ENTERED ON GIS

Name: Flora and Vegetation Survey of Caddadup Reserve and some adjacent bushland areas
Date: 05/05/2006
Capture Author: Thomas Leong / Ian Steward

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

Accuracy Levels:

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

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

Flora and Vegetation Survey of

Caddadup Reserve

and

some adjacent bushland areas

Prepared for the

City of Mandurah

by

Brian Morgan

April 2005

TABLE OF CONTENTS

EXECUTIVE SUMMARY

A vegetation and flora survey was conducted in Caddadup Reserve and some adjacent bushland, just south of the Dawesville Cut, between the Indian Ocean and the Harvey Estuary. The Caddadup survey area was bisected by the Dawesville Bypass road to form Caddadup-West and Caddadup-East survey areas. The purpose of this survey was to assess the flora and vegetation conservation values of the Caddadup survey area to assist with development planning.

The Caddadup survey area included the Quindalup landform element on the western side and the Cottesloe or Spearwood landform element on the eastern side, with a small area of Yoongarillup plains unit on the southern boundary.

The Caddadup survey was mainly conducted in late October and November 2004. The vegetation was described and mapped and a flora list of plant species was compiled for the survey area. The vegetation site data was databased and used in a floristic analysis to determine the floristic community type of a representative set of vegetation units. A table was referenced to determine if the survey area FCT's were Threatened Ecological Communities.

A total of 248 plant species were recorded in the Caddadup survey area, including one hunded and seventy three (173) native species.

No Declared Rare Flora were found. *Caladenia huegelii* has been previously reported in the Caddadup Reserve area (Emma Adams, Dept of CALM, *pers. comm.*), but was not recorded during this survey or a survey for *Caladenia huegelii* conducted by the Department of Conservation and Land Management in October 2004. The Department of CALM survey for *Caladenia huegelii* included the area around and to the south of the Water Tower (Area C, Caddadup-East) and Area B, Caddadup-West. One Priority 3 species, *Lasiopetalum membranaceum*, was recorded from the area on the southern side of the Water Tower in Area C, Caddadup-East. No other taxa of particular conservation interest were recorded in the survey area.

The vegetation units varied greatly across the Caddadup survey area, reflecting the three different landform elements and variation in habitat that occurred in the survey area. *Olearia axillaries*, *Acacia rostellifera*, *Spyridium globulosom* and *Scaevola crassifolia* were dominants in the heaths and scrubs growing on the Quindalup Dune white sands in

the western part of Caddadup-West. *Agonis flexuosa* (peppermint) woodlands to low open forests were extensive in the central and eastern part of Caddadup-West on the Cottesloe landform element. Tuart open forest (over peppermint and scattered shrubs) covered the north-eastern part of Caddadup-West, as well as in the Tuart Parkland Public Open Space on the south side of Caddadup-West. *Acacia rostellifera* scrub and mixed heaths grew on the small area of Yoongarillup Plain element on the south-eastern side of Caddadup-West. Jarrah (scattered), *Allocasuarina fraseriana* and *Banksia attenuata* woodlands occurred on the upper slopes and crests of the high dune (Cottesloe element) in the Caddadup-East area. Mixed tuart woodland and tuart over peppermint low open forest occurred on the mid and lower slopes over looking the Harvey Estuary. Small remnant bush areas occurred on the flats near the current and former estuary shoreline and included Melaleuca and *Casuarina obesa* woodlands.

The condition of the vegetation in the survey area was best in the Caddadup-West area, where it was quite outstanding and generally classified between Very Good to Excellent and Excellent, with patches of Pristine vegetation. Annual rye grass was the dominant weed on the older dunes in Caddadup-West (under the tuart and peppermint woodlands and open forests) while *Cakile maritime*, marram grass, dune onion weed (*Trachyandra divaricata*) and *Tetragona decumbens* were common weeds on the white Quindalup coastal sands. In the Caddadup-East area (Cottesloe sands), where weed cover was higher, vegetation condition was typically Very Good to Excellent. Blow fly grass (Briza maxima), annual veldt grass (**Ehrharta longiflora*), perennial veldt grass (**Ehrhata calycina*) and wild oats (*Avena barbata) were the dominant weeds.

A number of woody weeds, including the Victorian T-tree and *Retama raetam (an aggressive woody weed in Janis St Reserve) were observed in brushwood restoration areas in the Caddadup-West area (old blowouts and linear clearings for firebreaks/infrastructure lines). Apparently the brushwood used has been sourced from vegetation including the woody weeds.

The fairways of the recently opened golf course pose a significant threat to the generally Excellent condition of the adjacent bushland, mainly through the introduction of weeds. Disciplined management of the fairways will be required to limit the rate and scale of their impact on the adjacent bushland.

Floristic community types (FCT's) assigned to the Caddadup vegetation units were Quindalup units (mainly FCT's 29b and 30b) and Spearwood units (mainly FCT's 24 and 25 (some 28)). None of the FCT's in the survey area were TEC units.

The tuart vegetation units in the survey area have very high conservation value because of their large extent, their good condition (VeryGood to Excellent), the range of their variation and the extent of clearing and degradation of tuart stands outside the survey area. Tuart vegetation units in the survey area included scattered tuarts to tuart mixed woodland over peppermint low woodland to low open forest on the Cottesloe sands in the Caddadup-East area, an extensive area of tuart open forest over peppermint low open forest in the north eastern part of Caddadup-West (Very Good to Excellent condition) and a smaller linear area of tuart open to closed forest over various high shrublands (*Spyridium globulosum* high shrubland to open scrub in one area and a mixed high shrubland to open scrub of *Spyridium globulosum*, *Acacia rostellifera* and *Melaleuca huegelli)* in the Tuart Park Public Open Space area.

The eastern boundary of the Tuart Park Public Open Space currently runs North-south through the middle of the narrow belt of tuart open forest. It is recommended that the eastern boundary of the Tuart Park be reviewed and shifted to the eastern edge of the tuart open forest to make a more substantial and viable Tuart Park which would have a greater buffer to weeds and other disturbances.

Peppermint woodland to low open forest covered a large area in Caddadup-West. Peppermint also occured over a large area as a woodland to low open forest under tuart in both Caddadup-East and Caddadup-West.

The Dawesville Cut is the northern most extent of substantive stands of peppermint (Bromwyn Keighery, *pers. comm.*). For this reason and the fact that peppermint is not well represented in conservation areas between Perth and Bunbury (Yalgorup NP being the only park with significant stands (Trudgen, 1991)), occurrences of peppermint in the Caddadup survey area have high conservation value (particularly the extensive stands with no eucalypt overstorey in Area B).

The flora and vegetation of the Caddadup survey area has considerable regional significance for a number of reasons, namely representation of poorly secured ecological

communities (Vegetation Complexes), diversity of landforms and plant communities/associations and rarity of communities.

Each of the three vegetation Complexes present in the Caddadup survey area had more than 40 % of pre-1750 extent remaining. However, less than 15 %of each of the three vegetation Complexes found in the Caddadup survey area are in secure tenure, although the secured remnant of the Yoongarillup Vegetation Complex (13.9 %) comes close to meeting the target.

'Diversity' is another criteria for the identification of regionally significant natural areas in the System 6 and Part System 1 region (EPA, 2003). The Caddadup survey area contained a wide variety of landform units and a wide variety and large number of plant communities.

'Rarity' (of communities or species) is a third criteria for the identification of regionally significant natural areas in the System 6 and Part System 1 region (EPA, 2003). The extent and variety of the regionally restricted tuart and peppermint dominated vegetation in the Caddadup survey area and the fact that it contains one of the northern most substantial stands of peppermint woodland (B. Keighery, *pers. comm.*) means there is considerable rarity of communities in the survey area.

1.0 INTRODUCTION

1.1 Background

The City of Mandurah wishes to know the vegetation and flora values present in Caddadup Reserve and adjacent bushland to assist in developing management plans for the area.

1.2 Aims of this study

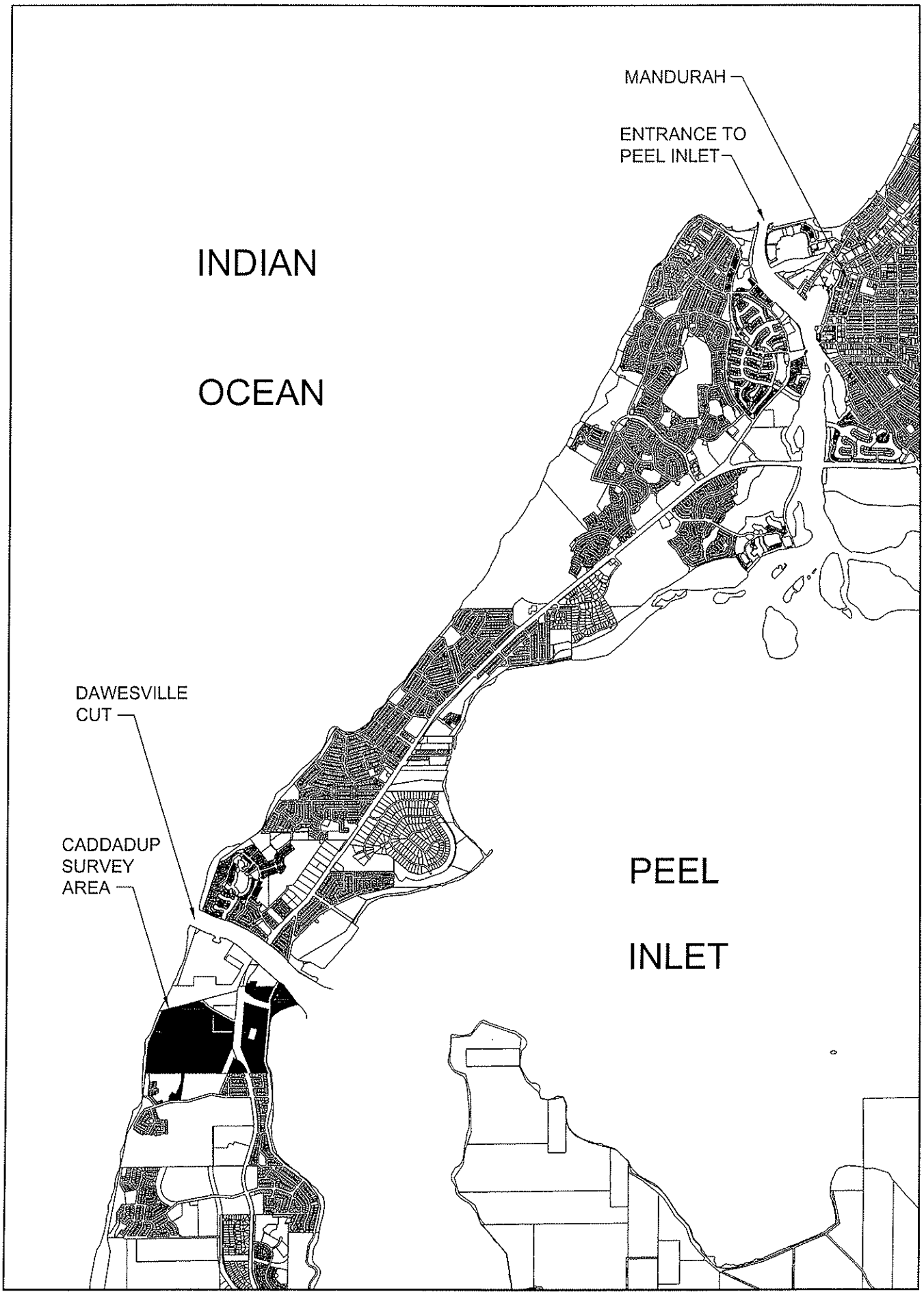
The aim of this study was to describe and assess the flora and vegetation conservation values of the Caddadup survey area. More specifically, this study had the following aims:

1. Record a flora species list for the survey area and determine if there was any flora in the bushland of special conservation significance, such as rare and priority species;
2. Describe and map the vegetation units occurring in the survey area;
3. Assess the conservation significance of the vegetation units in the survey area;
4. Map the condition of the vegetation in the study area;
5. Prepare a weed map for the study area.

1.3 The survey area

The Caddadup survey area is just south of the Dawesville Cut, south of Mandurah (see Figure 1). The survey area includes Caddadup Reserve and some adjacent areas and is bisected by the Dawesville Bypass Rd (see Figure 2). Each of the areas included in the survey area have been labeled with an alphabetic letter to make reference to them easier (see Figure 2).

Area B is the largest part of the survey area. It is on the western side of the Dawesville Bypass Rd, extends to the beach front and includes the Caddadup Water Treatment Plant, a pistol shooting club and most of the Port Bouvard Golf course fairways. Area F on the southern boundary of Area B is the Tuart Park Public Open Space. Area C is another large area of Caddadup Reserve that lies on the eastern side of the Dawesville Bypass Rd. A water tower (Area E) is located in the middle of Area C. Areas K, I and J include remnant bushland around the Port Bouvard Recreation and Sporting Club. Area H is an area reclaimed from the Harvey Estuary using the dredging material from the Dawesville Cut.



CADDUDUP SURVEY AREA

SMEC

ACN:065 475 149
Level 6, 12 St Georges Terrace
PERTH WA 6000
Tel:(08) 9323 5900 Fax(08) 9323 5901

LOCATION OF THE CADDADUP SURVEY AREA

Project Number: 36413

Figure Number: FIGURE 1

PISTOL SHOOTING CLUB

PORT BOUVARD GOLF COURSE AND COUNTRY CLUB (FAIRWAYS NOT SHOWN)

COUNTRY CLUB DVE

ESTUARY ROAD

PORT BOUVARD SPORTING AND RECREATION CLUB

CADDADUP WATER TREATMENT PLANT

BYPASS

WATER TANK

HARVEY ESTUARY

DAWESVILLE ROAD

COAST

OLD

TUART PARK PUBLIC OPEN SPACE

FLORIDA

OCEAN ROAD

A

B

C

D

E

F

G

H

I

J

K

CD

LEGEND:

SURVEY AREA

0 100 200 300 400m

SMEC
ACN:065 475 149
Level 6, 12 St Georges Terrace
PERTH WA 6000
Tel:(08) 9323 5900 Fax(08) 9323 5901

SUB AREAS OF THE CADDADUP SURVEY AREA

Project Number: 36413

Figure Number: FIGURE 2

L:\Projects\36413 - Mandurah Management Plans_Caddadup\DWG\FIGURE 2 - CADDADUP SURVEY AREA.dwg, 23/03/2006 8:43:32 AM

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 Caddadup survey area extends over a number of these elements including the Quindalup Dunes element in the western part, the Cottesloe unit of the Spearwood Dunes element in the eastern part (on the eastern side of the Dawesville Bypass Rd) and a small area of the Yoongarillup landform unit in the south-east part of Area B. The Yoongarillup unit consists of plains with low ridges and swales, with shallow yellow and brown sands over marine limestone (Churchwood and McArthur, 1980). The Yoongarillup unit has been built up from marine or estuarine deposits and is usually in association with the Spearwood Dunes element (Churchwood and McArthur, 1980).

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 survey 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 series 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 Caddadup survey area includes areas of three geomorphic elements and hence areas of three vegetation complexes. The vegetation complexes mapped by Heddle *et al* (1980) as occurring in the Caddadup survey area are the Quindalup Complex, the Cottesloe Complex- Central and South and the Yoongarillup Complex. The Quindalup Complex is restricted to the coastal dunes and can be subdivided mainly into two alliances: the strand and foredune alliances which contains *Cakile maritime*, *Spinifex hirsutus* and *Spinifex longifolius*; the mobile and stable dune alliance which contains *Lepidosperma gladiatum*, *Myoporum insulare*, *Olearia axillaries*, *Scaevola crassifolia*, *Scaevola nitida* and *Sporidium globulosum* (Heddle *et al.*, 1980). The Cottesloe Complex- Central and South supports heaths on the limestone outcrops, while the deeper sands support a mosaic of a woodland of tuart and an open forest of

tuart-jarrah-marri (Heddle *et al.*, 1980). The Yoongarillup Complex is generally dominated by an extensive tuart woodland, often over peppermint (*Agonis flexuosa*).

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).

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).

2.0 METHODS AND LIMITATIONS

2.1 Flora survey methods

2.1.1 Methods of the flora survey

The Caddadup flora survey was mainly conducted during late October and November, 2004.

All plant species present were recorded at each of the vegetation recording sites in the survey area (see Figure 3a and 3b below). Where a plant species was not well known, a specimen was collected and allocated a specimen number.

Plant species were also recorded elsewhere in the study area if they had not been observed at the vegetation sites or if they were of particular interest. Again, where a plant species was not well known, a specimen was collected and allocated a specimen number. GPS coordinates were recorded whenever it was considered there was a possibility that the plant species may be of special interest.

The specimens collected were pressed, dried and identified. The identifications were made by comparison to specimens in the reference and research collections of the Western Australian Herbarium, by the use of keys in various papers and books and by relevant experts on various groups of flora of the Swan Coastal Plain (see the acknowledgments section below).

The CALM Declared Rare and Priority Flora List (Atkins 2003; definitions in Appendix 1) was consulted as required to confirm the occurrence of any listed plant species in the survey area.

2.1.2 Limitations of the flora field survey

The major limitation of the flora survey is that any such survey is a sampling procedure of a variable environment with plant populations of variable growth habit, life span and flowering season. Some species, including annuals, are only available for collection for part of the year. This means that to locate all species that grow in an area is a substantial task, the success of which is related to the time available, the season in which the survey is conducted and the size and diversity of habitat in the survey. Consequently, it is possible that there are species present on the subject land that were not recorded during this survey as they have only low abundance on the land, or were not flowering at the time of the survey.

Given the limitations of the flora survey, it is likely that this survey recorded more than 85% to 90% of the vascular flora in the survey area. That is, while the flora survey is relatively thorough, it is possible that some species occurring in the survey area have not been recorded.

2.2 Vegetation survey methods: description of vegetation units

2.2.1 Methods of the vegetation survey

To describe the vegetation of the survey area it was necessary to select a representative site in each of a selection of vegetation types, describe the sites and record the plant species present at those sites.

At each site, the vegetation was described over an area of approximately 10 meters by 10 meters (the dimensions used in the Gibson *et al* (1994) study). The sites were not pegged or measured out with a measuring tape. The coordinates (WGS84) of each sites central point were recorded, using a Garmin Etrex GPS unit. Each site was then photographed and a site description made which included the site location, habitat (landform and aspect), surface soil texture and colour, any rock outcropping (including rock type), an estimate of the time since the site was last burnt and the vegetation condition. The vegetation structure was described using a modification by Mr M Trudgen (*pers comm.*) of Aplin's (1979) modification of Specht's vegetation description table (Appendix 2). All plant species occurring in the site area were recorded along with their height, percentage cover and specimen number if necessary.

The condition of vegetation was also recorded at each site using the same scale outlined in Bush Forever Volume 2 (Department of Environmental Protection, 2000; see Appendix 3).

The information recorded for each vegetation unit was consistent with the templates developed as part of the Perth Biodiversity Project and should enable completion of the templates if that is desired.

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 approximately 1:1700, 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 (see section 2.2.1 above). 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 2.3.1 above were used.

2.3.3 Methods of mapping weeds in the survey area

The location of aggressive individual shrub or tree weeds or small, discrete, patches of aggressive grass or herb weeds were mapped when observed in the survey area.

The weed point mapping survey work was undertaken in February 2005, well after the other field work had been completed. Weed species that were widely distributed through

the reserve or a sizeable part of the reserve were selected for the weed point mapping. Of these species, the more aggressive, invasive weed species present in each reserve were given priority (Brown and Brooks, 2002). Weed data points were established every 100 meters along each grid line, with the grid lines orientated north-south. Because of the large size of the survey area and the even distribution of key weed species over large areas, the distance between grid lines was generally fairly large, between 100 and 150 metres. Data recording points were centred in a circle of bushland, with at least a 5 meter radius of bushland. Where there was not bushland at the predetermined coordinate point, then data was either recorded nearby on the grid line where there was sufficient bushland or data was not recorded for that point. The predetermined grid recording points were located using a GPS unit (+/- 4 to 5 meter accuracy). At each grid point, an estimate of the cover of each selected weed species was recorded along side the point GPS coordinate. Weed percentage cover was estimated over an area defined by a 5 meter radius around each point.

For mapping the point weed data, the estimated percentage cover recorded in the field was converted into a cover class, using cover classes adopted from Brown and Brooks (2002) and shown in Table 1.

Table 1 Weed cover classes (adopted from Brown and Brooks, 2002).

Cover class	Range of estimated % cover
Light infestation	1-10
Light-medium	11-30
medium-high	31-70
high	>70

2.3.4 Mapping possible 'dieback' occurrences

Areas where possible dieback symptoms were observed (deaths of susceptible plant species) were marked on the vegetation condition map.

2.3.5 Limitations of mapping vegetation attributes

Vegetation unit boundaries should delineate areas of vegetation with consistently different dominant species, significantly different percentage cover of the dominants or significantly different species composition. However, mapping vegetation units is very subjective and the vegetation boundaries mapped for the survey areas are a particular interpretation of the vegetation of the area. Some areas assigned to a particular unit on the vegetation map, while having similar vegetation to the description of that unit, are variable in either structure, species dominance or floristics. Also, 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 map.

One important factor particularly limiting the weed mapping, was the condition of the annual weeds at the time of the survey. This made assessment of weed cover and in some cases, the identification of some weed species difficult. However, recording of vegetation description sites in the survey area during spring and weed mapping in both summer and spring in other projects in the Mandurah area increased the familiarity with the weeds and helped overcome these problems. Nevertheless, the weed map should be used as an indication of the occurrence and cover of significant weeds.

2.4 Floristic analysis methods

2.4.1 Introduction

The floristic analysis carried out was based on species presence/absence data collected from a selection of Caddadup sites that were representative of the range of vegetation types in the survey area, combined in a database with the 509 sites from Gibson *et al.* (1994).

2.4.2 Data storage and handling

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

2.4.3 Data preparation and compatibility

To conduct the analysis on the data from the Caddadup survey area 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 Caddadup 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 Caddadup site being a releve of estimated 10 metre by 10 metre area. However, Gibson *et al.* (1994) visited their sites twice to record plant species present, including a spring visit, compared to the single recording of the Caddadup sites. Weed species were included in both the Gibson *et al.* (1994) and Caddadup datasets.

2.4.4 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 Caddadup 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 Caddadup 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 Caddadup site.

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

2.4.5 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. However, this is unlikely to have occurred in this case as the data collection methods were similar.

2.4.6 Identification of Threatened Ecological Communities (TEC)

Once the Caddadup sites were each assigned to a Floristic Community Type, a table of Floristic Community Types on the Swan Coastal Plain and their TEC status (Department of Environmental Protection, 2000) was consulted to determine if any Caddadup 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.*).

3.0 FLORA IN THE SURVEY AREA

3.1. Flora list for the survey area

A total of 248 plant species were recorded in the Caddadup survey area (Appendix 4). One hundred and seventy-three (173) of these species were native to the area, including 172 species of native flowering plants and one native cycad (the Zamia Palm, *Macrozamia riedlei*). Seventy-five (75) weed species were recorded in the survey area. A list of all the species recorded from the survey area is provided in Appendix 4.

One of the native species on the flora list for the Caddadup survey area (Appendix 4), the spider orchid *Caladenia paludosa*, was not recorded during this survey, but was recorded by the Department of CALM in the survey area during their October 2004 survey (Emma Adams, Dept of CALM, *pers. comm.*).

Of the native flowering species recorded, 51 were monocotyledons and 121 were dicotyledons. Of the monocots, 27 grass (Poaceae) species were recorded of which 19 were weeds. Ten (10) orchid species (no weeds), nine (9) sedge species (no weeds) and eight (8) lily species were also recorded in the survey area. Of the dicotyledons, the family represented by the most species in the survey area was the daisy family (Asteraceae) with 22 species (3 weeds). Seventeen (17) peas (Papilionaceae, seven weeds), 16 Myrtaceae (three weeds), 13 Proteaceae (no weeds), 11 Acacias (one weed) and 10 Apiaceae (no weeds) were other families with prominent numbers of species in the survey area.

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

No Declared Rare Flora were recorded in the Caddadup survey area in this survey. However, the DRF species *Caladenia huegelii* has been recorded in the past from near the water tower in Area C (*pers. comm.*, Emma Adams, Dept of CALM Swan Region). In a survey for *Caladenia huegelii* coordinated by the Dept of CALM during spring 2004, no *Caladenia huegelii* plants were observed in Area C or Area B.

3.3 Priority flora species recorded from the survey area

One Priority three (P3) species, *Lasiopetalum membranaceum*, was recorded in the survey area. It was recorded in a small area south of the water tower in Area C. *Lasiopetalum membranaceum* was also recorded in the near by Dawesville Reserve in a recent survey of that area.

Lasiopetalum membranaceum is a multi-stemmed shrub up to 65 cm high, with pink flowers and branchlets covered by simple glandular hairs and stellate hairs (Marchant *et al.*, 1987). It occurs in sand over limestone, particularly in tuart woodland, on the Swan Coastal Plain and parts of the adjacent Darling Ranges (Paczkowska and Chapman, 2000; Flora Base web site, Dept of CALM).

3.4 Other species of conservation significance recorded from the survey area

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

3.5 Other species of botanical interest in the survey area

A 'taxon' of some botanical interest was given the name '*Acacia* aff. *rostellifera*'. It was recorded from parts of the Quindalup Dunes in Area B and was also collected during another survey by the same author on Spearwood Dunes in the Meadow Springs area.

'Typical' forms of *Acacia rostellifera* had narrow phyllodes and one prominent vein and were also collected from the locality. *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.

