ENVIRONMENTAL &
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DATABASES

Technical Report

March 2000

A Native Vegetation Survey of the Yorke Peninsula Region

South Australia 1994

Government of South Australia

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BIOLOGICAL SURVEY SOUTH AUSTRALIA

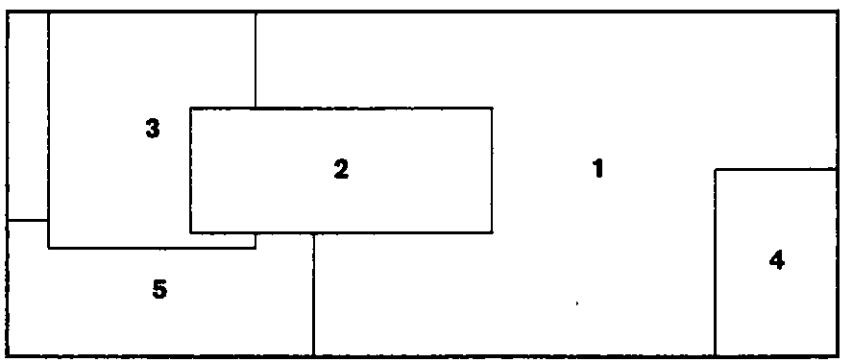

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Photo: SD Kenny

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Photo: J Kirk

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SUMMARY

During September 1994 a native vegetation survey of the Yorke Peninsula area was conducted using standard systematic and repeatable sampling techniques. This survey, partially funded by the National Estate Grants Program, is one of a series of vegetation surveys being conducted across South Australia's Agricultural Regions to provide background data on the native vegetation as an integral part of the Biological Survey of South Australia and the Environmental Data Base of South Australia (EDBSA).

Baseline vegetation and physical data was collected from 276 sites across the 132,224 hectares of native vegetation in the 927,096 hectare study area. The study area extended from Cape Spencer on the toe of Yorke Peninsula to west of Port Pirie in the north, Snowtown in the north east to just south of Port Wakefield in the south east. The average site density was one site per 479 ha of native vegetation.

A total of 9,798 plant species records were entered into the database and comprised 783 unique plant species. Of the 783 unique species, 168 species were recorded as having regional conservation significance according to Lang & Kraehenbuehl (1994), 57 as having a state rating and 10 species were recorded as having national conservation significance. The species recorded as having a national conservation significance were *Acacia enterocarpa* (Jumping-jack wattle), *Euphrasia collina ssp. osbornii* (Osborn's eyebright), *Caladenia bicalliata* (Limestone spider-orchid), *C. brumalis* (Winter spider-orchid), *C. conferta* (Coast spider-orchid), *Haegiela tatei* (Small nut-heads), *Prasophyllum calcicola* (Limestone leek-orchid), *P. goldsackii* (Goldsack's leek-orchid), *Senecio macrocarpus* (Large-fruit groundsel), and *Stipa multispiculis* (Small-seed spear-grass). All records of *Haegiela tatei* (Small nut-heads) and *Prasophyllum calcicola* (Limestone leek-orchid) were within National Estate areas, as was one record of *Caladenia brumalis* (Winter spider-orchid) and *Prasophyllum goldsackii* (Goldsack's leek-orchid).

There were 5 species collected that had not been previously recorded for the Yorke Peninsula Region. These were *Dillwynia hispida* (Red parrot-pea), *Olearia lepidophylla* (Club moss daisy bush), *Omphalolappula concava* (Burr stickweed), *Senecio tenuiflorus* (Woodland groundsel) and *Sida intricata* (Twiggy sida).

It was also noted that 151 of the 783 plant species were introduced. A total of 4,501 individual plant specimens were collected, processed and lodged with the Plant Biodiversity Centre.

A number of locations are considered to be significant in terms of vegetation communities. It is recommended that further investigations be undertaken to consider possible nominations to the Register of the National Estate.

All spatial data, such as the digitised landcover boundaries, are accessed, stored and maintained on a geographical information system (Environmental Systems Research Institute's [ESRI] ARC/INFO) while the biological data (textual data) are stored and maintained in the ORACLE relational database. Both the spatial and textual data, incorporated as part of the EDBSA, are maintained by the Information and Data Analysis Branch, Geographic Analysis and Research (GAR) Unit, Planning SA (formerly part of Department of Housing and Urban Development), within the Department for Transport, Urban Planning and the Arts (DTUPA).

ACKNOWLEDGMENTS

The Yorke Peninsula Native Vegetation Survey was carried out with the assistance of funds made available by the Commonwealth of Australia under the National Estate Grants Program.

Involved in any large-scale regional vegetation surveys are many people who provide a variety of expertise and assistance. The Yorke Peninsula Native Vegetation Survey was no exception.

In particular special thanks are extended to the landholders of the region, whose interest, support and cooperation contributed greatly to the success of this survey. In addition the Warooka Council (now part of the District Council of Yorke Peninsula) deserves special mention for the provision of office facilities for evening botanical work during the survey. The use of these facilities and assistance of the staff was greatly appreciated.

The list below (in alphabetical order) acknowledges the large number of people and organisations who have contributed. Thanks go to;

- Denzel Murfet, Rosemary Taplin and Peter Lang for their plant identification expertise, field knowledge and patience,
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All contributions and support was greatly appreciated.

1. INTRODUCTION

The Yorke Peninsula Native Vegetation Survey is one in a series of vegetation surveys being conducted in South Australia's Agricultural Region to provide background inventory data on the native vegetation of each region. These surveys are an integral part of the Biological Survey of South Australia and the ongoing development of the Environmental Database of South Australia (EDBSA), administered by Planning SA.

In 1993 funding was sought from the National Estate Grants Program (NEGP) for a native vegetation survey in the Yorke Peninsula region of South Australia (SA) with the aim of providing some baseline data on the vegetation of the area. Funding was received in mid 1994 and additional support was gained from the GAR Unit under the umbrella of consolidation of the Environmental Database of SA.

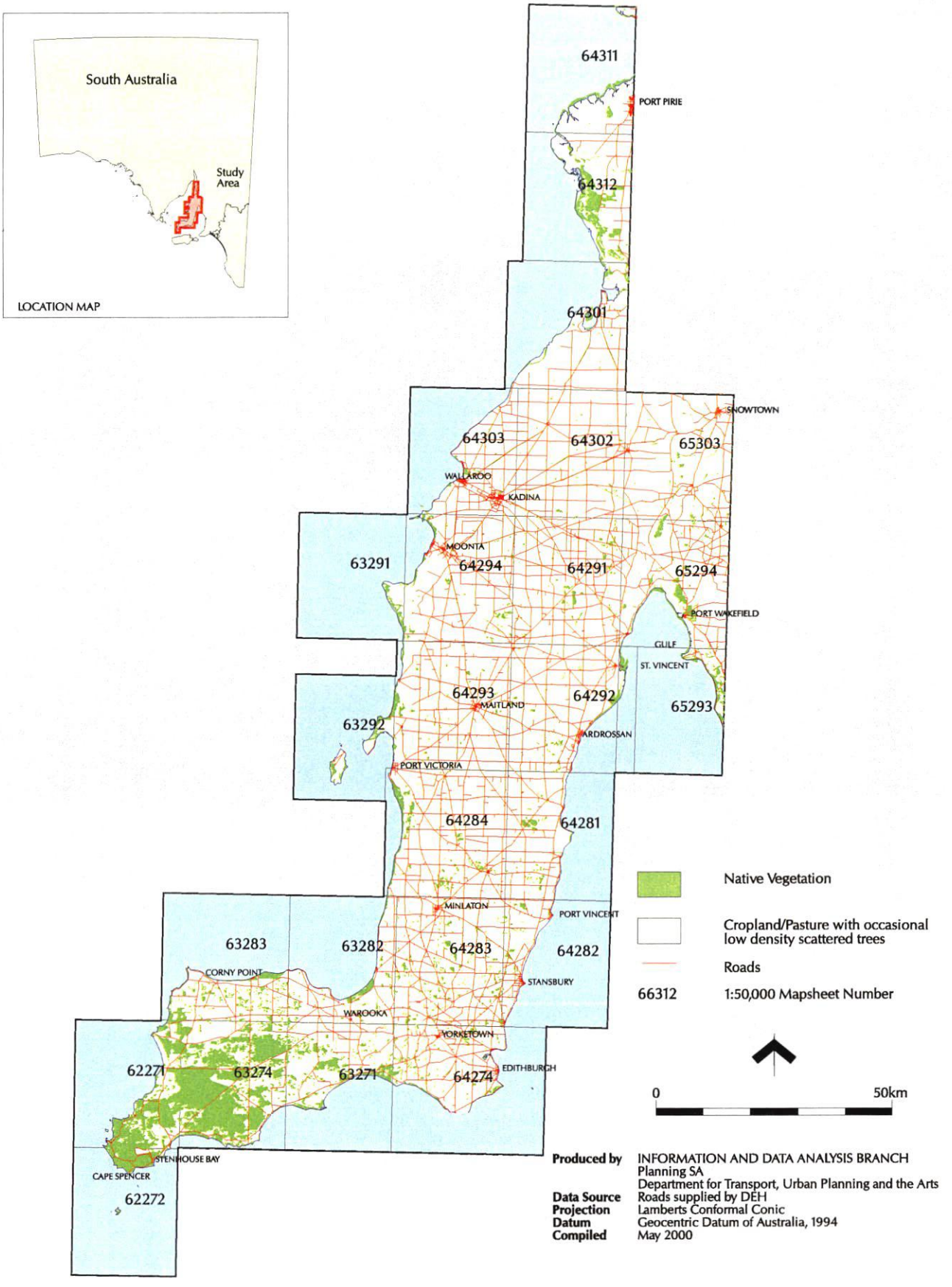
This survey contributes towards a comprehensive database of flora for the agricultural region of South Australia and eventually the whole of the State. It links with the adjacent Mid North Survey (1992) and subsequent Northern Adelaide Plains Survey (1996).

As this survey follows on from other similar surveys (Mid North, Western Murray Flats, South East, Murray Mallee, Kangaroo Island and Mt Lofty Ranges), the survey design was formulated so that data remains consistent and compatible with these surveys.

The survey area extends from Cape Spencer on the toe of Yorke Peninsula to just west of Port Pirie in the north, Snowtown in the north east and just south of Port Wakefield in the south east (see Figure 1). The total area across Yorke Peninsula and the adjacent areas of the Mid North is 927,096 hectares (9,271 square km) and involved approximately twenty five 1:50,000 standard mapsheets (refer to Figure 1). The survey was undertaken in September 1994.

This report provides details of the survey.

Figure 1. Yorke Peninsula Native Vegetation Study Area



2. BACKGROUND

Planning SA (DTUPA), in conjunction with the Department for Environment and Heritage (DEH)[1], has developed a vegetation mapping programme to survey, assess and classify remnant native vegetation in the State's agricultural region. These surveys, which come under the umbrella of the Biological Survey of SA, have been carried out by Biological Survey and Research Section, DEH and the Geographic Analysis and Research (GAR) Unit, Information and Data Analysis (IDA) Branch, Planning SA, with extensive support from other areas in these Departments.

The agricultural region is defined as the portion of South Australia not under Pastoral Lease. This region is characterised by a higher rainfall, more intensive agriculture and a fragmented landscape of easily recognisable areas of remaining native vegetation.

Biodiversity Monitoring and Evaluation[2] and Biological Survey and Research (DEH) are conducting assessment and classification of vegetation in the pastoral region. These sections are systematically investigating the impacts of pastoral activities on the environment and conducting vegetation and vertebrate surveys in environmental provinces within the region.

Both vegetation assessment and mapping programmes are devised and coordinated through the Biological Survey Coordinating Committee (BSCC). The role of the BSCC is to ensure support is available to conduct a survey, enforce data collection standards, identify gaps in existing knowledge and seek State and Federal government funds.

Data on native vegetation is fundamental to many of the State Government's activities ranging from clearance assessment (under the Native Vegetation Act 1991), biological and environmental research for land management, conservation and wilderness assessment, environmental impact assessment, fire and weed control and coastal management. This information may also be of future use in the assessment of vegetation condition for State of the Environment Reporting. All of these activities require, on an ongoing basis, varying degrees of information on the extent, quality and relative importance of remnant native vegetation.

The interest in native vegetation also extends widely outside Planning SA and DEH. Many organisations require detailed information about native vegetation. These include:

- Landcare and Coastcare Groups, Trees for Life and Greening Australia, and other groups with interests in seed sources, corridor establishment and optimising revegetation schemes to take advantage of existing remnants;
- organisations advising on catchment management schemes and salinity mitigation programmes;
- Primary Industries and Resources South Australia, for investigating land rehabilitation options and links between soil types and native vegetation communities;
- Mines and Energy South Australia, for assessing mining lease applications and suitable seed sources for rehabilitation;

[1] formerly Department for Environment, Heritage and Aboriginal Affairs.

[2] formerly the Pastoral Management Branch

- Country Fire Service, for determining bushfire hazard and the associated ecological values of native vegetation;
- corridor assessment being carried out by agencies including Transport SA, Local Government, Optus and ETSA Power;
- Tourism SA, for assessing the ecotourism potential in regional areas of the State;
- Local Governments for compiling biodiversity strategies, including weed management strategies; and
- Federal Government for determining policy, and for conducting monitoring as part of international agreements.

In addition, many research and academic institutions require detailed information on remnant vegetation to conduct research into its management and the associated benefits. The value of such research is often intangible and rarely accounted for when surveys are costed.

There are also many private landholders that value the opportunity to have some of the plants growing on their property identified, with scientific and common names supplied.

The need to systematically collect quantitative and qualitative data on the remaining native vegetation was identified prior to the creation of the Native Vegetation Heritage Scheme (1980). Many attempts had been made to conduct such surveys, but the lack of available tools to store and process this information limited their usefulness.

The purchase of a geographic information system (GIS) in 1984 by the Environmental Survey Branch (now the Geographic Analysis and Research [GAR] Unit) changed this situation. This system enabled the storage and manipulation of data about locations, and provided a set of tools that could describe and plot relationships about features on the Earth's surface. This is essential for analysing the distribution of species and environments in which they occur.

Since this time the GAR Unit, in conjunction with Biological Survey and Research (DEH), and under the auspices of the Biological Survey Coordinating Committee, have established data collection methods, data storage standards and data analysis techniques with an emphasis on preserving the original field data in digital form. This is to ensure that all the data are available for a range of different analysis techniques for any interested organisation. In addition, the survey data has facilitated the floristic mapping of remnant vegetation that now occurs using GIS techniques, resulting in a vegetation data layer.

The GAR Unit also represents the Environmental Node of South Australia's Land Information System. This role enables the collection and collation of many different data sets that relate to environmental and planning issues. The benefits of storing these data along with natural resource information means that it can be directly associated and plotted to reveal conflicts in land use, management policy and proposed developments.

2.1 Aims and Objectives

The Yorke Peninsula Native Vegetation Survey, partially funded by the NEGP, the GAR Unit and supported by the Biological Survey Coordinating Committee (BSCC) had the following main aims:

- produce a digital layer of the remnant vegetation patches coded according to the landcover type, which complies with established mapping standards;
- provide site-based plant species lists along with supporting physical environmental information at a density suitable for cluster analysis into meaningful floristic groupings;
- enable production of plant species distribution maps within the region; and
- use baseline data to suggest areas to be investigated for nomination to the National Estate Register.

The overall aim of the native vegetation survey programme in South Australia is to provide a baseline dataset on the floristic composition, structure, relative importance, area, perimeter, tenure and degree of disturbance of all remnants in the agricultural region of South Australia within the framework of South Australia's Land Information System. After further analysis, this will subsequently allow the following objectives to be achieved:

- objective classification of the vegetation communities and mapping of these;
- assessment of the status of the objectively classified vegetation communities with respect to the reserve system and past clearance activities;
- objectively advise on the proclamation of reserves and wilderness areas;
- produce maps of potential seed sources for revegetation schemes;
- predict the distribution of rare and threatened plant species and communities;
- produce datasets and maps, showing the most likely vegetation communities to have occurred prior to land clearance for revegetation schemes;
- produce datasets and maps, showing remnants, drainage lines, road reserves and tenure for identifying optimum paths for establishing habitat corridors;
- produce datasets and maps, showing areas of high fire danger and those of ecological importance in terms of fire management; and
- produce datasets and maps, identifying predicted habitat for conservation of significant fauna species.

2.2 Background on Native Vegetation

2.2.1 Historical Vegetation Records

Details of the vegetation communities recorded in literature references over time were summarised to assist with site selection (see Section 3.1.2) and are provided here as background.

Although the Biological Survey of South Australia methodology now uses the SA structural vegetation formation categories (Heard and Channon 1997) (refer Appendix 1) which were derived from Specht (1972) (Appendix 2) and Muir (1977) (Appendix 3), the historical data summarised here take their structural classification from Specht (1972). Where the taxonomy has changed, plant species names according to Jessop (1993) have been substituted with the exception of *Gahnia trifida*, which was presumed to be *Gahnia filum*[3]. The following communities are listed in the Structural Formation order (largest lifeform to smallest) according to Specht (1972). Where two or more vegetation types occur in the same structural category then these are listed alphabetically.

2.2.2 Woodland Associations

Melaleuca lanceolata (Dryland tea-tree) Woodlands
This association is widespread but rather patchy over Yorke Peninsula. It occurs on shallow, rocky calcareous soils in coastal/subcoastal areas or as thickets around clay pans or, less often, on heavy grey or brown clay loams over limestone (Boomsma and Lewis 1980). In the northern part of the study area where *Melaleuca lanceolata* (Dryland tea-tree) occurs as overstorey it is often found with *Pittosporum phylliraeoides* (Native apricot) and *Callitris preissii* (Southern cypress pine) over *Acacia ligulata* (Umbrella bush), *Geijera linearifolia* (Sheep bush), *Santalum acuminatum* (Quandong) and *Dodonaea viscosa* (Sticky hop-bush) with the ground layer consisting of chenopods and grasses. Further south near Yorketown it occurs over *Gahnia lanigera* (Black grass saw-sedge) and *Lomandra effusa* (Scented mat-rush) and just south of Port Julia it occurs in large numbers as an Open Heath formation between the cliffs and the sea. *Melaleuca lanceolata* (Dryland tea-tree) also occurs as a co-dominant with a number of mallee *Eucalyptus* species and occasionally with *Allocasuarina verticillata* (Drooping sheoak) (Foale 1975).

Allocasuarina verticillata (Drooping sheoak) Open woodland
This vegetation type occurs on shallow rocky calcareous soils in subcoastal areas and as the first medium sized tree on deep sands and dunes in the coastal communities (Boomsma and Lewis 1980). In Leven Beach Conservation Park, *Allocasuarina verticillata* (Drooping sheoak) occurs as Low or Low open woodland +/- *Melaleuca lanceolata* (Dryland tea-tree) over *Acacia calamifolia* (Wallowa), *A. ligulata* (Umbrella bush), *A. leiophylla* (Coast golden wattle), *Leucopogon parviflorus* (Coast beard-heath), *Rhagodia candolleana ssp. candolleana* (Seaberry saltbush), *Lepidosperma gladiatum* (Coast sword-sedge), *Lasiopetalum discolor* (Coast velvet-bush), *Exocarpus syrticola* (Coast cherry) and *Adriana klotzschii* (Coast bitter-bush) (Neagle 1995). Where it occurs in Warrenben Conservation Park it is either as the dominant species or in association with *Eucalyptus diversifolia* (Coastal white mallee) over *Melaleuca lanceolata* (Dryland tea-tree), *Beyeria lechenaultii* (Pale turpentine bush) and *Calytrix tetragona* (Common fringe-myrtle). In Innes National Park on the toe of Yorke Peninsula it occurs within the mallee associations in glades either with or without *Melaleuca lanceolata* (Dryland tea-tree), usually over a grassy understorey (Davies 1982).

Eucalyptus camaldulensis (River red gum) Open woodland
A limited distribution of *Eucalyptus camaldulensis* (River red gum) occurs on Yorke Peninsula and its main population is on the central leg of the peninsula on calcareous soil over a shallow water table which is within root reach (Boomsma and Lewis 1980). An example of these trees can be seen just beyond the Minlaton Golf Course at Gum Flat (Corbett 1973).

[3] *Gahnia trifida* was recorded in error in (Foale 1975). *Gahnia trifida* had not been recorded on Yorke Peninsula prior to 1999, but it has since been found at 2 locations. (R. Taplin, pers. comm., May 1999)

Avicennia marina var. resinifera (Grey mangrove) Low woodland / Closed scrub / Open scrub
Avicennia marina var. resinifera (Grey mangrove) formations usually occur as pure stands along mud flats around the top of the Gulf St Vincent and along the west coast of Yorke Peninsula from just north of Wallaroo to Port Pirie. The community inhabits the littoral zone where flooding occurs daily with the tides, and often follows drainage channels into salt marshes as far as the tide rises (Specht 1972).

Casuarina pauper (Black oak) Low woodland / Low open woodland/Open scrub
Casuarina pauper (Black oak) occurs in the northern part of the study area, usually on dunes over shallow calcareous soils. It is found sporadically as single trees or in clumps or groves intermingled with other species. Examples of species that may be found as co-dominants with the Black oak are; *Acacia ligulata* (Umbrella bush), *Callitris preissii* (Southern cypress pine), *Callitris verrucosa* (Scrub cypress pine), *Eucalyptus gracilis* (Yorrell), *E. oleosa* (Red mallee), *E. socialis* (Beaked red mallee), *Alectryon oleifolius* (Bullock bush) and *Myoporum platycarpum* (False sandalwood) (Boomsma and Lewis 1980).

Eucalyptus porosa (Mallee box) Low woodland / Tall shrubland
Eucalyptus porosa (Mallee box) occurs in a Low woodland structure as a dominant overstorey on low hills east of Maitland. Here the understorey is either *Melaleuca uncinata* (Broombush) and other low shrubs, or *Allocasuarina verticillata* (Drooping sheoak) and *Acacia pycnantha* (Golden wattle) over low shrubs and tussock grasses (Foale 1975). South of Minlaton this association occurs as a Low woodland with an understorey of *Bursaria spinosa* (Sweet bursaria) and tussock grasses (Foale 1975). Further south it occurs around the Leven Beach Conservation Park area as Low woodland with understorey of *Melaleuca lanceolata* (Dryland tea-tree), *Pomaderris paniculosa* (Mallee pomaderris), *Correa pulchella* (Salmon correa), *Templetonia retusa* (Flame bush), *Bursaria spinosa* (Sweet bursaria) and *Gahnia trifida* (Cutting grass). *Eucalyptus porosa* (Mallee box) is also recorded as a Tall shrubland occurring in the low hills of the South Hummocks (Foale 1975). At this location Foale (1975) indicates that the understorey is reduced to mainly introduced grasses with some native grasses and low shrubs and presumes this is due to past grazing pressure.

Melaleuca halmaturorum (Swamp paper-bark) Low Woodland / Closed scrub / Open scrub / Low open shrubland
Melaleuca halmaturorum (Swamp paper-bark) has a restricted distribution on Yorke Peninsula. It forms dense thickets around the fringes of salt marshes and saline lagoons and a more open scrub formation on heavy black soils subject to winter inundation. Examples of this association can be found in remnants between Stansbury and Hardwicke Bay, south of the road to Corny Point and in Innes National Park (Foale 1975).

2.2.3 Scrub/Shrubland (Mallee) Associations

Eucalyptus diversifolia (Coastal white mallee) Closed scrub / Open scrub / Tall shrublands
Eucalyptus diversifolia (Coastal white mallee) is widely distributed over the southern extension of Yorke Peninsula and commonly occurs as a Closed or Open shrubland (Foale 1975). Preferring calcareous sands and shallow calcareous soils it occurs as the exclusive dominant in some areas but often forms associations with a number of other mallee species (Boomsma and Lewis 1980). The more common associations are as follows;

> *Eucalyptus diversifolia* (Coastal white mallee) +/- *E. oleosa* (Red mallee) Tall shrublands
> This association occurs extensively over the foot of Yorke Peninsula. In Carribie Conservation Park this association may also contain *E. leptophylla* (Slender-leaved mallee) and *E.*

conglobata (Cong mallee) as part of the overstorey. Understorey plants include *Callitris canescens* (Scrubby cypress pine), *Gahnia lanigera* (Black grass saw-sedge) and in parts *Triodia irritans* (Spinifex) and *Acacia brachybotrya* (Grey mulga-wattle) (Davies 1982). The same association also occurs in a large patch south east of Warrenben Conservation Park with the inclusion of *Eucalyptus socialis* (Beaked red mallee) as an overstorey co-dominant (Foale 1975).

Eucalyptus diversifolia (Coastal white mallee) +/- *E. rugosa* (Kingscote mallee) +/- *E. oleosa* (Red mallee) Open scrub
Examples of this association can be found in Warrenben Conservation Park with an understorey of *Pomaderris obcordata* (Wedge-leaf pomaderris), *Melaleuca lanceolata* (Dryland tea-tree), *Beyeria lechenaultii* (Pale turpentine bush) and other heathy shrubs. In Innes National Park patches of this association include *Eucalyptus leptophylla* (Slender-leaved mallee) in the overstorey mix (Davies 1982).

Eucalyptus spp. (Mallee) over *Melaleuca uncinata* (Broombush) and/or *M. acuminata* (Mallee honey-myrtle) Closed scrub / Open scrub

This is a very common association extending along the length of Yorke Peninsula. The overstorey can be comprised of a varying mixture of mallee eucalypt species. The understorey commonly contains species of *Lasiopetalum* (Velvet-bush), *Acrotriche* (Ground-berry), *Hibbertia* (Guinea flower) and tussocks of *Lomandra effusa* (Scented mat-rush) and/or *Gahnia lanigera* (Black grass saw-sedge) (Foale 1975). An area of acid sands west of Stansbury hosts an interesting community of *Eucalyptus incrassata* (Ridge-fruited mallee) with an understorey consisting of *Melaleuca uncinata (Mallee honey-myrtle), Acrotriche spp.* (Ground-berry) and *Xanthorrhoea semiplana ssp.* (Yacca) over tussock grasses of *Lomandra effusa* (Scented mat-rush) and *Gahnia lanigera* (Black grass saw-sedge) (D. Krahenbuehl, pers. comm., 1994). This association continues northward but the understorey composition gradually changes. For example an association consisting of mallee *Eucalyptus* species over *Melaleuca uncinata* (Broombush) occurs just south of Moonta but the shrub layer is replaced by *Triodia irritans* (Spinifex) and *Lomandra effusa* (Scented mat-rush). North of Moonta the understorey grades to chenopod shrubs and mainly introduced grasses (Foale 1975).

Eucalyptus 'anceps'[4] (Sessile-fruit white mallee) Open scrub
Eucalyptus 'anceps' (Sessile-fruit white mallee) has often been included with *E. dumosa* (White mallee) and so has been omitted from many field records. According to Boomsma and Lewis (1980) it is widely distributed but occurs infrequently over Yorke Peninsula and often associates with one or more of the following - *Eucalyptus calycogona* (Square-fruit mallee), *E. dumosa* (White mallee), *E. gracilis* (Yorrell), *E. incrassata* (Ridge-fruited mallee), *E. oleosa* (Red mallee) or *E. socialis* (Beaked red mallee).
Eucalyptus brachycalyx (Gilja) Open scrub
In the northern section of the study area, on shallow rocky soils over limestone, a mosaic of different combinations of *Eucalyptus spp.* (Mallees) occur. *Eucalyptus brachycalyx* (Gilja) associates with *E. gracilis* (Yorrell), *E. socialis* (Beaked red mallee) and *E. leptophylla* (Slender-leaved mallee) (Boomsma and Lewis 1980). North of Ardrossan on cliff tops *E. brachycalyx* (Gilja) forms an Open scrub with *E. rugosa* (Kingscote mallee) and *E. gracilis* (Yorrell) while 15km south of Price the dominant species are *E. 'anceps'* (Sessile-fruit white mallee), *E. brachycalyx* (Gilja), *E. porosa* (Mallee box) and *Callitris preissii* (Southern cypress pine) (Boomsma and Lewis 1980).

[4] This species is now described as *Eucalyptus phenax*

Eucalyptus gracilis (Yorrell) Open scrub
Occasionally forming pure stands, *Eucalyptus gracilis* (Yorrell) often forms alliances with *E. socialis* (Beaked red mallee) and *E. dumosa* (White mallee) on Yorke Peninsula (Specht 1972). An example of this occurs in Clinton Conservation Park where it is the dominant species with an understorey of *Geijera linearifolia* (Sheep bush) and *Pittosporum phylliraeoides* (Native apricot) (Davies 1982).

Eucalyptus leptophylla (Narrow-leaf red mallee) Open scrub
This species becomes an equal dominant with *E. incrassata* (Ridge-fruited mallee) on deep siliceous sands over clay on southern Yorke Peninsula. *E. 'anceps'* (Sessile-fruit white mallee) and *E. diversifolia* (Coastal white mallee) may also be present (Boomsma and Lewis 1980).

