

Vegetation Management Plan Tennyson Dune Reserve Yaitya Worra (True Indigenous Sand)



Simon Cordingley and Claire Petherick
SA Urban Forest Biodiversity Program
for the City of Charles Sturt

August 2006



This Vegetation Management Plan is designed to be a flexible and dynamic document that should be adapted according to changes in the dune environment over time and as further information becomes available.

This Vegetation Management Plan has been developed by the SA Urban Forest Biodiversity Program (Department for Environment and Heritage) in partnership with the City of Charles Sturt as part of Planning SA's Coast Park initiative.

This report may be cited as:

Cordingley, S. P. and Petherick, C. E., 2006, *Vegetation Management Plan Tennyson Dune Reserve*, Urban Forest Biodiversity Program, Adelaide.

Information in this document may be copied provided that full acknowledgement is made.

TABLE OF CONTENTS

1. RESERVE IDENTIFICATION	2
2. PURPOSE OF THE PLAN	2
3. PLAN CONTEXT	3
3.1 COAST PARK	3
3.2 MANAGEMENT PLANS	4
3.2.1 Adelaide Metropolitan Coast Park Concept Plan.....	4
3.2.2 City of Charles Sturt Coastal Management Plan 2002-2007.....	4
3.2.3 Adelaide’s Living Beaches – A Strategy for 2005-2025	6
4. BACKGROUND, HISTORY AND STATUS OF RESERVE	7
4.1 PHYSICAL DESCRIPTION	14
4.1.1 Topography/ Landform.....	14
4.1.2 Soils.....	14
4.1.3 Climate.....	15
4.2 VEGETATION	15
4.2.1 Indigenous Vegetation	15
4.2.2 Plant Species Richness.....	16
4.2.3 Significant Flora	17
4.2.4 Significant Plant Communities	17
4.2.5 Condition	18
4.3 FAUNA	20
4.3.1 Native Fauna	20
4.3.2 Introduced Fauna.....	21
5. ADJOINING LAND USES AND VEGETATION	21
6. RESERVE VALUES	22
6.1 CONSERVATION VALUE	22
6.2 EDUCATION VALUE	22
6.3 AESTHETIC VALUE.....	22
6.4 SCIENTIFIC VALUE	22
6.5 OPEN SPACE VALUE.....	23
7. RESERVE MANAGEMENT OBJECTIVES	23
8. NATIVE VEGETATION MANAGEMENT ISSUES	24
8.1 WHOLE RESERVE MANAGEMENT ISSUES	24
8.1.1 Fragmentation	24
8.1.2 Weeds	25
8.1.3 Fire.....	34
8.1.4 Access and Fencing	34
8.1.5 Erosion	37
8.1.6 Introduced Fauna.....	38
8.2 MANAGEMENT ISSUES AND STRATEGIES WITHIN EACH MANAGEMENT ZONE	41
8.2.1 Management Zone 1 - Foredune.....	41
8.2.2 Management Zone 2 – Interdune Swale.....	44
8.2.3 Management Zones 3a and 3b – Hind Dune Seaward Face	48
8.2.4 Management Zones 4a and 4b – Hind Dune Ridge.....	54
8.2.5 Management Zone 5 - Rehabilitation.....	59
9. SUMMARY OF MANAGEMENT RECOMMENDATIONS/SUGGESTIONS	64
10. IMPLEMENTATION SCHEDULE AND APPROXIMATE BUDGETS	68
GLOSSARY	74
REFERENCES	76

APPENDIX 1: CONTEXT	80
INTERNATIONAL	80
NATIONAL	80
Coastal Zone Inquiry	81
Australian Coastal Policy	81
Coast and Clean Seas	82
STATE	82
REGIONAL	83
Adelaide and Mount Lofty Ranges	83
SA Urban Forest Biodiversity Program	86
ADELAIDE METROPOLITAN COAST	86
Coast Protection Board	87
Coast Park	87
LOCAL	87
Local Government	87
Community Groups	88
APPENDIX 2: PLANT SPECIES LIST FOR TENNYSON DUNE RESERVE	90
APPENDIX 3: PRIORITY WEED SPECIES	93
APPENDIX 4: WEEDING CALENDER	121
APPENDIX 5: COMMON WEED REMOVAL TECHNIQUES	122
APPENDIX 6: BUSHLAND WEEDING CODE	124
APPENDIX 7: COASTAL INDIGENOUS SPECIES	125
APPENDIX 8: PRIORITY ACTIONS FOR INDIGENOUS SPECIES WITHIN TENNYSON DUNE RESERVE.....	157
APPENDIX 9: SEED COLLECTION TECHNIQUES AND PROPAGATION METHODS.....	163
COLLECTION OF NATIVE PLANT MATERIALS	163
APPENDIX 10: REVEGETATION METHODS.....	165
REVEGETATION OBJECTIVES	165
USING LOCALLY INDIGENOUS SPECIES	165
WHAT TO PLANT WHERE?.....	166
PLANTING TUBE-STOCK	166
APPENDIX 11: REVEGETATION IMPLEMENTATION SCHEDULE (2007-2011).....	168

Acknowledgements

Thank you to everyone who has assisted with the preparation of this Management Plan. Your time and resources were greatly appreciated. Special thanks need to be made to Ron Sandercock (Coastal Protection Branch, Department for Environment and Heritage) and Amy Bruckman (SA Urban Forest Biodiversity Program) for their efforts in bringing this document to fruition.

GIS AND COMPUTER SUPPORT

Darcy Peters (SA Urban Forest Biodiversity Program)

BOTANICS

Jamie Mugridge (Indigeflora)

Ron Sandercock (Coastal Protection Branch, Department for Environment and Heritage)

HISTORY AND RESERVE STATUS

Stephen Cox (Coastal Protection Branch, Department for Environment and Heritage)

Nick Crouch (Henley and Grange Dunecare)

Christopher Naylor (Local Resident)

Ron Sandercock (Coastal Protection Branch, Department for Environment and Heritage)

PHOTOGRAPHS

All photographs, except where noted are by Simon Cordingley

Doug Fotheringham (Coastal Protection Branch, Department for Environment and Heritage)

Vicki Hagan (Bush A-new)

Ben Moulton (SA Urban Forest Biodiversity Program)

Ron Sandercock (Coastal Protection Branch, Department for Environment and Heritage)

Michael Smith (Local Resident)

GENERAL

Amy Bruckman (SA Urban Forest Biodiversity Program)

Angela Carson (City of Charles Sturt)

Brian Caton (Member South Australian Coast Protection Board)

Nick Crouch (Henley and Grange Dunecare)

Combined Coastal Groups of the City of Charles Sturt

Community Coastal Reference Group, City of Charles Sturt

Sharon Gardner (City of Charles Sturt)

Angela Loram (SA Urban Forest Biodiversity Program)

Rata Luckens (City of Charles Sturt)

Wendy McFadyen (City of Charles Sturt)

Mark Mobbs Planning SA)

Ben Moulton (SA Urban Forest Biodiversity Program)

Ross Oke (SA Urban Forest Biodiversity Program)

Renz Piovesan (City of Charles Sturt)

Ron Sandercock (Coastal Protection Branch, Department for Environment and Heritage)

Jenny Watson (City of Charles Sturt)



Source: Department for Environment and Heritage

1. Reserve Identification

Reserve Name: Tennyson Dune Reserve

Local Government Area: City of Charles Sturt

Location: The study area extends northward from Bournemouth Avenue, Tennyson to Cormorant Court, West Lakes Shore. The eastern boundary is marked by Military Road and residential boundaries. The western boundary is the high watermark. The Reserve location is shown in Figure 1.

Area: 20.5ha

Reserve Status: Tennyson Dune Reserve is divided into eight allotments and has several owners and managers, as summarised in Table 1. Hereafter these will be referred to as the 'landowners/managers'.

Table 1: Land Ownership and Management Bodies of Tennyson Dune Reserve

Owner	Land Manager
Unallotted Crown Land	Land Administration Branch
Freehold title by Coastal Protection Board	Coast Protection Branch
Crown record dedicated to the Coastal Protection Board	Coast Protection Branch
Freehold title by the City of Charles Sturt	City of Charles Sturt

2. Purpose of the Plan

Within the City of Charles Sturt there are a number of management issues which threaten the integrity of the region's coastal native vegetation. These issues have been identified as weed and pest animal invasion, pedestrian access, stormwater discharge, erosion and fire. A coordinated approach to management is crucial to prevent further degradation and to enhance the natural biodiversity of these fragile coastal environments.

Within this context, the City of Charles Sturt has identified the need to produce a series of practical, issue specific, management plans to guide the implementation of native vegetation enhancement works within the dune system.

General public consensus is that Tennyson Dune Reserve is classified as a Council Reserve. For the most part, this is not the case and its care and control has been a shared responsibility of the governing bodies mentioned in Table 1. This Plan attempts to reflect this relationship and has been a collaborative effort between the State Government, City of Charles Sturt and local community groups.

This plan features:

- Site and vegetation community descriptions, including species lists and aerial vegetation maps
- A weed control plan that includes a list of priority weed species, weed distribution maps and weed control methodology
- A revegetation plan detailing a list of suitable species, quantities required and revegetation methodology
- Recommendations for addressing native vegetation management issues including fire, access and fencing, erosion, introduced fauna and stormwater outfall areas

- Provision of background information, including history, current status and possible future sand management strategies
- Identification of opportunities for educational activities and signage
- A timetable for plan implementation with approximate budgets
- Detailed on-ground focussed appendices to guide in the implementation of the Management Plan recommendations.

The target audience for this plan includes State Government land owners, Local Council staff, contractors, community groups such as Coastcare/Dunecare groups and local schools and residents who may play a role in the management of this section of coast. It is intended that this plan provides the framework for a coordinated rehabilitation program for the above-mentioned groups. The plan will help optimise the success of on-ground works within the dune system from a native vegetation perspective.

3. Plan Context

This plan seeks to address numerous coastal management issues identified in the Adelaide Metropolitan Coast Park Concept Plan (PPK, 2001) and the City of Charles Sturt Coastal Management Plan 2002 – 2007 (Kinhill, 1999).

3.1 Coast Park

Delivered through Planning SA, the Adelaide Metropolitan Coast Park is a State Government initiative involving partnerships with other State Government agencies, Local Councils and key stakeholder groups. Essentially, Coast Park is a linear park extending approximately 70km along the Adelaide metropolitan coastline, from Sellicks Beach to North Haven. It will link key interest areas to provide a publicly accessible linear park along the length of the metropolitan coast. Coast Park will link with the River Torrens Linear Park, as well as other linear parks in metropolitan Adelaide.

Sections completed to date (May 2006) include the coastal walking trail at Marino/Hallett Cove Conservation Parks, as well as shared-use paths (providing access for pedestrians, cyclists and people with disabilities) at:

- North and South Esplanades, Glenelg
- Esplanade at South Brighton and Seacliff
- West Beach Dunes at Adelaide Shores
- Coastal strip from Semaphore South through to Taperoo
- Esplanade, Christies Beach.
- Ozone Street Carpark, Henley Beach South to Henley Sailing Club, West Beach.

As part of the Coast Park initiative, a series of coastal Vegetation Management Plans are being produced by the SA Urban Forest Biodiversity Program (UFBP). Planning SA has made funds available to the City of Charles Sturt for the production of a series of four Vegetation Management Plans (consistent with other plans developed by UFBP) for the coastal strip between Chetwynd Street, West Beach and Bower Road, Semaphore Park. This plan is the third in the series. Vegetation Management Plans completed to date are:

- Henley South and West Beach Dune Reserve (May 2005)
- Henley Beach to Tennyson Coastal Reserve (January 2006).

In addition, Coast Park funding is enabling the provision of technical advice and assistance to land managers to ensure these plans are implemented.

3.2 Management Plans

Several planning documents exist that provide context and direction on the management of this Reserve.

3.2.1 Adelaide Metropolitan Coast Park Concept Plan

The Adelaide Metropolitan Coast Park Concept Plan (PPK, 2001) sets out a number of possible strategies and recommended actions for the Coast Park over a ten-year time frame. The Coast Park vision is to:

'Revitalise and sustain a healthy, diverse and accessible Coast Park to be enjoyed and valued by present and future generations'.

The goals of this initiative are to:

- Maintain and enhance open space linkages ensuring free, safe and convenient access facilities are available for all ages and abilities
- Recognise, value and reinforce the diversity of the coastline, ensuring development takes place in appropriate locations and that social, economic and environmental values are achieved
- Provide appropriately for traffic and parking, ensuring convenient access for people wishing to use the coast, taking into account the need for safety for pedestrians and cyclists
- Recognise, value, protect and where possible, enhance sandy beaches, seagrass beds, remnant dunes, coastal reserves and buffers, and water quality along the coast
- Pursue every opportunity to educate the community and decision makers on the vision for, and the special value of the coast, and lessons learnt about the management of our coastline.

The Concept Plan identifies pressures on Tennyson Dune Reserve as pedestrian access, erosion, the introduction of pest flora and fauna and subsequent pressure on remnant vegetation. The Concept Plan also outlines strategies and responses to these pressures such as controlling access to the dunes, identifying, protecting and enhancing areas of significant vegetation and undertaking a weed and feral animal control program.

3.2.2 City of Charles Sturt Coastal Management Plan 2002 - 2007

The City of Charles Sturt Coastal Management Plan encompasses the Council's coastal region, stretching southwards from the City of Port Adelaide Enfield boundary at Bower Road to the Adelaide Shores Caravan Park (Kinhill Pty Ltd, 1999). The Plan was developed by Council in response to community concerns about a range of environmental and social issues within the coastal zone and a mutual desire for the sustainable use of common coastal resources.

The key purpose of the Coastal Management Plan is to provide Council with a more accurate decision making process for the allocation of resources. It is acknowledged that

the Plan operates within broader policy frameworks (i.e. the Corporate Plan and the Metropolitan Planning Strategy) and as such is not considered a strategic document.

The aims of the Coastal Management Plan are to:

- Identify environmental and coastal management issues in the City of Charles Sturt coastal area, for the purpose of creating a prioritised action plan for the future;
- Ensure sustainable resource usage and resource conservation taking into consideration the physical, environmental, economic, social, historical, recreational and cultural attributes of the coastal zone (Kinhill, 1999).

Through the Coastal Management Plan, Council, in consultation with an array of key stakeholder groups and individuals, identified four key management areas and associated goal as summarised in Table 2.

Table 2: Key Management Areas and Goals of the City of Charles Sturt’s Coastal Management Plan

Key Management Areas	Goals
Access	Provision of a formal network of roads, shared-use paths, beach access paths, ramps and corresponding support facilities that allow safe access for cyclists, pedestrians, vehicles and boats, (including disabled and all ages access where appropriate).
Activities	A diverse and well managed range of recreational and cultural activities, with minimal impact on other coastal users and that protect and/or enhance the coastal and marine environments.
Conservation	Ensure biological, social, cultural and heritage values are identified, protected and promoted to enhance biodiversity, coastal amenity, coastal character appreciation and visitor experiences.
Coastal Processes	Pre-emptive management of natural and accelerated coastal processes.

These key areas were investigated further and a series of detailed management aspects and strategies identified under each of these categories. These management aspects are (in no specific order of importance):

- Beach and water pollution/monitoring
- Capital works (timing)
- Cycling (access and safety)
- General patterns of development
- Linkages between areas
- Maintenance
- Public safety
- Sand dune protection
- Sand movement and replenishment
- Stormwater runoff and pollution.

These management aspects and consequent detailed management strategies are the primary focus of the City of Charles Sturt Coastal Management Plan.

The Plan makes the following comments concerning the Tennyson Dunes:

- ‘...extensive areas of biologically important remnant sand dune found in the vicinity of Estcourt House makes conservation a management priority in this section’ (Section 2.3)
- ‘Focus revegetation works on priority areas of sand depletion or vulnerable habitat, particularly Tennyson Dunes’ (Section 4.3).

In addition to these specific actions, it was recommended that the Management Plan be reviewed on an ongoing basis and the strong communication and coordinating link between Council and those with an active interest in the coast be maintained. As a result, a major recommendation included the establishment of a Community Coastal Reference Group to provide Council with feedback and assistance in the implementation of the Plan. This group began operation in May 2003 and consists of several community representatives, elected members, Council staff and a member of the Coastal Protection Branch.

The City of Charles Sturt Coastal Management Plan (Kinhill Pty Ltd, 1999) was adopted by Council in April 2002 with support for its implementation provided through its operating budget. External funding through NHT-Coastcare (Phase 1), Coastal Protection Branch Metropolitan Coastal Works, Coastal Protection Branch Small Participation Grants and the SA Urban Forest's Million Trees Program has been provided to assist in its implementation (refer to Appendix 1).

3.2.3 Adelaide's Living Beaches – A Strategy for 2005-2025

In 2000 the Department for Environment and Heritage, initiated a review of the management of Adelaide's Metropolitan coastline on behalf of the Coast Protection Board. This strategy supersedes the previous *Report of the Review of the Management of Adelaide Metropolitan Beaches, 1997*. Released in June 2005, it contains the Coast Protection Board's vision for the next 20 years.

The strategy identifies and addresses the issues of dwindling local sand sources, seagrass loss, rising sea levels and the need to bypass sand around the harbours of Holdfast Shores and Adelaide Shores.

The strategy has five main components:

1. Continue beach replenishment
2. Recycle sand more effectively using sand slurry pumping and pipelines
3. Add coarse sand from external sources
4. Build coastal structures in critical locations
5. Integrate sand bypassing at harbours with beach management.

It is important to note the following additional aims of the strategy with regards to implications for dune biodiversity and management:

- Trial sand slurry pumping methods...and investigate how pipelines can be installed unobtrusively behind dunes and at the top of sea walls.
- Maintain necessary sand dune buffer along the metropolitan coast to provide protection for two 1-in-100-year average return interval storms, with an allowance over time for one metre of sea level rise as a consequence of climate change. This is in accordance with Coast Protection Board policy and provides for a dry sandy beach amenity above high tide. Sand dune volumes and beach widths are used as management performance indicators.
- Redistribute the existing sand dune supplies that have built up over the last half-century in order to protect development and maintain beach width from Kingston Park to North Haven.
- Educate the community on the value of recently created dunes as primarily a source of sand to provide protection and beach amenity rather than for conservation of biodiversity. The dunes need to be vegetated to prevent sand drift

and this provides a secondary benefit as habitat for birds and animals. Even so, it must be recognised that the dunes could be eroded away in a storm event. In contrast, *the Tennyson and Minda dunes are remnants of the original Adelaide coastal dune field and will be preserved and restored accordingly*. Native vegetation at these and other locations will be managed according to current best practice and in line with management plans being prepared in conjunction with local councils.

Appendix 1 provides information on the international, national, state, regional and local contexts in which this plan has been written and will be implemented.

4. Background, History and Status of Reserve

'The tallest of the sandhills are near Estcourt House between the Semaphore and the Grange, the height probably reaching to about 50 feet. The breadth of the sandhills is only a few hundred yards. On the sea-front is a sharp rise immediately eastward of the highest tidal limits. This is followed by a shallow depression (swale) and then usually by the highest part of the dunes, with a fairly sharp descent on the landward sides, or there may be three rises altogether and two swales. In places the sandhills are bare and of shifting dazzling white sand, but for the most part, except on the actual seafront, they are covered with a vegetation of their own.' (Cleland, 1932)

The aim of this particular section is to provide a history and status of Tennyson Dune Reserve within the broader context of a dramatically altered metropolitan coastline. Accent will be upon how urban development has affected natural systems along the coast and how this development influences current management practices.

Pre-European History

Prior to European settlement in 1836, Adelaide's metropolitan coastline consisted of an almost uninterrupted 30km stretch of sand dunes, running from Seacliff in the south to Outer Harbour in the north. This dune system ranged between 200 and 300m in width and up to 10-15m in height. Generally characterised by several parallel ridges with narrow, often wet, swales in between, the dunes were home to a diverse array of flora and fauna. Very little of these original metropolitan dunes remain, notably only at Tennyson and a small section at North Brighton. Immediately behind these dunes were a series of freshwater wetlands affected by occasional tidal incursions. These freshwater swamps and lagoons stretched from Kingston Park in the south to the Port River in the north (Kraehenbuehl, 1996). They contained very different flora and fauna communities to those represented within the dune system proper.

The area along Adelaide's coast was originally inhabited by the Kurna people. Prior to their dispossession shortly after European settlement, they were accustomed to moving seasonally between the foothills in winter and the coast during warmer months.

The Kurna name for the land stretching roughly from West Lakes to Gillman is Yerta Bulti (Land of Sleep or Death). Yaitya Worra is the modern Kurna name for the Tennyson Dunes, meaning literally, 'true indigenous sand' (Kurna Warra Pintyandi, 2006).

The Port Adelaide Kurna people lived among the abundant resources the coastal environment provided. These included fish, shellfish, crustaceans, birds and native flax, which was essential for making mats, baskets clothing and nets used in the hunting large game birds and fish (Wanganeen et al, 1996).

As the Kurna people favoured campsites on high ground and those near fresh water, food and implement resources (Wanganeen et al, 1996), it is assumed the present day Tennyson Dunes would have been visited infrequently (Sandercock, pers comm., 2006).

Gara (2003) notes that the Kurna people used the area immediately behind the dunes closer to Henley Beach, (now known as the Reedbeds¹), as camping grounds after white settlement.

Early European Settlement

Adelaide's coastline began its history of urban development at Glenelg and Port Adelaide shortly after settlement. Other coastal developments began soon after at Largs Bay, Semaphore, Grange, Henley and Brighton, as these were seen as sites of safe anchorage (SA Coast Protection Board, 1993). During this early history the dunes were seen as a resource to be exploited or simply as a hindrance to progress. Early pressures on Adelaide's dune system reflected the desire to provide for the basic needs of the fledgling colony. These included using coastal vegetation as a source for grazing, firewood and timber. Similarly, initial construction practices at the coastal townships showed little knowledge or regard for coastal processes, as for the most part dunes were simply flattened and built over (Caton, 2004, pers. comm.). Figure 2 shows an early example of this practice at Henley Beach.

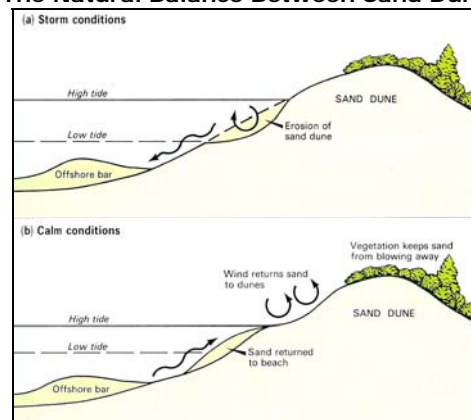
Figure 2: Henley Beach Hotel 1891 and 2005 respectively - Looking South



Photo courtesy of the State Library of South Australia, SLSA B - 2233

Coastal dunes act as a responsive transition zone between marine and terrestrial environments. They absorb and dissipate wave energy to provide an effective physical barrier to inland environments and are critical as a supply of erosive material in storm surge conditions. This interaction between seasonal wave energy and sand dunes is simplified in Figure 3.

