracilis	Slender Podolepis	A	herb	1 6	
Quinetia urvillei		A	herb		
Rhodanthe citrina		A	herb	1	
Senecio hispidulus var hispidulus	Hispid Fireweed	A	herb	1 9	
Siloxerus humifusus		A	herb		
*Tolpis barbata	Yellow Hawkweed	A	herb		
Trichocline spathulata	Native Gerbera	P	herb	2 4 5 6 9 12	
*Ursinia anthemoides	Ursinia	A	herb	1	
*Vellereophyton dealbatum	White Cudweed	A/P	herb	7	
*Asteraceae sp		A	herb	7	
CAESALPINIACEAE					
Labichea punctata	Lance-leaved Cassia	P	shrub	3 4 6 9 12	
CAMPANULACEAE					
Wahlenbergia littericola	Bluebell	P	herb	10	
Wahlenbergia multicaulis		P	herb	6 9	
Wahlenbergia preissii	Bluebell	A	herb	1 13	
CARYOPHYLLACEAE					
*Cerastium glomeratum	Mouse Ear Chichweed	A	herb		
*Petrorhagia velutina	Velvet Pink	A	herb		
*Silene gallica	French Catchfly	A	herb		
CENTROLEPIDACEAE					
Centrolepis aristata	Pointed Centrolepis	A	herb		
Centrolepis drummondiana		A	herb	1 13	
Centrolepis pilosa		A	herb		
COLCHICACEAE					
Burchardia umbellata	Milkmaids	A/P	herb	1 8 10 11 13	
CRASSULACEAE					
*Crassula decumbens var decumbens	Rufous Stonecrop	A	herb	13	
Crassula colorata	Dense Stonecrop	A	herb		

Family /Taxon	Common Name	Life Form	Growth form	Quadrat	Priority
CYPERACEAE					
Baumea juncea	Bare Twig Rush	P	sedge	7	
Baumea rubiginosa		P	sedge		
Cyathochaeta avencea		P	sedge	7	
*Isolepis marginata	Club-rush	P	sedge	13	
Lepidosperma leptostachyum	Sword Sedge	P	sedge	6 9	
Lepidosperma sp aff squamatum	Sword Sedge	P	sedge	7	
Schoenus efoliatus		P	sedge		
Tetraria capillaris	Hair Sedge	P	sedge	1 2 3 4 5 6 7 8 9 10 11 12	
Tetraria octandra		P	sedge	1 2 3 4 5 6 8 9 10 12 13	
DASYPOGONACEAE					
Lomandra caespitosa	Tufted Mat Rush	P	herb	6 8 11 13	
Lomandra drummondii		P	herb		
Lomandra hermaphrodita		P	herb	1 6 8 9 13	
Lomandra integra		P	herb	2 4 5 7	
Lomandra nigricans		P	herb	6 9 10 12 13	
Lomandra pauciflora		P	herb	7	
Lomandra preissii		P	herb	1 3 5 10 12	
Lomandra suaveolens		P	herb		
Lomandra sericea	Silky Mat Rush	P	herb	1 2 4 6 8 9 12	
DENNSTAEDTIACEAE					
Pteridium esculentum	Bracken	P	fern	6 7 8 10 11 13	
DILLENEACEAE					
Hibbertia amplexicaulis		P	shrub	2 3 4 5 6 8 9 10 11 12	
Hibbertia commutata		P	shrub	1 2 3 4 5 6 9 10 12	
Hibbertia hypericoides	Yellow Buttercups	P	shrub	1 2 3 4 5 6 8 9 10 11 12 13	
Hibbertia racemosa	Stalked Guinea Flower	P	shrub	8	
DROSERACEAE					
Drosera erythrorhiza	Red Ink Sundew	A/P	herb	1 3 4 5 6 8 10 12 13	
Drosera glanduligera	Pimpernel Sundew	A/P	herb		
Drosera pallida	Pale Rainbow	A/P	herb/vine	1 3 4 6 8 9 11 12 13	
Drosera stolonifera subsp stolonifera	Leafy Sundew	A/P	herb	2 6 9	
EPACRIDACEAE					
Astroloma ciliatum	Candle Cranberry	P	shrub	6 10	
Astroloma drummondii		P	shrub	2 4 6 8 9 10	

Family /Taxon	Common Name	Life Form	Growth form	Quadrat	Priority
EPACRIDACEAE cont.					
Astroloma pallidum	Kick Bush	P	shrub	2 3 4 5 9 12	
Leucopogon australis	Spiked Beard-heath	P	shrub		
Leucopogon elatior		P	shrub		
Leucopogon capitellatus		P	shrub	1 2 4 6 8 9 10 11 12	
Leucopogon propinquus		P	shrub	3 4 5 9	
Leucopogon verticillatus	Tassel Flower	P	shrub	5 10	
EUPHORBIACEAE					
Monotaxis occidentalis		P	herb/shrub	1 4 5 6 8 9 10 12 13	
Phyllanthus calycinus	False Boronia	P	shrub	6	
Poranthera huegelii		P	shrub	11	
Poranthera microphylla	Small Poranthera	A	herb		
FUMARIACEAE					
*Fumaria capreolata	Whiteflower Fumitory	A	herb		
GENTIANACEAE					
*Centaurium erythraea	Common Centaury	A	herb		
GERANIACEAE					
Pelargonium littorale subsp littorale		P	herb	7	
GOODENIACEAE					
Dampiera linearis	Common Dampiera	P	herb	1 2 3 4 6 8 9 10 11 12 13	
Goodenia caerulea		P	herb/shrub		
Goodenia eatoniana		P	shrub	1 2 4 10	
Scaevola calliptera	Royal Robe	P	herb/shrub	1 2 3 4 5 6 9 10 12 13	
Scaevola glandulifera	Viscid Hand-flower	P	shrub	3 7	
Velleia trinervis		P	herb	8 9	
HAEMODORACEAE					
Anigozanthus flavidus	Tall Kangaroo Paw	P	herb	7	
Anigozanthus manglesii subsp manglesii	Mangles Kangaroo Paw	P	herb	6 9	
Conostylis aculeata subsp aculeata	Prickly Conostylis	P	herb		
Conostylis serrulata		P	herb	1 3 5 7 8 10 11 13	
Haemodorum spicatum	Bloodroot	P	herb		
Phlebocarya ciliata		P	herb	4 8 11 13	
HYPOXIDACEAE					
Hypoxis occidentalis var quadriloba		A/P	herb		