Acacia aff. *rostellifera* is 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 descriptions

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

The vegetation units were considered to be mostly described at the plant community to vegetation association level.

4.2 Vegetation map of the Caddadup survey area

4.2.1 Abbreviations used for species in the vegetation unit codes

The codes that discriminate the vegetation units are shown on the vegetation maps (Figure 3A, 3B). The codes are derived from the generic and species names of the more abundant species in the different strata present in the unit. The code is made up of the capitalized first letter of a plants genus followed by a lower case letter which is the first letter of the species name (see Table 2). A second lower case letter is used to distinguish different plants with the same basic code.

Table 2. Abbreviations for species names used in codes for the vegetation.

Code	Species name	Code	Species name
Aar	*Acacia* aff. *rostellifera*	Hh	*Hibbertia hypericoides*
Af	*Allocasuarina fraseriana*	Ht	*Hakea trifurcata*
Afl	*Agonis flexuosa*	Js	*Jacksonia sternbergiana*
Ar	*Acacia rostellifera*	Kg	*Kunzea glabrescens*
As	*Acacia saligna*	Mc	*Melaleuca cuticularis*
At	*Acacia truncata* (Sand dune variant)	Mh	*Melaleuca huegelii*
Ba	*Banksia attenuata*	Mr	*Melaleuca raphiophylla*
Cc	*Corymbia calophylla*	Ms	*Melaleuca systena*
Cm	*Cakile maritima*	Oa	*Olearia axillaris*
Co	*Casuarina obesa*	Sa	*Santalum acuminatum*
Dd	*Diplolaena dampieri*	Sc	*Scaevola crassifolia*
Ds	*Dryandra sessilis*	Sg	*Spyridium globulosum*
Eg	*Eucalyptus gomphocephala*	Sh	*Spinifex hirsutus*
Em	*Eucalyptus marginata subsp. marginata*	Sl	*Spinifex longifolius*
Fn	*Ficinia nodulosa*	Td	*Tetragona decumbens*

4.2.2 Vegetation of the Caddadup survey area

A large number (40) of vegetation mapping units were used to map the vegetation in the survey area (Figures 3A and 3B below; section 4.2.3 below). This was the result of the large variation in vegetation structure and dominant species in the survey area, variation in floristic composition and the relatively high level of detail at which the vegetation units were generally mapped (between the plant community and vegetation association level).

The Caddadup-West vegetation includes heath and scrub vegetation units growing on the Quindalup dunes, tuart open forest units growing on older Quindalup dunes and on limestone flats, peppermint woodland to open forest units growing on older Quindalup dunes and scrub units growing on the limestone flats (Yoongarillup plains?). The Caddadup-East vegetation units are different to those of Caddadup-West reflecting the different landform elements that occurs there (Cottesloe unit of the Spearwood Dune element and Harvey Estuary foreshore units). The vegetation in the Caddadup-East area included a large area under scattered tuart to tuart woodland and a large area of jarrah-*Banksia attenuata*-sheok low woodland to low open forest (see section 4.1.3.2 below).

4.2.3 Vegetation mapping units of the Caddadup survey area

Caddadup West: Area B and Area F

I Tuart (*Eucalyptus gomphocephala*) open forest units

EgAflSg

Eucalyptus gomphocephala open forest over *Agonis flexuosa* low open forest over *Spyridium globulosum* high open shrubland over *Lepidosperma gladiatum* open sedgeland to sedgeland with *Acanthocarpus preissii*, *Parietaria debilis* very open herbland and **Lolium rigidum* open grassland to grassland.

Habitat and soil: slope of high dune; grey sand.

Notes: This vegetation unit description was recorded at site CB6 on the lower dune slopes (see Photograph 1, below). The vegetation was similar on the upper slopes but the tuart cover tended to be more open and there were more of the Quindalup slope species, such as *Olearia axillaries* and *Diplolaena dampieri* (see description CB13 in Appendix 5, Photograph 2 below).

LEGEND:

- BR BLOWOUT (RESTORATION)
- COMPLETELY DEGRADED
- TUART UNITS (OPEN FOREST)
- PEPPERMINT WOODLAND UNITS
- LIMESTONE FLATS UNITS
- GOLF FAIRWAY

VEGETATION RECORDING SITES (RELEVES): SEE DETAILS APPENDIX 5
VEGETATION UNITS: SEE DESCRIPTIONS SECTION 4.0

0 100 200 300 400m

SMEC
ACN:065 475 149
Level 6, 12 St Georges Terrace
PERTH WA 6000
Tel:(08) 9323 5900 Fax(08) 9323 5901

CADDADUP (WEST) VEGETATION UNIT MAP

Project Number: 36413

Figure Number: FIGURE 3A

L:\Projects\36413 - Mandurah Management Plans_Cad\default\Figures\FIGURE 3A - VEGETATION UNIT MAP.dwg, 18/04/2005 2:49:02 PM, 1:1.00013

AflAr
CD1
CD
EmAfBa
CD
CD (CLEARED)
AflAr
CC6
EgAflHh
EmAfBa
WATER TANK
CD
EmAfBa
CC2
EgCcBa
EgAflHh
EgCcBa
CD
EmAfBa
EgCcBa
CC1
MrMc
CC5
EgAflHh
EgEmAfl
CC3
CD
EgEmAfl
CC4
EgAr
EmAfBa
EgAflOa
CI1
EgCcBa
CD
EgCcBa
PORT BOUVARD SPORTING AND RECREATION CLUB
EgAs
CJ1
CD
EgAs
MrMc/EgAsKg
CG2
CG1
MrMc/EgAsKg
BUILDINGS
CD
CD
CD
AsJs
CH1
CD (RECLAIMED)
TUART OVER COUCH/BUFFALO PARKLAND
CG3
CARPARK
EgCoMc
MELALEUCA RAPHIOPHYLLA, CASUARINA OBESA PARKLAND
HARVEY ESTUARY

NOTES / LEGEND

VEGETATION UNITS: EgCcBa, EmAfBa, EgEmAfl, EgAr, EgAflHh, AflAr, MrMc, EgCoMc, AsJs, EgAflOa,EgAsKg (SEE DESCRIPTIONS SECTION 4.0)

VEGETATION RECORDING SITES (RELEVES): CC1 - CC6, CD1, CG1 - CG3, CH1, CI1 (SEE DETAILS APPENDIX 5)

COMPLETELY DEGRADED

TUART UNITS (SCATTERED TREES TO WOODLAND)

0 100 200 300 400m

SMEC
ACN:065 475 149
Level 6, 12 St Georges Terrace
PERTH WA 6000
Tel:(08) 9323 5900 Fax(08) 9323 5901

CADDADUP (EAST) VEGETATION UNITS

Project Number: 36413

Figure Number: FIGURE 3B

EgMhSg

Eucalyptus gomphocephala open forest over *Melaleuca huegelii* subsp. *huegelii*, (*Spyridium globulosum*) closed scrub over *Carex preissii* scattered sedges and *Calandrinia brevipedata*, (*Parietaria debilis*) herbland.

Habitat and soil: Edge of flat plain; dark grey sand.

Notes: This unit was represented by site CB31 on the north-west corner of Area F. See Photograph 19, Appendix 6.

EgOaDd

Eucalyptus gomphocephala scattered trees over *Agonis flexuosa* scattered low trees over *Acacia rostellifera* scattered tall shrubs over *Olearia axillaris* scattered shrubs over *Diplolaena dampieri* open heath over *Acanthocarpus preissii*, *Lomandra maritima* open herbland and **Lolium rigidum* very open grassland.

Habitat and soil: Steep mid-slope of sand dune; white calcareous sand.

Notes: This unit included a shrubland or open heath layer of *Diplolaena dampieri* and other dune slope heath species. It occurred in small areas amongst the more common unit, EgMhSg. It was represented by site CB11b on the mid to upper slopes and CB11c (see Appendix 5) on the lower slopes.

EgSg

Eucalyptus gomphocephala open to closed forest over *Spyridium globulosum*, (*Dryandra sessilis*) high shrubland to open scrub over *Olearia axillaris*, *Xanthorrhoea preissii*, *Melaleuca systena* open shrubland over *Desmocladus asper* open sedgeland with *Trachymene oleracea*, *Acanthocarpus preissii*, *Lomandra maritima* scattered herbs.

Habitat and soil: gently sloping, west-facing flat valley floor (swale); orange-yellow sand (Spearwood), with some surface limestone rock.

Notes: This unit was represented by site CF1 in the Tuart Park Open Public Space (Area F). See Photograph 2, below.

Photograph 1. Site CB6 (mapping unit EgAflSg). *Eucalyptus gomphocephala* open forest over *Agonis flexuosa* low open forest (see complete description above). This unit covers a large part of the north-east corner of Caddadup area B.

Photograph 2. Site CF1 (map unit EgSg). *Eucalyptus gomphocephala* open to closed forest over *Spyridium globulosum*, (*Dryandra sessilis*) high shrubland to open scrub (see complete description above). This unit occurred in the Tuart Pk Public Open Space.

EgSgAr

Eucalyptus gomphocephala open forest over *Spyridium globulosum*, *Acacia rostellifera*, *Melaleuca huegelii* high shrubland to open scrub over *Olearia axillaris*, *Rhagodia baccata* subsp. *baccata* scattered shrubs over *Acanthocarpus preissii* herbland.

Habitat and soil: gently sloping, west-facing flat area on edge of wide flat plain; yellow-grey sand.

Notes: This unit was represented by site CF3 (see Appendix 5). See Photograph 20, Appendix 6.

II Peppermint (*Agonis flexuosa*) woodland to open forest units

AflSg

Agonis flexuosa open forest over *Spyridium globulosum* high open shrubland over *Hibbertia cuneiformis*, *Leucopogon parviflorus* open shrubland over *Trymalium ledifolium* var *ledifolium* low open shrubland over **Lolium rigidum* open grassland to grassland and *Centella asiatica*, *Daucus glochidiatus* open herbland.

Habitat and soil: moderate, south-facing lower to mid slope of low ridge (dune); pale grey sand (calcarious).

Notes: This unit was represented by the lower slope sites CB08 (see Photograph 3, below) and CB17 (where the peppermint formed an open to closed forest). On the upper slopes of dunes in this mapping unit, peppermint woodland grew over an open shrubland of *Spyridium globulosum*, *Olearia axillaries* and other dune heath species, as represented by site CB15.

AflMh

Agonis flexuosa low closed forest over *Melaleuca huegelii* subsp. ***huegelii***, *Spyridium globulosum* high open shrubland to high shrubland over **Ehrharta longiflora* grassland.

Habitat and soil: Swale between dunes to the west and east; grey sand.

Notes: This unit occurred in a small area adjacent to the golf fairways and was represented by site CB16.

Photograph 3. Site CB8 (representing mapping unit AflSg). *Agonis flexuosa* open forest over *Spyridium globulosum* high open shrubland over *Hibbertia cuneiformis*, *Leucopogon parviflorus* open shrubland (see complete description above).

III Yoongarillup Plain units

ArSgHh

Acacia rostellifera, (*Spyridium globulosum*, *Olearia axillaris*, *Santalum acuminatum*) closed heath to closed scrub over *Hibbertia hypericoides*, *Melaleuca systena* low open shrubland to low shrubland over *Desmocladus asper* scattered sedges with *Lomandra maritima*, *Trachymene pilosa* open herbland.

Habitat and soil: edge of broad flat plain between sand dunes; pale brown sand.

Notes: This was an *Acacia rostellifera* scrub unit and was represented by site CB2. See Photograph 21, Appendix 6.

ArSgHt

Acacia rostellifera, Spyridium globulosum, (Hakea trifurcata) open to closed scrub over *Rhagodia baccata* subsp. *baccata* open shrubland over *Melaleuca systina, Grevillea preissii* subsp. *preissii* scattered low shrubs to low open shrubland over *Trachymene pilosa, Daucus glochidiatus, Lomandra maritima* open herbland and *Lepidosperma puhisqameum* scattered sedges with **Lolium rigidum* very open annual grassland.

Habitat and soil: flat plain near base (east of) of dunes; yellow-brown sand.

Notes: This unit was represented by site CB7. See Photograph 22, Appendix 6.

DsOaSg

Dryandra sessilis high shrubland over *Olearia axillaris , Spyridium globulosum* shrubland to open heath over *Templetonia retusa, Trymalium ledifolium* var. *ledifolium, Melaleuca systina* low shrubland over *Desmocladus asper* sedgeland to closed sedgeland.

Habitat and soil: lower slope to mid slope of low rise (long slope); yellow-orange brown sand. Lots of exposed limestone.

Notes: This unit was represented by site CF7. See Photograph 22, Appendix 6.

SaSgMs

Hakea trifurcata scattered tall shrubs over *Santalum acuminatum, Spyridium globulosum, Olearia axillaris* shrubland to tall shrubland over *Melaleuca systina, Allocasuarina humilis, Grevillea preissii* subsp. *preissii, Hibbertia hypericoides* low shrubland over *Desmocladus asper* open sedgeland to sedgeland with *Trachymene pilosa, Daucus glochidiatus, Lomandra maritima* very open herbland.

Habitat and soil: Very gentle, east-facing slope of broad flat plain; orange-brown sand with moderate outcropping of limestone.

Notes: This unit had no *Acacia rostellifera,* the main difference between it and neighbouring units ArSgOa, ArSgHt and SgAr. It was represented by site CB1. See Photograph 4, below.

Photograph 4. CB1 (mapping unit SaSgMs). *Hakea trifurcata* scattered tall shrubs over *Santalum acuminatum, Spyridium globulosum, Olearia axillaris* shrubland to tall shrubland over *Melaleuca systina, Allocasuarina humilis, Grevillea preissii* subsp. *preissii, Hibbertia hypericoides* low shrubland (see complete description above).

SgAr

Spyridium globulosum, Acacia rostellifera, Olearia axillaris high open scrub over *Rhagodia baccata* subsp. *baccata* scattered shrubs over *Melaleuca systina, Grevillea preissii* subsp. *preissii* low open shrubland over *Desmocladus asper, Desmocladus flexuosus* very open sedgeland with *Acanthocarpus preissii* very open herbland.

Habitat and soil: northern edge of broad flat plain at the base of a low ridge (dune); pale brown sand.

Notes: This unit was represented by site CB3. *Spyridium globulosum* had a cover of 30 to 35% and *Hibbertia hypericoides* was not present. It was at the base (south side) of a sand dune and is probably ecotonal.

IV The Quindalup Dune heath vegetation

AarSgOa

Acacia aff. *rostellifera* high open shrubland over *Spyridium globulosum*, *Olearia axillaris*, *Alyxia buxifolia*, *Leucopogon parviflorus* shrubland to open heath over *Rhagodia baccata* subsp. *baccata* low open shrubland over *Austrostipa flavescens* scattered grasses with *Acanthocarpus preissii*, *Lomandra maritima*, *Daucus glochidiatus* open herbland.

Habitat and soil: moderate, west-facing lower slopes of dune; white calcareous sand.

Notes: This unit was represented by site CB27.

AsOa

Acacia saligna shrubland over *Olearia axillaris*, *Scaevola crassifolia* low shrubland over *Ficinia nodosa* scattered sedges and **Avena barbata*, **Bromus diandrus* annual grassland with **Trachyandra divaricata* very open herbland.

Habitat and soil: swale behind first low dunes; white calcareous sand.

Notes: This unit occurred in a swale behind the foredunes. It was represented by site CB19.

AsAr

Acacia rostellifera, (*Spyridium globulosum*) open to closed scrub over *Olearia axillaris*, *Rhagodia baccata* subsp. *baccata* scattered shrubs over *Austrostipa flavescens* grassland with *Acanthocarpus preissii* scattered to very open herbland.

Habitat and soil: swale between dune ridges; white calcareous sand.

Notes: This unit occurred in a number of areas in swales or on the leeward side of dune crests, particularly amongst the sand dunes to the east and south of the Caddadup Water Treatment Plant. The vegetation unit description is based on the vegetation described at site CB4 (see Photograph 17, below). Other sites recorded in this mapping unit were CB5 and CB32.

CmSh

Cakile maritima low open shrubland over *Spinifex hirsutus* grassland.

Habitat and soil: crest and slope of very low foredune; white calcareous sand.

Notes: This vegetation unit was generally in the form of a narrow linear strip parallel with and nearest to the the beach and between a few and 5 metres wide. It was represented by site CB18 (see Photograph 24, Appendix 6).

McFn

(*Melaleuca cuticularis*) scattered shrubs over **Oenothera drummondii* subsp. *drummondii*, **Pelargonium capitatum* low open shrubland over *Ficinia nodosa*, *Isolepis stellata* sedgeland and **Vulpia fasciculate* scattered grasses with **Centaurium tenuiflorum*, **Crassula glomerata* open herbland.

Habitat and soil: dampland in narrow flat swale behind foredunes; white calcareous sand.

Notes: This small unit was represented by site CB22 (see Photograph 25, Appendix 6).

Mh

Melaleuca huegelii subsp. *huegelii*, (*Acacia rostellifera*) closed scrub over *Xanthorrhoea preissii* scattered shrubs over *Baumea juncea* scattered sedges and *Austrostipa flavescens* scattered grasses.

Habitat and soil: flat plain on eastern side of Quindalup dunes; grey sand

Notes: This small unit was represented by site CF5 on the western side of the Tuart Park Public Open Space (see Photograph 26, Appendix 6). A few small areas of stands of *Melaleuca huegelii* closed scrub also occurred on lower slopes and swales amongst the Quindalup dunes. The more common *Melaleuca huegelii* vegetation unit was SgMh.

OaArSc

Olearia axillaris, *Acacia rostellifera*, (*Myoporum insulare* open shrubland to shrubland over *Scaevola crassifolia*, (**Pelargonium capitatum*) low shrubland to low open heath over *Ficinia nodosa* scattered sedges to very open sedgeland.

Habitat and soil: steep, west-facing slope of high dune; white calcareous sand.

Notes: This unit was represented by site CB23 (west-facing slope; see Photograph 5, below). The vegetation of the crests and east-facing mid slopes of the high dunes varied to include more *Spyridium globulosum* in the shrubland and *Lepidosperma gladiatum* open sedgelands (represented by site CB24, see Photograph 27, Appendix 6).

OaDd

Acacia saligna scattered tall shrubs over *Olearia axillaris*, *Spyridium globulosum* open shrubland to high open shrubland over *Diplolaena dampieri* shrubland over *Trymalium ledifolium* var. *ledifolium*, (*Rhagodia baccata* subsp. *baccata*) low open shrubland to low shrubland over **Lolium rigidum* annual open grassland with *Acanthocarpus preissii*, *Lomandra maritima* open herbland.

Habitat and soil: moderate, west-facing mid-slope of low dune; white calcareous sand (Quindalup).

Notes: This unit description was based on the description for sites CB11 (see Photograph 28, Appendix 6), CB14 (see Photograph 6, below). Site CB28 was also located in this mapping unit. This vegetation mapping unit was similar to other upper dune slope heath units with *Olearia axillaries* and *Spyridium globulosum* dominants (SgAt, SaOa and SgOaAar/SgOaAr), but had *Acacia truncata* (Sand dune variant) as a codominant.

OaSg

Olearia axillaris, (*Acacia rostellifera*) closed heath over **Pelargonium capitatum*, *Rhagodia baccata* subsp. *baccata* low open shrubland over *Ficinia nodosa* scattered sedges with *Cassytha racemosa* open lianes.

Habitat and soil: crest and upper slope of low dune; white calcareous sand.

Notes: This unit was represented by site CB29 (see Photograph 29, Appendix 6). This mapping unit is very similar to the unit OaSgSc (site CB21).

Photograph 5. Site CB23 (map unit OaArSc). *Olearia axillaris, Acacia rostellifera, (Myoporum insulare)* open shrubland over *Scaevola crassifolia, (*Pelargonium capitatum)* low shrubland to low open heath (complete description above).

Photograph 6. Site CB14 (representing mapping unit OaDd). *Jacksonia furcellata* scattered tall shrubs over *Olearia axillaris* open shrubland over *Diplolaena dampieri* low open shrubland (see complete description in Appendix 5).

OaSgSc

Olearia axillaris, Spyridium globulosum shrubland to open heath over *Scaevola crassifolia, Rhagodia baccata* subsp. *baccata* low open shrubland over **Tetragonia decumbens* low open shrubland to low shrubland over **Ammophila arenaria* open grassland to grassland (forms closed grassland in patches on some slopes) and *Ficinia nodosa* scattered sedges with *Cassytha racemosa* very open lianes.

Habitat and soil: crest and slopes of high foredune; white calcareous sand .

Notes: This unit was represented by site CB21 (see Photograph 30, Appendix 6). This mapping unit is very similar to the units OaSg (site CB21) and OaSi (site CB29a).

OaSl

Olearia axillaries, (Spyridium globulosum) shrubland to open heath over *Spinifex longifolius* grassland to closed grassland with *Ficinia nodosa* scattered sedges.

Habitat and soil: crest and slopes, west-facing, of low dune, about 100 to 150 metres from beach; white calcareous sand.

Notes: This unit was represented by site CB29a (see Photograph 31, Appendix 6).

OaTd(Sc)

Olearia axillaris open to closed scrub over (*Scaevola crassifolia*), **Tetragonia decumbens* , **Cakile maritime*, **Pelargonium capitatum*, **Oenothera drummondii* subsp. *drummondii* low open shrubland over *Ficinia nodosa* scattered to very open sedges.

Habitat and soil: crest and lower slopes of first dune; white calcareous sand.

Notes: This unit was represented by site CB20 (see Photograph 7, below). *Scaevola crassifolia* was not present in the southern part of the unit.

SgAt

Acacia saligna scattered low trees over *Spyridium globulosum* high open shrubland over *Acacia truncata* (Sand dune variant), (*Olearia axillaris*) open heath over *Trymalium ledifolium* var. *ledifolium, Rhagodia baccata* subsp. *baccata, Leucopogon parviflorus* shrubland over **Lolium rigidum*, (*Austrostipa macalpinei*), *Poa porphyroclados* very

open grassland with *Acanthocarpus preissii*, *Lomandra maritima* very open herbland.

Habitat and soil: steep, east-facing mid-slope of moderately high sand dune; white calcareous sand.

Notes: This unit was represented by site CB12 (see Photograph 32, Appendix 6). This vegetation mapping unit was similar to other dune upper slope heath units with *Olearia axillaries* and *Spyridium globulosum* dominants (OaDd, SaOa and SgOaAar/SgOaAr), but had *Acacia truncata* (Sand dune variant) as a codominant.

Photograph 7. Site CB20 (representing mapping unit OaTd(Sc)). *Olearia axillaris* open to closed scrub over (*Scaevola crassifolia*), **Tetragonia decumbens* , **Cakile maritime*, **Pelargonium capitatum*, **Oenothera drummondii* subsp. *drummondii* low open shrubland (see complete description above).

SgMh

(*Agonis flexuosa* scattered low trees) over *Spyridium globulosum*, *Melaleuca huegelii*, (*Acacia rostellifera*, *Olearia axillaris*) closed scrub over *Trymalium ledifolium* var. *ledifolium*, *Leucopogon parviflorus* low open shrubland over *Austrostipa flavescens*,

**Lolium rigidum* very open grassland and *Desmocladus asper* scattered sedges with *Acanthocarpus preissii* very open herbland.

Habitat and soil: swale behind dunes; pale grey sand (some small patches of orange sand where ant excavations).

Notes: This swale unit was represented by site CB36. *Agonis flexuosa* scattered low trees were very few in the one area where they were present and did not appear to be an integral part of this vegetation unit. See Photograph 8, below.

SgOaAar/SgOaAr

Olearia axilaris, Spyridium globulosum, Acacia aff. *rostellifera, Santalum acuminatum* shrubland to open heath over *Rhagodia baccata* subsp. *baccata* scattered low shrubs over *Austrostipa flavescens* scattered grasses with *Acanthocarpus preissii, Lomandra maritima* very open herbland to oopen herbland.

Habitat and soil: moderate, west-facing mid to upper slope of dune; white calcareous sand.

Notes: This unit was represented by site CB26 (where *Acacia* aff. *rostellifera* was a co-dominant) and sites CB9 (see Photograph 33, Appendix 6) and CB10 (where *Acacia rostellifera* was a co-dominant). This differentiation between CB26 and CB9 and CB10 is only as substantial as the taxon *Acacia* aff. *rostellifera*. This vegetation mapping unit was similar to other dune upper slope heath units with *Olearia axillaris* and *Spyridium globulosum* dominants (OaDd, SgAt and SaOa), but had *Acacia* aff. *rostelliferalAcacia rostellifera* as a codominant.

SaOa

Santalum acuminatum high open shrubland over *Olearia axillaris, Spyridium globulosum* open shrubland to shrubland over *Trymalium ledifolium* var. *ledifolium, Leucopogon parviflorus, Acacia truncata* (Sand dune variant), *Adriana quadripartita* low shrubland over *Desmocladus asper, Lepidosperma pubisqameum* very open sedgeland with *Lomandra maritima* scattered herbs.

Habitat and soil: steep, south-facing lower to upper slope of dune; white calcareous sand.

Photograph 8. CB36 (representative of mapping unit SgMh). (*Agonis flexuosa* scattered low trees) over *Spyridium globulosum*, *Melaleuca huegelii*, (*Acacia rostellifera*, *Olearia axillaris*) closed scrub (see complete description above).

Photograph 9. CB33 (representative of mapping unit SgSc). *Spyridium globulosum* high shrubland to open heath over *Olearia axillaris* open shrubland over *Diplolaena dampieri* low open shrubland to low shrubland (see complete description below).