Figure 3: The Natural Balance Between Sand Dunes and Sea



Source: Dept. of Mines and Energy, 1984

¹ Originally *Witoinga*, meaning 'the reedy place' (Sandercock, 2005, pers. comm.)

A major consequence of urban development was that the store of sand in the dunes, so vital to dynamic coastal processes, began to be locked under urban houses and road systems. This isolation of sand from the coastal system, particularly from the late 1940s onward, led to an acceleration of natural erosion process along the metropolitan coast (Coast Protection Board, 1993). Other practices such as cattle grazing and the release of pigs into the Reedbeds during early settlement destroyed much understorey (and presumably sand dune) vegetation. The destruction of many rush and reed communities from early settlers' fires probably allowed the first introduction of weeds within the Reedbeds and dune communities (Kraehenbuehl, 1996).

Although early development was considerable, the first coastal townships remained isolated until the coincidence of two significant events contributed to rapid urbanisation of the metropolitan coastline. The first was initially of relatively local significance, but one which has had profound ramifications for the entire metropolitan coast and much of the Gulf St. Vincent; this was the channelling of the River Torrens to its present day outlet at West Beach in 1938. The second event was the *long boom*, occurring at the conclusion of World War II, with its major economic, demographic and technological changes (Forster, 1995).

The Torrens Outlet

Construction of the Torrens Outlet at West Beach was the culmination of several years of attempts at land reclamation and flood abatement. Prior to 1938 the River Torrens never directly reached the Gulf, even in peak winter floods. Instead, in years with average rainfall, water from the Torrens ran west until its energy dissipated amongst the inland coastal dunes around present day Lockleys and Fulham (Couper-Smartt, 2003). Water then slowly filtered northward toward the Port River and southward toward the Patawalonga Creek creating a series of swamps and lagoons commonly known as the Reedbeds, named after the Common Reed, (*Phragmites australis*) which grew in abundance there. Only in times of flood would the force of the waters be sufficient for the Torrens to break its banks and connect with both the Port River and the Patawalonga Creek. In periods of heavy rain and coinciding king high tides, the Torrens would not only flood through the Reedbeds but also the entire Port Adelaide and surrounding areas (Couper-Smartt, 2003).

Early attempts at land reclamation and alleviation of regular flooding events of the Torrens took the form of creating embankments around coastal townships. Due to their inadequacy, various drainage vents were dug in the mid-1870s (Couper-Smartt, 2003). After a particularly wet winter, the initial proposal for a channel for the river through the dunes at Henley Beach was made in 1917. However, it was not until after much debate between Local and State Governments of the time and another heavy flood in 1933 that the Torrens Outlet was finally completed in August 1938 (Couper-Smartt, 2003). Figure 4 shows the dissection of the original dune system making way for the Torrens Outlet.

Figure 4: 1937 - Torrens Outlet Construction, Looking South

Photo courtesy of the State Library of South Australia, SLSA B18651/14

The opening of the Torrens Outlet had two profound effects. The first was drainage of the Reedbeds, which depended on the Torrens' floodwaters for survival. This in turn readied large areas of land to be reclaimed and urbanised. Initially, the land immediately to the rear of the dunes (present day Fulham and Fulham Gardens) was utilised for market gardens and dairy farms but was quickly urbanised during the late 1950s and early 1960s.

Secondly, the Torrens Outlet led to a massive rise in the volume of fresh water and sediment entering Gulf St. Vincent. Prior to European settlement this water and sediment never reached the sea directly but rather, was filtered and absorbed through the intricate system of wetlands that existed within the Reedbeds. This, along with increased nutrient loads from stormwater and sewage discharges (arising from a rapidly urbanising environment), placed enormous pressures upon the seagrass meadows growing along the metropolitan coast which were accustomed to a low nutrient environment. As a result, these began to retreat at an alarming rate. The almost complete channelisation of much of Adelaide's creek system throughout the 1950s and 1970s contributed in similar fashion to the demise of seagrass populations along the Adelaide metropolitan coast.

Historically, seagrass meadows grew up to the low water line. Today, in most areas along the metropolitan coast, they are approximately 1km offshore (Caton, 2004, pers. comm.). The State of Our Environment Report (2003), states that approximately 5000ha of seagrass has been lost since 1935. This equates to a loss of approximately one quarter of the original meadows growing along the metropolitan coast since 1949. As seagrass meadows can trap at least one metre of sediment beneath them they function as an effective buffer to nearshore wave energy. The long-term effect of their retreat has been to release the sediment layer beneath, thus lowering seabed levels in the nearshore zone. Consequently, this dramatically increases wave energy along the coast and accelerates erosion along the adjacent beaches. The South Australian Coast Protection Board (N/D) describes this process:

'The seabed is readily eroded by waves and currents if the stabilising seagrass cover is lost. In consequence the seabed deepens and near-shore wave energy increases. Adjacent beaches become unstable as a result.'

The impact of these changes to the coastal and marine environment left the shoreline susceptible to major storms in the 1940s to the 1960s and led to major spending on hard protection of the coastline. Early examples of these took the form of vertical sea walls and groynes. Unfortunately, these artificial measures caused beach scouring and were a physical barrier which further separated sand from the beach and diminished the role coastal dunes played in combating erosion - thus shortening the lifespan of the beaches, which were of such attraction in the first instance.

During the late 1960s, State Government in conjunction with the Metropolitan Seaside Councils Committee commissioned Adelaide University to undertake a detailed study of the processes and problems of erosion affecting Adelaide's beaches (Figure 5).

Figure 5: 1968 – Culver Report, Henley South Looking South



Photo courtesy of Coastal Protection Branch

This report titled the *Beach Erosion Assessment Study – Summary Report* (colloquially known as the Culver Report after its main author, Dr. Bob Culver), concluded:

'... there was [is] no naturally continuing replenishment source of sand. When combined with the net northerly littoral drift¹, the ongoing increase in mean sea level and the development on the dune system, the long term effect is the need to artificially maintain the beaches, or eventually lose them' (Coast Protection Board, 1993).

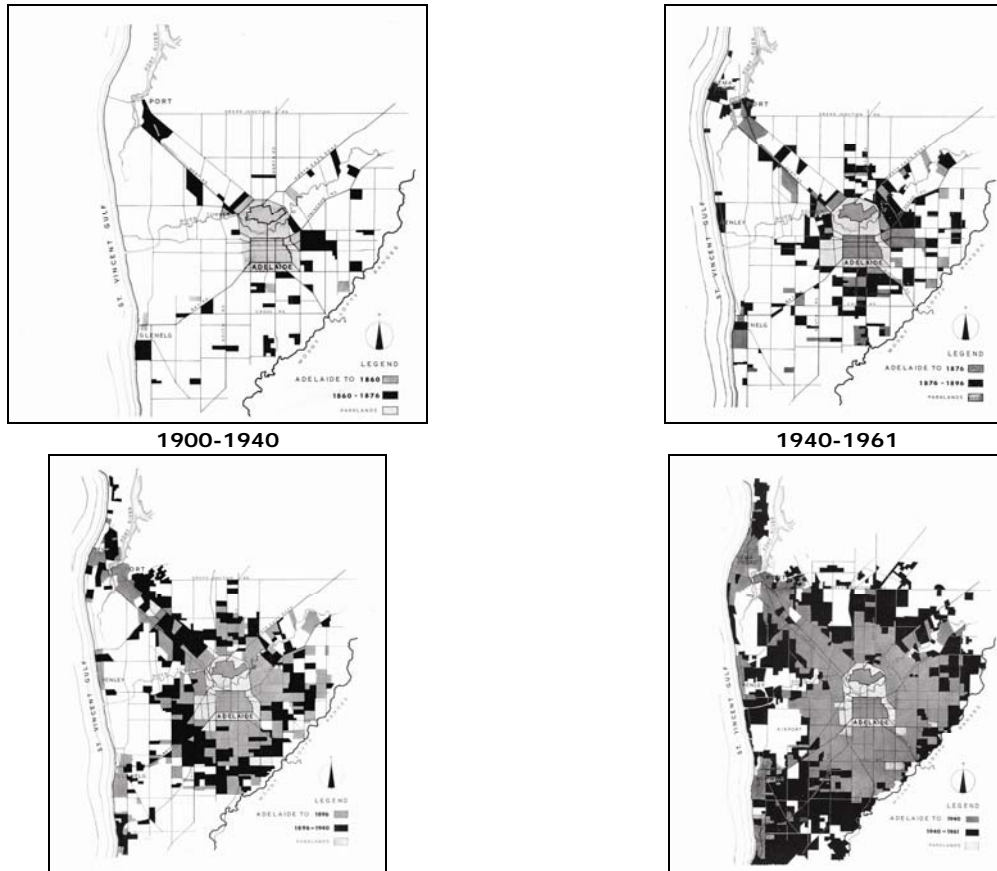
Considerable weight was placed upon this report and consequently, the Coast Protection Board was established in 1972. The main recommendation of the report was that a beach sand replenishment program, in conjunction with other protective works, be carried out as a matter of urgency (Coast Protection Board, 1993). Other recommendations were that a high priority be placed upon monitoring and data collection to enable a more systematic and informed approach to management.

The Long Boom Years

With reference to the post WWII economic boom, Forster (1995) notes the period between the early 1950s and early 1970s was marked by economic growth, population increase and a massive rise in automobile ownership. These, in conjunction with government housing and planning policies, fuelled a '...seemingly unstoppable chain reaction of metropolitan expansion and suburbanisation. Prior to WWII, urban development essentially remained close to established coastal townships, the City of Adelaide and radially along the major transport routes. During the boom, Adelaide entered into a period of economic growth, prosperity and full employment. With economic expansion came an equally rapid growth in population. These were the baby boom years, marked by high levels of overseas migration and natural internal growth. This period was also marked by increased affluence and significant improvements in manufacturing processes, which enabled far greater numbers of people access to automobile ownership. Consequently, urban development became much less dependent on public transport routes and more dependent on land availability. In close proximity to the Central Business District, the recently drained Reedbed and coastal dune areas provided the perfect location. Figure 6 displays Adelaide's urban development (note particularly, development along the coastal strip after 1940).

¹ Littoral drift is the process whereby sediment in the nearshore zone moves in a net northerly direction along the Adelaide metropolitan coast as a result of current movements and waves striking the coast at an oblique angle.

Figure 6: 1837 – 1961 - Urban Development of Adelaide
1860-1880 **1880-1900**



Maps courtesy of the State Library of South Australia from *Building Ideas* Vol. 2, No. 4 (1963). Copyright Permission: Royal Australian Institute of Architects.

Drainage of the Reedbeds by channelling the Torrens River, in conjunction with the Long Boom, began an intricate spiral of cause and effect, both ecologically and socially along the Adelaide metropolitan coast. A series of major storms throughout the 1940s to the 1960s exposed development errors of the past and highlighted the need for urgent and ongoing research, monitoring and practical measures to be carried out.

Tennyson Dunes and West Lakes

One of the last major urban expansions of the Long Boom period was the West Lakes Development Scheme. Commencing in 1970, the project was essentially a fulfilment of the Greater Port Adelaide Plan prepared by the South Australian Harbors Board in 1950 (Selby, 1984). At the time, this project was seen as a great economic boon for South Australia in an area described by some as a 'desolate swamp' and a 'liability and an eyesore' (Dyer, 2003). This view has not been shared by all. Consequently, the removal of the mangroves, samphire flats and Kangaroo Honey-myrtle (*Melaleuca halmaturorum* ssp. *halmaturorum*) habitats in the area has led to many species receiving a conservation rating for the Southern Mount Lofty region of South Australia (Kraehenbuehl, 1996). Many more species are locally rare or extinct.

Adding to the European cultural value of the dunes is the locally historic building, Estcourt House. Constructed by Frederick Estcourt Bucknall between 1881 and 1883, the residence was to be a gateway to a harbour and canal linking the sea and Port River. However, the Bucknall 'dream' was never completed due to the Colony's early lack of prosperity (Dyer, 2003). Eventually the house was purchased by the State Government to house incapacitated children. The building served this function between the early

1890s and 1995, after which it fell into disrepair. Recently, the property has been privately purchased and restored.

It is believed that Governor Tennyson (after whom the dunes are named) once owned a holiday residence nearby north of the dunes. This dwelling was subsequently bought and converted into a dairy, the cattle of which grazed throughout the samphire flats and dunes (Naylor, pers. comm., 2006). Figure 7 displays cattle grazing amongst dune vegetation at nearby Semaphore Park.

Figure 7: Circa 1900 - Cattle Grazing in Dunes near Tennyson



Photo courtesy of Michael Smith

Significant areas rear of the dunes have also been exploited for sand, used in the production of glass or as clean fill for building (Figure 8), especially during the construction of West Lakes. Not only has this past practice physically damaged the dunes, but also has allowed the establishment of the invasive weed *Ehrharta calycina* (Perennial Veldt Grass) which was introduced as a sand stabiliser after sand mining activities.

Figure 8: 1973 - Sand Mining in Rear Dunes



Photo courtesy of Coast Protection Board

During the mid 1970s a concerted public campaign was staged to save the last significant section of remnant coastal dunes along the metropolitan coast from development. In response, the State Government's Coast Protection Board purchased a considerable portion of the dunes. Now known as the Tennyson Dunes, they are managed by volunteers with State and Local Government assistance (Sandercock, 2006, pers. comm.).

The Latter Years

Although the Tennyson Dunes were saved from destruction in the 1970s, it was not until 1995 that the Tennyson Dunes Group was established. In conjunction with other dedicated community groups (such as the West Lakes Kiwanis) and State and Local Government assistance, the Tennyson Dunes Group has been actively involved in various projects and management of the local dunes. Funded initially through Coastcare, the group has undertaken activities including pest weed and animal control, fencing, carpark and access way maintenance and rationalisation, nursery construction, propagation of local native plants, revegetation projects, rare plant recovery, fire prevention, education, monitoring and interpretive signage.

Urban development along Adelaide's coastline has led to the need for balance between environmental, social and economic values with protection of Adelaide's highly erosive coastline. In an attempt to sustainably manage the metropolitan coast, the Coast Protection Board has implemented a sand replenishment program that began in the early 1970s.

Once considered as "passive coastal fixtures – a source of nuisance sand drift – some unused land – some unsold real estate" (Culver, 1968), Adelaide's coastal dunes, whether remnant or newly formed, have become both community treasures and critical sources of sand for infrastructure protection. This dichotomy of values will prove to be a significant challenge for community and Government in the early part of the twenty first century.

4.1 Physical Description

4.1.1 Topography/ Landform

The survey area encompassed by Tennyson Dune Reserve is generally characterised by a flat sandy beach, backed by vegetated semi-stable medium sized dunes that range from approximately 60 to 200m in width. Along with a small area at North Brighton, the Tennyson Dunes are the last significant relics of the original system that existed prior to European colonisation.

Dunes and beaches are dynamic systems which are responsive to winds, waves, tides, storms and seasonal changes. Sand dunes, in particular, are only as stable as the protection they receive from erosive forces and the amount of soil and vegetation cover on them. The narrow southern and northern ends of the Reserve are most at threat from current storm events on the seaward side and urban pressure on the eastern side. These are the least stable locations and the areas most in need of long-term management. Environmental and human influences are particularly severe on beaches and sand dunes and vegetation needs to be very resilient to survive.

4.1.2 Soils

Samples taken from the metropolitan coast by the Coastal Protection Branch (Department for Environment and Heritage) in 1999 show the sand is predominantly low in nutrients and made up of 90% fine siliceous (quartz) sands with a small proportion of calcareous (shell) sands (10%). There is no soil structure and only shallow organic staining on the hind dunes.

4.1.3 Climate

The Adelaide region generally experiences a Mediterranean climate with cool wet winters and warm dry summers. The average annual rainfall for the coast is 414mm and is less than that experienced by non-coastal areas of metropolitan Adelaide due to the effects of orographic rain, whereby rainfall declines along a gradient from the hills to the coast. Temperatures at the coast are slightly lower in summer and warmer in winter than inland areas due to the moderating effect of the ocean. This is due to the ocean having less temperature fluctuations than air (ID&A, 2000). Winds are predominantly from the south-west during the winter and early spring, however strong north-westerly winds are occasionally experienced.

4.2 Vegetation

4.2.1 Indigenous Vegetation

Vegetation communities on the coast often display considerable diversity over a small area due to the gradation of environmental factors such as exposure to sun, wind, salt spray, sand blasting, sand stability, availability of water and organic content in sand. Table 3 summarises pre-European and current vegetation along the Adelaide metropolitan coast. Using information derived from early botanical surveys, it can be extrapolated these species were also common to Tennyson Dune Reserve.

Table 3: Indigenous Vegetation of Tennyson Dune Reserve

Scientific name	Common Name	Botanist/Collector
<i>Acacia cupularis</i>	Cup Wattle	
<i>Acacia liquilata</i>	Umbrella Bush	Davis, Cleland, Ising
<i>Acacia longifolia</i> ssp. <i>sophorae</i>	Coastal Wattle	Cleland, Davis, Ising
<i>Acrotriche patula</i>	Prickly Ground-berry	Davis
<i>Actites megalocarpa</i> (formerly <i>Sonchus megalocarpus</i>)	Coast Sow-thistle	Cleland
<i>Adriana quadripartita</i> (formerly <i>A. klotzschii</i>)	Rare Bitterbush	Cleland, Ising
<i>Allocasuarina verticillata</i>	Drooping Sheoak	Davis
<i>Alyxia buxifolia</i>	Sea Box	Cleland, Davis
<i>Atriplex cinerea</i>	Coast Saltbush	Cleland
<i>Atriplex paludosa</i> ssp. <i>paludosa</i> (formerly <i>A. paludosa</i>)	Marsh Saltbush	Cleland
<i>Austrodanthonia caespitosa</i>	Common Wallaby-grass	
<i>Austrostipa flavescens</i>	Coast Spear-grass	
<i>Austrostipa scabra</i> ssp. <i>falcata</i>	Slender Spear-grass	
<i>Banksia marginata</i>	Silver Banksia	Davis
<i>Baumea juncea</i>	Bare Twig Rush	Cleland
<i>Brachyscome ciliaris</i> var. <i>brachyglossa</i> (formerly <i>B. ciliaris</i>)	Variable Daisy	Cleland
<i>Cakile maritima</i> ssp. <i>maritima</i>	Two-horned Sea Rocket	
<i>Calandrinia eremaea</i>	Dryland Purslane	
<i>Callitris gracilis</i> (formerly <i>Callitris preissii</i>)	Southern Cypress Pine	Davis
<i>Carpobrotus rossii</i>	Native Pigface	Cleland, Ising
<i>Cassytha pubescens</i>	Downy Dodder-laurel	
<i>Chrysocephalum apiculatum</i> (formerly <i>C. apiculatum</i> var. <i>apiculatum</i>)	Common Everlasting	Davis
<i>Clematis microphylla</i>	Old Man's Beard	Cleland, Ising
<i>Cotula australis</i>	Common Cotula	
<i>Crassula closiana</i>	Stalked Crassula	
<i>Crassula colligata</i> ssp. <i>lamprosperma</i>	Australian Stonecrop	Cleland
<i>Daucus glochidiatus</i>	Native Carrot	Cleland
<i>Dianella brevicaulis</i>	Short-stem Flax-lily	
<i>Dianella revoluta</i>	Black-anther Flax-lily	Cleland, Ising
<i>Disphyma crassifolium</i> ssp. <i>clavellatum</i>	Round-leaf Pigface	Field Naturalists' Section of the Royal Society.
<i>Distichlis distichophylla</i>	Emu-grass	
<i>Enchylaena tomentosa</i>	Ruby Salt-bush	Cleland
<i>Exocarpos cupressiformis</i>	Native Cherry	Davis

Table 3(cont.): Indigenous Vegetation of Tennyson Dune Reserve

Scientific name	Common Name	Botanist/Collector
<i>Geranium potentilloides</i> var. <i>potentilloides</i>	Downy Geranium	
<i>Grevillea ilicifolia</i> var. <i>ilicifolia</i>	Holly-leaved Grevillea	Cleland, Ising
<i>Helichrysum leucopsideum</i>	Satin Everlasting	Cleland, Davis
<i>Isolepis nodosa</i>	Knobby Club-rush	Cleland
<i>Kennedia prostrata</i>	Running Postman	Cleland, Ising
<i>Kunzea pomifera</i>	Muntries	Cleland, Ising
<i>Lepidosperma gladiatum</i>	Coast Sword-sedge	Cleland, Ising
<i>Leucophyta brownii</i>	Coast Cushion Bush	Cleland
<i>Leucopogon parviflorus</i>	Coast Beard-heath	Davis, Cleland, Ising
<i>Lomandra leucocephala</i> ssp. <i>robusta</i>	Woolly Mat-rush	Cleland
<i>Lotus australis</i>	Australian Trefoil	Cleland, Ising
<i>Melaleuca lanceolata</i> (formerly <i>M. lanceolata</i> ssp. <i>lanceolata</i>)	Dryland Tea-tree	Cleland
<i>Muehlenbeckia gunnii</i>	Coastal Climbing Lignum	Cleland
<i>Myoporum insulare</i>	Common Boobialla	Cleland, Davis, Ising
<i>Nitraria billardiarei</i>	Nitre Bush	Cleland
<i>Olearia axillaris</i>	Coast Daisy-bush	Cleland, Ising
<i>Parietaria debilis</i>	Smooth Nettle	
<i>Pelargonium australe</i>	Australian Pelargonium	Cleland, Ising
<i>Picris squarrosa</i>	Squat Picris	
<i>Pimelea serpyllifolia</i> ssp. <i>serpyllifolia</i>	Thyme Riceflower	Cleland, Ising
<i>Poa poliformis</i>	Coast Tussock-grass	
<i>Rhagodia candolleana</i> ssp. <i>candolleana</i>	Sea-berry Saltbush	
<i>Salsola kali</i>	Buckbush	
<i>Scaevola crassifolia</i>	Cushion Fanflower	Cleland, Ising
<i>Senecio pinnatifolius</i> (formerly <i>S. lautus</i>)	Variable Groundsel	Cleland, Ising
<i>Spinifex hirsutus</i> (formerly <i>S. sericeus</i>)	Hairy Spinifex	Cleland, Ising
<i>Stenopetalum lineare</i>	Narrow Thread-petal	Cleland
<i>Tetragonia implexicoma</i>	Bower Spinach	Cleland, Ising
<i>Threlkeldia diffusa</i>	Coast Bonefruit	Cleland
<i>Triglochin tricophorum</i>	Arrowgrass	
<i>Wahlenbergia gracilis</i>	Sprawling Bluebell	Cleland, Ising

KEY
Species present as remnant
Species recorded historically but not currently present or noted
Species lost but reinstated through revegetation programs
Historically recorded but more likely found in rear of dunes or sub-coastal locations
Historically recorded but more likely found favouring saline conditions on dune landward margins

For the purpose of this plan and to aid in its ongoing management, the Reserve has been divided into the following vegetation communities:

- *Spinifex hirsutus* with emergent *Olearia axillaris* and *Atriplex cinerea* Open Grassland
- *Olearia axillaris*/*Rhagodia candolleana* ssp. *candolleana* Low Open Shrubland)
- *Olearia axillaris*/*Leucopogon parviflorus* +/- *Nitraria billardiarei* Low Shrubland
- *Leucopogon parviflorus*/*Melaleuca lanceolata* +/- *Olearia axillaris* Open Shrubland
- *Melaleuca lanceolata*/*Tetragonia implexicoma* Tall Shrubland.