2.2.4 Coastal Shrubland Associations

Cliff System Shrublands / Low shrublands
Low shrubs occur on the cliffs that run almost continuously along the east coast of Yorke Peninsula and intermittently from Edithburgh to Corny Point (Foale 1975). The cliff faces are often vegetated and, depending on soil cover and slope, can host a variety of formations from open low scrub to dense low heath. Due to strong, salt laden onshore winds, cliff vegetation is often dwarfed and plant leaves become fleshy to cope with difficult conditions. Plants consistently associated with this habitat are *Scaevola crassifolia* (Cushion fanflower), *Beyeria lechenaultii* (Pale turpentine bush), *Isolepis nodosa* (Knobby club-rush), *Myoporum insulare* (Common boobialla), *Acacia longifolia var. sophorae* (Coastal wattle) and *Leucophyta brownii* (Coast cushion bush) (Foale 1975). The cliff tops can either be overlain with sand dunes or, more generally, consist of aeolianite limestone. Plants most consistently associated with cliff tops are *Olearia axillaris* (Coast daisy-bush), *Acacia longifolia var. sophorae* (Coastal wattle), *Lasiopetalum discolor* (Coastal velvet bush), *Acrotriche patula* (Prickly ground-berry), *Beyeria lechenaultii* (Pale turpentine bush), *Scaevola crassifolia* (Cushion fanflower), *Myoporum insulare* (Common boobialla), *Leucopogon parviflorus* (Coast beard-heath) and *Nitraria billardierei* (Nitre-bush) (Foale 1975).

Sand Dune Shrublands
At intervals, along the entire coastline of York Peninsula, coastal dune systems feature. The foredunes are chiefly colonised by *Cakile maritima* (Two-horned sea rocket) and *Spinifex sericeus* (Rolling spinifex) with *Atriplex cinerea* (Coast saltbush), *Leucophyta brownii* (Coast cushion bush) and *Isolepis nodosa* (Knobby club rush) also commonly present (Foale 1975). Once past the crest of the foredune, a low shrubland community forms dominated by species such as *Olearia axillaris* (Coast daisy bush), *Isolepis nodosa* (Knobby club rush), *Myoporum insulare* (Common boobialla), *Alyxia buxifolia* (Sea box), *Acacia longifolia var. sophorae* (Coastal wattle), *Acacia ligulata* (Umbrella bush) and *Exocarpus syrticola* (Coast cherry) (Foale 1975). Continuing inland a tall shrubland community emerges, which often comprises *Allocasuarina verticillata* (Drooping sheoak), *Melaleuca lanceolata* (Dryland tea-tree), *Eucalyptus diversifolia* (Coastal white mallee), *E. 'anceps'* (Sessile-fruit white mallee), *Adriana klotzschii* (Coast bitter-bush), *Melaleuca uncinata* (Broombush), *Lasiopetalum discolor* (Coast velvet-bush), *Acacia longifolia var. sophorae* (Coastal wattle), *Myoporum insulare* (Common boobialla) and *Olearia axillaris* (Coast daisy bush) (Foale 1975).

Low Saltmarsh Shrublands
These low samphire shrublands are found in the semi saline swamps and lagoons on the foot of Yorke Peninsula and along the intertidal and supra tidal salt marshes around Port Wakefield and north of Wallaroo. Various species dominate these areas depending on the level of inundation and salt concentration (Foale 1975). The species tolerating the highest levels of inundation and salt are

Sclerostegia arbuscula (Shrubby samphire) and *Sarcocornia quinqueflora* (Beaded samphire). Both these species grow on mud saturated with salt water and either can form pure stands but often grow in association with each other (Specht 1972). Species of *Halosarcia* (Samphire) tolerate only occasional flooding and so occur on the outer edges of the swamps or in the saltmarshes where they will only occasionally be flooded by high spring tides (Specht 1972, Foale 1975). *Atriplex paludosa* (Marsh saltbush) occurs on the upper limits of the salt marsh and prefers more friable soils with lower salt concentration. Still associated with saline soils but disliking inundation are shrublands of *Maireana oppositifolia* (Salt bluebush) and *Nitraria billardierei* (Nitre-bush)(Specht 1972).

2.2.5 Hummock Grasslands

Communities of *Triodia compacta* (Spinifex) occur in small areas on the west coast of Yorke Peninsula. It is found on the landward slopes of dunes and in swales and occasionally on the flats. This community is most widespread between Pt Rickaby and Chenowith and may cover as much as a hectare there. South of Minlacowie it is rare (Foale 1975).

2.2.6 Sedgelands

Around saline lagoons and swamps on the foot of Yorke Peninsula *Gahnia filum* (Cutting grass) forms open tussock sedgelands. Another sedgeland community in this area is *Gahnia lanigera* (Black grass saw-sedge) sedgelands. These types of sedgelands characterise some glades found within mallee eucalypt vegetation (Foale 1975). *Lepidosperma spp.* (Sword-sedge/rapier-sedge) form areas of sedgeland in Carribie Conservation Park (Davies 1982).

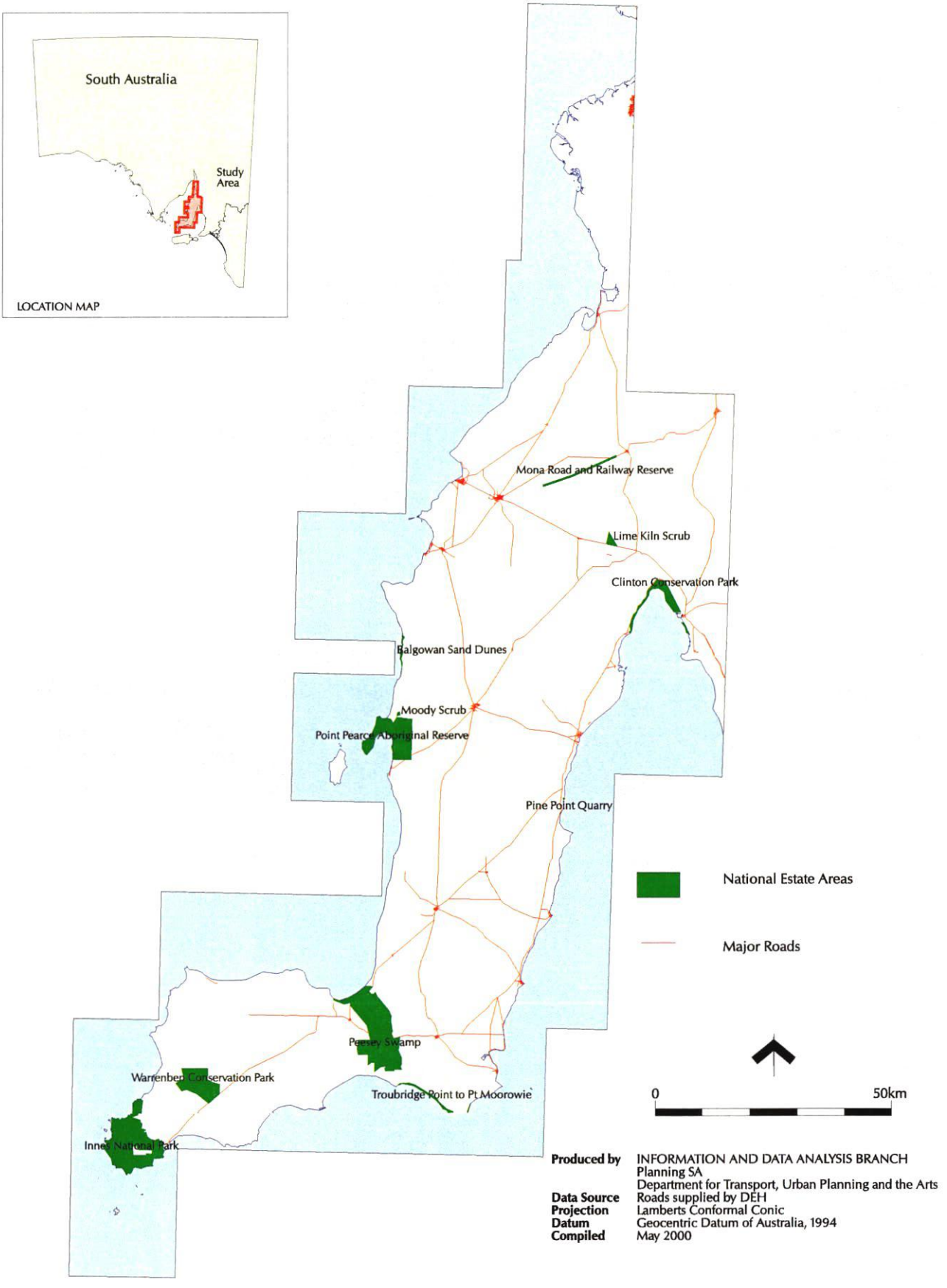
2.3 Background on National Estate Areas

The selection of sites for the survey took into account areas already on the register of the National Estate (see Section 3.1.2). Within the study area there are 11 major National Estate Areas located within national parks (1), conservation parks (2), roadside/railway reserves (1), Aboriginal reserves (1), historic locations (1) and areas of national (geological and floristic) significance (5). The total area represented on the National Estate Register within the study boundary is 46,996 hectares or 5.06% of the study area. Figure 2 depicts all areas of National Estate within the survey study area.

The southern extent of Yorke Peninsula is well represented by Innes National Park, Warrenben Conservation Park and Peesey Swamp. Other National Estate areas are Troubridge Point to Pt. Moorowie, which is on the south east coast and Point Pearce Aboriginal Reserve on the mid-west coast. The Balgowan sand dunes are another coastal area with National Estate listing and are found just north of Balgowan on the west coast of Yorke Peninsula. Moody scrub is located south of Balgowan and just north of Point Pearce. Pine Point Quarry is found on the central east coast. Other areas located on northern Yorke Peninsula are Lime Kiln Scrub and Mona Road and Railway Reserve. Clinton Conservation Park occurs at the top of Gulf St. Vincent.

Innes National Park was declared to preserve the habitat of the Western Whipbird (*Psophodes nigrogularis*). Warrenben Conservation Park is a 4,061 ha area of *Eucalyptus diversifolia* (Coastal white mallee), *E. porosa* (Mallee box) over a heath understorey, representative of the sand dune terrain of southern Yorke Peninsula, thus a reservoir of fauna and flora. Peesey Swamp is an area of marshy saline flats with low ridges of kunkarised shells and shell sand of marine origin extending

Figure 2. National Estate Locations within Survey Area



parallel to the swamp. Troubridge Point to Pt. Moorowie has classic coastal cliff vegetation, good species diversity and contains habitat for White-breasted sea eagles (*Haliaeetus leucogaster*) and Ospreys (*Pandion haliaetus*). It also has items of geological interest, for example Permian glacial deposits. Balgowan Sand Dunes represent an extensive area of a poorly conserved *Melaleuca lanceolata*
(Dryland tea-tree), *Callitris preissii* (Southern Cypress pine), *Allocasuarina verticillata* (Drooping sheoak) coastal plant association in near pristine condition. Lime Kiln Scrub has the only remaining South Australian population of *Phebalium glandulosum* (Glandular phebalium), is significant for birds and is also one of the largest areas of scrub remaining on the Northern Yorke Peninsula. Mona Road and Railway Reserve contains the best-preserved belt of remnant native vegetation on Northern/Central Yorke Peninsula. This 20km transect of native vegetation has considerable changes of vegetation associated with climatic and soil variations. It is a valuable habitat for birds and is significant as a wildlife corridor. Clinton Conservation Park preserves one of the major *Avicennia marina* (mangrove) and saltflat (saltmarsh) associations in South Australia.

3. PROJECT METHODOLOGY

The Yorke Peninsula Survey followed the standards and survey methodology developed by previous surveys, which have been carried out under the auspices of the BSCC. The process falls into 3 major parts:

- pre survey planning and organisation
- field survey
- post survey database work and feedback

Statistical floristic analysis and vegetation mapping which usually occurs following regional surveys were not part of this project. This has been undertaken and funded separately by the GAR Unit. The regional floristic analysis, using datasets amalgamated from this study area and adjoining areas, has been completed however results are not yet available for public release. The vegetation mapping, also in the final stages of completion, is expected to be available by September 2000.

Specific details on project planning procedures, particularly for the survey process, can be found in the Yorke Peninsula Vegetation Survey Manual compiled by the GAR Unit, Planning SA, for the survey.

3.1 Pre Survey

3.1.1 Digital Landcover Layer Compilation

Prior to the commencement of such a vegetation survey, it is necessary to compile a digital landcover layer. This then provides the foundation for location of survey sites and the production of accurate vegetation maps, based on colour aerial photography. To achieve this, a planimetric base must be produced on which site localities and aerial photo interpretations will be recorded, digitised and coded to establish appropriate digital coverages.

The planimetric base was produced with line features such as roads, railways, utility services (such as pipelines and transmission lines) and administrative boundaries digitised from Dept for Environment and Heritage (DEH) 1:50,000 standard mapping. Landcover boundaries (polygons) showing lakes, land subject to inundation, bare sand dunes, built-up areas and hardwood and softwood plantations, were also digitised from DEH 1:50,000 maps where they were greater than one hectare in area. All the data from approximately twenty-five 1:50,000 maps were plotted onto transparent mylar sheets at 1:40,000 scale, similar to the colour aerial photography. Using 1991 to 1993 aerial photography in stereo pairs, native vegetation landcover was then manually mapped onto the mylar bases. In some cases where pre-existing mapping occurred, of non-native vegetation landcover, the mapper may have noted a change or addition. Any necessary changes or additions were also made onto these mylar bases. Mapping and updates were then digitised. A series of checks were made following the digitising to ensure mapsheet linework and coding matched adjacent mapsheets.

All information was entered and coded using the Environmental Systems Research Institute's (ESRI) geographic information systems (GIS) software package ARC/INFO.

Table 1 provides a summary of the landcover types, area and percentage of the study area under each type and Table 2 provides a summary of the tenure within the study area.

Table 1: Landcover Area Estimates for Study Area

Type	Estimated Area (ha)	% of total area
Urban	1,632	<1
River/Lake/Swamp (inc. wetlands)	17,722	<1
Cropland/pasture with occasional low density scattered trees	774,513	84
Native Vegetation	132,224	14
Other (sand/cliff)	1,005	<1
Total	927,096	100

Source: Native vegetation mapping (GIS), (1991, 1992, 1993 colour aerial photography, Planning SA)

Table 2: Tenure of Native Vegetation for Study Area

	Tenure	Estimated Total Area (ha)	Estimated Area of Vegetation (ha)	% of total native vegetation	% of total region
Government Land	National Parks and Wildlife Reserves (*NPWS Act 1972*)	16,866	14,689	11	1.5
	Conservation Reserves (*Crown Lands Act 1929*)	n/a			
Private Land	Heritage Agreements	15,417	13,983	11	1.5
	Other		103,552	78	11
	Total		132,224	100	14

Note: Protected areas include NPWSA Reserves, Conservation Reserves and Heritage Agreements (all current to January 2000.)

Source: Native vegetation mapping (GIS), (1991,1992, 1993 colour aerial photography, Planning SA); NPWS Reserves (GIS), Heritage Agreements (GIS), and Pastoral Lease boundaries (GIS) DEH.

3.1.2 Site Selection

In conjunction with the landcover mapping a site based vegetation survey is necessary to provide accurate on-ground attribute data, which can then be used to describe the variety of vegetation communities that occur across the region. Two techniques commonly used for selection of vegetation sites are random sampling and stratified sampling. As fragmentation of the native vegetation has occurred due to European settlement and agricultural practices an initial level of stratification has been imposed. Working with this, the next level of stratification used involved aerial photography interpretation in conjunction with knowledge of the area from literature and other resources followed by field checking. As survey sites should be selected to sample as many remnants as possible and provide a roughly even coverage of the area, as well as to sample the range of Environmental Associations and vegetation and landform types across the study area, there were a number of tasks involved. These are documented below.

At the commencement of the project, a search and collation of published literature was undertaken to assist in the various stages of the project. Prior to selecting sites this literature was reviewed to highlight references that provided an overview of the regional vegetation and an understanding of the relationship between local vegetation communities, soil and landform types. References of particular assistance were National Parks and Wildlife Service (1982), Davies (1982), Green (1993), Foale (1975), Playfair (1994), Boomsma and Lewis (1980) and Laut et al. (1977). Other information sources included data recorded for Heritage Agreements and discussions with botanical experts, field naturalists and local people. These discussions, in particular, assisted in the location of significance areas and emphasised areas where further investigation would be useful. Enquiries were also made to determine where survey sites might exist that were not entered on the EDBSA. These enquiries revealed the Coast and Marine Section, Environmental Protection Agency (EPA)[5], had completed some transect survey sites west to south west of Port Pirie. This data would assist any subsequent analysis investigating the vegetation classification across the region and / or vegetation mapping in that area. This data was noted for inclusion into the Biological Survey database at a later stage.

A map showing spatial relationships of existing information was prepared using the GIS software (Arc/Info) to assist the site selection process. This map showed the National Estate areas, location of existing sites (to avoid duplication of survey effort), Environmental Associations of South Australia (ENVSA), National Parks and Wildlife (NPW) SA[6] parks and reserves, heritage agreement areas, roads, landcover, mapsheet boundaries and Local Government Area (LGA) boundaries. Figure 3 illustrates a section of this map, which was produced for the full survey area. The environmental associations acted as a guide so that sites could be selected to represent the widest possible range of different environments. As part of the site selection process, the aim was to select a representative of each different type of vegetation community present on each mapsheet, taking into account different landforms, geology and soil types.

Prior to the commencement of the actual selection of survey sites it was important to determine an approximate site density (per mapsheet) as a guide. Several factors contribute to this, particularly the amount and diversity of native vegetation in the survey area and a reasonable assessment of the practical capability of field staff to travel to and from survey sites. Previous survey work indicated that it was reasonable to expect that between 5 - 7 sites could be surveyed per day per team. Approximate calculations were made to estimate the number of sites to be selected per 1:50,000 mapsheet, that would provide representative coverage and could be adequately surveyed within the allotted survey time frame of two weeks (based on the grant funding allocation). As a result 10 –12 sites were estimated as the number of sites that could be adequately surveyed per mapsheet. A total of 250 - 300 sites were estimated to be required across the study area providing a site density of 1 site per 441 ha - 529 ha of native vegetation.

However the reality of site selection was different. Due to the diverse nature of Yorke Peninsula, with every mapsheet containing coastal and inland land systems, each mapsheet contained a wide variety of communities to be sampled making selection of only 10-12 sites difficult. To further complicate this process 46% of the remnant native vegetation was distributed within 25% of the entire study area (refer to Figure 1). As a result some mapsheets, particularly the southern ones where large blocks of native vegetation remain, required a greater number of sites to be selected to check the variety of communities perceived to be present according to aerial photo interpretation.

[5] Formerly the Coastal Management Section, Department for Environment, Heritage and Aboriginal Affairs.

[6] Formerly National Parks and Wildlife Service.

The task of site selection was undertaken using 1:40,000 scale colour aerial photography, viewed under a stereoscope. Individual blocks of remnant vegetation were examined then sites (quadrats) were selected, across the mapsheet, to meet criteria mentioned above.

Survey site locations were generally selected away from ecotones or disturbed areas and placed where access would not be too difficult. As a result sites were generally selected within 200 metres of access tracks, particularly in large blocks of remnant vegetation where disorientation can easily occur.

Preferential selection was given to sites that appeared to be in good condition (minimal disturbance), as perceived from the summer captured aerial photography and that would reflect the range of textural and tonal vegetation signatures that were observed. There appeared to be a human bias to select sites in the darker coloured tones, as these were perceived to be less disturbed. It was important to overcome this tendency, to avoid missing open woodland areas with native grassland understorey which were characterised by a sparser overstorey canopy and lighter colour tones. An effort was also made to sample areas of native grassland, sedgelands and samphire shrublands. On the aerial photography, these vegetation types are often indistinct and at best appeared as even, light to mid grey toned areas. Subsequent survey work found these areas were sometimes confused with pastures and/or cropland on damp soil areas close to saline lakes or areas subject to inundation, where salt marsh shrublands and sedgelands may have occurred previously.

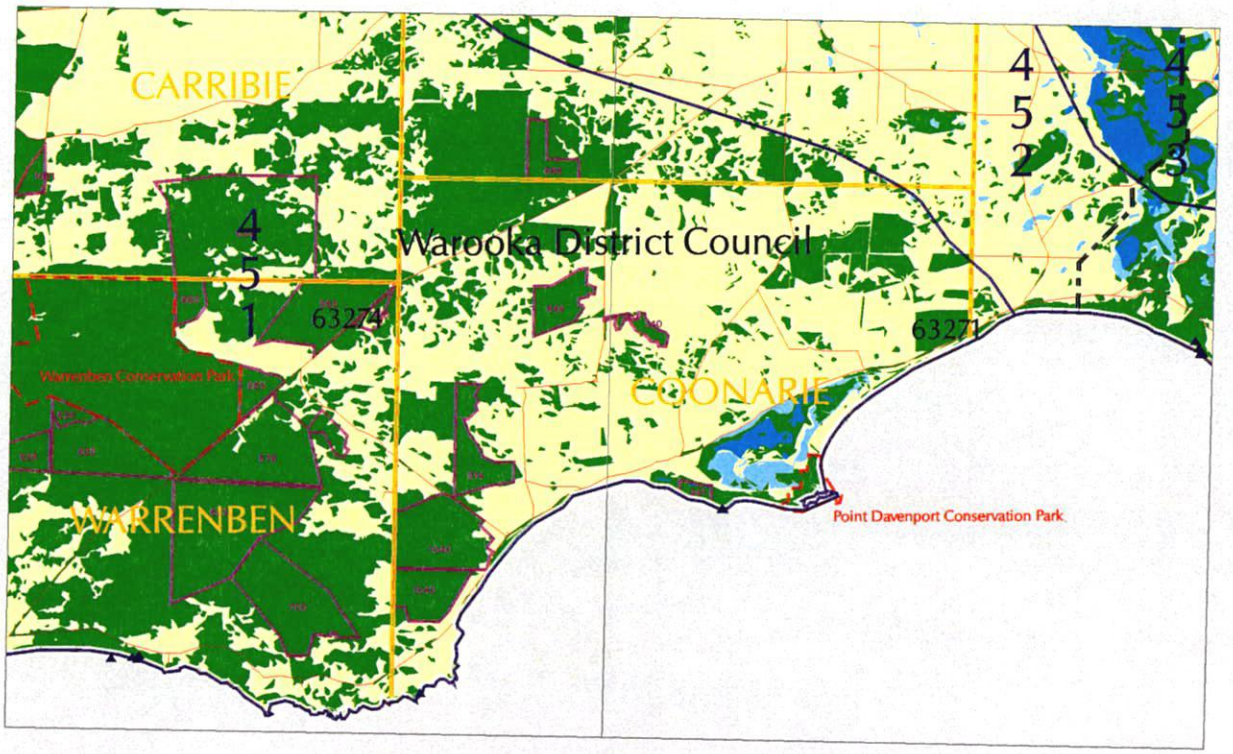
Another aspect considered in site selection was matching across mapsheet boundaries. Matching boundaries assists future floristic mapping continuity between adjacent mapsheets, while replication of vegetation types assists the vegetation classification process to gain adequate summaries and statistics for communities.

To assist site selection further, field trips were undertaken to gain better local knowledge and adequately correlate reality (on-ground vegetation) with the aerial photograph's colour tones and textures. These trips were also used to meet with local field naturalists to access local knowledge and gain suggestions for site locations. Local contacts included Ian Brown of Minlaton, Hugh Longbottom (Revegetation Officer, PIRSA) of Maitland and Jim Earl (NPW SA Ranger, DEH) Innes National Park. Other expert advice on botanically important areas was obtained from departmental scientific officers Peter Lang (Biological Survey & Research, DEH) and Darrell Kraehenbuehl (Biodiversity Conservation[7], DEH).

During site selection, notes were made on the aerial photographs at selected sites indicating what the site selector was attempting to direct the survey team to. This allowed essential communication between the site selector and survey team, giving the survey team the ability to make on-ground decisions regarding the best location to reflect the vegetation types, while also allowing the survey team the opportunity to add in further sites if necessary. This flexibility was essential.

[7] Formerly Wildlife Management, DEHAA.

Figure 3. Example of Existing Data used for Site Selection on Yorke Peninsula



- Built up Area
- Lakes
- Land Subject to Inundation
- Sand Dunes
- Native Vegetation
- Cropland / Pasture with Occasional Low Density Scattered Trees

- Major Roads
- IGA Boundary
- Heritage Agreement Areas / HA Number
- Hundreds / Hundred Name
- NPWS Boundary / NPWS Name
- ENVSA Boundary / ENVSA Number
- Mapsheet Boundary
- 66312 1:50,000 Mapsheet Number
- ▲ Existing Survey Sites

0 10km

Produced by INFORMATION AND DATA ANALYSIS BRANCH
Planning SA
Department of Transport, Urban Planning and the Arts
Data Source Roads supplied by DEH
Projection Transverse Mercator
Datum Geocentric Datum of Australia, 1994
Compiled May 2000

BIOLOGICAL SURVEY SOUTH AUSTRALIA
Government of South Australia
ENVIRONMENTAL & SOCIO-ECONOMIC DATABASES

GAR Map No: 2414

A site code system was designed to provide a unique and meaningful way to identify each site (quadrat). The system used indicated the mapsheet the site (quadrat) was on, the number of the remnant vegetation block to be visited on that sheet and the quadrat (site) within that particular block to be surveyed. For example, MIN0202 indicated that the site was on the Minlaton mapsheet, it was in the second block of remnant vegetation to visit on that mapsheet, and it was the second site (quadrat) within that block to be surveyed. To make new sites created during the actual field survey readily identifiable, a slight variation to the site selection naming system was used. The prefix by mapsheet name was still used and the team number and field sequence in which the site was recorded, made the numeric part of the code. For example MOO1A12, indicates the site is on the Moonta mapsheet, surveyed by team 1A (survey week 1 and team A) and was the 12th site Team A had surveyed for that week.

At the end of the site selection process a total of 337 sites had been selected representing approximately 1 site per 392 ha of remaining native vegetation.

Following the selection of sites and site naming, details associated with the site such as site code, hundred name and section number and comments about the sites were entered into INFO, the relational database associated with ARC/INFO, to form a "planning" database. This "planning" database was used to store information collated from interrogation of the spatial database, as a tool to query the stored information, to organise the landholder contact process, and to assist in determining field logistics such as allocation of sites for survey teams.

3.1.3 Landholder Contact

Public relations were handled through contact with the local media, local councils and interested parties such as Landcare Groups and Soil Conservation Boards. It was found that the local council ratepayer newsletter was very useful in advertising the survey, due to its widespread distribution, with a number of enquiries resulting from that source. In addition, letters were sent out to all Heritage Agreement owners advising them of the survey aims and objectives. This initial information did elicit some calls from people, wishing to have their patches of bushland surveyed. Wherever possible, these requests were met during site selection.

The bulk of the landholder contact however was handled on an individual landholder basis. Using Hundred name and Section number, details on each site's ownership, such as landholder name, address and telephone number, were collated with the assistance of Local Councils. Local Councils provided access to their ratepayers' records, which was an extremely necessary tool in addition to the use of the Department for Environment and Heritage's Land Ownership Tenure System (LOTS). Company searches were also conducted through the Australian Securities Commission. These details were then used to send letters to landholders, providing details about the survey and requesting permission to survey sites on their land. The letter contact was followed by telephone contact with each landholder, where permission for access and access logistics was discussed. This required approximately 250 telephone calls, with most calls being made in the evenings. Telephone contact time involved approximately 25 hours, with the average call length being approximately 6 minutes. Telephone contact was also used extensively in the field to re-contact landholders prior to visiting to clarify access details, arrange meeting times, or to advise of a more specific visit time.

3.2 Field Survey

3.2.1 Field Data Collected

Each site (quadrat) consisted of a 30 x 30m quadrat from which details of the vegetation and physical attributes were recorded. The dimensions of the quadrat could be altered to accommodate the vegetation type, such as a ridgeline or a swamp edge (e.g. 90 x 10m), however, it was important to maintain the quadrat area (ie. 900 m^2). Surveyors were asked to locate sites well within representative vegetation types so as to avoid ecotonal or disturbance effects from boundaries and to avoid gradations. The information collected at each site is listed below in Table 3.

