A1510

Attachment 2.3b

Flora and Vegetation Values

in a

Bushland Area at Meadow Springs

NE of Mandurah City Centre

Prepared for the

City of Mandurah

by

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EXECUTIVE SUMMARY

This survey was conducted in an area of about 15 hectares of bushland at Meadow Springs, about 4 kilometers north-east of the Mandurah town centre. The purpose of the survey was to assess the flora and vegetation conservation values of the study area to assist with development planning.

The Meadow Springs survey area lies in the Spearwood Dune geomorphological element. The survey area was located on a low limestone ridge with a shallow covering of yellow-brown Spearwood sand. It included the crest along the ridge and the slopes to the west and east.

The vegetation was described at sites and mapped. Plant species present at each site were recorded as part of the vegetation descriptions and the flora was also recorded opportunistically throughout the survey area. A vegetation unit map, a vegetation condition map and a flora list were prepared for the survey area. The vegetation data was databased and used in a floristic analysis which compared the vegetation units of the survey area with a standard data set from sites across the Swan Coastal Plain (Gibson *et al.*, 1994). The database of Swan Coastal Plain sites has previously been analysed and grouped into floristic community types (Gibson *et al.* 1994), a number of which have been identified as Threatened Ecological Communities of high conservation value.

Eighty four (84) native species were recorded in the survey area. No Declared Rare Flora were found in the survey area. One Priority 4 species, *Jacksonia sericea*, was recorded in a shrubland unit. No other species of particular conservation significance were recorded.

The survey area vegetation was mainly Melaleuca and Acacia open to closed scrub and heaths on the crest and upper slopes of the limestone ridge, with small areas of Allocasuarina humilis and Myrtaceous shrublands and scattered *Eucalyptus gomphocephala* (tuart). More tuarts occurred along the lower slopes of the ridge (near the boundary of the survey area) and a small area of tuart woodland occurs in a small amphitheatre-shaped area on the central-eastern side of the ridge.

The condition of the vegetation in the survey area on the limestone ridge crest and upper to mid slopes was mostly Very Good to Excellent with moderate to low weed cover and a good number of native species in the different vegetation strata.

The PATN analsis showed that none of the vegetation units were TEC units. The PATN analysis showed that most of the survey area vegetation types belonged to the Gibson *et al.* (1994) floristic community 24 ('Northern Spearwood shrublands'), which is not a Threatened Ecological Community (TEC). Two of those units, limestone ridge crest units, showed affinities to floristic community (26a) that is a TEC, but they were primarily related to the non-TEC floristic community 24 and assigned to that floristic community.

The tuart vegetation units were considered to be of moderately high conservation value. The Very Good to Excellent condition of much of the vegetation and the diversity of the vegetation units in the bushland added to the conservation value of the vegetation. The vegetation conservation values are moderately higher in the northern half of the bushland.

No Osprey nests were observed in the survey area, but a large stick nest was recorded in the road reserve on the west side of the survey area. About fifty eight tuart trees between 5 metres and 25 to 30 metres in height were examined in the survey area and hollows were observed in 13 of them.

1.0 INTRODUCTION

1.1 Background

The City of Mandurah plans to develop an area of bushland that is part of Lot 9007, Pebble Beach Boulevard, Meadow Springs that is designated for District Open Space on the 'Meadow Springs Estate' Outline Development Plan as approved by the Western Australian Planning Commission, 9 January 2002. The City of Mandurah wishes to know the vegetation and flora values present and their distributions in the bushland, to more effectively plan the location of developments in the area.

1.2 Aims of this study

The aim of this study was to describe and assess the flora and vegetation conservation values of the Meadow Springs study area. Specifically, this study had the following aims:

1. Determine if there was any flora in the bushland of special conservation significance, such as rare and priority species.
2. Determine if there were vegetation units of special conservation significance and their distribution.
3. Assess the condition of the vegetation in the study area.
4. Record any habitat trees in the study area, with particular interest in any trees with Osprey nests.

1.3 The survey area

The survey area is about 600 meters long and 250 meters wide (about 15 hectares) and lies in the Meadow Springs area, immediately to the east of the RAAF Association Retirement Village and about 4 kilometers north-east of the Mandurah town centre (see Figure 1). A road reserve runs along the eastern boundary of the RAAF Association Retirement Village and separates the Retirement Village from the study area.

1.4 The geomorphology of the survey area

The Swan Coastal Plain consists of a series of geomorphological elements which are sub-parallel to the present coastline (McArthur and Bettenay, 1960). Each of these geomorphic elements has distinctive geology, vegetation, topography and soils.

The Meadow Springs survey area lies in one of these elements, the Spearwood Dune System(McArthur and Bettenay, 1960). The Spearwood Dune element consists of a core of limestone covered by variable depths of yellow or brown sand. The limestone has

been extensively exposed along the western part of this element and the sand material deposited to the east by wind. To the west of the Spearwood dunes lies the younger Quindalup dunes.

1.5 Regional botanical context

Beard (1980) defined boundaries for botanical provinces, districts and subdistricts for Western Australia on the basis of his vegetation mapping of the State. In this framework, the study area lies in the Drummond Botanical Subdistrict (more or less equivalent to the Swan Coastal Plain and part of the Dandaragan Plateau) of the Darling Botanical District of the South Western Botanical Province of Western Australia.

Heddle *et al* (1980) mapped the vegetation of part of the Drummond Botanical Sub-district at a very broad scale, describing a seies of vegetation complexes. These are related groups of vegetation associations found on particular landform-soil units (geomorphic elements, see above). They mapped a total of 38 vegetation complexes on the Swan Coastal Plain. The vegetation of the Meadow Springs survey area belongs to one of these, the Cottesloe Complex - Central and South. This complex has heaths on limestone outcrops, with areas of deeper sands supporting tuart woodland and tuart-jarrah-marri open forest (Heddle *et al.*, 1980). The dominance of tuart is a distinguishing feature of the southern part of this complex.

More recently, an alternative analysis of the plant assemblages on the Swan Coastal Plain south of Gingin Brook was carried out using a floristic approach (Gibson *et al.*, 1994) and was extended in 2000. This work identified 66 floristic community types in four floristic 'Super Groups' for the southern Swan Coastal Plain. These units are defined at a similar level of synthesis to that of Heddle *et al.* (1980) (Trudgen, 1999). The four 'super groups' of sites correlate closely with the major geomorphological elements on the Swan Coastal Plain (and also to rainfall), with the exception of one group which contained the seasonal wetlands, which includes sites across all geomorphological groups (Gibson *et al.*, 1994).

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MEADOW SPRINGS LOCALITY PLAN

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36413	FIGURE 1

1.6 Threatened Ecological Communities (TEC's)

The Department of Conservation and Land Management has developed a procedure for identifying 'Threatened Ecological Communities' (Department of Environmental Protection 2000; English and Blythe 1997). Threatened ecological communities (TEC's) are assigned to one of four categories: 'Presumed Totally Destroyed'; 'Critically Endangered'; 'Endangered' or 'Vulnerable' (Department of Environmental Protection, 2000).

On the Swan Coastal Plain, twenty five potential threatened ecological communities, delineated by a number of floristic and other studies, have been assessed for threatened ecological community status. Of these, twenty four have been confirmed as 'threatened' (Department of Environmental Protection 2000). Sixteen of these Threatened Ecological Communities are floristic community types as identified by Gibson *et al.* (1994).

2.2.2 Limitations of the vegetation survey

There is a limit to the accuracy of the assignment of the different strata in the vegetation descriptions to structural units (eg., low open woodland, low woodland, low open forest, open shrubland, shrubland etc.). Referral of a stratum to a structural category depends on assessment of its cover. Such estimation is imprecise and it is not unusual for different observers to give quite different estimates of the cover of a species, or stratum in a stand. However, descriptive exercises such as that carried out for this report require only a moderate level of accuracy.

The cover estimate of each plant species recorded in the quadrats was based on estimating species canopy cover. The assumption was made that for most species, canopy cover and projected foliar cover are reasonably similar, or that the difference is less than the level of accuracy of the estimates.

2.3 Methods of mapping vegetation attributes in the study area

2.3.1 Methods for mapping vegetation units in the survey area

Vegetation units were recorded generally between plant community and plant association level. The vegetation unit boundaries were drawn on a computer generated aerial photograph while traversing the study area. The aerial photograph was at a scale of 1:1000, colour, orthocorrected and overlain with the UTM coordinate grid (GDA94 datum). The orthocorrected aerial photography was supplied by the City of Mandurah and SMEC Australia PL compiled and printed the field maps. GPS coordinate readings were used to confirm placement of vegetation boundaries on the map.

The vegetation mapping unit descriptions were based on the vegetation site descriptions. For those units where detailed vegetation site descriptions had not been recorded, brief mapping unit descriptions were recorded.

2.3.2 Methods for mapping vegetation condition in the study area

The vegetation condition was mapped using the vegetation condition assessment at each of the releves as a starting point. Generally the vegetation condition described at a site was representative of the vegetation condition throughout the vegetation. Where vegetation condition boundaries varied from that of the vegetation units, the mapping methods outlined in section 2.2.1 above were used.

2.4 Floristic analysis

2.4.1 Data storage and handling

The Meadow Springs vegetation site data was entered into a specially designed computer database developed by E. A. Griffin using Microsoft Access.

2.4.2 Floristic analysis methods

2.4.2.1 Introduction

The floristic analysis carried out was based on species presence/absence data from nine of the Meadow Springs sites combined in a database with the 509 sites from Gibson *et al.* (1994).

The nine Meadow Springs sites included five sites which had comprehensive species lists (sites MS1, MS2, MS4, MS5, MS6) and four other sites (MS3, MS7, MS11 and MS13) with good but incomplete species lists. These sites were in vegetation units of particular interest (see Appendix 5 for all site details). The number of species recorded at the sites with incomplete lists were 19 (MS3), 15 (MS7), 27 (MS11) and 14 (MS13). It should be noted that sites MS3 and MS13 were in vegetation units with relatively low numbers of species (*Acacia rostellifera* closed scrub and *Hakea trifurcata* open to closed scrub, respectively). Of the sites with complete species lists, site MS1 had the most species (50) and site MS6 had the lowest number of species (32).

2.4.2.2 Data preparation and compatibility

To conduct the analysis on the data from Meadow Springs and Gibson *et al.* (1994) datasets, it was first necessary to reconcile the flora species. This step was necessary because of changes in the nomenclature over the last ten years and the potential for survey specific variations in the application of names (Griffin and Trudgen, 2004). The reconciliation involved reducing some infra-specific names to the relevant species name, combining some taxa where confusion is known to have occurred in field observations and identifications and omitting some names (mostly where a taxon had only been identified to genus).

It should be noted that the Meadow Springs data was compatible with the Gibson *et al.* (1994) data. Both datasets were based on data collected from sites of similar sizes, with the Gibson *et al.* (1994) sites being 10 metre by 10 metre quadrats and the Meadow Spring sites being releves of estimated 10 metre by 10 metre areas. Gibson *et al.* (1994) visited their sites twice to record plant species present, including a spring visit, compared

to the single recording of the Meadow Spring sites. However, the single Meadow Springs recording took place during the spring season (when most plant species are most easily observed). Weed species were included in both the Gibson *et al.* (1994) and Meadow Springs datasets.

2.4.2.3 PATN analysis

The PATN modules used were ASO (calculation of similarity matrix), FUSE (classification), DEND (representation of classification) and NNB (determination of sites most similar to each site) (Griffin and Trudgen, 2004). The results of the analyses were imported into a database so that site characteristics and previous classifications (eg Floristic Community Types derived in earlier classifications) could be associated with them.

Two types of PATN analysis were used. The first method (using the PATN ASO, FUSE and DEND modules) ran an analysis of the combined Meadow Springs and Gibson *et al.* (1994) data sets to produce a classification of the sites vegetation in the form of a dendrogram of the combined data sets, with the Floristic Community Types defined by Gibson *et al.* (1984) assigned to the Gibson *et al.* (1994) sites. The appropriate floristic community type to assign to the Meadow Springs sites could then be interpreted by the relative position of those sites to the Gibson *et al.* sites in the dendrogram.

The second method (Nearest Neighbours method) used the NNB module of PATN to investigate which 20 sites in the combined data set were most similar to each of the Meadow Springs sites.

A final assignment of a Floristic Community Type was then made to each of the Meadow Springs sites taking into account the results of both methods and the fact that the dendrogram relationships can be arranged in a more 'spread out' and less easily interpretable manner.

2.4.3 Floristic analysis limitations

It has been found in other floristic analysis that the addition of new sites to the Gibson *et al.* (1994) data set to produce a combined classification may disrupt the original classification of sites (Griffin and Trudgen, 2004). The more data that is added, the higher the level of disruption. If this occurs it can make it difficult to assign the new sites to the Floristic Community Types of Gibson *et al.* (Griffin and Trudgen, 2004).

Another limitation in conducting a PATN floristic analysis using the above methods may arise depending on the degree of success in reconciling the two data sets. A further limitation may arise from any significant differences in data collection methods between the two surveys. This is unlikely to have caused a material difference in the results except for those Meadow Springs sites that had less complete species lists.

2.5 Identification of Threatened Ecological Communities (TEC)

Once each of the Meadow Springs sites was assigned to a Floristic Community Type, a table of Floristic Communities Types on the Swan Coastal Plain and their TEC status (Department of Environmental Protection, 2000) was consulted to determine if any of the Meadow Springs sites were TEC's. No new TEC's have been assessed for the western part of the Swan Coastal Plain (which includes the survey area) since the publication of Bush Forever Vol 2 (B.J. Keighery, *pers. comm.*).