Family /Taxon	Common Name	Life Form	Growth form	Quadrat	Priority
IRIDACEAE					
Orthrosanthus laxus var. laxus	Morning Iris	P	herb	10	
Patersonia babianoides		P	herb	2 3 4	
Patersonia occidentalis	Purple Flag	P	herb		
Patersonia umbrosa var xanthina	Yellow Flags	P	herb	1 2 3 4 5 6 7 8 10 11 13	
*Romulea rosea	Guilford Grass	A/P	herb		
*Watsonia marginata		A/P	herb		
*Watsonia meriana var bulbifera	Bulbil Watsonia	A/P	herb	1	
*Watsonia versfeldii		A/P	herb		
JUNCACEAE					
*Juncus capitatus	Capitate Rush	A	rush		
Juncus pallidus	Pale Rush	P	rush	7	
Luzula meridionalis	Field Woodrush	P	rush	3 9	
LAMIACEAE					
Hemigenia incana	Silky Hemigenia	P	shrub		
*Lavandula stoechas	French Lavender	P	shrub		
LAURACEAE					
Cassytha racemosa	Dodder Laurel	P	vine	1 2 4 6 8 10	
LINACEAE					
*Linum trigynum	French Flax	A	herb		
LOBELIACEAE					
Isotoma hypocrateriformis	Woodbrige Poison	A	herb	5	
LOGANIACEAE					
Logania serpyllifolia		P	herb/shrub	2 4 5 6 9 10 11 12 13	
MIMOSACEAE					
*Acacia baileyana	Cootamundra Wattle	P	tree		
Acacia extensa	Wiry Wattle	P	shrub	1 3 4 6 7 8 9 10 11 12 13	
Acacia insolita subsp insolita		P	shrub		
*Acacia longifolia	Sydney Golden Wattle	P	shrub		
*Acacia mearnsii	Black Wattle	P	tree		
Acacia nervosa	Rib Wattle	P	shrub		
Acacia pulchella var pulchella	Prickly Wattle	P	shrub	1 2 3 4 5 7 8 12	
Acacia saligna	Orange Wattle	P	shrub	7	
Acacia stenoptera	Narrow Winged Wattle	P	shrub	12	
Acacia urophylla		P	shrub		

Family /Taxon	Common Name	Life Form	Growth form	Quadrat	Priority
MYRTACEAE					
Agonis linearifolia	Swamp Peppermint	P	shrub	7	
Eucalyptus calophylla	Marri	P	tree	1 2 3 5 6 7 9 10 11 12 13	
Eucalyptus marginata subsp marginata	Jarrah	P	tree	1 2 3 4 5 6 8 9 10 11 12 13	
Eucalyptus patens	Swan River Blackbutt	P	tree	7	
Hypocalymma strictum		P	shrub		
*Leptospermum laevigatum	Coast Teatree	P	shrub		
ORCHIDACEAE					
Caladenia attingens subsp attingens	Forest Mantis Orchid	A/P	herb	5 8 9 13	
Caladenia flava	Cowslip Orchid	A/P	herb	1 4 6 8 9 11 12 13	
Caladenia longiclavata	Clubbed Spider Orchid	A/P			
Caladenia macrostylis	Leaping Spider Orchid	A/P	herb	2 3	
Caladenia magniclavata	Big Clubbed Spider Orchid	A/P	herb	5 11	
Caladenia reptans subsp reptans	Little Pink Fairy Orchid	A/P	herb	13	
Cyanicula sericea	Silky Blue Orchid	A/P			
Cyrtostylis robusta	Mosquito Orchid	A/P	herb	5 13	
Diuris longifolia	Common Donkey Orchid	A/P	herb		
Drakaea livida	Warty Hammer Orchid	A/P			
Elythranthera brunonis	Purple Enamel Orchid	A/P	herb		
Eriochilus dilatatus subsp multiflorus	White Bunny Orchid	A/P	herb	2 3 4 5 12 11 13	
Lyperanthus serratus	Rattlebeak Orchid	A/P	herb	12 13	
Microtis media var densiflora	Common Mignonette Orchid	A/P	herb		
*Monadenia bracteata	South African Orchid	A/P	herb	2	
Prasophyllum sp	Leek Orchid	A/P	herb	6 7	
Pterostylis aff nana	Snail Orchid	A/P	herb		
Pterostylis recurva	Jug Orchid	A/P	herb	1 3	
Pterostylis vittata	Banded Greenhood	A/P	herb	1 3 4 12 13	
Pyrorchis nigricans	Red Beak Orchid	A/P	herb	1 3 6 9 12 13	
Thelymitra crinita	Blue Lady Orchid	A/P	herb	2 3 4 6 8	
Thelymitra flexuosa	Twisted Sun Orchid	A/P	herb		
Thelymitra aff holmsii	Plain Sun Orchid	A/P	herb	1 3 5 6 8 13	
OROBANCHACEAE					
*Orobanche minor	Lesser Broomrape	P	herb	6	