Table 3: Data Collected during Field Survey

		FIELD DATA COLLECTED
		Physical Datasheet
1.	*	Site number
2.	*	Observers
3.	*	Survey date
4.	*	Field sequence (week, group, sequence of site surveyed in the field)
5.		Hundred
6.		Section
7.		Property (type of public land)
8.		Owners
9.		Mapsheet number
10.		Mapsheet name
11.	*	Amg zone
12.	*	Easting
13.	*	Northing
14.	*	Altitude
15.	*	Reliability (accuracy of location)
16.	*	Quadrat size (if not 30 x 30 m)
17.	*	Aerial survey / photo number
18.		East (measurement to pin prick in aerial photo [mm] from western photo edge)
19.		North (measurement to pin prick in aerial photo [mm] from southern photo edge)
20.		Site photo number
21.		Direction of site photo (degrees)
22.		Location map (sketch of location) locations comments (directions to the site from local major features)
23.	*	General landscape description
24.		Site landform pattern
25.	*	Site landform element (type)
26.	*	Site slope (degrees)
27.	*	Site aspect (degrees)
28.		Outcrop cover
29.		Outcrop lithology
30.	*	Surface strew size
31.	*	Surface strew cover
32.	*	Surface strew lithology
33.		Fire scars (y/n) last fire (year)
34.		Bare earth/litter estimate %
35.		Presence of erosion and comments
36.		Disturbance factors - Power lines/bee hives/water points/fire breaks/coppice regrowth/drains/earthworks/slashing/ remnant adjoins roadside vegetation/fence lines/rubbish dump/quarry pits/access tracks
37.		Vertebrate presence (presence/absence) Rabbit/hare/kangaroo/macropod/goat/sheep/cattle/echidna/mallee fowl/ possum/wombat/fox/emu/cat/horse/other vertebrate
38.	*	Surface soil texture class
		Vegetation Datasheet
39.		Climatic condition

Table 3: Cont'd

		FIELD DATA COLLECTED
40.	*	Plant species name
41.	*	Voucher number
42.		Lifeform (using Muir's' table)
43.	*	Cover/abundance (adapted Braun-Blanquet measure)
44.		Life stages (flowering fruiting budding etc.) / Comments (about the plant species / voucher specimen)
45.		Structural summary of the vegetation (structural assemblage)S
46.	*	Vegetation association description (overstorey dominant species, structural description (using Muir's' table), dominant shrub & ground species)
47.		Upper stratum age class (presence/absence of seedlings, saplings, mature trees, senescent trees and hollows for dominant/codominant overstorey tree/mallee species)
48.	*	Overstorey height (five estimates)
49.	*	Crown depth (five estimates)
50.	*	Canopy diameter (five estimates)
51.	*	Gap (five estimates)
52.	*	Canopy type %
53.		Overall vegetation comments, including emergents (if relevant)

** Considered to be essential for mapping and analysis and thus comprise the minimum data set.*

Datasheets, incorporating the data attributes indicated above, were designed to reflect the logical flow of the information as best recorded in the field, while also easing the data entry process, but maintaining the highest degree of accuracy. To explain the datasheet layout and survey methodology/techniques, a survey manual was produced. The manual also provided definitions relating to aspects such as landform types and cover/abundance categories as well as organisational aspects such as survey team members, accommodation details and overall survey schedules. Details of the survey methodology were also explained at a meeting of survey team members, at the start of each survey week, to clarify techniques. As a significant number of technique-related problems only arise after a day in the field, when each region's differences become apparent, some allowance was made for evening discussions to resolve these issues during the actual survey.

The general flow of data collection at a site is as follows. Initial observations of the general area in which the site has been selected are used to determine the most appropriate position for the site to be located while avoiding edge effects, gradations and physical disturbances. Generally the team then divides the tasks, with the most common way being one member concentrating on the location and physical aspects, while the other begins the botanically related aspects. Voucher specimens were required for each species encountered for the first time, and subsequently for any species which required clarification. The team member completing the physical aspects would usually take the site photograph and mark the site location on the aerial photograph. They would also collect data on the landform pattern and element, site slope and aspect, outcrop, surface strew, fire scars, percentage of bare earth and litter, erosion, disturbance factors, vertebrate presence, and soil type. Once the physical data were collected, this team member would also take five estimates of each of the dominant and co-dominant overstorey attributes of height, canopy depth, canopy diameter, gap and canopy type. A two-metre range pole was used as a guide for these estimations.

After this stage, the team members would join forces to complete the remaining plant species collection, vouchering and floristic assessment. The combination of both team members searching the quadrat for species resulted in a more complete assessment of the vegetation, as well as better efficiency in processing vouchered specimens. The collection of floristic data, in addition to a complete list of vascular plants included: recording the plants' lifeform/height class according to the

Muir's Table (Appendix 3); a cover/abundance score (adapted from the Braun-Blanquet system – refer to Appendix 4); and an indication of the life stage of the plant.

To provide data relating to habitat assessment, an overall vegetation structural summary (structural assemblage) was completed working from the highest to lowest stratum. Canopy cover was estimated according to Muir's canopy cover categories for each lifeform/height class that was observed as a dominant stratum. To complete the vegetation assessment, the observers provided an overall qualitative vegetation description of the site by indicating the dominant/codominant overstorey species, the corresponding dominant lifeform and canopy cover, and the dominant understorey species. This subjective assessment provides a generalised summary of each site's vegetation types, hence an overview of the regional vegetation types, particularly useful in the analysis stages.

Any observations made regarding the state or condition of the vegetation, noting details of disturbance were recorded in the *Overall Comments* section of the vegetation datasheet.

If a site was considered to be too degraded[8] or was in a community that had already been sampled many times then the team may have decided it would be better represented by another remnant native vegetation location or did not require a full survey site. In this case, a Ground Truth site was required, recording a minimum set of data. The primary data collected at the Ground Truth sites was the structural code, upper storey dominant species, understorey dominant species, site photo, and an explanation as to why a full survey site was not completed. This allowed teams to concentrate their efforts on the remaining sites, or on adding new sites with the permission of landholders. The Ground Truth data provides an explanation of the vegetation community at that location for vegetation mapping purposes.

Survey teams were also encouraged to make notes on the aerial photographs recording all vegetation communities observed near site locations.

3.2.2 Survey Logistics

Due to the nature of Yorke Peninsula the project area was rather elongated, encompassing an area 225 km long by 50 km wide. As a greater and more diverse area of native vegetation cover occurs in the southern extremity of the study area more sites were selected there. A single central base camp at Warooka was determined to be the most efficient way to minimise travelling in the first week. Eleven 1:50,000 mapsheets were covered in this area. In the second survey week a base camp at Wallaroo was the most effective location to cover the remaining fourteen 1:50,000 mapsheets in the north part of Yorke Peninsula. The main purpose of centralising the group was to enable all teams access to the survey's plant determination staff who provided advice on plant species identifications at the conclusion of each day's field work. This enhanced the accuracy and efficiency of the field work, as well as helped maintain consistency in data collection.

Each team was allocated 1-2 x 1:50,000 mapsheets to survey per week depending on the number of selected sites per mapsheet and the travel distances.

The survey teams were equipped with full field kits containing all the necessary equipment for the survey, including an appropriate set of the allocated mapsheets and 1:40,000 colour aerial

[8] Degraded either by a heavy weed infestation or disturbed by stock grazing.

photographs with sites marked. Consumable items in the kits could be replenished from supplies at the base camp.

Each team's daily schedule involved surveying sites and checking blocks of vegetation, as allocated, from 7.30 am till approximately 7.00 pm (depending on daylight), followed by the evening tasks of clarifying plant identifications with the plant determiners, pressing voucher specimens, editing datasheets and planning the next days schedule. Telephone contact was made with landholders to clarify access and any other details required at this time.

3.3 Post Survey

3.3.1 Plant Species Verification, Data Validation, Entry and Editing

During the course of the survey, plant determination staff were present each evening to clarify plant identifications for all vouchered specimens. At the completion of the survey, these identifications were then verified by a plant identification determiner who was contracted to view all the survey collections together (if necessary) and check any uncertain identifications thoroughly. Final identifications could then be resolved and datasheets updated accordingly. At this time all vouchered specimens were lodged at the Plant Biodiversity Centre.

Following the intensive post survey plant verification process, datasheets were also checked for completeness and correctness of location and physical data, as well as vegetation information. A considerable effort was spent tracing through plant identifications via voucher numbers to correct identification inconsistencies. At this stage taxonomic and identification problems were recognised with some species. Discussions were held with Dr Peter Lang, the Flora Database Manager, to resolve these difficulties before data entry. The Flora Database contains all plant species' names (indigenous and introduced) that occur in South Australia along with other details, based on the taxonomy currently recognised by the Plant Biodiversity Centre. Current names from the Flora Database are used in the data entry process. Cross checks were made to ensure that each survey team had vouchered every new plant specimen they found each week. If no voucher specimen had been collected by that survey team then the relevant survey team botanist was consulted, and a note was recorded in the "Comments" section for that plant, to indicate the degree of uncertainty in identification.

Data collected from the survey were then entered into the Department's relational data base, which was Interbase at that time, which was accessed via customised Powerhouse screens. This database contained a number of validation routines, to ensure that data was checked against valid lists ('lookup' tables) electronically prior to being incorporated into the data base. This is essential for ensuring all species names are current and entered correctly. Codes used for many of the attributes collected, were similarly checked electronically by use of 'look up' tables.

To speed aspects of the data entry process and more importantly avoid data entry errors, site codes, hundred and section numbers, mapsheets numbers, location details (AMG's and Latitude/Longitude) and environmental associations were globally loaded into the biological survey database at various stages. The majority of these data were available from the "planning" database, compiled during the initial site selection. Following the survey, these data were corrected in the "planning" database where necessary. Location data (grid references) were generated from points digitised from mylar film

overlays, the points having been marked onto the mylar film from georeferenced, pin pricked aerial photos.

On completion of the data entry phase, "validation" reports were produced detailing the data of each site, in field datasheet order, to be checked against the original field copies. To aid this labour intensive but essential editing process, frequencies (unique counts) were produced for all species recorded, the number of species at each site, the lifeform of each species and voucher numbers. Checks could be readily conducted to see that values were in the expected ranges, and if not, global updates performed to avoid further data entry errors.

Following the completion of all the data checks and editing, individual reports for each site were compiled consisting of details on locations, landform, vegetation association description and plants list with scientific and common name, and cover abundance. Presence of vertebrates at the site was also listed. These reports were sent to all landholders on whose properties sites were surveyed, thus providing feedback and records to landholders. A letter detailing the limitations of the data collected accompanied the site reports. For example, that the data only reflects the species at one location during a specific season and is not a comprehensive listing of flora for a whole block of native vegetation. The letter also provided a list of contacts for; enquiries regarding the data, local contacts for assistance in pest control or revegetation, and the Save the Bush Coordinator for those interested in further conservation information, particularly financial assistance for fencing or conservation purposes.

Ground Truth site data were entered into INFO using customised menus created by Arc Macro Language (AML), a programming tool. This menu system had pop-up screens with optional choices for the data entry person to select thus reducing typing errors and allowing data validation. The base data was available from the "planning" database, which was updated following the survey. Ground truth locations (grid references) were produced from points digitised from mylar overlays, the points having been marked onto the mylar from georeferenced pin pricked aerial photos. This data will be of use for future vegetation mapping and was also used to indicate why a full survey site was not completed at a pre-selected site.

All landholders that had agreed to a site was being surveyed within their block of bushland prior to the field survey, but whose bushland was not visited or was surveyed only as a Ground Truth site were advised accordingly.

4. SURVEY RESULTS

4.1 General

At the conclusion of the Yorke Peninsula Native Vegetation Survey, September 1994, 276 sites had been comprehensively surveyed throughout the 132,224 ha of remnant native vegetation in the 927,096 ha study area. As a result the average site density within remnant native vegetation was one site per 479 ha. A further 69 sites had Ground Truth data collected. Figure 4 indicates the location of sites across the study area.

This survey resulted in 9,798 plant species records being entered into the survey database, providing distribution and abundance data on 783 unique plant species recorded throughout that survey area. Of the total number of plant species records, 4,528 individual specimens were collected and examined during the plant species verification process. These were then lodged with the Plant Biodiversity Centre Herbarium. It should be noted that references to taxon numbers found and plant species names used in this report relate to current taxonomy for September 1994. Subsequent name changes have not been included.

Overall, the field survey took 10 working days with 6 teams of 2 people working approximately 12 hours per day. An additional team of people worked for two days providing an extra 48 hours of assistance. This total effort equates to 1488 hours, equivalent to one person working full time in the field for 198.4 calendar days (39.7 working weeks) or approximately 10 months.

A number of individual landholders also joined survey teams when sites were being surveyed within their patch of remnant vegetation. This enabled each landholder to gain an insight into how the survey was conducted and the importance of some species present. The presence of the landholders also helped the surveyors record landuse history, fire history, presence of native fauna or other local knowledge for the block. Information kits were also supplied to interested landholders providing details of programs offering financial assistance for conservation works including fencing and containing contact details for Landcare officers and other relevant agencies.

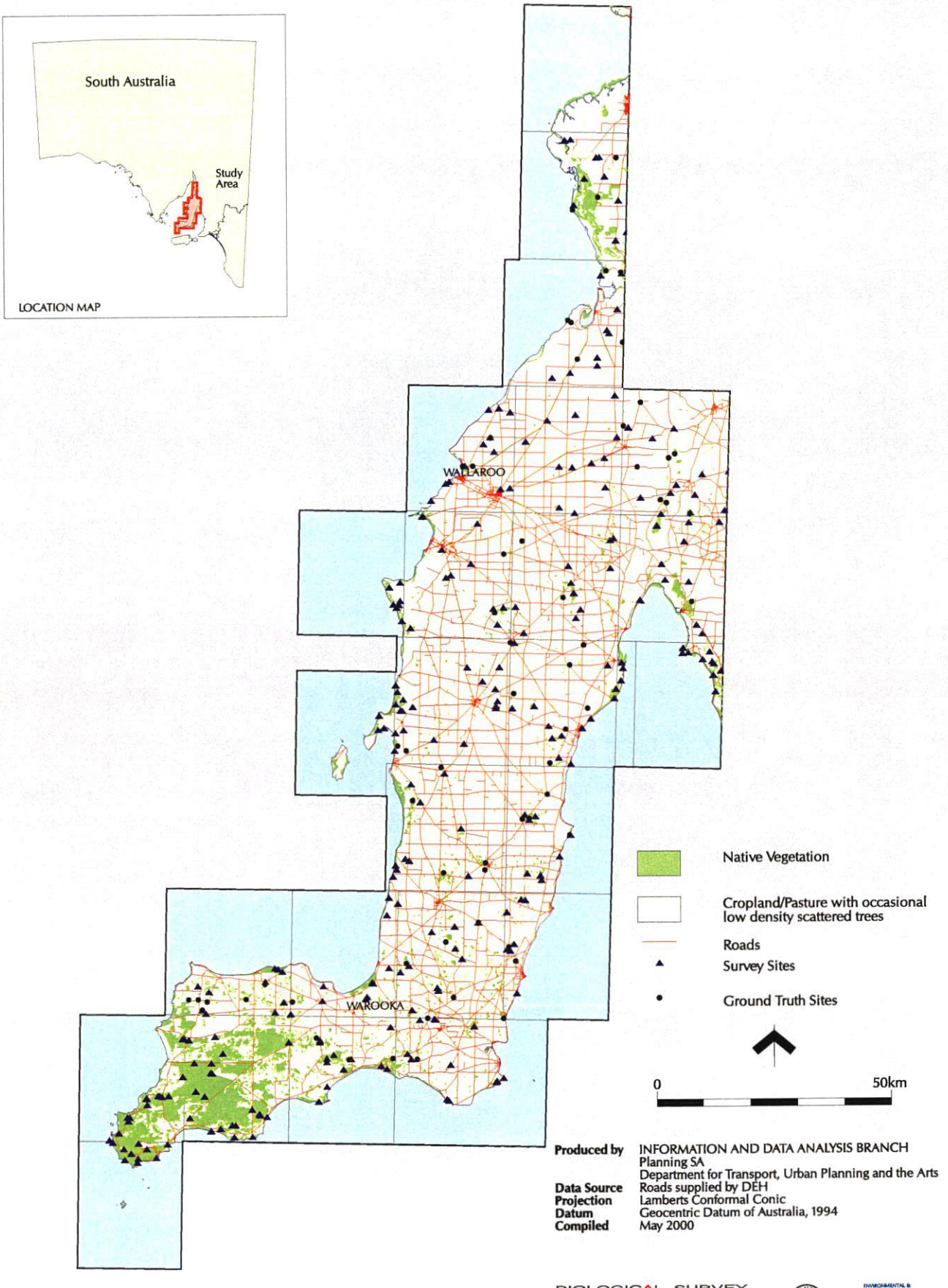
4.2 Plant Species not previously Recorded in Region

According to Lang and Kraehenbuehl (1994)[9], immediately following the survey, a total of 5 native plant species collected on the survey had not previously been recorded on the Yorke Peninsula. These were *Dillwynia hispida* (Red parrot-pea), *Olearia lepidophylla* (Club moss daisy bush), *Omphalolappula concava* (Burr stickweed), *Senecio tenuiflorus* (Woodland groundsel) and *Sida intricata* (Twiggy sida). In addition *Dodonaea tepperi* (Streaked hop-bush), which was presumed extinct for the region was also recorded during the survey.

Dillwynia hispida (Red parrot-pea) was found in a road reserve site in the Minlaton area. The site was dominated by *Eucalyptus incrassata* (Ridge-fruited mallee) Open mallee with *Melaleuca uncinata* (Broombush) understorey. This species has been recorded in all Herbarium regions within the

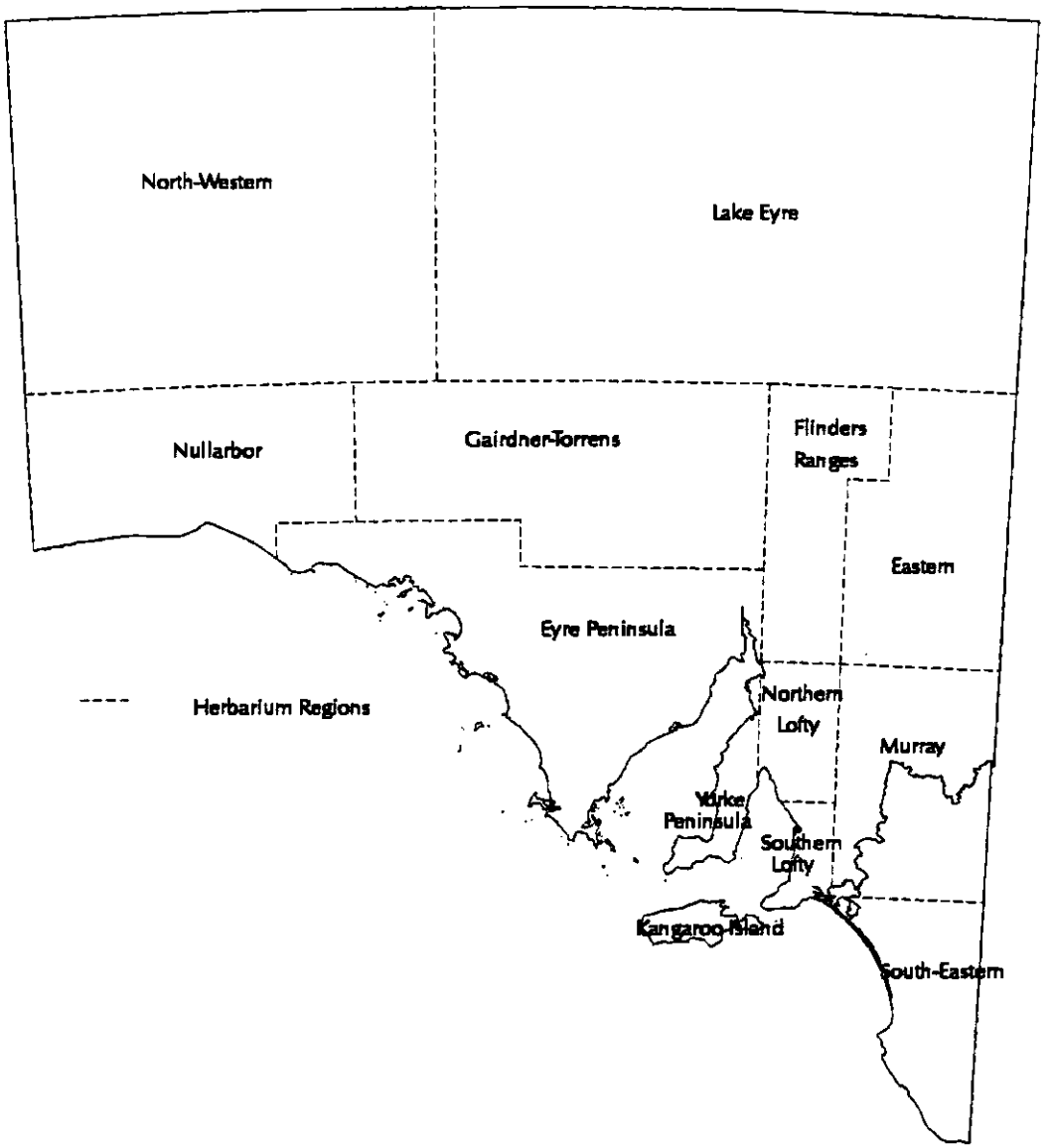
[9] Based on Plant Biodiversity Centre records and various other sources available up until that time.

Figure 4. Yorke Peninsula Native Vegetation Survey Sites 1994



southern agricultural zone (ie. Eyre Peninsula, Northern and Southern Lofty, Kangaroo Island, Murray and South East) with the exception of Yorke Peninsula (Jessop 1993), so its collection there is not surprising and fills a gap in its known distribution. Figure 5 below indicates the extent of Herbarium Regions in South Australia as defined by the Plant Biodiversity Centre.

Figure 5: Herbarium Regions of South Australia



Olearia lepidophylla (Club-moss daisy-bush) was found in the Moonta area, in the understorey layer of a remnant patch of *Eucalyptus 'anceps'* (Sessile-fruit white mallee), *Eucalyptus leptophylla* (Narrow-leaf red mallee), *Eucalyptus oleosa* (Red mallee) Mallee with *Melaleuca acuminata* (Mallee honey-myrtle) understorey. The site contained a total of 49 species, with evidence of regeneration in response to partial clearance in about 1979. This species has only been previously collected in the Eyre, Murray and South East Herbarium regions with an uncertain record for the Gairdner-Torrens Herbarium region (Jessop 1993).

Omphalolappula concava (Burr stickweed) was also discovered just south of Moonta, in a patch of *Eucalyptus dumosa* (White mallee) Open mallee with *Melaleuca uncinata* (Broombush) understorey. This species is widespread in arid and semi-arid habitats across the state being previously recorded in 10 of the 13 Herbarium regions, excluding Yorke Peninsula, South East and Kangaroo Island (Jessop 1993).

The biennial species *Senecio tenuiflorus* (Woodland groundsel) was found at nine different sites, including the same site that contained *Olearia lepidophylla* (Club-moss daisy-bush). Three of the sites are currently Heritage Agreement areas and one is a road reserve. These sites were widespread throughout Yorke Peninsula, with the most southerly being on the Hillock 1:50,000 mapsheet and the most northerly being near Lochiel. The main occurrences were in the Ardrossan area and one site near Maitland. At the time of the survey this species was recorded for the Southern Lofty and South East Herbarium Regions with uncertain records for the Flinders Ranges and Northern Lofty (Jessop 1993). It is known to be quite widespread in dry to moist woodland communities with definite records now in seven regions comprising the four listed above together with Yorke Peninsula, Eyre Peninsula and the Murray Regions (P. Lang, pers. comm., March 2000).

The small shrub *Sida intricata* (Twiggy sida) was found in an *Acacia victoriae* (Elegant wattle) Shrubland located in a road reserve. This site was approximately 10 km east of Wood Point near Wandearah West on the River Broughton Floodplain in the slither of the Yorke Peninsula Herbarium region that occurs south west of Port Pirie. The plant list for the site records 24 species, 9 of which were introduced species. The sole occurrence of the species, for this survey, in a road reserve with a high proportion of introduced species highlights the value of any area of remnant vegetation whether in pristine condition or not. It also highlights the need for conservation and appropriate management of roadside reserves. The species was previously recorded in seven contiguous Herbarium regions (ie. Lake Eyre, Nullarbor, Gairdner-Torrens, Flinders Ranges, Eastern, Eyre Peninsula and Murray) with a common link of semi-arid to arid flora. The area this species was found in within the Yorke Peninsula Herbarium region is unlike the majority of that region, as the Wandearah area is more typically aligned with semi-arid flora typical of the plains west of the Southern Flinders Ranges, north of Port Pirie. An uncertain record of this species is noted in the Southern Mt Lofty region (Jessop 1993).

Dodonaea tepperi (Streaked hop-bush) which had been presumed extinct in the Yorke Peninsula region was found in a *Eucalyptus porosa* (Mallee box) Woodland site south west of Maitland. *Alyxia buxifolia* (Sea box) and *Beyeria lechenaultii* (Pale turpentine bush) dominated the site's understorey. This plant is also recorded in the Flinders Ranges, Eyre Peninsula, Murray and Southern Lofty Herbarium regions (Jessop 1993).

4.3 Plant Species of Conservation Significance

Vegetation survey results are used in conjunction with information from the Plant Biodiversity Centre and other sources to assist the determination of plant conservation significance ratings for plant species in the agricultural zone. As the survey was conducted in 1994, and the survey data were used by Lang and Kraehenbuehl to reassess the plant conservation ratings for the Yorke Peninsula and Northern Lofty Herbarium regions, it is most appropriate to consider the ratings of plant species at that time. It is also relevant to consider how this survey's data has influenced these ratings. To achieve this, the survey data and the 1994 plant conservation significance ratings are considered and

discussed in section 4.3.1. This is then followed (in section 4.3.2) by a comparison of the September 1994 and March 2000 ratings.

4.3.1 Plant Conservation Significance – September 1994

Of the 783 unique plant species recorded by the survey, 168 species were recorded to have regional conservation significance ratings according to the database of *Plants of Particular Conservation Significance in SA's Agricultural Regions* (Lang and Kraehenbuehl September 1994). This is approximately twenty two percent of the species which Lang & Kraehenbuehl (1994) record with conservation significance in the Yorke Peninsula region and approximately five percent for the Northern Lofty Region. However given that the survey was not targeting rare plant associations or areas where these plants may occur, and due to seasonal influences, this was a significant number. It should also be noted that only a very small portion (12%) of the study area was within the Northern Lofty Herbarium Region. Of the regionally significant species recorded in this survey, 10 species also had national conservation significance ratings while 57 species had a rating at the South Australian level. Tables 4 and 5 list the species of conservation significance, their ratings at the Regional, State and National levels, and the frequency with which the species was recorded on the survey. Table 4 refers to the Yorke Peninsula Herbarium Region where 151 species are listed and Table 5 refers to the Northern Lofty Herbarium Region where 24 species are listed.

The 10 species of national significance were all within the Yorke Peninsula Herbarium Region. Summary information on these plant species is provided in the following Tables 4 and 5.

Table 4: Plant Species with Regional Conservation Significance (Sept, 1994) Recorded on this Survey - Yorke Peninsula Herbarium Region

Species	Australian Status	South Australian Status	Yorke Peninsula Regional Status	Number of Records from this Survey
Acacia brachybotrya		N	U	4
Acacia enterocarpa	E	E	E	1
Acacia farinosa		N	U	2
Acacia notabilis		N	V	11
Acaena novae-zelandiae		N	K	1
Acrotriche affinis		N	R	9
Alectryon oleifolius ssp. canescens		N	E	1
Allocasuarina pusilla		N	R	5
Amphipogon caricinus var. caricinus		N	K	6
Aotus subspinescens		N	R	1
Aphanes australiana		N	U	13
Arthropodium fimbriatum		N	T	24
Arthropodium minus		N	R	4
Arthropodium strictum		N	T	11
Astroloma conostephioides		N	E	1
Astroloma humifusum		N	R	12
Atriplex pumilio		N	U	1
Baumea juncea		N	V	2
Billardiera lehmanniana		E	E	2
Billardiera sericophora		N	U	5
Billardiera versicolor		U	T	3
Boronia coerulescens ssp. coerulescens		N	V	1
Boronia inornata ssp. leptophylla		N	R	4
Brachycome ciliaris var. lanuginosa		N	K	3

Table 4: Cont'd

Species	Australian Status	South Australian Status	Yorke Peninsula Regional Status	Number of Records from this Survey
Brachycome cuneifolia		U	U	9
Brachycome goniocarpa		N	R	6
Bromus arenarius		N	U	1
Caesia calliantha		N	E	10
Caladenia bicalliata	R	R	R	1
Caladenia brumalis	V	V	E	11
Caladenia conferta	K	E	E	1
Caladenia stricta		U	Q	5
Calandrinia brevipedata		U	Q	3
Calandrinia calyptrata		U	Q	4
Callistemon rugulosus var. rugulosus		N	R	1
Calocephalus citreus		U	K	1
Calostemma purpureum		N	V	5
Calytrix involucrata		N	V	10
Cassinia arcuata		U	U	6
Centrolepis cephaloformis ssp. cephaloformis		R	E	3
Chamaescilla corymbosa var. corymbosa		N	V	5
Cheiranthera alternifolia		N	K	3
Chrysocephalum semipapposum		N	K	7
Comesperma scoparium		N	T	1
Corybas despectans		U	U	8
Cymbonotus preissianus		U	K	2
Cynoglossum suaveolens		N	K	1
Daviesia benthamii ssp. humilis		R	K	2
Dissocarpus biflorus var. biflorus		N	K	1
Distichlis distichophylla		N	K	2
Diuris aff. corymbosa		N	R	6
Diuris palustris		U	R	20
Diuris pardina		N	T	3
Dodonaea stenozyga		N	K	2
Dodonaea tepperi			X	1
Drosera glanduligera		N	K	6
Drosera peltata		N	R	2
Elachanthus pusillus		U	E	2
Elymus scabrus var. scabrus		N	E	1
Enteropogon acicularis		Q	Q	1
Eremophila behriana		N	E	3
Eriochilus cucullatus		N	U	21
Eriochiton sclerolaenoides		N	K	1
Eriostemon pungens		N	U	4
Eucalyptus calycogona var. calycogona		N	V	4
Eucalyptus camaldulensis var. camaldulensis		N	V	1
Eucalyptus dumosa		N	V	15
Euphrasia collina ssp. osbornii	E	E	E	2
Eutaxia microphylla var. diffusa		U	R	3
Exocarpos cupressiformis		N	U	4
Gahnia filum		N	U	5
Goodenia pinnatifida		Q	N	12
Goodia lotifolia var. lotifolia		N	R	2
Gyrostemon thesioides		U	R	1
Haegiela tatei	R	R	R	2
Hakea muelleriana		N	V	2
Haloragis aspera		Q	Q	1
Homoranthus wilhelmii		N	R	2
Hydrocotyle medicaginoides		N	V	6

Table 4: Cont'd

Species	Australian Status	South Australian Status	Yorke Peninsula Regional Status	Number of Records from this Survey
Hydrocotyle pilifera var. glabrata		N	R	15
Lagenifera huegelii		N	E	18
Lawrencia spicata		U	R	1
Leptorhynchos elongatus		K	E	2
Leptorhynchos scabrus		R	R	1
Leptorhynchos tetrachaetus		U	T	2
Leucopogon clelandii		N	K	1
Leucopogon cordifolius		N	R	4
Levenhookia dubia		N	V	6
Lomandra densiflora		N	T	6
Lomandra micrantha ssp. micrantha		N	U	6
Maireana rohrlachii		R	K	1
Melaleuca gibbosa		N	U	4
Melaleuca pauperiflora		N	V	5
Muehlenbeckia florulenta		N	K	3
Myoporum parvifolium		R	R	1
Myoporum viscosum		U	R	1
Olearia pannosa ssp. pannosa		V	V	7
Ophioglossum lusitanicum		N	K	6
Ozothamnus retusus		Q	K	6
Panicum effusum var. effusum		Q	Q	1
Phebalium glandulosum ssp. glandulosum		E	E	1
Phyllanthus australis		N	V	5
Poa fax		R	R	2
Podolepis canescens		N	U	8
Podolepis jaceoides		R	E	12
Pogonolepis muelleriana		N	R	5
Poranthera triandra		U	R	15
Prasophyllum calcicola	R	V	V	1
Prasophyllum elatum		N	E	1
Prasophyllum fitzgeraldii		U	V	4
Prasophyllum goldsackii	R	R	R	2
Prostanthera serpyllifolia ssp. microphylla		N	V	1
Prostanthera serpyllifolia ssp. serpyllifolia (purplish-green flowers)		R	R	1
Pterostylis boormanii		U	E	2
Pterostylis dolichochila		N	R	1
Pterostylis pedunculata		N	U	4
Ranunculus sessiliflorus var. sessiliflorus		N	U	13
Santalum murrayanum		U	V	2
Scaevola angustata		N	U	2
Scaevola linearis ssp. confertifolia		U	E	2
Schoenus apogon		N	T	1
Schoenus breviculmis		N	R	18
Schoenus deformis		N	U	5
Schoenus nanus		N	E	5
Schoenus nitens		N	R	2
Senecio macrocarpus	V	V	E	1
Senecio picridioides		N	R	2
Senecio quadridentatus		N	R	4
Sida petrophila		N	T	1
Stackhousia annua		V	V	2
Stackhousia spathulata		N	K	2
Stipa hemipogon		N	T	1
Stipa mollis		N	T	3
Stipa multispiculis	R	R	R	2

Table 4: Cont'd

Species	Australian Status	South Australian Status	Yorke Peninsula Regional Status	Number of Records from this Survey
Stipa platychaeta		N	T	12
Stipa scabra ssp.		N	E	4
Stipa stipoides		N	U	3
Templetonia sulcata		U	V	1
Thomasia petalocalyx		N	K	1
Thryptomene micrantha		N	V	3
Thysanotus baueri		N	K	4
Trachymene cyanopetala		N	T	1
Triglochin calcitrapum		Q	Q	2
Triglochin minutissumum		R	R	2
Triglochin mucronatum		Q	Q	1
Westringia eremicola		N	R	1
Wilsonia rotundifolia		N	E	1

For Conservation Status Codes and definitions please refer to the explanation following Table 5.