2.6 Recording habitat trees

2.6.1 Methods for recording habitat trees in the study area

The study area was traversed and the trees present assessed for habitat indicators, particularly the presence of large nests that could be Osprey nests and the presence of branch hollows suitable for nesting birds such as Black cockatoos. The observation of the trees did not attempt to determine if there had been activity (eg nesting activity) at the hollows. The base of tree trunks were also examined for possum markings (bark scratchings).

A pair of 8x21mm binoculars were used to search the tree canopies for nests and hollows.

3.0 FLORA IN THE SURVEY AREA

3.1. Flora list for the survey area

A total of one hundred and nineteen plant species were recorded in the Meadow Springs study area. Eighty-four (84) of these species were native to the area, including 83 species of native flowering plants and one native cycad (the Zamia Palm, *Macrozamia riedlei*). Thirty-five (35) remaining species were weeds. A list of all the species recorded from the survey area is provided in Appendix 4.

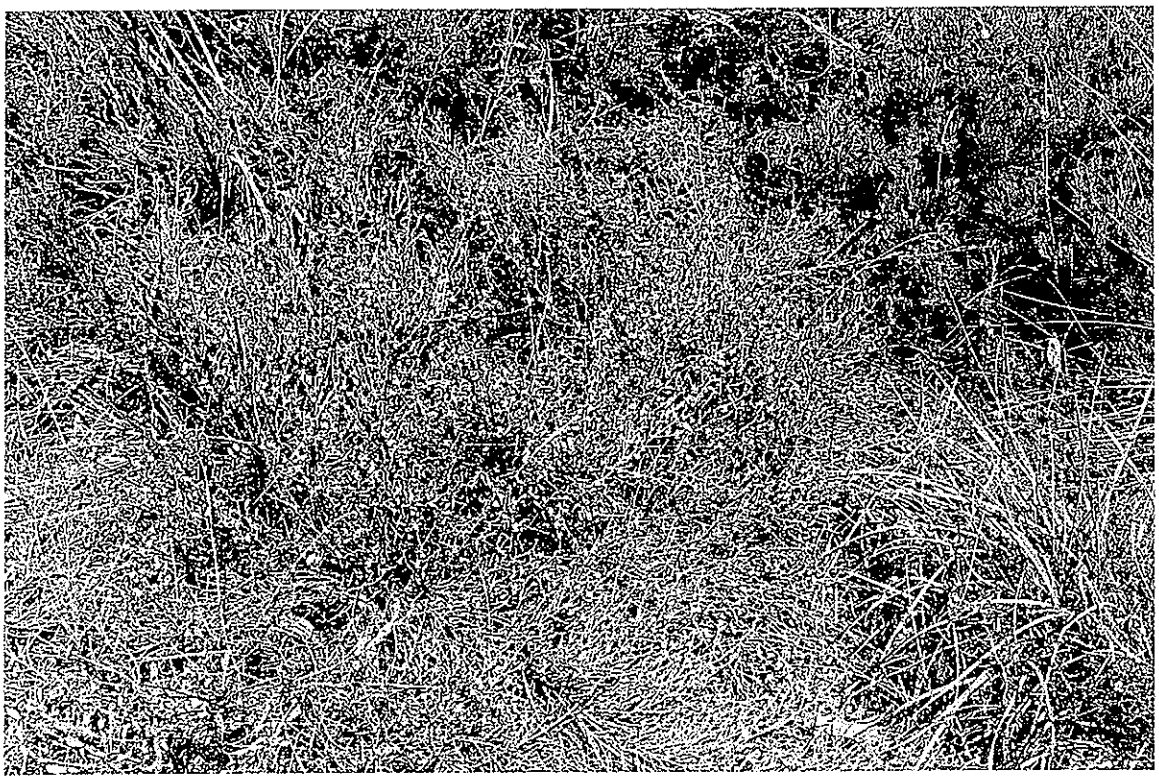
Of the native flowering species recorded, twenty four (24) were monocotyledons and fifty nine (59) were dicotyledons.

3.2 No declared rare flora species were recorded from the survey area

No declared rare species were recorded in the study area during this survey.

3.3 Priority flora species recorded from the survey area

One Priority 4 species, *Jacksonia sericea* (see Photograph 1below), was recorded during the survey (Atkins, 2003; see Appendix 1 for Priority classifications).



Photograph 1. *Jacksonia sericea*

Jacksonia sericea is a low spreading shrub to 60cm with orange pea flowers. It grows on calcareous and sandy soils on the Swan Coastal Plain between Perth and Pinjarra (Marchant *et al.*, 1987; Flora Base internet site, Department of Conservation and Land Management). It was observed in a number of locations in the Meadow Springs survey area, but was mainly associated with mapping unit Ah (see section 4.1.3 below).

3.4 Other species of conservation significance recorded from the survey area

No other species of conservation significance was recorded in this survey.

However, a 'taxon' of some botanical interest was given the name '*Acacia* aff. *rostellifera*'. It occurred over a large area of broad crest and upper slopes of the limestone ridge in the central eastern end of the study area (unit 'affAr', see section 4.1.3 below and Figure 2 below). 'Typical' forms of *Acacia rostellifera* with narrow phyllodes and one prominent vein grew on the surrounding lower slopes (vegetation units Ar and EgArGp, Figure 2). *Acacia* aff. *rostellifera* was about 1.3 to 1.5 meters high and formed an open to closed heath. It was distinguished by its relatively wide phyllodes, sometimes with an 'undulating' and slightly twisted surface and the common occurrence of a central vein with two other fine or poorly developed veins, one on each side of the central vein. The fact that it was clearly differentiated from surrounding areas of *Acacia rostellifera* by these characters as well as shrub height and habitat (crest and upper slopes of the limestone ridge) indicated that it was not simply an *Acacia rostellifera* stand of different fire age.

Acacia aff. *rostellifera* was quite similar in form to *Acacia xanthina* ('white-stemmed wattle'), which has been recorded on coastal limestone as far south as the Mandurah area (Bruce Maslin, *pers. comm.*). However, *Acacia xanthina* usually has pruinose stems (white, powdery coating) and glaucous phyllodes (blue-green colour with a whitish bloom) (Chapman and Maslin, 1992), where as *Acacia* aff. *rostellifera*, like *Acacia rostellifera*, had green phyllodes and branches that were not pruinose. One defining character for *Acacia xanthina* and *Acacia rostellifera* is aril colour, with the aril orange or red (where known) for *Acacia rostellifera* and white for *Acacia xanthina* (Chapman and Maslin, 1992). However, no pods of *Acacia* aff. *rostellifera* were present during this survey and so the nature of this character remains unknown for these plants. Bruce Maslin's opinion was that all the *Acacia* aff. *rostellifera* specimens were in fact *Acacia rostellifera* taxa (*pers comm.*) but he did note that a lot of research work needs to be done to clarify variation in *Acacia rostellifera*.

4.0 VEGETATION OF THE SURVEY AREA

4.1 Vegetation units mapped in the survey area

4.1.1 Introduction to vegetation descriptions

The description of vegetation units occurring in the Meadow Springs survey area is set out in Appendix 5. These vegetation descriptions are the basis of the vegetation mapping units described below.

The vegetation units are considered to be mostly described at the plant community to vegetation association level. Some areas assigned to a particular unit on the vegetation map (Figure 2), while having similar vegetation to the description of that unit, are variable in either structure, species dominance or floristics. Some areas of vegetation may have been described as a 'mosaic' of a number of vegetation units where the vegetation of the area varied throughout between those vegetation units. Mosaic vegetation is indicated by a string of vegetation unit codes separated by forward slashes (eg Ar/EgArGp unit is a mosaic of unit Ar and unit EgArGp, see Figure 2). Some stands of some of the vegetation units occurring in the areas mapped for vegetation units were quite small and as a result were not shown on the vegetation maps.

In some areas the vegetation was 'completely degraded' (largely cleared of native vegetation, see vegetation condition classifications, Appendix 3) and a vegetation unit could not be determined for the area. Some of these areas were mapped as 'Completely Degraded' (Figure 2), but some of the 'Completely Degraded' linear areas that could be clearly distinguished on the aerial photograph background of the map were not delineated to avoid a confusion of lines.

4.1.2 Abbreviations used for species in the vegetation unit codes

The codes for the vegetation units that discriminate the vegetation units are shown on the vegetation map (Figure 2). The codes are derived from the generic and species names of the more abundant genera or species in the different strata present in the unit. Where there is more than one species in the genus, or where two genera have the same initial, a lower case letter is used to distinguish which species is being referred to (see Table 1).

Table 1. Abbreviations for species names used in codes for the vegetation units mapped for the subject land.

Code	Species name	Code	Species name
Aco	*Acacia cochlearis*	Ht	*Hakea trifurcata*
affAr	*Acacia* aff. *rostellifera*	Mh	*Melaleuca huegelii* ssp. *huegelii*
Ar	*Acacia rostellifera*	Oa	*Olearia axillaris*
Eg	*Eucalyptus gomphocephala* (Tuart)	Sa	*Santalum acuminatum*
Gp	*Grevillea preissii* ssp *preissii*	Sg	*Spyridium globulosum*

4.1.3 Description of the vegetation mapping units in the Meadow Springs study area

Nine vegetation units were mapped in the Meadow Springs survey area (Figure 2). A high number of vegetation units were mapped because of the considerable diversity in vegetation structure and dominants in the survey area and because the mapping was done at a relatively high level of detail.

Aco

Acacia cochlearis, (*Acacia* aff *rostellifera*) shrubland over *Allocasuarina humilis*, *Grevillea preissii* subsp. *preissii*, *Hibbertia hypericoides* low open heath over *Desmocladus asper* open sedgeland and **Bromus diamdrus*, **Avena barbata* open grassland.

Habitat and soil: Saddle on the crest of a low ridge, sloping down to west and east and up to the north and south. Orange-yellow sand. Some exposed limestone.

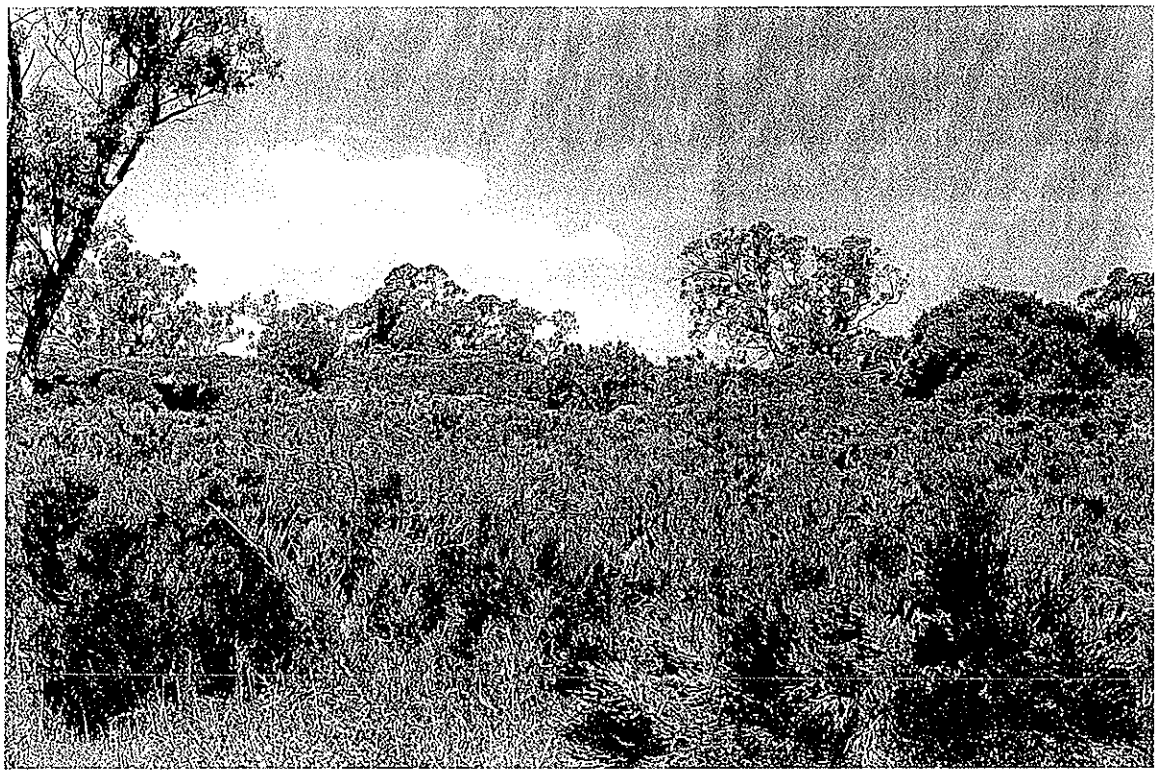
Notes: Unit represented by site MS7.

Ah

Hakea prostrata, Olearia axillaris scattered shrubs over *Allocasuarina humilis, (Acacia pulchella* var. *glaberrima)* shrubland over *Melaleuca systina, Grevillea erythmifolia, Hibbertia hypericoides* low open shrubland over *Desmocladus aspera* sedgeland and *Conostylis aculeata* subsp. *aculeata* very open herbland.

Habitat and soil: Very gently sloping, north-facing, floor of swale between two sand ridges. Fine to medium grained orange-brown siliceous sand (Spearwood sand).

Notes: This unit is represented by site MS1. A similar unit occurred in a shallow saddle on the ridge crest and upper slopes (MS8). *Jacksonia sericea* (Priority 4) occurred in this unit.