Notes: This vegetation unit description was based on that recorded for site CB30. A variant of the unit was also recorded at site CB35 (see Photograph 34, Appendix 6). This vegetation mapping unit was similar to other upper dune slope heath units with *Olearia axillaris* and *Spyridium globulosum* dominants (OaDd, SaAt and SgOaAar/SgOaAr), but had *Santalum acuminatum* as a codominant.

SgSc

Santalum acuminatum scattered tall shrubs over *Spyridium globulosum* high shrubland to open scrub over *Scaevola crassifolia, Rhagodia baccata* subsp. *baccata, Hibbertia cuneiformis* low shrubland over *Lepidosperma gladiatum* scattered to very open sedgeland with *Acanthocarpus preissii* very open herbland.

Habitat and soil: steep, south-east facing lower to mid slope of low dune; white calcareous sand.

Notes: This unit was based on the description for site CB25, with site CB33 (see Photograph 9, above) representing some of the variation within the vegetation mapping unit. The unit occurred on lower dune slopes and in swales between the dunes and was distinguished by the high cover of *Spyridium globulosum* (high shrubland to open scrub).

Caddadup East: Areas C, D, E, G, H, I, J, and K

I Tuart (*Eucalyptus gomphocephala*) units

EgAflHh

Eucalyptus gomphocephala, Eucalyptus marginata subsp. *marginata* scattered trees over *Agonis flexuosa, (Allocasuarina fraseriana, Banksia attenuata)* low woodland over *Xanthorrhoea preissii, Macrozamia riedlei* open shrubland over *Hibbertia hypericoides* open heath over **Briza maxima*, **Avena barbata* open annual grassland with *Dichopogon capillipes* very open herbland.

Habitat and soil: very gentle, NE-facing lower slope of low ridge (sand dune); pale yellow-brown sand.

Notes: This unit was represented by site CC5.

EgAflOa

Eucalyptus gomphocephala open woodland over *Agonis flexuosa*, (*Allocasuarina fraseriana*) low open woodland to low woodland over *Banksia attenuata* scattered low trees over *Jacksonia sternbergiana*, *Olearia axillaris* high open shrubland over *Xanthorrhoea preissii*, *Macrozamia riedlei*, *Rhagodia baccata* subsp. *baccata* open shrubland to shrubland over *Phyllanthus calycinus* scattered low shrubs over **Briza maxima*, **Lagurus ovatus*, **Avena barbata* open annual weed grassland with *Acanthocarpus preissii*, *Lomandra maritima* open herbland.

Habitat and soil: moderate, East-facing mid to upper slope of ridge; yellow-brown sand.

Notes: This unit was represented by site CI1. See Photograph 35, Appendix 6.

EgAr

Eucalyptus gomphocephala woodland over *Acacia rostellifera* high closed scrub over *Xanthorrhoea preissii* scattered high shrubs over *Macrozamia riedlei* scattered shrubs over *Acanthocarpus preissii* scattered herbs over **Ehrharta longiflora*, **Briza maxima* closed annual grassland.

Habitat and soil: steep, east-facing lower slope of high ridge (dune); yellow-brown sand.

Notes: This unit was represented by site CC4.

EgAs

Eucalyptus gomphocephala woodland over *Corymbia calophylla* open woodland over *Acacia saligna*, *Banksia grandis* low open woodland over *Jacksonia sterbergiana* , *Jacksonia furcellata* high open shrubland to high shrubland over *Xanthorrhoea preissii*, *Olearia axillaris*, *Macrozamia riedlei* open shrubland over *Lepidosperma pubisquameum*, *Ficinia nodosa* very open sedgeland and **Briza maxima*, **Avena barbata* annual grassland with *Corynotheca micrantha*, *Acanthocarpus preissii* very open herbland to open herbland.

Habitat and soil: swale (flat) at base of high dune; grey sand.

Notes: This unit was represented by site CJ1.

EgAsKg

Eucalyptus gomphocephala scattered trees to open woodland over *Acacia saligna, Melaleuca raphiophylla, Kunzea glabrescens, Jacksonia furcellata* low woodland to low open forest over *Olearia axillaries, Macrozamia riedlei, Sollya heterophylla* low open shrubland over *Baumea juncea, Schoenus subfasicularis* closed sedgeland with *Corynotheca micrantha* open herbland.

Habitat and soil: very gently sloping lower slopes of drainage line; grey sand.

Notes: This unit was represented by site CG2 and was recorded on the slopes adjacent to a drainage line.

EgCcBa

Eucalyptus gomphocephala, Corymbia calophylla scattered trees over *Banksia grandis, Banksia attenuata* low woodland over *Jacksonia sternbergiana, (Hakea prostrata)* high open shrubland over *Xanthorrhoea preissii, Macrozamia riedlei* shrubland over *Acanthocarpus preisii* low open shrubland and **Briza maxima, *Avena barbata* annual grassland

Habitat and soil: moderately steep, east-facing mid to upper slope of ridge (dune); yellow-brown sand.

Notes: This unit was represented by site CC1. See Photograph 10, below.

EgCoMc

Eucalyptus gomphocephala open forest over *Casuarina obesa, Melaleuca cuticularis* low woodland over *Suaeda australis* scattered low shrubs over *Juncus kraussii* subsp. *australiensis, (Ficinia nodosa)* sedgeland and **Cynodon dactylon* closed grassland.

Habitat and soil: flat foreshore.

Notes: This unit was represented by site CG3. This unit occurred on the banks of the Harvey Estuary.

EgEmAfl

Eucalyptus gomphocephala, Eucalyptus marginata subsp. *marginata*,

Corymbia calophylla open woodland to woodland over *Agonis flexuosa*, (*Allocasuarina fraseriana*, *Banksia attenuata*) low woodland to low open forest over *Jacksonia sterbergiana* scattered tall shrubs over *Xanthorrhoea preissii*, *Macrozamia riedlei* open shrubland over *Dichopogon capillipes*, **Trifolium campestre* var. *campestre* herbland and **Lolium rigidum*, **Briza maxima* annual grassland.

Habitat and soil: gentle, east-facing lower slope of ridge (dune); pale yellow-brown sand.

Notes: This unit was represented by site CC3. See Photograph 11, below.

II Other vegetation units

AflAr

Allocasuarina fraseriana, *Banksia attenuata* scattered low trees over *Jacksonia sterbergiana* high open shrubland over *Acacia rostellifera* high shrubland to open scrub over *Hibbertia hypericoides* low open shrubland over **Avena barbata*, **Ehrharta calycina* annual grassland.

Habitat and soil: gentle to moderate, west-facing, lower slope of low ridge.

Notes: This unit was represented by site CD1 and occurred over a very small area in Area D.

Photograph 10. Site CC1 (representing mapping unit EgCoBa). *Eucalyptus gomphocephala*, *Corymbia calophylla* scattered trees over *Banksia grandis*, *Banksia attenuata* low woodland over *Jacksonia sternbergiana*, (*Hakea prostrata*) high open shrubland over *Xanthorrhoea preissii*, *Macrozamia riedlei* shrubland (see complete description above).

Photograph 11. Site CC3 (representing mapping unit EgEmAfl). *Eucalyptus gomphocephala*, *Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* open woodland to woodland over *Agonis flexuosa*, (*Allocasuarina fraseriana*, *Banksia attenuata*) low woodland to low open forest (see complete description below).

EmAfBa

(*Eucalyptus marginata*) scattered trees over *Banksia attenuata, Allocasuarina fraseriana* low woodland to low open forest over *Jacksonia sternbergiana* high open shrubland over *Olearia axillaris, Acacia pulchella* var. *glaberrima* open shrubland over *Hibbertia hypericoides* low shrubland to low open heath over **Briza maxima, *Bromus diandrus* annual grassland and *Austrostipa macalpinei* scattered grasses with *Dichopogon capillipes, Asteridea pulverulenta* very open herbland.

Habitat and soil: very gently sloping, North-facing crest of ridge (dune); pale yellow-brown sand.

Notes: This unit was represented by site CC2 and was widespread across the crests and upper slopes of the Cottesloe dunes in the survey area. See Photograph 12, below.

MrMc

Melaleuca raphiophylla, Melaleuca cuticularis low woodland over *Astartea scoparia* low open sheubland over *Juncus kraussii* subsp. *australiensis, Baumea juncea* sedgeland and **Ehrharta calycina, *Briza maxima* very open annual grassland.

Habitat and soil: drainage line on western boundary of Area G; grey sand.

Notes: This unit was represented by site CG1. It was a small area along a drainage line, perhaps lying on or near the old Harvey Estuary shoreline before the construction of the Dawesville Cut and adjacent land reclaimation. See Photograph 13, below.

Photograph 12. Site CC2 (mapping unit EmAfBa). (*Eucalyptus marginata*) scattered trees over *Banksia attenuata*, *Allocasuarina fraseriana* low woodland to low open forest over *Jacksonia sternbergiana* high open shrubland (see complete description above).

Photograph 13. Site CG1 (representing mapping unit MrMc). *Melaleuca raphiophylla*, *Melaleuca cuticularis* low woodland over *Astartea scoparia* low open shrubland over *Juncus kraussii* subsp. *australiensis*, *Baumea juncea* sedgeland .

III Reclaimed area (Area H)

AsJs (Completely degraded reclaimed area)

Revegetation consists of a few scattered tall shrub and shrub species over an annual weed grassland:

Acacia saligna scattered low trees to low open woodland over *Jacksonia sterbergiana* , *Jacksonia furcellata* scattered tall shrubs over *Olearia axillaris*, *Acacia pulchella* var. *glaberrima* scattered shrubs over *Ficinia nodosa*, and **Cynodon dactylon*, **Lagurus ovatus*, **Avena barbata* annual grassland.

Notes: This unit was represented by site CH1. See Photograph 14, below.

Photograph 14. Vegetation on the reclaimed land at site CH1.

5.0 VEGETATION CONDITION AND WEEDS IN THE SURVEY AREA

5.1 Vegetation condition classification in the Caddadup survey area

Vegetation condition was mainly in the range of 'Very Good' to 'Excellent to Pristine' in the Cadadup-West survey area (Figure 4A; also see definitions in Appendix 3). Dry moss mats were common across the surface of the sandy slopes of the older dunes. The native herb and grass layers were mainly intact, with Austrostipa and Poa native grasses forming open grasslands in some units (see descriptions of sites CB4 and CB17, Appendix 5; see Photographs 15, 16 and 17 below). Weed cover was generally moderate. Vegetation condition in this area was best on the Yoongarillup Plain and Quindalup Dune landform units.

Generally there was little rubbish in the Caddadup-West area. However, discarded items from the golf fairways, including grass cuttings, black shade cloth and hardi-flex sheeting, were observed in adjacent bush (near the edge of the bushland) in a number of places (see Figure 4A).

Photograph 15. Open herbland of *Calandrinia linifolia* and *Trachymene pilosa* near site CB7 on the limestone flats.

Photograph 16. *Senecio pinnatifolius* and *Lobelia tenuior* (blue flowers) open herbland near site CB7, limestone flats.

Photograph 17. Site CB4, showing the *Acacia rostellifera* open to closed scrub over *Austrostipa flavescens* grassland .

DISCARDED HARDI FLEX SHEETS

CD (BLOWOUT/RESTORATION)

GRASS CUTTINGS

DISCARDED BLACK SHADE CLOTH

GRASS CUTTINGS

REGROWTH

OLD RUBISH TIP

RUBISH ON TRACK - OLD FENCING MATERIALS

WIRE MESH RUBBISH

CADDADUP WATER TREATMENT PLANT

HAND-RAIL LOOKOUT

POWER LINES

PISTOL SHOOTING CLUB

HEAP OF DISCARDED LAWN ROLLS - NEEDS SEPARATION FROM RESERVE TO PREVENT SPREAD OF COUCH.

LEGEND:

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

CD = COMPLETELY DEGRADED
GOLF FAIRWAY

0 100 200 300 400m

SMEC
ACN:065 475 149
Level 6, 12 St Georges Terrace
PERTH WA 6000
Tel:(08) 9323 5900 Fax(08) 9323 5901

CADDADUP (WEST) VEGETATION CONDITION MAP

Project Number: 36413

Figure Number: FIGURE 4A

EXTENSIVE BANKSIA ATTENUATA JARRAH AND SHEOK DECLINE AND SOME DEATHS

PATCHES OF OLD DISTURBANCE

PLANTED NATIVES

CD-VG (PATCHES)

RUBBISH (ROLL OF WIRE)

SCATTERED RUBBISH IN BUSH

CD (CLEARED)

GARDEN RUBBISH

2m DEEP HOLE

OLD PIT (STEEP BANKS)

WATER TANK

PORT BOUVARD SPORTING AND RECREATION CLUB

BUILDINGS

CD (RECLAIMED LAND)

TUART OVER COUCH/BUFFALO PARKLAND

CARPARK

REPLANTED SHORELINE VEGETATION

MELALEUCA RAPHIOPHYLLA, CASAURINA OBESA PARKLAND

HARVEY ESTUARY

LEGEND:

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

CD = COMPLETELY DEGRADED
GOLF FAIRWAY
Db DEAD AND DECLINING BANKSIAS, JARRAH, SHEOAK
RUBBISH LOCATION

0 100 200 300 400m

SMEC
ACN:065 475 149
Level 6, 12 St Georges Terrace
PERTH WA 6000
Tel:(08) 9323 5900 Fax(08) 9323 5901

CADDADUP (EAST) VEGETATION CONDITION MAP

Project Number: 36413

Figure Number: FIGURE 4B

L:\Projects\36413 - Mandurah Management Plans_Caddadup\Figures\FIGURE 4B - VEGETATION CONDITION MAP.dwg, 18/04/2005 2:39:23 PM, 1:1.00013

Vegetation condition in Caddadup-East areas was mainly in the range of Good - Very Good to Very Good – Excellent (Figure 4B). The vegetation condition was not as good as that in Caddadup-West, mainly because of higher weed cover.

Dead trees, mainly dead *Banksia attenuata* trees, were recorded in Areas C, D and I (see Figure 4B and section 4.4 below).
Household rubbish items were recorded at a number of sites, most noteably along the southern boundary of Area D and on the edge of a few firebreaks in Area C (Figure 4B).

5.2 Weed occurrence in the Caddadup survey area

The grid survey of weeds in the survey area showed that different weed species dominated the weed cover in different parts of the survey area (Figures 5A and 5B). Nearest the coast in the western part of the Caddadup-West area (Figure 5A), dune onion weed (*Trachyandra divaricata*), *Tetragonia decumbens* and *Pelargonium capitatum* (not shown on the map) were the most abundant weeds. The introduced Marram grass (*Ammophila arenaria*; see Photograph 30, Appendix 6) is a perennial grass introduced for dune stabilization projects and has become naturalized (Hussey *et al.*, 1997). Further inland, in the older parts of the Quindalup Dunes , annual rye grass (*Lolium rigidum*) was the most abundant and significant weed (mainly light to moderate cover).

In the Caddadup-East area (Figure 5B), the most aggressive widespread weeds were wild oats (*Avena barbata*), annual veldt grass (*Ehrharta longiflora*) and blow fly grass (*Briza maxima*). *Bromus diandrus* was a widespread weed but usually with only low cover.

Locations of local or 'one-off' weed problems are also shown in Figures 5A and 5B. In Caddadup-West dune onion weed occurs in significant patches along the edge of access tracks and old tracks and firebreaks. An important source of some significant woody weeds in the area has been the application of brush to old tracks and firebreaks. This has seen the introduction most noteably of Victorian t-tree (*Letospermum laevigatum*) and also *Eucalyptus platypus*, Rottnest Island Pine (*Callitris preissii*) and *Retama raetam*. In the Caddadup-East area, notable isolated occurrences of weeds includes the daisy weed *Osteospermum ecklonis*, Ixia, perennial veldt grass (*Ehrharta calycina*), and individual records of Geraldton wax and the Flinders Range wattle (*Acacia iteaphylla*). Buffalo grass and couch form closed grasslands in Area G. Dumped garden rubbish has been the source of many of these isolated weed occurrences.

GERALDTON WAX (INTRODUCED)

BRIDAL CREEPER

SOUR SOB

*OSTEOSPERMUM ECKLONIS (DAISY WEED)

*OSTEOSPERMUM ECKLONIS (DAISY WEED)

DUNE ONION WEED (*TRACHYANDRA DIVARICATA)

LOVE GRASS (*ERAGROSTIS CURVULA)

WATER TANK

SOUR SOB ALONG EDGE OF TRACK

TUART DEATHS (FIRE?)

MODERATE TO HIGH WEED COVER

BUFFALO GRASS

BUFFALO GRASS

IXIA ALONG EDGE OF TRACK

BUILDINGS

*ACACIA ITEAPHYLLA

PERENNIAL VELD GRASS (*EHRHATA CALYCINA) ALONG THE EDGE OF FIREBREAK

CARNATION WEED (*EUPHORBIA TERRACINA)

HARVEY ESTUARY

LEGEND:

- L (1-10)%
- L/M (11-30)%
- M/H (31-70)%
- H (>70)%

- EHRHARTA CALCINA
- BRIZA MAXIMA
- LOLIUM RIGIDUM
- BROMUS DIANRUS

- EHRHARTA LONGIFLORA
- AVENA BARBATA
- WEED PATCH

0 100 200 300 400m

SMEC
ACN:065 475 149
Level 6, 12 St Georges Terrace
PERTH WA 6000
Tel:(08) 9323 5900 Fax(08) 9323 5901

CADDADUP (EAST) WEED MAP

Project Number: 36413

Figure Number: FIGURE 5B

VICTORIAN T-TREE

*EUCALYPTUS PLATYPUS (INTRODUCED)

ROTTNEST ISLAND PINE (INTRODUCED)

VICTORIAN T-TREE

WOODY WEEDS INTRODUCED WITH BRUSHWOOD MULCHING OF OLD TRACKS/FIREBREAKS

VICTORIAN T-TREE

ROTTNEST ISLAND PINE (INTRODUCED)

*ANAGALIS ARVENSIS AND *EHRHARTA LONGIFLORA

CADDADUP WATER TREATMENT PLANT

BRIDAL CREEPER

DUNE ONION WEED

JAPANESE PEPPER SEEDLINGS

THICK DUNE ONION WEED (*TRACHYANDRA DIVARICATA ALONG POWERLINE TRACK)

DUNE ONION WEED (*TRACHYANDRA DIVARICATA) ALONG EDGE OF TRACK

PISTOL SHOOTING CLUB

PATCH OF DUNE ONION WEED

LEGEND:

- L (1-10)%
- L/M (11-30)%
- M/H (31-70)%
- H (>70)%

- LOLIUM RIGIDUM
- BROMUS DIANRUS
- TRACHYANDRA DIVARICATA
- AMMOPHILA ARENARIA
- TETRAGONIA DECUMBENS
- EHRHARTA LONGIFLORA
- AVENA BARBATA
- WEED PATCH

0 100 200 300 400m

SMEC
ACN:065 475 149
Level 6, 12 St Georges Terrace
PERTH WA 6000
Tel:(08) 9323 5900 Fax(08) 9323 5901

CADDADUP (WEST) WEED MAP

Project Number: 36413

Figure Number: FIGURE 5A

5.3 Tree deaths and (?dieback) in the Caddadup survey area

Groups of dead (including recent deaths) and declining trees (see Photograph 18 below), where there was no obvious explantation such as fire, were observed in Caddadup-East and are shown on Figure 4B. *Banksia attenuata* was the most common dead tree species, but jarrah and sheok deaths and decline also occurred. In a few places the area of deaths and decline were larger (up to 40 m diameter, see Figure 4B and Photograph 1 below).

It is suggested that these areas be further investigated by accredited 'dieback interpreters' for the presence of the dieback fungus, *Phytophthera cinnamom*. Other factors such as fire and drought may also be responsible for tree death and decline in the survey area.

Photograph 18. Dead *Banksia attenuata* trees in Area D, Caddadup survey area.

6.0 FLORISTIC COMMUNITIES AND THREATENED ECOLOGICAL COMMUNITIES IN THE SURVEY AREA

6.1 Determination of Floristic Community Types (FCT) by classification

The results of the PATN analysis of the combined data set of the Caddadup survey area sites (CB1, CB2, CB6, CB8, CB11, CB23, CB36, CC1, CC2, CF1, CF3, CI1) and Gibson *et al.* (1994) Swan Coastal Plain sites (Figure 4) are shown in Figure 6 (dendrogram), Table 3 (nearest neighbours) and summarised in Table 4, below. The Caddadup sites used in the analysis were complete releve sites and were representative of the main vegetation types.

The dendrogram analysis (Figure 6) grouped the Caddadup-West sites (CB1, CB2, CB6, CB8, CB11, CB23, CB36, CF1, CF3) with FCT 29a and 29b, both Quindalup FCT's. However, the nearest neighbour analysis showed that while CB11, CB23 and CB36 grouped with FCT 29b ('Acacia shrublands on taller dunes' – Quindalup), the other Caddadup-West sites showed affinities to a number of FCT's. Sites CB6 and CB8 (tuart and peppermint open forest sites) were most similar to FCT 30b, a Quindalup tuart and / or peppermint woodlands FCT. The Yoongarillup scrub sites CB1 and CB2 were most similar to Spearwood FCT's 24, and 26b and the Quindalup FCT 29b. This reflects the proximity of these vegetation units to Quindalup dunes and probably some Quindalup sand deposition on an essentially Spearwood limestone plain area. Sites CF1 and CF3 were most similar to both Spearwood FCT's 24 and 27 and the Quindalup FCT's 29b and 30b.

The dendrogram analysis (Figure 6) grouped the Caddadup-East sites that occurred on the Spearwood Dune element (CC1, CC2 and CI1) with the Spearwood FCT 24 ('Northern Spearwood shrublands and woodlands'). The nearest neighbour analysis determined that the sites CC1 and CC2 were most similar to FCT's 24 ('Northern Spearwood shrublands and woodlands'), 25 ('Southern tuart-peppermint woodlands') and 28 (Spearwood Banksia attenuata-Eucalyptus woodlands). These FCT's are all Spearwood units. The site CI1 was most similar to the Spearwood FCT's 24 and 25.

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.

Figure 6. Sections of the dendrogram produced from the classification of Caddadup survey area sites with the Gibson *et al.* (1994) sites.

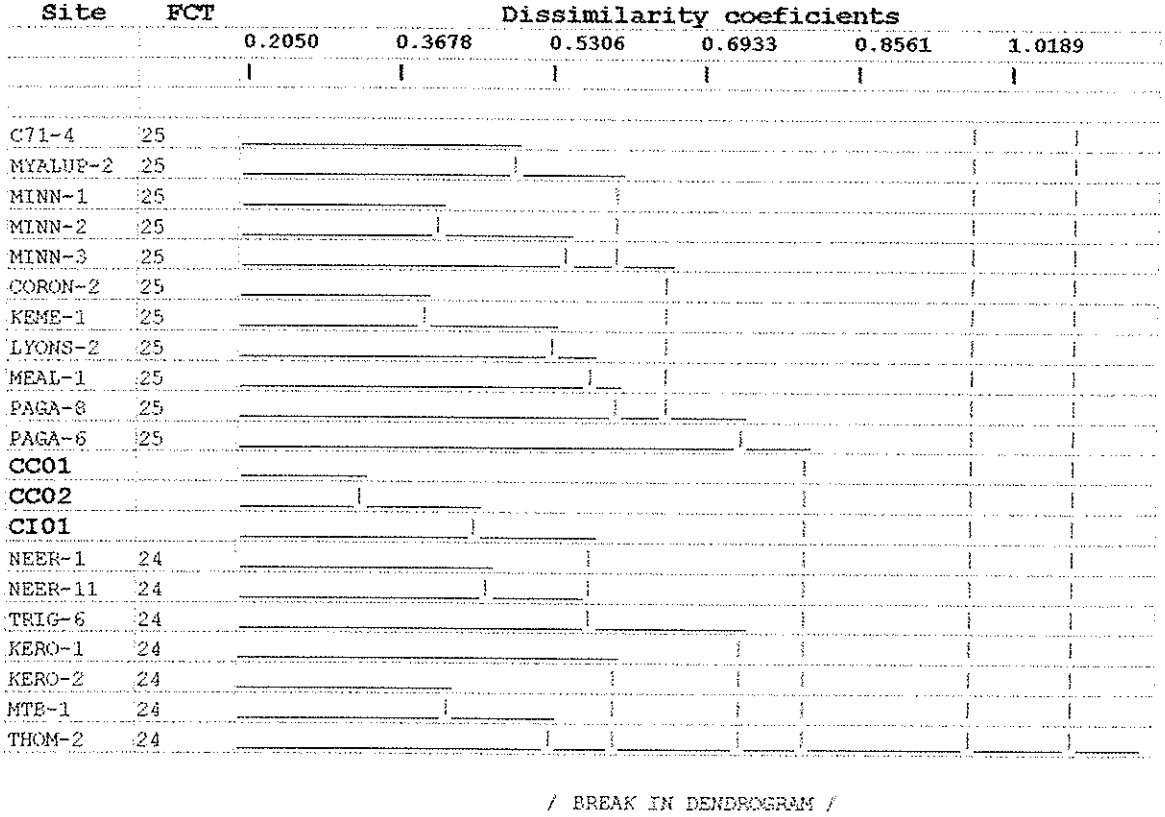


Figure 6 (cont). Sections of the dendrogram produced from the classification of Caddadup survey area sites with the Gibson *et al.* (1994) sites.