Codes are also defined in full in Lang and Kraehenbuehl (1994).

Table 5: Plant Species with Regional Conservation Significance (Sept, 1994) Recorded on this Survey - Northern Lofty Herbarium Region

Species	Australian Status	South Australian Status	Northern Lofty Regional Status	Number of Records from this Survey
Acacia rigens		N	U	1
Acrotriche patula		N	R	2
Amyema melaleucae		N	K	2
Cassinia arcuata		U	U	1
Dissocarpus biflorus var. biflorus		N	K	1
Dodonaea hexandra		N	K	2
Enneapogon nigricans		N	U	3
Enteropogon acicularis		Q	Q	1
Eucalyptus incrassata		N	R	3
Goodenia pinnatifida		Q	Q	2
Linum marginale		N	U	1
Lomandra leucocephala ssp. robusta		N	T	1
Maireana aphylla		N	V	1
Maireana enchylaenoides		N	U	2
Olearia pannosa ssp. pannosa		V	V	1
Phyllanthus saxosus		U	Q	1
Poa fax		R	Q	1
Santalum acuminatum		N	U	3
Stipa acrociliata		N	K	4
Stipa flavescens		N	R	1
Stipa mollis		N	R	2
Stipa platychaeta		N	R	3
Teucrium sessiliflorum		N	U	3
Tricoryne elatior		N	R	1

Conservation Status Codes:

X - Extinct - extinct or presumed extinct

E - Endangered - rare and in danger of becoming extinct

V - Vulnerable	- rare and at risk of becoming endangered
T - Threatened	- likely to be E or V but insufficient data is available
R - Rare	- low overall frequency/confined to a restricted area/sparse
K - Uncertain	- likely to be T or R but insufficient data is available
U - Uncommon	- less common species of interest, but not rare enough to warrant special protection
N - Not Significant	- common
Q	- not yet assessed, but flagged as being of possible significance

Codes are defined in full in Lang and Kraehenbuehl (1994).

The nationally endangered species *Acacia enterocarpa* (Jumping-jack wattle) was found only once in a site dominated by *Eucalyptus socialis* (Beaked red mallee), *E. incrassata* (Ridge-fruited mallee), *E. leptophylla* (Narrow-leaf red mallee), *E. 'anceps'* (Sessile-fruit white mallee) Open mallee just west of Port Vincent.

Caladenia bicalliata (Limestone spider-orchid), rare nationally, was also found only once, in an *Acacia leiophylla* (Coast golden wattle), *Leucopogon parviflorus* (Coast beard-heath) Shrubland on a beach ridge near Edithburgh.

Eleven sites were found to contain the nationally vulnerable species *Caladenia brumalis* (Winter spider-orchid). These sites were principally centred between Stansbury and Maitland and five of the sites were *Allocasuarina verticillata* (Drooping sheoak)+/- *Eucalyptus porosa* (Mallee box) Low Woodlands, two locations were *E. porosa* (Mallee box) Low Woodlands and the remainder were sites dominated by a mix of mallee eucalypt species.

Caladenia conferta (Coast spider-orchid), endangered regionally and status unknown nationally was discovered at a single site between Port Julia and Port Vincent. This site was *Eucalyptus porosa* (Mallee Box) Open mallee with an understorey of *Melaleuca uncinata* (Broombush) and *M. lanceolata* (Dryland tea-tree).

Two sites were found to contain the nationally endangered *Euphrasia collina ssp. osbornii* (Osborn's eyebright) and both sites contained over 60 native species, with only 2 to 3 introduced species present. These sites were between Stansbury and Ardrossan with one location in roadside vegetation comprising a *Eucalyptus socialis* (Beaked red mallee), *E. incrassata* (Ridge fruited mallee) Open mallee association and the other a *Eucalyptus porosa* (Mallee box) Open mallee association.

The nationally rare *Haegiela tatei* (Small nut-heads), occurred at two *Halosarcia sp.* (Samphire) shrubland sites. These sites were around salt lake depressions with one being in Innes National Park on a medium clay soil and the other in the Peesey Swamp area on sand.

A site dominated by *Eucalyptus gracilis* (Yorrell), *E. rugosa* (*Kingscote mallee*) Mallee in Innes National Park contained the nationally rare *Prasophyllum calcicola* (Limestone leek-orchid). The site was located on a consolidated dunefield with a sandy loam soil and an understorey of *Alyxia buxifolia* (Sea box) and *Templetonia retusa* (Cockies tongue).

At Warrenben Conservation Park and a nearby block of vegetation under heritage agreement *Prasophyllum goldsackii* (Goldsack's leek-orchid), a nationally rare species was found. Both sites were in *Eucalyptus rugosa* (Kingscote mallee), *E. diversifolia* (Coastal white mallee) Mallee with

particularly rich understoreys (70 species present at each site), of which less than 11 species (16 %) were introduced species.

Senecio macrocarpus (Large-fruit groundsel), a nationally vulnerable species, was found at a *Gahnia filum* (Smooth cutting-grass) Sedgeland at the foot of Yorke Peninsula on a clay loam flat. This privately owned area was not grazed at the time of the survey.

Stipa multispiculis (Small-seed spear-grass) occurred at two sites, both grassy woodlands with an overstorey of *Eucalyptus porosa* (Mallee box) within the Maitland area. The sites containing this nationally rare species were on fertile loam soils free of calcareous material. This type of country has been preferentially cleared and cultivated for agricultural purposes.

4.3.2 Comparison of Plant Conservation Significance Ratings 1994 - 2000

Tables 6 and 7 present comparisons of the conservation significance ratings between the survey date 1994 and March 2000, for the Yorke Peninsula Herbarium Region and the Northern Lofty Region respectively.

For the Yorke Peninsula Herbarium Region there have been rating changes for 52 (34%) of the original 151 rated plant species and for the Northern Lofty Herbarium Region there have been changes for 8 (33%) of the original 24 rated plant species found during the survey. The large number of species with conservation significance collected and recorded in a systematic way during the survey, for these Herbarium regions, has contributed considerably to the revision of ratings. This is the case particularly for species found on the leg of Yorke Peninsula (P. Lang, pers. comm., March 2000). Prior to the survey very little comprehensive information was available for Yorke Peninsula other than for the foot and toe areas where earlier surveys had occurred in the NPW SA parks and reserves. This vegetation survey was well timed in the spring season, picking up the orchid species component of the flora, and provided a very comprehensive picture for the Yorke Peninsula region in particular (P. Lang, pers. comm., March 2000). It also contributed to the knowledge of the Northern Lofty region which has had limited information available until a number of recent surveys in the 1990's. As this survey has only influenced rating changes at a regional level (P. Lang, pers. comm., March 2000) information on the changes are provided with an emphasis on this aspect. For convenience, abbreviated definitions of rating codes are used in the following text. For full rating code definitions please refer to the explanantions provided below Tables 6 and 7.

Of the 52 plant species for Yorke Peninsula Herbarium Region with rating changes, 5 species (*Chrysocephalum semipapposum* (Clustered everlasting), *Distichlis distichophylla* (Emu-grass), *Drosera glanduligera* (Scarlet sundew), *Leucopogon clelandii* (Cleland's beard-heath) and *Ophioglossum lusitanicum* (Austral adder's-tongue)) have had their regional ratings upgraded, all from K – Uncertain to either R – Rare or T- Threatened. A further five species (*Caladenia stricta* (Upright caladenia), *Calandrinia brevipedata* (Short-stalked purslane), *Calandrinia calyptrata* (Pink purslane), *Haloragis aspera* (Rough raspwort) and *Panicum effusum var. effusum* (Hairy panic)) have had a new regional assessment made moving from Q – Not yet assessed to K – Uncertain or R – Rare ratings. Thirty-four species have had their regional ratings downgraded with over a third (12 species) moving to U – Uncommon, 9 species to R – Rare, 6 species to N - Not significant, 4 species to K – Uncertain, 2 species to T-Threatened and 1 species to V – Vulnerable (refer to Table 5, below). One species (*Atriplex pumilio* (Mat saltbush)) has moved from U – Uncommon to Q – Not yet assessed, implying that further information is required to adequately assess this species. At the State level there have been 4 changes of which 3 are new assessments (*Cynoglossum* suaveolens (Sweet hound's-tongue),

Leucopogon clelandii (Cleland's beard-heath) and *Triglochin calcitrapum* (Spurred arrowgrass)) and 1 species is no longer rated (*Enteropogon acicularis* (Umbrella grass)). Changes noted at the National level are that 3 species previously unrated (*Maireana rohrlachii* (Rohrlach's bluebush), *Olearia pannosa ssp. pannosa* (Silver daisy-bush) and *Stackhousia annua* (Annual candles)) are now rated and 1 species (*Haegiela tatei* (Small nut-heads)) has moved from R – Rare to K – Uncertain.

Table 6: Comparison of Conservation Significance Ratings, for Plant Species whose Conservation Ratings have changed between 1994 – 2000, for the Yorke Peninsula Herbarium Region.

Species	Aust. Status 1994	Aust. Status 2000	SA Status 1994	SA Status 2000	YP Regional Status 1994	YP Regional Status 2000
Acrotriche affinis			N	N	R	U
Alectryon oleifolius ssp. canescens			N	N	E	T
Amphipogon caricinus var. caricinus			N	N	K	U
Arthropodium fimbriatum			N	N	T	N
Arthropodium strictum			N	N	T	R
Astroloma conostephioides			N	N	E	T
Astroloma humifusum			N	N	R	U
Atriplex pumilio			N	N	U	Q
Brachycome goniocarpa			N	N	R	U
Caesia calliantha			N	N	E	R
Caladenia stricta			U	U	Q	R
Calandrinia brevipedata			U	U	Q	K
Calandrinia calyptrata			U	N	Q	K
Calostemma purpureum			N	N	V	R
Calytrix involucrata			N	N	V	R
Chamaescilla corymbosa var. corymbosa			N	N	V	R
Chrysocephalum semipapposum			N	N	K	R
Corybas despectans			U	N	U	N
Cynoglossum suaveolens			N	Q	K	K
Distichlis distichophylla			N	N	K	R
Diuris palustris			U	U	R	U
Dodonaea tepperi					X	N
Drosera glanduligera			N	N	K	R
Elachanthus pusillus			U	U	E	K
Enteropogon acicularis			Q	-	Q	Q
Eriochilus cucullatus			N	N	U	N
Haegiela tatei	R	K	R	R	R	R
Haloragis aspera			Q	Q	Q	K
Hibbertia sp. C			N	N	R	U
Hydrocotyle pilifera var. glabrata			N	N	R	U
Lagenifera huegelii			N	N	E	U
Leucopogon clelandii			N	R	K	T
Levenhookia dubia			N	N	V	R
Lomandra micrantha ssp. micrantha			N	N	U	N
Maireana rohrlachii	-	R	R	R	K	K
Olearia pannosa ssp. pannosa	-	V	V	V	V	V
Ophioglossum lusitanicum			N	N	K	R
Panicum effusum var. effusum			Q	N	Q	K
Phyllanthus australis			N	N	V	R
Podolepis jaceoides			R	R	E	V
Pogonolepis muelleriana			N	N	R	U
Poranthera triandra			U	U	R	U
Prasophyllum elatum			N	N	E	R
Santalum murrayanum			U	U	V	R
Schoenus breviculmis			N	N	R	N
Schoenus nanus			N	N	E	K
Senecio picridioides			N	N	R	U

Table 6: Cont'd

Species	Aust. Status 1994	Aust. Status 2000	SA Status 1994	SA Status 2000	YP Regional Status 1994	YP Regional Status 2000
Stackhousia annua	-	V	V	V	V	V
Stipa multispiculis	R	R	R	R	R	K
Stipa platychaeta			N	N	T	U
Stipa scabra ssp.			N	N	E	K
Triglochin calcitrapum			Q	N	Q	Q

For Conservation Status Codes and definitions please refer to the explanation following Table 7.

Codes are defined in full in Lang and Kraehenbuehl (1994).

Table 7: Comparison of Conservation Significance Ratings, for Plant Species whose Conservation Ratings have changed between 1994 – 2000, for the Northern Lofty Herbarium Region.

Species	Aust. Status 1994	Aust. Status 2000	SA Status 1994	SA Status 2000	NL Regional Status 1994	NL Regional Status2000
Amyema melaleucae			N	N	K	R
Goodenia pinnatifida			Q	Q	Q	U
Maireana enchylaenoides			N	N	U	N
Olearia pannosa ssp. pannosa	-	V	V	V	V	V
Phyllanthus saxosus			U	U	Q	R
Poa fax			R	R	Q	K
Teucrium sessiliflorum			N	N	U	N

Conservation Status Codes:

X - Extinct	-	extinct or presumed extinct
E - Endangered	-	rare and in danger of becoming extinct
V - Vulnerable	-	rare and at risk of becoming endangered
T - Threatened	-	likely to be E or V but insufficient data is available
R - Rare	-	low overall frequency/confined to a restricted area/sparse
K - Uncertain	-	likely to be T or R but insufficient data is available
U - Uncommon	-	less common species of interest, but not rare enough to warrant special protection
N - Not Significant	-	common
Q	-	not yet assessed, but flagged as being of possible significance

Codes are defined in full in Lang and Kraehenbuehl (1994).

Of the 8 plant species for Northern Lofty Herbarium Region with rating changes, 1 species (*Amyema melaleucae* (Tea-tree mistletoe)) has been upgraded from K-Uncertain to R-Rare. Three species (*Goodenia pinnatifida* (Cut-leaf goodenia), *Phyllanthus saxosus* (Rock spurge) and *Poa fax* (Scaly poa)) have had new regional assessments made moving them from Q-Not yet assessed to either U -

Uncommon, R - Rare or K - Uncertain respectively (refer to Table 7, above). Two species (*Maireana enchylaenoides* (Wingless fissure-plant) and *Teucrium sessiliflorum* (Mallee germander)) have had ratings down-graded from U - Uncommon to N – Not significant. At a State level 1 species is no longer rated (*Enteropogon acicularis* (Umbrella grass)). Changes noted at the National level are that ratings now exist for 1 species (*Olearia pannosa ssp. pannosa* (Silver daisy-bush)) which was previously unrated.

4.4 Floristic Communities

Appendix 5 provides a summary listing of the overstorey and understorey dominants at each survey site. The structural data has been converted to follow the recent SA Structural Vegetation Formation Table (Heard and Channon 1997). These data have been summarised again into broader groups of structural and floristic similarity based on a subjective assessment of the raw data. As a result a general overview of the vegetation types encountered on the survey is provided below for comparison with the historical descriptions mentioned earlier in *Background on Native Vegetation* (Section 2.2). The plant communities are listed in the Structural Formation order (largest lifeform to smallest). Where two or more vegetation types occur in the same structural category then these are listed alphabetically. Plant species names are according to taxonomy recorded in Jessop (1993).

4.4.1 Forest Communities

- *Avicennia marina var. resinifera* (Grey mangrove) Low closed forest / Low open forest was sampled at 3 sites, on intertidal mud flats fringing the coastline. Generally these sites were totally dominated by *Avicennia marina var. resinifera* (Grey mangrove) with only one site recording another species present, *Sarcocornia quinqueflora* (Beaded samphire). Numerous conservation parks across the State contain this community, thus it is described by Neagle as having a reasonable conservation status (Neagle 1995).
- *Melaleuca halmaturorum* (Swamp paper bark) was found in dense stands as a Low closed forest/Low open forest at 7 sites around salt lakes, on the foot of Yorke Peninsula, south of Minlaton. One salt pan site had no other species present, but most sites had salt tolerant plants as understorey species such as *Rhagodia candolleana* (sea-berry saltbush), *Halosarcia pergranulata* (Black-seed samphire) and *Sarcocornia quinqueflora* (Beaded samphire). This community has a reasonable conservation status, with 6% of the vegetation cover of Innes National Park containing this community (Davies 1982).
- *Eucalyptus camaldulensis* (River redgum) Open forest was surveyed once only. The site was at the top of Yorke Peninsula on the Broughton River floodplain. The understorey species present were *Muehlenbeckia florulenta* (Lignum), *Acacia salicina* (Willow wattle) and *Cyperus gymnocaulos* (Spiny flat-sedge). A *Eucalyptus camaldulensis* (River redgum) Open Woodland was mentioned to be in the Minlaton area at Gum Flat (refer section 2.2), however no sites were sampled of this association in that specific area during the survey period. To gain a better representative picture of this vegetation type and to determine if differences occur between these disjunct locations more sampling of *Eucalyptus camaldulensis* areas are required (providing other suitable remnants can be found).
- *Eucalyptus porosa* (Mallee box) Low open forest occurred at 2 sites, one east of Yorketown and the other south of Port Wakefield. Both sites had *Pittosporum phylliraeoides* (Native apricot),

Lycium ferocissimum (African boxthorn) and *Melaleuca lanceolata* (Dryland tea-tree) present in the understorey with a mixture of grasses and herbaceous species.

- *Eucalyptus porosa* (Mallee box), *Callitris preissii* (Southern cypress pine) Low open forest was found at one site just north of Kadina with a shrubby understorey of *Rhagodia parabolica* (Mealy saltbush), *Acacia ligulata* (Umbrella bush), *Geijera linearifolia* (Sheep bush), *Acacia hakeoides* (Hakea wattle) and *Acacia nyssophylla* (Spine bush).
- *Callitris preissii* (Southern cypress pine) Low open forest was found at a single site on loamy sand near Port Broughton. The understorey comprised 26 species, mainly grasses and herbaceous species, of which over half were introduced species.
- *Allocasuarina verticillata* (Drooping sheoak) Low open forest / Very low open forest was surveyed at 4 sites, all north of Minlaton. These sites had a loam to clay loam surface soil with an average of 51 species present of which 9 (18%) were introduced species. This community had a variety of understorey shrubs, (*Acacia pycnantha* (Golden wattle), *Beyeria lechenaultii* (Pale turpentine bush), *Pomaderris paniculosa* (Mallee pomaderris)), sedges (*Gahnia lanigera* (Black grass saw-sedge)) and grasses (*Stipa sp., Bromus sp.).*

4.4.2 Woodland Communities

- *Eucalyptus porosa* (Mallee box) Woodland/Low woodland occurred at 8 sites. Most of these sites were located near Maitland. This community had a variety of understorey shrubs, sedges and grasses, including *Bursaria spinosa* (Sweet bursaria) *Alyxia buxifolia* (Sea box), *Gahnia lanigera* (Black grass saw-sedge), *Stipa sp.*(Spear grass) and *Bromus sp.*(Brome). This community has a moderate conservation status (Neagle, 1995).
- *Allocasuarina verticillata* (Drooping sheoak) Low woodland was found as a pure stand at 9 sites spread throughout the survey area. The understorey was dominated by a variety of shrubs and sedges, including *Melaleuca spp., Acacia ligulata* (Umbrella bush), *Lepidosperma congestum* (Clustered sword-sedge) and *Gahnia lanigera* (Black grass saw-sedge).
- *Allocasuarina verticillata* (Drooping sheoak) Low Woodland was also found at a further 11 sites in association with *Eucalyptus porosa* (Mallee box) (4 sites), or *Melaleuca lanceolata* (Dryland tea-tree) (7 sites). Most sites were located south of Minlaton, with the exception of one site just south of Ardrossan. The understorey contained a variety of shrub and sedge species very similar to the pure *Allocasuarina verticillata* (Drooping sheoak) stands mentioned above, with *Acrotriche patula* (Prickly ground-berry), *Bursaria spinosa* (Sweet bursaria), *Lepidosperma congestum* (Clustered sword-sedge) and *Gahnia lanigera* (Black grass saw-sedge) present.
- *Callitris preissii* (Southern cypress pine) Low woodland was found at a site near Moonta. It had 44 understorey species including many shrubs and only 4 introduced species. This community has been updated from a poor conservation status (Davies 1982) to a moderate conservation status (Neagle 1995).
- *Casuarina pauper* (Black oak) Low woodland was surveyed only once on an isolated sandy rise/dune amongst saltmarsh flats near the Fisherman Bay estuary, north east of Port Broughton. The site had 37 species present, with the dominant understorey species including *Atriplex paludosa ssp. cordata* (Marsh saltbush), *Lawrencia squamata* (Thorny lawrencia) and *Maireana erioclada* (Rosy bluebush). Other types of Black oak communities are found in this area (refer to section 2.2) which may be more typical. The survey did not sufficiently sample the variety of Black Oak communities in this area and targeting this vegetation type for further sampling should rectify this.

- *Melaleuca lanceolata* (Dryland tea-tree) Low woodland was found at 10 sites throughout the survey area, but principally on the foot of Yorke Peninsula. The understorey was composed of various shrub, sedge and grass species including *Exocarpus aphyllus* (leafless cherry), *Bursaria spinosa* (Sweet bursaria) and *Lepidosperma congestum* (Clustered sword-sedge) with *Lycium ferocissimum* (African boxthorn) invading.

4.4.3 Mallee Communities

Of the 276 sites surveyed, 130 were dominated by *Eucalyptus spp.*, with the next closest genera being *Acacia spp.* at 20 sites. Of the 130 sites dominated by *Eucalyptus spp.*, 111 were described as mallee communities.

- The most prevalent overstorey *Eucalypt* species was *Eucalyptus gracilis* (Yorrell), found at 30 sites throughout Yorke Peninsula. It only occurred as a pure stand at 2 sites, both in the northern portion of the survey area, with chenopod shrubs as the understorey. Other *Eucalyptus gracilis* (Yorrell) communities surveyed were:

  - *Eucalyptus gracilis* (Yorrell) +/- *E. brachycalyx* (Gilja) Mallee. This was found at 3 sites, all north of Maitland and with an understorey of *Rhagodia* spp.(Saltbush), *Enchylaena tomentosa* (Ruby saltbush), *Melaleuca* spp. (Tea-tree) and *Stipa* spp.(Spear-grass).

  - *Eucalyptus gracilis* (Yorrell) +/- *E. socialis* (Beaked red mallee) Open mallee was found at 3 sites, all situated north of Port Victoria. This association had an understorey of low shrubs such as *Rhagodia parabolica* (Mealy saltbush), *Enchylaena tomentosa* (Ruby saltbush) and *Geijera linearifolia* (Sheep bush).

  - The remaining 11 *Eucalyptus gracilis* (Yorrell) Mallee sites had a mixture of +/- *E. 'anceps'* (Sessile-fruit white mallee), +/- *E. leptophylla* (Narrow-leaf red mallee), +/- *E. diversifolia* (Coastal white mallee), +/- *E. rugosa* (Kingscote mallee), +/- *E. oleosa* (Red mallee), +/- *E. brachycalyx* (Gilja) and / or +/- *E. porosa* (Mallee box). These sites were scattered throughout the study area. In general all associations were on plains with sandy loam surface soils with the exception of the *Eucalyptus gracilis* (Yorrell), *E. diversifolia* (Coastal white mallee) community and the *Eucalyptus gracilis* (Yorrell), *E. rugosa* (Kingscote mallee) community.

- *Eucalyptus diversifolia* (Coastal white mallee) Mallee / Open low mallee occurred at 11 sites distributed across the southern extent of Yorke Peninsula. The understoreys were mainly comprised of low shrub species, with *Beyeria lechenaultii* (Pale turpentine bush) being the most prevalent. This community tended to be located on dunes with loamy to sandy surface soils with one exception being on clay loam. Other *Eucalyptus diversifolia* (Coastal white mallee) communities were :

  - *Eucalyptus diversifolia* (Coastal white mallee) +/- *E. rugosa* (Kingscote Mallee) Mallee. This was found at seven sites located at the foot of Yorke Peninsula. All these sites had *Melaleuca lanceolata* (Dryland tea-tree) understorey and outcrops of limestone with loose surface stone (strew) present.

  - *Eucalyptus diversifolia* (Coastal white mallee) +/- *E. oleosa* (Red mallee) Low mallee association. This was recorded at three sites and these were located at the extreme southwestern extent of the study area on consolidated dunes. Two locations were ridge sites having clay loam surface soils with outcrops of calcareous substrate present, the other dune site was on sandy loam soil with no calcareous material present. *Callitris*

canescens (Scrubby cypress pine) and *Gahnia lanigera* (Black grass saw-sedge) were the common understorey plants.

- *Eucalyptus socialis* (Beaked red mallee) +/- *E. incrassata* (Ridge-fruited mallee) +/- *E. leptophylla* (Slender-leaved mallee) Mallee with either *Melaleuca uncinata* (Broombush) or *Melaleuca acuminata* (Mallee honey-myrtle) understorey. This overstorey combination was the most common mallee association to have an understorey of either *Melaleuca uncinata* (Broombush) or *Melaleuca acuminata* (Mallee honey-myrtle). These 10 sites were spread throughout Yorke Peninsula.
- *Eucalyptus oleosa* (Red Mallee) Mallee / Open mallee was found in areas north of Maitland at 11 sites. Most sites contained an understorey of *Enchylaena tomentosa* (Ruby saltbush), *Rhagodia parabolica* (Mealy saltbush) and *Stipa* spp. The majority of sites were found on plains with sandy loam surface soil.
- *Eucalyptus porosa* (Mallee box) Mallee / Open mallee was found at 7 sites, mainly south of Maitland. This community was found to have an average of 45 species present, of which 25% were introduced plants. The understorey species varied with shrubs *Melaleuca lanceolata* (Dryland tea-tree) and *Bursaria spinosa* (Sweet bursaria), and/or grasses *Stipa sp.*(Spear-grass) and *Bromus sp.*(Brome).
- *Eucalyptus dumosa* (White mallee) Open mallee was recorded as a pure stand at 5 sites all north of Arthurton and on the western side of Yorke Peninsula, mainly on plains. The understorey species consisted of *Rhagodia parabolica* (Mealy saltbush), *Beyeria lechenaultii* (Pale turpentine bush) and *Geijera linearifolia* (Sheep bush).
- *Eucalyptus incrassata* (Ridge-fruited mallee) Open mallee occurred at 2 sites close to Minlaton and both were on consolidated sandy dunefields with understoreys' dominated by *Melaleuca uncinata* (Broombush). Other *Eucalyptus incrassata* (Ridge-fruited mallee) communities include:
  - *Eucalyptus incrassata* (Ridge-fruited mallee) +/- E. leptophylla (Slender-leaved mallee) Open mallee over a *Melaleuca uncinata* (Broombush) understorey. This community was surveyed once only in the Minlaton area and occurred on a sandy soil.
  - *Eucalyptus incrassata* (Ridge-fruited mallee) +/- E. socialis (Beaked red mallee) Open mallee with *Melaleuca acuminata* (Mallee honey-myrtle) understorey occurred at 2 sites close to Lochiel. Both sites were on consolidated dunefields.
- *Eucalyptus socialis* (Beaked red mallee) Open mallee was found at 2 sites north of Arthurton. At both sites 51 understorey species were recorded with *Lepidosperma viscidum* (Sticky sword-sedge) one of the few species common to both areas. The lack of shared understorey species may be due to differences in landform and soil types. One site was on a light medium clay plain while the other was on a sandy loam hill slope. Further sites are needed in both types to determine if these are two distinct floristic communities.
- *Eucalyptus 'anceps'* (Sessile-fruit white mallee) Open low mallee was found as a pure stand of overstorey at one site west of Curramulka. The site had an understorey comprised of 46 species, including *Acrotriche patula* (Prickly ground-berry), *Cryptandra amara* (Spiny cryptandra), *Melaleuca acuminata* (Mallee honey-myrtle) and *Gahnia lanigera* (Black grass saw-sedge). The only other *Eucalyptus 'anceps'* (Sessile-fruit white mallee) community surveyed was:
  - *Eucalyptus 'anceps'* (Sessile-fruit white mallee) +/- *E. leptophylla* (Slender-leaved mallee) Open mallee found at 3 sites between Ardrossan and just south of Minlaton. The understorey at each site was a very diverse shrubland averaging 70 species. All sites were located on the plains with varying percentage of clay present in the surface soil.