Photograph 2. *Allocasuarina humilis* shrubland (unit Ah) at site MS1, near the northern boundary of the survey area and looking south.

Ar

Acacia rostellifera tall closed scrub over *Allocasuarina humilus* scattered shrubs over *Hibbertia hypericoides, Phylanthus calycinus* low shrubland over *Conostylus aculeata* subsp. *aculeata, Caladenia latifolia* very open herbland with **Bromus diandrus* open annual grassland.

Habitat and soil: Swale on east side of low sand dune. Orange-brown sand.

Notes: This unit was predominantly a lower slope unit and was represented by site MS3. An upslope form of this unit was recorded at site MS6.

affAr

Acacia aff *rostellifera*, (*Grevillea preissii* subsp. *preissii, Rhagodia baccata* subsp. *baccata*) open heath over *Hibbertia hypericoides, Phyllanthus calycinus* low open shrubland over *Desmocladus asper* open sedgeland and *Dianella revoluta* var. *divaricata, Conostylis aculeata* subsp. *aculeata* very open herbland and **Avena barbata, *Bromus diandrus* open annual grassland.

Habitat and soil: Flat crest of low dune ridge. Orange-brown sand.

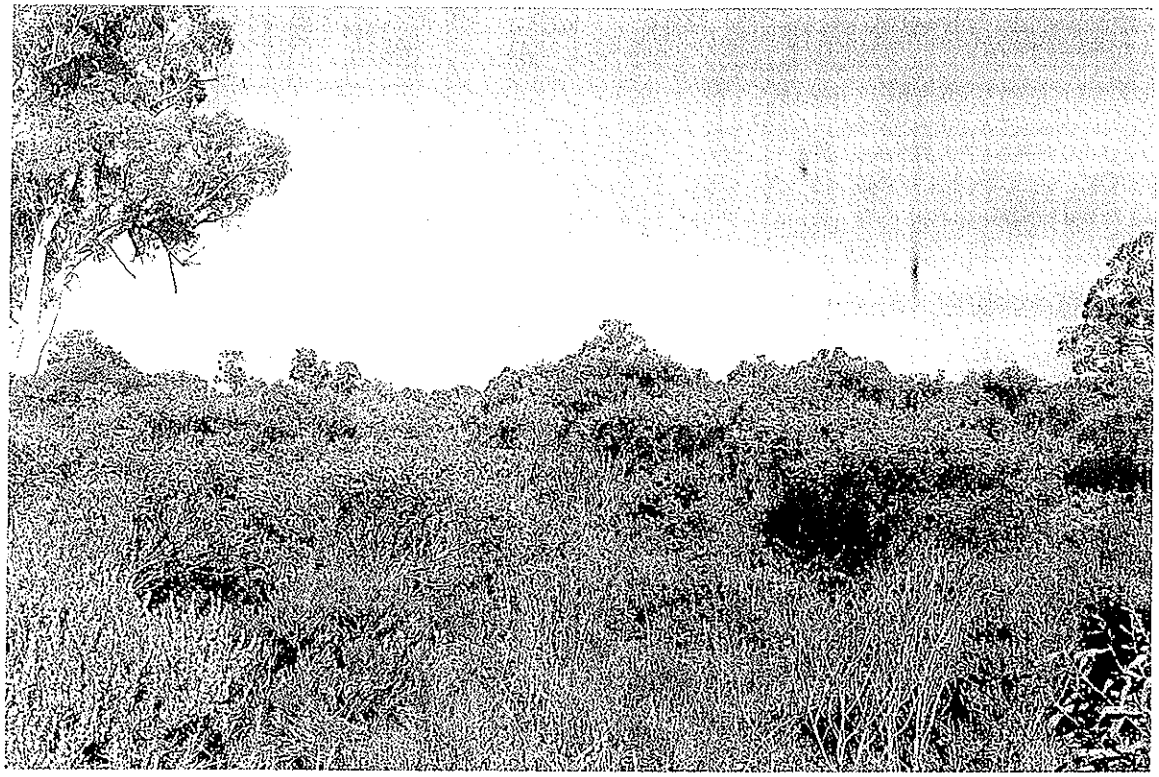
Notes: This unit was represented by site MS4 and covered a large area of the ridge crest and upper slope from the centre to the south of the survey area.

EgArGp

Eucalyptus gomphocephala scattered trees over *Acacia rostellifera*, (*Santalum acuminatum*) shrubland to tall open scrub over *Trymaleum ledifolium* var. *ledifolium* scattered shrubs over *Grevillea preissii* subsp. *preissii, Phylanthus calycinus* low open shrubland over *Desmocladus asper, Lepidosperma pubisquameum* open sedgeland with *Opercularia vaginata, Millotia myosotidifolia* herbland.

Habitat and soil: Gentle, west-facing upper slope of low dune. Fine to medium grained orange-brown siliceous sand with a small amount of calcium carbonate (Spearwood sand). Limestone outcropping common.

Notes: This unit was represented by site MS2



Photograph 3. ***Acacia*** **aff.** ***rostellifera*** **open heath (vegetation unit affAr) on the crest of the ridge at site MS4, near the centre of the survey area looking south.**

Photograph 4. ***Acacia rostellifera*** **shrubland (vegetation unit EgArGp) at site MS2.**

EgSgOa

Santalum acuminatum, (*Hakea trifurcate*, *Olearia axilaris*) shrubland over *Rhagodia baccata* subsp. *baccata*, *Allocasuarina humilis* open shrubland over *Grevillea preissii* subsp. *preissii*, (*Acacia lasiocarpa* var. *lasiocarpa*, *Gompholobium tomentosum*, *Phylanthus calycinus*) low open heath over *Desmocladus asper* open sedgeland and **Bromus diandrus* open annual grassland with *Opercularia vaginata* scattered herbs.

Habitat and soil: Gentle, west-facing lower slope of a low ridge. Orange-brown sand.

Notes: This unit occurred in only a small area along the south-west boundary of the survey area. It is represented by unit MS10

Ht

Hakea trifurcata, (*Santalum acuminatum*) open to closed scrub over *Rhagodia baccata* subsp. *baccata*, *Allocasuarina humilis* open shrubland over *Grevillea preissii* subsp. *preissii*, *Hibbertia hypericoides* low shrubland to low open heath over *Desmocladus asper* very open sedgeland and *Lomandra maritima* scattered herbs with **Bromus diandrus* very open annual grassland.

Habitat and soils: Gentle, west-facing lower slope of a low ridge. Orange-brown sand.

Notes: This unit is represented by site MS13. It was a small area in the north-east corner of the survey area.

Mh

Melaleuca huegelii open scrub (lots of it about 2m high) over *Templetonia retusa*, (*Spyridium globulosum*) scattered tall shrubs over *Trymaleum ledifolium* subsp. *ledifolium* open shrubland over *Grevillea preissii* subsp. *preissii*, *Acacia truncata* (Lake Preston variant), *Phyllanthus calycinus* low shrubland over *Desmocladus asper* open sedgeland to sedgeland with *Millotia myosotidifolia*, **Crassula glomerata*, **Dischisma arenarium* very open herbland.

Habitat and soils: Gentle, south-facing, upper to mid slope of low dune. Soil was orange-brown sand.

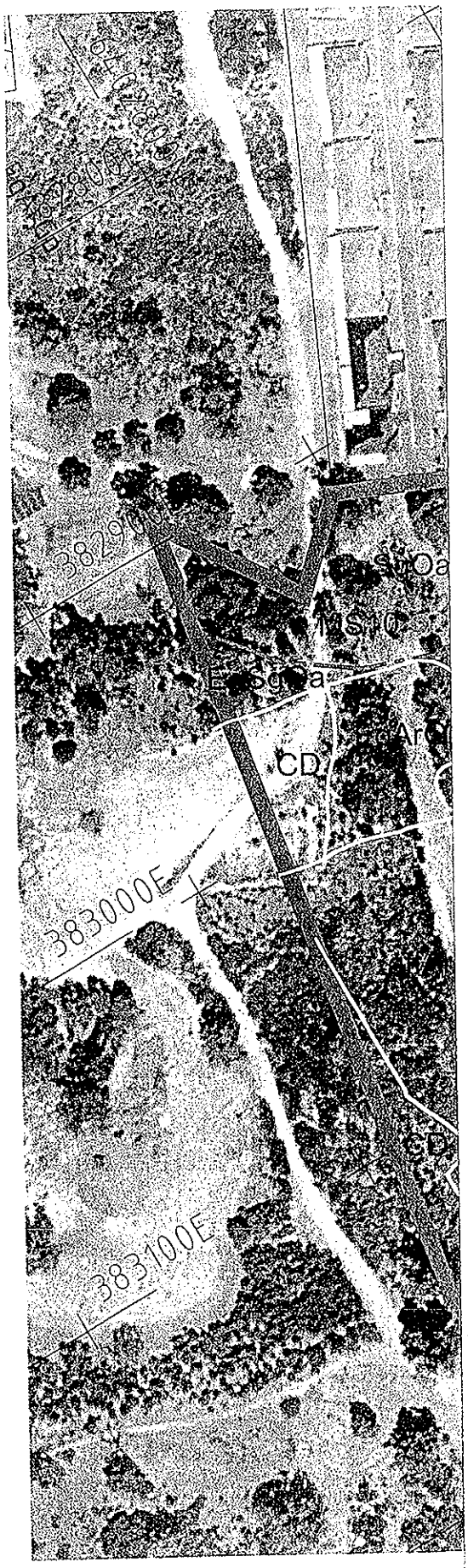
Notes: This unit was extensive along the crest and upper slopes of the ridge, especially in the northern half of the survey area. It is represented by site MS5.

SaAhGp

Eucalyptus gomphocephalus scattered trees over *Hakea prostrata, Olearia axillaris, Santalum acuminatum* scattered tall shrubs over *Allocasuarina humilis, Trymaleum ledifolium* var. *ledifolium* shrubland over *Grevillea preissii* subsp. *preissii, Hibbertia hypericoides, Phylanthus calycinus* low shrubland over *Desmocladus asper* very open sedgeland and **Bromus diandrus, *Avena barbata, *Lagurus ovartus* annual open grassland.

Habitat and soil: Gentle, east-facing midslope of low ridge. Orange-brown sand.

Notes: This mapping unit is represented by MS11. However, the species covers and composition of the shrubland varied across the mapping unit



NOTES: MS1 - MS13 = VEGE

Aco, Ah, affAr, Ar, Eg,

CD = COMPLETELY

LEGEND:

P = PRISTINE
E = EXCELLENT
VG = VERY GOOD
G = GOOD
D = DEGRADED
CD = COMPLETELY DEGRADED

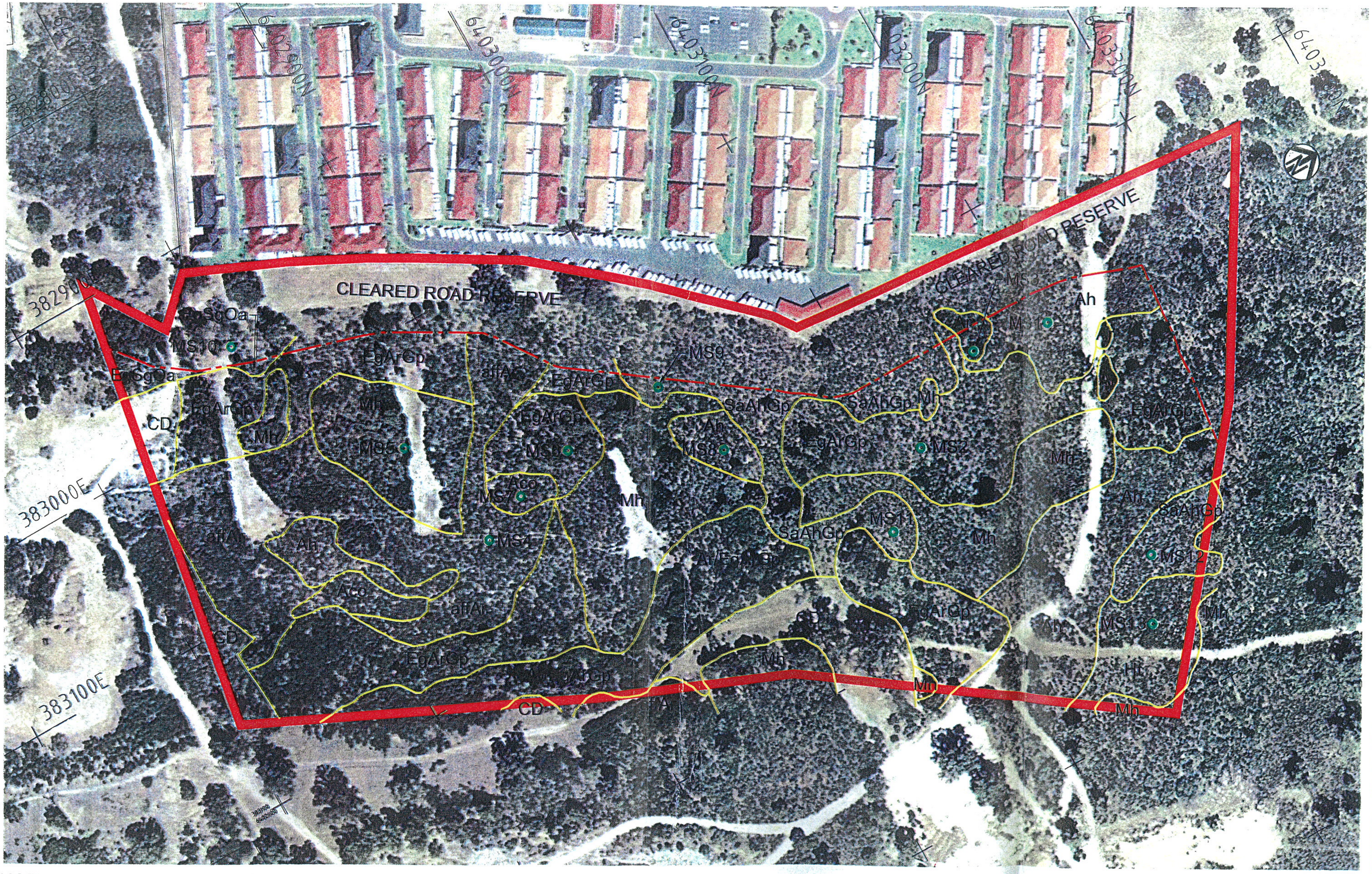
0 25 50 75 100m

SMEC

MEADOW SPRINGS
VEGETATION CONDITION MAP

Project Number: 36413

Figure Number: FIGURE 3



NOTES: MS1 - MS13 = VEGETATION RECORDING SITES
Aco, Ah, affAr, Ar, Eg, ArGp, EgSgOa, Ht, Mh, SaAhGp = VEGETATION UNITS
CD = COMPLETELY DEGRADED