Family /Taxon	Common Name	Life Form	Growth form	Quadrat	Priority
OXALIDACEAE					
*Oxalis pes-caprae	Sour Sob	A/P	herb		
*Oxalis purpurea	Largeflower Wood Sorrell	A/P	herb		
PAPILIONACEAE					
Bossiaea linophylla		P	shrub	1 3 6 8 10 11 12 13	
Bossiaea ornata	Broad Leaved Brown Pea	P	shrub	1 2 3 4 5 9 11 12	
Callistachys lanceolata	Native Willow	P	shrub	7	
*Chamaecytisus palmensis	Tree Lucerne	P	shrub/tree		
Chorizema cordatum	Flame Pea	P	shrub	10	
Chorizema ilicifolium	Holly Flame Pea	P	shrub	5	
Daviesia incrassata subsp incrassata		P	shrub		
Daviesia preissii		P	shrub		
Gastrolobium spinosum var spinosum	Prickly Poison	P	shrub		
forma typica		P	shrub		
*Genista monspessulana	Broom	P	shrub		
Gompholobium capitatum	Yellow Pea	P	shrub	8	
Gompholobium confertum		P	shrub	1 8	
Gompholobium marginatum		P	shrub	6 11	
Gompholobium ovatum		P	shrub		
Gompholobium polymorphum		P	shrub/vine	2 3 8 12	
Gompholobium preissii		P	shrub	1 3 4 6 8 9 10 11	
Hardenbergia comptoniana	Native Wisteria	P	vine		
Hovea chorizemifolia	Holly-leaved Hovea	P	shrub	2 3 4 5 6 9 10	
Isotropis cuneifolia	Granny Bonnets	P	herb	5 6 8 9 10 11 12	
Kennedia carinata		P	vine	2 9 10	
Kennedia coccinea	Coral Vine	P	vine	4 5 6	
Kennedia prostrata	Scarlet Runner	P	vine	6	
*Lupinus angustifolius	Narrowleaf Lupin	A	herb		
Mirbelia dilatata	Prickly Mirbelia	P	shrub		
*Ornithopus compressus	Yellow Serradella	A	herb	10	
Sphaerolobium medium	Globe Pea	P	shrub	1 2 3 4 5 6 8 9 10 11 12	
*Trifolium campestre	Hop Clover	A	herb		
*Trifolium dubium	Slender Suckling Clover	A	herb		
*Trifolium ligusticum	Ligurian Clover	A	herb		
*Trifolium subterraneum	Subterraneum Clover	A	herb	10	

Family /Taxon	Common Name	Life Form	Growth form	Quadrat	Priority
PHORMIACEAE					
Dianella revoluta	Blueberry Lily	P	herb	6 10	
PINACEAE					
*Pinus pinaster	Pinaster Pine	P	tree		
*Pinus radiata	Radiater Pine	P	tree		
PITTOSPORACEAE					
Billardiera floribunda	White Flowered Billardiera	P	vine	7 8 10	
Billardiera variifolia		P	vine	2 3 4 7 8 9 10 11 12 13	
Sollya heterophylla	Australian Bluebell	P	vine		
PLANTAGINACEAE					
*Plantago lanceolata	Ribwort Plantain	A/P	herb		
POACEAE					
*Aira caryophyllea	Silvery Hairgrass	A	grass	8 13	
*Aira praecox	Early Hairgrass	A	grass		
*Avena barbata	Bearded Oat	A	grass		
Amphipogon amphipogonoides		P	grass	2 4	
Austrodanthonia caespitosa	Common Wallaby Grass	P	grass		
Austrodanthonia occidentalis		P	grass	1 3 4 6 8	
Austrodanthonia pilosa		P	grass	2 5 10	
Austrostipa campylachne	Spear Grass	P	grass	1 2 5 6 9 10 12	
*Briza maxima	Blowfly Grass	A	grass	1 6 8 9 10 12 13	
*Briza minor	Shivery Grass	A	grass		
*Bromus diandrus	Great Brome	A	grass		
*Bromus hordeaceus	Soft Brome	A	grass		
*Cynodon dactylon	Couch	P	grass		
Deyeuxia quadriseta	Reed Bentgrass	P	grass	2 4 5 6 10 12	
Dichelachne crinita	Longhair Plume Grass	P	grass	6	
*Ehrharta calycinus	Perennial Veldtgrass	P	grass		
*Ehrharta longifolia	Annual Veldtgrass	A	grass		
*Eragrostis curvula	African Lovegrass	P	grass		
*Holcus lanatus	Yorkshire Fog	P	grass	7	
Microlaena stipoides	Weeping Grass	P	grass	6 10	
*Poa annua	Winter Grass	A	grass		
Tetrarrhena laevis	Forest Ricegrass	P	grass	2 3 4 5 6 79 10 12	
*Vulpia bromoides	Squirrel Tail Fescue	A	grass		
*Vulpia myuros	Rat's Tail Fescue	A	grass	8	

Family /Taxon	Common Name	Life Form	Growth form	Quadrat	Priority
PODOCARPACEAE					
Podocarpus drouynianus	Wild Plum	P	shrub	13	
POLYGALACEAE					
Comesperma calymega	Blue-Spike Milkwort	P	shrub/herb	6	
Comesperma virgatum	Milkwort	P	shrub	2 6 12	
POLYGONACEAE					
*Acetellosa vulgaris	Sorrel	A	herb		
*Rumex crispus x pulcher	Dock	P	herb		
PROTEACEAE					
Adenanthos obovatus	Basket Flower	P	shrub		
Banksia grandis	Bull Banksia	P	shrub/tree	1 3 4 5 12	
Conospermum capitatum subsp		P	shrub		
capitatum		P	shrub		
Dryandra lindleyana subsp		P	shrub	5 6	
silvestris		P	shrub		
Hakea amplexicaulis	Prickly Hakea	P	shrub	4 12	
Hakea lissocarpha	Honey Bush	P	shrub	2	
Hakea ruscifolia	Candle Hakea	P	shrub		
Persoonia longifolia	Snottygobble	P	shrub/tree	1 2 3 4 5 6 8 10 11 12	
Petrophile linearis	Pixie Mops	P	shrub		
Synaphea sp.		P	shrub		
Xylomelum occidentale	Woody Pear	P	shrub/tree	8 11 13	
RANUNCULACEAE					
Clematis pubescens	Common Clematis	P	vine	6 9 10	
RESTIONACEAE					
Desmocladus fasciculatus		P	rush	1 3 5 6 8 9 10 11	
Hypolaena exsulca		P	rush	7 8 11 13	
Loxocarya cinerea		P	rush	8 11 13	
Lyginia imberbis		P	rush		
ROSACEAE					
*Rubus fruiticosa sensu lat	Blackberry	P	shrub/vine		
RUBIACEAE					
*Galium divaricatum	Slender Bedstraw	A	herb		
Opercularia apiciflora		P	herb/shrub	2 4 6 8 9 10 12	
Opercularia hispidula	Hispid Stinkweed	P	herb/shrub	1 5 7 8 11	
RUTACEAE					
Philotheca spicata	Pepper and Salt	P	shrub	1 8 9 11	