4.4.4 Shrubland Communities

- Eighteen *Acacia spp.* shrubland sites were surveyed within the Yorke Peninsula Herbarium Region and all fell into distinctive regional groups, mainly within the coastal communities (refer section 4.4.5). Two non-coastal Acacia shrublands were:

  - *Acacia oswaldii* (Umbrella wattle), *Geijera linearifolia* (Sheep bush) Shrubland which occurred at 2 sites south of Port Vincent. These sites are similar in that they each had less than a 10% cover of loose calcareous surface stone present and were located on plains but differ in terms of understorey species present. These sites were located further inland than other *Acacia spp.* Shrublands surveyed and may represent two different inland shrubland communities.

  - *Acacia victoriae* (Elegant wattle) Low shrubland was only recorded once, on a road reserve 10 km east of Wood Point in the Wandearah West area. This inland *Acacia spp.* shrubland site also had a high cover abundance of *Scaevola spinescens* (Spiny fanflower) and an understorey of chenopod shrubs and grasses. This community is typical of *Acacia victoriae* (Elegant wattle) shrublands in the northern areas of the Northern Lofty Herbarium Region.

- *Geijera linearifolia* (Sheep bush) +/- *Melaleuca lanceolata* (Dryland tea-tree) Shrubland was found at 3 sites all north of Port Vincent. The understorey varied from low shrubs to grasses. No calcareous substrate or loose surface stone was present at these sites.

- *Maireana oppositifolia* (Salt bluebush) Low shrubland, typical of coastal areas, was found at 4 sites, all located on the western coastline from Point Turton to just north of Wallaroo. Salt tolerant plants such as *Sclerostegia arbuscula* (Shrubby samphire), *Nitraria billardierei* (Nitre bush), and *Sarcocornia quinqueflora* (Beaded samphire) dominated the understorey.

- *Maireana brevifolia* (Short-leaf bluebush) Low shrubland occurred at 2 sites, both just south of Port Wakefield. As the vegetation in this area has had a history of disturbance, with land cleared for agricultural use, this shrubland type may have resulted from the removal of the mallee overstorey.

4.4.5 Coastal Shrubland Communities

As some previous survey work had been conducted in Innes National Park, the full complement of different types of coastal shrublands were not covered in the site selection process. This was to avoid duplication of effort and to more effectively use resources by targeting vegetation communities where limited information was available. As a result the shrublands summarised here only reflect those surveyed in 1994. These include;

- *Acacia cyclops* (Western coastal wattle) Tall closed shrubland. This was only recorded once on a consolidated dunefield near Tiparra Springs. *Rhagodia candolleana ssp. candolleana* (Seaberry saltbush) and *Tetragonia implexicoma* (Bower spinach) were the dominant understorey species.

- *Acacia anceps* (Angled wattle) Shrubland occurred at one site at the southern extreme of Yorke Peninsula on a dune footslope. The understorey included *Leucopogon parviflorus* (Coast beard-heath), *Lasiopetalum discolor* (Coast velvet-bush) and *Beyeria lechenaultii* (Pale turpentine bush).

- *Acacia leiophylla* (Coast golden wattle), *Leucopogon parviflorus* (Coast beard-heath) Shrubland occurred at 2 sites south of Edithburgh. These sites were located on sandy beach ridge plains within 3 km of each other.

- *Acacia ligulata* (Umbrella bush) +/- *Olearia axillaris* (Coast daisy-bush) Shrubland was the most common *Acacia sp.* shrubland association found. This association was surveyed at 7 sites, all located within 3 km of the coastline, typically on sandy coastal dunefields.
- *Acacia longifolia var. sophorae* (Coastal wattle), *Leucopogon parviflorus* (Coast beard-heath) Shrubland was recorded at 2 sites also on coastal sandy dunes south of Edithburgh. This community has a reasonable conservation status, as it occurs in numerous conservation and national parks, including Innes National Park. Damage from tourists accessing the coastline has been identified as one of the threats to this community (Davies 1982).
- *Leucopogon parviflorus* (Coast beard-heath) +/- *Olearia axillaris* (Coast daisy-bush) Shrubland occurred at 7 sites all in dunefields on the foot of Yorke Peninsula. The understorey included *Isolepis nodosa* (Knobby club-rush) and *Calytrix tetragona* (Common fringe-myrtle).
- *Acacia nematophylla* (Coast wallowa) Low shrubland occurred once within Innes National Park fringing Deep Lake. Of the 43 species present at the site, an average of 11 species (26%) was introduced. The understorey was a mixture of small shrubs typical of a coastal community.
- *Olearia axillaris* (Coast daisy-bush) Low shrubland occurred at 9 sites throughout the study area with all sites being within 1 kilometre of the coastline. The understorey species composition varied greatly with an average of 28 understorey species present, 43% of which were introduced species.
- Of the 21 saltmarsh (samphire) community sites surveyed, 15 were dominated by *Halosarcia sp.* (Samphire), 5 dominated by *Sclerostegia arbuscula* (Shrubby samphire), and 1 dominated by *Sarcocornia quinqueflora* (Beaded samphire). Only the *Halosarcia spp.* (Samphire) sites had introduced species present, with the remainder of the saltmarsh sites being composed entirely of native species. This may be a reflection of the habitat (salinity and inundation), the time of year that sites where surveyed and / or the lack of disturbance at the sites.

Several of these coastal shrubland communities may be amalgamated in a floristic analysis, which compares the whole species composition at each site across the region. In reference to analyses all sites located within 5 kilometres of the coastline have been incorporated into an analysis of coastal communities throughout South Australia. This analysis was part of the Coastal Dune and Clifftop Survey conducted by the Coast and Marine Section, EPA. For further details please refer to the recently published report by Oppermann (1999).

4.4.6 Hummock Grassland Communities

- *Triodia compacta* (Spinifex) Hummock Grassland communities occurred at 2 sites in the southern portion of the survey area. Both sites had *Lepidosperma congestum* (Clustered sword-sedge), *Acrotriche cordata* (Blunt-leaf ground-berry) and *Allocasuarina pusilla* (Dwarf oak-bush) present and were located on sandy consolidated dunefields.

4.4.7 Tussock Grassland Communities

Tussock grasslands were poorly represented in the survey results. This may be a reflection of the difficulty in determining this community from aerial photos, a natural lack of occurrence of this community within the survey region, and / or a decline in the community due to previous vegetation clearance across the region. The Tussock grasslands recorded during the survey are detailed below:

- *Lomandra effusa* (Scented mat-rush), *Lomandra collina* (Sand mat-rush) Tussock grassland was found on a cliff top just south of Stansbury. The understorey comprised *Lepidosperma congestum* (Clustered sword-sedge), *Chrysocephalum apiculatum* (Common everlasting) and *Goodenia willisiana* (Silver goodenia).
- *Lomandra effusa* (Scented mat-rush) Tussock grassland was found at 2 sites, one south west of Point Pearce along the coastline and the other near Bute. Both sites had 23 species present with 5 and 6 introduced species respectively. *Goodenia pusilliflora* (Small-flower goodenia), *Vittadinia megacephala* (Giant New Holland daisy), *Bromus rubens* (Red brome), *Danthonia caespitosa* (Common wallaby grass), and *Stipa sp.* (Spear grass) were understorey species present at both sites.
- *Stipa scabra group* (Rough spear grass), *Danthonia caespitosa* (Common wallaby grass) Open (tussock) grassland which occurred on a cliff top area in the town of Ardrossan just north of Ardrossan town centre. This location had an understorey of *Lomandra effusa* (Scented mat-rush), *Chrysocephalum apiculatum* (Common everlasting) and *Goodenia willisiana* (Silver goodenia). This is a very significant site in terms of the plant species present, containing several species of conservation significance. The area is owned and managed by the council and is subject to periodic mowing.

The *Lomandra effusa* (Scented mat-rush) associations listed above have a priority 1 conservation status according to Neagle (1995), as there are no areas in South Australia that specifically conserve this association.

4.4.8 Sedgeland Communities

Generally sedgeland sites selected in the study area were around the southern saline swamps or lagoons on the foot of Yorke Peninsula (8 sites). Sedgelands in the north were more difficult to locate on aerial photos, with only one site found. The sedgelands are described below:

- *Gahnia lanigera* (Black grass saw-sedge) Sedgeland was found in association with *Lomandra effusa* (Scented mat-rush) and *Lepidosperma congestum* (Clustered sword-sedge) at 3 sites. These sites were concentrated in the Peesey Swamp area with the exception of one site located in the north near Kainton.
- *Gahnia filum* (Smooth cutting-grass) Sedgeland was found to occur in thickets on clay soils around saline swamps and lagoons on the southern foot of Yorke Peninsula. It was recorded at 3 sites.

Of the sedgeland sites selected and surveyed no sites were found to contain *Gahnia trifida* (Cutting grass), which had been recorded in error in Foale (1975), but has since been recorded at 2 locations in 1999.

4.5 Introduced Plants and Disturbance Indicators

Of the 783 unique plant species recorded by the survey, 151 (or 19%) are introduced species. A list of the introduced species recorded during the survey is included as Appendix 6.

A cursory examination of the distribution of introduced species reveals some interesting statistics for some weeds of agricultural significance and highlights some issues of concern for remnant native vegetation.

- Brome grasses (*Bromus rubens* (Red brome), *B. diandrus* (Great brome), *B. rigidus* (Rigid brome), *B. madritensis* (Compact brome), *B. catharticus* (Prairie grass)) - occurred at 106 sites spread throughout the study area and within all floristic groups except the samphire communities.
- Onion Weed (*Asphodelus fistulosus*) - recorded at 20 sites, mostly around the towns of Maitland, Ardrossan, Moonta and Wallaroo.
- Barley Grass (*Critesion murinum* ssp.) - occurred at 8 sites, limited to Wallaroo and the most easterly portion of the study area around Port Wakefield and Lochiel.
- Wild Oats (*Avena barbata, A. fatua*) - was found in 76 sites, mainly in the northern half of the area, particularly around Maitland. Only 4 sites had *Avena fatua* present, 2 of which were near Maitland, one near Moonta and one near Wallaroo.
- Ward's Weed (*Carrichtera annua*) - was recorded in 43 sites, all to the north of Curramulka. The majority appeared in the Wallaroo/Bute region.
- African Boxthorn (*Lycium ferocissimum*) - occurred at 108 sites spread across the entire survey area. This represents over 39% of the total survey sites. As this species is a proclaimed weed this level of infestation is of particular concern. The control of this species requires the extraction of the plant from the ground and then follow-up work in spraying or hand pulling of seedlings as they appear. The Animal and Plant Control Commission have indicated that this survey data is valuable for targeting locations of infestation for eradication, thus reducing the threat to native vegetation communities.
- Bridal Creeper (*Myrsiphyllum asparagoides*) - was recorded at 52 sites, mainly north of Curramulka. This species has been designated as a weed of National Significance under the National Weed Strategy (National Weed Strategy Executive Committee, 1998). It is a highly invasive species, with little effective means of control available at present. Local councils and conservation orientated community groups would find the location data of the sites containing this species helpful for management and monitoring purposes.
- Cape Weed (*Arctotheca calendula*) - occurred at 35 sites spread widely across the survey area.

Appendix 5 presents a list of the surveyed sites ranked in order of the percentage of introduced plants on their species list. This percentage is derived from the total number of plant species at each site and does not take into account the cover/abundance of each species present. It must be noted that the seasons' influence which species are found at any location, therefore, care must be taken when interpreting these figures. However it is interesting to note the following:

- no introduced species were listed at 15 of the 276 sites visited;
    - 8 sites where no introduced species were found were Samphire communities, mostly with a *Sarcocornia spp.* understorey and an average plant list of 3 species,
    - 3 sites were Mangrove communities of *Avicennia marina var. resinifera* (Grey mangrove),
    - 2 sites were *Melaleuca sp.* thickets on the foot of Yorke Peninsula, and
    - 2 sites were Open mallee, one of *Eucalyptus oleosa* (Red mallee) and one of *Eucalyptus diversifolia* (Coastal white mallee). Both of these sites were in continuous blocks of

vegetation. The *Eucalyptus oleosa* (Red mallee) site has never been grazed by stock and the *Eucalyptus diversifolia* (Coastal white mallee) site had not been grazed for at least 10 years.

- 25 out of the total 130 sites with *Eucalyptus* spp. overstorey (Mallee and Woodland) had 2 or less introduced species listed, with 2 of these sites being entirely weed free and most sites had an understorey of *Melaleuca* spp.;
- an average of 23.3% introduced species per site was recorded over the whole 276 sites visited;
- 41 sites were in National Estate Areas with an average of 21% introduced species per site;
- the 14 grassland and sedgeland sites, generally with species lists of between 11 and 50 plants had an average of 25% introduced species present;
- the site with the highest percentage of weeds (81%) was a *Halosarcia pergranulata* (Black seed samphire) Low shrubland with a total of 16 species present. The site was just south of Port Hughes and has a long history of stock grazing; and
- most sites that had a higher than 50% weed infestation were *Olearia axillaris* (Coast daisy bush) Shrublands or *Chenopodiaceae* species Low shrublands such as those dominated by *Halosarcia sp.* or *Maireana sp.*.

4.6 National Estate Areas

The total area of landcover on the Register of the National Estate within the study boundary is 46,996 hectares (5.07% of the total study area). Within this total National Estate area 41 survey sites were located. Appendix 7 indicates the sites within National Estate Areas.

Of the 22 sites that had species with National Conservation Significance, 3 sites were found within current National Estate Areas. A site at Moody Scrub contained *Caladenia brumalis* (Winter spider-orchid), however this was also recorded at 10 other locations on Yorke Peninsula. *Haegiela tatei* (Small nut-heads) was found at both Innes National Park and Peesey Swamp.

A set of criteria was determined and used to highlight which sites, of the remaining 235 survey sites, were worthy of further investigation toward consideration for nomination to the Register of the National Estate. The criteria used for this process were the:

- location of a plant species of conservation significance at a national level according to Lang and Kraehenbuehl, 1994;
- presence of a vegetation association of conservation significance at the state level according to Davies (1982) and /or Neagle (1995);
- location of plant species of conservation significance at a state or regional level according to Lang and Kraehenbuehl, 1994; and
- native species not recorded before in the region.

Using this criteria 16 sites were found to require further investigation. Many of these sites are on private property and therefore any nomination will require consultation and discussion with the landholders. The sites to be considered for investigation and the reasons for selection are listed below.

Sites, which contain a plant species of conservation significance at a national level that may be worthy of investigation for nomination, are:

- *Eucalyptus porosa* (Mallee box) Open mallee site with a diverse understorey, totalling 65 species, of which only 3 were introduced. The site contained the nationally significant species *Euphrasia collina ssp. osbornii* (Osborn's eyebright), which was found at only two locations during the survey. The site also contained the nationally vulnerable *Caladenia brumalis* (Winter spider-orchid). This site is located in native vegetation placed under Heritage Agreement;
- *Eucalyptus socialis* (Beaked red mallee), *E. incrassata* (Ridge fruited mallee) Open mallee site with a *Melaleuca uncinata* (Broombush) understorey. This site is located in a narrow road reserve, approximately 6 metres wide, and contained 63 species of which 61 were native. This site contained the one other recorded observation for the survey of the nationally endangered *Euphrasia collina ssp. osbornii* (Osborn's eyebright). *Dillwynia hispida* (Red parrot-pea), which had not been recorded in the Yorke Peninsula region prior to the survey, was found only at this site during the survey. The site is managed by the District Council of Yorke Peninsula[10];
- *Eucalyptus porosa* (Mallee box) Low woodland site with an understorey of various native and introduced grasses. Of the 36 species present, 10 were introduced. *Stipa multispiculis* (Small-seed spear-grass), rare at the national, state and region levels was found at this site and one other site. The other location was highly weed infested (8 of 14 species were introduced), whereas at this site the majority of plant species were native, particularly in the groundcover stratum of the understorey. Many other examples of this vegetation community have a more degraded understorey. Being a reasonable representative of a *Eucalyptus porosa* (Mallee box) Woodland, classified as having only a moderate conservation status by Neagle (1995), further enhances the conservation significance of the site;
- A site of *Eucalyptus socialis* (Beaked red mallee), *E. incrassata* (Ridge fruited mallee), *E. leptophylla* (Narrow-leaf red mallee), *E. 'anceps'* (Sessile-fruit white mallee) Open Mallee over *Melaleuca uncinata* (Broombush) contained 41 species, of which 5 were introduced. *Acacia enterocarpa* (Jumping-jack wattle) which is endangered nationally was recorded only at this site during the survey;
- A *Gahnia filum* (Smooth cutting-grass) Tall sedgeland site had 34 native species and 8 introduced species recorded. This was the only site containing *Senecio macrocarpus* (Large-fruit groundsel), which is vulnerable at the national and state levels, and considered endangered on a regional basis;
- A site of *Eucalyptus diversifolia* (Coastal white mallee) +/- *Eucalyptus rugosa* (*Kingscote mallee*) white mallee) Mallee over *Melaleuca lanceolata* (Dryland tea-tree) and *Templetonia retusa* (Cockies tongue), contained the nationally rare *Prasophyllum goldsackii* (Goldsack's leek-orchid). This orchid was only recorded at one other location during the survey. A total of 58 native species were found at this Heritage Agreement site, of which 11 were introduced;
- *Eucalyptus porosa* (Mallee Box) Open mallee site with an understorey of *Melaleuca uncinata* (Broombush) and *M. lanceolata* (Dryland tea-tree). This site contained *Caladenia conferta* (Coast

[10] Formerly District Council of Minlaton

spider-orchid) which has an uncertain status nationally, but is endangered at the state and regional levels. This species was only recorded once during this survey. This *Eucalyptus porosa* (Mallee Box) Open mallee site had 11 introduced species (16.4 %) of the total number of 67 species present. This site is in native vegetation placed under Heritage Agreement; and

- *Acacia leiophylla* (Coast golden wattle), *Leucopogon parviflorus* (Coast beard-heath) Shrubland site with an understorey of *Olearia axillaris* (Coast daisy bush). Of the 39 other species present, 10 were introduced species. *Caladenia bicalliata* (Limestone spider- orchid), nationally rare, was found at this site, having been recorded prior to this survey at 3 other sites on Yorke Peninsula. Two of the previous recordings were in National Estate areas. This site is on the lower eastern side of Yorke Peninsula (the heel) and has not been grazed by stock for 40 years.

The next three sites containing communities with *Lomandra effusa* (Scented mat-rush) as their dominant overstorey are listed as rare and endangered communities with a priority one rating for conservation (Neagle 1995). Neagle (1995) suggests these communities should be "protected by Heritage Agreements or acquired by the National Parks and Wildlife Service as a matter of urgency". These sites should be considered as having State significance.

- *Lomandra effusa* (Scented mat-rush), *Gahnia lanigera* (Black grass saw-sedge), *Lepidosperma congestum* (Clustered sword-sedge) Closed tussock grassland. This site was in good condition with 23 species of which 5 were introduced. This type of community is important, as according to Neagle (1995), it is not conserved in any of the 489 reserves considered in his report. This site is within the Point Pearce Aboriginal Reserve, which has previously been nominated and included in the National Estate.

- *Lomandra effusa* (Scented mat-rush) Open tussock grassland site located just north of Bute. Of the 23 species present 6 were introduced species.

- *Lomandra effusa* (Scented mat-rush), *Lepidosperma congestum* (Clustered sword-sedge) Tussock grassland site on an exposed cliff top near a quarry just south of Stansbury. Twenty-three native species were found here with only five introduced species being present. The District Council of Yorke Peninsula[11] owns the area.

The following site is also considered to be of significance at a state level, due to its uniqueness and because it contains four species of conservation significance at a state and regional level.

- *Danthonia caespitosa* (Common wallaby-grass), *Stipa sp. (scabra group)* (Falcate-awn spear-grass) and *Chrysocephalum apiculatum* (Common everlasting) Open (tussock) grassland over a herbaceous native understorey. A total of 50 species were found, of which 3 were regionally endangered (and also had state ratings) and one other had possible conservation significance at the state level. The site had 41 native species present and 9 introduced. While this area appears to be mown on a regular basis the practice does not seem to be adversely affecting the grassland communities, however it is important and appropriate to monitor and investigate this situation to determine if the practice is useful for conservation management of the grassland community. The perimeter of this area also has couch grass present, which may pose a threat to the community, should it be allowed to further invade the site. The District Council of Central Yorke Peninsula owns this site, located on the clifftop within the Ardrossan township. The species of significance

[11] Formerly District Council of Yorketown

are *Elachanthus pusillus* (Elachanth), *Goodenia pinnatifida* (Cut-leaf goodenia), *Leptorhynchos elongatus* (Lanky buttons) and *Podolepis jaceoides* (Showy copper-wire daisy).

Other sites that also may be considered worthy of investigation are areas containing species that had not previously been recorded in the Yorke Peninsula Herbarium Region. Lang and Kraehenbuehl (1994) assigned these species a regional conservation status of uncertain until they can be assessed. Therefore following sites may be of Regional Significance:

- *Eucalyptus oleosa* (Red mallee), *E. leptophylla* (Narrow-leaf red mallee) Mallee site. Two species previously not recorded in the region that were recorded here are *Olearia lepidophylla* (Club moss daisy bush) and *Senecio tenuiflorus* (Woodland groundsel). The survey team indicated that the site was reasonably diverse (49 species) although the species weren't particularly abundant and had a low presence of introduced species (4.1%). This site had evidence of regeneration in response to partial clearance in about 1979. It is a few kilometres south of Agery and has a history of being grazed by sheep and cattle.
- *Acacia victoriae* (Elegant wattle) Low shrubland site containing a total of 24 species, 9 of which were introduced. A population of *Sida intricata* (Twiggy sida), a species previously not recorded in the Yorke Peninsula region, was found at this site. This site is a road reserve under the control of the District Council of Port Pirie.
- *Eucalyptus dumosa* (White mallee) Open mallee with a *Melaleuca uncinata* (Broombush) and *Beyeria lechenaultii* (Pale turpentine bush) understorey. This site had 10 introduced species present and 41 native species. The only known population in the Yorke Peninsula Region of *Omphalolappula concava* (Burr stickweed) occurs at this location. Stock grazing was occurring at this location at the time of the survey.

A final site to be considered on the basis of presence of fauna species is indicated below:

- A *Triodia compacta* (Spinifex) Hummock Grassland site with 29 native species and only one introduced species (*Lycium ferocissimum*- African Boxthorn) present. This site was one of only two such vegetation associations found during the survey, the other having a 15% weed composition. Southern Hairy-Nosed Wombats *(Lasiorhinus latifrons)* have also been seen in the area by the property owners. The Southern Hairy-Nosed Wombat *(Lasiorhinus latifrons)* is not represented in any conservation parks on Yorke Peninsula and although the species has no official status, it has been described as endangered in the Plan of Management for Hairy-Nosed Wombats in South Australia (St. John and Saunders, 1989).

5. CONCLUSIONS AND RECOMMENDATIONS

Largely geographical features such as topography, soil type, geology and climate determine the vegetation of the region. This survey sampled a diverse range of all vegetation types across the region, adding to existing knowledge by providing more information with which to describe these vegetation types for the region. Furthermore, survey site information has now been incorporated into the EDBSA and as a result is accessible to any person or organisation undertaking environmental related projects in the region.

In reference to the main vegetation information noted from previous literature and recorded in the background information (section 2.2), this survey successfully located and sampled the majority of these communities. In addition some previously poorly described vegetation types were included. Examples include *Callitris preissii* (Southern cypress pine) Low Woodland, *Lomandra effusa* (Scented mat-rush) Tussock grassland, *Stipa scabra group* (Spear grass), *Danthonia* spp. (Wallaby grass) Open (tussock) grassland and *Eucalyptus oleosa* (Red mallee) Mallee.

Following the survey, individual site's survey results were communicated to all landholders involved in the survey. Individual plant species lists were provided for each landholder's site location indicating scientific and common names and cover/abundance scores. Media releases summarising results from the survey were sent to local newspapers and to councils for inclusion in ratepayer's newsletters. Site data from this survey have already been supplied to grassland researchers to supplement their knowledge of native grasslands in the region. In addition it has been supplied to the Revegetation Officer (PIRSA) and the Landcare Officer based at Kadina to assist in landcare work on Yorke Peninsula and associated areas. The site data have also assisted a number of research projects including a Coastal Ecology and Rehabilitation Manual for Coastcare Groups of Yorke Peninsula, South Australia (pers comm. Andrew West, 1995) and the Thematic Identification of Remnant Bush and Tussock Lands in Coastal South Australia (Grund, 1997). The data collected within 5 kilometres of the coastline has been incorporated into the Coastal Dune and Clifftop Survey project analysis, conducted by the Coast and Marine Section, EPA. Additional sites were also surveyed in the Yorke Peninsula region by the Coastal Dune and Clifftop Survey during 1997, increasing the dataset available for a floristic analysis of the area (refer to section 5.3 Further Work). The data collected has also been used extensively in the Preliminary to the Biodiversity Plan for the Northern Agricultural Districts of South Australia (Graham, 1999) and the Biodiversity Plan for the Northern Agricultural Districts of South Australia (Graham, in prep).

The data has also contributed greatly to updating the conservation significance of plants within the survey region, particularly the Yorke Peninsula Herbarium region (refer to section 4.3.2). Systematic surveys such as this result in a large number of plant species records (9,798) being added to the existing databases and the plant specimens (4,501) being lodged with the Plant Biodiversity Centre Herbarium. These new data assist in updating the conservation status of plant species in the region based on the frequency of collection and geographical distribution. The addition of previously unrecorded species to the lists of vascular plants for the herbarium regions is another positive outcome of the survey process. All of these findings have contributed to the updating of the database of *Plants of Particular Conservation Significance in SA's Agricultural Regions*, Lang & Kraehenbuehl (2000).

5.1 Significant Species

Many of the surveyed sites in this region have been greatly modified by human activity over a long time period, particularly in the central and northern extent of the study area. As a result, the original botanical composition of many areas of native vegetation has been substantially altered, in some cases to the extent that very few of the understorey species still remain and regeneration of the overstorey has all but halted. However, some interesting finds were made. Five species not previously recorded from the Yorke Peninsula region were discovered and many species with conservation significance were recorded throughout the study area (Refer section 4.3). Previously only a limited picture of the conservation status for the Yorke Peninsula Herbarium Region was available. This survey was significant in that it was seasonally well timed and provided a comprehensive overview of the vegetation of Yorke Peninsula (P.Lang, DEH, March 2000). This survey resulted in a review of the conservation status of 60 plant species and has provided valuable material to the Plant Biodiversity Centre. The plants of conservation significance and vegetation associations of conservation significance, in conjunction with the new species recorded for the region have formed the basis for recommendations of sites to be investigated for nomination to the Register of the National Estate. These sites are important areas for conservation and, if managed correctly, could protect species and communities that are currently rare or threatened.

5.2 Significant Areas

A large proportion of the lower Yorke Peninsula is currently on the Register of the National Estate, with Innes National Park and Warrenben Conservation Park covering over 13,200 hectares. The northern portion of the study area has a far smaller area represented. The sites identified in this report for nomination to the National Estate Register have been selected based on the presence of new, rare or threatened plant species and vegetation associations of conservation significance (Refer section 4.6). This has not been a thorough or exhaustive search for areas to investigate for nomination, only a preliminary review based on very narrow criteria and subjective assessment. Further quantitative analysis, with the inclusion of additional criteria, may well highlight other areas equally worthy of investigation for nomination.