0 25 50 75 100m

SMEC
Level 6, 12 St Georges Terrace
PERTH WA 6000
Tel (08) 9323 5800 Fax (08) 9323 5801

MEADOW SPRINGS
VEGETATION UNIT MAP

Project Number:	Figure Number:
36413	FIGURE 2

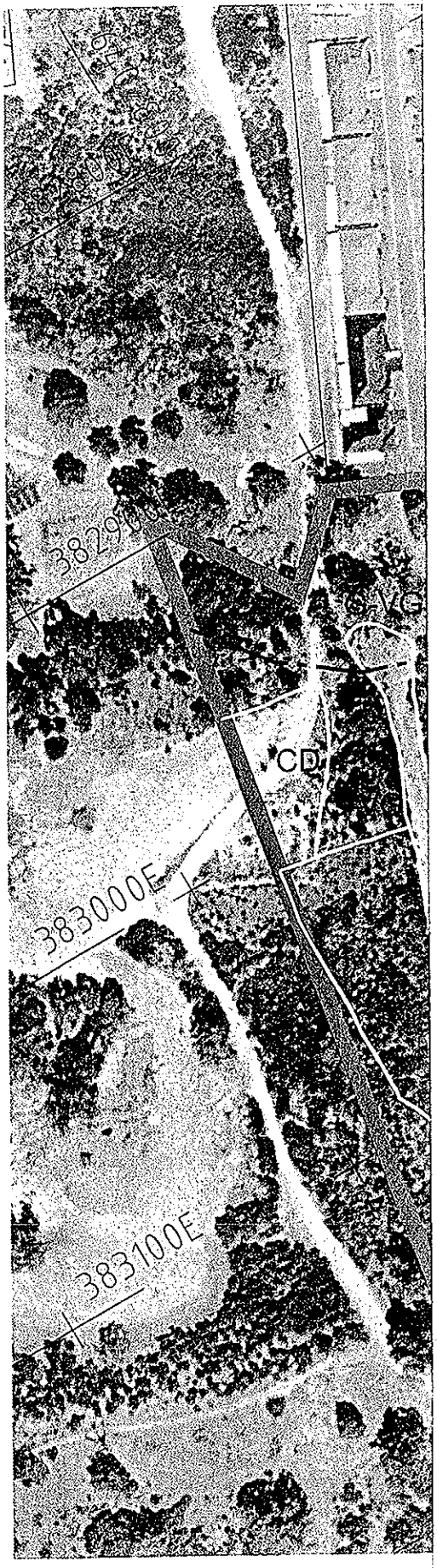
4.2 Vegetation units in the survey area

The vegetation varied considerably in the survey area. As a result, there is a large number of vegetation mapping units (nine) in the survey area.

Scrub and heath units Mh, affAr and EgArGp dominated the ridge crest and upper slopes (section 4.1.3; Figure 2) where there sand layer was shallow and there was considerable exposed limestone. Tuarts were either scattered or absent over much of this habitat. Scattered tuart unit EgArGp covered much of the ridge mid slopes and the *Acacia rostellifera* scrub unit Ar occurred along much of the lower slopes. The shrubland to open heath unit Ah occurred in swales and depressions on the ridge crest where more sand had accumulated.

4.3 Vegetation condition in the survey area

Vegetation condition along the ridge crest and slopes was mainly in the range of Very Good to Excellent (see Appendix 3; Figure 3), with only moderate to low weed cover and a good representation of native species in all strata. Some of the lower slope areas had high weed cover and so the vegetation condition rated as low as Good. There were three prominent cleared linear areas in the central and south part of the ridge crest (Figure 3). Some areas adjacent to the track that runs along the eastern side of the survey area had been disturbed and had high weed cover, especially the small area with more tuarts (tuart woodland).



LEGEND:

P = PRISTINE
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VG = VERY GOOD
G = GOOD
D = DEGRADED

5.0 FLORISTIC COMMUNITIES AND THREATENED ECOLOGICAL COMMUNITIES IN THE SURVEY AREA

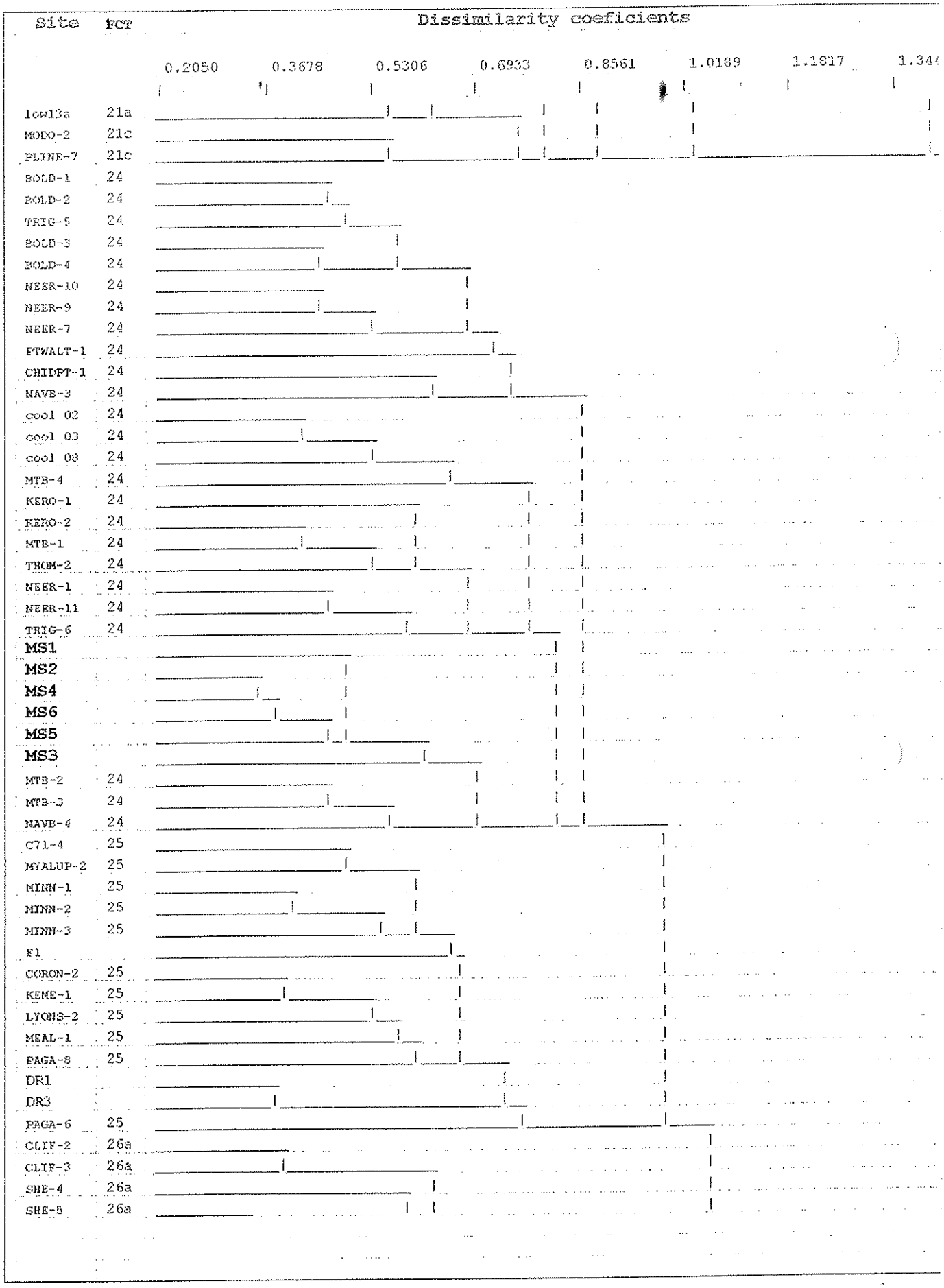
5.1 Determination of floristic community types by classification

The dendrogram generated by the PATN analysis from the combined data set of Meadow Springs survey area sites and Gibson *et al.* (1994) Swan Coastal Plain sites (Figure 4) grouped sites MS1, MS2, MS3, MS4, MS5 and MS6 together, indicating they are similar to each other. Sites MS7, MS11 and MS13 formed a separate group and were most similar to each other. They were also similar to members of the other Meadow Springs site group with the most similar site having a dissimilarity coefficient between 0.5 and 0.6 (Table 2). It is difficult to assess the effect of sites MS7, MS11 and MS13 having incomplete species lists. The grouping of the Meadow Springs sites is most probably because they are very geographically close (within 200 to 300 meters of each other) relative to the distance between them and the other Gibson *et al.* (1994) sites.

Table 3 below shows the Floristic Community Type (FCT) to which the Meadows Spring sites were assigned by both the dendrogram and nearest neighbour PATN analysis. Sites MS1, MS2, MS3, MS4, MS5 and MS6 were all assigned to Floristic Community Type 24, the 'Northern Spearwood shrublands and woodlands' floristic community type of Gibson *et al.* (1994). All of those sites, except site MS3, had complete species lists. Site MS3 had a list of 19 species. Two sites, MS2 and MS5, were assigned to FCT 24 by the dendrogram analysis and the nearest neighbour analysis, but also had some affinity to FCT 26a (dissimilarity coefficient levels of 0.5814 and 0.5870 respectively with FCT26a sites). Floristic community 26a group is the '*Melaleuca huegelii-M. systina* shrublands of limestone ridges' of Gibson *et al.* (1994).

Sites MS7, MS11 and MS13, which had incomplete species lists, were grouped by the dendrogram analysis with floristic community types 29 and 30, which are generally associated with sites on the Quindalup dunes. However the nearest neighbour analysis assigned sites MS7 and MS13to FCT 24 ('Northern Spearwood shrublands') and sites MS11 and MS13 (affinity) to FCT 27 ('Species poor mallees and shrublands on limestone'; MS11). The nearest neighbour analysis is more easily interpreted and reliable (Ted Griffin, *pers. comm.*) and its assignment to FCT's is given more weight here. However, the dissimilarity coefficients between these Meadow Springs sites and their most similar sites are high (>0.62) and therefore these sites are less closely related to the floristic community types to which these sites belong.

Figure 4. Sections of the dendrogram produced from the classification of the Meadow Springs sites with the Gibson *et al.* (1994) sites.