4.2.2 Plant Species Richness

The vegetation survey conducted for this Management Plan revealed 52 indigenous and 68 introduced plant species in Tennyson Dune Reserve. The high number of introduced species reflects the modified nature of the Reserve and can be attributed to:

- Edge effects of dune fragmentation caused by pathways and urban boundaries

- A history of unrestrained pedestrian access through the dune system, creating erosion corridors and contributing to weed incursions
- The highly invasive and pioneering nature of many of the introduced species and the resultant lack of remnant indigenous plant communities
- The adjacent urbanised environment providing a source of garden weed incursions, for example through dumping of plant debris and illegal planting within the dunes
- Areas of the dune used for sand mining, with the purposeful introduction of exotic grass species used as sand stabilisers and now considered as highly invasive weed species.

Refer to Appendix 2 for a plant species list for the Reserve.

4.2.3 Significant Flora

Of the 52 indigenous species identified within the Reserve, 16 are of conservation significance at a state or regional level. Several other species are considered uncommon for the Adelaide metropolitan area. Species with official conservation ratings are detailed in Table 4.

Table 4: Significant Flora Occurring Naturally Within Tennyson Dune Reserve

Scientific Name	Common Name	Conservation Status	Region
<i>Acacia cupularis</i>	Cup Wattle	(R) rare	Southern Lofty Region
<i>Acacia ligulata</i>	Umbrella Bush	(K) uncertain. Likely to be threatened or rare.	Southern Lofty Region
<i>Adriana quadripartita</i>	Rare Bitterbush	(U) uncommon	Southern Lofty Region
<i>Alyxia buxifolia</i>	Sea Box	(R) rare	Southern Lofty Region
<i>Calandrinia eremaea</i>	Dryland Purslane	(U) uncommon	Southern Lofty Region
<i>Geranium potentilloides</i> var. <i>potentilloides</i>	Downy Geranium	(Q) Not yet assessed but of possible significance	Southern Lofty Region
<i>Helichrysum leucopsideum</i>	Satin Everlasting	(U) uncommon	Southern Lofty Region
<i>Kunzea pomifera</i>	Muntries	(U) uncommon	Southern Lofty Region
<i>Lepidosperma gladiatum</i>	Coast Sword-sedge	(U) uncommon	Southern Lofty Region
<i>Lomandra leucocephala</i> ssp. <i>robusta</i>	Woolly Mat-rush	(R) rare	Southern Lofty Region
<i>Lotus australis</i>	Austral Trefoil	(U) uncommon	Southern Lofty Region
<i>Melaleuca lanceolata</i>	Dryland Tea-tree	(U) uncommon	Southern Lofty Region
<i>Pelargonium australe</i>	Native Storks Bill	(U) uncommon	Southern Lofty Region
<i>Picris squarrosa</i>	Squat Picris	(R) rare	South Australia
		(E) endangered	Southern Lofty Region
<i>Scaevola crassifolia</i>	Cushion Fanflower	(R) rare	Southern Lofty Region
<i>Triglochin trichophorum</i>	Arrow Grass	(K) uncertain. Likely to be threatened or rare.	Southern Lofty Region

4.2.4 Significant Plant Communities

The Reserve does not contain any priority plant communities that are considered rare or threatened at the national and state levels. There is no official regional class for plant communities, however it is expected that coastal plant communities would feature given their fragmented distribution (Turner in Petherick, 2004, pers. comm.).

In light of this, it is important to note however, Tennyson Dune Reserve is the most significant remnant representative of the original white sand dune system that existed along the metropolitan coast prior to European colonisation. An ongoing management approach which utilises the most current research regarding ecological restoration techniques will provide the best long-term conservation measures for the dunes. This

should be conducted in an integrated manner, involving State and Local Government agencies, and the community.

Effective integrated management of Tennyson Dune Reserve is currently hampered through a multiplicity of ownership and management bodies (see Table 1). To preserve and restore the Tennyson dunes it is recommended that the State Government, in conjunction with the City of Charles Sturt, investigate options for awarding Tennyson Dune Reserve a conservation status. Formal acknowledgement of the ecological and historical importance of the Reserve will contribute greatly to its long-term conservation.

4.2.5 Condition

The difficulty of classifying dunes into management zones is nowhere more apparent than at Tennyson. Describing a dune system in terms of foredune, swales and hind dune is a simplistic representation of a complex set of interrelated processes. This method does not accurately represent the many and varied plant associations that exist within each zone, especially within the more secluded swales and rear dunes. Representative plant associations vary considerably within each zone. This needs to be taken into account when recommending species for rehabilitation works.

The Reserve has been divided into five Vegetation Management Zones. These have been classified based upon the vegetation communities discussed in section 4.2.1, the areas they occupy in the dunes, environmental conditions and human modifications. Most of the Management Zones are stable to semi-stable and contain good quality remnant vegetation. Some areas however, particularly to the rear of the dunes, are dominated by alien species. Figure 9 shows the location of these Management Zones. It is important to note these zones are guidelines only and do not necessarily accurately represent the original vegetation associations occurring in this area.

Changes may arise in the position of the management zones depending on natural recession and accretion of the coast and the extent of dune accretion from the Coast Protection Board's beach replenishment program (in conjunction with the City of Charles Sturt's sand drift fencing program).

The following is a summary of the condition and status of each Management Zone.

Zone 1 - Foredune

(*Spinifex hirsutus* with emergent *Olearia axillaris* and *Atriplex cinerea*
Open Grassland)

This Management Zone stretches along the Reserve's seaward boundary and features a foredune of medium height. Its width is determined by the relative dune scarping by coastal processes. The Coastal Reserve immediately north of Bournemouth Avenue, Tennyson, is an area of particular concern as storm damage has removed a 100m linear section of foredune, threatening vegetation in the near vicinity.

Vegetation found in this zone must be able to withstand harsh conditions that include strong winds, salt spray, sand abrasion and burial, undermining and inundation, dry infertile sand and intense sun exposure. *Spinifex hirsutus* (Hairy Spinifex) is the dominant species with traces of *Atriplex cinerea* (Coast Saltbush) and *Isolepis nodosa* (Knobby Club-rush). Smaller, immature *Olearia axillaris* (Coast Daisy-bush) are regenerating vigorously at the landward edge.

Zone 2 - Interdune Swale

(*Olearia axillaris*/*Rhagodia candolleana* ssp. *candolleana* Low Open Shrubland)

Management Zone 2 occurs immediately behind the foredune and extends into the first interdunal depression (swale). Its width varies from only five to ten metres at the northern end of the Reserve to approximately 50m wide immediately south of Estcourt House.

Swales are slightly more protected from harsh conditions experienced on the foredune due to their low-lying nature. These conditions enable the establishment of plants that favour more protected environments, including the species listed in the vegetation community description for Management Zone 2. At times swales may be subject to inundation by the sea. It is important to note the role of the dunes as a buffer and that this area is considered to be vulnerable to storm damage.

Zones 3a and 3b – Hind Dune/Seaward Face

(*Olearia axillaris*/*Leucopogon parviflorus*+/-*Nitraria billardierei* Low Shrubland)

Management Zone 3 is a complex area with several distinct plant associations. The key characteristic of this zone is that it occupies an area on the seaward face of the hind dune. Hind dunes are more protected from extreme coastal conditions than the foredune and are therefore more stable as a result. These conditions allow a greater diversity of shrubs and other plants to establish.

The dominant species throughout this zone is *Olearia axillaris* (Coast Daisy-bush) with a band of *Leucopogon parviflorus* (Coast Beard-heath) on an intermediate dune ridge. *Scaevola crassifolia* (Cushion Fanflower) is a very dominant understorey species with *Alyxia buxifolia* (Sea Box) found in dense clumps at various locations. In isolated deeper depressions, *Lepidosperma gladiatum* (Coast Sword-sedge) is dominant. Species such as *Rhagodia candolleana* ssp. *candolleana* (Sea-berry Saltbush), *Spinifex hirsutus* (Hairy Spinifex), *Threlkeldia diffusa* (Coast Bonefruit), *Tetragonia implexicoma* (Bower Spinach), *Carpobrotus rossii* (Native Pigface) and *Senecio pinnatifolius* (Variable Groundsel) are also found here. Traces of taller species such as *Acacia longifolia* ssp. *sophorae* (Coastal Wattle) and *Nitraria billardierei* (Nitrate Bush) are also present. In spring, this area has the strongest herb layer.

Garden encroachments are problematic wherever residential properties abut the Reserve. Lawn extensions, landscape structures, irrigation systems and general weediness are symptomatic of these areas. For this reason, Management Zone 3 has been divided into two sub-zones. Zone 3a represents the zone in its more intact state, whereas Zone 3b is in an altered condition and will require differing management techniques. A systematic approach to rehabilitation should be developed by the land owners/managers. Targeted weed control should occur over several years.

Zones 4a and 4b – Hind Dune Ridge

(*Leucopogon parviflorus*/*Melaleuca lanceolata*+/-*Olearia axillaris* Open Shrubland)

Hind dune vegetation is dominated by *Leucopogon parviflorus* (Coast Beard-heath) and the deep-rooted tree, *Melaleuca lanceolata* (Dryland Tea-tree), with *Scaevola crassifolia* (Cushion Fanflower) dominating the understorey.

This Management Zone has also been divided into two sub-zones. Areas considered relatively intact and representative of the original vegetation structure are within Zone 3a. Areas affected by the introduced *Ehrharta calycina* (Perennial Veldt Grass) and *Arctotis stoechadifolia* (White Arctotis) have been included in Zone 3b.

Zone 5 – Rehabilitation

(*Melaleuca lanceolata*/*Tetragonia implexicoma* Tall Shrubland)

Management Zone 5 occupies the leeward face of the hind dune and is the most publicly visible. Unfortunately, it is also the most altered area, having been exploited for sand mining, and even having been utilised for housing, which was subsequently demolished (Sandercock, 2006, pers. comm.).

The zone is heavily infested with Perennial Veldt Grass (likely to have been introduced to stabilise the dunes after sand extraction), White Arctotis and *Euphorbia terracina* (False Caper). This zone will need to be the focus of a long-term rehabilitation program.

4.3 Fauna

4.3.1 Native Fauna

No official fauna surveys have been carried out within Tennyson Dune Reserve. Informal observations over several years by Tennyson Duncare volunteers have noted the presence of numerous native bird and reptile species. These observations are summarised in Tables 5 and 6.

Table 5: Observed Native Reptiles of Tennyson Dune Reserve

Common Name	Scientific Name	Conservation Rating
Marbled Gecko	<i>Christinus marmoratus</i>	
Painted Dragon	<i>Ctenophorus pictus</i>	Uncommon (Metro Region)
Tree Dtella	<i>Gehyra variegata</i>	
Legless Lizard	Genus and species unconfirmed	
Bougainville's Skink	<i>Lerista bougainvillii</i>	
Southern Four-toed Slider	<i>Lerista dorsalis</i>	
Dwarf Skink	<i>Menetia greyii</i>	
Eastern Bearded Dragon	<i>Pogona barbata</i>	Vulnerable (Metro Region)
Brown Snake	<i>Pseudonaja textilis</i>	
Eastern Blue Tongue	<i>Teliqua scincoides</i>	
Sleepy Lizard	<i>Tiliqua rugosa</i> ssp. <i>asper</i>	

Table 6: Observed Native Bird Species of Tennyson Dune Reserve

Common Name	Scientific Name	Conservation Rating
Red Wattlebird	<i>Anthochaera carunculata</i>	
Galah	<i>Cacatua roseicapilla</i>	
Raven	<i>Corvus</i> spp.	
Black-shouldered Kite	<i>Elanus axillaris</i>	
Australian Kestrel	<i>Falco cenchroides</i>	
Grey Falcon	<i>Falco hypoleucos</i>	Rare (SA)
Tern	Genus and species unconfirmed	
Magpie	<i>Gymnorhina tibicen</i>	
Welcome Swallow	<i>Hirundo neoxena</i>	
Silver Gull	<i>Larus novaehollandiae</i>	
Pacific Gull	<i>Larus pacificus</i>	Uncommon (SMLR)
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	
Singing Honeyeater	<i>Lichenostomus virescens</i>	
Rock Parrot	<i>Neophema petrophila</i>	Rare (SMLR and SA)
Crested Pigeon	<i>Ocyphaps lophotes</i>	
Pelican	<i>Pelecanus conspicillatus</i>	
Little Pied Cormorant	<i>Phalacrocorax sulcirostris</i>	
Pied Cormorant	<i>Phalacrocorax varius</i>	
New Holland Honeyeater	<i>Phylidonyris albifrons</i>	
Grey Fantail	<i>Rhipidura albiscapa</i>	
Willie Wagtail	<i>Rhipidura leucophrys</i>	
Masked Lapwing	<i>Vanellus miles</i>	

No native mammals have been sighted within the Reserve, although it is highly likely several species once inhabited the dunes prior to urbanisation. No formal surveys have been carried out to indicate macro-invertebrate diversity and abundance.

Reserve isolation, combined with dissection by formal and informal tracks contribute to habitat fragmentation. This severely reduces the Reserve's capacity to sustain indigenous fauna in particular. Introduced predators further exacerbates this issue.

Whilst unobserved in Tennyson Dune Reserve, a population of Bitter-bush Blue Butterfly (*Theclinessthes albocincta*) exist at Torrens Island, on Adelaide's northern metropolitan coast (Grund in Petherick, 2004, pers. comm.). Butterfly species have specific food requirements and the loss of particular plant species can lead to the extinction of a species. The Bitter-bush Blue Butterfly relies on the native plant *Adriana quadripartita* (Rare Bitterbush) as a caterpillar food plant; however urban sprawl has seen the butterfly's distribution reduced to only a few isolated populations. Butterfly Conservation South Australia (BCSA) received a grant in 2003 to propagate Rare Bitterbush for planting in the hind dune areas from Outer Harbor to Normanville with the aim of creating a coastal corridor for the butterfly. It is recommended this plant continue to be included in revegetation works to assist in the creation of the corridor and to aid the Reserve's restoration and rehabilitation. Rare Bitterbush was originally one of the more common plants along Adelaide's metropolitan coastline (Cleland, 1932).

Extensive fauna studies, including assessments of bird, reptile, mammal and butterfly populations have been conducted in the Taperoo and Largs North dune systems. These surveys provide an insight into the type of indigenous fauna that can potentially inhabit dune systems containing appropriate habitats (refer to Playfair, 1999).

4.3.2 Introduced Fauna

Due to its size and urban surrounds, the Reserve provides a favourable environment for introduced fauna. The City of Charles Sturt carries out an annual fox control program in conjunction with regular rabbit control. Table 7 describes the introduced fauna commonly observed within the Reserve (no formal survey has been undertaken).

Table 7: Observed Introduced Fauna of Tennyson Dune Reserve

Common Name	Scientific Name
Domestic Dog	<i>Canis familiaris</i>
Domestic/Stray Cat	<i>Felis catus</i>
House Mouse	<i>Mus musculus</i>
European Rabbit	<i>Oryctolagus cuniculus</i>
House Sparrow	<i>Passer domesticus</i>
Black rat	<i>Ratus ratus</i>
Common Starling	<i>Sturnus vulgaris</i>
European Red Fox	<i>Vulpes vulpes</i>

Domestic dogs and cats are of particular concern as they cannot be controlled by traditional methods such as baiting or sterilisation and must be the focus of a concerted public education program perhaps supported by Local Government By-Laws. Potential By-Laws might include cat curfews, registration and dogs on leads at all times.

5. Adjoining Land Uses and Vegetation

This 1.5km section of coastal reserve forms part of the City of Charles Sturt coastline. At the southern extremity of the Reserve is Bournemouth Avenue, Tennyson, and the Henley Beach to Tennyson Coastal Reserve. To the east is Military Road and various dwellings fronting the dunes. To the west is Gulf St. Vincent. The northern extremity of

the study area is bounded by the West Lakes Shore grass coastal reserve and the Semaphore Park Coastal Reserve. The historic Estcourt House is centrepiece to the dunes and adds to their historical significance.

Coastal Reserves to the north and south of Tennyson Dune Reserve provide excellent opportunities for the creation of coastal biodiversity linkages.

6. Reserve Values

Tennyson Dune Reserve is the most ecologically significant strip of dunes on the Adelaide metropolitan coastline. Several environmental and community groups take an active interest in the areas conservation and there is a strong sense of community ownership in the region.

It is beyond the capacity and scope of this Plan to identify all of the values of Tennyson Dune Reserve. The following serves as a starting point for identification of the area's values.

6.1 Conservation Value

The area is of importance as:

- A remnant coastal dune system along a highly modified metropolitan coastline
- It provides habitat and food resources for local birds, reptiles and insects in an urban area
- Part of a significant corridor for indigenous fauna of local and regional significance along the coastal strip between the Port Adelaide Enfield and Adelaide Shores dunes and potentially further along the coast
- It contains remnant indigenous plant species of local, regional and state significance.

6.2 Education Value

The Reserve is of educational importance as it illustrates:

- Examples of vegetation historically native to the Adelaide coastline
- Examples of vegetation used by the Kurna people for food, medicinal and craft
- How vegetation (species, communities, dune succession) has changed with European settlement
- How coastal processes have been affected by European settlement and how the Adelaide coastline is managed as a result
- The impacts of weed invasion and fragmentation on remnant vegetation.

6.3 Aesthetic Value

The Reserve is an aesthetically appealing backdrop to the beach, featuring a number of attractive flowering indigenous plants, particularly in spring. It also forms a buffer between human development such as houses, roads, parks and footpaths, as well as being the transitional foreshore area delineating the marine environment and development.

6.4 Scientific Value

The Reserve provides an historical example of coastal and ecological processes occurring along a metropolitan coastline.

6.5 Open Space Value

The beach adjacent to Tennyson Dune Reserve is popular for swimming, sunbathing, walking, jogging, fishing, kite flying and various other recreational and tourist activities. The Reserve is also of recreational value as a picturesque place to visit, with the dunes used as a sheltered area near which to relax.

7. Reserve Management Objectives

The following aims and objectives for Tennyson Dune Reserve seek to provide a technically sound and practical basis for management of this important area. These aims and objectives are consistent with other coastal management plans for the Adelaide metropolitan coast and broader regional plans such as the City of Charles Sturt Coastal Management Plan (Kinhill Pty. Ltd, 1999) and the Adelaide Metropolitan Coast Park Concept Plan (PPK, 2001).

The Aims of the Tennyson Dune Reserve Vegetation Management Plan are to:

- Protect and restore native vegetation, particularly species of conservation significance
- Increase native vegetation and wildlife habitat within the Reserve, with particular focus on rehabilitation Zones 3b, 4b and 5
- Protect existing native fauna and provide habitat and conditions that encourage their return (i.e. habitat corridors)
- Contribute to management of the potential and actual impact of fire in the Reserve in accordance with other management objectives
- Encourage and support community participation in dune management and foster an appreciation of Reserve values within the wider community
- Develop and recommend strategic actions for vegetation management and rehabilitation within the Reserve for environmental, school and other community groups.

The Objectives of the Tennyson Dune Reserve Vegetation Management Plan are to ensure that:

- The extent of weed invasion is reduced and native vegetation increased
- Feral animal populations are controlled
- The Reserve is used appropriately
- The number of access paths are minimised and those present are designed to reduce informal pedestrian access and are correctly aligned to prevent further erosion
- Reserve boundaries are managed consistently with other management objectives and a cooperative approach involving adjacent land managers is continued
- An adaptive management approach is employed, whereby management directions are regularly reviewed and adapted according to changes in the dune environment over time and as further information becomes available.

8. Native Vegetation Management Issues

8.1 Whole Reserve Management Issues

8.1.1 Fragmentation

(See also Section 8.1.4 Access and Fencing- Dune Dissection)

Tennyson Dune Reserve is the most significant area of remnant vegetation along Adelaide's metropolitan coastline, where only approximately 27 hectares (16.5ha at Tennyson, 3.5ha at Semaphore Park and 3.5ha at North Brighton) of remnant dune remain as isolated fragments. These dune remnants equate to only 3% of their original extent. Alarming, Tennyson Dune Reserve is located within the 12 842ha Reedbeds IBRA¹ (Interim Biogeographic Regionalisation for Australia) Association that has less than 0.1% of its original vegetation remaining.

Until quite recently the '*island biogeography concept*' (MacArthur and Wilson, 1967) has been used to form the basis of understanding for isolated patches of remnant vegetation and their management implications. The island biogeography concept was originally developed to explain why smaller, more isolated islands have fewer species than larger islands closer to large landmasses. Consequently, this was adapted to be a useful early model of human disturbance upon native habitat at a landscape level, where remnants of native vegetation existing within a human altered environment are essentially islands of habitat surrounded by a sea of non-habitat (the human environment).

Recent considerations on ecological restoration suggest however, the interpretation of the island biogeography concept may be too simplistic. It is suggested rather that habitat modification occurs along a continuum of disturbance, with a tendency for habitats to become progressively more modified with increasing levels of destruction due to an increase in the edge ratio (see glossary) as remnants reduce in size (McIntyre & Hobbs, 2000).

Through analysis of remnancy figures within a defined landscape unit, landscape patterns of habitat destruction can be classified as either:

- **Intact** (less than 10% destroyed)
- **Variegated** (10-40% destroyed)
- **Fragmented** (40-90% destroyed)
- **Relictual** (more than 90% destroyed)

As the Reedbeds IBRA Association has less than 0.1% of its original vegetation remaining, it is classified as **relictual** and Tennyson Dune Reserve that exists within this relictual landscape is considered a **fragment**. It is generally held that if less than 10% of any particular native vegetation association remains with no significant ongoing management, its long-term survival is in jeopardy.

Due to their isolation, relictual patches of vegetation such as that at Tennyson Dune Reserve, face several threats which are not immediately apparent. In general terms these include:

- Edge effects, where the physical environment is altered, usually becoming windier, drier, warmer in summer and cooler in winter. Areas with increased edge ratios thus provide environments less favourable as habitat for local species and more conducive to introduced species invasion

¹ Associations within the Interim Biogeographic Regionalisation for Australia hierarchy represent a landscape based approach to classifying the land surface of Australia from a range of continental environmental attributes. The regions have been developed to assess and plan for the protection of biological diversity. The regionalisation forms a hierarchy with State based associations being grouped into sub-regions, which in turn are grouped to form the regions. The associations were initially derived from the Environmental Associations of SA created by the CSIRO in 1977.