Of particular importance, this survey located a unique area on a clifftop site within the township of Ardrossan (see section 4.5). The site, classified as an Open tussock grassland, contained many native grass species and compositae (Daisy) species, a number of which have conservation significance. This type of association has not been recorded anywhere else on Yorke Peninsula, and given the lack of remnant native vegetation and the rarity of this association, it is unlikely to be represented in many of the remaining areas. The plants of conservation significance combined with the colourful display of Compositae (daisy) species in spring, make this area not only botanically attractive but also important in terms of conservation. This area, if managed for the purpose of conservation, could provide a possible tourist attraction for the District Council of Central Yorke Peninsula whilst preserving a unique vegetation association. By placing the site under Heritage Agreement the council could ensure that no future development occurs on the site.

Mulburra Park can be found between Port Julia and Port Vincent and a survey site was completed within this National Trust Reserve. This *Allocasuarina verticillata* (Drooping sheoak) Very low

woodland site had the highest diversity of plant species found during the survey. A total of 90 species were recorded, of which 79 were native. This park is currently under Heritage Agreement and the findings of this survey serve to highlight the value of the continuing protection this area should be afforded.

5.3 Summary of Areas to Investigate for National Estate Nomination

Sixteen sites that are worthy of further consideration for nomination to the National Estate Register are highlighted in this report. An *Acacia victoriae* (Elegant wattle) Low shrubland, a *Eucalyptus socialis* (Beaked red mallee), *E. incrassata* (Ridge fruited mallee) Open Mallee, a *Danthonia caespitosa* (Common wallaby-grass) Open Tussock grassland community and two *Lomandra* effusa (Scented mat-rush), *Lepidosperma congestum* (Clustered sword-sedge) Low Tussock grasslands were five sites identified as belonging to Local District Councils. A further three sites were located on private properties that are currently under Heritage Agreement. These properties contained *Eucalyptus diversifolia* (Coastal white mallee) +/- *E. rugosa* (*Kingscote mallee*) Mallee and two *Eucalyptus porosa* (Mallee box) Open mallee communities. The balance of sites recommended for investigation for nomination to the National Estate Register (8) are on private property and include *Eucalyptus porosa* (Mallee box) Low Woodland, *Eucalyptus socialis* (Beaked red mallee), *E. incrassata* (Ridge fruited mallee), *E. leptophylla* (Narrow-leaf red mallee), *E. 'anceps'* (Sessile-fruit white mallee) Open mallee, *Eucalyptus oleosa* (Red mallee), *E. leptophylla* (Narrow-leaf mallee) Mallee, *Eucalyptus dumosa* (White mallee) Open Mallee, an *Acacia leiophylla* (Coast golden wattle), *Leucopogon parviflorus* (Coast beard-heath) Shrubland, a *Gahnia filum* (Smooth cutting-grass) Tall Sedgeland, a *Triodia compacta* (Spinifex) Hummock Grassland and a *Lomandra effusa* (Scented mat-rush) Open Tussock Grassland.

Although only a preliminary examination of the data has occurred, it is considered that the site *Eucalyptus socialis* (Beaked red mallee), *E. incrassata* (Ridge fruited mallee) Open mallee association may be an important find. It contains 2 significant species, *Dillwynia hispida* (Red parrot-pea), and *Euphrasia collina ssp. osbornii* (Osborn's eyebright). The site is also on public land as a road reserve, and had only 2 introduced species present out of a total of 63 species.

The 16 sites detailed above all warrant investigation for nomination to the register, as they cover a diverse range of vegetation associations and each have at least one species of National, State or Regional conservation significance.

5.4 Further Work

Data from this survey have been collated with data from adjoining areas and any new sites within the region to assist a bioregional floristic analysis. A regional floristic analysis helps to refine existing knowledge of native vegetation in the area and provides a tool to summarise information for regional vegetation types. Floristic mapping across the region follows the floristic analysis process. These processes assist in obtaining a clearer picture of the regions floristic communities, their distribution and conservation status. This work has commenced and is expected to be available by December 2000.

There is a need to further examine communities that were not sufficiently sampled during this survey. The floristic analysis and floristic mapping process will highlight those communities that are poorly or under-represented in terms of site data. The analysis process will identify how many sites were completed within each floristic community. Some of these communities may have too few members to allow extrapolation to other areas of remnant native vegetation. Therefore, more visits to the region may be required to determine whether these communities exist elsewhere on Yorke Peninsula. It is likely that a number of additional survey sites will be required. From the current subjective assessment of the coverage of sites and communities represented it is suggested that further site data should be collected in:

- *Eucalyptus camaldulensis* (River redgum) communities as only one representative site was surveyed;
- Sedgelands surrounding swamp areas, particularly in the north of the study area where no sites were surveyed;
- Drainage line areas particularly in the north on the Broughton River flood plain;
- *Lomandra effusa* (Scented mat-rush) Tussock grassland communities due to the low number of representative sites completed;
- *Callitris preissii* (Southern cypress pine) communities as only 2 sites were surveyed; and
- *Casuarina pauper* communities, as only one site was sampled which may not be typical of these communities in the northern extent of the study area.

A detailed survey should be undertaken investigating the fauna (including invertebrates) across all vegetation communities, including the less well recognised sedgeland, grassland and grassy woodland communities.

There is also a need to ensure the data collected is made available to as many community groups, researchers and local interest groups as possible, either through publications, journal articles or public speaking engagements such as Field Days. It is particularly important that any groups or individuals that conduct other vegetation surveys in the region become familiar with the Environmental Database of South Australia and the Biological Survey of South Australia methodology, such that any further data collected will be compatible with existing data. The methodology of the native vegetation survey component of the Biological Survey of South Australia is detailed in Heard and Channon (1997), which is available from the GAR Unit.

Further investigation of sites considered worthy of nomination to the Register of the National Estate, as previously discussed (refer to section 4.6 & 5.3) is also required. For the purposes of this document, only a preliminary review has been conducted.

6. REFERENCES

Allaby, A. and M. (1990) *The Concise Oxford Dictionary of Earth Sciences.* Oxford University Press, Oxford.

American Geological Institute (1976) *Dictionary of Geological Terms.* Revised Ed. Anchor Books USA.

Boomsma, C.D. and Lewis, N.D. (1980) *The Native Forest and Woodland Vegetation of South Australia.* Bulletin 25. Woods and Forests Department. Government Printer. South Australia.

Corbett,D (ed) (1973) *Yorke Peninsula. A Natural History.* Department of Adult Education, The University of Adelaide.

Davies, R.J-P. (1982) *The Conservation of Major Plant Associations in South Australia.* Conservation Council of S.A. Incorporated.

Foale, M. (1975) *The Vegetation of Yorke Peninsula.* Nature Conservation Society of South Australia.

Forward, L.R. and Robinson, A.C. (eds) (1996) *A Biological Survey of the South Olary Plain South Australia.*, 1991 - 1992. Department of Environment and Natural Resources, South Australia.

Graham, A. (1999) *Preliminary to the Biodiversity Plan for the Northern Agricultural Districts of South Australia.* Department for Environment, Heritage and Aboriginal Affairs, South Australia.

Graham, A. (in prep) *Biodiversity Plan for the Northern Agricultural Districts of South Australia.* Department for Environment and Heritage, South Australia.

Grund, R. (March, 1997) *Thematic Identification of Remnant Bush Tussock Lands in Coastal South Australia.* Department of Environment and Natural Resources, South Australia.

Heard,L. and Channon, B. (1997) *A Guide to the Native Vegetation Survey Using the Biological Survey of South Australia Methodology.* Department of Housing and Urban Development.

Jessop, J.P. (ed) (1993) *A List of the Vascular Plants of South Australia (Edition IV).* The Botanic Gardens of Adelaide and State Herbarium.

Lang, P. and Kraehenbuehl, D. (1994) *Plants of Particular Conservation Significance in SA's Agricultural Regions*, database version September 1994.

McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J. and Hopkins, M.S. (1990) *Australian Soil and Land Survey Field Handbook.* Inkata Press Pty Ltd, Sydney.

Muir, B.G. (1977) *Biological Survey of Western Australian Wheatbelt. Part 2. Vegetation and Habitat of Bendering Reserve.* Records of the Western Australian Museum, Supplement No. 3. Perth.

National Weeds Strategy Executive Committee (1998) *Weeds Australia - Inaugural List of Weeds of National Significance.* Web page www.weeds.org.au/natsig.htm#list

Neagle, N (1995) *An Update of the Conservation Status of the Major Plant Associations of South Australia.* Department of Environment and Natural Resources, South Australia.

Oppermann, A. (1999) *A Biological Survey of the South Australian Coastal Dune and Clifftop Vegetation.* Coast and Marine Section, Environment Protection Agency, South Australia.

Playfair, R. (1994) *Central Yorke Peninsula Conservation Areas Study.* Resource Monitoring and Planning. Draft edition.

Specht, R.L. (1972) *The Vegetation of South Australia.* Government Printer, Adelaide.

St. John B.J. and Saunders, G.M. (1989) *Plan of Management for the Hairy-Nosed Wombat in South Australia.* Department of Environment and Planning, South Australia.

Wood, J.G. (1937) *Vegetation of South Australia.* Government Printer, Adelaide

APPENDICES

Appendix 1: South Australian Vegetation Structural Formations

Life Form/Height Class	Projective Foliage Cover of Tallest Stratum			
	Dense (70-100%)	Mid-dense (30-70%)	Sparse (10-30%)	Very sparse (<10%)
Trees > 30m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland
Trees 10-30m	Closed forest	Open forest	Woodland	Open woodland
Trees 5-10m	Low closed forest	Low open forest	Low woodland	Low open woodland
Trees <5m	Very low closed forest	Very low open forest	Very low woodland	Very low open woodland
Mallee (>3m)	Closed mallee	Mallee	Open mallee	Very open mallee
Low Mallee (<3m)	Closed low mallee	Low mallee	Open low mallee	Very open low mallee
Shrubs > 2m	Tall closed shrubland	Tall shrubland	Tall open shrubland	Tall very open shrubland
Shrubs 1-2m	Closed shrubland	Shrubland	Open shrubland	Very open shrubland
Shrubs < 1m	Low closed shrubland	Low shrubland	Low open shrubland	Low very open shrubland
Mat plants	Closed mat plants	Mat plants	Open mat plants	Very open mat plants
Hummock grasses	Closed Hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland
Tussock grasses	Closed (tussock) grassland	(Tussock) grassland	Open (tussock) grassland	Very open (tussock) grassland
Sedges	Closed sedgeland	Sedgeland	Open sedgeland	Very open sedgeland
Herbs	Closed herbland	Herbland	Open herbland	Very open herbland
Ferns	Closed fernland	Fernland	Open fernland	Very open fernland

[Note: Table originally derived from Specht (1972) and Muir (1977)]

Lifeform Definitions

Trees - woody; perennial; erect; canopy raised well above the ground. Depth of canopy is usually less than or equal to two thirds of the total tree height. Single stemmed, or if multistemmed, fewer than five individual trunks resulting from branching of a single short trunk, that is not a mallee-like lignotuber. Height usually >2m.

Mallees - genus *Eucalyptus;* multi-stemmed, trunks arising from lignotuber. Low mallee - < 3m. Mallee - > 3m.

Shrubs- woody; perennial; erect, procumbent or weeping; foliage occupies all or part of total plant height; multiple stems and branches arising from a rootstock or very short common trunk; generally <5m tall.

Mat Plants - Herbaceous or woody plants of prostrate habit, with major stems growing along the ground. Rarely exceeds 10 cm in height. Examples of mat plants are *Kunzea pomifera*, *Myoporum parvifolium*, *Carpobrotus rossii* and *Mimulus repens*.

Hummock Grass - Genera *Triodia* or *Plectrachne* only.

Grasses (tussock) - family Poaceae (Gramineae); leaf sheath always split.

Sedges - herbaceous, usually perennial, erect, generally tufted; arise from stolons, tubers, bulbs, rhizomes or seeds. Leaf sheath never split. Includes Cyperaceae, Juncaceae, Restionaceae, Typhaceae and Xyridaceae and other sedge-like forms.

Herbs - herbaceous or slightly woody; annual or sometimes perennial; erect or creepers; rarely exceeds 0.5m height.

Ferns - Ferns and fern allies, i.e. non-vascular cryptogams of classes Filicopsida and Lycopsida. This category includes *Ophioglossum* spp., *Lycopodium* spp., *Selaginella* spp. and *Isoetes* spp.

Note: Adapted from Forward, L.R., and Robinson, A.C. (eds) (1996). *A Biological Survey of the South Olary Plain South Australia*, 1991 - 1992. Biological Survey and Research, Natural Resources Group, Department of Environment and Natural Resources, South Australia.

Source: Heard and Channon (1997) Guide to a Native Vegetation Survey - Using the Biological Survey of South Australia Methodology, GAR Unit, IDA Branch, DHUD.

Appendix 2: Structural Formations in Australia according to Specht (1972)

Lifeform and Height of Tallest Stratum*	Projective Foliage Cover of Tallest Stratum			
	Dense (70 - 100%)@	**Mid Dense (30 - 70%)**	**Sparse (10 - 30%)**	**Very Sparse^^ (< 10%)**
*#Trees > 30m	Tall closed-forest*	Tall open-forest	Tall woodland	Tall open-woodland
#Trees 10-30m	Closed-forest*	Open-forest	Woodland	Open-woodland
#Trees 5-10m	Low closed-forest*	Low open-forest	Low woodland	Low open-woodland
*#Shrubs 2-8m	Closed-scrub	Open-scrub	Tall shrubland	Low open-shrubland
#Shrubs 0-2m	Closed-heath	Open-heath	Low Shrubland	Low open-shrubland
Hummock grasses 0-2m	----	—	Hummock grassland	Open hummock grassland
Herbs (including moss, ferns, hemicrytophytes, geophytes, therophytes, hydrophytes, helophytes)	Closed-herbland$ (1) Closed-tussock grassland (2) Closed grassland (3) Closed-herbfield (4) Closed-sedgeland (5) Closed-fernland (6) Closed-mossland	Herbland$ (1) Tussock grassland (2) Grassland (3) Herbfield (4) Sedgeland (5) Fernland (6) Mossland	Open-herbland$ (1) Open-tussock grassland (2) Open-grassland (3) Open-herbfield (4) Open-sedgeland (5) Open-fernland (6) Open-mossland	Ephemeral herbland

\# A tree is defined as a woody plant more than 5m tall, usually a single stem.
A shrub is a woody plant less than 8m tall, frequently with many stems arising at or near the base.

* Isolated trees (emergents) may project from the canopy of some communities. In some closed-forests, emergent *Araucaria*, *Acacia* or *Eucalyptus* species may be so frequent that the resultant structural form may be classified better as an open-forest.

^^ Some ecologists prefer to ignore scattered trees and shrubs, equivalent to emergents in a predominantly grassland, heath, or shrubland formation.

$ Appropriate names for the community will depend on the nature of the dominant herb.

@ The above values are based on the percentage number of leaf interceptions by random vertical point quadrats: stereoscoping profiling, developed by Howard (1970), would give higher scores.

Appendix 3: Structural Formations modified from Muir (1976) [Muirs Table]

LIFE FORM/HEIGHT CLASS	CANOPY COVER			
	DENSE 70 - 100%	MID DENSE 30 - 70%	SPARSE 10 - 30%	VERY SPARSE 1 - 10%
T Trees > 30m	Dense tall forest	Tall forest	Tall woodland	Open tall woodland
M Trees 15 – 30m	Dense forest	Forest	Woodland	Open woodland
LA Trees 5 - 15m	Dense low forest A	Low forest A	Low woodland A	Open low woodland A
LB Trees < 5m	Dense low forest	Low forest B	Low woodland B	Open low woodland B
KT Mallee tree form*(>3m)	Dense tree mallee	Tree mallee	Open tree mallee	Very open tree mallee
KS Mallee shrub form*(<3m)	Dense shrub mallee	Shrub mallee	Open shrub mallee	Very open shrub mallee
S Shrubs > 2m	Dense thicket	Thicket	Scrub	Open scrub
SA Shrubs 1.5 - 2.0 m	Dense heath A	Heath A	Low scrub A	Open low scrub A
SB Shrubs 1 - 1.5 m	Dense heath B	Heath B	Low scrub B	Open low scrub B
SC Shrubs 0.5 - 1.0 m	Dense low heath C	Low heath C	Dwarf scrub C	Open dwarf scrub C
SD Shrubs 0 - 0.5 m	Dense low heath D	Low heath D	Dwarf scrub D	Open dwarf scrub D
P Mat plants (single plant)	Dense mat plants	Mat plants	Open mat plants	Very open mat plants
H Hummock grass	Dense hummock grass	Middense hummock grass	Hummock grass	Open hummock grass
GT Grass > 0.5 m	Dense tall grass	Tall grass	Open tall grass	Very open tall grass
GL Grass < 0.5 m	Dense low grass	Low grass	Open low grass	Very open low grass
J Herbaceous spp.	Dense herbs	Herbs	Open herbs	Very open herbs
VT Sedges > 0.5 m	Dense tall sedges	Tall sedges	Open tall sedges	Very open tall sedges
VL Sedges < 0.5 m	Dense low sedges	Low sedges	Open low sedges	Very open low sedges
V Vines (twiners)	Dense vines	Vines	Open vines	Very open vines
MI Mistletoes	Dense mistletoes	Mistletoes	Open mistletoes	Very open mistletoes
X Ferns	Dense ferns	Ferns	Open ferns	Very open ferns
MO Mosses, Liverworts	Dense mosses	Mosses	Open mosses	Very open mosses
LI Lichens	Dense lichens	Lichens	Open lichens	Very open lichens

Source: Adapted from Muir B.G. (1977) See definitions overleaf. Adapted from 8m to 3m for South Australia.*

LIFE FORMS

TREES (T,M,LA,LB) - Woody, usually perennial plants, generally erect, of variable outline but commonly with a spherical or ovoid canopy raised well above the ground. The major part of the canopy from bottom to top less than or equal to two thirds of the total height of the tree. Single stemmed, or if multi-stemmed, with fewer than 5 individual trunks that result from branching of a single trunk (which may be quite short) and which do not arise from a mallee-like lignotuber.

MALLEES (KT, KS) - Woody, usually perennial plants of the genus *Eucalyptus*, generally erect, of variable outline but commonly with a spherical or vertically flattened canopy raised well above the ground. Leaves are commonly born only near the ends of branches. The major part of the canopy from bottom to top may extend from the ground to the maximum height of the plant, or may occupy only the upper portion of the total height. Multi-stemmed, the individual trunks arising from a lignotuber or swelling at the base of the stem, at or below soil-level, and bearing dormant buds.

TREE MALLEE (KT) - Usually greater than 3m* tall, with fewer than 5 trunks, of which at least three exceed 10cm at breast height. When dead, hollow limbs and trunks provide habitats for large vertebrates.

SHRUB MALLEE (KS) - Commonly less than 3m* tall, usually with 5 or more trunks, of which at least three do not exceed 10cm in diameter at breast height. When the mallee is dead the hollow limbs and trunks are rarely of sufficient size to provide habitats for vertebrates.

SHRUBS (S, SA, SB, SC, SD) - Woody, usually perennial plants, generally erect but may be procumbent or of weeping habit. Commonly broadly conical in form with the foliage occupying all or only part of the total height of the plant. Multiple stems and branches arise from a rootstock or very short common trunk. Lignotubers of the mallee type absent. Shrubs may be of any height but are generally less than 5m tall. Dead hollow branches rarely reach sufficient size to provide habitats for vertebrates.

MAT PLANTS (P) - Herbaceous or woody plants, usually perennial, prostrate and cushion-like. With densely compacted foliage which may occupy the whole volume of the aerial portion of the plant, or may occupy the outside surface of the cushion. Usually numerous, very short stems. Plants may vary from a few centimetres to several metres in diameter but rarely exceed 10cm in height. Mat plants may be shrub-like woody species (e.g. *Astroloma humifusum*) or herb-like species such as *Wilsonia humilis*.

HUMMOCK GRASSES (H) - Herbaceous, perennial grasses of the genera *Triodia* or *Plectrachne*. Have a typical mound-like form due to trapping of debris and soil within the stem bases, building up into a hummock. Commonly with dead grass in the middle and living grass on the outer edge. The clumps are of uniform height and the seed heads rise above the clumps. The height of the clump, not the seed heads is stated.

GRASSES (GT, GL) - Herbaceous or rarely woody plants of the family Poaceae (Gramineae). Perennial or annual, generally erect or spreading. Usually with distinct individual shoots arising from a single root system, or if not, then not forming a hummock.

HERBS (J) - Herbaceous or slightly woody, annual or sometimes perennial plants. Herbaceous, annual species are commonly erect and woody, perennial species commonly creepers or climbers. Some species are tufted. Foliage usually covers the majority of the branches in shrubby and creeping forms. May arise from stolons, tubers, bulbs, rhizomes or seeds, but usually not from lignotubers. Rarely exceeds 0.5m in height, unless climbing species.

SEDGES (VT, VL) - Herbaceous, usually perennial, erect plants. Generally of tufted habit. Arise from stolons, tubers, bulbs, rhizomes or seeds. Term includes Cyperaceae, Juncaceae, Restionaceae, Typhaceae and Xyridaceae and other plants of sedge-like form.

The following table may be of assistance in differentiating between grasses and sedges which are not flowering.

GRASSES	SEDGES
Leaf sheath always split	Leaf sheath never split
Ligule present	Usually no ligule
Leaf always flat	Leaf not always flat
Stem cross section circular	Stem cross section circular, triangular or polygonal
Evenly spaced internodes	Extended internode below inflorescence

Source: *Adapted from Muir B.G. (1977) Biological Survey of the Western Australian Wheatbelt. Part 2: Vegetation and Habitat of Bendering Reserve. Records of the Western Australian Museum, Supplement No. 3, WA Museum, Perth.*

* Adapted from 8m to 3m at the time of the Murray Mallee Survey for the South Australian situation.

Appendix 4: Cover / Abundance Scores and Lifestages

Cover/Abundance Score

R – Solitary plant
T - sparsely present; cover small (less than 5%)
1 - plentiful, but of small cover (less than 5%)
2 - any number of individuals covering 5 - 25% of the area
3 - any number of individuals covering 25 - 50% of the area
4 - any number of individuals covering 50 - 75% of the area
5 - covering more than 75% of the area

Note: *Adapted from Braun-Blanquet (1965).*

Life Stages

Definitions and Usage - Enter each respective code where it is relevant to >10% of individuals of that species population at that representative site. However this does not apply to seedlings - enter seedlings whenever they are observed present. For the reproductive stages i.e. fruiting or budding, only record if more than 10% of the reproductive organs are at that stage.

V - Vegetative	- only refers to plants in a non-reproductive phase i.e. no flowers, buds or unshed seed.
R - Regenerating	- woody perennial which is resprouting after significant foliage loss.
D - Dead/Dormant	- indicates that above ground material only is dead and includes plant species that may still have dormant below ground organs i.e. orchids, lilies etc.
B - Budding	- plants have buds formed in varying stages of development for flowering.
F - Flowering	- plants are in flower.
I - Immature Fruits	- immature fruits not shedding seed.
M - Mature Fruits	- fruits ripe and/or shedding
X - Recently Shed	- plants that are in a non-reproductive phase that show signs of having shed seed or fruits within the last 12 months.
S - Seedling	- record when any number of seedlings are observed.

Appendix 5: Summary of Survey Sites with Percentage of Introduced Species Indicated

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% Introduced plants in site
WAK0802	*Avicennia marina var. resinifera*	Low closed forest		1	0.0
INK0801	*Avicennia marina var. resinifera*	Low open forest		1	0.0
WAN2D15	*Avicennia marina var. resinifera*	Very low closed forest	*Sarcocornia quinqueflora*	2	0.0
COO0301	*Eucalyptus diversifolia, Melaleuca lanceolata ssp. lanceolata*	Very open mallee	*Beyeria lechenaultii, Hibbertia riparia (glabriuscula), Acrotriche cordata, Lasiopetalum discolor*	35	0.0
ALF1201	*Eucalyptus oleosa*	Open mallee	*Enchylaena tomentosa var. tomentosa, Sclerolaena diacantha, Rhagodia parabolica*	7	0 .0
WAR0102	*Halosarcia sp., Sarcocornia quinqueflora*	Low closed shrubland		5	0.0
WAL1201	*Maireana oppositifolia*	Low closed shrubland	*Sarcocornia quinqueflora, Halosarcia sp.*	7	0.0
COO0501	*Melaleuca acuminata, Melaleuca lanceolata ssp. lanceolata, Eucalyptus leptophylla*	Open shrubland	*Gahnia lanigera, Lepidosperma congestum, Triodia compacta*	38	0.0
COR0301	*Melaleuca halmaturorum ssp. halmaturorum*	Very low closed forest		1	0.0
INK1201	*Sarcocornia quinqueflora*	Low shrubland		3	0.0
INK0601	*Sclerostegia arbuscula*	Closed shrubland	*Sarcocornia quinqueflora, Maireana oppositifolia, Suaeda australis*	4	0.0
INK1102	*Sclerostegia arbuscula*	Closed shrubland	*Sarcocornia quinqueflora*	2	0.0
INK1101	*Sclerostegia arbuscula*	Low closed shrubland	*Sarcocornia quinqueflora*	2	0.0
WAK0801	*Sclerostegia arbuscula*	Low closed shrubland	*Sarcocornia quinqueflora*	2	0.0
MOO0201	*Sclerostegia arbuscula*	Shrubland	*Sarcocornia quinqueflora, Suaeda australis, Maireana oppositifolia*	4	0.0
MIN0501	*Eucalyptus incrassata, Eucalyptus leptophylla*	Open mallee	*Melaleuca uncinata, Lepidosperma viscidum, Gahnia lanigera*	63	1.6
HIL1201	*Eucalyptus rugosa, Eucalyptus oleosa*	Open mallee	*Melaleuca lanceolata ssp. lanceolata, Acrotriche cordata, Gahnia lanigera*	58	1.7
HIL1501	*Eucalyptus diversifolia*	Very open low mallee	*Allocasuarina pusilla, Logania ovata, Acrotriche cordata*	55	1.8
HIL0801	*Eucalyptus diversifolia*	Very open low mallee	*Melaleuca lanceolata ssp. lanceolata, Melaleuca acuminata*	52	1.9

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% Introduced plants in site
STA0401	*Eucalyptus leptophylla, Eucalyptus incrassata, Eucalyptus porosa*	Open mallee	*Melaleuca uncinata, Gahnia lanigera, Lasiopetalum behrii, Baeckea crassifolia, Dodonaea hexandra*	52	1.9
ALT0501	*Eucalyptus diversifolia*	Low mallee	*Acrotriche patula, Acacia leiophylla*	43	2.3
ALT0801	*Eucalyptus diversifolia*	Very open low mallee	*Lasiopetalum discolor, Gahnia lanigera, Acrotriche cordata, Lomandra effusa, Acrotriche patula*	41	2.4
MIN1B11	*Eucalyptus incrassata, Eucalyptus socialis*	Open mallee	*Melaleuca uncinata*	63	3.2
COR1F25	*Eucalyptus diversifolia, Eucalyptus oleosa, Callitris canescens*	Low mallee	*Gahnia lanigera*	30	3.3
MOO2B06	*Eucalyptus socialis, Eucalyptus incrassata, Eucalyptus 'anceps'*	Mallee	*Gahnia deusta, Melaleuca acuminata*	60	3.3
TUR0101	*Triodia compacta*	Hummock grassland	*Lepidosperma congestum, Acrotriche cordata*	29	3.4
MIN0201	*Eucalyptus incrassata*	Open mallee	*Melaleuca uncinata, Leptospermum coriaceum, Calytrix involucrata, Homoranthus wilhelmii*	25	4.0
MOO1201	*Eucalyptus 'anceps', Eucalyptus leptophylla, Eucalyptus oleosa*	Mallee	*Gahnia deusta, Melaleuca acuminata, Stipa scabra group*	49	4.1
ALT0701	*Eucalyptus 'anceps', Eucalyptus diversifolia*	Mallee	*Templetonia retusa, Dodonaea humilis, Gahnia deusta, Gahnia lanigera, Dianella brevicaulis/revoluta var.*	46	4.3
POR0301	*Eucalyptus leptophylla, Eucalyptus 'anceps'*	Open mallee	*Gahnia lanigera, Lepidosperma congestum, Gahnia deusta, Arthropodium fimbriatum*	68	4.4
POR0201	*Eucalyptus porosa*	Open mallee	*Melaleuca lanceolata ssp. lanceolata, Gahnia lanigera, Lepidosperma viscidum, Lepidosperma congestum, Melaleuca acuminata(T*	65	4.6
HIL1601	*Eucalyptus diversifolia*	Very open low mallee	*Triodia compacta*	57	5.3
MIN0401	*Eucalyptus incrassata*	Open mallee	*Melaleuca uncinata, Calytrix involucrata, Schoenus breviculmis, Neurachne alopecuroidea, Baeckea crassifolia*	38	5.3
ARD0801	*Eucalyptus 'anceps', Eucalyptus leptophylla, Eucalyptus calycogona var. calycogona*	Mallee	*Melaleuca uncinata, Acacia microcarpa, Dodonaea baueri, Stipa scabra ssp. falcata*	56	5.4
COO0901	*Melaleuca halmaturorum ssp. halmaturorum*	Tall closed shrubland	*Samolus repens, Hypoxis glabella var. glabella, Hydrocotyle medicaginoides, *Sonchus oleraceus*	15	6.7
PON0303	*Eucalyptus gracilis, Eucalyptus diversifolia*	Low open forest	*Callitris canescens, Acrotriche patula, Lasiopetalum discolor, Melaleuca acuminata*	42	7.1