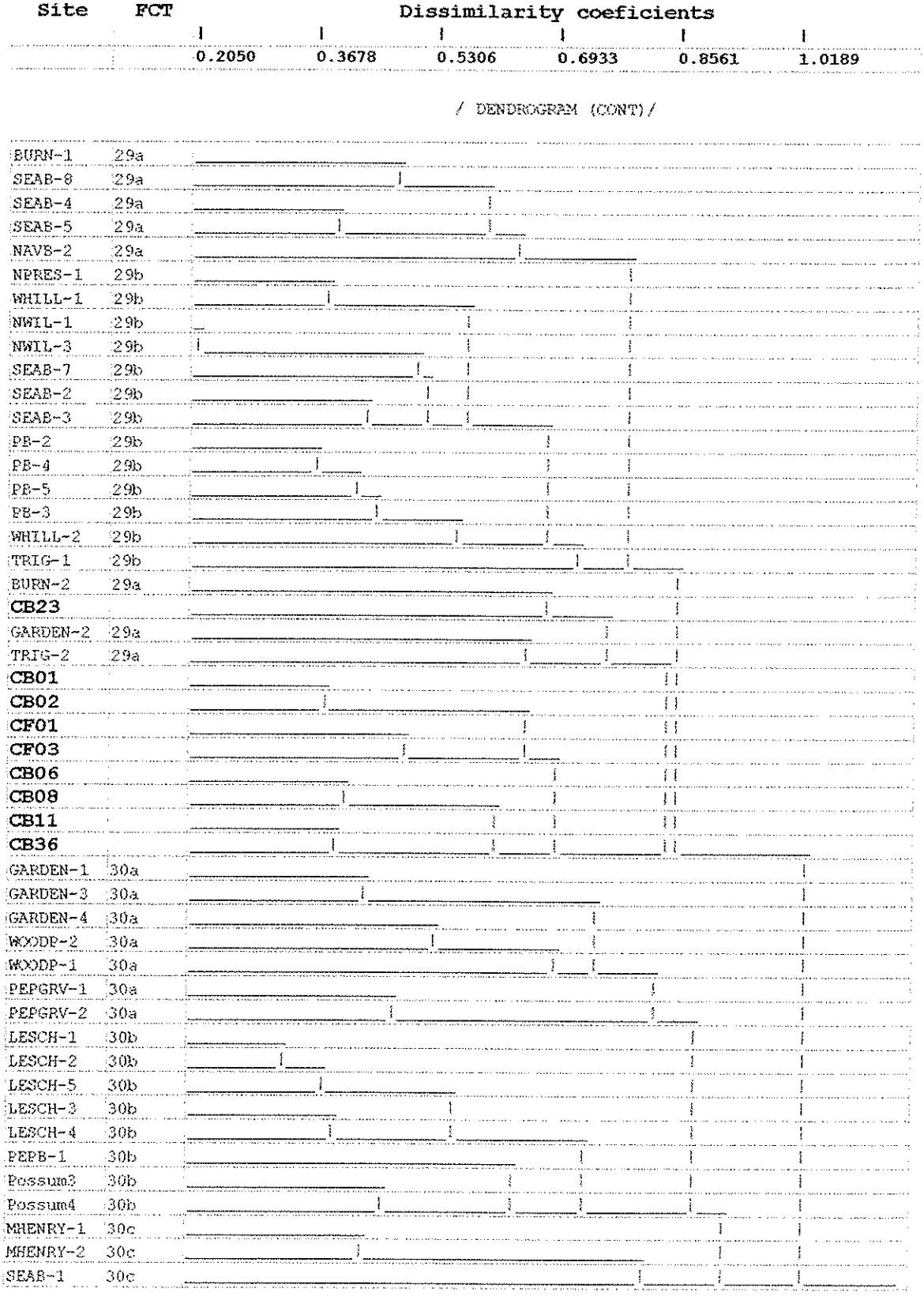


TABLE 3. Ten 'Nearest Neighbours' for the Caddadup survey area

Column headings:

s1 to s10: next most similar sites, ranked 1 to 10;

fc: Floristic Community Type of next most similar sites;

v1 to v10: dissimilarity coefficient for next most similar site.

Site	s1	fc1	v1	s2	fc2	v2	s3	fc3	v3	s4	fc4	v4	s5	fc5	v5	s6	fc6	v6	s7	fc7	v7	s8	fc8	v8	s9	fc9	v9	s10	fc10	v10
CB01	CB02		0.38	CF01		0.52	PB-4	29b	0.55	BOLD-4	24	0.55	BOLD-3	24	0.55	BURN-1	29a	0.56	YAN-2	26a	0.58	NPRES-1	29b	0.58	CLIF-2	26a	0.59	NEER-9	24	0.60
CB02	CB01		0.38	WHIL L-5	26b	0.54	CC02		0.54	CC01		0.54	BOLD-3	24	0.56	NPRES-1	29b	0.57	CI01		0.58	C71-4	25	0.6	CLIF-2	26a	0.6	BOLD-4	24	0.60
CB06	CB08		0.4	LESC H-1	30b	0.55	CF03		0.58	CI01		0.59	MINN-1	25	0.59	LESC H-2	30b	0.6	CB36		0.6	BOLD-3	24	0.61	LESC H-5	30b	0.62	BURN-1	29a	0.63
CB08	CB06		0.4	CB36		0.49	CF03		0.51	LESC H-4	30b	0.52	LESC H-5	30b	0.53	LESC H-2	30b	0.54	LESC H-1	30b	0.54	CB11		0.55	CB02		0.61	BOLD-3	24	0.62
CB11	CB36		0.39	PB-4	29b	0.48	PB-2	29b	0.51	PB-5	29b	0.54	CB08		0.55	WHIL L-2	29b	0.58	NPRES-1	29b	0.58	CB23		0.59	CF03		0.6	PB-3	29b	0.61
CB23	PB-4	29b	0.58	CB11		0.59	PB-2	29b	0.63	WHIL L-2	29b	0.64	cool 08	24	0.65	CB36		0.67	TRIG-2	29a	0.67	BURN-2	29a	0.67	PB-3	29b	0.68	SEAB-8	29a	0.69
CB36	CB11		0.39	CB08		0.49	PB-4	29b	0.54	NWIL-3	29b	0.59	PB-2	29b	0.57	LESC H-4	30b	0.58	WHIL L-2	29b	0.58	CF03		0.6	CB06		0.6	PB-5	29b	0.61
CC01	CC02		0.33	CI01		0.45	NEER-11	24	0.53	TRIG-3	28	0.54	C71-4	25	0.54	CB02		0.54	NEER-1	24	0.56	PAGA-8	25	0.57	MINN-2	25	0.57	CORON-2	25	0.57
CC02	CC01		0.33	CI01		0.41	TRIG-3	28	0.5	MINN-1	25	0.51	WOO DV-2	28	0.51	NEER-11	24	0.52	MINN-2	25	0.53	CB02		0.54	NEER-3	28	0.55	NEER-1	24	0.55
CF01	CF03		0.49	CB01		0.52	WHIL L-4	27	0.58	TRIG-6	24	0.59	cool 08	24	0.6	PB-4	29b	0.61	BURN-1	29a	0.61	WHIL L-2	29b	0.62	YAN-24	26a	0.63	CHIDPT-1	24	0.63
CF03	CF01		0.49	CB08		0.51	WOO DP-2	30a	0.54	BOLD-3	24	0.58	CB06		0.58	LESC H-1	30b	0.59	LESC H-4	30b	0.59	LESC H-5	30b	0.59	CB36		0.6	SEAB-5	29a	0.6
CI01	CC02		0.41	CC01		0.45	TRIG-6	24	0.48	NEER-1	24	0.51	C71-4	25	0.54	NEER-11	24	0.54	CB02		0.58	BOLD-3	24	0.59	CB06		0.59	MINN-1	25	0.59

Table 4. Assignment of Floristic Community Type to Caddadup sites giving consideration to both dendrogram and nearest neighbour analysis.

Caddadup Site	From Dendrogram	From Nearest Neighbour	Floristic Community Types Assigned
CB1	29b	24/29b	24/29b
CB2	29b	26b/24/29b	26b/24/29b
CB6	29b	30b	30b
CB8	29b	30b	30b
CB11	29b	29b	29b
CB23	29a	29b	29b
CB36	29b	29b	29b
CC1	24	24/25/28	24/25/28
CC2	24	28/25/24	28/25/24
CF1	29b	27/24/29b	27/24/29b
CF3	29b	24/30b	24/30b
CI1	24	24/25	24/25

6.2 Threatened Ecological Communities (TEC's) in the Caddadup survey area

The Floristic Community Types (FCT's) assigned to the Caddadup sites (see Table 4 above) are not currently recognized as having TEC status by the Department of Environmental Protection (2000).

7.0 VEGETATION CONSERVATION VALUES IN THE SURVEY AREA

7.1 Floristic community types occurring in the survey area and Threatened Ecological Communities

The PATN analysis showed that none of the vegetation units in the Caddadup survey area were TEC units (see section 6.2 above).

7.2 Other vegetation conservation values in the Caddadup survey area

7.2.1 Conservation values for tuart (*Eucalyptus gomphcephala*) vegetation units in the survey area

Although regionally uncommon, tuart vegetation units formed a significant component of the vegetation of the survey area. They included scattered tuarts to tuart-jarrah-marri mixed woodland over peppermint low woodland on the Cottesloe sands in the Caddadup-East area, an extensive area of tuart open forest over peppermint low open forest in the north eastern part of Caddadup-West (Very Good to Excellent condition) and a smaller linear area of tuart open to closed forest over various high shrublands (*Spyridium globulosum* high shrubland to open scrub in one area and a mixed high shrubland to open scrub of *Spyridium globulosum*, *Acacia rostellifera* and *Melaleuca huegelii* in another area). Trudgen (1991, p57) noted a considerable variation in the tuart vegetation units that occurred along the coast from Mandurah south to the northern part of Lake Clifton and commented on their conservation value.

Tuart is endemic to the Swan Coastal Plain where it grows mainly on the Quindalup 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, the 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. Given that Trudgen (1991 pp41-42) described twenty six separate vegetation units in which tuart was a component, the six structural units are obviously very broad units and are likely to underestimate the conservation value of the variation found in vegetation including 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; Trudgen, 1991). 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 in the north and Yalgorup NP in the south and that this makes any tuart vegetation in that area, particularly if in good condition, of high conservation value (Bromwyn Keighery, *pers. comm.*).

Taking these points into consideration, the tuart vegetation units in the survey area have very high conservation value because of their relatively large extent, their VeryGood to Excellent condition, the range of variation in them and the extent of clearing and degradation of tuart stands outside the survey area.

7.2.2 Conservation values for peppermint (*Agonis flexuosa*) vegetation units in the survey area

While restricted in overall extent, peppermint woodland to low open forest covers a significant part of the Caddadup-West survey area. It also forms a lower tree storey of a woodland to low open forest under tuart in both the Caddadup-East and Caddadup-West parts of the survey area.

Like tuart, peppermint is endemic to the south west of Western Australia and occurs on coastal dunes, limestone heath and sandy soils. Its range extends along the coast from Perth to the south coast and east to Bremer Bay and inland to Boyup Brook (Marchant *et al*, 1987; Wheeler *et al* 2002). However, the peppermint stands at the Dawesville Cut are the northern most extent of substantive stands of peppermint (Bromwyn Keighery, *pers. comm.*). For this reason and the fact that peppermint is not well represented in conservation areas between Perth and Bunbury (Yalgorup NP being the only park with significant stands, Trudgen (1991)), the occurrences of peppermint in the Caddadup survey area have high conservation value. The extensive stands with no eucalypt overstorey in Area B are particularly significant.

7.2.3 Conservation values associated with the vegetation of the limestone areas of the Yoongarillup Plains

Trudgen (1991) assessed the conservation values of the vegetation along a 45 kilometres coastal strip between Singleton (10 kilomtres north of Mandurah) and the southern

boundary of the City of Mandurah, based on detailed mapping of the vegetation of the area. He concluded that the vegetation of the limestone areas (including the limestones of the Yoongarillup plain) were of high conservation value because of the diversity of different vegetation types found there and 'the generally good condition of the vegetation of the limestone areas'. Part of these limestone areas of the Yoongarillup plains occurs in the southern section of the Caddadup-West survey area.

In conclusion, the vegetation of the Yoongarillup plains part of the survey area has high conservation value because of the diversity of the vegetation on that landform unit, the restricted distribution and area of that landform unit, the small part of that landform unit vegetation that is in secure conservation reserves and the Excellent condition of the survey area vegetation.

7.3 Regional significance of the flora and vegetation of the Caddadup survey area

The flora and vegetation of the Caddadup survey area has considerable regional significance for:

- representation of poorly secured 'ecological communities' (Vegetation Complexes);
- diversity of landforms and plant communities/associations, and
- rarity of vegetation units.

Three vegetation complexes, based on major landform elements, occur in the survey area: the Cottesloe Complex – Central and South; the Quindalup Complex and a small area of the Yoongarillup Complex.

The original ('pre-1750') extent of each of these three Complexes is shown in Table 5, below. The remaining area of each Complex as a percentage of its pre-1750 extent and the remaining area of each Complex in secure tenure as a percentage of its pre-1750 extent are also shown in Table 5. It can be seen that the remaining area of each of the three Complexes is greater than 40%, while the remaining area of each of the Complexes in secure tenure are 8.8 %, 5.2 % and 13.9 % of the pre-1750 extent of the Cottesloe, Quindalup and Yoongarilup Complexes respectively (Table 5).

'Representation of ecological communities' is one of the six criteria for the identification of regionally significant natural areas identified by the EPA (EPA, 2003). The National Objectives and Targets for Biodiversity Conservation 2001-2005 recognised a standard level of native vegetation retention of at least 30 % of the pre-clearing extent of the

ecological communities. While each of the three vegetation Complexes present in the Caddadup survey area has more than 40 % of pre-1750 extent remaining, the situation is not secure. This is because to meet the target for the conservation of remnant Cottesloe Complex – Central and South, almost 75% of the remaining (as at the time of the data compilation in 2002) area of the Complex would have to be protected. A further target that has been adopted nationally for representation of ecological communities is that at least 15% of the remaining area of the Vegetation Complexes be in secure tenure (Gary Whissen, *pers. comm.*). It can be seen from Table 5 (2002 data) that less than 15 % of each of the three vegetation Complexes found in the Caddadup survey area are in secure tenure, although the secured remnant of the Yoongarillup Vegetation Complex (13.9 %) comes close to meeting that minimum target.

'Diversity' is another criteria for the identification of regionally significant natural areas in the System 6 and Part System 1 region (EPA, 2003). The Caddadup survey area contains a wide variety of landform units (the strand or area of the beach where only specially adapted species can survive; four ages of Quindalup dunes (Q4 and Q3 and older Q2 and Q1 dunes), Yoongarillup limestone flats and the Spearwood Dune system (Cottesloe unit; eastern side of the Dawseville Bypass road). The Caddadup survey area also contained a large number and wide variety of plant communities (see section 4 above and Appendix 5).

'Rarity' (of 'communities' or species) is a third criteria for the identification of regionally significant natural areas in the System 6 and Part System 1 region (EPA, 2003). The extent and variety of tuart and peppermint dominated vegetation units in the Caddadup survey area and the fact that it contains one of the northern most substantial stands of peppermint woodland (B. Keighery, *pers. comm.*) means there is considerable 'rarity' of communities in the survey area. It should be noted that no TEC's were identified in the survey area and only one Priority 3 plant (*Lasiopetalum membranaceum*) was recorded in the survey area (although the DRF orchid *Caladenia huegelii* has been previously reported from Area C in the survey area).

Furthermore, while there have been a number of developments in the Caddadup survey area (Port Bouvard golf fairways, Water Treatment plant and Pistol shooting Club), the condition of the vegetation remains generally 'Very Good to Excellent' (particularly in Area B and F; see section 5.1 above).

Table 5. Remnant vegetation of the Swan Coastal Plain Bioregion within the System 6/part System 1 (adapted from Table 4, Appendix 3, EPA (2003)).

Vegetation Complex	**Total pre-1750 extent (ha)**	**% remaining (1997/98) in the System 6/part System 1 area**	**% remaining of pre-1750 extent in secure tenure**
Cottesloe Complex – Central and south	44,995	41.1	8.8
Quindalup Complex	38,238	47.1	5.2
Yoongarillup Complex	24,767	45.0	13.9

8.0 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 Kane Robinson of SMEC Australia PL produced the computer maps used in this report.

Mr Ted Griffin ran the PATN analysis and gave advice on the interpretation of the results. Thanks also to Malcolm Trudgen who supplied the computer with the Gibson *et al.* (1984) base data and PATN software.

Thanks to Mr Frank Obens for his assistance with specimen identifications for this report. Thanks also to various botanical specialists for assistance with identifications: Mr Andrew Brown for his assistance with the identification of the orchids; Mr Bruce Maslin for his examination of the *Acacia* aff. *rostellifera* specimens; Mr Paul Wilson for his assistance with identification of the daisies and Mr Alex Williams for his assistance with identification of the spear grasses (Austrostipa's). Thanks also to Mr Rob Davis and Mr Malcolm Trudgen for general assistance with identifications.

9.0 REFERENCES

Aplin, T.E.H. (1979) 'The Flora' IN: *Environment and Science*, B.J. O'Brien (ed.). University of WA Press, Perth.

Atkins, K.J. (2003) *Declared Rare and Priority Flora List for Western Australia.*. Department of Conservation and Land Management, Woodvale.

Beard, J. S. (1980). A new phytogeographic map of Western Australia. Western Australian Herbarium Research Notes 3, 37-58.

Brown, K. and Brooks, K. (2002). *Bushland weeds. A Practical Guide to Their Management*. Environmental Weeds Action Network, Greenwood Australia.

Chapman, A. R. and Maslin, B. R. (1992). *Acacia* Miscellany 5. A review of the *A. bivenosa* group (Leguminosae: Mimosoideae: Section *Phyllodineae*). *Nuytsia* Vol. 8, No 2., 249-283.

Churchwood, H. M. and McArthur, W. M. (1980). Landforms and soils of the Darling System, Western Australia. *In* Atlas of Natural Resources Darling System Western Australia. Dept of Conservation and Environment. University of Western Australia Press.

Department of Environmental Protection (2000) Bush Forever Vol. 2 Directory of Bush Forever Sites. Dept of Environmental Protection, Perth.

English, V., and Blyth, J. (1997) *Identifying and conserving threatened ecological communities (TECs) in the South West Botanical Province*. ANCA National Reserves System Cooperative Program: Project Number N702, Australian National Conservation Agency, Canberra.

Environmental Protection Authority. (2003). Guidance for the assessment of environmental Factors (In accordance with the Environmental Protection Act 1986). No. 10. January 2003. Western Australia.

Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H., and Lyons, M.N. (1994) *A Floristic Survey of the Southern Swan Coastal Plain*. Unpublished report for the

Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc).

Griffin, T. and Trudgen, M. (2004). Floristic analysis of quadrat data from remnant native vegetation at Pearce RAAF Airbase. (Unpublished report prepared for Ecoscape (Australia) Pty Ltd).

Heddle, E.M., Loneragan, O.W., and Havel, J.J. (1980) 'Vegetation complexes of the Darling System, Western Australia.' In: *Atlas of Natural Resources, Darling System Western Australia.*, M.J. Mulcahy (ed.) pp37-76 and accompanying map. Department of Conservation and Environment, Perth.

Hussey, B. M. J., Keighery, G. J., Cousens, R. D., Dodd, J. and Lloyd, S. G. (1997). Western Weeds. A Guide to the Weeds of Western Australia. the Plant Protection Society of Western Australia. Perth.

Keighery, B. J., Keighery, G. J. and Shepherd, D. (2002). The distribution and conservation of tuart and the community with which it lives. In *Tuart and the Tuart Communities*. Eds: Keighery, B. J. and Longman, V. M. Wildflower Society of Western Australia.

Marchent, N. G., Wheeler, J. R., Rye, B. L., Bennett, E. M., Lander, N. S. and Macfarlane, T. D. (1987). *Flora of the Perth Region*. Western Australian Herbarium and Department of Agriculture, Western Australia.

McArthur, W. M. and Bettenay, E. (1960). The development and distribution of the soils of the Swan Coastal Plain, Western Australia. Soil Publication No. 16. CSIRO. Melbourne.

Paczkowska, G. and Chapman, A. R. (2000). *The Western Australian Flora. A Descriptive Catalogue*. Wildflower Society of Western Australia (Inc), the Western Australian Herbarium (Dept of CALM) and the Botanic Gardens and Parks Authority, Western Australia.

Trudgen, M. (1991). A flora and vegetation survey of the coast of the City of Mandurah. Unpublished report. Department of Planning and Urban evelopment, Western Australia.

Trudgen, M. (1999). A flora and vegetation survey of Lots 46 and 47 Maralla Road and Lexia Avenue, Ellenbrook. Unpublished report prepared by M.E.Trudgen and Associates for The Crown Solicitors Office, Government of Western Australia.

Tuart Response Group (2002). Status report on the conservation and protection of Tuart. Western Australia.

Wheeler, J., Marchant, N. and Lewington, M. (2002). Flora of the South-West. Volume 2. Dicotyledons. Flora of Australia Supplementary Series No. 12. University of Western Australia Press.

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 Caddadup survey area

Notes:
1. An 'x' in a cell indicates that that particular species (row) occurs in that area (column).
3. 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.
4. The numbers in front of the plant families are the numbers for families used at the Western Australian Herbarium.

FAMILY/TAXA	Common names	Priority Status	Area B	Area C
GYMNOSPERMAE				
016A ZAMIACEAE				
Macrozamia riedlei	Zamia			
018 CUPRESSACEAE				
* Callitris preissii	Rottnest Island pine			
ANGIOSPERMAE (flowering plants)				
MONOCOTYLEDONS				
031 POACEAE (grasses)				
*Ammophila arenaria	Marram grass			
Austrodanthonia occidentalis				
Austrostipa flavescens				
Austrostipa macalpinei				
* Avena barbata	Wild oats			
* Briza maxima	Blowfly grass			
* Briza minor				
* Bromus diandrus	Great brome grass			
*Cynodon dactylon	couch			
* Cynosurus echinatus * Ehrharta calycina	Rough dogs tail Perennial veldt grass			
*Ehrharta longiflora	Annual veldt grass			
* Eragrostis curvula	Love grass			
*Hordeum distichon				
* Hordeum vulgare	Barley grass			
* Lagurus ovatus	Hair's tail grass			
*Lolium rigidum	Annual ryegrass			
Poa drummondiana	Knotted Poa			
Poa poiformis				

Poa porphyroclados				
* Polypogon monspeliensis	Annual barb grass			
Spinifex hirsutus				
Spinifex longifolius				
* Stenotaphrum secundatum	buffalo			
* Vulpia fasciculata				
* Vulpia muralis				
* Vulpia myuros var. myuros	Silver grass			
032 CYPERACEAE (sedges)				
Baumea juncea				
Carex preissii				
Ficinia nodosa	Knotted club rush			
Gahnia trifida	Coast saw-sedge			
Isolepis stellata				
Lepidosperma gladiatum Lepidosperma pubisquameum	Coast sword sedge			
Schoenus grandiflorus				
Schoenus subfascicularis				
039 RESTIONACEAE (rushes)				
Desmocladus asper				
Desmocladus flexuosus				
052 JUNCACEAE				
Juncus kraussii subsp. australiensis				
Luzula meridionalis	Field woodrush			
054B ASPARAGACEAE				
* Asparagus asparagoides	Bridal creeper			
054C DASYPOGONACEAE				
Acanthocarpus preissii	Prickle lily			
Lomandra maritima				
Lomandra suaveolens				
054D XANTHORRHOEACEAE				
Xanthorrhoea preissii				
054E PHORMIACEAE				
Dianella revoluta var. divaricata	Blueberry lily			
054F ANTHERICACEAE				

Caesia micrantha				
Chamaescilla corymbosa var corymbosa				
Corynotheca micrantha				
Dichopogon capillipes				
Sowerbaea laxiflora	Purple tassels			
Thysanotus manglesianus	Fringed lily			
Thysanotus ?sparteus				
Thysanotus sparteus				
Tricoryne elatior	Yellow autumn lily			
054G ASPHODELACEAE				
* Trachyandra divaricata	Dune onion weed			
054J COLCHICACEAE				
Burchardia umbellata				
Wurmbea monantha				
055 HAEMODORACEAE				
Conostylis aculeata subsp. aculeata	Prickly Conostylis			
Conostylis candicans	Grey cottonhead			
Haemodorum paniculatum				
060 IRIDACEAE (Iris family)				
*Ixia sp.				
Patersonia occidentalis	Purple flag			
*Watsonia meriana var bulbillifera				
066 ORCHIDACEAE (orchids)				
Caladenia arenicola	Carousel spider orchid			
Caladenia flava subsp. flava	Cowslip orchid			
Caladenia georgei	Tuart spider orchid			
Caladenia huegelii complex	poor material			
Caladenia latifolia Caladenia paludosa	Pink fairy orchid reported from Dpt of CALM survey			
Diuris magnifica	Pansy (donkey) orchid			
Microtis media subsp. media	Common mignonette orchid			
Pterostylis aff. sanguinea	Coastal banded greenhood			