BREAK IN DENDROGRAM

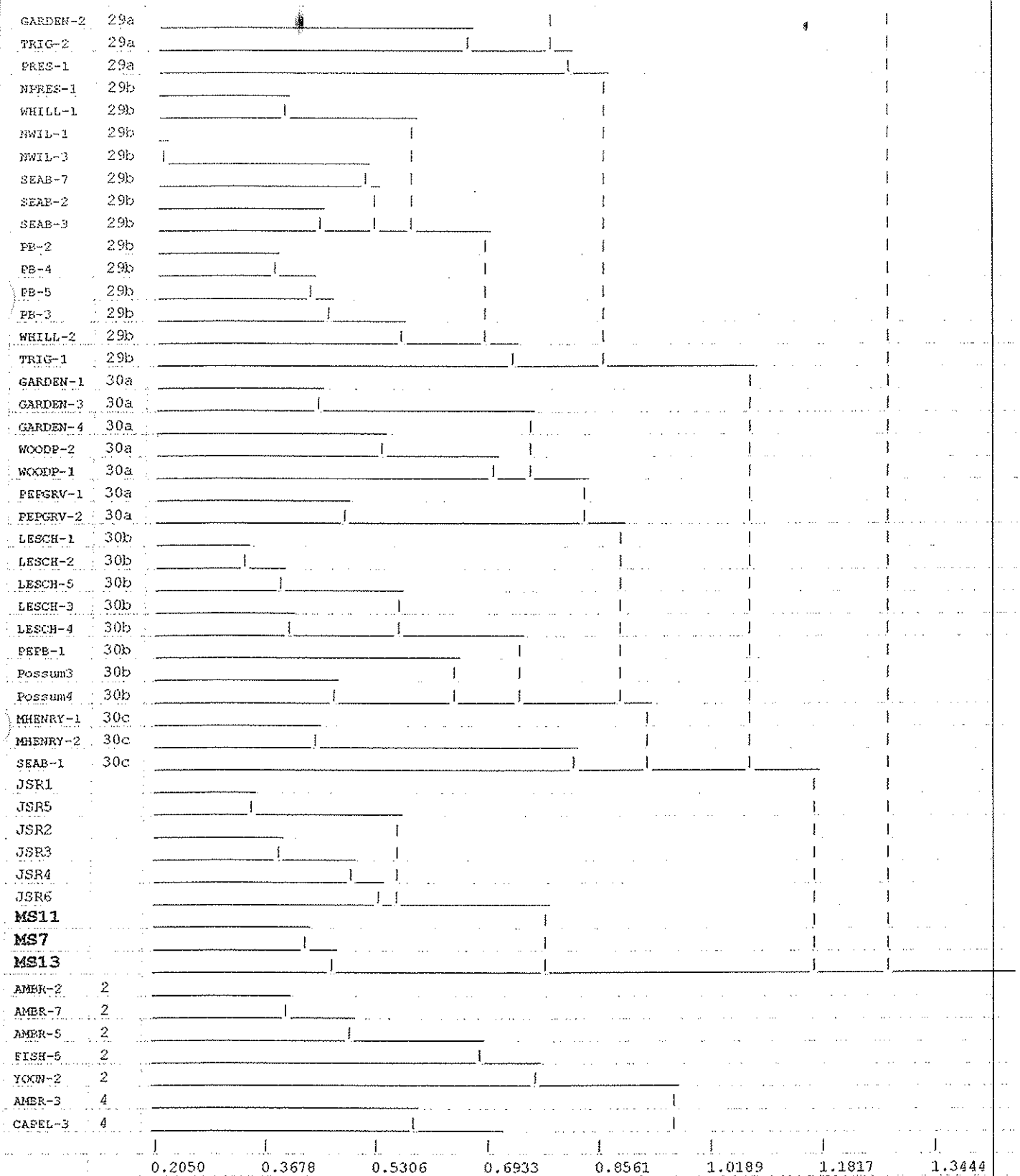


Table 2. Ten 'Nearest Neighbours' for the Meadow Springs sites

Column headings:

s: next most similar sites 1 to 10;

dc: dissimilarity coefficient for next most similar site;

f: Floristic Community Type of next most similar site.

Site	s1	dc1	f1	s2	dc2	f2	s3	dc3	f3	s4	dc4	f4	s5	dc5	f5	s6	dc6	f6	s7	dc7	f7	s8	dc8	f8	s9	dc9	f9	s10	dc10	f10
MS1	MS4	0.42		MS2	0.46		MS6	0.46		BOLD-1	0.47	24	MS5	0.52		BOLD-4	0.53	24	BOLD-2	0.54	24	NAVB-4	0.55	24	BOLD-3	0.55	24	TAM-1	0.58	21a
MS11	MS7	0.41		JSR5	0.45		MS13	0.48		JSR1	0.53		MS5	0.56		MS6	0.59		JSR3	0.61		MS4	0.62		MS2	0.62		YALG-4	0.62	27
MS13	MS7	0.42		MS11	0.48		MS6	0.55		JSR3	0.58		JSR5	0.59		MS3	0.63		JSR4	0.66		JSR1	0.67		MS2	0.68		MS4	0.68	
MS2	MS4	0.35		MS6	0.38		MS1	0.46		MS5	0.48		JSR5	0.54		JSR1	0.55		NAVB-4	0.56	24	MS3	0.58		SHE-4	0.58	26a	MTB-2	0.59	24
MS3	MS6	0.49		MS4	0.50		MS2	0.58		MS7	0.59		KERO-1	0.61	24	MTB-3	0.62	24	MS1	0.62		MS13	0.63		cool02	0.63	24	JSR3	0.64	
MS4	MS2	0.35		MS6	0.36		MS5	0.38		MS1	0.43		MS3	0.50		NAVB-4	0.50	24	JSR1	0.52		cool02	0.52	24	MTB-3	0.55	24	KERO-1	0.56	24
MS5	MS4	0.37		MS6	0.45		MS2	0.48		MS1	0.52		JSR1	0.55		MS11	0.56		cool08	0.58	24	BOLD-4	0.58	24	SVH-1	0.59	26a	cool02	0.59	24
MS6	MS4	0.36		MS2	0.38		MS5	0.45		MS1	0.46		MS3	0.49		cool03	0.54	24	cool02	0.55	24	KERO-1	0.56	24	MS13	0.56		WHILL-5	0.57	26b
MS7	MS11	0.41		MS13	0.42		JSR5	0.56		MS4	0.58		MS3	0.59		JSR3	0.60		MS6	0.62		JSR1	0.65		MS2	0.66		JSR6	0.67	

Table 3. Assignment of Floristic Community Type to Meadow Springs sites based on the dendrogram, nearest neighbour analysis and finally giving consideration to both methods.

Meadow Springs Site	From Dendrogram	From Nearest Neighbour	Floristic Community Types Assigned
MS1	24	24	24
MS11	29/30	27	27
MS13	29/30	24/27	24/27
MS2	24	24/26a	24/26a
MS3	24	24	24
MS4	24	24	24
MS5	24	24/26a	24/26a
MS6	24	24	24
MS7	29/30	24	24

6.0 VEGETATION CONSERVATION VALUES

6.1 Assessment for Threatened Ecological Communities (TEC) in the survey area

The vegetation in the Meadow Springs survey area predominantly belongs to floristic community 24 (see Table 3 above). This floristic community has not been identified as a TEC (Department of Environmental Protection (2000)). The PATN analysis showed that two vegetation types had affinities with the TEC floristic community 26a, but they were primarily related to the non-TEC floristic community 24.

Site MS11 was assigned by PATN analysis (nearest neighbour) to floristic community 27. This floristic community also has not been identified as a TEC (Department of Environmental Protection, 2000).

6.2 Tuart conservation values at Meadow Springs

Scattered tuart trees occurred over part of the limestone ridge crest and upper slopes (mainly in the northern half of the survey area) and along some of the slopes of the ridge, especially along the lower slopes (near the edge of the survey area).

Tuart is endemic to the Swan Coastal Plain where it grows mainly on the Quindelup and Spearwood Dunes, from Jurien Bay in the north to Sabina River east of Busselton, with some outlier populations near the Murray, Swan, Serpentine and Canning Rivers (Tuart Response Group, 2002).

The Tuart Response Group (2002) concluded that while Tuart as a species seems to be well represented in parks and reserves, its conservation status of tuart is less clear when considered relative to firstly the presently described six structural tuart ecosystems and secondly the composition of the flora associated with tuart. Another important factor impacting on tuart conservation is that tuart dominated communities have been significantly impacted by grazing,frequent fire, weed invasion and other threatening processes resulting in this vegetation being in a more disturbed condition than surrounding vegetation (Keighery *et al.*, 2002). For this reason Keighery *et al.* (2002) argued that areas of Tuart dominated vegetation in good condition should be a priority for retention and protection.

Another factor to consider is that there is little tuart vegetation in conservation reserves in the Mandurah area between Paganoni Rd and Yalgorup NP and that this makes any tuart

vegetation in that area, particularly if in good condition, of high conservation value (Bromwyn Keighery, *pers. comm.*).

In conclusion, the tuart vegetation in the survey area does have significant conservation value. However, the conservation value of the small area of tuart woodland on the central-eastern side of the limestone ridge is compromised by the fact that the understorey vegetation has been cleared in some of this area for tracks and other purposes and has left much of this small area Completely Degraded (Figure 2).

6.3 Other vegetation conservation values at Meadow Springs

The survey area has conservation value for the populations of the native species occurring within it. Eighty four native species were recorded in the survey area and most of the vegetation was in Very Good to Excellent condition with a good number of species in the different strata of vegetation and moderate to low weed cover. Furthermore, the diversity of the vegetation units in the survey area (particularly in the northern half of the survey area) adds to the conservation value.

7.0 HABITAT TREES

Sixty one trees were inspected in the Meadow Springs survey area for habitat indicators – branch hollows, nests and bark scratchings (see Table 4, Appendix 6). All of the tuart trees would provide habitat in many different ways for a wide range of fauna (especially insects and birds), but the focus of this survey was on Osprey nests.

All the trees in the survey area were tuart trees. Only tuarts greater than 5 metres high were recorded as hollows etc were not observed in juvenile trees.

Only one nest that was probably an Osprey nest was recorded during the survey. The nest was in tree T5 in the road reserve on the west side of the survey area. No nests were observed in the survey area.

Hollows were recorded in 13 trees. Only hollows that appeared to have depth were recorded. Five trees were recorded with hollows less than 10cm diameter, eight trees with hollows 10 to 20 cm diameter and three trees with hollows greater than 20 cm diameter. Signs of activity at the hollows was not recorded.

No scratch mark evidence of possum tree use were observed.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Flora conservation values of the survey area were moderate. While eighty four species were found to occur in the survey area, only one of them was of particular conservation value, the Priority 4 low shrub *Jacksonia sericea*.

No Threatened Ecological Communities (TEC's) were found to occur in the survey area. However, other notable vegetation conservation values exist in the survey area bushland, due to the presence of tuart in some of the vegetation units, the considerable number of flora species in the area, the Very Good to Excellent condition of much of the vegetation (especially on the limestone ridge crest and upper to mid slopes) and the diversity of vegetation units in the bushland.

Vegetation conservation values are moderately higher in the northern half of the survey area where there is greater diversity in the vegetation structure, there is a little more scattered tuart on the ridge crest and upper slopes and where vegetation condition is a little better, with fewer degradation points (see Figure 3).

No Osprey nests were observed in trees in the survey area, although one large stick nest (probably an Osprey nest) was observed in a tree in the road reserve on the west side of the survey area. However, the 58 trees in the survey area would offer some form of habitat function to a range of fauna.

9.0 ACKNOWLEDGEMENTS

City of Mandurah provided the ortho-corrected aerial photography from which SMEC Australia PL prepared aerial photograph base maps for the vegetation mapping.

Mr Ted Griffin ran the PATN analysis and gave advice on the interpretation of the results.

Thanks to Mr Andrew Brown for his assistance with the identification of the orchids and Mr Bruce Maslin for his examination of the *Acacia* aff. *rostellifera* specimens. Thanks also to Mr Malcolm Trudgen and Mr Mike Hislop for some general assistance with some identifications.

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APPENDIX 1. The Department of Conservation and Land Management Priority Flora Categories

Definition of CALM Declared Rare and Priority Flora categories (from Atkins 2003).

Declared Rare Flora - Extant Taxa

Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

Declared Rare Flora - Presumed Extinct Flora

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.

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.

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

Priority Three - Poorly Known Taxa.

Taxa which are known from several populations, and the taxa are not believed to under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally > 5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further study.

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 2. Vegetation structural table of Trudgen based on Aplin's (1979) modification of Specht's classification

Life form and height of tallest stratum	Projective foliage cover of tallest stratum as %	Description
Trees over 30 metres	70 -100	High closed forest
	30 -70	High open forest
	10 - 30	high woodland
	2 -10	high open woodland
	under 2	Scattered tall trees
Trees 10 - 30 metres	70 -100	Closed forest
	30 -70	Open forest
	10 - 30	Woodland
	2 -10	Open woodland
	under 2	Scattered trees
Trees under 10 metres	70 -100	Low closed forest
	30 - 70	Low open forest
	10 - 30	Low woodland
	2 -10	Low open woodland
	under 2	Scattered low trees
Shrubs over 2 metres	70 - 100	Closed scrub
	30 - 70	Open scrub
	10 - 30	High shrubland
	2 -10	High open shrubland
	under 2	Scattered tall shrubs
Shrubs 1 - 2 metres	70 - 100	Closed heath
	30 - 70	Open heath
	10 - 30	Shrubland
	2 -10	Open shrubland
	under 2	Scattered shrubs
Shrubs under 1 metre	70 - 100	low closed heath
	30 - 70	low open heath
	10 - 30	low shrubland
	2 -10	Low open shrubland
	under 2	Low scattered shrubs
Herbs/Sedges/Grasses	70 - 100	Closed herb, sedge, grassland
	30 - 70	Herb, sedge, grassland
	10 - 30	Open herb, sedge, grassland
	2 -10	Very open herb, sedge, g'land
	under 2	Scattered herbs sedges, grasses

Grasslands then divided into:
Tussock grasslands (perennial tussock species, e.g. Eragrostis species);
Hummock grasslands (Triodia and Plectrachne species that form hummocks)
Curly spinifex grassland (Plectrachne pungens, which does not form hummocks) (follows J.S. Beard).
Annual tussock grassland (e.g. annual Sorghum species).

APPENDIX 3 Vegetation condition scale and descriptions
(from Keighery 1994, reproduced in Department of Environmental Protection 2000b)

Pristine (1) : Pristine or nearly so, no obvious signs of disturbance

Excellent (2) : Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.

Very Good (3) : 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.

Good (4) : Vegetation structure significantly altered by very obvious signs 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.

Degraded (5) : 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.

Completely Degraded (6) : 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 comprising weed or crop species with isolated native trees or shrubs.

APPENDIX 4. Flora list for the Meadow Springs survey area.

Notes:
1. The numbers in front of the plant families are the numbers for families used at the Western Australian Herbarium.
2. An asterisk (*) beside the taxon name indicates an introduced species (weed).
3. The priority status column shows the conservation code of any rare or priority plants in the list.

FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
GYMNOSPERMAE		
016A ZAMIACEAE		
Macrozamia riedlei	Zamia	
ANGIOSPERMAE (flowering plants)		
MONOCOTYLEDONS		
031 POACEAE (grasses)		
Austrostipa flavescens		
*Avena barbata	Wild oats	
*Briza maxima	Blowfly grass	
*Briza minor		
*Bromus diandrus	Great brome grass	
*Ehrharta calycina	Perennial veldt grass	
*Ehrharta longiflora	Annual veldt grass	
*Holcus setiger	Annual fog grass	
*Lagurus ovatus	Hair's tail grass	
*Lolium rigidum	Annual rye grass	
Poa drummondiana	Knotted Poa	
*Vulpia myuros var. myuros	Silver grass	
032 CYPERACEAE (sedges)		
*Isolepis marginata		
Lepidosperma pubisquameum		
Lepidosperma sp.		
Schoenus grandiflorus		
039 RESTIONACEAE (rushes)		
Desmocladus asper		
040 JUNACEAE		
Centrolepis drummondiana		

054C DASYPOGONACEAE

Acanthocarpus preissii	Prickle lily
Lomandra maritima	

054D XANTHORRHOEACEAE

Xanthorrhoea sp.	

054E PHORMIACEAE

Dianella revoluta var. divaricata	Blueberry lily

054F ANTHERIACEAE

Sowerbaea laxiflora	Purple tassels
Thysanotus manglesianus	Fringed lily
Thysanotus sparteus	
Tricoryne elatior	Yellow autumn lily

054G ASPHODELACEAE

*Trachyandra divaricata	Dune onion weed

054J COLCHICACEAE

Wurmbea ?monantha	

055 HAEMODORACEAE

Anigozanthos humilis	Catspaw
Conostylis aculeata subsp. aculeata	Prickly Conostylis
Conostylis candicans	Grey cottonhead
Conostylis candicans subsp. calcicola	

066 ORCHIDACEAE (orchids)

Caladenia flava subsp. flava	Cowslip orchid
Caladenia latifolia	Pink fairy orchid
Caladenia longicauda	Common white spider orchid
Eriochilus dilatatus subsp. multiflorus	White bunny orchid

DICOTYLEDONS

070 CASUARINACEAE

Allocasuarina humilis	Dwarf sheok

090 PROTEACEAE

Dryandra lindleyana var. lindleyana	
Dryandra sessilis	Parrot bush
Grevillea crithmifolia	
Grevillea preissii subsp. preissii	
Grevillea vestita subsp. vestita	
Hakea prostrata	Harsh hakea

Hakea trifurcata	Two-leaf hakea
Petrophile axillaris	

092 SANTALACEAE

Santalum acuminatum	Quandong

097 LORANTHACEAE

Nuytsia floribunda	Christmas tree

105 CHENOPODIACEAE

Rhagodia baccata subsp. baccata

106 AMARANTHACEAE

Ptilotus polystachyus var. polystachyus

110 AIZOACEAE

*Carpobrotus edulis	Pigface, Hottentot fig

111 PORTULACACEAE

Calandrinia brevipedata	
Calandrinia liniflora	Parakeelya
Calandrinia sp.	

113 CARYOPHYLLACEAE

*Cerastium glomeratum	Mouse-ear chick weed
*Minuartia mediterranea	Sand wort
*Petrorhagia dubia	Velvet pink

138 BRASSICACEAE

*Heliophila pusilla

143 DROSERACEAE (sundew family)

Drosera stolonifera subsp. stolonifera	Leafy sundew

149 CRASSULACEAE

Crassula colorata	
*Crassula glomerata	

163 MIMOSACEAE (Acacias)

Acacia aff rostellifera	
Acacia cochlearis	Rigid wattle
Acacia lasiocarpa var. lasiocarpa	
Acacia pulchella var. glaberrima	Prickly moses
Acacia rostellifera	Summer scented wattle
Acacia truncata (Lake Preston variant)	

165 PAPILIONACEAE (peas)		
Bossiaea eriocarpa	Common brown pea	
Daviesia physodes		
Gompholobium tomentosum		
Hardenbergia comptoniana	Native Wisteria	
Hovea trisperma	Common Hovea	
Jacksonia furcellata	Grey stinkwood	
Jacksonia sericea		P4
*Lupinus cosentinii	Sandplain (blue) lupin	
*Melilotus indicus		
Templetonia retusa	Cockies tongue	
*Trifolium campestre var. campestre		
167 GERANIACEAE		
*Erodium cicutarium	Common storksbill	
*Geranium molle	Dove's foot	
*Pelargonium capitatum	Rose Pelargonium	
183 POLYGALACEAE		
Comesperma confertum		
185 EUPHORBIACEAE		
Beyeria cinerea		
*Euphorbia terracina		
Phyllanthus calycinus	False Boronia	
215 RHAMNACEAE		
Spyridium globulosum	Basket bush	
Trymalium ledifolium var. ledifolium		
226 DILLENIACEAE		
Hibbertia hypericoides	Yellow buttercups	
Hibbertia racemosa		
243 VIOLACEAE		
Hybanthus calycinus	Wild violet	
263 THYMELAEACEAE		
Pimelea calcicola		
273 MYRTACEAE		
Eucalyptus gomphocephala	Tuart	
Melaleuca huegelii	Chenille honeymyrtle	
Melaleuca systena	Coastal honeymyrtle	

281 APIACEAE	
Centella asiatica	
Daucus glochidiatus	Australian carrot
Homalosciadium homalocarpum	
Trachymene coerulea subsp. coerulea	Blue laceflower
Trachymene pilosa	Native parsnip
288 EPACRIDACEAE	
Leucopogon parviflorus	Coast beard-heath
293 PRIMULACEAE	
*Anagallis arvensis var. caerulea	Pimpernel
315 SOLANACEAE	
*Solanum nigrum	Deadly nightshades
316 SCROPHULARIACEAE (snapdaragon family)	
*Dischisma arenarium	
*Parentucellia latifolia	Red bartsia
320 OROBANCHACEAE	
*Orobanche minor	Lesser broomrape
331 RUBIACEAE	
Opercularia vaginata	
334 VALERIANACEAE	
*Centranthus macrosiphon	Pretty betsy
340 LOBELIACEAE	
Lobelia tenuior	Slender lobelia
341 GOODENIACEAE	
Scaevola anchusifolia	Silky scaevola
345 ASTERACEAE(daisies)	
*Arctotheca calendula	Capeweed
Asteridea pulverulenta	
Brachyscome iberidifolia	Swan river daisy
Hyalosperma cotula	
*Hypochaeris glabra	Smooth catsear
Millotia myosotidifolia	
Olearia axillaris	Coastal daisy bush
Podolepis lessonii	
*Sonchus oleraceus	Common sowthistle
*Ursinia anthemoides	

APPENDIX 5. Site descriptions and species lists for the Meadow Springs study area

Mandurah-City of **Site** MS1

Described by BRM **Date** 16/10/2004

Location NW corner of MS project area

Air Photo **Photo** 2 **on Roll** BM5(2004) **Video** N **E Photo**

Photo Notes Taken from NW side of site.

AMG Zone: 50H0383179mE; UTM6403209mN

Habitat: Very gently sloping, Nth-facing, floor of swale between two sand ridges.

Soil: Fine to medium grained orange-brown siliceous sand (Spearwood sand). (Sample SMS1).

Rock Type:

Vegetation: Hakea prostrata, Olearia axillaris scattered shrubs over Allocasuarina humilis, (Acacia pulchella var. glaberrima) shrubland over Melaleuca systina, Grevillea crythmifolia, Jacksonia sericea, Hibbertia hypericoides low open shrubland over Desmocladus aspera sedgeland and Conostylis aculeata subsp. aculeata very open herbland.

Veg Condition: (BF) Very Good to Excellent. Low to moderate weed cover.

Fire Age:

Notes: Releve over approximately 10x10 area around the GPS point. Complete releve.

Rock Pile:

Species List:

Quad Name	Cover Class	Height	Specimen	Notes
Acacia lasiocarpa var. lasiocarpa	+	35cm	MS1-25	
Acacia pulchella var. glaberrima	4-5	1.1	MS1-2	
Allocasuarina humilis	30-40%	80cm-		
Anagallis arvensis var. caerulea blue flr	+	10cm		Anagallis
Asteridea pulverulenta (minature)	+	15cm	MS1-28	daisy
Astroloma pallidum	+	15cm	MS1-27	Astrolcma
Austrostipa flavescens	+	50cm	MS1-24	austrostipa
Avena barbata	+	45cm		
Bossiaea eriocarpa	+	30cm		
Briza maxima	5-8	25cm		
Briza minor	+	20cm		
Bromus diandrus	1-2	30-35cm	MS1-6	*
Calandrinia liniflora	+	2cm	MS1-9	
Centrolepis drummondiana	+	4cm	MS1-33	herb
Cerastium glomeratum	+	15cm	MS1-21	*herb? Weed
Conostylis aculeata subsp. aculeata	3-4	30cm	MS1-4	
Crassula colorata	+	1-3cm	MS1-16	
Crassula glomerata	+	2cm	MS1-19	
Desmocladus asper	10-15	20cm	MS1-1	
Dianella revoluta var. divaricata	+	35cm		not flowering
Dischisma arenarium	+	4cm	MS1-15	*small herb
Dryandra lindleyana var. lindleyana stems	1%	15cm		underground
Ehrharta calycina	1-2	1.1m		
Erodium cicutarium	+	12cm	MS1-34	*Erodium
Gompholobium tomentosum			MS1-25a	
Grevillea crithmifolia	1-2	25cm	MS1-8	
Hakea prostrata	+	1.7m		
Hibbertia hypericoides	3-5%	30-60cm		

Hibbertia racemosa	+	30cm	MS1-18	
Homalosciadium homalocarpum	+	2cm	MS1-29	short green herb
Hovea trisperma	+	25cm	MS1-10	
Hypochaeris glabra	+	10cm	MS1-11	Hypochaeris ?glabra
Isolepis marginata	+	2cm	MS1-31	
Jacksonia sericea	3-5	30-35cm	MS1-12	prostrate
Lepidosperma sp.	+	30cm	MS1-32	sedge
Lolium rigidum	+	30cm	MS1-13	rye grass
Lomandra maritima	+	20cm	MS1-14	
Melaleuca systena	3	50-60cm	MS1-22	
Millotia myosotidifolia	+	10cm	MS1-17	small daisy white flr top
Olearia axillaris	+	1.8m		
Orobanche minor	+	12cm		
Petrorhagia dubia	+	15-30cm	MS1-5	*Pink flr weed
Phyllanthus calycinus	+	15cm		
Rhagodia baccata subsp. baccata	1	70-80cm	MS1-23	
Schoenus grandiflorus	+	60cm	MS1-3	
Sonchus oleraceus	+	15cm	MS1-26	juv.
Thysanotus manglesianus	+	35cm	MS1-20	Thysanotus climber
Trachymene pilosa	+	5cm	MS1-30	Trachymene ?pilosa
Trifolium campestre var. campestre	1-2		MS1-7	Trifolium ?campestre
Ursinia anthemoides	+	20cm		

Mandurah-City of **Site** MS2

Described by BRM **Date** 16/10/2004

Location NW corner of MS project area

Air Photo **Photo** 5 **on Roll** BM5(2004) **Video** N **E Photo**

Photo Notes Taken from west side.

AMG Zone 50 383206mE, 640316mN

Habitat Gentle, West-facing slope of low dune.

Soil Fine to medium grained orange-brown siliceous sand with a small amount of calcium carbonate (Spearwood sand). (Sample SMS2).

Rock Type Limestone (outcropping common).

Vegetation Eucalyptus gomphocephala scattered trees over Acacia rostellifera, (Santalum acuminatum) shrubland to tall open scrub over Trymaleum ledifolium var. ledifolium scattered shrubs over Grevillea preissii subsp. preissii, Phylanthus calycinus low open shrubland over Desmocladus asper, Lepidosperma pubisquameum open sedgeland with Opercularia vaginata, Millotia myosotidifolia herbland.

Veg Condition (BF) Excellent.

Fire Age

Notes Releve over approximately 10x10 area around the GPS point. Complete releve.

Rock Pile

Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes

Acacia lasiocarpa var. lasiocarpa	1	30cm	MS2-17	Aca las
Acacia rostellifera	30-40	1.1-2.5m	MS2-1	
Anagallis arvensis var. caerulea	+	10cm		Anagalis blue
flr				
Austrostipa flavescens	+	80cm	=MS1-24	Austrostipa
Avena barbata	+	45cm		
Beyeria cinerea	2-3	50cm	MS2-12	under shrubs
Brachyscome iberidifolia	+	12cm	=MSGC1	purple daisy
Bromus diandrus	+	30cm	=MS1-6	Bromus
?diandrus				
Calandrinia liniflora	+	5cm	MS2-19	Calandrinia
Cerastium glomeratum	+	20cm	MS2-18	*
Conostylis aculeata subsp. aculeata	+	25cm	=MS1-4	
Conostylis candicans	+	20cm	=MSGC5	
Crassula colorata	+	2cm	=MS1-16	
Crassula glomerata	+	2cm	=MS1-19	
Daucus glochidiatus	+	12cm	MS2-10	fine lobe
Desmocladus asper	15-20	15cm	=MS1-1	
Dischisma arenarium	+	4cm	=MS1-15	
Dryandra lindleyana var. lindleyana	+	15cm		
Ehrharta calycina	+	70cm		
Ehrharta longiflora	1-2	30cm		
Gompholobium tomentosum	+	20cm	MS2-5	
Gompholobium isii				
Grevillea crithmifolia	1	40cm	=MS1-8	
Grevillea preissii subsp. preissii	20-30	40-90cm	=MSGC4	
Heliophila pusilla	+	20cm	=MSGC9	Bras. weed
herb wte flr				
Hybanthus calycinus	+	20cm		
Hypochaeris glabra	+	15cm	=MS1-11	
Lepidosperma pubisquameum	+	25cm	MS2-3	sedge
Lolium rigidum	+	30cm	=MS1-13	rye grass
Lomandra maritima	+	35cm	MS2-14	Lomandra
Millotia myosotidifolia	10	12-15cm	=MS1-17	daisy wte flr
Minuartia mediterranea	+	2cm	MS2-9	herb
Opercularia vaginata	+	25cm	MS2-4	
Parentucellia latifolia	+	3cm	MS2-16	Parentucellia
Petrorhagia dubia	+	30cm	=MS1-5	pink flr weed
Phyllanthus calycinus	3-4	35-40cm		
Poa drummondiana	+	50cm	MS2-15	tall bulb grass
Rhagodia baccata subsp. baccata	2-3	80cm	MS2-7	
Santalum acuminatum	3-5	90cm-	MS2-2	Santalum
Sonchus oleraceus	+	25cm	MS2-8	
Thysanotus manglesianus	+	40cm	MS2-13	Thysanotus
climber				
Trachymene pilosa	+	4cm	MS2-11	Trachymene
short				
Trymalium ledifolium var. ledifolium	1-2	1.2m	=MSGC7	
Vulpia myuros var. myuros	+	15cm	MS2-6	*Vulpia grass

Mandurah-City of **Site** MS3

Described by BRM **Date** 17/10/2004

Location Near north end of the Meadow Springs survey area.