Family /Taxon	Common Name	Life Form	Growth form	Quadrat	Priority
SANTALACEAE					
Leptomeria cunninghamii		P	shrub	9	
SCROPHULARIACEAE					
Gratiola pubescens	Austral Brooklime	P	herb		
*Parentucellia latifolia	Common Bartsia	A	herb		
*Parentucellia viscosa	Sticky Bartsia	A	herb		
Veronica calycina	Cup Speedwell	P	herb	10	
STACKHOUSIACEAE					
Stackhousia monogyna		P	herb		
Tripterococcus brunonis		P	herb	1 3 6 8 9	
STERCULIACEAE					
Thomasia pauciflora	Few-flowered Thomasia	P	shrub	7	
STYLIDACEAE					
Levenhookia pusilla	Midget Stylewort	A	herb	1 4 8 9 10 13	
Levenhookia stipitata	Common Stylewort	A	herb		
Stylidium amoenum	Lovely Trigger Plant	P	herb	1 2 3 4 5 6 10 11 12	
Stylidium calcaratum	Book Trigger Plant	A	herb	8 9 13	
Stylidium crassifolium	Thick-leaved Trigger Plant	P	herb		
Stylidium schoenoides	Cow Kicks	P	herb	8 11 13	
Stylidium violaceum	Violet Trigger Plant	P	herb	8 11	
THYMELAEACEAE					
Pimelea lehmanniana subsp nervosa		P	shrub		
Pimelea suaveolens subsp	Scented Banjine	P	shrub		
suaveolens					
TREMANDRACEAE					
Tetratheca affinis		P	shrub	10	
Tetratheca hirsuta	Black Eyed Susan	P	shrub	1 2 3 4 6 8 10 11 12	
Tetratheca parvifolia		P	shrub		P3
Tetratheca setigera		P	shrub	5 12	
Tremandra diffusa		P	shrub	7 10	
VIOLACEAE					
Hybanthus debilissimus		P	herb	4	
XANTHORRHOEACEAE					
Xanthorrhoea gracilis	Graceful Grasstree	P	grasstree	2 4 5	
Xanthorrhoea preissii	Grasstree	P	grasstree	6 7 8 11	
ZAMIACEAE					
Macrozamia riedlei	Zamia	P	cycad	3 4 6 8 9 11 13	

APPENDIX 2 INTRODUCED SPECIES NORTH BALINGUP RESERVES

Family	Species	Common name	Habit	EWSWA rating
AIZOACEAE				
	*Lampranthus coccinea		creeper/shrub	low
APIACEAE				
	*Foeniculum vulgare	Fennel	herb	*TBA
ASTERACEAE				
	*Arctotheca calendula	Cape Weed	herb	moderate
	*Conyza sp.	Fleabane	herb	low
	*Cotula turbinata	Funnel Weed	herb	low
	*Filago gallica	Slender Cudweed	herb	low
	*Hypochaeris glabra	Smooth Catsear	herb	moderate
	*Hypochaeris radicata	Flatweed	herb	*n/a
	*Tolpis barbata	Yellow Hawkweed	herb	low
	*Ursinia anthemoides	Ursinia	herb	moderate
	*Vellereophyton dealbatum	White Cudweed	herb	moderate
	*Asteraceae sp.		herb	
CARYOPHYLLACEAE				
	*Cerastium glomeratum	Mouse Ear Chickweed	herb	low
	*Petrorhagia velutina	Velvet Pink	herb	mild
	*Silene gallica	French Catchfly	herb	low
CRASSULACEAE				
	*Crassula decumbens	Rufous Stonecrop	herb	n/a
CYPERACEAE				
	*Isolepis marginata	Coarse Club Rush		n/a
FUMARIACEAE				
	*Fumaria capreolata	White Flower Fumitory	herb	mild
GENTIANACEAE				
	*Centaurium erythraea	Common Centaury	herb	moderate
IRIDACEAE				
	*Romulea rosea	Guilford Grass	herb	high
	*Watsonia marginata		herb	moderate
	*Watsonia meriana v.bulbifera	Bulbil Watsonia	herb	high
	*Watsonia versfeldii		herb	mild
JUNCACEAE				
	*Juncus capitatus	Capitate Rush	rush	moderate
LAMIACEAE				
	*Lavandula stoechas	French lavender	shrub	low
LINACEAE				
	*Linum trigynum	French Flax	herb	low
MIMOSACEAE				
	*Acacia baileyana	Cootamundra Wattle	tree	low
	*Acacia longifolia	Sydney Golden Wattle	shrub	n/a
	*Acacia mearnsii	Black Wattle	tree	n/a
MYRTACEAE				
	*Leptospermum laevigatum	Coast Teatree	shrub	high
ORCHIDACEAE				
	*Monadenia bracteata	South African Orchid	herb	moderate
OROBANCHACEAE				
	*Orobanche minor	Lesser Broomrape	herb	moderate

*TBA = to be announced

*n/a = not available

APPENDIX 2 Cont.