- Widespread disruption of ecosystem processes such as fire regimes, seed dispersal, decomposition and water and nutrient cycling processes
- Reduction in the quality and quantity of seed production through the impacts of weeds and altered nutrient levels (Hall 2003)
- Increased vulnerability to catastrophic events such as fire, flood and droughts
- Inbreeding of plants (particularly less common species) and loss of genetic diversity. Pollinators may not be able to reach isolated sites (Hall 2003)
- Population reductions, where there may not be enough plants flowering at the same time to enable a good mix of genes (Hall 2003)
- Prevention of self-fertilisation through their inability to encounter genetically similar mates (Hall 2003)

Broad priority management actions identified by McIntyre and Hobbs (2000) for a relictual landscape are:

- Improve fragments through the reduction and removal of exogenous disturbances, active management to improve condition (weed removal and re-introduction of native plant species) and potentially the reinstatement of endogenous disturbances
- Reconstruct buffer areas through revegetation to increase fragments that are below viable size

Due to their importance as a source of seed and vegetative material for rehabilitation works along the metropolitan coast, Tennyson Dune Reserve is also under enormous pressure from seed collectors, especially in drought years. As Table 4 shows there are several species of local and regional significance within the dune system. It is vital these species are not negatively impacted by collection of seed and vegetative materials and that they are conserved.

Therefore to improve the condition, resilience and long term viability of Tennyson Dune Reserve, it is recommended that:

- Strategic vegetation buffers are established utilising indigenous species
- Species richness is increased through reinstatement to reflect the sites original diversity
- Numbers of less common species currently existing on site are increased
- Improved management of future seed and vegetative material collection activities
- Plants grown from seed and vegetative material collected from the site are established in other nearby locations
- A coastal landscape linkage is established along (and beyond) the City of Charles Sturt coastline, linking sites of significance.

8.1.2 Weeds

8.1.2.1 Impacts of Weeds

Weeds are an indicator of an altered environment and pose one of the greatest threats to biodiversity within the Reserve. The Cooperative Research Centre (CRC) for Australian Weed Management (2003) states, 'weeds are one of the most serious threats facing Australia's primary production and biodiversity, costing the economy an estimated \$4 billion per year. The cost to the environment is also high, with weeds second only to land clearing as a cause of biodiversity loss'.

Weeds are plants not naturally present in an area, and include plants introduced from overseas and Australian plants inappropriate to the local environment (South Australian Coast Protection Board, 2003). They threaten biodiversity through competition for resources such as sunlight, nutrients, space and water, readily establishing and displacing native vegetation communities. They also reduce the amount of native habitat, food, nesting material and shelter available for indigenous fauna.

Weeds are considered a serious threat along Australia's coastline. They can increase soil nutrient levels and change vegetation cover, causing disruptions to sand movement processes essential to dune formation, as well as alter dune shape and form, resulting in significant alterations to the coastal landscape (Coast Protection Board, 2003).

Many plants are promoted in the media and generalist gardening books as being beneficial in garden settings because of their tolerance to low water conditions. These species commonly derive from Mediterranean climates and are well suited to conditions along the Adelaide coastline. Often simple to propagate and easily purchased from nurseries and community activities such as fetes and garage sales, these species can be found in many gardens and council plantings. Common examples of such plants are *Arctotis stoechadifolia* (White Arctotis) *Argyranthemum frutescens* (Marguerite Daisy), *Gazania* spp. (Gazania), *Osteospermum fruticosum* (Seascape Daisy) and various Succulent and Cacti species. Unfortunately, many of these garden plants are extremely invasive in native vegetation.

It is therefore recommended that Council investigate the options for placing an encumbrance on dune frontage properties in respect to what species may or may not be planted in gardens abutting the Reserve.

8.1.2.2 Weeds in Tennyson Dune Reserve

A total of 68 introduced plant species were recorded within Tennyson Dune Reserve as at May 2006 (see Appendix 2). These species occur throughout the dune system, although their density is highest along the eastern Reserve boundary where garden encroachments are a major problem and the Reserve has been disturbed by sand mining. Succulent species are particularly prevalent adjacent to houses between Shore Court, West Lakes Shore and the northern extent of the Reserve. Other species such as *Galenia pubescens* (Coastal Galenia) and *Mesembryanthemum crystallinum* (Ice Plant) show a distinct correlation between their abundance and the location of pathways and the Reserve boundary.

Survey work to map the distribution of weed populations was carried out using a Global Positioning System (GPS) unit. Geographic Information System (GIS) was then utilised to display the data in map form at a scale of 1:3000.

A priority weeds list for the Reserve has been developed using weed distribution maps in conjunction with the Weed Risk Assessment (WRA) and Weed Assessment Scoresheet (WAS) developed by the Animal and Plant Control Commission of South Australia. The guide is available at: www.pir.sa.gov.au/pages/susres/animalplant/wraguide.pdf

The WAS is a score sheet divided into three main criteria to prioritise weed species:

- *Invasiveness* (rate of weed spread – faster spreading weeds are higher priority)
- *Impacts* (economic, environmental and social effects of the weed)
- *Potential distribution* (indicates the total area the weed could spread to).

A priority weeds workshop involving coastal and weed experts was convened by the SA Urban Forest Biodiversity Program to determine weed risk scores using weed distribution maps and the Weed Risk Assessment and Scoresheet. Scores for each of the above

criteria are multiplied (each ranging between 0 and 10), to give a weed importance score out of 1000. The weed risk (very high, high, medium, low or negligible) of each species scored was then determined according to the WRA guidelines. The results are illustrated in Table 8. Priority weed distribution maps of species in this table are available in Figures 10-14.

Several weed species currently provide sand stability and habitat, which needs to be taken into consideration when determining appropriate management.

The list does not include certain species such as *Reichardia tingitana* (False Sow Thistle), *Cakile maritima* (Sea Rocket), *Thinopyrum junceiforme* (Sea Wheat Grass) and several other grasses. These species are considered as naturalised in the Reserve and therefore unfeasible to remove. Some other species such as *Oxalis pes-caprae* (Soursob) were not apparent, due to the survey being carried out in summer. In addition, it is important to note that some weed species are in low abundance and therefore easily eradicated. These weeds should receive attention prior to those that have already become widespread (refer to pages 28-35 and the weed control recommendations in each Management Zone for these low abundance species).

Garden escapes currently pose a serious problem, especially between Coronado Court, West Lakes Shore, and the northern extent of the Reserve. It is recommended these be systematically removed over several years and the area be revegetated using indigenous species. Temporary stabilisation material such as jute matting or mulch may be needed in some areas to reduce erosion.

Table 8: Priority Weeds List for Tennyson Dune Reserve

Priority	Scientific Name	Common Name	Importance Score	Weed Risk
1	<i>Lycium ferocissimum</i>	African Boxthorn	486.3	Very High
2	<i>Trachyandra divaricata</i>	Dune Onion Weed	463.2	Very High
3	<i>Asparagus asparagoides</i>	Bridal Creeper	416.8	Very High
4	<i>Ehrharta calycina</i>	Perennial Veldt Grass	302.6	Very High
5	<i>Gazania</i> sp.	Gazania	263.2	Very High
6	<i>Acacia cyclops</i>	Western Coastal Wattle	237.2	Very High
7	<i>Euphorbia paralias</i>	Sea Spurge	229.6	Very High
8	<i>Succulent</i> spp./ <i>Cacti</i> spp.	Succulent & Cacti	202.1	High
9	<i>Leptospermum laevigatum</i>	Coast Tea-tree	164.2	High
10	<i>Argyranthemum frutescens</i>	Marguerite Daisy	154.4	High
11	<i>Mesembryanthemum crystallinum</i>	Common Ice Plant	135.1	High
12	<i>Euphorbia terracina</i>	False Caper	126.3	High
13	<i>Arctotis stoechadifolia</i>	White Arctotis	110.5	High
14	<i>Carpobrotus edulis</i>	Hottentot Fig	95.8	High
15	<i>Galenia pubescens</i>	Coastal Galenia	94.7	High
16	<i>Chondrilla juncea</i>	Skeleton Weed	89.8	High
17	<i>Osteospermum fruticosum</i>	Seascape Daisy	73.7	Medium
18	<i>Oenothera stricta</i>	Evening Primrose	55.3	Medium
19	<i>Olea europaea</i>	European Olive	50.5	Medium
20	<i>Cynodon</i> spp.	Couch	44.2	Medium
21	<i>Rhamnus alaternus</i>	Buckthorn	37.9	Medium
22	<i>Pennisetum clandestinum</i>	Kikuyu	15.8	Low
23	<i>Stenotaphrum secundatum</i>	Buffalo Grass	15.8	Low
24	<i>Acacia saligna</i>	Golden Wreath Wattle	11.2	Low
25	<i>Lupinus consentii</i>	Blue Lupin	3.5	Low

The following describes the priority weed species listed in Table 8. Appendices 3-6 should be consulted for detailed information on species descriptions, distribution, management recommendations and control techniques.

1. *Lycium ferocissimum* (African Boxthorn)

African Boxthorn attained the highest rating for priority weeds, with 204 individuals distributed throughout the Reserve. This species tolerates harsh coastal conditions and can inhabit the foredune, swale and hind dune areas. It is an aggressive weed that shades and crowds out native vegetation. It often occurs under trees and shrubs where birds roost when left unchecked will form impenetrable thickets, which in turn provide habitat for introduced animals such as rabbits, starlings and foxes. Refer to Appendix 3 for information on native species that may be confused with this woody weed.

African Boxthorn can be found between the mid to rear dune, but is most commonly found emerging from existing vegetation. It has been a target for ongoing control for several years and while plants are numerous, they are not large. It is important to undertake control before they become further established and difficult to remove.

2. *Trachyandra divaricata* (Dune Onion Weed)

Dune Onion Weed is highly invasive, has significant environmental, economic and social impacts, and has the potential to infest the foredune through to the hind dune. It has been observed in both degraded and high quality vegetation (Petherick, 2004).

Dune Onion Weed is a tufted perennial herb to knee high with flat, shiny, hairless leaves. It flowers predominantly from winter to late spring, although has been observed flowering after episodes of summer rain. The flower stems are branched and sprawling, detaching at maturity to blow as 'tumbleweeds', dispersing seeds. Heyligers (1998) estimates mature plants produce approximately 200 capsules per inflorescence per season, each containing roughly 12 seeds. This equates to up to 50,000 seeds per flowering season. It is toxic to livestock.

This species originates from South Africa where it is a coastal dune plant. It was introduced to Western Australia in the 1920s most likely through contaminated ballast water. Within 50 years it had infested a 300km stretch of the Western Australian coast between Perth and Karridale (Heyligers, 1998). It is also present in coastal areas of New South Wales where it is believed to have been introduced to revegetation sites through contaminated tubestock from Western Australia (Heyligers, 1998).

Dune Onion Weed was first recorded along Adelaide's metropolitan coast in the mid to late 1990s at Taperoo Dune Reserve, which forms part of the Port Adelaide dune system on Adelaide's northern metropolitan coastline. Until recently it was known to be present in only two dune systems - serious infestations are present in the Port Adelaide dunes while a relatively small population exists in the Port Noarlunga dunes on Adelaide's southern metropolitan coast. Outlying specimens have recently been seen on the central metropolitan coast at Tennyson, Brighton, Henley South and Grange,.

Dune Onion Weed was recently found in Tennyson Dune Reserve. Although subsequent efforts to remove it appear to have been successful it is important to continue monitoring the area as the potential for a seedbank to exist in the vicinity is high. Experience in the Henley South and West Beach Dune Reserve has shown that small numbers of Dune Onion Weed can reinfest an area very quickly even after removal has taken place.

It is recommended annual site assessments are undertaken using the Nature Conservation Society's '*Bushland Condition Monitoring Manual: Southern Mount Lofty Ranges Coastal Version*' (Croft et al, 2005) to assess whether removal has been successful. Community groups active along the City of Charles Sturt coastline will be able to play a vital role in monitoring and controlling Dune Onion Weed and reporting any new outbreaks.

3. *Asparagus asparagoides* (Bridal Creeper)

Bridal Creeper has great potential for spread and can significantly affect natural bushland processes. It is therefore essential to monitor and control its spread.

A large population of Bridal Creeper exists north of Bournemouth Avenue and extends to Lakeside Court in a linear fashion. It is most often found concentrated near disturbed areas such as access paths and adjacent housing developments. Increasingly however, it is found invading more intact vegetation. Numbers are relatively low north of Lakeside Court. Bridal Creeper has been observed growing on the foredune through to the rear dune, although it favours the more stable parts of the dune system.

It is recommended the biological control program using Bridal Creeper Rust Fungus is continued within the Reserve.

4. *Ehrharta calycina* (Perennial Veldt Grass)

Perennial Veldt Grass has been deliberately introduced as a sand stabiliser following sand mining processes. This, combined with its aggressive nature has resulted in its persistence as a coastal weed.

Perennial Veldt grass is dominant on eastern facing slopes of the hind dune both north and south of Estcourt House with several other smaller infestations throughout the Reserve. It has the capacity to form monocultures in disturbed areas and can easily tolerate conditions as far forward as the leeward side of the foredune.

5. *Gazania* sp. (Gazania)

Gazania is a popular garden plant that has become a problematic weed. It is a hardy, highly adaptable, salt tolerant plant capable of occupying from the foredune scarp through to the hind dune (Taylor N/D). It is often deliberately planted in the dunes or dumped. Gazania readily colonizes dunes, competing with and suppressing indigenous species such as *Carpobrotus rossii* (Native Pigface). Furthermore, Gazania is thought to have allelopathic properties, as patches of this plant are usually devoid of other species (Sandercock, 2004, pers. comm.).

Gazania is common at the northern end of the Reserve. Control should begin from the areas of best native vegetation (where Gazania numbers are generally also at their lowest density) and continue outward.

6. *Acacia cyclops* (Western Coastal Wattle)

Western Coastal Wattle is distributed across all Management Zones, although it prefers the protection of swales and hind dunes. A large infestation extends along the eastern section of Tennyson Dune Reserve between Bournemouth Avenue and Sunlake Place where it borders residential gardens.

7. *Euphorbia paralias* (Sea Spurge)

Sea Spurge colonises disturbed areas and those of relatively high salt content, from the incipient foredune through to the hind dunes. It can withstand a variety of conditions including sand accretion, full-sun, drought, high salinity, inundation, undermining and strong winds. The species can form monocultures that out-compete indigenous plants for space and resources.

It predominantly occurs northward from Estcourt Road. Sea spurge was observed both on the exposed foredune and within the sheltered first swale. These infestations should be subject to staged removal and replaced with indigenous vegetation.

8. *Succulent* spp./*Cacti* spp.

Numerous Succulent and Cacti species were recorded in the Coastal Reserve, and have been classified in the same category. Species in this grouping include *Opuntia* sp. (Prickly Pear), *Aloe* spp., *Crassula* spp., and *Agave* spp. Many are garden escapes that can be observed in nearby residential gardens, some of which have been deliberately planted into the hind dune area and are spreading further into the Reserve.

Once established, Succulents and Cacti are very difficult and time consuming to remove. They reduce biodiversity by increasing nutrient levels and out-compete native vegetation. These species also alter dune profiles and harbour feral animals such as rabbits and rodents.

Succulent and Cacti can be found throughout the length of Tennyson Dune Reserve, however the highest density is adjacent to residential properties with absolute beach frontage. Areas between Coronado Court and the northern extent of the Reserve are of particular concern. All plants should be removed as a priority to prevent further establishment.

9. *Leptospermum laevigatum* (Coast Tea-tree)

Coast Tea-tree is an Australian native that was introduced from Victoria into South Australia as a garden ornamental. It invades disturbed areas and coastal heaths and forests, significantly altering the environment by forming dense thickets that out-compete indigenous plants through shading and competition for resources.

Several large plants currently exist within the Reserve. Isolated stands extend from Estcourt Road to the northernmost point of Tennyson Dune Reserve. Predominately observed in the more protected hind dune and in the vicinity of residential housing, Coast Tea-tree is able to thrive in all areas between the foredune and the hind dune. As these plants are currently providing habitat and sand stability, removal and revegetation works will need to be staged over several years.

10. *Argyranthemum frutescens* (Marguerite Daisy)

Marguerite Daisy is a garden escape which aggressively competes with less vigorous native vegetation through shading and competition for resources. It is most often found in disturbed areas or in places of low biodiversity. Marguerite Daisy occurs in close proximity to housing developments due to its popularity as a garden plant and subsequent escape into the dune environment. It prefers the protection of swales and the leeward face of dunes.

Primarily due to volunteer efforts, Marguerite Daisy numbers are low at present. Several plants were surveyed at the terminus of Coronado Court and north of Shore Court. An infestation extends northward from Sunlake Place to Lakeside Court. Given their low numbers, removal should be a priority.

11. *Mesembryanthemum crystallinum* (Common Ice Plant)

Ice Plant is often found in degraded areas in a variety of loamy and well-drained soils. It has a severe allelopathic effect on other plants and can form dense mats that smother existing native vegetation and suppress seedling growth.

Plants appear in the most disturbed areas of the dune system, predominantly in newly landscaped areas adjacent carparks and along paths. All plants should be eradicated and the site monitored for any new outbreaks.

A large infestation extends northward from Sunlake Place to Estcourt Road, where it principally runs adjacent to the north-south access path. It is commonly found in

degraded areas of the dune system and prefers a more stable environment in which to establish. Common Ice Plant occurs from the mid to hind dune.

12. *Euphorbia terracina* (False Caper)

False Caper became naturalised in coastal sand dunes near Adelaide during early settlement. It inhabits well-drained sandy soils and is commonly found in degraded areas. False Caper generally occupies the mid and hind dune areas and is now considered naturalised within the Reserve. Long-term control is required.

False Caper is distributed from the mid to rear dune across all Management Zones. Severe infestations extend northward from Sunlake Place to Lakeside Court.

13. *Arctotis stoechadifolia* (White Arctotis)

White Arctotis is a rampant perennial groundcover. It colonises disturbed areas and significantly alters vegetation in the coastal environment through smothering, shading and competition for resources. This reduces biodiversity as indigenous plants are replaced with a dense monoculture of White Arctotis. White Arctotis is capable of withstanding harsh coastal conditions and can occupy areas extending from the foredune to protected rear dune. It prefers sandier soils and protection offered in the hind dune and swale system.

There are several occurrences within the Reserve. Large infestations occur north of Sunlake Place and Shore Court. These infestations should be progressively removed and the areas revegetated over the short to medium term. It is important to note that in the absence of suitable native flora, White Arctotis is providing habitat for the Legless Lizard. Native flora reinstatement should focus on species that have similar habit. Care must be taken to avoid harm to lizards when removing White Arctotis.

14. *Carpobrotus edulis* (Hottentot Fig)

Hottentot Fig occupies the same niche as the local native, *Carpobrotus rossii* (Native Pigface) and can inhabit the foredune to the more sheltered hind dune. It will tolerate drought and is frost resistant.

While in flower it is easy to discern from Native Pigface by its yellow 'petals' as opposed to the native's pink petals and white base. The difficulty of distinguishing between these species while not in flower may result in lower than actual numbers in the survey data (very few plants were noted during survey work for Tennyson Dune Reserve). It is thought Hottentot Fig readily hybridises with the local species and as such, is considered a serious threat to the integrity of local populations of Native Pigface and genetic biodiversity in general.

Plants should be identified and marked when flowering in spring and summer, with removal in late autumn and revegetation through the winter months with appropriate local native species.

15. *Galenia pubescens* (Coastal Galenia)

Coastal Galenia inhabits degraded areas, forming dense mats that out-compete native groundcovers and smother established vegetation. This species is present throughout the Reserve, particularly along edges of the eastern boundary and access paths. Smaller infestations and plants are smothering native vegetation and should be removed immediately, while larger infestations must be contained and controlled to prevent further spread.

Due to its ground hugging nature and the absence of adequate numbers of equivalent native groundcover, Coastal Galenia acts as habitat for ground dwelling small reptiles,

such as the Legless Lizard. Native flora reinstatement should be staged and focus on species that have similar habit. Care must be taken to look for lizards when removing.

16. *Chondrilla juncea* (Skeleton Weed)

Skeleton Weed has spread rapidly throughout Australia and is a major weed in agricultural regions. Requirements for optimum growth include high summer temperatures, some summer rainfall, a distinct autumn break with lower temperatures, deep, light textured soil for taproot penetration, and minimum shading and competition from other plants. All of these conditions are experienced in the Reserve and the potential exists for Skeleton Weed to become more prevalent in the middle and rear dune area.

Fifteen plants currently exist within Tennyson Dune Reserve, and all except for one occur in the hind dunes west of Coronado Court. These should be a high priority for removal due to their ability to spread and readily establish.

17. *Osteospermum fruticosum* (Seascape Daisy)

Seascape Daisy is a groundcover often spreading from public and private gardens, or is deliberately introduced through plantings and dumped garden debris. It is predominantly found in disturbed areas of the rear swale and hind dunes as a garden escape, and where shelter is provided from harsh coastal conditions. Seascape Daisy readily colonises sandy areas where it competes with and suppresses indigenous species such as *Carpobrotus rossii* (Native Pigface).

Although not in large numbers, Seascape Daisy is widely dispersed along the length of the Coastal Reserve. It occurs near residential housing west of Sunlake Place, with its population concentrated between Estcourt Road and Shore Court. These should be a high priority for removal.

18. *Oenothera stricta* (Evening Primrose)

Evening Primrose originates from South America. It is widespread throughout Australia, commonly found in disturbed areas along roadsides and on sandy soils. It is common in sand dunes along the northern Adelaide metropolitan coast where it prefers more open, sandy soils of the rear dune. It can withstand sand burial although it appears to favour semi-stable areas.

Evening Primrose is present northward from Sunlake Place to Shore Court, occurring in greatest density between Sunlake Place and Estcourt Road. This plant is commonly found in degraded areas from the mid to rear dune, such as along pathways.

19. *Olea europaea* (European Olive)

European Olive is slow growing but extremely hardy, able to withstand low winter temperatures and hot dry summers in harsh exposed sites (Muyt, 2001). European Olive prefers protection offered by the hind dune environment, and where soils are heavier. Many pest animals and birds, which act as vectors of seed dispersal, are also attracted to these sites.

Twelve plants were observed during survey work for this Management Plan. It is important these plants are removed before they mature and spread further within the dune system.

20. *Cynodon dactylon* (Couch)

Couch is a commonly used lawn grass in Australia that is often deliberately planted in public and private gardens, and spreads from dumped lawn clippings. It is extremely

invasive and can invade native bushland where it spreads from the outskirts, smothering and out-competing native plants.