Air Photo **Photo** 6 **on Roll** BM5(2004) **Video** N **E Photo**

Photo Notes

AMG Zone 50 383175mE, 6403163mN

Habitat Swale on east side of low sand dune.

Soil Orange-brown sand (sample SMS3).

Rock Type

Vegetation Acacia rostellifera tall closed scrub over Allocasuarina humilus scattered shrubs over Hibbertia hypericoides, Phylanthus calycinus low shrubland over Conostylus aculeata subsp. aculeata, Caladenia latifolia very open herbland with *Bromus diandrus open annual grassland.

Veg Condition

Fire Age

Notes . Incomplete sp list. Approximate equivalent area of a 10x10m releve over the irregular area of the MS3 vegetation unit, based around the GPS point

Rock Pile

Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia rostellifera				MS3-1	Acacia rostellifera
	Allocasuarina humilis					
	Anagallis arvensis var. caerulea					Anagalis blue
	Briza minor					
	Bromus diandrus					
	Caladenia latifolia				=MSGC15	
	Conostylis aculeata subsp. aculeata				=MS1-4	
	Dianella revoluta var. divaricata					
	Dischisma arenarium				=MS1-15	
	Drosera stolonifera subsp. stolonifera				MS3-4	Drosera upright
	Ehrharta longiflora					
	Grevillea preissii subsp. preissii				=MSGC4	
	Hibbertia hypericoides					
	Hybanthus calycinus				MS3-5	Hybanthus calycinus
	Hypochaeris glabra					
	Phyllanthus calycinus					
	Rhagodia baccata subsp. baccata				=MS2-7	Rhagodia
	Thysanotus manglesianus				MS3-3	Thysanotus climber
	Trachymene pilosa				MS3-2	Trachymene

Mandurah-City of **Site** MS4

Described by BRM **Date** 17/10/2004

Location Central area of Meadow Springs survey area.

Air Photo **Photo** 9 **on Roll** BM5 **Video** N **E Photo**

Photo Notes

AMG Zone 50 383124mE, 6402887mN

Habitat Flat crest of low dune ridge.

Soil Orange-brown sand

Rock Type

Vegetation Acacia aff rostellifera, (Grevillea preissii subsp. preissii, Rhagodia baccata subsp. baccata) open heath over Hibbertia hypericoides, Phyllanthus calycinus low open shrubland over

Desmocladus asper open sedgeland and Dianella revoluta var. divaricata, Conostylis aculeata subsp. aculeata very open herbland and *Avena barbata, *Bromus diandrus open annual grassland.

Veg Condition (BF) VG to Excellent (moderate weed cover).

Fire Age

Notes Releve over approximately 10x10 area around the GPS point. Complete releve.

Rock Pile

Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia aff rostellifera	60-70		1.3-1.6m	MS4-1	Acacia
	Anagallis arvensis var. caerulea	+		10cm		Anagalis blue flr
	Austrostipa flavescens	+		40cm	MS4-7	Austrostipa
	Avena barbata	3-5		60cm		
	Briza maxima	+		40cm		
	Bromus diandrus	5-10		30cm	MS4-3	*
	Cerastium glomeratum	+		10cm	=MS2-18	many headed herb
	Conostylis aculeata subsp. aculeata	2-3		30cm	=MS1-4	
	Crassula colorata	+		4cm	=MS1-16	
	Crassula glomerata	2-4%		2cm	=MS1-19	
	Desmocladus asper	15-20		25cm	=MS1-1	
	Dianella revoluta var. divaricata	1		45cm		
	Dischisma arenarium	1-2		5cm	=MS1-15	
	Dryandra lindleyana var. lindleyana	+		15cm		
	Ehrharta longiflora	+		25cm		
	Gompholobium tomentosum	+		35cm		
	Grevillea preissii subsp. preissii	5-10%		90cm-	MS4-9	Grevillea preisii
	Heliophila pusilla	+		15cm	=MSGC9	Brassicaceae small wte flr
	Hibbertia hypericoides	1-5%				
	Hybanthus calycinus	+		20cm		
	Hypochaeris glabra	+		20cm	=MS1-11	
	Lolium rigidum	1-2%		40cm	=MS1-13	?rye grass
	Lomandra maritima	+		25cm	MS4-6	
	Lupinus cosentinii	+		35cm		blue lupin
	Minuartia mediterranea	+		3cm	=MS2-9	herb small
	Petrorhagia dubia	+		30cm	=MS1-5	pink flr weed
	Phyllanthus calycinus	1		35cm		
	Ptilotus polystachyus var. polystachyus	grassland.		+	40cm	=MSGC2
	Rhagodia baccata subsp. baccata	+		1.1m	MS4-2	
	Schoenus grandiflorus	+		35cm		
	Sonchus oleraceus	+		20cm		
	Sowerbaca laxiflora	+		40cm		
	Trachyandra divaricata	+		35cm	MS4-5	*
	Trachymene pilosa	+		3cm	MS4-8	Trachymene ?pilosa
	Tricoryne elatior	+		25cm	=MSGC18	
	Trifolium campestre var. campestre	+		12cm	=MS1-7	
	Vulpia myuros var. myuros	+		20cm	MS4-4	?Vulpia

Mandurah-City of Site MS5

Described by BRM Date 17/10/2004

Location West side of central-southern part of Meadow Springs survey area.

Air Photo **Photo** 10 **on Roll** BM5 **Video** N **E Photo**

Photo Notes Taken from NW side.

AMG Zone 50 383057mE, 6402847mN

Habitat Gentle upper to mid slope, south-facing, of low dune.

Soil Orange-brown sand.

Rock Type Moderate limestone outcropping.

Vegetation Melaleuca huegelii open scrub (lots of it about 2m high) over Templetonia retusa, (Spyridium globulosum) scattered tall shrubs over Trymalium ledifolium subsp. ledifolium open shrubland over Grevillea preissii subsp. preissii, Acacia truncata (Lake Preston variant), Phyllanthus calycinus low shrubland over Desmocladus asper open sedgeland to sedgeland with Millotia myosotidifolia, *Crassula glomerata, *Dischisma arenarium very open herbland.

Veg Cond (BF) VG to Excellent (moderate weed cover).

Fire Age >5-7 years since fire. (NB. some old M hueg).

Notes Releve over approximately 10x10 area around the GPS point. Complete releve.

Rock Pile

Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia truncata (Lake Preston variant)	1-2		70cm	MS5-3	
	Anagallis arvensis var. caerulea	+		12cm		
	Austrostipa flavescens	+		40cm	MS5-12	Austrostipa
	Avena barbata	1-2		50cm		
	Briza maxima	+		20cm		
	Bromus diandrus	1		30cm	=MS4-3	
	Caladenia latifolia (base leaves)	+		15cm	=MSGC15	Thelymitra
	Centella asiatica	+		20cm	MS5-10	
	Comesperma confertum ?Comesperma	+		90cm	MS5-11	
	Conostylis aculeata subsp. aculeata	+		25cm	=MS1-4	
	Crassula glomerata	2-3		2-3m	=MS1-19	
	Desmocladus asper	15-20		15cm	=MS1-1	
	Dianella revoluta var. divaricata	+		40cm		
	Dischisma arenarium	1		3-5cm	=MS1-15	
	Dryandra lindleyana var. lindleyana stems	1-2		15cm		underground
	Ehrharta calycina	1		60cm		
	Geranium molle (?Erodium)	+		10cm	=MSGC19	pink flr herb
	Gompholobium tomentosum	+		35cm		
	Grevillea preissii subsp. preissii	5-6		60cm	=MS4-9	
	Hardenbergia comptoniana	+		1.1		
	Hypochaeris glabra	+		20cm	=MS1-11	
	Lagurus ovatus	+		35cm		
	Leucopogon parviflorus	+		25cm	MS5-9	Leucopogon
	Lomandra maritima	+		25cm	=MS4-6	Lomandra
	Melaleuca huegelii	50-60		1.2-1.5(5)m	MS5-4	
	Millotia myosotidifolia	1%		12cm	MS5-2	wte flr daisy
	Minuartia mediterranea heads	+		3cm	=MS2-9	herb smll flr
	Petrorhagia dubia	+		35cm	=MS1-5	Pink flr weed
	Phyllanthus calycinus	2-3		35cm		

Sonchus oleraceus	+	20cm		
Spyridium globulosum	1	1.9m	MS5-5	
Templetonia retusa	3-4	2.1m		
Trachymene pilosa	+	12cm	MS5-8	Trachymene
Tricoryne elatior	+		=MSGC18	
Trifolium campestre var. campestre	+	10cm	=MS1-7	
Trymalium ledifolium var. ledifolium	5-10%	1.2m	MS5-1	
Vulpia myuros var. myuros	+	15cm	=MS4-4	?Vulpia
Wurmbea ?monantha	+	20cm	MS5-7	(a few)

Mandurah-City of **Site** MS6

Described by BRM **Date** 17/10/2004

Location West side of central part of Meadow Springs survey area.

Air Photo **Photo** 11 **on Roll** BM5 **Video** N **E Photo**

Photo Notes Looking from west side.

AMG Zone 50 383112mE, 6402939mN

Habitat Gentle, West-facing, mid to upper slope of low dune.

Soil Orange-brown sand.

Rock Type

Vegetation Eucalyptus gomphocephala scattered trees over Acacia rostellifera, (Melaleuca huegelii) open

to closed scrub over Grevillea preissii subsp. preissii, Phylanthus calycinus, Grevillea crithmifolia low open shrubland over Desmocladus asper open sedgeland and *Crassula glomerata, *Dischisma arenarium, Conostylis aculeata subsp. aculeata very open herbland.

Veg Condition (BF) VG to Excellent (moderate weed cover).

Fire Age

Notes Releve over approximately 10x10 area around the GPS point. Complete releve.

Rock Pile

Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia rostellifera	70-80		1.7-2.4m	MS6-1	
	Allocasuarina humilis	1-2		70cm		
	Anagallis arvensis var. caerulea	+		15cm		Anagalis arvensis
	Bromus diandrus	3-5		30cm		
	Cerastium glomeratum	+		15cm	=MS2-18	Also MS6-4a
	Conostylis aculeata subsp. aculeata	1		30cm	=MS1-4	
	Crassula colorata	+		2-3cm	=MS1-16	
	Crassula glomerata	1-2		2-3m	=MS1-19	
	Desmocladus asper	20-25		20cm		
	Dianella revoluta var. divaricata	+				
	Dischisma arenarium	1-2		5cm	=MS1-15	*
	Dryandra lindleyana var. lindleyana	+		15cm		
	Ehrharta calycina	+		40cm		
	Eucalyptus gomphocephala	3%		4m		lge tree nearby
	Gompholobium tomentosum	+		40cm		
	Grevillea crithmifolia	1-2		60cm	MS6-3	
	Grevillea preissii subsp. preissii	3-5		70cm	MS6-2	
	Hakea trifurcata	+		1.5m		
	Hardenbergia comptoniana	1		1.5m		
	Heliophila pusilla	+		20cm	=MSGC9	Brassicaceae

wte flr small

Hibbertia hypericoides	+	40cm		
Hybanthus calycinus	+	20cm		
Hypochaeris glabra	+	20cm	=MS1-11	
Isolepis marginata	+	2-3cm	=MSGC30	?Isolepis
Lolium rigidum	+	30cm	=MS1-13	rye grass
Melaleuca huegelii	3-4	1.7m		
Millotia myosotidifolia	+	12cm	=MS5-2	wte daisy
Minuartia mediterranea	+	3-5cm	MS6-4	*herb
Phyllanthus calycinus	3-5	40cm		
Rhagodia baccata subsp. baccata	1-2	1.1m		
Trifolium campestre var. campestre	+	10cm	=MS1-7	
Trymalium ledifolium var. ledifolium	1-2	60cm	=MS5-1	

Mandurah-City of **Site** MS7

Described by BRM **Date** 4/12/2004

Location Central part of of Meadow Springs survey area.

Air Photo **Photo** **on Roll** **Video** N E **Photo**

Photo Notes

AMG Zone 50 383116mE, 6402905mN

Habitat Saddle of ridge (dune) crest, sloping down to west and esat and up to the north and south.