Pterostylis nana complex	Snail orchid			
DICOTYLEDONS				
070 CASUARINACEAE				
Allocasuarina fraseriana	Sheok			
Allocasuarina humilis	Dwarf sheok			
*? Casuarina obesa	Swamp sheok			
088 URTICACEAE				
Parietaria debilis	Pellitory			
090 PROTEACEAE				
Banksia attenuata	Slender banksia			
Banksia grandis	Bull banksia			
Banksia litoralis	Swamp banksia			
Conospermum stoechadis subsp. sclerophyllum				
Dryandra lindleyana var. lindleyana Dryandra sessilis				
Grevillea crithmifolia				
Grevillea preissii subsp. preissii				
Hakea lissocarpha				
Hakea prostrata	Harsh hakea			
Hakea trifurcata	Two-leaf hakea			
Petrophile linearis	Pixie mops			
Synaphea spinulosa subsp. spinulosa				
092 SANTALACEAE				
Exocarpos sparteus				
Santalum acuminatum	Quandong			
105 CHENOPODEACEAE				
Rhagodia baccata subsp. baccata				
Suaeda australis				
Threlkeldia diffusa				
106 AMARANTHACEAE				
Ptilotus drummondii var drummondii				
110 AIZOACEAE				
Carprobrotus virescens				
* Tetragonia decumbens	Sea spinnach			

*Tetragonia implexicoma				
111 PORTULACACEAE				
Calandrinia brevipedata				
Calandrinia liniflora				
113 CARYOPHYLLACEAE				
*Cerastium glomeratum	Mouse-ear chick weed			
*Petrorhagia dubia	Velvet pink			
*Polycarpon tetraphyllum	Four leaf allseed			
*Silene gallica				
119 RANUNCULACEAE				
Clematis linearifolia				
Clematis pubescens	Common Clematis			
Ranunculus colonorum				
131 LAURACEAE				
Cassytha racemosa forma racemosa				
136 FUMARIACEAE				
*Fumaria capreolata	White fumitory			
138 BRASSICACEAE				
*Cakile maritima				
* Heliophila pusilla				
* Stenopetalum gracile	Wild raddish			
143 DROSERACEAE				
Drosera menziesii	Pink rainbow			
Drosera pallida	Pale rainbow			
Drosera stolonifera subsp. stolonifera	Leafy sundew			
149 CRASSULACEAE Crassula colorata var acuminata				
* Crassula glomerata				
163 MIMOSACEAE				
Acacia aff. rostellifera				
Acacia cochlearis	Rigid wattle			
Acacia cyclops	Coastal wattle			
Acacia huegelii				

* Acacia iteaphylla	Flinders Range wattle			
Acacia lasiocarpa var. lasiocarpa	Dune moses			
Acacia pulchella var. glaberrima	Prickly moses			
Acacia rostellifera Acacia aff. rostellifera	Summer scented wattle			
Acacia saligna	Golden wreath wattle			
Acacia truncata (Sand dune variant)				
165 PAPILIONACEAE				
Daviesia decurrens				
Daviesia divaricata subsp. divaricata				
*Genista linifolia	Flaxleaf Broom			
Gompholobium tomentosum				
Hardenbergia comptoniana	Native Wisteria			
Isotropis cuneifolia subsp. cuneifolia	Granny bonnets			
Jacksonia furcellata	Grey stinkwood			
Jacksonia sternbergiana	Stinkwood			
Kennedia prostrata	Scarlet runner			
*Lotus subbiflorus				
* Lupinus cosentinii	Sandplain (blue) lupin			
* Melilotus indicus				
* Retama raetam				
Templetonia retusa	Cockies tongue			
* Trifolium campestre var. campestre	Hop clover			
* Vicia sativa				
Viminaria juncea				
167 GERANIACEAE				
*Erodium cicutarium				
*Geranium molle	Dove's foot			
Geranium solanderi				
* Pelargonium capitatum	Rose Pelargonium			
168 OXALIDACEAE				
*Oxalis corniculata	Yellow wood sorrel			
*Oxalis pes-caprae	Soursob			

175 RUTACEAE				
Diplolaena dampieri	Dampier's rose (southern Diplolaena)			
183 POLYGALACEAE				
Comesperma integerrimum				
185 EUPHORBIACEAE				
Adriana quadripartita				
*Euphorbia paralias				
*Euphorbia peplus				
* Euphorbia terracina	Geraldton carnation weed			
Phyllanthus calycinus	False Boronia			
Poranthera microphylla	Castor oil plant			
194 ANACARDIACEAE				
* Schinus terebinthifolia	Japanese pepper			
215 RHAMNACEAE				
Spyridium globulosum	Basket bush			
Trymalium ledifolium var ledifolium				
221 MALVACEAE				
Alyogyne huegelii var. huegelii	Lilac Hibiscus			
223 STERCULIACEAE				
Lasiopetalum membranaceum		**P3**		
226 DILLENIACEAE				
Hibbertia cuneiformis				
Hibbertia hypericoides	Yellow buttercups			
Hibbertia racemosa				
243 VIOLACEAE				
Hybanthus calycinus	Wild violet			
263 THYMELAEACEAE				
Pimelea calcicola				
273 MYRTACEAE				
Agonis flexuosa	Peppermint			
Astartea scoparia				

*Chamelaucium uncinatum	Geraldton wax			
Corymbia calophylla				
Eucalyptus gomphocephala	Tuart			
Eucalyptus marginata subsp. marginata	Jarrah			
* Eucalyptus platypus				
Hypocalymma robustum	Swan river myrtle			
Kunzea glabrescens				
* Leptospermum laevigatum	Victorian t-tree			
Melaleuca cuticularis	Salt water paperbark			
Melaleuca huegelii subsp. huegelii	Chenille honeymyrtle			
Melaleuca nesophila Melaleuca rhaphiophylla	Swamp paperbark			
Melaleuca systena	Coastal honeymyrtle			
Regelia ciliata				
275 ONAGRACEAE				
* Oenothera drummondii subsp. drummondii	Beach evening primrose			
281 APIACEAE				
Apium annuum				
Centella asiatica				
Daucus glochidiatus	Australian carrot			
Eryngium pinnatifidum				
Homalosciadium homalocarpum				
Hydrocotyle ?tetragonocarpa				
Hydrocotyle sp.				
Trachymene coerulea subsp. coerulea	Blue laceflower			
Trachymene pilosa	Native parsnip			
Xanthosia ciliata				
288 EPACRIDACEAE				
Astroloma ciliatum	Candle cranberry			
Leucopogon parviflorus	Coast beard-heath			
Leucopogon propinquus				
293 PRIMULACEAE				
*Anagallis arvensis var. caerulea				
294 PLUMBAGINACEAE				

*Limonium sinuatum	Statice			
302 LOGANACEAE				
Logania vaginalis	White spray			
303 GENTIANACEAE				
* Centaurium tenuiflorum	Slender centaury			
304 APOCYNACEAE				
Alyxia buxifolia	Sea box, Dysentery bush			
307 CONVOLVULACEAE				
* Ipomoea cairica	mile-a-minute			
313 LAMIACEAE				
Hemiandra glabra subsp. glabra				
316 SCROPHULARIACEAE				
* Bellardia trixago	white bartsia			
* Dischisma arenarium				
* Parentucellia latifolia				
Veronica distans				
320 OROBANCHACEAE				
* Orobanche minor	Lesser broomrape			
326 MYOPORACEAE				
Eremophila glabra				
Myoporum insulare				
331 RUBIACEAE				
Opercularia hispidula	Hispid stinkweed			
Opercularia vaginata				
334 VALERIANACEAE				
*Centranthus macrosiphon	Pretty betsy			
340 LOBELIACEAE				
Isotoma hypocrateriformis				
Lobelia tenuior	Slender lobelia			
341 GOODENIACEAE				
Scaevola crassifolia	Thickleaved fanflower			

Scaevola nitida				
Scaevola repens var. repens				
343 STYLIDIACEAE (trigger plants)				
Stylidium schoenoides	Cow kicks			
345 ASTERACEAE				
*Arctotheca calendula	Capeweed			
Asteridea pulverulenta				
Brachyscome iberidifolia				
* Centaurea melitensis	Maltese cockspur			
* Conyza ?sumatrensis				
* Gazania linearis				
* Hypochaeris glabra				
Ixiolaena viscosa	Smooth catsear			
Lagenifera huegelii				
Millotia myosotidifolia				
Olearia axillaris	Coastal daisy bush			
* Osteospermum ecklonis				
Ozothamnus cordatus				
Podolepis canescens				
Podolepis gracilis				
Podolepis lessonii Podotheca gnaphalioides	Yellow Podotheca			
Rhodanthe citrina				
Senecio pinnatifolius				
* Sonchus oleraceus	Common sowthistle			
* Symphyrtrichum subulatum	Bushy starwort (=Aster subulatus)			
* Ursinia anthemoides				

APPENDIX 5. Site descriptions and species lists for the Caddadup reserve survey area

Note: sites recorded for mapping notes (incomplete site data) do not have a complete species list, but list representative species under 'Associtaed species'.

CADDADUP AREA B

Mandurah - **Site** CB01
Described by BRM **Date** 31/10/2004
Location Area B, Caddadup Reserve (west side of the Dawseville Bypass).
Photo 7 **on Roll** BM5(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371798mE, 6390025mN
Habitat Very gentle, east-facing slope of flat plain.
Soil Orange-brown sand.
Rock Type Moderate outcroppig of limestone.
Vegetation Hakea trifurcata scattered tall shrubs over Santalum acuminatum, Spyridium globulosum, Olearia axillaris shrubland to tall shrubland over Melaleuca systina, Allocasuarina humilis, Grevillea preissii subsp. preissii, Hibbertia hypericoides low shrubland over Desmocladus asper open sedgeland to sedgeland with Trachymene pilosa, Daucus glochidiatus, Lomandra maritima very open herbland.
Veg (BF) Very good. Weed cover moderate and god representation of species in strata.
Fire Age More than 7-10 years since fire.
Notes Releve recorded over approximately 10m x 10m and 30m x 30m area.
Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia cyclops	+		35cm	CB1-19	juvenile
	Acacia lasiocarpa var. lasiocarpa lasiocarpha	+		15cm	CB1-25	Acacia
	Allocasuarina humilis	1-2		90cm-		
	Anagallis arvensis var. caerulea	+		10cm		blue flr
	Austrostipa flavescens	+		40-70cm	CB1-12	
	Austrostipa					
	Briza maxima	+		15cm		
	Bromus diandrus	+		30cm	CB1-14	
	Cerastium glomeratum	+		12cm	CB1-27	dead herb
	Conostylis aculeata subsp. aculeata	+		20cm	CB1-23	
	Daucus glochidiatus	1-2		15cm	CB1-5	
	Desmocladus asper	15-20		20cm	CB1-3	
	Desmocladus flexuosus	+		15cm		
	Dryandra lindleyana var. lindleyana	+		15cm		
	Geranium solanderi	+		15cm	CB1-13	
	Grevillea preissii subsp. preissii	5-6		40-70cm	CB1-2	
	Hakea trifurcata	+		2.5-3m		
	Heliophila pusilla short	+		20cm	CB1-11	*wte flr
	Hibbertia hypericoides	5-6		30cm		
	Hibbertia racemosa	+		12cm	CB1-18	
	Hybanthus calycinus	+		20cm		
	Hypochaeris glabra	+		30cm		
	Lepidosperma pubisquameum	+		35cm	CB1-16	
	Lepidosperma					
	Leucopogon parviflorus	+		70cm	CB1-8	

Leucopogon				
Lobelia tenuior	+	20-30cm	CB1-28	
Logania sp.	+	40cm	CB1-22	Poor material
Lolium rigidum	15-20	30cm	CB1-9	
Lomandra maritima	1-2	20cm	CB1-6	
Lupinus cosentinii	+	35cm		
Luzula meridionalis	+	30cm	CB1-15	
Cyperaceae				
Melaleuca systena	10-12	70cm	CB1-7	
Olearia axillaris	3-5	1.3-2m		
Parietaria debilis	+	25cm	CB1-24	
Petrorhagia dubia	+	20cm		pink flr herb weed
Phyllanthus calycinus	+	30cm		
Poa poiformis	+	90cm	CB1-21	
Rhagodia baccata subsp. baccata	1-2	90cm	CB1-10	
Santalum acuminatum	2-3	1.8-2.3m	CB1-1	
Schoenus grandiflorus	+	15cm		
Sonchus oleraceus	+	12cm		
Spyridium globulosum	8-10	1.2-2m		
Trachymene pilosa	5-6	5-15cm	CB1-4	
Trifolium campestre var. campestre	5-6	10cm		
Xanthorrhoea preissii	+	1.1m	CB1-20	
Acacia cochlearis	+	1.3m		
Kennedia prostrata	+	30cm		
Pimelea calcicola	+	35cm		
Senecio pinnatifolius	+		=CBGC1	
Templetonia retusa	+	80cm		

Mandurah - **Site** CB02
Described by BRM **Date** 1/11/2004
Location SE corner of Area B, Caddadup Reserve (west side of Dawesville Bypass).
Air Photo **Photo** 7 **on Roll** BM7 **Video** N **E Photo**
Photo Notes
AMG Zone 50 371882mE, 6390036mN
Habitat Edge of flat plain between sand dunes.
Soil Pale brown sand.
Rock Type
Vegetation Acacia rostellifera, (Spyridium globulosum, Olearia axillaris, Santalum acuminatum) closed heath to closed scrub over hibbertia hypericoides, Melaleuca systena low open shrubland to low shrubland over Desmocladus asper scattered sedges with Lomandra maritima, Trachymene pilosa open herbland.
Veg (BF) Excellent (to Pristine in small patches). Moderate weed cover.
Fire Age Estimated more than 7-10 years since fire.
Notes Releve recorded over approximately 10m x 10m and 30m x 30m area. No evidence of dieback. Not a very good search in the 30x30 because scrub very thick.
Rock Pile
Species List:

Quad Name	Cove	C Class	Height	Specimen	Notes
Acacia rostellifera	70-80		1.2-2.5m	CB2-1	
Anagallis arvensis var. caerulea	+				blue flr
Austrostipa macalpinei	+		1.3m	CB2-4	
Austrostipa					
Avena barbata	+		70cm		

Briza maxima	+	30cm		
Briza minor	+	20cm		
Bromus diandrus	+	35cm	=CB1-14	
Caladenia latifolia	+	12cm	=CBGC2	
Calandrinia liniflora	+	3cm	=CBGC3	
Calandrinia				
Cerastium glomeratum	+	15cm	=CB1-27	dead herb
Conostylis aculeata subsp. aculeata	+	20cm	=CB1-23	
Daucus glochidiatus	+	15cm	=CB1-5	fine lobe
herb				
Daviesia decurrens	+	35cm	CB2-12	dead
Daviesia broad leaf				
Daviesia divaricata subsp. divaricata	+	45cm	CB2-11	Daviesia
Desmocladus asper	5-8	15cm	=CB1-3	
Dianella revoluta var. divaricata	+	30cm		no flr
spikes				
Dischisma arenarium	+	3cm	CB2-5	
Dryandra lindleyana var. lindleyana	+	15cm		undergrd
stem				
Ehrharta longiflora	+	35cm		
Gompholobium tomentosum	+	40cm		
Heliophila pusilla	+		=CB1-11	Wte flr
Brasicacaea				
Hibbertia hypericoides	10-15	30-40cm		
Hibbertia racemosa	+	20cm	=CB1-18	
Homalosciadium homalocarpum	+	3cm	CB2-3	small
green herb				
Hybanthus calycinus	+	25cm		
Hypochaeris glabra	+	20cm		
Leucopogon parviflorus	+	70cm	=CB1-8	
Leucopogon				
Lobelia tenuior	+	20cm	=CB1-28	
Lolium rigidum	2-4	30cm	=CB1-9	rye grass
Lomandra maritima	1-2	30cm	=CB1-6	
Melaleuca systena	5-8	40-60cm	=CB1-7	
Millotia myosotidifolia	+	3cm	CB2-6	small
white daisy				
Olearia axillaris	1	1.8-2.5m		
Orobanche minor	+	10cm		
Parietaria debilis	+	35cm	CB2-10	red stem
ovate leaf herb				
Petrorhagia dubia	+	30cm		Pink flr
hern wear				
Phyllanthus calycinus	1-2	35cm		
Poa drummondiana	+	80cm	CB2-9	tall grass
Poranthera microphylla	+	5cm	CB2-13	small
green herb				
Rhagodia baccata subsp. baccata	1	70cm	CB2-2	
Santalum acuminatum	2-3	1.9-2.2m	=CB1-1	
Schoenus grandiflorus	+	30cm		
Sonchus oleraceus	+	20cm		
Sowerbaea laxiflora	+	35cm		
Spyridium globulosum	3-5	2-3		
Stenopetalum gracile	+	35cm	CB2-7	
Trachymene pilosa	5-10	12cm	=CB1-4	
Trachemene wide lf lobe				

Trifolium campestre var. campestre	+	12cm		
Vulpia muralis	+	12cm	CB2-8	Vulpia grass
Xanthorrhoea preissii	+	1.5m		
Acacia cochlearis	+	2.5m		
Allocasuarina humilis	+			
Ptilotus drummondii var. drummondii	+	30cm		

Mandurah - **Site** CB03
Described by BRM **Date** 1/11/2004
Location Caddadup Area B.
Photo 1,2 **on Roll** BM8(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371817mE, 6390120mN
Habitat Northern edge of flat plain at the base of a loe ridge (dune).
Soil Pale brown sand.
Rock Type .
Vegetation Acacia rostellifera, Spyridium globulosum, Olearia axillaris high open scrub over Rhagodia baccata subsp. baccata scattered shrubs over Melaleuca systina, Grevillea preissii subsp. preissii low open shrubland over Desmocladus asper, Desmocladus flexuosus very open sedgeland with Acanthocarpus preissii very open herbland.
Veg Cond (BF) Excellent. Moderate weed cover, especially in open patches of vegetation.
Fire Age:
Notes Incomplete flora list.
Assoc. species: Lobelia tenuior, Tricoryne elatior, Lomandra maritime, Daucus glochidiatus, Trachymene pilosa, Caladenia latifolia, Lepidosperma pubisquameum, Daviesia divaricata subsp. divaricata, Pterostylis nana complex.

Mandurah - **Site** CB04
Described by BRM **Date** 1/11/2004
Location west side of Area B.
Photo 8,9 **on Roll** BM7(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371934mE, 6390220mN
Habitat swale between dune ridges
Soil white calcareous sand.
Rock Type .
Vegetation Acacia rostellifera, (Spyridium globulosum) open to closed scrub over Olearia axillaris, Rhagodia baccata subsp. baccata scattered shrubs over Austrostipa flavescens grassland with Acanthocarpus preissii scattered to very open herbland.
Veg (BF) Excellent to Pristine.
Fire Age
Notes Incomplete flora list.
Assoc. species: Phyllanthus calycinus, Daucus glochidiatus, Hardenbergia comptoniana, Poa poiformis, Parietaria debilis, Lobelia tenuior, Adriana quadripartita, Cassytha racemosa, Caladenia latifolia.

Mandurah - **Site** CB05
Described by BRM **Date** 1/11/2004
Location West side of Area B.
Photo 10 **on Roll** BM7(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371882mE, 6390269mN
Habitat Swale between dunes.
Soil White calcareous sand.

Rock Type
Vegetation Acacia saligna scattered tall shrubs to high open shrubland over Acacia rostellifera open to closed scrub over Spyridium globulosum, Olearia axillaris scattered shrubs to scattered tall shrubs over Trymalium ledifolium var. ledifolium scattered low shrubs over Desmocladus asper very open sedgeland with Acanthocarpus preissii, Lomandra maritima very open herbland Austrostipa flavescens scattered grasses.
Veg (BF) Excellent. Moderate weed cover.
Fire Age More than 7 years since fire.
Notes Incomplete flora list.
Assoc. species: Lobelia tenuior, Daucus glochidiatus, Caladenia latifolia, Conostylis candicans, *Lolium rigidum, Trachymene pilosa.

Mandurah - **Site** CB06
Described by BRM **Date:** 1/11/04
Location
Air Photo **Photo** 5 **on Roll** BM8 **Video** N **E Photo**
Photo Notes
AMG Zone 50 371803mE, 6390444mN
Habitat Moderate, south-facing lower slope of dune.
Soil Grey sand.
Rock Type
Vegetation Eucalyptus gomphocephala open forest over Agonis flexuosa low open forest over Spyridium globulosum high open shrubland over Lepidosperma gladiatum open sedgeland to sedgeland with Acanthocarpus preissii, Parietaria debilis very open herbland and Lolium rigidum grassland.
Veg (BF) Very good. High weed cover.
Fire Age
Notes Releve recorded over approximately 10m x 10m and 30 30m area. No evidence of dieback. No dieback symptoms.
Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acanthocarpus preissii	3-4		40cm		
	Agonis flexuosa	50-60		4-8m		
	Anagallis arvensis var. caerulea	+		12cm		blue flr
	Bromus diandrus	+		25cm	=CB1-14	
	Caladenia latifolia	+		5cm	CB6-7	
	Centella asiatica	2-3		5cm	CB6-3	
	Daucus glochidiatus	1-2		12cm	=CB1-5	
	Dichopogon capillipes	1-2		15cm		
	Ehrharta longiflora	5-10		30cm		
	Eucalyptus gomphocephala	40-50		20-25m		
	Geranium solanderi	+		20cm	CB6-5	
	Hardenbergia comptoniana	+		3m		
	Lagurus ovatus	+		30cm		
	Lepidosperma gladiatum	25-30		1.3m	CB6-1	
	Leucopogon parviflorus	+		90cm	=CB1-8	
	Leucopogon					
	Lobelia tenuior	+		25cm	=CB1-28	Lobelia
	Lolium rigidum	15-20			CB6-2	rye grass
	Olearia axillaris	+		50cm		
	Orobanche minor	+		12cm	CB6-4	
	Oxalis corniculata	+		15cm	CB6-8	
	Parietaria debilis	1-2		40-50cm	=CB1-24	red stem

herb

Rhagodia baccata subsp. baccata	2-3	50cm	CB6-6	
Spyridium globulosum	5-8	2.5m		
Caladenia latifolia	+		CB6-10	orchid
Hibbertia cuneiformis	+	2.1m	CB6-9	

Mandurah - **Site** CB07
Described by BRM **Date** 2/11/2004
Location .central south part of Area B.
Photo 10 **on Roll** BM8(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371569mE, 6390017mN
Habitat Flat plain near base (east of) of dunes.
Soil Yellow-brown sand.
Rock Type
Vegetation Acacia rostellifera, Spyridium globulosum, (Hakea trifurcata) open to closed scrub over Rhagodia baccata subsp. baccata open shrubland over Melaleuca systina, Grevillea preissii subsp. preissii scattered low shrubs to low open shrubland over Trachymene pilosa, Daucus glochidiatus, Lomandra maritime open herbland and Lepidosperma pubisqameum scattered sedges with *Lolium rigidum very open annual grassland.
Veg Cond (BF) Excellent. Moderate weed cover; native herb/grass layer present.
Dieback: no symptoms observed.
Fire Age More than 7 years since last fire.
Notes Incomplete flora list.
Assoc. species: Hibbertia hypericoides, Carex preissii, Lobelia tenuior, Caladenia latifolia, Acacia truncata (Sand dune variant), Acanthocarpus preissii, Poa poiformis, Calandrinia liniflora.

Mandurah - **Site** CB08
Described by BRM **Date** 2/11/2004
Location Caddadup Reserve, west of the Dawesville Bypass. SW of the water treatment plant.
Air Photo **Photo** 11 **on Roll** BM8 **Video** N **E Photo**
Photo Notes
AMG Zone 50 371462mE, 6390099mN
Habitat Moderate, south-facing mid slope of low ridge (dune).
Soil Pale grey sand (calcarious).
Rock Type
Vegetation Agonis flexuosa open forest over Spyridium globulosum high open shrubland over Hibbertia cuneiformis, Leucopogon parviflorus open shrubland over Trymalium ledifolium var ledifolium
low open shrubland over *Lolium rigidum open grassland to grassland and Centella asiatica, Daucus glochidiatus open herbland.
Veg (BF) Very Good to Excellent. Moderate to high rye grass cover.
Fire Age Estimated more than 7 years since last fire.
Notes Releve recorded over approximately 10m x 10m and 30x30m area. No evidence of dieback. No dieback symptoms.
Much of soil covered by moss, where vegetation/soil undisturbed. In these areas there is a good herb layer.
Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia rostellifera	1-2		1.5m		
	Acacia saligna	+		3.5m		
	Acanthocarpus preissii	+		35cm		
	Agonis flexuosa	60		8-12m		

Alyxia buxifolia	+	(80cm)3m		CB8-2
?Alyxia				
Anagallis arvensis var. caerulea	+	10cm		blue flr
Apium annuum	3-5	5-15cm	CB8-3	herb,
celery lf, glabrous				
Austrostipa flavescens	+	1.2m	CB8-8	
Austrostipa				
Caladenia latifolia	+	15cm	=CB6-10	
Calandrinia brevipedata	+	3cm	=CBGC33	
Calandrinia prostrate				
Carex preissii	+	35cm	CB8-9	
Centella asiatica	5-10	3-5cm	=CB6-3	
Cerastium glomeratum	+		=CB1-27	dead herb
Daucus glochidiatus	3-5	15cm	=CB1-5	
Desmocladus asper	+	12cm		
Dichopogon capillipes	+	10cm		
Dischisma arenarium	+	5cm	=CB2-5	
Geranium solanderi	+	20cm	=CBGC31	
Hardenbergia comptoniana	+	2-4m		
Hibbertia cuneiformis	3-4	1.1(2.5)m	=CB6-9	
Hydrocotyle ?tetragonocarpa	+	3cm	CB8-5	maple leaf
herb				
Isolepis stellata	+	4cm	CB8-4	?Isolepis
Lepidosperma gladiatum	+	70cm	=CB6-1	
Leucopogon parviflorus	+	80cm	=CB1-8	
Leucopogon				
Lobelia tenuior	+	20cm	=CB1-28	
Lolium rigidum	15-20	40cm	=CB6-2	
Lomandra maritima	+	30cm	=CB1-6	
Orobanche minor	+	12cm	=CB6-4	
Parietaria debilis	+		=CB1-24	red stem
herb				
Phyllanthus calycinus	+	30cm		
Rhagodia baccata subsp. baccata	1-2	80cm	=CB6-6	
Rhodanthe citrina	+	12cm	CB8-6	yellow
daisy				
Sonchus oleraceus	+	65cm		
Spyridium globulosum	10-15	2-4m		
Trymalium ledifolium var. ledifolium	4-5	60cm(1.3	CB8-1	
Fumaria capreolata	+	25cm	CB8-7	

Mandurah - **Site** CB09
Described by BRM **Date** 2/11/2004
Location .most southern part of Area B.
Photo 12 **on Roll** BM8 **Video** N **E Photo**
Photo Notes
AMG Zone 50 371623mE, 6390110mN.
Habitat Moderate, south-facing midslope of low dune.
Soil White calcareous sand.
Rock Type
Vegetation Acacia rostellifera, Olearia axillaris, Spyridium globulosum shrubland to open heath over Leucopogon parviflorus, Rhagodia baccata subsp. baccata, Acacia cyclops scattered shrubs over Lomandra maritime, Acanthocarpus preissii open herbland with *Lololium rigidum very open grassland.
Veg Cond (BF) Excellent (Pristine in places). Low to moderate weed cover; moss and herb layersstill intact.