Couch is generally present along the Reserve's eastern boundary and extends into the rear swales. Its population is concentrated in the rear dune where it has escaped from adjacent housing, or been deliberately planted to extend domestic lawns. Lawn clippings were observed in the dune system and are further encouraging its spread. Lawned areas immediately east of the Reserve are also thought to be facilitating its spread. The largest infestation is between Sunlake Place and Bournemouth Avenue. Another large infestation exists parallel to the car park between Sunlake Place and Lakeside Court.

Larger infestations should be controlled and contained to ensure they do not continue to spread into the dunes. Smaller patches should be sprayed immediately before they become more established. Replace with appropriate indigenous plants (see recommendations for individual Management Zones in Section 8.2).

21. *Rhamnus alaternus* (Buckthorn)

Well adapted to Mediterranean climates, Buckthorn rapidly forms dense thickets that shade out native species and alter the vegetation community structure. It reduces biodiversity through habitat degradation and altering the natural community composition. Buckthorn prefers the protection offered by swales and the hind dunes.

Six plants exist within the Coastal Reserve, and were observed along the eastern boundary in close proximity to residential housing. These plants should be given priority for removal as they are presently in low numbers and therefore relatively easy to control.

22. *Pennisetum clandestinum* (Kikuyu)

Kikuyu is a common lawn grass that spreads into native vegetation from nearby gardens, contaminated soil and dumped garden waste. It can form dense mats that smother and exclude indigenous plant species.

Kikuyu is concentrated along the eastern boundary between Bournemouth Avenue and Sunlake Place, but was observed at other locations in the dune system.

23. *Stenotaphrum secundatum* (Buffalo Grass)

Buffalo Grass is a lawn grass that has become naturalised in some parts of Australia. It is often dumped into the dunes as garden waste or escapes from gardens. Occasionally it is deliberately planted in rear dunes to extend domestic lawns. It prefers damp situations and significantly alters areas of native vegetation by smothering small plants and inhibiting natural regeneration.

Buffalo Grass is confined to three small infestations between Sunlake Place and Lakeside Court. It also occurs adjacent to residential housing west of Bucknall Court.

24. *Acacia saligna* (Golden Wreath Wattle)

Golden Wreath Wattle is an Australian native originally from Western Australia, which is occasionally weedy along the Adelaide metropolitan coastline. It can form dense thickets that suppress indigenous vegetation through shading and competition for resources. It occurs on the rear dune where the environment is more stable and protected.

At present only one specimen exists in Tennyson Dune Reserve, and is situated north-east of Estcourt Road where it is suspected to have spread from an adjacent garden. This plant should be removed immediately before further seed set and potential spread.

25. *Lupinus consentii* (Blue Lupin)

Native to the Mediterranean and south-western Europe. Blue Lupin is a common weed of roadsides and disturbed areas, and is also known to invade bushland. Seven plants occur along the eastern boundary adjacent the car park north of Sunlake Place. Blue Lupin prefers heavier soils situated in the hind dunes.

Current management practices for Blue Lupin appear to be successful. Monitoring the site will play an important role in ensuring further outbreaks do not occur.

8.1.3 Fire

Naturally occurring fires are not regarded as common events in the coastal dune environment due to relatively low fuels loads, higher humidity levels experienced at the coast and the fact most coastal plants are not highly volatile. Extreme conditions are required for fire to take hold (Sandercock in Petherick, 2004, pers. comm.). Most native species are able to reproduce in the absence of fire. Seeds of species normally associated with the need for fire to germinate, such as *Acacia* spp. are likely to have dormancy broken through seed coat abrasion from sand.

All natural environments have a fire regime that indigenous plant and animal species have adapted to. The fire regime of a location is made up of three factors (New South Wales Department of Land and Water Conservation, 2001):

1. Frequency (how often a fire occurs)
2. Intensity and duration (how hot and how long the fire burns)
3. Timing (what time of the year/ season).

Variation of these factors will result in changes to the flora and fauna of that area. A fire frequency that is too high will change vegetation composition and structure with the loss of some species (New South Wales Department of Land and Water Conservation, 2001). Fires in the dune environment can also lead to dune instability (such as the development of blowouts¹) and increased susceptibility to weed invasion.

Although Tennyson Dune Reserve is considered a low-fire risk area, there are several areas where the risk is somewhat greater. These are adjacent to housing where introduced annual grasses and woody weeds provide greater fuel loads. Regular slashing, herbicide application and planting of appropriate indigenous species along these areas will ensure the risk of fire is low. In the event of fire, vehicular access could occur along either Military Road, Estcourt Road or Bournemouth Avenue.

8.1.4 Access and Fencing

Coastal vegetation is especially vulnerable to damage from pedestrian and vehicular traffic. Fences are therefore used in coastal environments to protect naturally vegetated dunes and revegetation works from uncontrolled traffic, as well as assisting in the formation of sand dunes (New South Wales Department of Land and Water Conservation, 2001). Access paths enable pedestrian and vehicular traffic to gain access to beaches in a manner that preserves adjacent dunes and vegetation (Telfer, 2001). Carefully designed access ways can also ensure people with disabilities are able to experience the beach and dune environments.

¹ Blowouts are hollows in sand dunes that develop where vegetation cover is destroyed or removed, exposing the dune to excavation by wind action. They occur naturally when part of the foredune is cut away during storm activity, leaving an unvegetated cliff of loose sand (Bird, 1984). They are most often initiated by human activity that damages vegetation, such as informal access paths that are worn over the dunes, creation of vehicular tracks and burning of coastal vegetation, or poorly aligned formal access paths that create wind tunnels.

Fencing is one of the primary costs in maintaining dunes and protecting habitat. Dune Fencing is currently installed and maintained by the West Lakes/Grange Kiwanis in conjunction with the Tennyson Dune Group. Funding for installation and maintenance is through the Coastal Protection Branch.

8.1.4.1 Dune Dissection

(See also Section 8.1.1 – Fragmentation)

As aerial imagery in Figure 9 illustrates, the Reserve is heavily dissected with 11 formal east-west aligned access paths and a lengthy north-south pathway. This high number of paths is detrimental to biodiversity conservation as it fragments areas of native vegetation, increases susceptibility to degradation by pedestrian traffic, enables weeds to invade more readily and significantly reduces habitat for native fauna. This issue is further exacerbated by the presence of several informal paths that run through the dune system. Some weeds display a direct correlation with the existence of pathways and urban boundaries, which act as dispersal corridors. Examples include *Galenia pubescens* (Coastal Galenia) and *Mesembryanthemum crystallinum* (Ice Plant).

Without adequate fencing, education and active legislation, public access to the beach becomes haphazard and highly erosive. Since the 1970s, Council and community groups have undertaken various public education programs in conjunction with the use of strained wire fencing. This appears to have been relatively successful in controlling pedestrian access throughout the Reserve.

Illicit activity within the dunes is a social issue within Tennyson Dune Reserve. Persistent disregard for fencing and signage, informal path formation and litter has several environmental ramifications such as erosion, plant loss, dune fragmentation and weed introduction. Historically these activities have been policed by volunteers. This is both unsuitable, in respect to their safety, and ineffective in terms of curbing behaviour. It is recommended therefore that the land owners/managers, along with seaside Councils and appropriate State Government Departments, review options for effective policing of the coastal dune systems, including Tennyson Dune Reserve.

8.1.4.2 Public Access

Public access along the length of the Reserve varies between formal vehicle access at the rear dune carparks to pedestrian pathways. Figure 15 displays the typical pedestrian access as it currently exists. Figure 16 is an example of an informal pathway within a sensitive area of dune.

Figure 15: Tennyson Dune Reserve Access. Below left: East-West. Below Right: North-South.



Figure 16: Informal Track



Several informal paths have been created where residents have attempted to gain access to the north-south pathway in the area between Coronado Court and Shore Court, West Lakes Shore. This has significantly increasing strain upon an area already under considerable urban pressure.

It is recommended therefore, that Council investigate options for addressing local resident access in this area.

8.1.4.3 Sand Drift Fencing

In conjunction with the Coastal Protection Branch, the City of Charles Sturt has constructed a series of sand drift fences to aid the recovery and protection of dunes and to protect residential infrastructure from storm damage.

These fences reduce wind speed, which in turn causes drifting sand to accumulate near the fence (New South Wales Department of Land and Water Conservation, 2001). Drift fencing is an integral aspect of dune management and is associated with revegetation and access control. These measures are effective at trapping sand and contribute to coastal stability by minimising loss of wind-blown sand from the coast but have minimal effect in resisting erosion by waves during storms (Department for Environment and Heritage, 2005). Sand drift fencing will continue to play an integral role in Council's management of the dune system and should continue to be utilised as an effective management technique.

The Tennyson Dunes, as with the entire metropolitan coast, is measured annually and recommendations for sand replenishment are made by the Coastal Protection Branch.

8.1.4.4 Garden Encroachments

Currently, several owners of property between Coronado Court, West Lakes Shore and the northern extent of the Reserve have illegally extended gardens into the dune environment. This has created an atmosphere of implied ownership by private residents upon public land. The negative effects these incursions create extend not only to the immediate vicinity but also to the entire dune system. These include altered soil chemistry and composition, resulting in high levels of weed and feral animal infestations.

In some cases, (Figure 17) residents will physically remove dune vegetation beyond their property boundaries during building construction or to make way for private plantings. In other cases residents may plant introduced species into the dunes and install irrigation systems to encourage their growth. These garden incursions and the associated follow-on effects, are a major contributor to the highly degraded nature of the Reserve. Until these problems are addressed, this area will remain in a degraded state and continue to be a source of environmental weeds.

Figure 17 : Dune Vegetation Clearance



It is recommended that:

- All garden incursions be removed using a staged approach and the areas rehabilitated using appropriate indigenous species
- Council in conjunction with the State Government investigate options for creating clear boundary delineation between properties with beach frontage and the dunes from Coronado Court northward, to discourage goat tracks and the encroachment of alien garden species, irrigation and landscaping
- The effects of the north-south aligned pathway between Coronado Court and Bournemouth Avenue is investigated in terms of dune fragmentation in a highly vulnerable area.

8.1.5 Erosion

Erosion is a significant management issue within the Reserve, given it is an area prone to natural recession. Of particular concern is a 100m section of dune immediately north of Bournemouth Avenue, Tennyson, where erosive processes have left this area with no foredune. Further storm damage may threaten rare plant populations in the near vicinity.

Erosion is also an issue where vegetation growth is inadequate and trampling by pedestrians has occurred. Informal goat tracks have formed where the dunes are used for recreational pursuits. This is most evident where gardens encroach upon the dunes between Coronado Court and the northern end of the Reserve. Furthermore, considerable erosion has occurred in other areas where domestic animals have been allowed unrestricted access into the dunes.

Management options to address the effects of erosion include:

- Fencing and formalisation of pedestrian access (as discussed in Section 8.1.4)
- Use of signage (also discussed in Section 8.1.3)
- Adoption of stabilisation techniques such as revegetation works.

It is recommended that Council's policy of constructing dune forming fences (between October and December) along the Reserve continue in conjunction with the Coast Protection Board's policy of sand carting, to aid in the reconstruction and protection of the dunes.

8.1.6 Introduced Fauna

Introduced species such as rabbits, foxes, feral cats and domestic dogs pose a major threat to indigenous flora and fauna along the coast and can adversely affect the success of any rehabilitation work undertaken. When and where these species are observed in the Reserve, appropriate control techniques will need to be considered by the Landowners/Managers.

Rabbits, foxes, and feral cats are all 'proclaimed' species under Schedule 1 of the *Natural Resource Management Act 2004*. Their sale or transport is illegal and landholders may be obliged to control them on their properties (State of the Environment Report for South Australia, Supplementary Report, 2003). These species have been identified as key threatening processes under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). Threat abatement plans for each of these species have been developed by the Australian Government, Department of the Environment and Heritage. These plans are available at:

www.deh.gov.au/biodiversity/threatened/tap/index.html. It is important that the most humane control techniques available be utilised in the control of these species.

European Red Fox (*Vulpes vulpes*)

Foxes were introduced to Australia in 1855 for recreational hunting and by the 1870s populations had become established in the wild (Federal Department of the Environment and Heritage, 2004). The fox has played a major role in the decline of ground-nesting birds, small to medium sized mammals and reptiles. This species is also thought to be responsible for a severe reduction in populations of many threatened species (Federal Department of the Environment and Heritage, 2004).

Historically, foxes have been controlled through hunting and more recently through fencing and baiting programs. Studies are currently being undertaken to develop biological controls, including contraceptive vaccines, which are aimed at reducing harm to non-target animals and making control methods more effective and humane.

City of Charles Sturt staff have conducted a fox control program over the past three years in association with numerous adjacent land managers. It is recommended all future control continues to be in alignment with the Australian Government's *Threat Abatement Plan for Predation by the European Red Fox* and that advice be sought from the local authorised Pest Plant and Animal Control Officer.

European Wild Rabbit (*Oryctolagus cuniculus*)

The European rabbit is considered Australia's most widespread and destructive pest. Introduced onto the mainland in 1859 near Geelong, they now occupy a large portion of southern Australia, including most of South Australia (State of the Environment Report for South Australia, 2003, Supplementary Report). Feral rabbits compete with native wildlife for food and habitat resources. They damage vegetation and degrade the environment through ringbarking trees and shrubs and preventing plant regeneration.

Rabbits are also responsible for the extinction of several small ground-dwelling mammals and have contributed to the decline of many native flora and fauna species (Federal Department of the Environment and Heritage, 2004).

Traditional control methods have included fencing, destroying burrows, shooting, trapping and poisoning. The introduction of the myxoma virus (causing myxomatosis) in 1950 and the more recent calicivirus have been effective in significantly reducing numbers. Whilst still developing new practices, present research is focussed on improving the effectiveness of traditional control techniques and existing viruses.

Rabbits are a recurring problem within Tennyson Dune Reserve. Targeted control has recently been carried out by Council along the majority of coastline under its management. These works included the removal of large succulent infestations known to harbour pest animals, warren closure and treatment with phostoxin tablets (Clutterham, pers. comm., 2005). Rehabilitation and revegetation of the site using local indigenous plants closely followed the control program. Treatment of feral rabbits within Tennyson Dune Reserve, however has been negligible due to the difficulty of coordination, deriving from the multiplicity of ownership.

Rabbit control needs to be coordinated in conjunction with other on-ground conservation works and programs to control predatory species such as foxes and stray and domestic cats. It is therefore recommended that all future control continues to occur in alignment with the Australian Government's *Threat Abatement Plan for Competition and Land Degradation by Feral Rabbits* and that advice be sought from local authorised Pest Plant and Animal Control Officer.

Stray and Domestic Cats (*Felis catus*)

It is believed cats were introduced to the Australian continent as early as the 17th century by Dutch shipwrecks. Colonies were established in the wild by the 1850s and intentional release occurred in the late 1880s in the hope they would control rabbits, mice and rats (Federal Department of the Environment and Heritage, 2004).

The following definitions have been developed by the Federal Department of the Environment and Heritage (2006) and are used for the purposes of this plan:

- *Feral cats* live and reproduce in the wild, eg. forests, woodlands, grasslands and wetlands and survive by hunting or scavenging. None of their needs are satisfied intentionally by people.
- *Stray cats* are found in and around cities, towns and rural properties. They may depend on some resources provided by humans, but are not owned.
- *Domestic cats* are those owned by an individual, household, business or corporation. Most of their needs are supplied by their owners.

In determining the most appropriate management actions, it is important cat populations within Tennyson Dune Reserve are identified and categorised correctly. It is unlikely feral cats exist within the Reserve and that the greatest threat arises from domestic and stray cats. They are a direct threat to bird and reptile populations and are in competition with other species such as the European Red Fox and local indigenous species such as the Australian Kestrel (*Falco cenchroides*) and the Black-shouldered Kite (*Elanus axillaris*).

Control of cats is difficult in urban environments such as the Tennyson Dunes as it is important not to harm domestic populations. Domestic cats are of particular concern as they cannot be controlled by traditional methods such as baiting or sterilisation and must be the focus of a concerted public education program perhaps supported by Local Government By-Laws - examples of which may be cat curfews and/or registration.

It is recommended that the landowners/managers, and the local authorised Pest Plant and Animal Control Officer, investigate options for the effective control of stray and domestic cats.

Domestic Dogs (*Canis lupus familiaris*)

Whilst undertaking fieldwork for this Management Plan, it was observed that domestic dogs were frequently allowed loose in the dunes by their owners. The presence of dogs is detrimental to biodiversity conservation as they can damage native vegetation, disturb or harm native fauna, destabilise sand, act as vectors for weeds and increase nutrient levels where they defecate. Furthermore, considerable environmental damage can occur, particularly if a domestic dog is resident and allowed unrestricted dune access. Evidence suggests that even the mere presence of dogs can have a detrimental effect on eating and breeding patterns of local fauna (Turner, 2001).

Formalising access paths will address the issue of dogs in the dunes to some extent; however it is also recommended that an audit of dog litter stations occur and any additional stations be installed at strategic locations if required. These stations should include bags for waste and signage outlining the reasons why dogs should not enter the dunes.

It is recommended that Council adjust By-Laws to state that dogs should be on leads at all times within the Reserve.

8.2 Management Issues and Strategies within each Management Zone

8.2.1 Management Zone 1 - Foredune

Spinifex hirsutus with emergent *Olearia axillaris* and *Atriplex cinerea*
Open Grassland

Background

Management Zone 1 is situated on exposed, unstable, sandy sites at the front of the coastal dune system (foredune) and for this reason is the least stable zone. The foredune environment is highly dynamic and subject to continuous and substantial changes in response to variations in weather, climate, tides, sea levels, waves and currents. The type and extent of shoreline change is determined by the relative intensity of tides, waves and sea level fluctuations. For example, changes that occur during severe storms will produce considerable changes in the position of the foredune and shape of the beach (Government of Western Australia, 2003). Such extreme changes in shoreline position need to be considered when managing this area, as there is a high probability that similar events will re-occur.

Vegetation in this Management Zone consists of primary sand-colonising plant species that play a vital role in building and stabilising coastal sand dune systems. This includes the ground-hugging, fast-growing grass, *Spinifex hirsutus* (Hairy Spinifex) - a colonising species that stabilises accumulations of windblown sand, spreading rapidly due to its strong creeping runners. Like other primary species, it can withstand highly saline conditions, occasional inundation from the sea, undermining, sand burial and blasting, very low to non-existent nutrient levels, periods of drought and high surface sand temperatures. The introduced plant, *Thinopyrum junceiforme* (Sea Wheat) gives the foredune a regular tabletop appearance, caused by its lateral growth habit. There are some traces of *Atriplex cinerea* (Grey Saltbush) and *Isolepis nodosa* (Knobby Club-rush), while smaller immature *Olearia axillaris* (Coast Daisy-bush) are regenerating vigorously at the landward edge.

Characteristics that enable these plants to survive in such extreme conditions include:

- Leaves with a waxy coating or hairs that prevent salt entering or sand abrasion and/or leaves that are hairy, rolled, or fleshy, to store water internally, and prevent water loss;
- Shallow, extensive root systems that enable plants to cope with sand burial or very deep root systems that enable plants to overcome water and nutrient deficiencies;
- High seed production and the ability to grow vegetatively (whereby parts broken off a plant can regrow to form a new plant).

Figures 9 and 18 illustrate the current situation of Management Zone 1 at Tennyson Dune Reserve. Note the typically large amount of exposed sand and stunted nature of species that inhabit this zone. Management emphasis is on controlling weeds and maintaining a low dune profile.

Figure 18: Management Zone 1 - Foredune
Spinifex hirsutus with emergent *Olearia axillaris* and *Atriplex cinerea*
 Open Grassland



The Nature Conservation Society's *Bushland Condition Monitoring Manual Southern Mount Lofty Ranges Coastal Version* (Croft et al, 2005) should be adopted to monitor changes in the Reserve's condition over time and will involve annual audits. In addition, photo-points should be established to monitor changes (refer to the UFBP website for correct techniques: www.urbanforest.on.net).

Management Recommendations

8.2.1.1 WEED CONTROL

Several high priority weed species should be targeted for removal within this zone. The dominant weed in Management Zone 1 is *Thinopyrum junceiforme* (Sea Wheat-grass). removal is considered unfeasible as the weed has naturalised in the dunes. Several individual *Trachyandra divaricata* (Dune Onion Weed) plants were recorded and removed within this Management Zone. Given that Dune Onion Weed has now been documented within the Reserve, it is critical ongoing monitoring for new plants occurs across all Management Zones. Any new plants or seed heads discovered must be removed immediately to prevent re-establishment and further spread. Several populations of *Euphorbia paralias* (Sea Spurge) exist along the foredune. It is important these are controlled before they become large infestations.

Due to the unstable and fragile nature of the dune environment, it is important to ensure weed control is staged and that revegetation with local provenance species coincides with these works. Weed control should never be carried out as an isolated measure, particularly in disturbed areas, where many weeds are fulfilling useful roles, such as habitat provision and sand binding. See Appendices 3-9 for further detail on weeding and revegetation. Table 9 lists the priority weeds occurring within Management Zone 1.

Table 9: Weed Control Prioritised Listing for Management Zone 1

Scientific Name	Common Name
<i>Trachyandra divaricata</i>	Dune Onion Weed
<i>Euphorbia paralias</i>	Sea Spurge
<i>Oenothera stricta</i>	Evening Primrose

8.2.1.2 REHABILITATION / REVEGETATION

It is recommended that rehabilitation works occur to enhance biodiversity within the Reserve and to stabilise areas affected by natural dune recession. Of particular concern, is a 100m section of dune immediately north of Bournemouth Avenue, Tennyson, where

erosive processes have left this area with a steep scarp and temporarily removed the foredune. Further storm damage may threaten rare plant populations in the near vicinity.

When undertaking rehabilitation works it is important to recognise this section of the dune system is highly dynamic and will accrete and erode significantly in response to seasonal changes and coastal processes. Sand management practices conducted by the Coastal Protection Branch in conjunction with the City of Charles Sturt will continue to have a significant effect on the continued existence of the Coastal Reserve.

Recommended species, plant characteristics and quantities required for revegetation in Management Zone 1 are listed in Table 10 (refer to Appendices 7-9 for images and information on revegetation methods). These species are based on pre-European vegetation communities (refer to Kraehenbuehl, 1996), current vegetation associations and environmental conditions within the Management Zone. Species recommended are likely to survive if the structure of the dunes changes as a result of sand accumulation. Note that quantities required are based on a Management Zone size of approximately 20 000m² and a planting density of 1 plant per 30m².

Use of the species mentioned in Table 10 will ensure the vegetation:

- Is suited to the highly variable foredune environment
- Will be fast growing
- Helps bind mobile sand
- Provides habitat for local native fauna.

Seed used in rehabilitation projects should be sourced from the nearest indigenous source (refer to Appendices 7-9 for images and information on revegetation methods and seed collection techniques).

To prioritise management actions it is important to determine native species diversity and distribution. It is recommended therefore, that a detailed native vegetation survey be undertaken before works commence. It is recommended therefore, that a detailed native vegetation survey be undertaken before works commence.