Soil Orange-yellow sand.

Rock Type Some exposed limestone.

Vegetatio Acacia cochlearis, (Acacia aff rostellifera) shrubland over Allocasuarina humilis, Grevillea preissii subsp. preissii, Hibbertia hypericoides low open heath over Desmocladus asper open sedgeland and *Bromus diamdrus, *Avena barbata open grassland.

Veg Condition (BF) VG to Excellent.

Fire Age

Notes Releve over approximately 10x10 area around the GPS point. Incomplete sp list.

Rock Pile

Species List:

Quad Name	Cove	C Class	Height	Specimen	Notes
Acacia aff rostellifera	2-5			MS7-2	
Acacia cochlearis	10-20			MS7-1	
Acacia lasiocarpa var. lasiocarpa	+				
Allocasuarina humilis	3-4				
Avena barbata					
Bromus diandrus					
Conostylis aculeata subsp. aculeata	+				
Desmocladus asper	20-30				
Dryandra lindleyana var. lindleyana					
Grevillea preissii subsp. preissii	20-30				
Hibbertia hypericoides	5-10				
Lomandra maritima					
Lupinus cosentinii	+				blue lupins
Rhagodia baccata subsp. baccata					
Templetonia retusa	+				

Mandurah-City of Site MS8

Described by BRM Date 4/12/2004

Location Meadow Springs survey area.
Air Photo Photo on Roll Video N E Photo
Photo Notes
AMG Zone 50 383151mE, UTM6403012mN
Habitat: Saddle on crest of low ridge.
Soil: Orange-brown sand.
Rock Type
Vegetation Hakea trifurcata, Santalum acuminatum scattered tall shrubs over Allocasuarina humilis shrubland to
open heath over Hibbertia hypericoides, Gompholobium tomentosum, Phylanthus calycinus, Dryandra lindeyana var. lindleyana low shrubland over Desmocladus asper, (Lepidosperma pubisquameum)
open sedgeland and *Bromus diandrus scattered annual grasses.

Assoc species: *Trifolium campestre var. campestre; Conostylis aculeate subsp. aculeate; Daucus glochidiatus;
Lobelia tenuior; Acacia pulchella var. glaberrima.

Veg Condition: (BF) G to VG. (Moderate weed cover of *Trifolium campestre var. campestre, *Lupinus cosentinii
and Petrrohagia dubia).
Fire Age
Notes Incomplete sp list.
Rock Pile

Mandurah-City of Site MS9
Described by BRM Date 4/12/2004
Location Meadow Springs survey area.
Air Photo Photo on Roll Video N E Photo
Photo Notes
AMG Zone 50 383109mE, UTM6402998mN
Habitat: Gentle, West-facing upper slope of low ridge.
Soil: Orange-brown sand.
Rock Type
Vegetation Santalum acuminatum, (Hakea trifurcate, Olearia axilaris) shrubland over Rhagodia baccata subsp. baccata, Allocasuarina humilis open shrubland over Grevillea preissii subsp. preissii, (Acacia lasiocarpa var. lasiocarpa, Gompholobium tomentosum, Phylanthus calycinus) low open heath over Desmocladus asper open sedgeland and *Bromus diandrus open annual grassland with Opercularia vaginata scattered herbs.

Assoc species: Lupinus cosentinii; Melaleuca systina; Dryandra lindleyana var. lindleyana; Dianella revolute var. divaricata; Acacia rostellifera; Conostylis aculeate subsp. aculeate.

Veg Condition: (BF) VG to Excellent. (Moderate high weed cover of *Bromus diandrus and , *Avena barbata).

Fire Age
Notes Incomplete sp list.
Rock Pile

Mandurah-City of Site MS10

Described by BRM Date 4/12/2004

Location Just outside the survey area in the road reserve on the west side of the Meadow Springs survey area.

Air Photo Photo on Roll Video N E Photo

Photo Notes

AMG Zone 50 382967mE, UTM6402800mN

Habitat: Gentle, West-facing lower slope of low ridge.

Soil: Orange-brown sand.

Rock Type

Vegetation Santalum acuminatum, (Hakea trifurcate, Olearia axilaris) shrubland over Rhagodia baccata subsp. baccata, Allocasuarina humilis open shrubland over Grevillea preissii subsp. preissii, (Acacia lasiocarpa var. lasiocarpa, Gompholobium tomentosum, Phylanthus calycinus) low open heath over Desmocladus asper open sedgeland and *Bromus diandrus open annual grassland with Opercularia vaginata scattered herbs.

Assoc species: *Lupinus cosentinii; Melaleuca systina; Dryandra lindleyana var. lindleyana; Dianella revolute var. divaricata; Acacia rostellifera; Conostylis aculeate subsp. aculeate.

Veg Condition: (BF) Good to Very Good. (Moderate to high weed cover of *Ehrharta calycina and , *Avena barbata).

Fire Age

Notes Incomplete sp list. Very disturbed surrounds – edge of road reserve (cleared) and edge of old clearing.

Rock Pile

Mandurah-City of Site MS11

Described by BRM Date 5/12/2004

Location East side of northern end of Meadow Springs survey area.

Air Photo Photo 6 on Roll BM12 Video N E Photo

Photo Notes

AMG Zone 50 383238mE, 6403075mN

Habitat Gentle, East-facing midslope of low ridge.

Soil Orange-brown sand.

Rock Type

Vegetation Eucalyptus gomphocephalus scattered trees over Hakea prostrata, Olearia axillaris, Santalum acuminatum scattered tall shrubs over Allocasuarina humilis, Trymalenm ledifolium var. ledifolium shrubland over Grevillea preissii subsp. preissii, Hibbertia hypericoides, Phylanthus calycinus low shrubland over Desmocladus asper very open sedgeland and *Bromus diandrus, *Avena barbata, *Lagurus ovartus annual open grassland.

Veg Condition (BF) (G) to VG. (Moderate to high weed cover of *Lagurus ovatus, *Avena barbata, *Bromus diandrus and blue lupins

Fire Age

Notes Releve over approximately 10x10 area around the GPS point. Incomplete sp list.

Rock Pile

Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia lasiocarpa var. lasiocarpa	+				
	Acacia truncata (Lake Preston variant)	+			MS11-4	Acacia
	Allocasuarina humilis	5-10				
	Avena barbata	2-3				
	Bromus diandrus	3-5				
	Conostylis aculeata subsp. aculeata	+				
	Daviesia physodes	+			MS11-5	Daviesia
	Desmocladus asper	5-10				
	Dryandra lindleyana var. lindleyana	+				
	Eucalyptus gomphocephala	+				
	Grevillea preissii subsp. preissii	15-20			MS11-2	
	Hakea trifurcata	+				
	Hibbertia hypericoides	2-3				
	Lagurus ovatus	1-2				
	Leucopogon parviflorus	+			MS11-3	Leecopogon
	Lomandra maritima	+				
	Lupinus cosentinii	+				blue lupin
	Olearia axillaris	+				
	Opercularia vaginata	+				
	Petrophile axillaris	+				Petrophile
	Phyllanthus calycinus	1-3				
	Rhagodia baccata subsp. baccata	1-2				
	Santalum acuminatum	2-5%				
	Schoenus grandiflorus	+				
	Templetonia retusa	+				
	Tricoryne elatior	+				
	Trymalium ledifolium var. ledifolium	3-5			MS11-1	

Mandurah-City of **Site** MS12

Described by BRM **Date** 5/12/2004

Location NE corner of Meadow Springs survey area.

Air Photo **Photo** 7 **on Roll** BM12(2004) **Video** N **E Photo**

Photo Notes

AMG Zone 50 383321mE, UTM6403195mN

Habitat: Swale and gentle, West-facing lower slope of low ridge.

Soil: Orange-brown sand.

Rock Type

Vegetation Hakea trifurcate, Hakea prostrate scattered tall shrubs over Santalum acuminatum, Allocasuarina humilis (Acacia cochlearis) open heath over Grevillea preissii subsp. preissii, Hibbertia hypericoides low open shrubland over Schoenus grandiflorus and Desmocladus flexuosus open and Conostylis aculeate subsp. aculeate very open herbland.

Assoc species: Olearia axillaries; Conostylis candicans; Grevillea crithmifolia; Tricoryne elatior; Rhagodia baccata subsp. baccata; Dryandra lindleyana var. lindleyana; Acacia pulchella var. glaberrima.

Veg Condition: (BF) VG to Excellent.

Fire Age

Notes Incomplete sp list.

Rock Pile

Mandurah-City of Site MS13

Described by BRM **Date** 5/12/2004

Location NE corner of Meadow Springs survey area.

Air Photo **Photo** 10,11,12 **on Roll** BM12(2004) **Video** N **E Photo**

Photo Notes

AMG Zone 50 383354mE, 6403179mN

Habitat Gentle, W-facing lower slope of low ridge

Soil Orange-brown sand.

Rock Type

Vegetatio Hakea trifurcata, (Santalum acuminatum) open to closed scrub over Rhagodia baccata subsp. baccata, Allocasuarina humilis open shrubland over Grevillea preissii subsp. preissii, Hibbertia hypericoides low shrubland to low open heath over Desmocladus asper very open sedgeland and Lomandra maritima scattered herbs with *Bromus diandrus very open annual grassland.

Veg Condition (BF) Excellent (low weed cover).

Fire Age

Notes Releve over approximately 10x10 area around the GPS point. Incomplete sp list.

Rock Pile

Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Allocasuarina humilis	+				
	Austrostipa flavescens	+				Austrostipa sp.
	Bromus diandrus	1-5				
	Desmocladus asper	1-5				
	Dianella revoluta var. divaricata	+				
	Dryandra lindleyana var. lindleyana	+				
	Ehrharta calycina	+				
	Grevillea preissii subsp. preissii	20-30			MS13-1	
	Hakea trifurcata	70-80				
	Hibbertia hypericoides	1-2				
	Lepidosperma pubisquameum	+				
	Lomandra maritima	+				
	Rhagodia baccata subsp. baccata	3-4				
	Santalum acuminatum	4-5				

APPENDIX 6 Tree habitat data

Table 4 Tree habitat records for the Meadow Springs survey area

Note:

1. all trees examined were tuarts.
2. Trees T1, T5, T6 were located in the road reserve on east side of RAAF Association Retirement Village
3. Trunks: scratch marks on trunk

Tree ID	Tag Nos	Easting 50H	Northg	Hght (m)	Habitat Indicators					Comments
					Nests	Hollows (diam cm)			Trunk	
						<10	10-20	>20		
T1		382949	6402808	18	N	1			N	
T5	579	383025	6402938	18	1		1		N	Lge stick nest (Osprey?); bee hive
T6		383046	6402971		N				N	
T2		383984	6402772	18	N			1	N	20x8cm hollow
T3		382996	6402801	15	N				N	
T4		383064	6402862	7	N				N	
T7		383106	6402947	18	N	1	1	1	N	
T8		383118	6402983	15	N				?	
T9		383149	6403050	6	N				N	young tree
T10		383165	6403016	5	N				N	young tree
T11		383178	6402994	8	N				N	Nos of small-med dead bches
T12		383183	6403016	10	N				N	
T13		383178	6403041	4	N				N	young tree

T14	548	383172	6403057	8	N				N	
T15		383154	6403076	5	N					young tree
T16		383257	6403124	20	N				N	Nos of smll dead bches
T17		383198	6403179		N				N	Nos of smll dead bches
T18		383233	6403213	18	N				N	Nos of smll/lge dead bches
T19		383209	6403246	18	N		1			Nos of smll/lge dead bches
T20		383208	6403258	18	N	1			N	Nos of smll dead bches
T21		383216	6403238	6	N				N	
T22	540	383284	6403243	15	N				N	Nos of smll dead bches
T23		383309	6403238	18	N	1			N	
T24	538	383313	6403244	7	N				N	
T25	536	383327	6403227	6	N				N	
T26		383314	6403138	12	N				N	Nos of smll dead bches
T27	545	383310	6403132	16	N				N	Nos of smll dead bches; bee hive
T28	543	383324	6403119	8	N				N	
T29		383346	6403101	15	N				N	
T30		383360	6403099	9	N				N	
T31		383343	6403088	10	N				N	
T32	542	383335	6403092	11	N				N	
T33	549	383299	6403085	12	N		2			Nos of smll dead bches; bee hive
T34	552	383258	6403054	20	N		1		N	
T35	553	383249	6403055	25	N	1	1		N	
T36	554	383240	6403060	18	N				N	
T37	555	383207	6403036	25	N		1		N	
T38	556	383203	6403036	15	N				N	Nos of smll dead

										bches
T39	559	383246	6403014	14	N				N	
T40		383294	6403038	25	N				N	
T41	567	383295	6403030	13	N				N	
T42										Trunk broken at 4m
T43		383268	6403012	22	N		4			bee hive
T44	565	383272	6403011	22	N					
T45	563			6				4		trunks broken off
T46	562			25	N				N	Nos of smll/lge dead bches
T47				25	N				N	"
T48	558	383223	6402978	8	N				N	
T49		"	"	8	N				N	
T50		383254	6402958	12	N					
T51		"	"		N					
T52		"	"		N					
T53		"	"		N					
T54		383245	6402876	10	N					
T55		383231	6402853	20	N					
T56		"	"	20	N					
T57		383224	6402845	15	N					
T58		383212	640284	8	N					
T59	570	383185	6402835	13	N					
T60		383185	6402830	9						
T61	571	383188	6402906	12						Nos of smll/lge dead bches