Family	Species	Common name	Habit	EWSWA rating
OXALIDACEAE				
	*Oxalis pes-caprae	Sour Sob	herb	*TBA
	*Oxalis purpurea	Largeflower Wood Sorrell		low
PAPILIONACEAE				
	*Chamaecytisus palmensis	Tree Lucerne	shrub/tree	mild
	*Genista monspessulana	Broom	shrub	mild
	*Lupinus angustifolius	Narrowleaf Lupin	herb	mild
	*Ornithopus compressus	Yellow Serradella	herb	mild
	*Trifolium campestre	Hop Clover	herb	moderate
	*Trifolium dubium	Slender Suckling Clover	herb	moderate
	*Trifolium ligusticum	Ligurian Clover	herb	low
	*Trifolium subterraneum	Subterraneum Clover	herb	moderate
PINACEAE				
	*Pinus pinaster	Pinaster Pine	tree	moderate
	*Pinus radiata	Radiata Pine	tree	moderate
PLANTAGINACEAE				
	*Plantago lanceolata	Ribwort Plantain	herb	low
POACEAE				
	*Aira caryophyllea	Silvery Hairgrass	grass	moderate
	*Aira praecox	Early Hairgrass	grass	low
	*Avena barbata	Bearded Oat	grass	moderate
	*Briza maxima	Blowfly Grass	grass	moderate
	*Briza minor	Shivery Grass	grass	moderate
	*Bromus diandrus	Great Brome	grass	high
	*Bromus hordeaceus	Soft Brome	grass	low
	*Cynodon dactylon	Couch	grass	moderate
	*Ehrharta calycinus	Perennial Veldtgrass	grass	high
	*Ehrharta longifolia	Annual Veldtgrass	grass	moderate
	*Eragrostis curvula	African Lovegrass	grass	high
	*Holcus lanatus	Yorkshire Fog	grass	moderate
	*Poa annua	Winter Grass	grass	mild
	*Vulpia bromoides	Squirrel Tail Fescue	grass	moderate
	*Vulpia myuros	Rat's Tail Fescue	grass	moderate
POLYGONACEAE				
	*Acetellosa vulgaris	Sorrel	herb	low
	*Rumex crispus x pulcher	Dock	herb	
ROSACEAE				
	*Rubus fruiticosa sensu lat	Blackberry	shrub/vine	n/a
RUBIACEAE				
	*Galium divaricatum	Slender Bedstraw	herb	moderate
SCROPHULARIACEAE				
	*Parentucellia latifolia	Common Bartsia	herb	moderate
	*Parentucellia viscosa	Sticky Bartsis	herb	moderate

*TBA = to be announced

APPENDIX 3 CONSERVATION CODES FOR WESTERN AUSTRALIA

R: Declared Rare Flora –Extant Taxa (= Threatened Flora = Endangered + Vulnerable).

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, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Threatened Species Scientific Committee.

X: 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 populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Threatened Species Scientific Committee.

I: Priority One-Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as "rare flora", but are in urgent need of further survey.

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 (i.e. not currently endangered). Such taxa are under consideration for declaration as "rare flora but are in urgent need of further survey.

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, (i.e. not currently endangered).). Such taxa are under consideration for declaration as "rare flora but are in need of further survey.

4: Priority Four – Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

APPENDIX 4: QUADRAT DATA, VEGETATION COMMUNITIES & SOIL PROFILES

Species	Vegetation Community											
	1			2			3					4
	Quadrats											
	11	13	8	9	10	6	1	2	4	12	3	5	7
Podocarpus drouynianus		+											
*Isolepis marginata		+											
Lyperanthus serratus		+								+			
Pterostylis recruva		+											
*Crassula decumbens		+											
Wahlenbergia preissii		+					+						
Caladenia reptans v.reptans		+											
Hydrocotyle callicarpa		+											
Caladenia magniclavata	+												
Asplenium flabellifolium	+												
Poranthera huegelii	+												
Phlebocarya ciliata	+	+	+						+				
Thysanotus manglesianus	+	+	+			+							
Xylomelum occidentale	+	+	+										
Loxocarya cinerea	+	+	+										
Hypoloaena exsulca	+	+	+										+
Stylidium violaceum	+		+										
Stylidium schoenoides	+	+	+										
Pteridium esculentum	+	+	+		+	+							+
Lomandra caespitosa	+	+	+			+							
Millotia tenuifolia		+	+				+						
*Aira caryophyllea		+	+				+						
Velleia trinervis			+	+									
Stylidium calcaratum		+	+	+									
Lomandra hermaphrodita		+	+	+		+	+						
Levenhookia pusilla		+	+	+	+		+		+				
Lomandra nigricans		+		+	+	+				+			
Caladenia attingens		+	+	+								+	
Isotropis cuneifolia	+		+	+	+	+				+		+	
Kennedia carinata				+	+			+					
Anigozanthus manglesii				+		+							
Clematis pubescens				+	+	+							
Astroloma ciliatum					+	+							
Dianella revoluta					+	+							
Microlaena stipoides					+	+							+
Conostylis aculeata			+	+		+					+		
Astroloma drummondii			+	+	+	+		+	+				
Tripterococcus brunonis			+	+		+	+				+		
Xanthorrhoea preissii	+		+	+		+							+
Philotheca spicata	+		+	+			+						
Macrozamia reidlei	+	–	+	+		+			+		+		
Burchardia umbellata	+	–	+		+		+						
*Hypochaeris glabra		–	+	+	+	+	+					+	+
*Briza maxima		–	+	+	+	+	+			+			
Trachymene pilosa		–	+	+		+	+						
Xanthosia huegelii	+		+	+	+		+	+		+	+		
Opercularia apiciflora			+	+	+	+		+	+	+			
Cassytha racemosa			+		+	+	+	+	+				
Austrostipa campylachne				+	+	+	+	+		+		+	
Caladenia flava	+	–	+	+		+	+		+	+			
Gompholobium preissii	+		+	+	+	+	+		+		+		
Acacia extensa	+	–	+	+	+	+	+		+	+	+		+
Hibbertia hypericoides	+	–	+	+	+	+	+	+	+	+	+	+	
Eucalyptus marginata	+	–	+	+	+	+	+	+	+	+	+	+	
Sphaerolobium medium	+		+	+	+	+	+	+	+	+	+	+	

APPENDIX 4 cont.