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% introduced plants in site
POR0203	*Eucalyptus socialis, Eucalyptus leptophylla*	Mallee	*Melaleuca acuminata, Melaleuca uncinata, Gahnia deusta*	42	7.1
CUR0801	*Eucalyptus oleosa, Eucalyptus 'anceps', Eucalyptus gracilis*	Open mallee	*Melaleuca acuminata, Westringia rigida*	27	7.4
CUR1301	*Geijera linearifolia, Acacia oswaldii*	Tall open shrubland	*Westringia rigida, Senna artemisioides nothossp. coriacea*	39	7.7
ARD2B20	*Eucalyptus leptophylla, Eucalyptus 'anceps', Eucalyptus socialis*	Open mallee	*Melaleuca uncinata, Acrotriche patula, Gonocarpus mezianus, Gahnia lanigera*	39	7.7
STA0404	*Eucalyptus porosa*	Open mallee	*Gahnia lanigera, Bursaria spinosa, Acrotriche patula, Hibbertia sericea var., Dodonaea hexandra*	50	8.0
COO0601	*Eucalyptus gracilis, Eucalyptus oleosa*	Very open mallee	*Melaleuca acuminata, Acrotriche cordata, Melaleuca lanceolata ssp. lanceolata, Acrotriche patula*	37	8.1
COO0401	*Eucalyptus rugosa*	Open mallee	*Eucalyptus diversifolia, Acacia rupicola, Beyeria lechenaultii, Melaleuca lanceolata ssp. lanceolata, Alyxia buxifolia*	36	8.3
PON0402	*Callitris canescens*	Tall open shrubland	*Gahnia lanigera, Calytrix tetragona*	35	8.6
MOO2B05	*Callitris preissii*	Low woodland	*Westringia rigida*	45	8.9
ALT0601	*Eucalyptus rugosa, Eucalyptus gracilis*	Mallee	*Alyxia buxifolia, Templetonia retusa*	45	8.9
COR0401	*Eucalyptus rugosa, Eucalyptus gracilis, Eucalyptus oleosa*	Mallee	*Pimelea serpyllifolia ssp. serpyllifolia*	22	9.1
ARD1201	*Eucalyptus 'anceps', Eucalyptus leptophylla*	Open mallee	*Melaleuca uncinata, Dodonaea hexandra, Lasiopetalum behrii, Gahnia lanigera*	88	9.1
MOO2C28	*Sclerostegia arbuscula, Maireana oppositifolia*	Low open shrubland	*Wilsonia humilis var. humilis*	11	9.1
HIL1A23	*Eucalyptus rugosa, Eucalyptus diversifolia*	Low mallee	*Pomaderris obcordata, Melaleuca lanceolata ssp. lanceolata*	63	9.5
POR0501	*Eucalyptus incrassata, Eucalyptus socialis, Eucalyptus leptophylla*	Open mallee	*Melaleuca uncinata, Gahnia lanigera, Schoenus breviculmis*	42	9.5
LOC1401	*Eucalyptus socialis*	Open mallee	*Gahnia lanigera, Goodenia willisiana, Chrysocephalum apiculatum, Microseris lanceolata*	52	9.6
PON0101	*Eucalyptus diversifolia, Melaleuca lanceolata ssp. lanceolata, Acacia leiophylla*	Mallee	*Acrotriche patula, Dodonaea humilis*	61	9.8

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% Introduced plants in site
HIL0701	*Eucalyptus rugosa*	Mallee	*Melaleuca lanceolata ssp. lanceolata, Acrotriche patula*	50	**10.0**
MAI1101	*Eucalyptus socialis, Eucalyptus dumosa*	Mallee	*Melaleuca lanceolata ssp. lanceolata, Melaleuca acuminata, Exocarpos aphyllus, Dianella revoluta var. revoluta, Lepidosperm*	80	**10.0**
KAI0902	*Lepidosperma viscidum, Gahnia lanigera*	Open sedgeland	*Helichrysum leucopsideum, Chrysocephalum semipapposum, Goodenia willisiana, Thysanotus patersonii*	40	**10.0**
STA0403	*Santalum acuminatum, Allocasuarina verticillata, Bursaria spinosa*	Very low open woodland	*Gahnia lanigera, Grevillea ilicifolia var. ilicifolia, Acacia hakeoides, Lasiopetalum behrii, Lasiopetalum baueri*	49	**10.2**
STA0102	*Allocasuarina verticillata, Eucalyptus porosa*	Very low open woodland	*Dodonaea hexandra, Gahnia lanigera, Lepidosperma congestum, Acrotriche patula, Calytrix involucrata*	59	**10.2**
MOO0101	*Eucalyptus oleosa, Eucalyptus gracilis, Eucalyptus brachycalyx*	Mallee	*Enchylaena tomentosa var. tomentosa, *Oxalis pes-caprae, Geijera linearifolia, Rhagodia parabolica*	29	**10.3**
KAI0101	*Eucalyptus leptophylla, Eucalyptus dumosa*	Open mallee	*Lomandra effusa, Bursaria spinosa*	29	**10.3**
STA0201	*Eucalyptus porosa, Eucalyptus leptophylla(N)*	Very open mallee	*Gahnia lanigera, Lepidosperma congestum, Acrotriche patula, Grevillea ilicifolia var. ilicifolia, Bursaria spinosa*	47	**10.6**
HIL1101	*Eucalyptus rugosa, Eucalyptus diversifolia*	Mallee	*Melaleuca lanceolata ssp. lanceolata*	56	**10.7**
BRO0601	*Eucalyptus brachycalyx, Eucalyptus gracilis*	Closed mallee	*Stipa nitida, Stipa eremophila, Stipa acrociliata, Zygophyllum ovatum(N)*	18	**11.1**
LOC0501	*Eucalyptus oleosa*	Low woodland	*Zygophyllum confluens, Enchylaena tomentosa var. tomentosa, Sclerolaena diacantha, Atriplex stipitata*	18	**11.1**
MAI0101	*Eucalyptus socialis, Eucalyptus leptophylla, Eucalyptus calycogona var. calycogona*	Mallee	*Cassytha peninsularis var. peninsularis, Melaleuca acuminata, Melaleuca uncinata, Melaleuca lanceolata ssp. lanceolata*	63	**11.1**
HIL1202	*Eucalyptus rugosa*	Mallee	*Melaleuca lanceolata ssp. lanceolata, Templetonia retusa, Beyeria lechenaultii*	70	**11.4**
HIL0602	*Eucalyptus rugosa*	Open mallee	*Acrotriche cordata, Melaleuca lanceolata ssp. lanceolata, Gahnia lanigera*	70	**11.4**
HIL1401	*Lasiopetalum discolor, Acrotriche cordata*	Low closed shrubland	*Gahnia lanigera, Lepidosperma congestum, Lomandra collina, Dianella brevicaulis*	42	**11.9**
EDI1001	*Acacia leiophylla, Leucopogon parviflorus*	Shrubland	*Alyxia buxifolia, Acrotriche patula, Lepidosperma gladiatum*	25	**12.0**
POR0701	*Allocasuarina verticillata*	Very low woodland	*Gahnia lanigera, Lasiopetalum behrii, Dodonaea hexandra, Lepidosperma congestum*	90	**12.2**
MAI1401	*Eucalyptus porosa*	Open mallee	*Gahnia lanigera, Dodonaea baueri, Lepidosperma viscidum, Lepidosperma congestum, Alyxia buxifolia*	74	**12.2**

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% Introduced plants in site
STA0101	*Eucalyptus incrassata, Eucalyptus socialis, Eucalyptus 'anceps'*	Open mallee	*Melaleuca uncinata, Acacia enterocarpa, Gahnia deusta, Dodonaea bursariifolia*	41	12.2
MAI0201	*Eucalyptus socialis, Eucalyptus 'anceps'*	Mallee	*Melaleuca uncinata*	57	12.3
HIL0501	*Eucalyptus diversifolia*	Mallee	*Beyeria lechenaultii*	56	12.5
ALF1001	*Eucalyptus oleosa, Eucalyptus dumosa*	Open mallee	*Rhagodia parabolica, Senna artemisioides ssp. petiolaris, Rhagodia candolleana ssp. candolleana, Senna artemisioides ssp. fil*	32	12.5
PON0901	*Olearia axillaris*	Low open shrubland	*Scaevola crassifolia, Calytrix tetragona*	32	12.5
KAI0201	*Eucalyptus gracilis, Eucalyptus leptophylla*	Open mallee	*Melaleuca acuminata, Westringia rigida, Goodenia willisiana, *Avena barbata, Melaleuca lanceolata ssp. lanceolata(N)*	39	12.8
ALT0301	*Eucalyptus rugosa*	Mallee	*Melaleuca lanceolata ssp. lanceolata*	39	12.8
COO0404	*Melaleuca lanceolata ssp. lanceolata, Allocasuarina verticillata(N),Eucalyptus diversifolia(N)*	Very low open woodland	*Acacia rupicola, Acrotriche patula, Pimelea serpyllifolia ssp. serpyllifolia, Lepidosperma congestum*	38	13.2
MIN0801	*Allocasuarina verticillata, Melaleuca lanceolata ssp. lanceolata*	Very low woodland	*Lepidosperma congestum, Exocarpos aphyllus, Bursaria spinosa*	89	13.5
ARD0501	*Eucalyptus socialis*	Open mallee	*Alyxia buxifolia*	52	13.5
WAN1001	*Melaleuca lanceolata ssp. lanceolata, Geijera linearifolia*	Tall shrubland	*Scaevola spinescens, Atriplex paludosa ssp. cordata, Tetragonia implexicoma*	37	13.5
ALT0101	*Melaleuca halmaturorum ssp. halmaturorum*	Very low closed forest	*Samolus repens, Sarcocornia blackiana, Sarcocornia quinqueflora, Rhagodia candolleana ssp. candolleana*	22	13.6
BRO0301	*Eucalyptus oleosa, Casuarina pauper*	Mallee	*Rhagodia parabolica, Geijera linearifolia, Sclerolaena diacantha*	29	13.8
MAI1201	*Eucalyptus porosa*	Low open woodland	*Alyxia buxifolia, Beyeria lechenaultii*	80	13.8
ALF0801	*Eucalyptus oleosa, Eucalyptus gracilis*	Open mallee	*Carrichtera annua, Rhagodia parabolica, Enchylaena tomentosa var. tomentosa*	14	14.3
WAN0401	*Halosarcia sp., Maireana oppositifolia, Halosarcia halocnemoides ssp. halocnemoides*	Low closed shrubland	*Wilsonia humilis var. humilis, Frankenia sessilis*	14	14.3
CUR0701	*Triodia compacta*	Hummock grassland	*Santalum acuminatum, Allocasuarina pusilla, Olearia axillaris*	48	14.6
PON0501	*Eucalyptus diversifolia, Eucalyptus oleosa*	Open low mallee	*Beyeria lechenaultii, Melaleuca lanceolata ssp. lanceolata, Templetonia retusa*	47	14.9

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% introduced plants in site
MIN1003	*Melaleuca lanceolata ssp. lanceolata, Allocasuarina verticillata*	Low woodland	*Lepidosperma congestum, Lomandra effusa, Gahnia lanigera, Bursaria spinosa*	60	15.0
LOC1701	*Eucalyptus oleosa*	Low woodland	*Enchylaena tomentosa var. tomentosa, Rhagodia parabolica, Stipa nitida, Stipa elegantissima*	20	15.0
HIL0401	*Allocasuarina verticillata*	Low open woodland	*Beyeria lechenaultii, Melaleuca lanceolata ssp. lanceolata*	53	15.1
MOO0301	*Geijera linearifolia, Melaleuca lanceolata ssp. lanceolata*	Tall open shrubland	*Westringia rigida, Beyeria lechenaultii, Alyxia buxifolia*	53	15.1
BRO1401	*Eucalyptus oleosa, Eucalyptus gracilis*	Closed mallee	*Chenopodium desertorum ssp., Stipa nitida, Stipa acrociliata, Stipa scabra ssp. falcata*	19	15.8
HIL0802	*Eucalyptus diversifolia, Eucalyptus rugosa*	Mallee	*Melaleuca lanceolata ssp. lanceolata, Templetonia retusa*	69	15.9
POR0601	*Eucalyptus porosa*	Very open mallee	*Gahnia lanigera, Lepidosperma congestum, Melaleuca uncinata, Melaleuca lanceolata ssp. lanceolata*	67	16.4
LOC2F21	*Allocasuarina verticillata*	Very low open forest	*Gahnia lanigera, Dianella revoluta var. revoluta, Goodenia willisiana*	42	16.7
WAL0401	*Eucalyptus dumosa*	Open mallee	*Geijera linearifolia, Rhagodia parabolica, Stipa elegantissima, Stipa scabra group, Stipa platychaeta*	18	16.7
WAL0201	*Eucalyptus oleosa*	Open mallee	*Geijera linearifolia, Rhagodia parabolica*	24	16.7
ALF1002	*Eucalyptus oleosa, Eucalyptus 'anceps'*	Mallee	*Rhagodia parabolica, Enchylaena tomentosa var. tomentosa*	12	16.7
WAK0201	*Eucalyptus socialis, Eucalyptus incrassata, Eucalyptus 'anceps'*	Mallee	*Melaleuca acuminata, Goodenia willisiana, Senecio glossanthus, *Bromus rubens, Danthonia setacea var. setacea*	24	16.7
PON0602	*Halosarcia sp.*	Low open shrubland	*Lawrencia squamata, Wilsonia humilis var. humilis*	12	16.7
TIP0402	*Maireana oppositifolia, Myoporum insulare*	Low open shrubland	*Juncus kraussii, Cassytha peninsularis var. peninsularis, Sporobolus virginicus*	30	16.7
TIP0401	*Olearia axillaris, Atriplex cinerea*	Shrubland	**Cakile maritima ssp. maritima, Tetragonia implexicoma, Senecio lautus, *Limonium companyonis*	12	16.7
ARD2B16	*Eucalyptus 'anceps', Eucalyptus gracilis, Eucalyptus oleosa*	Mallee	*Melaleuca lanceolata ssp. lanceolata, Melaleuca acuminata, Rhagodia candolleana ssp. candolleana, Boronia inornata ssp. lepto*	46	17.4
MAI1001	*Allocasuarina verticillata*	Very low open forest	*Gahnia lanigera, Exocarpos aphyllus, Stipa eremophila, Millotia myosotidifolia, *Brassica tournefortii*	80	17.5
ARD0601	*Eucalyptus oleosa, Eucalyptus gracilis*	Open mallee	*Melaleuca lanceolata ssp. lanceolata, *Carrichtera annua, Stipa nitida*	40	17.5

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% Introduced plants in site
TUR0301	*Allocasuarina verticillata*	Very low open woodland	*Geijera linearifolia, Lepidosperma congestum*	39	17.9
STA0701	*Lepidosperma congestum, Lomandra effusa, Stipa sp.*	Sedgeland	*Goodenia willisiana, Velleia arguta, Helichrysum leucopsideum*	28	17.9
ARD2B13	*Danthonia caespitosa, Stipa scabra group, Chrysocephalum apiculatum*	Open (tussock) grassland		50	18.0
CUR1B12	*Allocasuarina verticillata*	Very low open woodland	*Pomaderris paniculosa ssp. paniculosa, Melaleuca lanceolata ssp. lanceolata, Eremophila deserti*	44	18.2
TUR0603	*Allocasuarina verticillata*	Very low open woodland	*Bursaria spinosa, Lepidosperma congestum, Gahnia lanigera*	33	18.2
MOO1101	*Eucalyptus brachycalyx, Eucalyptus calycogona var. calycogona, Eucalyptus 'anceps'*	Mallee	*Stipa scabra group, Melaleuca lanceolata ssp. lanceolata*	38	18.4
HIL1602	*Eucalyptus diversifolia*	Mallee	*Beyeria lechenaultii, Acrotriche patula*	59	18.6
ARD1101	*Eucalyptus porosa, Eucalyptus leptophylla*	Open mallee	*Beyeria lechenaultii, Dodonaea hexandra, Gahnia lanigera*	91	18.7
ALF2E15	*Melaleuca lanceolata ssp. lanceolata*	Tall open shrubland	**Gynandriris setifolia, Stipa scabra group, *Carrichtera annua, Stipa platychaeta*	32	18.8
ALT1001	*Templetonia retusa*	Shrubland	*Leucopogon parviflorus, Zygophyllum billardierei, Olearia axillaris*	32	18.8
HIL0301	*Gahnia filum*	Sedgeland	**Trifolium scabrum, Gramineae sp., *Dittrichia graveolens*	42	19.0
PON0201	*Eucalyptus rugosa, Eucalyptus diversifolia*	Mallee	*Templetonia retusa, Beyeria lechenaultii, Melaleuca lanceolata ssp. lanceolata*	47	19.1
HIL0601	*Podolepis canescens, *Erodium cicutarium, Plantago sp. B*	Closed herbland	*Moss sp., Triglochin mucronatum*	57	19.3
WAK0401	*Allocasuarina verticillata*	Low open forest	*Acacia pycnantha, Bursaria spinosa, Beyeria lechenaultii, Pomaderris paniculosa ssp. paniculosa*	31	19.4
KAI0701	*Eucalyptus leptophylla, Eucalyptus dumosa, Eucalyptus 'anceps'*	Open mallee	*Melaleuca lanceolata ssp. lanceolata, Melaleuca acuminata*	31	19.4
COO0402	*Melaleuca lanceolata ssp. lanceolata, Allocasuarina verticillata*	Very low open woodland	*Exocarpos aphyllus, Acrotriche patula, Acacia rupicola, Alyxia buxifolia, Beyeria lechenaultii*	41	19.5
MOO0701	*Eucalyptus dumosa*	Open mallee	*Melaleuca uncinata, Beyeria lechenaultii*	51	19.6
ALT0201	*Leucopogon parviflorus*	Shrubland	*Calytrix tetragona, Lasiopetalum discolor*	46	19.6

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% introduced plants in site
MIN1B03	*Eucalyptus porosa, Allocasuarina verticillata*	Woodland	*Santalum acuminatum, Stipa acrociliata, Stipa mollis, Stipa sp.*	61	19.7
ARD0102	*Allocasuarina verticillata, Eucalyptus porosa*	Low woodland	*Lepidosperma congestum, Gahnia lanigera, Dodonaea hexandra, Acrotriche patula*	91	19.8
MOO0601	*Eucalyptus dumosa, Eucalyptus leptophylla*	Open mallee	*Melaleuca lanceolata ssp. lanceolata, Melaleuca acuminata, Alyxia buxifolia, Triodia sp.*	86	19.8
ALF2E22	*Eucalyptus dumosa*	Open mallee	*Beyeria lechenaultii, *Myrsiphyllum asparagoides, Gahnia lanigera, Goodenia varia*	40	20.0
MIN0601	*Eucalyptus 'anceps', Eucalyptus leptophylla*	Open mallee	*Alyxia buxifolia, Acacia microcarpa, Acacia hakeoides, Olearia pannosa ssp. pannosa*	50	20.0
LOC1301	*Eucalyptus oleosa*	Mallee	*Zygophyllum confluens, Westringia rigida, Stipa scabra ssp., Stipa acrociliata, Stipa nitida*	30	20.0
LOC0201	*Eucalyptus porosa*	Low woodland	*Cassinia arcuata, Stipa blackii, Lomandra effusa, Stipa acrociliata*	35	20.0
COR0701	*Eucalyptus diversifolia, Eucalyptus porosa*	Open mallee	*Melaleuca acuminata, Pimelea serpyllifolia ssp. serpyllifolia*	40	20.0
WAK1201	*Halosarcia halocnemoides ssp. halocnemoides*	Low shrubland	*Senecio glossanthus, *Molineriella minuta*	5	20.0
COO1001	*Leucopogon parviflorus*	Open shrubland	*Alyxia buxifolia, *Lagurus ovatus, Acrotriche cordata*	40	20.0
INK1301	*Nitraria billardierei*	Shrubland	*Rhagodia candolleana ssp. candolleana, Threlkeldia diffusa, Tetragonia implexicoma*	5	20.0
POR0901	*Eucalyptus leptophylla, Eucalyptus oleosa*	Mallee	*Melaleuca pauperiflora (NC)*	24	20.8
MIN1001	*Melaleuca halmaturorum ssp. halmaturorum*	Very low open forest	*Gahnia filum*	19	21.1
MIN0901	*Allocasuarina verticillata, Melaleuca lanceolata ssp. lanceolata*	Very low woodland	*Lomandra effusa, Lepidosperma congestum, Bursaria spinosa*	52	21.2
PON0302	*Eucalyptus diversifolia*	Mallee	*Melaleuca lanceolata ssp. lanceolata, Templetonia retusa*	42	21.4
CUR1B19	*Eucalyptus gracilis, Eucalyptus oleosa*	Low woodland	*Melaleuca lanceolata ssp. lanceolata, Alyxia buxifolia, Rhagodia candolleana ssp. candolleana, Threlkeldia diffusa*	37	21.6
MAI1701	*Eucalyptus gracilis, Eucalyptus socialis*	Open mallee	*Alyxia buxifolia, Geijera linearifolia*	37	21.6
WAR2G04	*Lomandra effusa, Gahnia lanigera, Lepidosperma congestum*	Closed sedgeland	*Helichrysum leucopsideum, Stackhousia monogyna, *Linum strictum ssp. strictum, *Gynandriris setifolia, Vittadinia megacepha*	23	21.7
ALT0401	*Acacia anceps (NC)*	Shrubland	*Leucopogon parviflorus, Lasiopetalum discolor*	32	21.9

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% Introduced plants in site
KAI1101	*Eucalyptus gracilis*	Open mallee	*Templetonia sulcata, Enchylaena tomentosa var. tomentosa*	32	21.9
HIL1701	*Leucopogon parviflorus*	Tall closed shrubland	*Poa labillardieri var. labillardieri, Acacia nematophylla, Olearia axillaris, Poa poiformis*	41	22.0
PON0301	*Templetonia retusa, Melaleuca lanceolata ssp. lanceolata*	Open shrubland	*Beyeria lechenaultii*	40	22.5
ALF0301	*Eucalyptus oleosa*	Open mallee	*Olearia muelleri, Stipa scabra group, Stipa acrociliata*	22	22.7
WAL2F09	*Eucalyptus dumosa*	Open mallee	*Acacia nyssophylla, Senna artemisioides nothossp. coriacea, Acacia oswaldii, Pittosporum phylliraeoides var. microcarpa*	35	22.9
HIL1301	*Leucopogon parviflorus, Olearia axillaris*	Shrubland	**Lagurus ovatus, *Lolium rigidum, Stipa flavescens*	39	23.1
ALF2E17	*Eucalyptus gracilis, Eucalyptus 'anceps'*	Open mallee	*Rhagodia parabolica, Senna artemisioides ssp. petiolaris, Zygophyllum aurantiacum ssp. "simplicifolium", Geijera linearifolia*	34	23.5
MAI0301	*Cassinia arcuata*	Tall shrubland	**Bromus diandrus, *Bromus rubens, Goodenia willisiana, Goodenia pinnatifida, *Vulpia myuros forma myuros*	55	23.6
EDI1002	*Acacia ielophylla, Leucopogon parviflorus*	Very low open forest	**Polygala myrtifolia, Olearia axillaris, Isolepis nodosa, Dianella brevicaulis*	42	23.8
CUR0401	*Eucalyptus porosa*	Low woodland	*Acrotriche patula, Gahnia lanigera, Helichrysum leucopsideum*	63	23.8
CUR1B15	*Eucalyptus gracilis, Eucalyptus oleosa*	Open mallee	*Melaleuca lanceolata ssp. lanceolata, Melaleuca pauperiflora ssp. mutica, Geijera linearifolia, Nitraria billardierei*	33	24.2
PON0701	*Melaleuca halmaturorum ssp. halmaturorum*	Very low open forest	*Beyeria lechenaultii, Callitris canescens*	37	24.3
MAI0701	*Allocasuarina verticillata*	Very low woodland	*Melaleuca acuminata, Beyeria lechenaultii*	93	24.7
COR1101	*Allocasuarina verticillata*	Very low woodland	*Bursaria spinosa, Exocarpos aphyllus, Lepidosperma congestum, Acrotriche patula*	32	25.0
KAI0901	*Eucalyptus oleosa, Eucalyptus gracilis*	Open mallee	*Helichrysum leucopsideum, *Bromus rubens, *Sonchus oleraceus, Stipa scabra group*	32	25.0
ALF1101	*Eucalyptus oleosa*	Open mallee	*Enchylaena tomentosa var. tomentosa, Sclerolaena diacantha*	8	25.0
MAI1202	*Eucalyptus porosa*	Low woodland	*Cassinia arcuata, Alyxia buxifolia, *Avena barbata, *Bromus rubens*	52	25.0
ARD0201	*Halosarcia halocnemoides ssp. halocnemoides, Halosarcia pergranulata ssp. pergranulata*	Low open shrubland	*Disphyma crassifolium ssp. clavellatum, *Hymenolobus procumbens, *Spergularia diandra, Senecio glossanthus, Gramineae sp.(T*	8	25.0
MOO0901	*Melaleuca acuminata, Melaleuca lanceolata ssp. lanceolata*	Open shrubland	*Lepidosperma congestum, Gahnia lanigera, Beyeria lechenaultii*	47	25.5

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% Introduced plants in site
HIL0201	*Melaleuca lanceolata ssp. lanceolata*	Very low woodland	*Moss sp., Pimelea serpyllifolia ssp. serpyllifolia, *Linum strictum ssp. strictum, *Lagurus ovatus, Danthonia caespitosa*	51	**25.5**
ALT0901	*Acacia nematophylla*	Low shrubland	*Calytrix tetragona, Beyeria lechenaultii, Melaleuca gibbosa*	43	**25.6**
LOC0301	*Eucalyptus gracilis, Eucalyptus socialis*	Low open forest	*Stipa nitida, Stipa platychaeta, Santalum acuminatum, Stipa elegantissima*	31	**25.8**
KAI1401	*Eucalyptus oleosa*	Open mallee	*Stipa scabra group, Senecio glossanthus, *Bromus rubens, *Critesion murinum ssp. glaucum, Goodenia willisiana*	23	**26.1**
WAL0901	*Eucalyptus porosa*	Low open woodland	*Geijera linearifolia, Rhagodia parabolica*	23	**26.1**
WAN2D16	*Atriplex vesicaria ssp. macrocystidia, Halosarcia halocnemoides ssp. halocnemoides*	Low shrubland	*Plantago sp. B, Pogonolepis muelleriana, *Hainardia cylindrica*	23	**26.1**
LOC1802	*Lomandra effusa*	Open sedgeland	*Asteridea athrixioides forma athrixioides, Goodenia pusilliflora, Ptilotus spathulatus forma spathulatus, Danthonia caespitos*	23	**26.1**
INK0901	*Melaleuca lanceolata ssp. lanceolata*	Tall shrubland	*Threlkeldia diffusa, *Mesembryanthemum crystallinum, *Bromus rubens, *Vulpia myuros forma myuros, Dianella brevicaulis/revo*	23	**26.1**
PON0401	*Eucalyptus rugosa, Eucalyptus diversifolia, Eucalyptus oleosa*	Mallee	*Melaleuca lanceolata ssp. lanceolata, Olearia minor*	42	**26.2**
KAI0801	*Eucalyptus oleosa, Eucalyptus gracilis*	Open mallee	*Danthonia sp., *Bromus rubens*	19	**26.3**
PON0801	*Leucopogon parviflorus*	Tall closed shrubland	*Olearia axillaris, Rhagodia candolleana ssp. candolleana*	38	**26.3**
ALF0201	*Eucalyptus oleosa, Melaleuca lanceolata ssp. lanceolata*	Tall open shrubland	*Bromus sp., *Alyssum linifolium, *Schismus barbatus*	15	**26.7**
CUR0501	*Allocasuarina verticillata*	Very low woodland	*Geijera linearifolia, Acacia nematophylla, Acacia cupularis, Acacia ligulata, Olearia axillaris*	37	**27.0**
COO0701	*Alyxia buxifolia, Acacia anceps (NC)*	Low shrubland	*Acrotriche patula, Threlkeldia diffusa, Helichrysum leucopsideum*	37	**27.0**
TUR0801	*Gahnia filum*	Very open sedgeland		11	**27.3**
TUR0901	*Melaleuca lanceolata ssp. lanceolata, Eucalyptus porosa, Acacia pycnantha*	Mallee	*Bursaria spinosa, Gramineae sp., Stipa elegantissima, Danthonia caespitosa, *Lagurus ovatus*	29	**27.6**
COO0702	*Gahnia lanigera, Lomandra effusa, Lepidosperma congestum*	Sedgeland	*Lagurus ovatus, Craspedia glauca, Acaena echinata var.*	29	**27.6**