Dieback: no symptoms observed.
Fire Age More than 7 years since fire.
Notes Incomplete flora list.
Assoc. species: Daucus glochidiatus, Podolepis gracilis, *Heliophila pusilla, *Dischisma arenarium, Rhodanthe citrine, Parietaria debilis, Wurmbea monantha, Caladenia latifolia, Conostylis candicans, Alyogyne huegelii var. huegelii, Lepidosperma pubisqameum, Lobelia tenuior, Austrostipa flavescens.

Mandurah - **Site** CB10
Described by BRM **Date** 2/11/2004
Location .south side of Area B.
Photo 13 **on Roll** BM8(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 ?
Habitat Steep, south-east-facing mid slope of low ridge (dune).
Soil White calcareous sand.
Rock Type
Vegetation Acacia rostellifera high open shrubland over Spyridium globulosum, Olearia axillaris open shrubland over Rhagodia baccata subsp. baccata low open shrubland over Austrostipa flavescens, *Lolium rigidum grassland and Lepidosperma pubisqameum scattered sedges with Rhodanthe citrine, Podolepis gracilis, Acanthocarpus preissii, Lomandra maritima very open herbland.
Veg Cond (BF) Very Good. Moderate cover of rye grass. Moss cover on soil surface mostly intact.
Fire Age More than 5 years since fire.
Notes Incomplete flora list.
Assoc. species: Poa porphyroclados, *Bromus diandrus, Adriana quadripartita, Daucus glochidiatus, Caladenia latifolia, Trachymene pilosa, Phyllanthus calycinus.

Mandurah - **Site** CB11
Described by BRM **Date** 2/11/2004
Location West side of water treatment plant, Caddadup-west
Air Photo **Photo** 14 **on Roll** BM8 **Video** N **E Photo**
Photo Notes
AMG Zone 50 371769mE, 6390302mN.
Habitat Moderate, west-facing mid-slope of low dune.
Soil White calcareous sand (Quindalup).
Rock Type
Vegetatio Acacia saligna scattered tall shrubs over Olearia axillaris, Spyridium globulosum open shrubland to high open shrubland over Diplolaena dampieri shrubland over Trymalium ledifolium var. ledifolium, (Rhagodia baccata subsp. baccata) low open shrubland to low shrubland over *Lolium rigidum annual open grassland with Acanthocarpus preissii, Lomandra maritima open herbland.
Veg (BF) Very Good. Moderate rye grass cover. Large areas with moss intact on sand
Fire Age More than 5 years since last fire.
Notes Releve recorded over approximately 10m x 10m and 30 x 30m area. No evidence of dieback.
Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia lasiocarpa var. lasiocarpa lasiocarpha	+		20cm	CB11-7	Acacia
	Acacia saligna	+		3-5m		
	Acanthocarpus preissii	5-7		40cm		
	Austrostipa macalpinei	1-2		90cm	CB11-4	Ausrostipa
	Bromus diandrus	1		30cm	=CB1-14	
	Caladenia latifolia	+		15cm	CB11-5	Thelymitra

Conostylis candicans	+	12cm		
Crassula glomerata	+	3cm		
Daucus glochidiatus	+	5cm	=CB1-5	
Desmocladus asper	+	12cm		
Diplolaena dampieri	15	1.3m	CB11-1	
Dischisma arenarium	+	4cm	=CB2-5	
Isolepis stellata	+	3cm		Isolepis
Lepidosperma pubisquameum	+	30cm	CB11-10	
Lepidosperma				
Leucopogon parviflorus	+	35cm	=CB1-	
Leucopogon				
Lolium rigidum	20-25	30cm		
Lomandra maritima	2-3	30cm		
Olearia axillaris	5-6	1-2m		
Opercularia vaginata	+	20cm	CB11-6	
Poa porphyroclados	+	60cm	=CB10-3	Poa
Podolepis gracilis	+	12cm	=CB9-1	white
daisy				
Podotheca gnaphalioides	+	10cm	=CBGC34	Podotheca
Rhagodia baccata subsp. baccata	1	35cm	CB11-3	
Senecio pinnatifolius	+	25cm		Senecio
Spyridium globulosum	1-2	1.8m		
Trachyandra divaricata	+	30cm		Tracyandra
divaricata				
Trachymene pilosa	+	5-12cm	=CB1-4	
Trachymene broad lobe				
Trymalium ledifolium var. ledifolium	7-8	40-60cm	CB11-2	
Acacia rostellifera	+			
Acacia truncata	+		CB11-8	
Hardenbergia comptoniana	+			
Poranthera microphylla	+		CB11-9	herb
Rhodanthe citrina	+		=CB8-6	yellow
daisy				

Mandurah - **Site** CB11b
Described by BRM **Date** 2/11/2004
Location Just west of Pistol shooting club.
Photo 18 **on Roll** BM8(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371849mE, 6390537mN.
Habitat North-west facing steep slope of dune.
Soil White calcareous sand.
Rock Type
Vegetation Eucalyptus gomphocephala scattered trees over Agonis flexuosa scattered low trees over Acacia rostellifera scattered tall shrubs over Olearia axillaris scattered shrubs over Diplolaena dampieri open heath over Acanthocarpus preissii, Lomandra maritima open herbland and *Lolium rigidum very open grassland.
Veg Cond (BF) Excellent. Moderate rye grass cover.
Fire Age
Notes Incomplete flora list.
Assoc. species: Leucopogon parviflorus, Acacia cochlearis, Trachymene pilosa, Conostylis candicans, Daucus glochidiatus, Phyllanthus calycinus.

Mandurah - **Site** CB11c

Described by BRM **Date** 20/11/2004
Location .Just west of Pistol shooting club.
Photo **on Roll** **Video** N **E Photo**
Photo Notes
AMG Zone 50 371831mE, 6390652mN.
Habitat Moderate to steep, north-facing, lower slope of high sand dune.
Soil White calcareous sand.
Rock Type
Vegetation Eucalyptus gomphocephala open forest over Agonis flexuosa low woodland over Spyridium globulosum high open shrubland to scattered tall shrubs over Diplolaena dampieri shrubland over *Lolium rigidum, Lepidosperma gladiatum very open annual grassland/sedgeland with Acanthocarpus preissii, (Lomandra maritima) herbland.
Veg Cond (BF) Excellent.
Dieback: No symptoms observed.
Fire Age 5 to 10 years since fire.
Notes Incomplete flora list.
Assoc. species: Lobelia tenuior, *Lagurus obovatus, *Anagallis arvensis, Olearia axillaris, Rhagodia baccata subsp. baccata, Austrostipa flavescens, Daucus glochidiatus, *Dischisma arenarium.

Mandurah - **Site** CB12
Described by BRM **Date** 4/11/2004
Location Just east of Water Treatment Plant.
Photo 15, 16 **on Roll** BM8 **Video** N **E Photo**
Photo Notes
AMG Zone 50 371831mE, 6390290mN
Habitat Steep, east-facing mid-slope of moderately high sand dune.
Soil White calcareous sand.
Rock Type
Vegetation Acacia saligna scattered low trees over Spyridium globulosum high open shrubland over Acacia truncata (Sand dune variant), (Olearia axillaris) open heath over Trymalium ledifolium var. ledifolium, Rhagodia baccata subsp. baccata, Leucopogon parviflorus shrubland over *Lolium rigidum, (Austrostipa macalpinei), Poa porphyroclados very open grassland with Acanthocarpus preissii, Lomandra maritima very open herbland.
Veg Cond (BF) .Excellent.
Fire Age
Notes Incomplete flora list.
Assoc. species: Acacia rostellifera, Adriana quadripartita, Exocarpos sparteus, Jacksonia furcellata, Daucus glochidiatus, Podolepis gracilis, Rhodanthe citrina, Lobelia tenuior, Conostylis candicans.

Mandurah - **Site** CB13
Described by BRM **Date** 20/11/2004
Location .western end of Pistol Shooting Club.
Photo **on Roll** **Video** N **E Photo**
Photo Notes
AMG Zone 50 371832mE, 6390700mN.
Habitat Crest and upper slopes of dunes.
Soil Grey sand.
Rock Type
Vegetation Eucalyptus gomphocephala woodland to open forest over Agonis flexuosa low open forest over Spyridium globulosum high open shrubland over Rhagodia baccata subsp. baccata, Olearia axillaris scattered shrubs over *Lolium rigidum, *Lagurus ovatus open annual grassland with Acanthocarpus preissii, (Lomandra maritima) herbland.
Veg Cond (BF) Very Good to Excellent. Moderate to high weed cover, but still some herbs
Dieback: No symptoms observed.

Fire Age More thn 5 to 7 years since fire.
Notes Incomplete flora list.
Assoc. species: Lobelia tenuior, Ficinia nodosa, Hardenbergia comptoniana, Austrostipa flavescens, Daucus glochidiatus, *Vulpia fasciculate, Trachymene pilosa, Comesperma integerrimum, Lepidosperma gladiatum, Leucopogon parviflorus, *Ehrhart longiflora, *Euphorbia terracina.

Mandurah - **Site** CB14
Described by BRM **Date** 21/11/2004
Location Middle of Caddadup Area B, just NW of the Water Treatment Plant and on a slope below and
on the west side of an old point on the crest of a sand dune. Just east of the prsent golf course.
Air Photo **Photo** 37 **on Roll** BM9 **Video** N **E Photo**
Photo Notes
AMG Zone 50 371603mE, 6390621mN.
Habitat Steep, west-facing slope of high sand dune.
Soil White calcareous sand.
Rock Type
Vegetation Agonis flexuosa scattered low trees over Jacksonia furcellata scattered tall shrubs over Olearia axillaris open shrubland over Diplolaena dampieri low open shrubland over Austrostipa flavescens, Lepidosperma gladiatum scattered grasses and sedges with Acanthocarpus preissii, Lomandra maritima herbland.
Veg (BF) Excellent to Pristine. Low weed cover. The slope may have been partially cleared of Agonis flexuosa for viewing purposes.
Dieback: No evidence of dieback.
Fire Age More than 5 to 7 years since last fire.
Notes Releve recorded over approximately 10m x 10m area only.
Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia lasiocarpa var. lasiocarpa	+		20cm		
	Acacia truncata	+		40cm	=CB12-1	
	Acanthocarpus preissii	20-30		30-40cm		
	Agonis flexuosa	+		3.5m		
	Austrostipa flavescens	+		40-80cm	CB14-3	
	Austrostipa					
	Bromus diandrus	1		20cm		
	Conostylis candicans	+		15cm	CB14-9	
	Desmocladus asper	+		15cm	CB14-11	
	Diplolaena dampieri	3-5		70cm(1.1	CB14-2	
	Disclisma arenarium	+		5cm	=CB2-5	
	Hemiandra glabra subsp. glabra	+		10cm	CB14-8	Hemiandra
	Hibbertia racemosa	+		10cm	CB14-6	
	Isolepis stellata	+		4cm	CB14-13	Isolepis
	Jacksonia furcellata	+		2.5m	CB14-1	
	Lepidosperma gladiatum	+		60cm	CB14-4	
	Lepidosperma wide leaf					
	Lolium rigidum	+		30cm		
	Lomandra maritima	5-6		30-35cm	(=CB13-1)	
	Lomandra					
	Olearia axillaris	5-10		1.3m		
	Opercularia vaginata	1-2		15cm	CB14-5	
	Phyllanthus calycinus	+		35cm		
	Rhagodia baccata subsp. baccata	+		40cm		Rhagodia
	Schoenus grandiflorus	+		12cm	CB14-15	

Senecio pinnatifolius	+	25cm	CB14-10	Senecio
Spyridium globulosum	+	70cm		
Threlkeldia diffusa	+	20cm	CB14-14	Chenopod
Vulpia fasciculata	+	20cm	CB14-7	grass

Mandurah - **Site** CB15
Described by BRM **Date** 21/11/2004
Location just East of golf course.
Photo 36 **on Roll** BM9(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371603mE, 6390545mN
Habitat Gently sloping, West-facing crest of low ridge (dune).
Soil White calcareous sand.
Rock Type
Vegetation Agonis flexuosa low woodland over Spyridium globulosum, Olearia axillaris high open shrubland over Diplolaena dampieri, (Trymalium ledifolium var. ledifolium) open shrubland over *Lolium rigidum, Desmocladus asper open grassland/sedgeland with Daucus glochidiatus, Lomandra maritima very open herbland.
Veg Cond (BF) Excellent. Moderate cover of rye grass.
Dieback: No symptoms observed.
Fire Age More than 5 to 7 years since last fires.
Notes Incomplete flora list.
Assoc. species: Santalum acuminatum, Acacia truncata (Sand dune variant), Acanthocarpus preissii, Acacia rostellifera, Podolepis gracilis, Opercularia vaginata, Conostylis candicans, *Crassula glomerata, *Dischisma arenarium.

Mandurah - **Site** CB16
Described by BRM **Date** 21/11/2004
Location .Golf course, near northern end.
Photo n.a. **on Roll** **Video** N **E Photo**
Photo Notes
AMG Zone 50 371461mE, 6390690mN.
Habitat Swale between dunes.
Soil Grey sand.
Rock Type
Vegetation Agonis flexuosa low closed forest over Melaleuca huegelii subsp. huegelii, Spyridium globulosum high open shrubland to high shrubland over *Ehrharta longiflora annual grassland.
Veg Cond (BF) Good to Very Good..
Fire Age
Notes Incomplete flora list.
Assoc. species: Anagallis arvensis var. caerulea, Lobelia temuior, Parietaria debilis, *Solanum nigrum, Lepidosperma gladiatum, Alyxia buxifolia, Hibbertia cuneiformis, Acanthocarpus preissii.

Mandurah - **Site** CB17
Described by BRM **Date** 21/11/2004
Location Just East of golfcourse.
Photo na **on Roll** **Video** N **E Photo**
Photo Notes
AMG Zone 50 371387mE, 6390505mN.
Habitat Swale
Soil White calcareous sand.
Rock Type
Vegetation Agonis flexuosa open to closed forest over Spyridium globulosum high open shrubland to

open scrub over Rhagodia baccata subsp. baccata scattered shrubs over Austrostipa flavescens, *Lolium rigidum grassland with Acanthocarpus preissii, Daucus glochidiatus very open herbland
Veg Cond (BF) Excellent. Moderate cover of rye grass..
Dieback: no symptoms observed.
Fire Age More than 7 years since fire.
Notes Incomplete flora list.
Assoc. species: Hardenbergia comptoniana, Lobelia tenuior, Caladenia latifolia, Clematis linearifolia, Lepidosperma gladiatum, Senecio pinnatifolius.

Mandurah - **Site** CB18
Described by BRM **Date** 26/11/2004
Location Foredune on beach, Caddadup west.
Air Photo **Photo** 6 **on Roll** BM10(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 370883mE, 6390084mN
Habitat Crest and slope of very low foredune.
Soil White calcareous sand.
Rock Type
Vegetation *Cakile maritima low open shrubland over Spinifex hirsutus grassland.
Veg (BF) Very Good. Numerous weeds.
Dieback: No symptoms observed.
Fire Age
Notes Releve recorded over approximately 10m x 10m area only.
This was a very narrow vegetation unit (about 5m wide).
Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Avena barbata	+		20cm		
	Briza minor	+				
	Bromus diandrus	+		20cm		
	Cakile maritima	5-10		30cm	CB18-1	
	Ehrharta longiflora	+				
	Euphorbia paralias	+		30cm	CB18-3	Euphorbia
	Ficinia nodosa	+		50cm	CB18-4	
	Pelargonium capitatum	+		20cm	CB18-6	
	Sonchus oleraceus	+		5cm		
	Spinifex hirsutus	30-40		30-40cm	CB18-2	
	Tetragonia decumbens	+		20cm	CB18-5	
	Trachyandra divaricata	+		35cm		prostrate leaves

Mandurah - **Site** CB19
Described by BRM **Date** 26/11/2004
Location .SW corner of Area B.
Photo 7 **on Roll** BM10(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 370929mE, 6390012mN
Habitat Swale behind first low dunes
Soil White calcareous sand.
Rock Type
Vegetation Acacia saligna shrubland over Olearia axillaris, Scaevola crassifolia low shrubland over Ficinia nodosa scattered sedges and *Avena barbata, *Bromus diandrus annual grassland with *Trachyandra divaricata very open herbland.
Veg Cond (BF) Good to Very Good. High weed cover.

Fire Age More than 4 to 5 years since last fire.
Notes Incomplete flora list.
Assoc. species: Conostylis candicans, *Oenothera drummondii, *Pelargonium capitatum, Acanthocarpus preissii, *Tetragonia decumbens .

Mandurah - **Site** CB20
Described by BRM **Date** 26/11/2004
Location SW corner of Area B.
Photo 8 **on Roll** BM10(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 370894mE, 6390021mN.
Habitat Crest and lower slopes of first dune.
Soil White calcareous sand.
Rock Type
Vegetation Olearia axillaris open to closed scrub over *Tetragonia decumbens , *Cakile maritime, *Pelargonium capitatum, *Oenothera drummondii subsp. drummondii low open shrubland over Ficinia nodosa scattered to very open sedges.
Veg Cond (BF) Excellent.
Dieback: no symptoms observed.
Fire Age More than 5 years since last fire.
Notes Incomplete flora list.
Assoc. species: *Lagurus ovatus, Spinifex longifolius, *Ammophila arenaria, *Vulpia fasciculate, *Trachyandra divaricata.

Mandurah - **Site** **CB21**
Described by BRM **Date** 27/11/2004
Location South end of golf course area, Area B.
Photo 9,10 **on Roll** BM10(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371002mE, 6390022mN
Habitat Crest and slopes of high foredune.
Soil White calcareous sand.
Rock Type
Vegetation Olearia axillaris, Spyridium globulosum shrubland to open heath over Scaevola crassifolia, Rhagodia baccata subsp. baccata low open shrubland over *Tetragonia decumbens low open shrubland to low shrubland over *Ammophila arenaria open grassland to grassland (forms closed grassland in patches on some slopes) and Ficinia nodosa scattered sedges with Cassytha racemosa very open lianes.
Veg Cond (BF) Very Good toExcellent. Medium to high weed cover.
Fire Age Mor e than 5 years since fire.
Notes Incomplete flora list.
Assoc. species: *Avena barbata, *Trachyandra divaricata, *Bromus diandrus, *Ehrharta longiflora, *Cakile maritime, *Pelargonium capitatum, *Oenothera drummondii subsp. drummondii, Threlkeldia diffusa, Senecio pinnatifolius.

Mandurah - **Site** CB22
Described by BRM **Date** 27/11/2004
Location .beach-side of golf course.
Photo 11,12 **on Roll** BM10(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 370935mE, 6390228mN
Habitat Dampland in narrow flat swale behind foredunes.
Soil White calcareous sand.
Rock Type
Vegetation Melaleuca cuticularis scattered shrubs over *Oenothera drummondii subsp. drummondii,

*Pelargonium capitatum low open shrubland over Ficinia nodosa, Isolepis stellata sedgeland and *Vulpia fasciculate scaterred grasses with *Centaurium tenuiflorum, *Crassula glomerata open herbland.
Veg Cond (BF) Very Good to Excellent. Weeds include *Oenothera drummondii subsp. drummondii, *Crassula glomerata, *Pelargonium capitatum.
Fire Age
Notes Incomplete flora list.
Assoc. species: *Cynodon dactylon, Appium annuum, *Ammophila arenaria, *Symphotrichum subulatum, *Polypogon monspeliensis.

Mandurah - **Site** CB23
Described by BRM **Date** 27/11/2004
Location west side of Caddadup west.
Air Photo **Photo** 13 **on Roll** BM10(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371077mE, 6390254mN.
Habitat Steep, west-facing slope of high dune.
Soil White calcareous sand.
Rock Type
Vegetation Olearia axillaris, Acacia rostellifera, (Myoporum insulare open shrubland to shrubland over Scaevola crassifolia, (*Pelargonium capitatum) low shrubland to low open heath over Ficinia nodosa scattered sedges to very open sedgeland.
Veg Excellent to Pristine.
Fire Age More than 5 years since fire.
Notes Releve recorded over approximately 10m x 10m and 30 x 30m area. No evidence of dieback.

Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia rostellifera	5-6		(60cm)1.3m	CB23-1	
	Acanthocarpus preissii	+		20cm		
	Bromus diandrus	+			CB23-5	
	Carpobrotus virescens	+		40cm		pink flr
pigface						
	Conostylis candicans	+		15cm		
	Crassula glomerata	+		3cm		
	Dischisma arenarium	+		5c	=CB2-	
	Ficinia nodosa	1-2		60-80cm	=CB18-4	
	Hardenbergia comptoniana	1-2		60cm		
	Leucopogon parviflorus	1		50cm	=CB13-8	
Leucopogon						
	Myoporum insulare	+		70cm	CB23-2	
	Olearia axillaris	10-12		1.1-1.6m		
	Pelargonium capitatum	2-3		40cm		
	Rhagodia baccata subsp. baccata	1-2		40cm	=CB21-1	
	Scaevola crassifolia	30-40		50-70cm	CB23-3	Scaevola
	Senecio pinnatifolius	+		60cm		Senecio
	Tetragonia decumbens	+		60cm	=CB18-5	
	Threlkeldia diffusa	+		35cm	=CB21-2	
	Jacksonia furcellata	+			CB23-4	

Mandurah - **Site** CB24
Described by BRM **Date** 27/11/2004
Location West side of golf course.

Air Photo **Photo** 14,15,16 **on Roll** BM10(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371090mE, 6390241mN
Habitat Steep east-facing upper slope and edge of crest of sand dune.
Soil White calcareous sand.
Rock Type
Vegetation Acacia rostellifera scattered tall shrubs over Myoporum insulare, Spyridium globulosum open shrubland to shrubland over Olearia axillaris, Rhagodia baccata subsp. baccata low open shrubland over Scaevola crassifolia low shrubland over Lepidosperma gladiatum very open sedgeland to open sedgeland with Acanthocarpus preissii very open herbland.
Veg (BF) Excellent to Pristine. Very few weeds.
Fire Age More than 5 to 7 years since fire.
Notes Releve recorded over approximately 10m x 10m and 30 x 30m area. No evidence of dieback.
Some minor variation in the vegetation in the 30x30m area because the site was part of an 'amphitheatre'
(curved) slope.
Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia rostellifera	+		2-4m		
	Acanthocarpus preissii	3-5		60cm		
	Alyxia buxifolia	1-2		60cm(1m)		CB24-3
	green shiny leaf					
	Crassula glomerata	+		3cm		
	Dischisma arenarium	+		5cm	=CB2-5	
	Hardenbergia comptoniana	+				
	Hemiandra glabra subsp. glabra	+		30cm	CB24-2	Hemiandra
	Lepidosperma gladiatum	5-		1-1.3m	CB24-1	
	Lepidosperma					
	Leucopogon parviflorus	+		80-90cm	=CB	
	Leucopogon					
	Myoporum insulare	5-10		1.5-1.8m	=CB23-2	
	Olearia axillaris	2-3		70cm		
	Pelargonium capitatum	+		15cm		
	Rhagodia baccata subsp. baccata	5-6		70cm	=CB21-1	
	Scaevola crassifolia	15-20			=CB23-3	Scaevola
	Senecio pinnatifolius	+		20cm	=CBGC54	Senecio
	Spyridium globulosum	3-5(5-		1.2-1.5m		
	Threlkeldia diffusa	2-3		40-50cm	=CB21-2	Chenopod
	Bromus diandrus	+				
	Carpobrotus virescens	+				
	Cassytha racemosa	+			=CB21-	Cassytha
	Hibbertia cuneiformis	+			CB24-5	
	Orobanche minor	+				
	Ozothamnus cordatus	+				Ozo daisy
	Poa poiformis	+		70cm	CB24-6	Poa
	Spinifex longifolius	+				
	Tetragonia implexicoma	+		60cm	CB24-7	

Mandurah - **Site** CB25
Described by BRM **Date** 27/11/2004
Location 80 metres north of CB24.
Photo n.a. **on Roll** **Video** N **E Photo**

Photo Notes
AMG Zone 50 371128mE, 6390360mN.
Habitat Steep, south-east facing lower to mid slope of low dune.
Soil White calcareous sand.
Rock Type
Vegetation Santalum acuminatum scattered tall shrubs over Spyridium globulosum high shrubland to oopen scrub over Scaevola crassifolia, Rhagodia baccata subsp. baccata, Hibbertia cuneiformis low shrubland over Lepidosperma gladiatum scattered to very open sedgeland with Acanthocarpus preissii very open herbland.
Veg Cond (BF) Excellent..
Fire Age More than 5 years since last fire.
Notes Incomplete flora list.
Assoc. species: Olearia axillaris, *Bromus diandrus, Diplolaena dampieri, Daucus glochidiatus, Senecio pinnatifolius, Carex preissii, *Lolium rigidum.