Species	Vegetation Community												
	1			2			3						4
	Quadrats												
	11	13	8	9	10	6	1	2	4	12	3	5	7
Dampiera linearis	+	+	+	+	+	+	+	+	+	+	+		
Leucopogon capitellatus	+		+	+	+	+	+	+	+	+			
Eucalyptus calophylla	+	+		+	+	+	+	+		+	+	+	+
Patersonia umbrosa v.xanthina	+	+	+		+	+	+	+	+		+	+	+
Monotaxis occidentale		+	+	+	+	+	+		+	+		+	
Persoonia longifolia	+		+		+	+	+	+	+	+	+	+	
Drosera pallida	+	+	+	+		+	+		+	+	+		
Drosera erythrorhiza		+	+		+	+	+		+	+	+	+	
Tetraria capillaris	+		+	+	+	+	+	+	+	+	+	+	+
Tetraria octandra		+	+	+	+	+	+	+	+	+	+	+	
Scaevola calliptera		+		+	+	+	+	+	+	+	+	+	
Hibbertia amplexicaulis	+		+	+	+	+		+	+	+	+	+	
Bossiaea linophylla	+	+	+		+	+	+			+	+		
Lagenophora huegelii	+	+	+	+	+	+		+	+	+	+		+
Logania serpyllifolia	+	+		+	+	+		+	+	+		+	
Platysace filiformis	+	+		+	+		+		+	+		+	
Billardiera variifolia	+	+	+	+	+			+	+	+	+		+
Stylidium amoenum	+				+	+	+	+	+	+	+	+	
Tetrarrhena laevis				+	+	+		+	+	+	+	+	+
Hibbertia commutata				+	+	+	+	+	+	+	+	+	
Lomandra sericea			+	+		+	+	+	+	+		+	
Hovea chorizemifolia				+	+	+		+	+	+	+	+	
Conostylis serrulata	+	+	+		+		+		+		+	+	+
Desmocladus fasciculatus	+		+	+	+	+	+				+	+	
Pyrorchis nigricans		+		+		+	+			+	+		
Tetratheca hirsuta	+		+		+	+	+	+	+	+	+		
Labichea punctata				+		+			+	+	+		
Thysanotus multiflorus					+	+	+	+	+	+	+	+	
Deyeuxia quadriseta					+	+		+	+	+		+	
Xanthosia atkinsonia							+	+		+	+		
Trichocline spathulata				+		+		+	+	+		+	
Xanthosia candida						+		+	+	+		+	
Banksia grandis							+		+	+	+	+	
Thelymitra aff holmsii		+	+			+	+				+	+	
Acacia pulchella			+				+	+	+	+	+	+	+
Bossiaea ornata	+			+			+	+	+	+	+	+	
Pterostylis vittata		+					+		+	+	+		
Agrostocrinum scabrum	+	+			+		+		+		+	+	
Astroloma pallidum				+				+	+	+	+	+	
Eriochilus dilatatus	+	+						+	+	+	+	+	
Austrodanthonia occidentalis			+			+	+		+		+		
Chamaescilla corymbosa		+			+		+	+	+		+		+
Goodenia eatoniana					+		+	+	+				
Thelymitra crinita			+			+		+	+		+		
Patersonia babianoides								+	+		+		
Amphipogon amphipogonoides								+	+				
Xanthorrhoea gracilis								+	+			+	
Leucopogon propinquus				+					+		+	+	
Lomandra preissii					+		+			+	+	+	
Gompholobium polymorphum			+					+		+	+		
Tetratheca setigera										+		+	
Hakea amplexicaulis									+	+			
Opercularia hispidula	+		+				+					+	+
Drosera stolonifera				+		+		+					
Podolepis gracilis						+	+						
Luzula meridionalis				+							+		

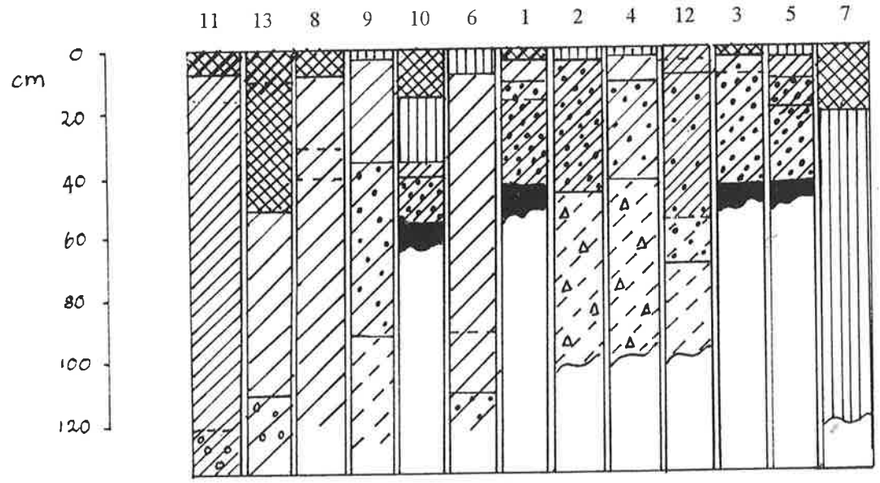
APPENDIX 4 cont.

Species	Vegetation Community												
	1			2			3						4
	Quadrats												
	11	13	8	9	10	6	1	2	4	12	3	5	7
Lomandra integra								+	+			+	+
Kennedia coccinea						+			+			+	
Chorizema ilicifolia												+	
Dryandra lindleyana						+						+	
Leucopogon verticillatus					+							+	
Caladenia longiclavata												+	
Isotoma hypocrateriformis												+	
Cyrtostylis robusta		+										+	
Eucalyptus patens													+
Acacia saligna													+
Callistachys lanceolata													+
Agonis linearifolia													+
Thomasia pauciflora													+
Billardiera floribunda			+		+								+
*Holcus lanatus													+
Anigozanthus flavidus													+
*Vellereophyton dealbatum													+
*Conyza sp													+
Pelargonium littorale													+
Caesia micrantha					+								+
Tremandra diffusa													+
Prasophyllum sp.													+
Baumea juncea													+
Cyathochaeta avenacea													+
Juncus pallidus													+
Lepidosperma aff squamatum						+							+
*Asteraceae sp													+
Lomandra pauciflora													+
Rhodanthe citrina								+					
Centrolepis drummondiana		+						+					
*Ursinia anthemoides								+					
Caladenia sp								+					
Hybanthus debillisimus										+			
Tetratheca affinis					+								
Kennedia prostrata						+							
Phyllanthus calycinus						+							
Gompholobium marginatum	+					+							
Comosperma virgatum						+		+		+			
Prasophyllum sp.						+							
Ptilotus manglesii						+							
Comosperma calymega						+							
Dichelachne crinita						+							
Wahlenbergia multicaulis				+		+							
*Monadenia bracteata								+					
Caladenia macrostylis								+				+	
Pterostylis sp								+					
Poranthera microphylla													
*Watsonia meriana								+					
Gompholobium confertum								+					
Hakea lissocarpa			+										
Drosera glanduligera								+				+	
Gompholobium capitatum			+										
Hibbertia racemosa			+										
Pterostylis sp			+										
Pterostylis aff nana			+										
Leptomeria cunninghamii				+									