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% Introduced plants in site
PON0601	*Melaleuca halmaturorum ssp. halmaturorum*	Very low open forest	*Sclerostegia arbuscula, Lawrencia squamata*	29	27.6
EDI1101	*Olearia axillaris*	Low open shrubland	*Pimelea serpyllifolia ssp. serpyllifolia, Stipa stipoides, Dianella brevicaulis*	29	27.6
CUR0601	*Eucalyptus 'anceps'*	Open low mallee	*Acrotriche patula, Cryptandra amara var. amara, Gahnia lanigera, Melaleuca acuminata*	47	27.7
MAI1301	*Eucalyptus porosa*	Low woodland	*Stipa scabra ssp. falcata, *Bromus diandrus, *Bromus rubens, Stipa multispiculis, Stipa elegantissima*	36	27.8
WAR0101	*Acacia ligulata, Olearia axillaris*	Tall shrubland	*Rhagodia candolleana ssp. candolleana, Isolepis nodosa, Carpobrotus rossii*	25	28.0
COR0902	*Callitris canescens*	Open shrubland	*Lepidosperma congestum, Gahnia lanigera, Dianella brevicaulis/revoluta var.*	42	28.6
ALF0101	*Eucalyptus gracilis, Eucalyptus socialis*	Open mallee	*Rhagodia parabolica, Enchylaena tomentosa var. tomentosa, Senna artemisioides ssp. petiolaris*	28	28.6
LOC1001	*Eucalyptus oleosa*	Mallee	*Maireana brevifolia, Enchylaena tomentosa var. tomentosa, Maireana enchylaenoides*	21	28.6
WAK0101	*Eucalyptus gracilis, Eucalyptus brachycalyx, Eucalyptus porosa*	Mallee	*Melaleuca lanceolata ssp. lanceolata, Beyeria lechenaultii*	35	28.6
WAN1301	*Eucalyptus oleosa, Myoporum platycarpum ssp. platycarpum*	Mallee	*Atriplex stipitata, Enchylaena tomentosa var. tomentosa, Maireana trichoptera, Stipa scabra group*	31	29.0
INK1001	*Melaleuca lanceolata ssp. lanceolata*	Very low open forest	*Exocarpos aphyllus, Rhagodia candolleana ssp. candolleana, Threlkeldia diffusa, *Bromus rubens, *Avena barbata*	31	29.0
HIL1001	*Leucopogon parviflorus, Olearia axillaris*	Shrubland	*Isolepis nodosa, Spinifex sericeus, *Lagurus ovatus, *Lolium rigidum*	31	29.0
WAL1301	*Eucalyptus porosa, Callitris preissii*	Low open forest	*Acacia ligulata, Acacia hakeoides, Senna artemisioides nothossp. coriacea, Acacia nyssophylla*	24	29.2
CUR1B21	*Melaleuca lanceolata ssp. lanceolata, Acacia oswaldii, Myoporum platycarpum ssp. platycarpum*	Very low woodland	*Atriplex paludosa ssp. cordata, Nitraria billardierei, Lycium australe, Halosarcia pterygosperma ssp. pterygosperma*	27	29.6
COR0202	*Leucopogon parviflorus, Acacia nematophylla, Olearia axillaris*	Tall shrubland	*Rhagodia candolleana ssp. candolleana, Isolepis nodosa*	30	30.0
TUR0601	*Lomandra effusa, Lepidosperma congestum, Gahnia lanigera*	Sedgeland	**Lagurus ovatus*	23	30.4
COR1201	*Bursaria spinosa*	Open shrubland	*Acrotriche patula, Lepidosperma congestum*	36	30.6

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% Introduced plants in site
INK0201	*Eucalyptus gracilis*	Low open forest	*Rhagodia candolleana ssp. candolleana, Enchylaena tomentosa var. tomentosa, *Carrichtera annua, *Mesembryanthemum crystallinu*	13	**30.8**
COO0302	*Lepidosperma congestum, Dianella brevicaulis*	Sedgeland	**Bromus diandrus, *Medicago minima var. minima, Danthonia sp.*	26	**30.8**
WAK0402	*Eucalyptus gracilis, Eucalyptus brachycalyx*	Mallee	*Melaleuca lanceolata ssp. lanceolata, Rhagodia parabolica, *Anagallis arvensis, Helichrysum leucopsideum, Stipa scabra ssp.*	19	**31.6**
WAK0301	*Eucalyptus oleosa, Eucalyptus porosa*	Mallee	*Maireana brevifolia, *Critesion murinum ssp. glaucum, Enchylaena tomentosa var. tomentosa, Sclerolaena diacantha, *Carricht*	19	**31.6**
MAI0801	*Acacia ligulata*	Closed shrubland	*Stipa elegantissima, *Euphorbia terracina, *Lagurus ovatus*	41	**31.7**
EDI0301	*Eucalyptus porosa*	Low woodland		41	**31.7**
KAI0401	*Eucalyptus oleosa, Eucalyptus dumosa*	Open mallee	*Rhagodia parabolica*	22	**31.8**
MAI1501	*Geijera linearifolia*	Open shrubland	*Minuria leptophylla, Stackhousia monogyna, Stipa scabra group, *Bromus diandrus, Stipa sp.*	44	**31.8**
TUR0501	*Melaleuca lanceolata ssp. lanceolata*	Low woodland	*Gramineae sp., Stipa sp., Danthonia caespitosa, *Lagurus ovatus*	22	**31.8**
HIL0901	*Eucalyptus diversifolia*	Very open mallee	*Beyeria lechenaultii*	50	**32.0**
BRO0501	*Eucalyptus oleosa, Eucalyptus gracilis*	Mallee	*Geijera linearifolia, *Carrichtera annua*	28	**32.1**
MAI0901	*Eucalyptus oleosa*	Mallee	*Pimelea serpyllifolia ssp. serpyllifolia, Westringia rigida, Stipa nitida*	56	**32.1**
HIL1002	*Acacia nematophylla, Leucopogon parviflorus, Olearia axillaris*	Open shrubland	*Lepidosperma gladiatum, *Bromus diandrus, Poa poiformis, *Lolium rigidum, *Lagurus ovatus*	28	**32.1**
TIP0403	*Acacia cyclops*	Tall closed shrubland	*Rhagodia candolleana ssp. candolleana*	18	**33.3**
TIP0501	*Allocasuarina verticillata*	Very low open woodland	*Acacia ligulata, *Euphorbia terracina, *Lycium ferocissimum*	39	**33.3**
WAL0301	*Eucalyptus dumosa*	Very open mallee	*Maireana trichoptera, Rhagodia parabolica, Nitraria billardierei*	21	**33.3**
STA0501	*Eucalyptus porosa*	Low open woodland	*Gahnia lanigera, Lepidosperma congestum, Acrotriche patula, Bursaria spinosa, Calytrix involucrata*	48	**33.3**
WAL2F05	*Halosarcia halocnemoides ssp. halocnemoides*	Low shrubland	*Frankenia sessilis, Disphyma crassifolium ssp. clavellatum*	9	**33.3**
EDI1D07	*Halosarcia halocnemoides ssp.*	Low closed shrubland	**Sonchus oleraceus, *Parapholis incurva*	6	**33.3**

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% Introduced plants in site
TIP0301	*Sclerostegia arbuscula, Halosarcia halocnemoides ssp. halocnemoides*	Low closed shrubland	**Parapholis incurva*	12	**33.3**
PON0102	*Allocasuarina verticillata, Melaleuca lanceolata ssp. lanceolata*	Very low open woodland	*Beyeria lechenaultii, Dodonaea viscosa ssp. spatulata, Exocarpos aphyllus*	53	**34.0**
EDI1201	*Leucopogon parviflorus, Acacia longifolia var. sophorae*	Shrubland	*Alyxia buxifolia, Olearia axillaris, Pimelea serpyllifolia ssp. serpyllifolia*	38	**34.2**
COR0201	*Melaleuca lanceolata ssp. lanceolata, Allocasuarina verticillata*	Mallee	*Rhagodia candolleana ssp. candolleana, Lepidosperma gladiatum, *Bromus diandrus*	29	**34.5**
WAN1501	*Eucalyptus gracilis, Eucalyptus brachycalyx, Eucalyptus oleosa*	Mallee	*Sclerolaena diacantha, Enchylaena tomentosa var. tomentosa, *Carrichtera annua, *Critesion murinum ssp. glaucum*	26	**34.6**
TUR1101	*Melaleuca lanceolata ssp. lanceolata*	Very low woodland	*Lepidosperma congestum, Bursaria spinosa*	26	**34.6**
INK0501	*Olearia axillaris*	Shrubland	*Threlkeldia diffusa, Senecio lautus, *Vulpia myuros forma myuros, Crassula colorata var. acuminata, Halosarcia halocnemoide*	20	**35.0**
WAL0801	*Eucalyptus oleosa*	Low woodland	*Atriplex stipitata, Zygophyllum aurantiacum ssp. "simplicifolium", Stipa eremophila*	34	**35.3**
TUR1201	*Halosarcia halocnemoides ssp., Maireana oppositifolia, Chenopodiaceae sp.*	Low shrubland	**Parapholis incurva, *Gynandriris setifolia, Hydrocotyle medicaginoides, Angianthus preissianus, *Lagurus ovatus*	17	**35.3**
BRO1101	*Eucalyptus flocktoniae x socialis, Eucalyptus porosa, Eucalyptus gracilis*	Open mallee	**Brassica tournefortii, *Bromus rubens, *Critesion murinum ssp. glaucum, *Oxalis pes-caprae*	48	**35.4**
COR0101	*Melaleuca lanceolata ssp. lanceolata, Acacia brachybotrya, Exocarpos aphyllus*	Tall open shrubland	*Lepidosperma congestum*	33	**36.4**
COO0101	*Halosarcia sp., Frankenia sessilis, Frankenia pauciflora var. fruticulosa*	Low shrubland	*Senecio glossanthus, *Gynandriris setifolia, *Parapholis incurva, Haegiela tatei*	11	**36.4**
BRO0102	*Allocasuarina verticillata*	Low woodland	*Acacia ligulata, Pimelea serpyllifolia ssp. serpyllifolia, Tetragonia implexicoma*	38	**36.8**
LOC1601	*Eucalyptus incrassata*	Open mallee	*Dianella revoluta var. revoluta, Acacia ligulata*	27	**37.0**

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% Introduced plants in site
WAN0701	*Scaevola spinescens, Acacia victoriae ssp. victoriae*	Open shrubland	**Avena barbata, Stipa flavescens, *Gynandriris setifolia, *Bromus rubens, *Medicago truncatula*	24	37.5
EDI0901	*Acacia longifolia var. sophorae, Leucopogon parviflorus*	Tall shrubland	**Argyranthemum frutescens ssp. frutescens, *Polygala myrtifolia, Exocarpos syrticola, Alyxia buxifolia, Dianella brevicauli*	29	37.9
LOC2F25	*Eucalyptus incrassata*	Mallee	*Enchylaena tomentosa var. tomentosa, Melaleuca acuminata, Rhagodia parabolica, *Brassica tournefortii, *Gynandriris setifol*	26	38.5
WAK0501	*Halosarcia halocnemoides ssp. halocnemoides*	Low shrubland	*Disphyma crassifolium ssp. clavellatum, Senecio glossanthus, *Hymenolobus procumbens, *Parapholis incurva, Poa fax*	13	38.5
WAL2F04	*Lycium australe*	Low shrubland	*Lawrencia squamata, Danthonia caespitosa*	39	38.5
INK0701	*Olearia axillaris*	Tall shrubland	*Atriplex paludosa ssp. cordata, Senecio lautus, *Bromus rubens, Nitraria billardierei, Zygophyllum ammophilum*	26	38.5
MAI0501	*Olearia axillaris*	Shrubland	**Lagurus ovatus, Poa poiformis*	36	38.9
EDI0101	*Eucalyptus porosa*	Low open forest	*Stipa sp., Helichrysum leucopsideum, Goodenia willisiana, *Bromus rubens, *Lolium rigidum*	41	39.0
WAL0101	*Sida petrophila, Scaevola spinescens*	Low very open shrubland	**Bromus rubens, Ptilotus obovatus var. obovatus, Paspalidium constrictum, Stipa eremophila*	35	40.0
BRO0201	*Casuarina pauper*	Low woodland	*Atriplex paludosa ssp. cordata, *Carrichtera annua, *Bromus rubens, Lawrencia squamata, Maireana erioclada*	37	40.5
WAN0601	*Dodonaea viscosa ssp. spatulata, Acacia ligulata, *Lycium ferocissimum*	Tall shrubland	**Brassica tournefortii, *Bromus rubens, Enchylaena tomentosa var. tomentosa(N)*	32	40.6
MAI0601	*Acacia ligulata, Olearia axillaris*	Shrubland	**Lagurus ovatus, *Euphorbia terracina, *Bromus rubens, Danthonia caespitosa, *Avena barbata*	39	41.0
WAN0201	*Eucalyptus camaldulensis var. camaldulensis*	Open forest	*Muehlenbeckia florulenta, Acacia salicina, Cyperus gymnocaulos*	19	42.1
ALF1401	*Eucalyptus oleosa, Eucalyptus gracilis, Eucalyptus 'anceps'*	Mallee	**Critesion murinum ssp. glaucum, *Bromus rubens, Stipa scabra group, Stipa acrociliata(N)*	19	42.1
KAI1301	*Eucalyptus oleosa, Eucalyptus gracilis*	Open mallee	*Stipa scabra group, *Bromus diandrus, *Critesion murinum ssp. leporinum*	14	42.9
EDI0401	*Melaleuca lanceolata ssp. lanceolata*	Low woodland	**Lycium ferocissimum, *Bromus rubens, *Avena barbata, *Gynandriris setifolia*	37	43.2
ARD1401	*Olearia axillaris, Acacia ligulata, Geijera linearifolia*	Open shrubland	*Dianella brevicaulis, *Lagurus ovatus, *Avena barbata, *Bromus rubens, *Bromus diandrus*	39	43.6

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% Introduced plants in site
TUR0201	*Eucalyptus gracilis, Eucalyptus oleosa, Eucalyptus rugosa*	Open mallee	*Melaleuca acuminata, Melaleuca lanceolata ssp. lanceolata*	39	43.6
TIP0201	*Acacia ligulata, Olearia axillaris, *Lycium ferocissimum*	Open shrubland	**Euphorbia terracina, *Melilotus indica*	39	46.2
POR1001	*Dodonaea viscosa ssp. spatulata, Olearia axillaris*	Tall shrubland	*Dianella brevicaulis, Clematis microphylla, *Oxalis pes-caprae, Isolepis nodosa*	26	46.2
WAK1101	*Eucalyptus porosa*	Low open forest		26	46.2
WAN0501	*Eucalyptus gracilis*	Open mallee	*Halosarcia indica ssp. leiostachya, Enchylaena tomentosa var. tomentosa, Einadia nutans ssp. nutans, *Critesion murinum ssp.*	15	46.7
KAI1201	*Eucalyptus porosa*	Open mallee	**Bromus diandrus, Stipa nitida, *Critesion murinum ssp. glaucum, *Vulpia myuros forma myuros, *Bromus rubens*	15	46.7
TUR0701	*Melaleuca lanceolata ssp. lanceolata*	Very low woodland	**Lagurus ovatus, *Vulpia myuros forma myuros, *Lycium ferocissimum, Stipa sp., *Critesion murinum ssp. glaucum*	17	47.1
PON0403	**Sherardia arvensis, *Melilotus indica, Gramineae sp.*	Hummock grassland	**Gynandriris setifolia, *Erodium cicutarium, *Cerastium glomeratum*	29	48.3
BRO1201	*Eucalyptus incrassata, Eucalyptus brachycalyx*	Mallee	*Rhagodia parabolica, Enchylaena tomentosa var. tomentosa, *Bromus diandrus*	31	48.4
LOC1801	*Eucalyptus socialis, Eucalyptus dumosa*	Low woodland	*Maireana brevifolia, *Vulpia myuros forma myuros, *Critesion murinum ssp. glaucum, *Avena barbata*	18	50.0
MIN1002	*Gahnia filum*	Sedgeland	**Gallum murale, Helichrysum leucopsideum, Lagenifera huegelii, *Bromus diandrus, Poa labillardieri var. labillardieri*	16	50.0
EDI0201	*Melaleuca halmaturorum ssp. halmaturorum*	Very low open forest	*Sarcocornia quinqueflora, Halosarcia pergranulata ssp. pergranulata*	16	50.0
EDI0701	*Melaleuca lanceolata ssp. lanceolata*	Low woodland	*Exocarpos aphyllus, Pimelea serpyllifolia ssp. serpyllifolia, Stipa scabra group, *Gynandriris setifolia*	37	51.4
TIP0101	*Acacia ligulata, Olearia axillaris*	Shrubland	**Asphodelus fistulosus, *Bromus rubens, *Galium murale, *Avena barbata*	31	51.6
BRO1402	*Callitris preissii*	Low open forest	**Critesion murinum ssp. glaucum, *Bromus rubens, *Vulpia myuros forma myuros, Stipa eremophila*	27	51.9
EDI0801	*Sclerostegia arbuscula, Halosarcia pterygosperma ssp. pterygosperma, Lawrencia squamata*	Low shrubland	**Gynandriris setifolia, *Bromus rubens, *Melilotus indica, *Medicago truncatula, Stipa scabra ssp.*	23	52.2
WAR0103	*Olearia axillaris*	Tall open shrubland	**Asphodelus fistulosus, *Euphorbia terracina, Isolepis nodosa*	22	54.5

Site No.	Overstorey species	Vegetation Structure	Understorey species	Total no. of plant species	% introduced plants in site
INK0301	**Lycium ferocissimum*	Very open shrubland	*Nitraria billardierei, Enchylaena tomentosa var. tomentosa, Maireana erioclada, *Carrichtera annua, *Oncosiphon suffruticos*	20	**55.0**
LOC0601	*Halosarcia halocnemoides ssp.*	Low shrubland	*Senecio glossanthus, *Spergularia diandra, *Mesembryanthemum nodiflorum, Parietaria debilis, *Sonchus oleraceus*	9	**55.6**
INK0101	*Maireana brevifolia*	Low open shrubland	**Oncosiphon suffruticosum, *Marrubium vulgare, Enchylaena tomentosa var. tomentosa, Atriplex paludosa ssp. cordata, *Carric*	16	**56.3**
WAK0901	*Nitraria billardierei, Maireana aphylla*	Low shrubland	**Critesion murinum ssp., *Avena barbata, Tetragonia tetragonioides, *Sonchus oleraceus, Stipa nitida*	16	**56.3**
MAI0401	*Eucalyptus porosa*	Mallee	**Critesion murinum ssp. glaucum, *Bromus diandrus*	14	**57.1**
WAL1001	*Olearia axillaris*	Tall open shrubland	*Acacia ligulata, Dianella brevicaulis/revoluta var.*	29	**58.6**
WAN0301	*Muehlenbeckia florulenta, Panicum effusum var. effusum*	Shrubland	**Lolium rigidum, Eleocharis acuta, *Critesion marinum*	17	**58.8**
WAK0601	*Halosarcia halocnemoides ssp. halocnemoides*	Low closed shrubland	*Senecio glossanthus, *Sonchus oleraceus, *Molineriella minuta, *Hymenolobus procumbens*	5	**60.0**
MAI1601	*Olearia axillaris*	Open shrubland	**Lagurus ovatus, *Asphodelus fistulosus, *Bromus diandrus, *Brassica tournefortii, *Euphorbia terracina*	30	**60.0**
ARD1301	*Olearia axillaris*	Tall shrubland	*Rhagodia candolleana ssp. candolleana*	30	**60.0**
INK0401	*Maireana brevifolia*	Low shrubland	**Oncosiphon suffruticosum, *Marrubium vulgare, *Critesion murinum ssp., *Carrichtera annua, Einadia nutans ssp. nutans*	14	**78.6**
WAL1101	*Halosarcia pergranulata ssp. pergranulata*	Low open shrubland	**Critesion murinum ssp. glaucum, Disphyma crassifolium ssp. clavellatum*	16	**81.3**

Appendix 6: Introduced Species Recorded during the Yorke Peninsula Native Vegetation Survey

Scientific Name	Common Name
**Adonis microcarpa*	Pheasant's eye
**Aira caryophyllea*	Silvery hair-grass
**Ajuga iva*	Bugle
**Alyssum linifolium*	Flax-leaf alyssum
**Ammophila arenaria*	Marram grass
**Anagallis arvensis*	Pimpernel
**Arctotheca calendula*	Cape weed
**Arenaria leptoclados*	Lesser thyme-leaved sandwort
**Argyranthemum frutescens ssp. frutescens*	Marguerite daisy
**Asphodelus fistulosus*	Onion weed
**Aster subulatus*	Aster-weed
**Avellinia michelii*	Avellinia
**Avena barbata*	Bearded oat
**Avena fatua*	Wild oat
**Avena sp.*	Oat
**Bellardia trixago*	Bellardia
**Brachypodium distachyon*	False brome
**Brassica tournefortii*	Wild turnip
**Briza maxima*	Large quaking-grass
**Briza minor*	Lesser quaking-grass
**Bromus catharticus*	Prairie grass
**Bromus diandrus*	Great brome
**Bromus madritensis*	Compact brome
**Bromus rigidus*	Rigid brome
**Bromus rubens*	Red brome
**Buglossoides arvensis*	Sheepweed
**Bupleurum semicompositum*	Hare's ear
**Cakile maritima ssp. maritima*	Two-horned sea rocket
**Cardaria draba*	Hoary cress
**Carduus tenuiflorus*	Slender thistle
**Carrichtera annua*	Ward's weed
**Carthamus lanatus*	Saffron thistle
**Centaurea sp.*	Centaury
**Centaurium tenuiflorum*	Branched centaury
**Cerastium balearicum*	Chickweed
**Cerastium glomeratum*	Common mouse-ear chickweed
**Cirsium vulgare*	Spear thistle
**Crassula natans var. minus*	Water crassula
**Critesion marinum*	Sea barley-grass
**Critesion murinum ssp.*	Barley-grass
**Critesion murinum ssp. glaucum*	Blue barley-grass
**Critesion murinum ssp. leporinum*	Wall barley-grass
**Critesion sp.*	Barley-grass
**Cynara cardunculus*	Artichoke thistle

Scientific Name	Common Name
**Desmazeria rigida*	Rigid fescue
**Diplotaxis tenuifolia*	Lincoln weed
**Dischisma arenarium*	Sand dichisma
**Dittrichia graveolens*	Stinkweed
**Ehrharta longiflora*	Annual veldt grass
**Emex australis*	Three-corner jack
**Erodium botrys*	Long heron's-bill
**Erodium cicutarium*	Cut-leaf heron's-bill
**Euphorbia helioscopia*	Sun spurge
**Euphorbia paralias*	Sea spurge
**Euphorbia peplus*	Petty spurge
**Euphorbia terracina*	False caper
**Freesia hybrid*	Freesia
**Fumaria bastardii*	Bastard fumitory
**Galenia pubescens var. pubescens*	Coastal galenia
**Galium murale*	Small bedstraw
**Galium tricornutum*	Three-horned bedstraw
**Geranium molle var. molle*	Soft geranium
**Gynandriris setifolia*	Thread iris
**Hainardia cylindrica*	Common barb-grass
**Hedypnois rhagadioloides*	Cretan weed
**Herniaria cinerea*	Rupturewort
**Homeria flaccida*	One-leaf Cape tulip
**Hymenolobus procumbens*	Oval purse
**Hypochaeris glabra*	Smooth cat's ear
**Hypochaeris radicata*	Rough cat's ear
**Iris germanica*	Flag iris
**Kickxia elatine ssp. crinita*	Twining toadflax
**Lactuca serriola*	Prickly lettuce
**Lagurus ovatus*	Hare's tail grass
**Lamarckia aurea*	Toothbrush grass
**Lamium amplexicaule var. amplexicaule*	Deadnettle
**Lepidium africanum*	Common peppercress
**Limonium companyonis*	Sea-lavender
**Linum strictum ssp. strictum*	Upright yellow flax
**Lolium rigidum*	Wimmera ryegrass
**Lolium sp.*	Ryegrass
**Lycium ferocissimum*	African boxthorn
**Malva parviflora*	Small-flower marshmallow
**Marrubium vulgare*	Horehound
**Medicago arabica*	Spotted medic
**Medicago littoralis*	Strand medic
**Medicago minima var. minima*	Little medic
**Medicago polymorpha var. polymorpha*	Burr-medic

Scientific Name	Common Name
**Medicago sp.*	Medic
**Medicago truncatula*	Barrel medic
**Melilotus indica*	King Island melilot
**Mesembryanthemum aitonis*	Angled iceplant
**Mesembryanthemum crystallinum*	Common iceplant
**Mesembryanthemum nodiflorum*	Slender iceplant
**Mesembryanthemum sp.*	Iceplant
**Minuartia mediterranea*	Slender sandwort
**Molineriella minuta*	Small hair-grass
**Myrsiphyllum asparagoides*	Bridal creeper
**Oenothera stricta ssp. stricta*	Common evening primrose
**Olea europaea ssp. europaea*	Olive
**Oncosiphon suffruticosum*	Calomba daisy
**Oxalis pes-caprae*	Soursob
**Oxalis purpurea*	One-o'clock
**Pallenis spinosa*	Golden pallensis
**Papaver hybridum*	Rough poppy
**Parapholis incurva*	Curly ryegrass
**Parentucellia latifolia*	Red bartsia
**Picris hieracioides var.*	
**Picris hieracioides var. hieracioides*	Hawkweed picris
**Pinus halepensis*	Aleppo pine
**Piptatherum miliaceum*	Rice millet
**Plantago lanceolata var. lanceolata*	Ribwort
**Polygala myrtifolia*	Myrtle-leaf milkwort
**Polypogon maritimus*	Coast beard-grass
**Rapistrum rugosum ssp. rugosum*	Turnip weed
**Reichardia tingitana*	False sowthistle
**Reseda lutea*	Cut-leaf mignonette
**Reseda luteola*	Wild mignonette
**Romulea minutiflora*	Lesser Guildford grass
**Rostraria cristata*	Annual cat's-tail
**Rostraria pumila*	Tiny bristle-grass
**Sagina apetala*	Annual pearlwort
**Sagina maritima*	Sea pearlwort
**Salvia verbenaca form A*	Wild sage
**Schismus barbatus*	Arabian grass
**Senecio pterophorus var. pterophorus*	African daisy
**Sherardia arvensis*	Field madder
**Silene apetala*	Mallee catchfly
**Silene nocturna*	Mediterranean catchfly
**Silene sp.*	
**Silene tridentata*	
**Sisymbrium*	Smooth mustard
erysimoides	
**Sisymbrium irio*	London rocket
**Sisymbrium officinale*	Hedge mustard
**Solanum nigrum*	Black nightshade
**Sonchus oleraceus*	Common sow-thistle
**Sonchus tenerrimus*	Clammy sow-thistle
**Spergularia diandra*	Lesser sand-spurrey
**Spergularia marina*	Salt sand-spurrey
**Stellaria media*	Chickweed
**Trifolium angustifolium*	Narrow-leaf clover
**Trifolium campestre*	Hop clover
**Trifolium scabrum*	Rough clover
**Trifolium sp.*	
**Trifolium subterraneum*	Subterranean clover
**Trifolium tomentosum*	Woolly clover
**Urospermum picroides*	False hawkbit
**Urtica urens*	Small nettle
**Vicia monantha*	Spurred vetch
**Vulpia bromoides*	Squirrel-tail fescue
**Vulpia myuros forma myuros*	Rat's-tail fescue

* introduced species

Appendix 7: Yorke Peninsula Vegetation Survey Sites in National Estate Areas

Site Number	National Estate Code	Area Name
KAI0101	3/6/42/2	Lime Kiln Scrub
KAI0201	3/6/42/2	Lime Kiln Scrub
WAK0501	3/6/61/1	Clinton Conservation Park
WAK0801	3/6/61/1	Clinton Conservation Park
WAK0802	3/6/61/1	Clinton Conservation Park
MAI1601	3/6/60/13	Point Pearce Aboriginal Reserve - Former
MAI1501	3/6/60/13	Point Pearce Aboriginal Reserve - Former
WAR0103	3/6/60/13	Point Pearce Aboriginal Reserve - Former
WAR0102	3/6/60/13	Point Pearce Aboriginal Reserve - Former
WAR0101	3/6/60/13	Point Pearce Aboriginal Reserve - Former
WAR2G04	3/6/60/13	Point Pearce Aboriginal Reserve - Former
MAI1001	3/6/60/4	Moody Scrub
EDI1201	3/6/64/4	Troubridge Point to Pt Moorowie
EDI1101	3/6/64/4	Troubridge Point to Pt Moorowie
COO0101	3/6/63/6	Peesey Swamp
TUR0701	3/6/63/6	Peesey Swamp
TUR1201	3/6/63/6	Peesey Swamp
TUR0601	3/6/63/6	Peesey Swamp
TUR0603	3/6/63/6	Peesey Swamp
ALT0101	3/6/63/2	Innes National Park
ALT0201	3/6/63/2	Innes National Park
ALT0401	3/6/63/2	Innes National Park
ALT0501	3/6/63/2	Innes National Park
ALT0601	3/6/63/2	Innes National Park
ALT0701	3/6/63/2	Innes National Park
ALT0901	3/6/63/2	Innes National Park
ALT1001	3/6/63/2	Innes National Park
PON0901	3/6/63/2	Innes National Park
PON0801	3/6/63/2	Innes National Park
PON0701	3/6/63/2	Innes National Park
PON0601	3/6/63/2	Innes National Park
PON0602	3/6/63/2	Innes National Park
PON0301	3/6/63/2	Innes National Park
PON0302	3/6/63/2	Innes National Park
PON0303	3/6/63/2	Innes National Park
HIL0601	3/6/63/4	Warrenben Conservation Park
HIL0602	3/6/63/4	Warrenben Conservation Park
HIL0501	3/6/63/4	Warrenben Conservation Park
HIL0401	3/6/63/4	Warrenben Conservation Park
PON0201	3/6/63/4	Warrenben Conservation Park
ALF1002	3.6/44/12	Mona Road and Railway Reserve