Table 10: Species Recommended for Rehabilitation in Management Zone 1

Scientific Name	Common Name	Plant Characteristics	Number Required
<i>Atriplex cinerea</i>	Grey Saltbush	Saltbush with grey foliage. Grows to 1m. To be located in more exposed areas.	50
<i>Carpobrotus rossii</i>	Native Pigface	Ground creeper with thick, fleshy succulent leaves and large pink flowers. Ideal for sand stabilisation. Plant in more sheltered areas.	30
<i>Leucophyta brownii</i>	Coast Cushion Bush	Dense, multi-branched small shrub. Attractive grey-white foliage. Flowers globular and yellow. Effective sand binder.	20
<i>Olearia axillaris</i>	Coast Daisy-bush	Attractive shrub to head high. Leaves dark green/blue on top, white below with small yellow flowers. Fast growing and an important stabiliser.	30
<i>Spinifex hirsutus</i> (formerly <i>S.sericeus</i>)	Hairy Spinifex	Important coloniser species. Light green hardy grass, growing to shin high with large spiky seeds. Ideal for sand stabilisation.	530
TOTAL			660

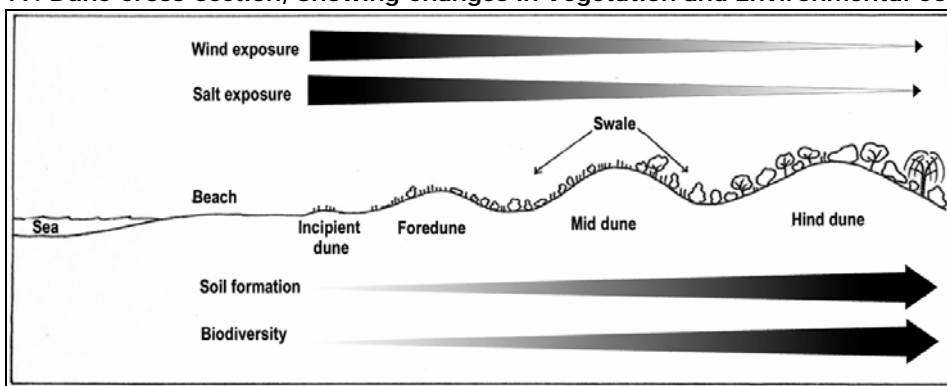
8.2.2 Management Zone 2 – Interdune Swale

Olearia axillaris*/*Rhagodia candolleana* ssp. *candolleana
Low Open Shrubland

Background

Management Zone 2 is semi-stable and features interdune corridors or swale areas located between the sand dunes. Environmental stress on plants is reduced in swales as the dunes provide some protection from harsh coastal conditions. These areas usually experience a decline in wind exposure, are more stable, have a tendency to collect water and are generally closer to the water table, enabling the development of low shrubs, rushes, sedges and groundcovers. This transition of species according to environmental conditions is termed 'dune succession' and is demonstrated in Figure 19.

Figure 19: Dune Cross-section, Showing Changes in Vegetation and Environmental Conditions



Source: Petherick, 2004

Figures 9 and 20 illustrate the current position and state of Management Zone 2 at Tennyson Dune Reserve. Note how protection offered by the foredune enables a different association of vegetation to develop. *Olearia axillaris* (Coast Daisy-bush), is the dominant species within this Management Zone with *Rhagodia candolleana* (Sea-berry Saltbush) and *Spinifex hirsutus* (Hairy Spinifex) the main understorey. Traces of a number of other bird driven plants such as *Threlkeldia diffusa* (Coast Bonefruit) and *Tetragonia implexicoma* (Bower Spinach) and common pioneer species such as *Acacia longifolia* ssp. *sophorae* (Coastal Wattle), *Carpobrotus rossii* (Native Pigface) and *Senecio pinnatifolius* (Variable Groundsel) are also found here. This is a common floristic group in dunes of southern Australia.

Figure 20: Management Zone 2 - Interdune Swale *Olearia axillaris*/*Rhagodia candolleana* ssp. *candolleana*
Low Open Shrubland



All revegetation and rehabilitation plans for Management Zone 2 should initially focus on targeted, sensitive weed control. Monitoring and controlling new outbreaks of *Trachyandra divaricata* (Dune Onion Weed) should be a high priority. Whilst other weed species present in this zone are of priority, they are far less invasive and have a wider distribution along the Adelaide coastline. Control of Dune Onion Weed infestations in the Cities of Port Adelaide Enfield and Onkaparinga have required costly control programs with ongoing commitments to follow-up control and monitoring. It is therefore essential that this species does not become established within the Reserve.

It is recommended that swale species are planted to enhance biodiversity and stabilise disturbed areas. This will ensure plants are suited to the protected, damper swale environment.

The Nature Conservation Society's *Bushland Condition Monitoring Manual Southern Mount Lofty Ranges Coastal Version* (Croft et al, 2005) should be adopted to monitor changes in the Reserve condition over time and will involve annual audits of the Reserve. In addition, photopoints should be established to monitor changes (refer to the UFBP website for correct photopoint monitoring techniques: www.urbanforest.on.net).

Management Recommendations

8.2.2.1 WEED CONTROL

A number of high priority weed species should be targeted for removal within this Management Zone. Dune Onion Weed should be the major focus for monitoring with any plants and/or seed heads observed being removed immediately to prevent re-establishment and further spread.

Lycium ferocissimum (African Boxthorn) has been a long-term problem within the Tennyson Dunes and should be the focus of ongoing control and monitoring. *Leptospermum laevigatum* (Coast Tea-tree) also occurs within this zone and should be a priority for removal. As these plants are currently fulfilling valuable habitat and sand binding functions, their removal should be staged using the principles outlined in Appendix 3-6.

Table 11 lists the priority weeds occurring within Management Zone 2. Weed control methods and weeding calendars for these priority weed species are detailed in Appendices 3-6. When removing introduced plant species, it is important they are replaced with appropriate indigenous vegetation to prevent erosion.

Table 11: Weed Control Prioritised Listing for Management Zone 2

Scientific Name	Common Name
<i>Lycium ferocissimum</i>	African Boxthorn
<i>Trachyandra divaricata</i>	Dune Onion Weed
<i>Asparagus asparagoides</i>	Bridal Creeper
<i>Ehrharta calycina</i>	Perennial Veldt Grass
<i>Gazania</i> sp.	Gazania
<i>Acacia cyclops</i>	Western Coastal Wattle
<i>Succulent</i> spp / <i>Cacti</i> spp.	Succulents
<i>Leptospermum laevigatum</i>	Coastal Tea Tree
<i>Argyranthemum frutescens</i>	Marguerite Daisy
<i>Mesembryanthemum crystallinum</i>	Ice Plant
<i>Euphorbia terracina</i>	False Caper
<i>Arctotis stoechadifolia</i>	White Arctotis
<i>Galenia pubescens</i>	Coastal Galenia
<i>Chondrilla juncea</i>	Skeleton Weed
<i>Oenothera stricta</i>	Evening Primrose

8.2.2.2 REHABILITATION / REVEGETATION

Sensitive weed control should be the primary focus of rehabilitation works. If the whole of reserve management issues are addressed (Section 8.1), little further action should be necessary besides allowing for natural regeneration with low scale supplementary plantings of structural and rarer species. It is recommended rehabilitation works occur to enhance biodiversity and stabilise areas affected by natural dune recession.

Recommended species, plant characteristics and quantities required for revegetation in Management Zone 2 are listed in Table 12 (refer to Appendices 7-9 for images and information on revegetation methods). These species are based on pre-European vegetation communities (refer to Kraehenbuehl, 1996), current vegetation associations and environmental conditions within the Management Zone. Note that quantities required are based on Management Zone size of approximately 36 500m² and a planting density of 1 plant per 25m².

To prioritise management actions it is important to determine native species diversity and distribution. It is recommended therefore, that a detailed native vegetation survey be undertaken before works commence.

Seed used in rehabilitation projects should be sourced from the nearest locality (refer to Appendices 7-9 for images and information on revegetation methods and seed collection techniques).

Table 12: Species Recommended for Rehabilitation in Management Zone 2

Scientific Name	Common Name	Plant Characteristics	Number Required
<i>Acacia cupularis</i>	Cup Wattle	Bushy, spreading shrub between 1 and 3m high and 4 to 6m wide. Thick, light green phyllodes with yellow wattle flowers. Important pioneer species.	20
<i>Acacia longifolia</i> ssp. <i>sophorae</i>	Coastal Wattle	Large shrub to 3m high and 5m wide, with thick green phyllodes and yellow wattle flowers. Fast growing, hardy plant that binds sand and provides shelter.	10
<i>Adriana quadripartita</i> (formerly <i>A. klotzschii</i>)	Rare Bitterbush	Large attractive shrub to 2m high with dark green leaves, red stems and flowers with a red tinge.	20
<i>Carpobrotus rossii</i>	Native Pigface	Ground creeper with thick, fleshy succulent leaves and large pink flowers. Ideal for sand stabilisation. One plant can occupy 3m ² .	300
<i>Dianella brevicaulis</i>	Short-stem Flax-lily	Attractive dark green lily with purple fruits and flowers. Grows in clumps to 0.5m ² .	60
<i>Isolepis nodosa</i>	Knobby Club-rush	Attractive green/ brown sedge that grows in clumps to thigh high. Ideal sand binder that is often used in coastal streetscape plantings.	90
<i>Leucophyta brownii</i>	Cushion Bush	Dense, multi-branched small shrub. Attractive grey-white foliage. Flowers globular and yellow. Effective sand binder.	50
<i>Muehlenbeckia gunnii</i>	Coastal Lignum	Climber found growing on shrubs. Dark green lobe-shaped leaves. Plant near existing indigenous vegetation.	10
<i>Nitraria billardierei</i>	Nitre Bush	Hardy spreading shrub to head high. Features thick green/grey foliage, white flowers and fleshy yellow, red or purple fruit. Provides habitat and protection for indigenous species. Difficult to propagate and grow.	50

Table 12 (cont.): Species Recommended for Rehabilitation in Management Zone 2

Scientific Name	Common Name	Plant Characteristics	Number Required
<i>Olearia axillaris</i>	Coast Daisy-bush	Attractive shrub to head high. Leaves dark-green/ blue on top, white below with small yellow flowers. Fast growing and an important stabiliser.	70
<i>Rhagodia candolleana</i> ssp. <i>candolleana</i>	Seaberry Saltbush	Scrambling saltbush to 1m with green/grey foliage and red berries. Fast growing hardy coastal plant.	150
<i>Scaevola crassifolia</i>	Cushion Fanflower	Spreading shrub to 1.5m high with dark green serrated leaves and blue fan-like flowers in clusters.	50
<i>Spinifex hirsutus</i> (formerly <i>S. sericeus</i>)	Hairy Spinifex	Important coloniser species. Light green hardy grass, growing to shin high with large spiky seeds. Ideal for sand stabilisation.	440
<i>Tetragonia implexicoma</i>	Bower Spinach	Succulent perennial twiner. Leaves thick, fleshy and green. Flowers small and yellow, small fruits green changing to red/ black when ripe.	640
<i>Threlkeldia diffusa</i>	Coast Bonefruit	A low groundcover with green/ maroon succulent foliage.	320
TOTAL			1480

There have been some issues with gall wasp on *Acacia* species at the nearby Semaphore Park dunes. Trees For Life conducted an experiment cutting the galls off *Acacias* and found those with the galls removed grew back better than those with the galls still present (Hemmings in Petherick, 2004, pers. comm.). It is recommended that this control technique be adopted if galls become an issue at Tennyson Dune Reserve.

8.2.3 Management Zones 3a and 3b – Hind Dune Seaward Face

Olearia axillaris/Leucopogon parviflorus+/-Nitraria billardierei
Low Shrubland

Background

This Management Zone is relatively stable and extends from the interdune depression to the upper seaward slopes of the hind dune. It features groundcovers and low to medium sized woody shrubs that are more densely spaced than in previous Management Zones. As Figure 19 demonstrates, environmental stresses change along a gradient, with a reduction in wind speed and salinity, and increases in soil stability and humus content (Harvey and Caton, 2003). These changes allow for increased biodiversity and enable the development of a low shrubland vegetation community.

Figures 11 and 21-22 depict the current position and state of Management Zone 3. Note the increase in size and density of vegetation in this section as a result of decreased environmental stress.

The dominant species throughout Management Zone 3 is *Olearia axillaris* (Coast Daisy-bush) with a band of *Leucopogon parviflorus* (Coast Beard-heath) on an intermediate dune ridge. *Scaevola crassifolium* (Cushion Fanflower) is a dominant understorey with *Alyxia buxifolia* (Sea Box) found in dense clumps at various locations. In isolated deeper depressions *Lepidosperma gladiatum* (Coast Sword-sedge) is a dominant understorey plant. Other species such as *Rhagodia candolleana* ssp. *candolleana* (Sea-berry Saltbush), *Spinifex hirsutus* (Hairy Spinifex), *Threlkeldia diffusa* (Coast Bonefruit), *Tetragonia implexicoma* (Bower Spinach), *Carpobrotus rossii* (Native Pigface) and *Senecio pinnatifolius* (Variable Groundsel) are also found here. Traces of taller species such as *Acacia longifolia* ssp. *sophorae* (Coastal Wattle) and *Nitraria billardierei* (Nitre Bush) also occur. In spring this area has the strongest herb layer.

The impact of housing on the condition of the Reserve has necessitated the sub-division of Management Zone 3. Zone 3a represents the zone in its more intact state (majority of the zone) whereas Zone 3b is in an altered condition and will require differing management techniques.

8.2.3.1 ZONE 3– INTACT AREAS

Figure 21: Management Zone 3a - Hind Dune Seaward Face
Olearia axillaris/Leucopogon parviflorus+/-Nitraria billardierei Low Shrubland



Management of management Zone 3a will need to be a two staged approach, with an initial focus on removing smaller, more easily accessible priority weed populations and those which threaten significant native flora and allowing for natural regeneration. Following this, restoration of significant native flora populations should occur, focussing primarily on weed control and enhancement. Buffer plantings may also be necessary if the immediate areas are deemed disturbed or unstable.

8.2.3.2 ZONE 3b – REHABILITATION

Figure 22: Management Zone 3b - Hind Dune Seaward Face - Rehabilitation



Garden encroachments are a serious problem in the Reserve, particularly at its northern and southern extents where housing impinges. Parts of this area are highly degraded with little indigenous vegetation. This state can be primarily attributed to the immediacy of housing upon the dunes. These issues include:

- Numerous informal paths
- Illegal dumping of garden and housing debris
- Illegal extensions of gardens and lawns
- Illegal sprinkler system installations at the rear of properties
- Increased nutrient loads from fertiliser applications.

Consequently, the area has been negatively modified in its soil chemistry and composition, physical profiles and flora and fauna communities. Several weed species have their densest populations in this zone, for example, *Cynodon* spp. (Couch), *Succulent* spp./*Cacti* spp. (Succulents), *Lycium ferocissimum* (African Boxthorn) and *Gazania* sp. (Gazania). It is essential the issues associated with garden encroachments are addressed.

A systematic and coordinated approach should be developed by the land owners/managers to rehabilitation, along with targeted weed control for several years, to minimise the effects of garden extensions in this area. It is recommended that Council's current policy of public consultation, education and signage in conjunction with clear boundary delineation should continue in these areas.

The Nature Conservation Society's *Bushland Condition Monitoring Manual Southern Mount Lofty Ranges Coastal Version* (Croft et al, 2005) should be adopted to monitor changes in the Reserve's condition over time and will involve annual audits of the Reserve. In addition, photopoints should be established to monitor changes (refer to the UFBP website for correct photopoint monitoring techniques: www.urbanforest.on.net).

Management Recommendations

8.2.3.3 WEED CONTROL

All revegetation and rehabilitation plans for this zone should initially focus on targeted, sensitive weed control. *Trachyandra divaricata* (Dune Onion Weed) should be monitored and contained as a priority. Any new plants should be reported to the City of Charles Sturt Coastal Officer and removed immediately to prevent its re-establishment and spread. Several other high priority weeds also occur within this zone and are currently fulfilling useful roles such as habitat provision and stabilisation. It is important to ensure weed control is staged with indigenous plants used in the rehabilitation process.

The highly invasive species *Lycium ferocissimum* (Boxthorn), *Asparagus asparagoides* (Bridal Creeper) and *Ehrharta calycina* (Perennial Veldt Grass) also occur in this management zone, particularly in the central and northern sections. Further research into long-term control and removal strategies will need to be conducted for the rehabilitation of these areas.

Table 13 lists the priority weeds occurring within Management Zone 2. Weed control methods and weeding calendars for these priority weed species are detailed in Appendices 3-6.

Table 13: Weed Control Prioritised Listing for Management Zone 3

Scientific Name	Common Name
<i>Lycium ferocissimum</i>	African Boxthorn
<i>Trachyandra divaricata</i>	Dune Onion Weed
<i>Ehrharta calycina</i>	Perennial Veldt Grass
<i>Gazania</i> sp.	Gazania
<i>Acacia cyclops</i>	Western Coastal Wattle
<i>Succulent</i> spp./ <i>Cacti</i> spp.	Succulents and Cacti
<i>Leptospermum laevigatum</i>	Coast Tea-tree
<i>Argyranthemum frutescens</i>	Marguerite Daisy
<i>Mesembryanthemum crystallinum</i>	Ice Plant
<i>Euphorbia terracina</i>	False Caper
<i>Arctotis stoechadifolia</i>	White Arctotis
<i>Carpobrotus edulis</i>	Hottentot Fig
<i>Galenia pubescens</i>	Coastal Galenia
<i>Chondrilla juncea</i>	Skeleton Weed
<i>Tamarix aphylla</i>	Tamarisk
<i>Osteospermum fruticosum</i>	Seascape Daisy
<i>Oenothera stricta</i>	Evening Primrose
<i>Cynodon</i> spp.	Couch
<i>Rhamnus alaternus</i>	Buckthorn
<i>Pennisetum clandestinum</i>	Kikuyu
<i>Acacia saligna</i>	Golden Wreath Wattle

8.2.3.4 REHABILITATION / REVEGETATION

Management Zone 3 contains the most diverse area of native vegetation in the Reserve, however is also at the greatest risk from garden encroachments. It is recommended rehabilitation works occur to enhance biodiversity (Zone 3a) and control garden encroachments (Zone 3b).

As with Management Zone 2, the primary focus should be on management of the whole of reserve issues and sensitive weed control in association with low scale supplementary plantings of structural and rarer species. Areas affected by garden encroachments need to be managed on a case-by-case basis.

Recommended species, plant characteristics and quantities required for revegetation works in this Management Zone are listed in Table 14 (refer to Appendices 7-9 for photographs and information on revegetation methods). These species are based on pre-European vegetation communities (refer to Kraehenbuehl, 1996), current vegetation associations and environmental conditions within the Management Zone. Species choice for rehabilitation will need to be sensitive to the fact plant associations vary considerably throughout this zone. Species mentioned in Table 14 are therefore a broad guide only and may not be appropriate for all sections. Note that quantities required are based on Management Zone sizes of approximately 42 000m² for Management Zone 3a and 14 000m² for Management Zone 3b. Planting densities are 1 plant per 40m² and 1 plant per 4m² respectively.

To prioritise management actions it is important to determine native species diversity and distribution. It is recommended therefore, that a detailed native vegetation survey be undertaken before works commence.

Seed used in rehabilitation projects should be sourced from the nearest locality (refer to Appendices 7-9 for images and information on revegetation methods and seed collection techniques).