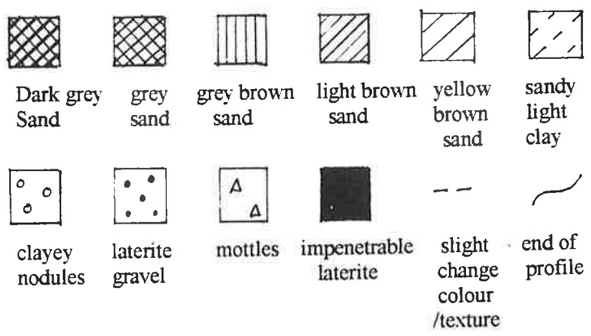
APPENDIX 4 cont.

Species	Vegetation Community												
	1			2			3						4
	Quadrats												
	11	13	8	9	10	6	1	2	4	12	3	5	7
Daucus glochidiatus		+		+									
Craspedia variabilis				+									
Lepidosperma leptostachyum				+									
Johnsonia lupulina	+			+									
Cyaniculea sericea				+									
Wahlenbergia littericola					+								
Chorizema cordatum					+								
Orthrosanthus laxus var laxus					+								
*Trifolium subterraneum					+								
*Ornithopus compressus					+								
Veronica calycina					+								
Acacia stenoptera										+			
*Orobanche minor						+							
Senecio hispidula v. hispidula				+			+						
*Vulpia myuros			+										
Austrodanthonia pilosa					+			+				+	
Scaevola glandulifera											+		+

Soil Profiles



Key



APPENDIX 5 QUADRAT VEGETATION & SITE DESCRIPTIONS & CONDITION

Soil profiles are also illustrated at the end of Appendix 4.
"=" signifies a gradual change in soil characteristics from one level to the profile to the next
"-" indicates a sharp change

QUADRAT 1
Eucalyptus marginata/Eucalyptus calophylla Woodland over *Acacia extensa* Open Shrubland, Mixed Low Open Shrubland, *Patersonia umbrosa* var *xanthina* Open Herbland and *Tetraria capillaris/Tetraria octandra* Very Open Sedgeland

Condition: Excellent
Landscape: Very gentle NW sloping upper flank to a broad crest
Soil: Some laterite blocks outcrop
0 to 4 cm Dark grey sand
=4 to 10 cm Pale to light yellow brown sand
=10 to 15 cm as above, but with much laterite gravel
=15 to 40cm Light brown sand with much laterite gravel
Non-penetrable beyond 45 cm,depth due to coarse laterite fragments
Drainage: good
Number of species: 61 Native: 56 Weeds: 5

QUADRAT 2
Eucalyptus marginata/Eucalyptus calophylla Woodland over *Acacia pulchella* Open Shrubland, Mixed Open Low Heath, *Patersonia umbrosa* var *xanthina* Herbland and *Tetraria capillaris/Tetraria octandra* Very Open Sedgeland

Condition: Excellent
Landscape: Very gentle east slope, broad crest
Soil: Rare laterite duricrust blocks
0 to 4cm Dark greyish brown sand
=4 to 45 cm Light brown to brown sand, much laterite gravel, somecoarse fragments to 10cm.
=45cm Yellow brown with pale yellow brown mottles, sandy light clay
Continues beyond 100cm
Drainage: good
Number of species: 51 Native: 51 Weeds: 0

QUADRAT 3
Eucalpytus marginata Tall Woodland over *Banksia grandis* Tall Open Shrubland over *Acacia extensa* Open Shrubland, *Bossiaea ornata/Sphaerolobium medium/Hibbertia hypericoides* Low Shrubland, *Patersonia umbrosa* var *xanthina* Herbland and *Desmocladus fasciculata* Very Open Sedgeland

Condition: Excellent
Landscape: Very gentle west slope
Soil: Few laterite duricrust blocks outcrop
0 to 3cm Grey sand
=3 to 6cm Light yellowish brown to yellow brown sand, with some laterite gravel
=6 to 40 cm Light yellow brown to yellow brown sand, with heavy gravel
Non-penetrable beyond 45cm depth due to coarse laterite fragments
Drainage: good
Number of species: 50 Native: 50 Weeds: 0

APPENDIX 5 Cont.

QUADRAT 4
Eucalyptus calophylla/Eucalyptus marginata Open Forest over *Acacia pulchella/Acacia extensa* Open Shrubland. *Hibbertia hypericoides/Sphaerolobium medium* Low Shrubland, Mixed Very Open Grassland, *Patersonia umbrosa* var *xanthina* Open Herbland and *Tetraria capillaris/Tetraria octandra* Very Open Sedgeland

Condition: Excellent
Landscape: Gentle to Moderate SE slope 16m from crest, a distinct break of slope separates this slope element from the crest
Soil: 0 to 3 cm Grey brown sand
= 3 to 10 cm Light yellow brown sand
=10 to 40 cm Light brownish yellow to yellow brown sand with light to moderate laterite gravel
40 cm Yellow brown and light yellow brown mottles, dandy light clay. Continues beyond 100cm depth
Drainage: good
Number of species: 58 Native: 58 Weeds: 0

QUADRAT 5
Eucalyptus marginata/Eucalyptus calophylla Jarrah/Marri Open Forest over *Banksia grandis* Tall Open Shrubland, *Sphaerolobium medium/Hibbertia hypericoides* Low Shrubland, *Patersonia umbrosa* var *xanthina* Open Herbland and *Tetraria capillaris/Tetraria octandra* Very Open Sedgeland

Condition: Very Good -Excellent
Landscape: Very gentle SW slope rising to a broad crest to the north.
Soil: Rare laterite blocks outcrop
=3 to 10 cm Dark grey brown sand
=10 to 20 cm Light brown sand with heavy laterite gravel
=20 to 40 cm light brown to yellowish brown with heavy gravel
Non-penetrable at 45 cm depth due to coarse laterite fragments.
Drainage: good
Number of species: 50 Native: 49 Weeds: 1