Mandurah - **Site** CB26
Described by BRM **Date** 27/11/2004
Location .200 metres east of beach on the southern boundary of Area B.
Photo 17 **on Roll** BM10(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371134mE, 6390002mN.
Habitat Moderate, West-facing mid to upper slope of dune.
Soil White calcareous sand.
Rock Type
Vegetation Olearia axxilaris, Spyridium globulosum, Acacia aff. rostellifera, Santalum acuminatum shrubland to open heath over Rhagodia baccata subsp. baccata scattered low shrubs over Austrostipa flavescens scattered grasses with Acanthocarpus preissii, Lomandra maritima very open herbland to oopen herbland.
Veg Cond (BF) Excellent toPristine. Very low weed cover.
Fire Age
Notes Incomplete flora list.
Assoc. species: Jacksonia furcellata, Trachymene pilosa, * Dischisma arenarium, Daucus glochidiatus, Senecio pinnatifolius, Desmocladus asper, Acacia Cyclops.

Mandurah - **Site** CB27
Described by BRM **Date** 27/11/2004
Location south-west corner of Area B.
Photo n.a. **on Roll** **Video** N **E Photo**
Photo Notes
AMG Zone 50 371141mE, 6390040mN.
Habitat Moderate, west-facing lower slopes of dune.
Soil White calcareous sand.
Rock Type
Vegetation Acacia aff. rostellifera high open shrubland over Spyridium globulosum, Olearia axillaris, Alyxia buxifolia, Leucopogon parviflorus shrubland to open heath over Rhagodia baccata subsp. baccata low open shrubland over Austrostipa flavescens scattered grasses with Acanthocarpus preissii, Lomandra maritima, Daucus glochidiatus open herbland.
Veg Cond (BF) Excellent to Pristine. Only scattered weeds.
Fire Age More than 5 to 7 years since fire.
Notes Incomplete flora list.
A lot of Spyridium globulosum dieback/death.
Assoc. species: Senecio pinnatifolius, *Crassula glomerata, Acacia cochlearis, Phyllanthus calycinus, Carex preissii.

Mandurah - **Site** CB28
Described by BRM **Date** 28/11/2004
Location .west side od Area B.
Photo n.a. **on Roll** **Video** N **E Photo**
Photo Notes
AMG Zone 50 371262mE, 6390142mN.
Habitat Moderate, north-facing mid slope of dune.
Soil White calcareous sand.
Rock Type
Vegetation Acacia saligna scattered low trees over Olearia axillaris, Spyridium globulosum, Santalum acuminatum open shrubland over Diplolaena dampieri, Acacia cochlearis low shrubland over Desmocladus asper, Lepidosperma pubisquameum very open sedgeland and *Lolium rigidum, Austrostipa flavescens, Poa porphyroclados very open grassland with Acanthocarpus preissii, Lomandra maritima open herbland.
Veg Cond (BF) Excellent. Moderate weed cover.
Fire Age More than 5 years since fire.
Notes Incomplete flora list.
Assoc. species: Rhagodia baccata subsp. baccata, Daucus glochidiatus, Leucopogon parviflorus, Acacia saligna, Acacia aff. rostellifera, Conostylis candicans, Acacia truncata (Sand dune variant).

Mandurah - **Site** CB29
Described by BRM **Date** 28/11/2004
Location 200 meres east of beach near south end of golf course.
Photo 20 **on Roll** BM10 **Video** N **E Photo**
Photo Notes: looking south.
AMG Zone 50 371160mE, 6390176mN.
Habitat Crest and upper slope of low dune.
Soil White calcareous sand.
Rock Type
Vegetation Olearia axillaris, (Acacia rostellifera) closed heath over *Pelargonium capitatum, Rhagodia baccata subsp. baccata low open shrubland over Ficinia nodosa scattered sedges with Cassytha racemosa open lianes.
Veg Cond (BF) excellent. *Pelargonium capitatum weeds.
Fire Age More than 3 to 5 years since fire.
Notes Incomplete flora list.
Assoc. species: Senecio pinnatifolius, *Bromus diandrus, Cassytha racemosa, *Crassula glomerata, Lepidosperma gladiatum, *Ammophila arenaria.

Mandurah - **Site** CB29a
Described by BRM **Date** 28/11/2004
Location NW side of golf course.
Photo 8 **on Roll** BM11 **Video** N **E Photo**
Photo Notes:
AMG Zone 50 371160mE, 6390600mN.
Habitat Crest and slopes, west-facing, of low dune, about 100 to 150 metres from beach.
Soil White calcareous sand.
Rock Type
Vegetation Olearia axillaries, (Spyridium globulosum) shrubland to open heath over Spinifex longifolius grassland to closed grassland with Ficinia nodosa scattered sedges.
Veg Cond (BF) Excellent to Pristine.
Fire Age More than 3 to 5 years since fire.
Notes Incomplete flora list. Only a few small areas of this unit. This recording site was largest of areas of this vegetation unit seen.
Assoc. species: Rhagodia baccata subsp. baccata; *Avena barbata, *Tetragona decumbens, *Oenothera

drummondii subsp. drummondii, *Lagurus ovatus, Senecio pinnatifolius, *Bromus diandrus, *Crassula glomerata.

Mandurah - **Site** CB30
Described by BRM **Date** 28/11/2004
Location .SW corner of Area B, south of golf course.
Photo 21 **on Roll** BM10(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371383mE, 6390101mN.
Habitat steep, south-facing lower to upper slope of dune.
Soil white calcareous sand.
Rock Type
Vegetation Santalum acuminatum high open shrubland over Olearia axillaris, Spyridium globulosum open shrubland to shrubland over Trymalium ledifolium var. ledifolium, Leucopogon parviflorus, Acacia truncata (Sand dune variant), Adriana quadripartita low shrubland over Desmocladus asper, Lepidosperma pubisquameum very open sedgeland with Lomandra maritima scattered herbs.
Veg Cond (BF) Excellent. Light weed cover of rye grass.
Fire Age More than 5 years since fire.
Notes Incomplete flora list.
Assoc. species: *Lolium rigidum, Acanthocarpus preissii, Rhagodia baccata subsp. baccata, Opercularia vaginatus, Scaevola crassifolia, Podolepis gracilis, Isotoma hypocrateriformis, Lobelia tenuior

Mandurah - **Site** CB31
Described by BRM **Date** 28/11/2004
Location Southern boundary of Area B, where it joins with Area F.
Photo 22 **on Roll** BM10(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371376mE, 6389949mN.
Habitat Edge of flat plain.
Soil Dark grey sand.
Rock Type
Vegetation Eucalyptus gomphocephala open forest over Melaleuca huegelii subsp. huegelii, (Spyridium globulosum) closed scrub over Carex preissii scattered sedges and Calandrinia brevipedata, (Parietaria debilis) herbland.
Veg Cond (BF) Excellent.
Fire Age
Notes Incomplete flora list.
Assoc. species: Rhagodia baccata subsp. baccata, Hardenbergia comptoniana, *Anagallis arvensis var. caerulea, Lobelia tenuior, Acanthocarpus preissii, Trachymene pilosa, Clematis linearifolia, Thysanotus manglesianus, Daucus glochidiatus.

Mandurah - **Site** CB32
Described by BRM **Date** 28/11/2004
Location SW end of Area B.
Photo 24 **on Roll** BM10(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371278mE, 6390097.
Habitat Moderate, east-facing upper slope of high dune.
Soil White calcareous sand.
Rock Type
Vegetation Acacia aff. rostellifera open to closed scrub over Spyridium globulosum scattered tall shrubs

over Rhagodia baccata subsp. baccata scattered low shrubs over Desmocladus asper scattered sedges and rye grass open grassland with Acanthocarpus preissii, (Lomandra maritima) herbland.
Veg Cond (BF) Excellent. Moderate rye grass cover.
Fire Age More than 5 to 7 years since fire.
Notes Incomplete flora list.
Assoc. species: Phyllanthus calycinus, Olearia axillaris, Daucus glochidiatus, *Trachyandra divaricata, Santalum acuminatum.

Mandurah - **Site** CB33
Described by BRM **Date** 29/11/2004
Location .
Photo 1,2 **on Roll** BM11(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371304mE, 6390333mN.
Habitat Undulating area at base of dune, esat side.
Soil White calcareous sand.
Rock Type
Vegetation Spyridium globulosum high shrubland to open heath over Olearia axillaris open shrubland over Diplolaena dampieri low open shrubland to low shrubland over Desmocladus asper, Carex preissii scattered sedges and *Lolium rigidum open grassland with Acanthocarpus preissii, Lomandra maritima very open herbland.
Veg Cond (BF) Excellent. Moderate rye grass cover.
Fire Age More than 5 to 7 years since last fire.
Notes Incomplete flora list.
Assoc. species: Acacia cochlearis, Rhagodia baccata subsp. baccata, Austrostipa flavescens, *Bromus diandrus, Lobelia tenuior, Cassytha racemosa, Senecio pinnatifolius, Daucus glochidiatus.

Mandurah - **Site** CB34
Described by BRM **Date** 29/11/2004
Location near beach at north end of Area B.
Photo 3 **on Roll** BM11(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371068mE, 6390684mN
Habitat Shallow swale behind first dune on beach front.
Soil White calcareous sand.
Rock Type
Vegetation Olearia axillaris low open shrubland over Ficinia nodosa very open sedgeland with Carprobrotus virescens, *Crassula glomerata scattered herbs.
Veg Cond (BF) Excellent. (Some weeds).
Fire Age
Notes Incomplete flora list.
Assoc. species: *Oenothera drummondii subsp. drummondii, *Lagurus ovatus, *Pelargonium capitatum, Spinifex hirsutus.

Mandurah - **Site** CB35
Described by BRM **Date** 29/11/2004
Location North end of golf course.
Photo 5 **on Roll** BM11(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371346mE, 6390719mN.
Habitat Moderate, north-facing slope of low dune.

Soil White calcareous sand.
Rock Type
Vegetation Santalum acuminatum, Spyridium globulosum, (Olearia axillaris), Jacksonia furcellata (on upper slope) open heath to open scrub over Acacia rostellifera, Acacia cochlearis scattered shrubs over Leucopogon parviflorus scattered low shrubs over Desmocladus asper scattered sedges with Acanthocarpus preissii, Lomandra maritima herbland and *Lolium rigidum open grassland.
Veg Cond (BF) Excellent. Moderate cover of rye grass.
Fire Age More than 5 to 7 years since fire.
Notes Incomplete flora list.
Assoc. species: Hemiandra glabra subsp. glabra, Austrostipa flavescens, Senecio pinnatifolius, *Bromus diandrus, *Trachyandra divaricata, Diplolaena dampieri, Phyllanthus calycinus.

Mandurah - **Site** CB36
Described by BRM **Date** 28/11/2004
Location Central western part of Caddadup-west.
Air Photo **Photo** 9,10,11 **on Roll** BM11(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371264mE, 6390567mN.
Habitat Swale behind dunes.
Soil Pale grey sand (some small patches of orange sand where ant excavations).
Rock Type
Vegetation Agonis flexuosa scattered low trees over Spyridium globulosum, Melaleuca huegelii, (Acacia rostellifera, Olearia axillaris) closed scrub over Trymalium ledifolium var. ledifolium, Leucopogon parviflorus low open shrubland over Austrostipa flavescens, *Lolium rigidum very open grassland and Desmocladus asper scattered sedges with Acanthocarpus preissii very open herbland.
Veg (BF) Excellent. Moderate rye grass cover.
Fire Age More than 7 to 10 years since last fire.
Notes Releve recorded over approximately 10m x 10m and 30 x 30m area. No evidence of dieback.
Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia rostellifera	2-3		1.8-2.5m		
	Acanthocarpus preissii	2-3		30cm		
	Alyxia buxifolia	1		30cm		shiny green leaf
	Austrostipa flavescens	5-10		90cm	CB36-1	
	Austrostipa					
	Bromus diandrus	+		30cm		
	Conostylis candicans	+		20cm		
	Crassula glomerata	+		3cm		
	Daucus glochidiatus	1-2		15cm		
	Desmocladus asper	+		15cm		
	Ehrharta longiflora	+		30cm		
	Hardenbergia comptoniana	+		1.3m	CB36-5	
	Leucopogon parviflorus	+		70cm		
	Leucopogon					
	Lolium rigidum	2-3		30cm		
	Melaleuca huegelii	15-20		3-4m		
	Olearia axillaris	1-3		1.8-2.8m		
	Parietaria debilis	+		20cm	CB36-4	red stem herb
	Phyllanthus calycinus	+		30cm		

Poa poiformis	+	40cm	CB36-2	poa
Poranthera microphylla	+	10cm	CB36-3	herb
Senecio pinnatifolius	+	10cm		Senecio
Spyridium globulosum	50-60	2-2.5m		
Thysanotus manglesianus	+	60cm		
Thysanotus climber				
Trymalium ledifolium var. ledifolium	3-4	40-80cm		Trymalium
Acacia saligna	+			
Acacia truncata	+	1.1m	CB36-6	Acacia
Agonis flexuosa	+			
Austrodanthonia occidentalis	+	70cm	CB36-7	
Austrodanthonia				
Calandrinia brevipedata	+		=CB31-3	
Calandrinia				
Dischisma arenarium	+			
Hemiandra glabra subsp. glabra	+			Hemiandra
Lepidosperma pubisquameum	+		CB36-8	sedge
Lobelia tenuior	+			
Trachymene pilosa	+			
Trachymene wide lf lobe				

CADDADUP AREA C

Mandurah - **Site** CC01
Described by BRM **Date** 24/10/2004
Location Caddadup Reserve, east side of Dawseville Bypass
Air Photo **Photo** 20 **on Roll** BM **Video** N **E Photo**
Photo Notes
AMG Zone 50 372420mE, 6390829mN
Habitat Moderately steep, East-facing mid to upper slope of ridge (dune).
Soil Yellow-brown sand
Rock Type
Vegetation Eucalyptus gomphocephala, Corymbia calophylla scattered trees over Banksia grandis, Banksia attenuata low woodland over Jacksonia sternbergiana, (Hakea prostrata) high open shrubland over Xanthorrhoea preissii, Macrozamia riedlei shrubland over Acanthocarpus preisii low open shrubland and *Briza maxima, *Avena barbata annual grassland
Veg (BF) (Very good) to Excellent. Moderate weed cover.
Fire Age >5 to 7 years since fire
Notes Releve recorded over approximately 10m x 10m and 30m x 30m area. No Eucalyptus gompholobium trees in releve.
Rock Pile
Species List:

Quad Name	Cove	C Class	Height	Specimen	Notes
Acanthocarpus preissii	2-4		60cm		
Anagallis arvensis var. caerulea	+		10cm		
Asteridea pulverulenta	+		25cm	c1-8	white daisy
Avena barbata	1-2		90cm		
Banksia attenuata	15-20		4-5m		
Banksia grandis	5-8		5-6		
Briza maxima	10-15		30cm		
Bromus diandrus	+		35cm		
Caesia micrantha	+		30cm	c1-10	
Caladenia latifolia	+		20cm	c1-11	
Calandrinia liniflora	+		3cm	C1-1	

Calandrinia terete leaf				
Conostylis aculeata subsp. aculeata	+	15cm	c1-6	
Corymbia calophylla	3-5	12m		
Corynotheca micrantha	+	30cm	c1-5	
Crassula colorata var. acuminata	+	3cm	C1-3	Crassula colorata
Daucus glochidiatus	+	15cm	c1-15	
Dianella revoluta var. divaricata	+	50cm		
Dichopogon capillipes	2-3	15cm		
Drosera stolonifera subsp. stolonifera	+	30cm	c1-9	Drosera upright
Ehrharta longiflora	+	35cm		
Erodium cicutarium	+	15cm	c1-14	
Eryngium pinnatifidum	+	35cm	C1-4	
Gompholobium tomentosum	+	25cm		
Hakea prostrata	2-3	3.5m		
Hardenbergia comptoniana	+	45cm		
Hypochaeris glabra	+	5cm		
Isolepis stellata	+	3cm	C1-2	small sedge
Jacksonia sternbergiana	+	4-5m	C1-21	
Lagurus ovatus	2-3	15cm		
Macrozamia riedlei	3-5	1.1m		
Millotia myosotidifolia	+	3cm	c1-23	small white daisy
Orobanche minor	+	20cm		
Parentucellia latifolia	+	12cm	c1-13	
Petrorhagia dubia	+	30cm		pink flr weed
Phyllanthus calycinus	+	30cm		
Poa poiformis	+	90cm	c1-12	tall grass
Sonchus oleraceus	+	15cm		
Sowerbaea laxiflora	+	35cm		
Sowerbaea laxiflora	+	45cm	c1-16	tall herb
Trachymene pilosa	+	15cm	c1-7	
Trachymene brd lobes				
Trifolium campestre var. campestre	3-5	12cm		
Ursinia anthemoides	+	35cm		
Xanthorrhoea preissii	10-15	1.6(2.5)m		
Clematis pubescens	+	70cm		
Conospermum stoechadis subsp. sclerophyllum	+	10cm	c1-19	
Hybanthus calycinus	+	20cm		
Leucopogon propinquus	+	5cm	c1-20	
Lomandra suaveolens	+	20cm	c1-22	lomandra
Olearia axillaris	+	0.1m		
Poa poiformis	+	60cm	c1-18	bulb grass
Rhagodia baccata subsp. baccata	+	50cm	c1-17	Rhagodia

Mandurah - **Site** CC02
Described by BRM **Date** 24/10/2004
Location Area C, Caddadup Reserve on East side of the Dawsville Bypass.
Air Photo **Photo** 21 **on Roll** BM **Video** N **E Photo**
Photo Notes
AMG Zone 50 372289mE, 6390592mN
Habitat Very gently sloping, North-facing crest of ridge (dune).

Soil Pale yellow-brown sand
Rock Type
Vegetation (Eucalyptus marginata) scattered trees over Banksia attenuata, Allocasuarina fraseriana low woodland to low open forest over Jacksonia sternbergiana high open shrubland over Olearia axillaris, Acacia pulchella var. glaberrima open shrubland over Hibbertia hypericoides low shrubland to
low open heath over *Briza maxima, *Bromus diandrus annual grassland and Anstrostipa macalpinei scattered grasses with Dichopogon capillipes, Asteridea pulverulenta very open herbland.
Veg (BF) Very Good (moderate weed cover - mainly Briza maxima)
Fire Age Last fire more than (5) 7 to 10 years ago?
Notes Releve recorded over approximately 10m x 10m and 30m x 30m area.
1 recently dead Banksia attenuata. 2 old Allocasuarina fraseriana deaths (fire?)
Eucalyptus marginata was outside plot.
Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia pulchella var. glaberrima	1-2		1.5m	c2-1	Acacia pulchela
	Allocasuarina fraseriana	5-6		5m		
	Anagallis arvensis var. caerulea	+		10cm		
	Asteridea pulverulenta	+		25cm	c2-7	white daisy
	Austrostipa macalpinei	+		40cm	c2-3	
	Austrostipa					
	Avena barbata	+		90cm		
	Banksia attenuata	30-40		5m		
	Briza maxima	+		20cm		
	Briza maxima	10-15		35cm		
	Bromus diandrus	+		35cm	c2-2	
	Burchardia umbellata	+		30cm		
	Caesia micrantha	+		40cm	=c1-10	
	Caesia micrantha	+		20cm	c2-13	
	Caladenia flava subsp. flava	+		20cm	c2-12	
	Calandrinia liniflora	+		5cm	=c1-1	
	Calandrinia (terete leaf)					
	Conostylis aculeata subsp. aculeata	+		15cm	=c1-6	
	Corynotheca micrantha	+		15cm	=c1-5	
	Daucus glochidiatus	+		15cm	=c1-15	
	Dianella revoluta var. divaricata	+		45cm		
	Dichopogon capillipes	1		20cm		
	Drosera menziesii	+		15cm	c2-14	Drosera fine climbing
	Dryandra lindleyana var. lindleyana	+		15cm		
	Ehrharta longiflora	+		35cm		
	Eryngium pinnatifidum	+		30cm	=c1-4	
	Hibbertia hypericoides	30-35		45cm		
	Homalosciadium homalocarpum	+		3cm	c2-5	short green herb
	Hybanthus calycinus	+		20cm		
	Hypochaeris glabra	+		3cm		
	Isotropis cuneifolia subsp. cuneifolia	+		12cm	=SDR	
	Jacksonia sternbergiana	3-5		4m		
	Lagenifera huegelii	+		3cm		Lagenifera
	Lagurus ovatus	+		30cm		
	Lomandra suaveolens	+		12cm	c2-8	Lomandra

Macrozamia riedlei	3-5	1.5m		
Olearia axillaris	+	1.1m		
Orobanche minor	+	15cm		
Petrorhagia dubia	+	30cm	=MS1-	pinkflower weed
Phyllanthus calycinus	+	30cm		
Scaevola repens var. repens	+	20cm	c2-4	
Silene gallica	+	20cm	c2-11	
Sonchus oleraceus	+	30cm		
Sowerbaea laxiflora	+	50cm		
Thysanotus ?sparteus ?Thysanotus	+	15cm	c2-6	
Thysanotus sparteus Thysanotus	+	35cm	c2-10	tall
Trachyandra divaricata	+	30cm		
Trachymene pilosa Trachymene broad lobe	+	10cm	=c1-7	
Trifolium campestre var. campestre	+	10cm	=MS1-	
Ursinia anthemoides	+	20cm		
Xanthorrhoea preissii	1	(60cm)1.7m		
Xanthosia ciliata	+	15cm	c2-9	Xanthosia
Acacia saligna	+	4-5m		
Agonis flexuosa	+	3.5m		
Eucalyptus marginata subsp. marginata	+	6m		
Hardenbergia comptoniana	+	50cm		
Leucopogon propinquus Leucopogon	+	40cm	c2-15	
Rhagodia baccata subsp. baccata	+	45cm		Rhagodia

Mandurah - **Site** CC03
Described by BRM **Date** 25/10/2004
Location Western side, near south end.
Photo 22 **on Roll** BM5(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 372416mE, 6390209mN
Habitat Gentle, east-facing lower slope of ridge (dune).
Soil Pale yellow-brown sand
Rock Type
Vegetation Eucalyptus gomphocephala, Eucalyptus marginata subsp. marginata, Corymbia calophylla open woodland to woodland over Agonis flexuosa, (Allocasuarina fraseriana,Banksia attenuata) low woodland to low open forest over Jacksonia sterbergiana scattered tall shrubs over Xanthorrhoea preissii, Macrozamia riedlei open shrubland over Dichopogon capillipes, *Trifolium campestre var. campestre herbland and *Lolium rigidum, *Briza maxima annual grassland.
Veg Health a number of tuarts dead, others with crown decline.
Veg Cond (BF) VG-E. High weed cover.
Fire Age More than 7-10 years since fire.
Notes Incomplete flora list.
Assoc. species: *Centranthus macrosiphon, Ranunculus colonorum, Clematis pubescens, Caladenia latifolia, *Cynosurus echinatus,Veronica distans, Lomandra suaveolens.

Mandurah - **Site** CC04
Described by BRM **Date** 25/10/2004
Location near NE corner.

Photo 23,24 **on Roll** BM5(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 372464mE, 6390746mN.
Habitat Steep, east-facing lower slope of high ridge (dune).
Soil Yellow-brown sand.
Rock Type
Vegetation Eucalyptus gomphocephala woodland over Acacia rostellifera high closed scrub over Xanthorrhoea preissii scattered high shrubs over Macrozamia riedlei scattered shrubs over Acanthocarpus preissii scattered herbs over *Ehrharta longiflora, *Briza maxima closed annual grassland.
Veg health: Excellent. (Some nearby deaths, but with old fire scars).
Veg Cond (BF) Very Good. High weed cover (*Trifolium campestre and *Ehrharta longiflora)
Fire Age About 5-7 years since fire.
Notes Incomplete flora list.
Assoc. species: Hardenbergia comptoniana, Hakea prostrate, *Sonchus oleraceus, Opercularia vaginatus, Phylanthus calycinus, Sowerbaea laxiflora.

Mandurah - **Site** CC05
Described by BRM **Date** 26/10/2004
Location south end of Area C.
Photo 25 **on Roll** BM5(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 372286mE, 6390037.
Habitat Very gentle, NE-facing lower slope of low ridge (sand dune).
Soil Pale yellow-brown sand.
Rock Type
Vegetation Eucalyptus gomphocephala, Eucalyptus marginata subsp. marginata scattered trees over Agonis flexuosa, (Allocasuarina fraseriana, Banksia attenuata) low woodland over Xanthorrhoea preissii, Macrozamia riedlei open shrubland over Hibbertia hypericoides open heath over *Briza maxima, *Avena barbata open annual grassland with Dichopogon capillipes very open herbland.
Veg health: A number of old dead trees nearby – some fire damage.
Veg Cond (BF) VG. Moderate weed cover (*Briza maxima, *Avena barbata).
Fire Age Hot fire more than 5 to 7 years ago.
Notes Incomplete flora list.
Assoc. species: Caladenia flava subsp. flavs, Caesia micrantha, Scaevola repens var. repens, Sowerbaea laxiflora, Podolepis gracilis, Drosera stolonifera subsp. stolonifera.