Table 14: Species Recommended for Rehabilitation in Management Zone 3

Scientific Name	Common Name	Plant Characteristics	Number Required
<i>Acacia cupularis</i>	Cup Wattle	Bushy, spreading shrub between 1 and 3m high and 4 to 6m wide. Thick, light green phyllodes with yellow wattle flowers. Important pioneer species.	30
<i>Acacia longifolia</i> ssp. <i>sophorae</i>	Coastal Wattle	Large shrub to 3m high and 5m wide, with thick green phyllodes and yellow wattle flowers. Fast growing, hardy plant that binds sand and provides shelter.	10
<i>Adriana quadripartita</i> (formerly <i>A. klotzschii</i>)	Rare Bitterbush	Large attractive shrub to 2m high with dark green leaves, red stems and flowers with a red tinge.	90
<i>Alyxia buxifolia</i>	Sea Box	Woody medium shrub to 2m high by 3m wide. Leaves paired, thick, dark green and shiny on top.	60
<i>Austrodanthonia caespitosa</i>	Common Wallaby-grass	Native grass growing 20-90cm in height. Plant small clumps in sheltered areas.	270
<i>Austrostipa flavescens</i>	Coast Spear-grass	Grass growing to 1.2m. Plant in small clumps in sheltered areas.	270
<i>Austrostipa scabra</i> ssp. <i>falcata</i>	Slender Spear-grass	Grass growing to 1m. Plant in small clumps in sheltered areas.	270

Table 14 (cont.): Species Recommended for Rehabilitation in Management Zone 3

Scientific Name	Common Name	Plant Characteristics	Number Required
<i>Baumea juncea</i>	Bare Twig-rush	Perennial rush growing up to 30-100cm tall. Important sand binder.	40
<i>Carpobrotus rossii</i>	Native Pigface	Ground creeper spreading to 3m ² with thick, fleshy succulent leaves and large pink flowers. Ideal for sand stabilisation.	240
<i>Clematis microphylla</i>	Old Man's Beard	Climber into adjacent shrubs. Leaves pale green in three leaflets. Often heavily covered in flowers. Feathery seeds. Plant near other shrubs.	100
<i>Dianella brevicaulis</i>	Short-stem Flax-lily	Attractive dark green lily with purple fruits and flowers. Grows in clumps to 0.5m ² .	140
<i>Enchylaena tomentosa</i>	Ruby Saltbush	Prostrate shrub, grey-blue in colour, with red to yellow berries.	100
<i>Geranium potentilloides</i> ssp. <i>potentilloides</i>	Downy Geranium	Delicate perennial herb to ankle high. Flowers are small, pink, chiefly solitary. Basal leaves are larger and absent in summer.	130
<i>Helichrysum leucopsideum</i>	Satin Everlasting	Erect perennial herb 15-50cm high. Flowers white, 25-35mm in diameter.	130
<i>Isolepis nodosa</i>	Knobby Club-rush	Attractive green-brown sedge. Grows in clumps to 1m high. Ideal sand binder.	100
<i>Kennedia prostrata</i>	Running Postman	Mat-forming groundcover with soft green leaves and bright red pea flowers. Grows to a width of 1.5m.	70
<i>Kunzea pomifera</i>	Muntries	Shrub with ground-running stems to ankle height. Flowers are white, 1cm across. Edible fruit.	70
<i>Lepidosperma gladiatum</i>	Coast Sword-sedge	Rigid sedge to 1m high. Stems and leaves are sharp. Difficult to propagate.	50
<i>Leucopogon parviflorus</i>	Coast Beard-heath	Erect shrub growing between 3 and 5m high. Pale green leaves are sometimes curled backwards. Flowers are very small, white and produce fleshy white fruit.	110
<i>Lomandra leucocephala</i> ssp. <i>robusta</i>	Woolly Mat-rush	Tussocky plant to knee high with tough, grass-like leaves. Flowers, a white cylindrical cluster.	70
<i>Lotus australis</i>	Australian Trefoil	Small attractive perennial herb with light green leaves. Flowers pink or white.	390
<i>Muehlenbeckia gunnii</i>	Coastal Climbing Lignum	Climber found growing on shrubs. Dark green lobe-shaped leaves. Plant near existing indigenous vegetation.	50
<i>Nitraria billardierei</i>	Nitre Bush	Hardy spreading shrub to 2m high. Foliage thick green/grey. Flowers white with fleshy yellow, red or purple fruit. Provides habitat and protection for indigenous fauna.	80

Table 14 (cont.): Species Recommended for Rehabilitation in Management Zone 3

Scientific Name	Common Name	Plant Characteristics	Number Required
<i>Olearia axillaris</i>	Coast Daisy-bush	Attractive shrub to 2m high. Leaves dark green-blue on top, white below with small yellow flowers. Fast growing and an important stabiliser.	110
<i>Parietaria debilis</i>	Smooth-nettle	Delicate herb to thigh high. Insignificant flowers usually in groups of three. Grows in shady places. Plant in established settings.	50
<i>Pelargonium australe</i>	Australian Pelargonium	Robust herb to shin high. Stems and leaves velvety with soft hairs. Flowers pink with red spots.	390
<i>Pimelea serpyllifolia ssp. serpyllifolia</i>	Thyme Riceflower	Erect shrub to waist high. Flowers, tiny and yellow. Difficult to propagate	70
<i>Poa poiformis</i>	Coast Tussock-grass	A fine-leaved erect grass growing to 1m high. Plant in clumps in sheltered areas.	270
<i>Rhagodia candolleana ssp. candolleana</i>	Seaberry Saltbush	Scrambling saltbush to 1m with green-grey foliage and red berries. Fast growing and hardy.	70
<i>Salsola kali</i>	Buckbush	Upright prickly plant to waist high. Bright green. Fruit has papery segments. Plant away from pathways.	15
<i>Scaevola crassifolium</i>	Cushion Fanflower	Spreading shrub to 1.5m high with dark green serrated leaves and blue fan-like flowers in clusters.	90
<i>Senecio pinnatifolius</i> (formerly <i>S. lautus</i>)	Variable Groundsel	Attractive annual or biennial herb to 0.5m high. Bright green leaves with yellow flowers.	100
<i>Spinifex hirsutus</i> (formerly <i>S. sericeus</i>)	Hairy Spinifex	Important coloniser species. Light green hardy grass, growing to 0.25m high with large spiky seeds. Ideal for sand stabilisation.	270
<i>Tetragonia implexicoma</i>	Bower Spinach	Succulent perennial twiner. Leaves thick, fleshy and green. Flowers small and yellow, small fruits green changing to red/black when ripe.	70
<i>Threlkeldia diffusa</i>	Coast Bonefruit	A low groundcover with green/maroon succulent foliage.	90
TOTAL			4465

There have been some issues with gall wasp on *Acacia* species at the nearby Semaphore Park dunes. Trees For Life conducted an experiment cutting the galls off *Acacias* and found those with the galls removed grew back better than those with the galls still present (Hemmings in Petherick, 2004, pers. comm.). It is recommended that this control technique be adopted if galls become an issue at Tennyson Dune Reserve.

8.2.4 Management Zones 4a and 4b – Hind Dune Ridge

***Leucopogon parviflorus*/*Melaleuca lanceolata* +/- *Olearia axillaris*
Open Shrubland**

Background

Management Zone 4 is primarily located along the ridge of the hind dune. The dominant canopy species are *Leucopogon parviflorus* (Coast Beard-heath) and *Melaleuca lanceolata* (Dryland Tea-tree) in association with *Scaevola crassifolia* (Cushion Fanflower) as the dominant understorey. This zone contains specimens of Coast Beard-heath which are several hundred years old (Sandercock, 2006, pers. comm.). The Dryland Tea-tree in this zone are found nowhere else in the Reserve and are an uncommon species in the Southern Lofty Region.

Figures 9 and 23-24 depict the current position and state of Management Zone 4. Note the increase in size and density of vegetation in this part of the dune system as a result of decreased environmental stress.

Previous exploitation of the dunes for sand used in the process of glass manufacturing has left significant areas of the dune reserve open to weed invasion. The most significant of these weeds is the aggressive *Ehrharta calycina* (Perennial Veldt Grass) which was introduced to stabilise sand after mining. Other species of concern are *Lycium ferocissimum* (Boxthorn), *Asparagus asparagoides* (Bridal Creeper) and *Arctotis stoechadifolia* (White Arctotis). Such is the distribution of these weeds that this Management Zone has been divided into two sub-zones, 4a and 4b. Zone 4a is most representative of the plant association once common in this area, whilst Zone 4b is highly degraded and bears little resemblance to the original vegetation community.

Due to the degraded state of certain areas within Management Zone 4 due to housing and weed infestation, it has been sub-divided. Zone 4a represents the zone in its more intact state whereas Zone 4b is in an altered condition and will require differing management techniques.

8.2.4.1 MANAGEMENT ZONE 4a – INTACT AREAS

Figure 23: Management Zone 4a – Hind Dune Ridge
Leucopogon parviflorus/*Melaleuca lanceolata* +/- *Olearia axillaris*
Open Shrubland



Management of management Zone 3a will need to be a two staged approach, with an initial focus on removing smaller, more easily accessible priority weed populations and those which threaten significant native flora and allowing for natural regeneration. Following this, restoration of significant native flora populations should occur, focussing primarily on weed control and enhancement. Buffer plantings may also be necessary if the immediate areas are deemed disturbed or unstable.

8.2.4.2 MANAGEMENT ZONE 4b – REHABILITATION AREAS

Figure 24: Management Zone 4b – Hind Dune Ridge - Rehabilitation



Management Recommendations

8.2.4.3 WEED CONTROL

Weed control in this Management Zone will be an ongoing issue given its history of sand mining, garden encroachments and altered soil conditions. It is recommended special attention be given to weed control due to the favourable conditions for weed growth and the persistence of many of these species. This Management Zone should be monitored for the establishment of *Trachyandra divaricata* (Dune Onion Weed). In the short-term focus should be on the control of woody weeds such as *Lycium ferocissimum* (Boxthorn), *Acacia cyclops* (Western Coastal Wattle), *Leptospermum laevigatum* (Coastal Tea Tree) and *Tamarix aphylla* (Tamarisk). The control of *Ehrharta calycina* (Perennial Veldt Grass), *Asparagus asparagoides* (Bridal Creeper), and *Arctotis stoechadifolia* (White Arctotis) will be the focus for long-term weed management.

Numerous other high priority weed species also require targeted removal. Table 15 lists the priority weeds for Management Zone 4. Weed control methods and weeding calendars for priority weed species are detailed in Appendices 3-6 respectively. It is important to remove introduced species in a staged fashion, as they often fulfil habitat or sand stabilisation functions. It is also important to ensure introduced plant species are replaced with appropriate indigenous vegetation.

Table 15: Weed Control Prioritised Listing for Management Zone 4

Scientific Name	Common Name
<i>Lycium ferocissimum</i>	Boxthorn
<i>Trachyandra divaricata</i>	Dune Onion Weed
<i>Asparagus asparagoides</i>	Bridal creeper
<i>Ehrharta calycina</i>	Perennial Veldt Grass
<i>Acacia cyclops</i>	Western Coastal Wattle
<i>Succulent spp./Cacti spp.</i>	Succulents and Cacti
<i>Leptospermum laevigatum</i>	Coastal Tea-tree
<i>Mesembryanthemum crystallinum</i>	Ice Plant
<i>Euphorbia terracina</i>	False Caper
<i>Arctotis stoechadifolia</i>	White Arctotis
<i>Carpobrotus edulis</i>	Hottentot Fig
<i>Galenia pubescens</i>	Coastal Galenia
<i>Tamarix aphylla</i>	Tamarisk
<i>Oenothera strictum</i>	Evening Primrose
<i>Cynodon spp.</i>	Couch
<i>Stenotaphrum secundatum</i>	Buffalo Grass

8.2.4.4 REHABILITATION/ REVEGETATION

Intact areas of this Management Zone will need to be treated in a similar fashion to the intact areas of Management Zones 2 and 3, with the primary focus on managing the whole of reserve issues along with sensitive weed control and low scale supplementary plantings of structural and rarer species.

Recommended species, plant characteristics and quantities required are detailed in Table 16. These species are based on pre-European vegetation communities (refer to Kraehenbuehl, 1996), current vegetation associations and environmental conditions within the Management Zone. Seed used in rehabilitation projects should be sourced locally (refer to Appendices 7-9 for images and information on revegetation methods and seed collection techniques). The quantities required are based on Management Zone sizes of approximately 18 000m² for Management Zone 4a and 17 000m² for Management Zone 4b. Planting densities are 1 plant per 35m² and 1 plant per 5m² respectively.

To prioritise management actions it is important to determine native species diversity and distribution. It is recommended therefore, that a detailed native vegetation survey be undertaken before works commence.

Table 16: Species Recommended for Rehabilitation in Management Zone 4

Scientific Name	Common Name	Plant Characteristics	Number Required
<i>Acacia cupularis</i> [#]	Cup Wattle	Bushy, spreading shrub between 1 and 3m high and 4 to 6m wide. Thick, light green phyllodes with yellow wattle flowers. Important pioneer species.	35
<i>Acacia longifolia</i> var. <i>sophorae</i> [#]	Coastal Wattle	Large shrub to 3m high and 5m wide, with thick green phyllodes and yellow wattle flowers. Fast growing, hardy plant that binds sand and provides shelter.	35
<i>Adriana quadripartita</i>	Rare Bitterbush	Large attractive shrub to head high with dark green leaves, red stems and flowers with a red tinge.	90
<i>Alyxia buxifolia</i>	Sea Box	Woody medium shrub to 2m high by 3m wide. Leaves paired, thick, dark green and shiny on top.	60

Table 16(cont.): Species Recommended for Rehabilitation in Management Zone 4

Scientific Name	Common Name	Plant Characteristics	Number Required
<i>Austrodanthonia caespitosa</i>	Common Wallaby-grass	Native grass growing 20-90cm in height. Plant small clumps in sheltered areas.	200
<i>Austrostipa flavescens</i>	Coast Spear-grass	Grass growing to 1.2m. Plant in small clumps in sheltered areas.	200
<i>Austrostipa scabra</i> ssp. <i>falcata</i>	Slender Spear-grass	Grass growing to 1m. Plant in small clumps in sheltered areas.	200
<i>Baumea juncea</i>	Bare Twig-rush	Perennial rush growing up to 30-100cm tall. Important sand binder.	25
<i>Carpobrotus rossii</i>	Native Pigface	Ground creeper with thick, fleshy succulent leaves and large pink flowers. Ideal for sand stabilisation. One plant can grow to 3m ² .	60
<i>Cassytha pubescens</i>	Downy Dodder-laurel	Twining climbing plant. Stems are thin, yellowy-green, leafless. Flowers small, green, in groups. Fruit a fleshy green globe.	8
<i>Clematis microphylla</i>	Old Man's Beard	Climber into adjacent shrubs. Leaves pale green in three leaflets. Often heavily covered in flowers. Feathery seeds. Plant near other shrubs.	100
<i>Dianella brevicaulis</i>	Short-stem Flax-lily	Attractive dark green lily with purple fruits and flowers. Grows in clumps to 0.5m ² .	100
<i>Enchylaena tomentosa</i>	Ruby Saltbush	Prostrate shrub, grey/blue in colour, drying to black, with red berries. One plant can grow to 3m ² . Plant on outskirts of stormwater outlets.	60
<i>Geranium potentilloides. potentilloides</i>	Downy Geranium	Delicate perennial herb to ankle high. Flowers are small, pink, chiefly solitary. Basal leaves are larger and absent in summer.	240
<i>Isolepis nodosa</i>	Knobby Club-rush	Attractive green/ brown sedge that grows in clumps to thigh high. Ideal sand binder that is often used in coastal streetscape plantings.	110
<i>Kennedia prostrata</i>	Running Postman	Mat-forming groundcover with soft green leaves and bright red pea flowers. Grows to 1.5m wide.	60
<i>Kunzea pomifera</i>	Muntries	Attractive mat-forming groundcover with white flowers, small leaves and edible fruit. Provides good habitat for ground dwelling reptiles.	60
<i>Lepidosperma gladiatum</i>	Coast Sword-sedge	Rigid sedge to 1m high. Stems and leaves are sharp. Difficult to propagate.	120
<i>Leucopogon parviflorus</i>	Coast Beard-heath	Erect shrub growing between 3 and 5m high. Pale green leaves are sometimes curled backwards. Flowers are very small, white and produce fleshy white fruit. Difficult to propagate.	350
<i>Lotus australis</i>	Australian Trefoil	Small attractive perennial herb with light green leaves. Flowers pink or white.	240
<i>Muehlenbeckia gunnii</i>	Coastal Climbing Lignum	Climber found growing on shrubs. Dark green lobe-shaped leaves. Plant near existing indigenous vegetation.	120

Table 16(cont.): Species Recommended for Rehabilitation in Management Zone 4

Scientific Name	Common Name	Plant Characteristics	Number Required
<i>Nitraria billardierei</i>	Nitre Bush	Hardy spreading shrub to head high. Features thick green/grey foliage, white flowers and fleshy yellow, red or purple fruit. Provides habitat and protection for indigenous species. Difficult to propagate and grow.	60
<i>Olearia axillaris</i>	Coast Daisy-bush	Attractive shrub to head high. Leaves dark-green/ blue on top, white below with small yellow flowers. Fast growing and an important stabiliser.	230
<i>Pelargonium australe</i>	Australian Pelargonium	Robust herb to shin high. Stems and leaves velvety with soft hairs. Flowers pink with red spots.	500
<i>Pimelea serpyllifolia</i> ssp. <i>serpyllifolia</i>	Thyme Riceflower	Erect shrub to waist high. Flowers, tiny and yellow. Difficult to propagate	50
<i>Poa poiformis</i>	Coast Tussock-grass	A fine-leaved erect grass growing to thigh high. Plant in clumps in sheltered areas.	160
<i>Rhagodia candolleana</i> ssp. <i>candolleana</i>	Seaberry Saltbush	Scrambling saltbush to 1m with green/grey foliage and red berries. Fast growing hardy coastal plant.	60
<i>Salsola kali</i>	Buckbush	Upright prickly plant to waist high. Bright green. Fruit has papery segments. Plant away from pathways.	50
<i>Scaevola crassifolia</i>	Cushion Fanflower	Spreading shrub to waist high with dark green serrated leaves and blue fan-like flowers in clusters.	160
<i>Senecio pinnatifolius</i> (formerly <i>S. lautus</i>)	Variable Groundsel	Attractive annual or biennial herb to knee high. Bright green leaves with yellow flowers.	35
<i>Spinifex hirsutus</i> (formerly <i>S. sericeus</i>)	Hairy Spinifex	Important coloniser species. Light green hardy grass, growing to shin high with large spiky seeds. Ideal for sand stabilisation.	35
<i>Tetragonia implexicoma</i>	Bower Spinach	Succulent perennial, either ground running or creeper. Leaves thick and fleshy, green in colour. Flowers small and yellow, small fruits green changing to red/ black when ripe.	140
<i>Threlkeldia diffusa</i>	Coastal Bonefruit	A low groundcover with green/ maroon succulent foliage.	60
TOTAL			3963

There have been some issues with gall wasp on *Acacia* species at the nearby Semaphore Park dunes. Trees For Life conducted an experiment cutting the galls off *Acacias* and found those with the galls removed grew back better than those with the galls still present (Hemmings in Petherick, 2004, pers. comm.). It is recommended that this control technique be adopted if galls become an issue at Tennyson Dune Reserve.

8.2.5 Management Zone 5 - Rehabilitation

Melaleuca lanceolata*/*Tetragonia implexicoma
Tall Shrubland

Background

Management Zone 5 contains very little remnant vegetation and has been the area most affected by human activity - namely sand mining, residential development and clearing. Due to its degraded state this area has been categorized as a rehabilitation zone. *Ehrharta calycina* (Perennial Veldt Grass) is now the dominant species in this Management Zone. It is hypothesised other priority weeds in this area were introduced through cattle grazing and subsequent early housing developments. Figures 9 and 25 depict the current position and typical state of Management Zone 5.

Native species within this Management Zone predominantly exist on the upper leeward face of the rear dune, with scattered populations on the lower slopes. Of particular importance is the occurrence of *Distichlis distichophylla* (Emu-grass), *Baumea juncea* (Bare Twig-rush) and *Lomandra leucocephala* ssp. *robusta* (Woolly Mat-rush).

Figure 25: Management Zone 5 - Rehabilitation
Melaleuca lanceolata/*Tetragonia implexicoma* Tall Shrubland



Although Management Zone 5 is marked by general paucity of indigenous species, there is enough evidence both botanically and historically to suggest this area should be characterised by a dominant overstorey of *Melaleuca lanceolata*. The dominant understorey is *Tetragonia implexicoma* (Bower Spinach), whilst the sub-dominant species are *Threlkeldia diffusa* (Coast Bonefruit) and *Rhagodia candolleana* ssp. *candolleana* (Sea-berry Saltbush) As the *Coastal Dune and Clifftop Vegetation Survey* (Oppermann, 1999) suggests this vegetation community to be relatively common throughout the state, it is recommended that it be used as the general reference for restoration within this zone.

Revegetation and rehabilitation plans should initially focus on sensitive, targeted weed control, with the removal of high priority species.

The Nature Conservation Society's *Bushland Condition Monitoring Manual Southern Mount Lofty Ranges Coastal Version* (Croft et al, 2005) should be adopted to monitor changes in the Reserve condition over time and will involve annual audits of the Reserve. In addition, photopoints should be established to monitor changes (refer to the UFBP website for correct photopoint monitoring techniques: www.urbanforest.on.net).

Management Recommendations

8.2.5.1. WEED CONTROL

Management Zone 5 is dominated by *Ehrharta calycina* (Perennial Veldt Grass). It is recommended trials are undertaken to determine the most appropriate control strategy for this species and to adequately rehabilitate the site. It is also recommended native vegetation surveys are undertaken prior to commencement of rehabilitation works to determine the locality of sensitive species.

Furthermore, this Management Zone should also be monitored for the establishment of Dune Onion Weed (*Trachyandra divaricata*).

Numerous other high priority weed species occur within this Management Zone and should also be targeted for removal. Table 17 lists the priority weeds for control in Management Zone 4. Due to the highly degraded nature of this site, rehabilitation should be viewed as a long-term prospect. Weed control methods and weeding calendars for priority weed species are detailed in Appendices 3-6.

Table 17: Weed Control Prioritised Listing for Management Zone 5

Scientific Name	Common Name
<i>Lycium ferocissimum</i>	Boxthorn
<i>Trachyandra divaricata</i>	Dune Onion Weed
<i>Asparagus asparagoides</i>	Bridal Creeper
<i>Ehrharta calycina</i>	Perennial Veldt Grass
<i>Acacia cyclops</i>	Western Coastal Wattle
<i>Succulent spp./Cacti spp.</i>	Succulents and Cacti
<i>Mesembryanthemum crystallinum</i>	Ice Plant
<i>Euphorbia terracina</i>	False Caper
<i>Arctotis stoechadifolia</i>	White Arctotis
<i>Galenia pubescens</i>	Coastal Galenia
<i>Tamarix aphylla</i>	Tamarisk
<i>Oenothera stricta</i>	Evening Primrose
<i>Pennisetum clandestinum</i>	Kikuyu
<i>Cynodon dactylon</i>	Couch
<i>Pennisetum clandestinum</i>	Kikuyu
<i>Stenotaphrum secundatum</i>	Buffalo Grass
<i>Acacia saligna</i>	Golden Wreath Wattle
<i>Lupinus consentii</i>	Blue Lupin

8.2.5.2 REHABILITATION/ REVEGETATION

It is recommended rehabilitation works occur to enhance biodiversity within the Reserve, stabilise eroded areas and assist weed control. Revegetation and weed control around these sites will increase plant survival rates.

Along the Adelaide coastline there has been the loss of several significant indigenous species. Some, like *Allocasuarina verticillata* (Drooping Sheoak), *Callitris preissii* (Southern Cypress Pine) and *Santalum* spp. (Quandong), are locally near extinction. Specht (1972) alluded to Drooping Sheoak as the climax species in natural dune vegetation succession in the Adelaide region. The nature and severity of these changes are without doubt the result of human interference. Table 3 documents all species noted in historical records along with current indigenous species within the Reserve.

The re-introduction of species recorded as existing historically but now locally extinct within Tennyson Dune Reserve is considered reasonable. This is provided the integrity of the main dune system is maintained. It is important these species are sourced from the

nearest appropriate remnant populations. Careful study of companion planting could add to its value as habitat.

Recommended species, plant characteristics and quantities required for Management Zone 5 are detailed in Table 18. These species are based on pre-European vegetation communities (refer to Kraehenbuehl, 1996), current vegetation associations and environmental conditions within the Management Zone. Seed to be used in rehabilitation projects should be from the nearest source (refer to Appendices 7-9 for images and information on revegetation methods and seed collection techniques). The quantities required are based on Management Zone size of approximately 20 000m² and a planting density of 1 plant per 5m².

To prioritise management actions it is important to determine native species diversity and distribution. It is recommended that a detailed native vegetation survey be undertaken before works commence.