QUADRAT 6
Eucalyptus marginata/Eucalyptus calophylla Tall Woodland over Mixed Shrubland, Mixed Low Shrubland, Mixed Herbland and *Tetraria octandra/Desmocladus fasciculatus* Very Open Sedgeland

Condition: Very good
Landscape: Very gentle W slope
Soil: 0 to 8 cm Grey brown sand
=8 to 90 cm Yellowish brown to light yellowish brown sand
=90 to 110 cm Light brown sand
=110 cm Laterite gravels appear in a light yellowish brown sand
Drainage: good
Number of species: 74 Native: 71 Weeds: 3

QUADRAT 7
Eucalyptus patens Open Woodland over *Acacia saligna/Acacia extensa/Callistachys lanceolata* Tall Open Scrub, *Acacia pulchella/Agonis linearifolia* Open Heath, Mixed Very Open Herbland, *Tetrarrhena laevis/Microlaena stipoides* Very Open Grassland and *Lepidosperma* sp aff *squamatum/Baumea juncea* Sedgeland

Condition: Excellent
Landscape Slightly inclined floor of a broad shallow vale
Soil: 0 to 8cm Grey sand
=20 to120cm Grey brown to greyish brown sand continuing with depth.
The soil profile was very moist from a depth 80cm
Drainage : moderate
Number of species: 41 Native: 36 Weeds: 5

APPENDIX 5 Cont.

QUADRAT 8
Eucalyptus marginata Open Woodland over *Xylomelum occidentale* Low Open Woodland over *Bossiaea linophylla/Acacia extensa/Xanthorrhoea preissii* Tall Shrubland, *Hibbertia hypericoides/Gompholobium capitatum* Low Open Shrubland, *Phlebocarya ciliata* Very Open Herbland and *Loxocarya cinerea/Hypolaena exsulca* Very Open Sedgeland

Condition: Very good -Excellent
Landscape: Gentle E slope
Soil: 0 to 8 cm Grey sand
=8 to 30cm Pale yellow brown sand
=30 to 40 cm Light yellow brown sand
=40 to 120cm Brownish yellow to yellow sand, becoming increasingly bright through this depth range
Drainage: good
Number of species: 64 Native: 60 Weeds: 4

QUADRAT 9
Eucalyptus marginata/Eucalyptus calophylla Open Forest over *Acacia extensa/Macrozamia reidlei* Shrubland, *Hibbertia hypericoides/Leucopogon capitellatus* Low Shrubland, *Austrostipa campylachne/*Briza maxima* Very Open Grassland, Mixed Open Herbland and Mixed Open Sedgeland

Condition: Excellent
Landscape: Gentle to very gentle slope down from moderate to gentle slope element that flanks the broad crest to the west.
Soil: 0 to 3 cm Grey brown and
=3 to 35 cm Yellowish brown sand
=35 to 90 cm Light yellow brown sand with laterite gravel
-90cm Light brownish yellow dandy light clay continuing beyond 100cm depth
Drainage: good
Number of species: 61 Native: 59 Weeds: 2

QUADRAT 10
Corymbia calophylla/Eucalyptus marginata Tall Open Forest over *Bossiaea linophylla* Open Heath Mixed Low Shrubland and Mixed Herbland

Condition: Excellent
Landscape: Gentle to moderate slope to broad crest to the north
Soil: 0 to 15 cm Grey sand
= 15 to 35 cm Greyish brown sand
= 35 to 40 cm Brown sand
=40 to 55cm Brown sand with much laterite gravel
=55cm Non penetrable, due to coarse laterite gravel
Drainage: good
Number of species: 61 Native: 58 Weeds: 3

QUADRAT 11
Eucalyptus marginata/Eucalyptus calophylla Woodland over *Xylomelum occidentale* Very Open Low Woodland , *Bossiaea linophylla/Xanthorrhoea preissii/Acacia extensa* Open Heath , Mixed Low Open Shrubland, *Phlebocarya ciliata/Patersonia umbrosa* var *xanthina* Herbland and Very Open Sedgeland

Condition Rating: Excellent
Landscape: Slightly inclined floor of a broad shallow vale
Soil: 0 to 6cm Very dark grey sand
=6 to 15 cm Pale brown sand
=15 to 120cm Light brown sand
=120cm Brown sand with dark brown, firm clayey sand nodules Continues with depth.
Drainage: good
Number of species: 47 Native: 47 Weeds: 0

APPENDIX 5 Cont.

QUADRAT 12

Eucalyptus marginata Tall Open Forest over Mixed Open Shrubland and *Acacia stenoptera/Hibbertia hypericoides/Bossiaea ornata* Closed Low Heath *and Tetraria octandra/Tetraria capillaris* Very Open Sedgeland

Condition: Excellent

Landscape: Broad crest very gently rising to the east.

Soil: 0 to 5 m Brown light brown sand
=10 to 55 cm Brown to light brown gravelly sand
-55 to 70 cm Yellow brown sandy clay loam with some laterite gravels.
=70 to 100cm Sandy clay loam to sandy light clay. Continues with depth

Drainage: good

Number of species: 53 Native: 52 Weeds: 1

QUADRAT 13

Eucalyptus marginata/Eucalyptus calophylla Open Woodland over *Xylomelum occidentale* Low Open Woodland *over Bossiaea linophylla/Acacia extensa* Tall Open Scrub and *Podocarpus drouanianus/Pteridium esculentum* Open Shrubland over *Patersonia umbrosa* var *xanthina/Phlebocarya ciliata* Open Herbland

Condition: Excellent

Landscape: Slightly inclined floor of a broad shallow vale

Soil: 0 to 10cm Very dark grey sand
=10 to 50 cm Grey to dark grey sand
=50 to 110 cm Very pale brownish yellow sand
-110cm Sudden appearance of light brown to brown, firm, irregular nodules, set in light yellow brown sand. Continues beyond 120cm depth.

Drainage: Good

Number of species: 55 Native: 50 Weeds: 5