Mandurah - **Site** CC06
Described by BRM **Date** 26/10/2004
Location .
Photo **on Roll** **Video** N **E Photo**
Photo Notes
AMG Zone 50 372189mE, 6390460mN
Habitat Moderate, west-facing midslope.
Soil Yellow-brown sand.
Rock Type
Vegetation Agonis flexuosa, (Allocasuarina fraseriana, Banksia attenuata) low woodland over Acacia rostellifera high open shrubland over Hibbertia hypericoides low open shrubland to shrubland.
Veg Cond (BF) .
Fire Age About 3-4 years since fire.
Notes Incomplete flora list.
Small area.

CADDADUP AREA D

Mandurah - **Site** CD01
Described by BRM **Date** 30/10/2004
Location Near SW corner of Area D.
Photo **on Roll** **Video** N **E Photo**
Photo Notes
AMG Zone 50 371998mE, 6390012mN
Habitat Gentle to moderate, west-facing, lower slope of low ridge
Soil
Rock Type
Vegetation Allocasuarina fraseriana, Banksia attenuata scattered low trees over Jacksonia sterbergiana high open shrubland over Acacia rostellifera high shrubland to open scrub over Hibbertia hypericoides low open shrubland over *Avena barbata, *Ehrharta calycina annual grassland.
Veg Cond (BF).
Fire Age
Notes Incomplete flora list.
Assoc. species:

CADDADUP AREA F

Mandurah - **Site** CF01
Described by BRM **Date** 1/12/2004
Location Area F (Tuart Park Public Open Space, Ocean Rd).
Air Photo **Photo** 13 **on Roll** BM **Video** N **E Photo**
Photo Notes
AMG Zone 50 371423mE, 6389782mN
Habitat Gently sloping, west-facing flat valley floor (swale).
Soil Orange yellow sand (Spearwood).
Rock Type Some surface limestone rock.
Vegetation Eucalyptus gomphocephala open to closed forest over Spyridium globulosum, (Dryandra sessilis) high shrubland to open scrub over Olearia axillaris, Xanthorrhoea preissii, Melaleuca systena open shrubland over Desmocladus asper open sedgeland with Trachymene oleracea, Acanthocarpus preissii, Lomandra maritima scattered herbs.
Veg (BF) Pristine. Some signs of nearby disturbance - old picnic area. Not much
Fire Age More than 7 years since fire.
Notes Releve recorded over approximately 10m x 10m and 30 x 30m area. No evidence of dieback.
Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Austrostipa flavescens	+		40cm	(=CB36-Austrostipa	
	Desmocladus asper	10-15			CF1-2	
	Desmocladus flexuosus	+		15cm		
	Dianella revoluta var. divaricata	+		80cm	CF1-10	
	Dischisma arenarium	+		10cm		herb fine lf lobe
	Dryandra lindleyana var. lindleyana	+		15cm		
	Dryandra sessilis	1-2		2.5-5m		
	Eucalyptus gomphocephala	70-75		10-15m		
	Grevillea preissii subsp. preissii	+			CF1-3	
	Hardenbergia comptoniana	+		2.5m	CF1-7	
	Lepidosperma pubisquameum	+		20cm	CF1-6	sedge

Leucopogon parviflorus	+	90cm(1.8	=CB	
Leucopogon				
Lobelia tenuior	+	20cm	CF1-8	purple 3-
petals				
Lomandra maritima	1	30cm	CF1-5	
Melaleuca systena	2-5	70cm(1.8	CF1-1	
Olearia axillaris	1-2	0.7-2m		
Poa poiformis	+	40cm	=CB36-2	poa
Rhagodia baccata subsp. baccata	+	30cm(90c		
Sonchus oleraceus	+	12cm		
Spyridium globulosum	30-40	2-3m		
Templetonia retusa	+	40cm		
Trachymene coerulea	+	30-40cm	CF1-4	
Veronica distans	+	15cm	CF1-9	herb
Xanthorrhoea preissii	1-2	1-2m		
Anagallis arvensis var. caerulea	+	10cm		no flower
Tricoryne elatior	+		CF1-11	

Mandurah - **Site** CF03
Described by BRM **Date** 1/12/2004
Location Area F (Tuart Park Public Open Space, Ocean Rd).
Air Photo **Photo** 14,15 **on Roll** BM **Video** N **E Photo**
Photo Notes
AMG Zone 50 371401mE, 638991mN
Habitat Gently sloping, west-facing flat valley floor (swale?).
Soil Yellow-grey sand.
Rock Type
Vegetation Eucalyptus gomphocephala open forest over Spyridium globulosum, Acacia rostellifera, Melaleuca huegellii high shrubland to open scrub over Ollearia axillaris, Rhagodia baccata subsp. baccata scattered shrubs over Acanthocarpus preissii herbland.
Veg (BF) Excellent to Pristine. (Almost no weeds).
Fire Age ore than 7-10 years since last fire.
Notes Releve recorded over approximately 10m x 10m and 30 x 30m area. No evidence of dieback.
Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia rostellifera	5-8		3-4m		
	Acanthocarpus preissii	50-60		30-40cm		
	Anagallis arvensis var. caerulea	+		10cm		blue flr
	Asparagus asparagoides	+		30cm		bridal
creeper						
	Austrostipa flavescens	+		40cm	=CB36-	
	Austrostipa					
	Caladenia latifolia	+		35cm	CF3-7	
	Carex preissii	+		30cm	CF3-2	sedge
	Clematis linearifolia	+		15cm	CF3-6	creeper
	Daucus glochidiatus	3-5		15cm		fine lf lobe
herb						
	Desmocladus asper	+		15cm		
	Dischisma arenarium	+		12cm	CF3-5	
	Eremophila glabra	+		35cm	CF3-4	
	Eucalyptus gomphocephala	50-60		10-15m		
	Euphorbia peplus	+		15cm	CF3-1	Euphorbia
	Hardenbergia comptoniana	+		2m	=CF1-	

Lobelia tenuior	+	20cm		
Lomandra maritima	+	30cm		
Melaleuca huegelii	5-10	3m		
Melilotus indicus	+	25cm	CF3-3	small yellow flower pea
Olearia axillaris	1-2	1m		
Orobanche minor	+	12cm		
Rhagodia baccata subsp. baccata	3-4	40-60cm		
Sonchus oleraceus	+			
Spyridium globulosum	15-20	2-2.5m		
Thysanotus manglesianus	+			
Thysanotus climber				
Trachyandra divaricata	+	30cm		leaves prostrate
Trachymene coerulea	1	20-80cm		
Trifolium campestre var. campestre	+	15cm		
Cassytha racemosa	+			Cassytha
Melaleuca systena	+			

Mandurah - **Site** CF04
Described by BRM **Date** 1/12/2004
Location .
Photo 17 **on Roll** BM11(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371230mE, 6389660mN
Habitat Part of a flat plain on the eastern side of the Quindalup dunes.
Soil Grey sand.
Rock Type .
Vegetation Eucalyptus gomphocephala open forest over Banksia littoralis low open woodland over Melaleuca huegelii, Spyridium globulosum, Acacia rostellifera high shrubland over Xanthorrhoea preissii open shrubland over Desmocladus asper open sedgeland.
Veg Cond (BF) Excellent to Pristine. Some old tracks and physical disturbance nearby (east side).
Fire Age more than 7 to 10 years since fire.
Notes .Incomplete flora list.
Assoc. species: Melaleuca systina, Daucus glochidiatus, Olearia axillaries, Hardenbergia comptoniana, Trachymene oleracea, Juncus kraussii subsp. kraussii.

Mandurah - **Site** CF05
Described by BRM **Date** 1/12/2004
Location .SW corner of area F.
Photo 20 **on Roll** BM11(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371212mE, 6389677mN
Habitat Flat plain on eastern side of Quindalup dunes.
Soil Grey sand.
Rock Type
Vegetation Melaleuca huegelii subsp. huegelii, (Acacia rostellifera) closed scrub over Xanthorrhoea preissii scattered shrubs over Baumea juncea scattered sedges and Austrostipa flavens scattered grasses.
Veg Cond (BF) Pristine.
Fire Age More than 7 to 10 years since last fire.
Notes Incomplete flora list.
Small unit.
Assoc. species: Olearia axillaries, Spyridium glabosum, Xanthorrhoea preissii, Hakea prostrate, Hakea trifurcatta, Lepidosperma pubisqameum, Trachymene pilosa, Daucus glochidiatus.

Mandurah - **Site** CF07
Described by BRM **Date** 1/12/2004
Location East of SE corner of Area F.
Photo 19 **on Roll** BM11(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 371433mE, 6389676mN.
Habitat Lower slope to mid slope of low rise (long slope).
Soil Yellow-orange brown sand.
Rock Type Lots of exposed limestone.
Vegetation Dryandra sessilis highshrubland over Olearia axillaris , Spyridium globulosum shrubland to open heath over Templetonia retusa, Trymalium ledifolium var. ledifolium, Melaleuca systina low shrubland over Desmocladus asper sedgeland to closed sedgeland.
Veg Cond (BF) E to P. (Some *Anagallis arvensis weed).
Fire Age More than 5-7 years since fire.
Notes .Incomplete flora list.
Assoc. species: Grevillea preissii subsp. preissii, Lomandra maritima, Trachymene oleracea, Daucus glochidiatus, Hakea trifurcate, Rhagodia baccata.

CADDADUP AREA G

Mandurah - **Site** CG01
Described by BRM **Date** 1/12/2004
Location .
Photo 23 **on Roll** BM11(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 372603, 6391025mE.
Habitat Drainage line on western boundary of Area G
Soil Grey sand.
Rock Type
Vegetation Melaleuca raphiophylla, Melaleuca cuticularis low eoodland over Astartea scoparia low open sheubland over Juncus kraussii subsp. australiensis, Baumea juncea sedgeland and *Ehrharta calycina, *Briza maxima very open annual grassland.
Veg Cond (BF) G. numerous weeds.
Fire Age 7 to 10 years since fire.
Notes Incomplete flora list.
Assoc. species: *Solanum nigricans, Casuarina obesa, *Vulpia myuros var. myuros, Lobelia tenuior, Ficinia nodosa, Acacia saligna, *Laguros ovatus.

Mandurah - **Site** CG02
Described by BRM **Date** 1/12/2004
Location .
Photo 24 **on Roll** BM11(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 372573mE, 6391045mN.
Habitat Very gently sloping lower slopes of drainage line.
Soil Grey sand.
Rock Type
Vegetation Eucalyptus gomphocephala scattered trees to open woodland over Acacia saligna, Melaleuca raphiophylla, Kunzea glabrescens, Jacksonia furcellata low woodland to low open forest over Olearia axillaries, Macrozamia riedlei, Sollya heterophylla low open shrubland over Baumea juncea, Schoenus

subfasicularis closed sedgeland with Corynotheca micrantha open herbland.
Veg Cond (BF) Excellent.
Fire Age
Notes Incomplete flora list.
Assoc. species: *Ehrharta calycina, *Briza maxima, *Eragrostis curvula, Conostylis aculeate, Patersonia occidentalis, Thysanotus manglesianus, Jacksonia sterbergiana .

Mandurah - **Site** CG03
Described by BRM **Date** 1/12/2004
Location .south end of Area G.
Photo **on Roll** **Video** N **E Photo**
Photo Notes
AMG Zone 50 372528mE, 6390702mN
Habitat Flat foreshore.
Soil
Rock Type
Vegetation Tuart open forest over Casuarina obesa, Melaleuca cuticularis low woodland over Suaeda australis scattered low shrubs over Juncus kraussii subsp. australiensis, (Ficinia nodosa) sedgeland and *Cynodon dactylon closed grassland.
Veg Cond (BF) na ("SEPA with City of MAndurah and Water and Rivers Commission sponsors are replanting the foreshore).
Fire Age
Notes Incomplete flora list.
Assoc. species: Acacia saligna

CADDADUP AREA H

Mandurah - **Site** CH01
Described by BRM **Date** 2/12/2004
Location .
Photo 25, BM11(2004) and 1, BM12(2004) **Video** N **E Photo**
Photo Notes
AMG Zone 50 372627mE, 6390851mN
Habitat Gently undulating, sandy rises.
Soil Pale yellow-white silicious sand.
Rock Type
Vegetation Acacia saligna scattered low trees to low open woodland over Jacksonia sterbergiana , Jacksonia furcellata scattered tall shrubs over Olearia axillaris, Acacia pulchella var. glaberrima scattered shrubs over Ficinia nodosa, and *Cynodon dactylon, *Lagurus ovatus, *Avena barbata annual grassland.
Veg Cond (BF) n.a. Reclamation and revegatation.
Fire Age
Notes Incomplete flora list.
Reclaimed area.
Assoc. species:

CADDADUP AREA I

Mandurah - **Site** CI01
Described by BRM **Date** 31/10/2004
Location
Air Photo **Photo** 4 **on Roll** BM **Video** N **E Photo**
Photo Notes
AMG Zone 50 372310mE, 6391086mN

Habitat Moderate, East-facing mid to upper slope of ridge.
Soil Yellow-brown sand
Rock Type
Vegetation Eucalyptus gomphocephala open woodland over Agonis flexuosa, (Allocasuarina fraseriana) low open woodland to low woodland over Banksia attenuata scattered low trees over Jacksonia sternbergiana, Olearia axillaris high open shrubland over Xanthorrhoea preissii, Macrozamia riedlei, Rhagodia baccata subsp. baccata open shrubland to shrubland over Phyllanthus calycinus scattered low shrubs over *Briza maxima, *Lagurus ovatus, *Avena barbata open annual weed grassland with Acanthocarpus preissii, Lomandra maritima open herbland.
Veg (BF) Very Good. (Too weedy for Excellent. High weed cover of *Briza maxima, *Trifolium campestre var. campestre, *Avena barbata, *Ehrharta caycina
Fire Age Greater than 5 to 7 years since last fire.
Notes Releve recorded over approximately 10m x 10m and 30m x 30m area.
Dead Banksias further along slope. No dieback evident at site.
Rock Pile
Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	Acacia pulchella var. glaberrima	+		1.4m		Acacia pulchela
	Acanthocarpus preissii	2-3		35cm		
	Agonis flexuosa	5-10		6-9m		
	Allocasuarina fraseriana	3-5		7-10m		
	Anagallis arvensis var. caerulea	+		10cm		
	Avena barbata	1-2		90cm		
	Briza maxima	3-5		30cm		
	Briza minor	+		20cm		
	Bromus diandrus	+		30cm		
	Burchardia umbellata	+		50cm		
	Conostylis aculeata subsp. aculeata	+		20cm	CI1-4	
	Corynotheca micrantha	+		20cm	CI1-3	
	Cynosurus echinatus	+		30cm		grass red hairy spines
	Dianella revoluta var. divaricata	+		45cm		not flowering
	Dichopogon capillipes	+		20cm		
	Ehrharta calycina	+		80cm		
	Ehrharta longiflora	10-15		30cm		
	Eucalyptus gomphocephala	5-10		18-20m		
	Geranium solanderi	+		20cm	CI1-5	
	Hardenbergia comptoniana	2-3		30cm		
	Jacksonia sternbergiana	2-3		4m		
	Lagurus ovatus	2-3		30cm		
	Lolium rigidum	+		40cm		rye grass
	Lomandra maritima	1		30cm	CI1-1	Lomandra mar.
	Macrozamia riedlei			2-3 1.1m		
	Melilotus indicus	+		30cm	=CKGC6	tall clover
	Olearia axillaris	6-8		2.5m(3-		
	Petrorhagia dubia	2-3		35cm	CI1-2	small pink flr herb weed
	Phyllanthus calycinus	+		40cm		
	Ptilotus drummondii var. drummondii	+		20cm		Ptilotus pink flr
	Rhagodia baccata subsp. baccata	+		1.4m		
	Scaevola repens var. repens	+		15cm	=c2-	Scaevola

Sowerbaea laxiflora	+	40cm	
Trifolium campestre var. campestre	5-10	12xm	
Xanthorrhoea preissii	5-8	1-	
Acacia saligna	+	4-5m	
Banksia attenuata	+		
Banksia grandis	+		
Hakea prostrata	+	3m	
Leucopogon parviflorus	+	60cm	CI1-6
Leucopogon			
Sonchus oleraceus	+		
Spyridium globulosum	+		

CADDADUP AREA J

Mandurah - **Site** CJ01
Described by BRM **Date** 31/10/2004
Location .
Photo **on Roll** **Video** N **E Photo**
Photo Notes
AMG Zone 50 372479mE, 6390929mN.
Habitat Swale (flat) at base of high dune
Soil Grey sand.
Rock Type .
Vegetation Eucalyptus gomphocephala woodland over Corymbia calophylla open woodland over Acacia saligna, Banksia grandis low open woodland over Jacksonia sterbergiana , Jacksonia furcellata high open shrubland to high shrubland over Xanthorrhoea preissii, Olearia axillaris, Macrozamia riedlei open shrubland over Lepidosperma pubisquameum, Ficinia nodosa very open sedgeland and *Briza maxima, *Avena barbata annual grassland with Corynotheca micrantha, Acanthocarpus preissii very open herbland to open herbland.
Veg Cond (BF) Very Good (Excellent). High weed cover of *Briza maxima and *Avena barbata.
Fire Age 5 to 7 years since fire.
Notes Incomplete flora list.
Assoc. species: Hardenbergia comptoniana, Rhagodia baccata subsp. baccata, Sollya heterophylla, Phyllanthus calycinus, Conostylis aculeate, Opercularia hispidula.

APPENDIX 6 Photographs of vegetation in the Caddadup survey area

Photograph 19. Site CB31 (representing mapping unit EgMhSg). *Eucalyptus gomphocephala* open forest over *Melaleuca huegelii* subsp. *huegelii*, (*Spyridium globulosum*) closed scrub over *Carex preissii* scattered sedges and *Calandrinia brevipedata*, (*Parietaria debilis*) herbland.

Photograph 20. Site CF3 (representing mapping unit EgSgAr). *Eucalyptus gomphocephala* open forest over *Spyridium globulosum*, *Acacia rostellifera*, *Melaleuca huegelii* high shrubland to open scrub over *Olearia axillaris*, *Rhagodia baccata* subsp. *baccata* scattered shrubs over *Acanthocarpus preissii* herbland.

Photograph 21. Site CB2 (representing mapping unit ArSgHh). *Acacia rostellifera*, (*Spyridium globulosum*, *Olearia axillaris*, *Santalum acuminatum*) closed heath to closed scrub over *Hibbertia hypericoides*, *Melaleuca systena* low open shrubland to low shrubland over *Desmocladus asper* scattered sedges with *Lomandra maritima*, *Trachymene pilosa* open herbland.

Photograph 22. Site CB7 (representing mapping unit ArSgHt). *Acacia rostellifera*, *Spyridium globulosum*, (*Hakea trifurcata*) open to closed scrub over *Rhagodia baccata* subsp. *baccata* open shrubland over *Melaleuca systina*, *Grevillea preissii* subsp. *preissii* scattered low shrubs to low open shrubland over *Trachymene pilosa*, *Daucus glochidiatus*, *Lomandra maritima* open herbland and *Lepidosperma pubisquameum* scattered sedges with **Lolium rigidum* very open annual grassland.

Photograph 23. Site CF7 (representing mapping unit DsOaSg). *Dryandra sessilis* high shrubland over *Olearia axillaris* , *Spyridium globulosum* shrubland to open heath over *Templetonia retusa, Trymalium ledifolium* var. *ledifolium, Melaleuca systina* low shrubland over *Desmocladus asper* sedgeland to closed sedgeland.

Photograph 24. Site CB18 (representing mapping unit CmSh). *Cakile maritima* low open shrubland over *Spinifex hirsutus* grassland. This vegetation unit was generally in the form of a narrow linear strip parallel with and nearest to the the beach and between a few and 5 metres wide.

Photograph 25. Site CB22 (representing mapping unit McFn). (*Melaleuca cuticularis*) scattered shrubs over **Oenothera drummondii* subsp. *drummondii*, **Pelargonium capitatum* low open shrubland over *Ficinia nodosa*, *Isolepis stellata* sedgeland and **Vulpia fasciculate* scattered grasses with **Centaurium tenuiflorum*, **Crassula glomerata* open herbland. This small unit was a dampland in narrow flat swale behind foredunes.

Photograph 26. Site CF5 (representing mapping unit Mh). *Melaleuca huegelii* subsp. *huegelii*, (*Acacia rostellifera*) closed scrub over *Xanthorrhoea preissii* scattered shrubs over *Baumea juncea* scattered sedges and *Austrostipa flavescens* scattered grasses. This small unit was recorded on the west side of the Tuart Park Public Open Space. Other small stands of *M. huegelii* closed scrub also occurred on lower slopes and swales on the Quinalup dunes. The more common *M. huegelii* vegetation unit was SgMh (Photograph 8).

Photograph 27. Site CB24. *Acacia rostellifera* scattered tall shrubs over *Myoporum insulare, Spyridium globulosum* shrubland over *Olearia axillaris, Rhagodia baccata* subsp. *baccata* low open shrubland over *Scaevola crassifolia* low shrubland over *Lepidosperma gladiatum* very open sedgeland to open sedgeland with *Acanthocarpus preissii* very open herbland. (On an east-facing upper slope of a Quindalup dune).

Photograph 28. Site CB11 (representing mapping unit OaDd). *Acacia saligna* scattered tall shrubs over *Olearia axillaris, Spyridium globulosum* open shrubland to high open shrubland over *Diplolaena dampieri* shrubland over *Trymalium ledifolium* var. *ledifolium*, (*Rhagodia baccata* subsp. *baccata*) low open shrubland to low shrubland over **Lolium rigidum* annual open grassland with *Acanthocarpus preissii, Lomandra maritima* open herbland. On a west-facing mid-slope of low Quindalup dune.

Photograph 29. Site CB29 (representing mapping unit OaSg). *Olearia axillaris*, (*Acacia rostellifera*) closed heath over **Pelargonium capitatum*, *Rhagodia baccata* subsp. *baccata* low open shrubland over *Ficinia nodosa* scattered sedges with *Cassytha racemosa* open lianes. Recorded on the crest and upper slope of a low dune. Very similar to the unit OaSgSc (site CB21).

Photograph 30. Site CB21 (representing mapping unit OaSgSc). *Olearia axillaris*, *Spyridium globulosum* shrubland to open heath over *Scaevola crassifolia*, *Rhagodia baccata* subsp. *baccata* low open shrubland over **Tetragonia decumbens* low open shrubland to low shrubland over **Ammophila arenaria* open grassland to grassland (forms closed grassland in patches on some slopes) and *Ficinia nodosa* scattered sedges with *Cassytha racemosa* very open lianes.

Photograph 31. Site CB29a (representing mapping unit OaSl). *Olearia axillaries*, (*Spyridium globulosum*) shrubland to open heath over *Spinifex longifolius* grassland to closed grassland with *Ficinia nodosa* scattered sedges. Only a few small areas of this vegetation observed. Recorded on a crest and slopes of a west-facing, low dune, about 100 to 150 metres from beach.

Photograph 32. Site CB12 (representing mapping unit SgAt). *Acacia saligna* scattered low trees over *Spyridium globulosum* high open shrubland over *Acacia truncata* (Sand dune variant), (*Olearia axillaris*) open heath over *Trymalium iedifolium* var. *iedifolium*, *Rhagodia baccata* subsp. *baccata*, *Leucopogon parviflorus* shrubland over **Lolium rigidum*, (*Austrostipa macalpinei*), *Poa porphyroclados* very open grassland with *Acanthocarpus preissii*, *Lomandra maritima* very open herbland. Similar to other dune upper slope heath units with *Olearia axillaries* and *Spyridium globulosum* dominants (OaDd, SaOa and SgOaAar/SgOaAr), but had *Acacia truncata* (Sand dune variant) as a codominant.

Photograph 33. Site CB9 (representing mapping unit SgOaAr). *Acacia rostellifera, Olearia axillaris, Spyridium globulosum* shrubland to open heath over *Leucopogon parviflorus, Rhagodia baccata* subsp. *baccata, Acacia cyclops* scattered shrubs over *Lomandra maritime, Acanthocarpus preissii* open herbland with **Lololium rigidum* very open grassland.

Photograph 34. Site CB35 (representing mapping unit SaOa). *Santalum acuminatum, Spyridium globulosum, (Olearia axillaris), Jacksonia furcellata* (on upper slope) open heath to open scrub over *Acacia rostellifera, Acacia cochlearis* scattered shrubs over *Leucopogon parviflorus* scattered low shrubs over *Desmocladus asper* scattered sedges with *Acanthocarpus preissii, Lomandra maritima* herbland and **Lolium rigidum* open grassland.

Photograph 35. Site CI1 (representing mapping unit EgAflOa). *Eucalyptus gomphocephala* open woodland over *Agonis flexuosa*, (*Allocasuarina fraseriana*) low open woodland to low woodland over *Banksia attenuata* scattered low trees over *Jacksonia sternbergiana*, *Olearia axillaris* high open shrubland over *Xanthorrhoea preissii*, *Macrozamia riedlei*, *Rhagodia baccata* subsp. *baccata* open shrubland to shrubland over *Phyllanthus calycinus* scattered low shrubs over **Briza maxima*, **Lagurus ovatus*, **Avena barbata* open annual weed grassland with *Acanthocarpus preissii*, *Lomandra maritima* open herbland.

Brian Morgan's
Caddadup Reserve
(City of Mandurah)
Access Database