Table 18: Species Recommended for Rehabilitation in Management Zone 5

Scientific Name	Common Name	Plant Characteristics	Number Required
<i>Acacia cupularis</i> [#]	Cup Wattle	Bushy, spreading shrub 1-3m high and 4-6m wide. Thick, light green phyllodes with yellow wattle flowers. Important pioneer species.	80
<i>Acacia longifolia</i> var. <i>sophorae</i> [#]	Coastal Wattle	Large shrub to 3m high and 5m wide with thick green phyllode and yellow wattle flowers. Fast growing, hardy plants that binds sand and provides habitat.	60
<i>Acacia pycnantha</i>	Golden Wattle	Small upright tree with blackish trunk. Leaves curved and leathery. Flowers	80
<i>Adriana quadripartita</i> (formerly <i>A. klotzschii</i>)	Rare Bitterbush	Large attractive shrub to head high with dark green leaves, red stems and flowers with a red tinge.	40
<i>Austrodanthonia caespitosa</i>	Common Wallaby-grass	Native grass growing 20-90cm in height. Plant small clumps in sheltered areas.	150
<i>Austrostipa flavescens</i>	Coast Spear-grass	Grass growing to 1.2m. Plant in small clumps in sheltered areas.	150
<i>Austrostipa scabra</i> ssp. <i>falcata</i>	Slender Spear-grass	Grass growing to 1m. Plant in small clumps in sheltered areas.	150
<i>Baumea juncea</i>	Bare Twig-rush	Perennial rush between 30-100cm high. Spikelets 4-5mm long, reddish brown and densely clustered. Long rhizome. Leaves reduced to points.	50
<i>Carpobrotus rossii</i>	Native Pigface	Ground creeper with thick, fleshy succulent leaves and large pink flowers. Ideal for sand stabilisation. One plant can grow to 3m ² .	50
<i>Cassytha pubescens</i>	Downy Dodder-laurel	Twining climbing plant. Stems are thin, yellowy-green, leafless. Flowers small, green, in groups. Fruit a fleshy green globe.	3
<i>Clematis microphylla</i>	Old Man's Beard	Climber into adjacent shrubs. Leaves pale green in three leaflets. Often heavily covered in flowers. Feathery seeds. Plant near other shrubs.	120
<i>Dianella brevicaulis</i>	Short-stem Flax-lily	Attractive dark green lily with purple fruits and flowers. Grows in clumps to 0.5m ² .	70
<i>Distichlis distichophylla</i>	Emu Grass	Indigenous grass commonly found in saline, sandy soils on the coast.	160
<i>Enchylaena tomentosa</i>	Ruby Saltbush	Prostrate shrub, grey/blue in colour, drying to black, with red berries. One plant can grow to 3m ² .	50

Table 18 (cont.): Species Recommended for Rehabilitation in Management Zone 5

Scientific Name	Common Name	Plant Characteristics	Number Required
<i>Geranium potentilloides</i> var. <i>potentilloides</i>	Downy Geranium	Delicate perennial herb to ankle high. Flowers are small, pink, chiefly solitary. Basal leaves are larger and absent in summer.	80
<i>Helichrysum leucopsideum</i>	Satin Everlasting	Erect perennial herb 15-50cm high. Flowers white, 25-35mm in diameter.	40
<i>Isolepis nodosa</i>	Knobby Club-rush	Attractive green/ brown sedge that grows in clumps to thigh high. Ideal sand binder.	70
<i>Kennedia prostrata</i>	Running Postman	Mat-forming groundcover with soft green leaves and bright red pea flowers. Grows to 1.5m wide.	40
<i>Kunzea pomifera</i>	Muntries	Attractive mat-forming groundcover with white flowers, small leaves and edible fruit. Provides good habitat for ground dwelling reptiles.	40
<i>Lepidosperma gladiatum</i>	Coast Sword-sedge	Rigid sedge to 1m high. Stems and leaves are sharp. Difficult to propagate.	60
<i>Leucopogon parviflorus</i>	Coast Beard-heath	Erect shrub growing between 3 and 5m high. Pale green leaves are sometimes curled backwards. Flowers are very small, white and produce fleshy white fruit. Difficult to propagate.	120
<i>Lomandra leucocephala</i>	Woolly Mat-rush	Tussocky plant to knee high with tough, grass-like leaves. Flowers, a white cylindrical cluster.	50
<i>Lotus australis</i>	Austral Trefoil	Small attractive perennial herb with light green leaves. Flowers pink or white.	80
<i>Melaleuca lanceolata</i>	Dryland Tea-tree	Large shrub or small tree. Flowers are white clusters along the stem. Good habitat species.	730
<i>Muehlenbeckia gunnii</i>	Coastal Climbing Lignum	Climber found growing on shrubs. Dark green lobe-shaped leaves. Plant near existing indigenous vegetation.	120
<i>Myoporum insulare</i>	Common Boobialla	Tall, spreading shrub to over head high. Thick, fleshy leaves with white and purple flowers, purple fruits.	80
<i>Nitraria billardierei</i>	Nitre-bush	Hardy spreading shrub to head high. Features thick green/grey foliage, white flowers and fleshy yellow, red or purple fruit. Provides habitat and protection for indigenous species. Difficult to propagate and grow.	40
<i>Olearia axillaris</i>	Coastal Daisy-bush	Attractive shrub to head high. Leaves dark-green/ blue on top, white below with small yellow flowers. Fast growing and an important stabiliser.	200
<i>Pelargonium australe</i>	Australian Pelargonium	Robust herb to shin high. Stems and leaves velvety with soft hairs. Flowers pink with red spots.	200
<i>Pimelea serpyllifolia</i> ssp. <i>serpyllifolia</i>	Thyme Riceflower	Erect shrub to waist high. Flowers, tiny and yellow. Difficult to propagate	40
<i>Poa poiformis</i>	Coast Tussock-grass	A fine-leaved erect grass growing to thigh high. Plant in clumps in sheltered areas.	150
<i>Rhagodia candolleana</i> ssp. <i>candolleana</i>	Seaberry Saltbush	Scrambling saltbush to 1m with green/grey foliage and red berries. Fast growing hardy coastal plant.	120
<i>Salsola kali</i>	Buckbush	Upright prickly plant to waist high. Bright green. Fruit has papery segments. Plant away from pathways.	20
<i>Scaevola crassifolia</i>	Cushion Fanflower	Spreading shrub to waist high with dark green serrated leaves and blue fan-like flowers in clusters.	80

Table 18 (cont.): Species Recommended for Rehabilitation in Management Zone 5

Scientific Name	Common Name	Plant Characteristics	Number Required
<i>Senecio pinnatifolius</i> (formerly <i>S. lautus</i>)	Variable Groundsel	Attractive annual or biennial herb to knee high. Bright green leaves with yellow flowers.	50
<i>Spinifex hirsutus</i> (formerly <i>S. sericeus</i>)	Hairy Spinifex	Important coloniser species. Light green hardy grass, growing to shin high with large spiky seeds. Ideal for sand stabilisation.	40
<i>Tetragonia implexicoma</i>	Bower Spinach	Succulent perennial, either ground running or creeper. Leaves thick and fleshy, green in colour. Flowers small and yellow, small fruits green changing to red/ black when ripe.	370
<i>Threlkeldia diffusa</i>	Coastal Bonefruit	A low groundcover with green/ maroon succulent foliage.	70
TOTAL			4053

There have been some issues with gall wasp on *Acacia* species at the nearby Semaphore Park dunes. Trees For Life conducted an experiment cutting the galls off *Acacias* and found those with the galls removed recovered better than those with the galls still present (Hemmings in Petherick, 2004, pers. comm.). It is recommended that this control technique be adopted if galls become an issue at Tennyson Dune Reserve.

9. Summary of Management Recommendations/Suggestions

Report Location/ Management Issue	Key Points/ Recommendations
4.2.1 Indigenous Vegetation	<p>The Reserve has been divided into the following vegetation communities that will act as a guide for future rehabilitation works:</p> <ul style="list-style-type: none"> • <i>Spinifex hirsutus</i> with emergent <i>Olearia axillaris</i> and <i>Atriplex cinerea</i> <u>Open Grassland</u> • <i>Olearia axillaris/Rhagodia candolleana</i> ssp. <i>candolleana</i> <u>Low Open Shrubland</u> • <i>Olearia axillaris/Leucopogon parviflorus</i> +/- <i>Nitraria billardierei</i> <u>Low Shrubland</u> • <i>Leucopogon parviflorus/Melaleuca lanceolata</i> +/- <i>Olearia axillaris</i> <u>Open Shrubland</u> • <i>Allocasuarina verticillata/Melaleuca lanceolata</i> <u>Tall Shrubland</u>
4.2.4 Significant Plant Communities	<p>To preserve and restore the Tennyson dunes it is recommended that:</p> <ul style="list-style-type: none"> • the State Government, in conjunction with the City of Charles Sturt, investigate options for awarding Tennyson Dune Reserve a conservation status. <p>Formal acknowledgement of the ecological and historical importance of the Reserve will contribute greatly to its long term preservation and restoration.</p>
4.3.1 Native Fauna	<p>It is recommended that:</p> <p><i>Adriana quadripartita</i> (Rare Bitterbush) continue to be included in revegetation works to assist in the creation of a corridor for Bitter-bush Blue Butterfly (<i>Theclinesthes albocincta</i>).</p>
8.1.1 Fragmentation	<p>To improve the condition, resilience and long term viability of Tennyson Dune Reserve, it is recommended that:</p> <ul style="list-style-type: none"> • Strategic vegetation buffers are established utilising indigenous species. • Species richness is increased through species reinstatement to reflect the original diversity of the dunes • Increase numbers of less common species currently existing on site • Improved management of future seed and vegetative material collection activities • Plants grown from seed and vegetative material collected from the site are established in other nearby locations • A small percentage (5-10%) of material collected for propagation purposes and used in rehabilitation works be collected from other remnant sites • A coastal landscape linkage is established along (and beyond) the City of Charles Sturt coastline, linking sites of significance.
8.1.2 Weeds	<p>Weeds are the greatest threat to biodiversity within the Reserve. Some species are in low abundance and are therefore easily eradicated. These should receive attention before those that have already become widespread. Refer to Section 8.1.2, Appendices 3-4 and weed control recommendations in individual Management Zones for low abundance species.</p> <p><i>Lycium ferocissimum</i> (Boxthorn) is classified as the highest priority weed throughout the Reserve due to its long history of affecting biodiversity. It is important that Boxthorn removal continues in the Reserve.</p> <p><i>Trachyandra divaricata</i> (Dune Onion Weed) is the second highest priority weed for the Reserve as it also presents a serious threat to biodiversity. Experience within the Port Adelaide region shows the weed has the ability to form vast monocultures and out-compete native vegetation. It is critical that Dune Onion Weed does not become established within Tennyson Dune Reserve. All plants discovered should be removed immediately, with any seedheads securely bagged. The location of these plants should be reported promptly to the City of Charles Sturt Coastal Officer for GPS referencing.</p>

9 (cont.) Summary of Management Recommendations/Suggestions

Report Location/ Management Issue	Key Points/ Recommendations
8.1.2 (cont.) Weeds	<p>Control of other priority weed species must be closely linked with appropriate revegetation and habitat replacement techniques.</p> <p>It is recommended that: Council investigate the possibilities of placing an encumbrance on dune frontage properties in respect to what species may or may not be planted in gardens abutting the Reserve.</p> <p>Monitoring</p> <p>It is suggested that:</p> <ul style="list-style-type: none"> • Site assessments are undertaken every two years using the <i>NCS Bushland Condition Monitoring Manual Southern Mount Lofty Ranges Coastal Version</i> to assess the success of this control strategy and record changes in the weed's distribution.
8.1.3 Fire	<p>Tennyson Dune Reserve is generally considered a low-fire risk area given the low fuel load present in the dunes. The risk is increased near adjacent housing areas, where introduced annual grasses and woody weeds increase fuel loads.</p> <p>In the event of fire, vehicular access is possible along Military Road, Estcourt Road or Bournemouth Avenue.</p> <p>It is recommended that:</p> <ul style="list-style-type: none"> • areas of increased risk receive regular slashing and herbicide application with follow-up plantings of appropriate indigenous species.
8.1.4 Access and Fencing	<p>It is recommended that:</p> <ul style="list-style-type: none"> • The land landowners/managers, in conjunction with the State Government, investigate options for effective policing of coastal reserves, with particular focus on Tennyson Dune Reserve. • All garden incursions to be removed in stages followed by rehabilitation using appropriate indigenous species. • The number of formal access paths be reviewed and fencing be installed at strategic locations to prevent informal access into the dunes. • It is recommended therefore, that Council investigate options for addressing local resident access in the area between Coronado Court and Shore Court, West lakes Shore. • Options are investigated for creating clear boundary delineation between properties with dune frontage and the dunes (from Coronado Court to the northern end of the Reserve) to discourage goat tracks and the encroachment of alien garden species, irrigation and landscaping.
8.1.5 Erosion	<p>It is recommended that:</p> <ul style="list-style-type: none"> • Council's policy of constructing dune forming fences (between October and early December) at various localities along the Reserve continue in conjunction with the Coast Protection Board's policy of sand carting, to aid the reconstruction and protection of the dunes. <p>Of particular concern, is a 100m section of dune immediately north of Bournemouth Avenue, Tennyson, where erosive processes have removed the foredune. Further storm damage may threaten rare plant populations in the near vicinity.</p>
8.1.6 Introduced Fauna	<p>It is recommended that:</p> <ul style="list-style-type: none"> • The control of foxes and rabbits should continue to occur in alignment with the Federal Government's <i>Threat Abatement Plans</i>. • An audit of dog litter stations occur and additional stations be installed at strategic locations if required. These should include bags for waste and signage outlining the reasons why dogs should not enter the dunes.

9 (cont.) Summary of Management Recommendations/Suggestions

Report Location/ Management Issue	Key Points/ Recommendations
8.1.6 (cont.) Introduced Fauna	<ul style="list-style-type: none"> • Council adjust By-Laws to state that dogs should be on leads at all times within the Reserve and on the foreshore adjacent the Reserve. • It is recommended that the landowners/managers, and the local authorised Pest Plant and Animal Control Officer, investigate options for the effective control of stray and domestic cats.
8.2 Management Issues and Strategies within each Management Zone	<p>Targeted and staged weed control must be a high priority. Planting of indigenous colonising species should occur to stabilise any disturbed areas. Recommended species and numbers for each Management Zone are described in Sections 8.2.1 - 8.2.5.</p> <p>The Nature Conservation Society's <i>Bushland Condition Monitoring Manual Southern Mount Lofty Ranges Coastal Version</i> should be adopted to monitor changes in the Reserve's condition over time and will involve annual site audits. In addition, photopoints are to be established to monitor changes in vegetation over time (refer to UFBP website for correct photopoint monitoring technique).</p> <p>Priority weed lists for each Management Zone detail weeds specific to those zones, their distributions and recommended control strategies.</p> <p>It is important that weeds are replaced with appropriate indigenous vegetation to enhance biodiversity, provide habitat, prevent erosion and assist with weed control (refer to relevant tables and Appendices 7-9 for images of indigenous species and revegetation techniques).</p> <p>Seed for rehabilitation projects should be of local provenance.</p> <p>It is recommended that:</p> <ul style="list-style-type: none"> • Native vegetation surveys are undertaken prior to rehabilitation works to determine the locality of sensitive or conservation rated species. <p>Management Zone 1 The foredune is subject to extreme changes in shoreline position. This needs to be considered when managing this area as there is a high probability that significant changes will occur. Planting in the rear foredune area will provide a good stock of indigenous plants that may then naturally spread to the front of the foredune.</p> <p>It is recommended that:</p> <ul style="list-style-type: none"> • Rehabilitation works occur to enhance biodiversity within the Reserve and to stabilise areas affected by natural dune recession. <p>Management Zone 2 It is recommended that:</p> <ul style="list-style-type: none"> ▪ Management focus on managing the whole of reserve issues along with sensitive weed control and low scale supplementary plantings of structural and rarer species. <p>Management Zone 3: Management Zone 3 has been subdivided into Zones 3a and 3b.</p> <p>It is recommended that:</p> <ul style="list-style-type: none"> ▪ Efforts should focus on addressing the whole of reserve issues (detailed in Section 8.1), along with sensitive weed control and low scale supplementary plantings of structural and rarer species. ▪ Areas affected by garden encroachments (Management Zone 3b) be managed on a case by case basis, with emphasis being on rehabilitating the least affected areas first.

9 (cont.) Summary of Management Recommendations/Suggestions

Report Location/ Management Issue	Key Points/ Recommendations
<p>8.2 (cont.) Management Issues and Strategies within each Management Zone</p>	<p>Management Zone 4: Management Zone 4 has been sub-divided into Zones 4a and 4b.</p> <p>It is recommended that:</p> <p>Emphasis is on managing the whole of reserve issues along with sensitive weed control and low scale supplementary plantings of structural and rarer species.</p> <ul style="list-style-type: none"> • Long-term rehabilitation of Management Zone 4b aim at controlling priority woody weeds, <i>Ehrharta calycina</i> (Perennial Veldt Grass) and <i>Arctotis stoechadifolia</i> (White Arctotis), whilst reinstating the dominant plant association. <p>Management Zone 5: It is recommended that:</p> <ul style="list-style-type: none"> ▪ Trials are undertaken to control <i>Ehrharta calycina</i> (Perennial Veldt Grass) to adequately rehabilitate the site.

10. Implementation Schedule and Approximate Budgets

The following budget outlines on-ground works to be implemented over a five-year period within Tennyson Dune Reserve in accordance with recommendations featured in this Management Plan. As this is a flexible document, the five-year time frame may be adjusted according to works completed in previous years and funding availability. Specific project schedules based on this implementation schedule and budget will be developed by the landowners/managers and the SA Urban Forest Biodiversity Program on an annual basis.

Management of the coast is a joint responsibility and as such, funding will need to be sourced accordingly. The landowners/managers will actively seek external funding for implementation of this Plan. Some of the possible funding bodies include the SA Urban Forest Million Trees Program, Department for Environment and Heritage Coastal Protection Branch, Coast Park and the Adelaide Mount Lofty Ranges Natural Resource Management Board. These options will need to be explored in addition to utilising part of Council's Coastal Management Plan funding; assuming annual operating budget bids are successful.

In addition to the potential funding bodies, programs such as Green Corps, Youth Conservation Corps, Conservation Volunteers Australia, Maxima Horticultural Trainees, school groups and Dunecare volunteers could undertake works, all of which will add to the in-kind contribution and reduce actual costs to Council.

VEGETATION MANAGEMENT PLAN, TENNYSON DUNE RESERVE

Year 1: July 2007 - June 2008															
Action	JULY					AUGUST					SEPTEMBER				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	5	10	15	10	15	5	10	15	10	15	5	10	15	10	15
Weed Control (cost)	\$200	\$400	\$600	\$400	\$600	\$200	\$400	\$600	\$400	\$600	\$200	\$400	\$600	\$400	\$600
Monthly Total per Zone	\$200	\$400	\$600	\$400	\$600	\$200	\$400	\$600	\$400	\$600	\$200	\$400	\$600	\$400	\$600
Monthly Total for Site	\$2,200					\$2,200					\$2,200				
Action	OCTOBER					NOVEMBER					DECEMBER				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	5	10	15	10	15	5	10	15	10	10	5	5	15	5	5
Weed Control (cost)	\$200	\$400	\$600	\$400	\$600	\$200	\$400	\$600	\$400	\$400	\$200	\$200	\$600	\$200	\$200
Order Tubestock (# tubes)	185	465	2,025	1,706	1,170										
Purchase Tubestock	\$222	\$558	\$2,430	\$2,047	\$1,404										
Monthly Total per Zone	\$422	\$958	\$3,030	\$2,447	\$2,004	\$200	\$400	\$600	\$400	\$400	\$200	\$200	\$600	\$200	\$200
Monthly Total for Site	\$8,861					\$2,000					\$1,400				
Action	JANUARY					FEBRUARY					MARCH				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	2.5	2.5	15	2.5	2.5	2.5	2.5	15	2.5	2.5	2.5	2.5	7.5	2.5	2.5
Weed Control (cost)	\$100	\$100	\$600	\$100	\$100	\$100	\$100	\$600	\$100	\$100	\$100	\$100	\$300	\$100	\$100
Monthly Total per Zone	\$100	\$100	\$600	\$100	\$100	\$100	\$100	\$600	\$100	\$100	\$100	\$100	\$300	\$100	\$100
Monthly Total for Site	\$1,000					\$1,000					\$700				
Action	APRIL					MAY					JUNE				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	2.5	2.5	7.5	2.5	2.5	5	5	7.5	5	10	5	10	10	10	15
Weed Control (cost)	\$100	\$100	\$300	\$100	\$100	\$200	\$200	\$300	\$200	\$400	\$200	\$400	\$400	\$400	\$600
Revegetation (# tubes)						185	465	2,025	1,706	1,170					
Revegetation (cost)						\$377	\$949	\$4,131	\$3,480	\$2,387					
Monthly Total per Zone	\$100	\$100	\$300	\$100	\$100	\$577	\$1,149	\$4,431	\$3,680	\$2,787	\$200	\$400	\$400	\$400	\$600
Monthly Total for Site	\$700					\$12,624					\$2,000				
Annual Total per Zone											\$2,599	\$4,707	\$12,661	\$8,727	\$8,191
Annual Total for Site											\$36,885				

Year 2: July 2008 -June 2009

Action	JULY					AUGUST					SEPTEMBER				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	5	10	15	10	15	5	10	15	10	15	5	10	15	10	15
Weed Control (cost)	\$208	\$416	\$624	\$416	\$624	\$208	\$416	\$624	\$416	\$624	\$208	\$416	\$624	\$416	\$624
Monthly Total per Zone	\$208	\$416	\$624	\$416	\$624	\$208	\$416	\$624	\$416	\$624	\$208	\$416	\$624	\$416	\$624
Monthly Total for Site	\$2,288					\$2,288					\$2,288				

Action	OCTOBER					NOVEMBER					DECEMBER				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	5	5	15	10	10	5	5	8	5	5	5	5	7.5	5	5
Weed Control (cost)	\$208	\$208	\$624	\$416	\$416	\$208	\$208	\$312	\$208	\$208	\$208	\$208	\$312	\$208	\$208
Order Tubestock (# tubes)	190	395	1,240	1,147	1,060										
Purchase Tubestock	\$236	\$490	\$1,538	\$1,422	\$1,314										
Fencing and Signage						\$3,500									
Monthly Total per Zone	\$444	\$698	\$2,162	\$1,838	\$1,730	\$3,708	\$208	\$312	\$208	\$208	\$208	\$208	\$312	\$208	\$208
Monthly Total for Site	\$6,872					\$4,644					\$1,144				

Action	JANUARY					FEBRUARY					MARCH				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	2.5	2.5	7.5	2.5	2.5	2.5	2.5	7.5	2.5	2.5	2.5	2.5	7.5	2.5	2.5
Weed Control (Cost)	\$104	\$104	\$312	\$104	\$104	\$104	\$104	\$312	\$104	\$104	\$104	\$104	\$312	\$104	\$104
Monthly Total per Zone	\$104	\$104	\$312	\$104	\$104	\$104	\$104	\$312	\$104	\$104	\$104	\$104	\$312	\$104	\$104
Monthly Total for Site	\$728					\$728					\$728				

Action	APRIL					MAY					JUNE				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	5	5	7.5	5	10	5	5	7.5	5	10	5	10	8	10	15
Weed Control (cost)	\$208	\$208	\$312	\$208	\$416	\$208	\$208	\$312	\$208	\$416	\$208	\$416	\$312	\$416	\$624
Revegetation (# tubes)						190	395	1,240	1,147	1,060					
Revegetation (cost)						\$410	\$853	\$2,678	\$2,478	\$2,290					
Monthly Total per Zone	\$208	\$208	\$312	\$208	\$416	\$618	\$1,061	\$2,990	\$2,686	\$2,706	\$208	\$416	\$312	\$416	\$624
Monthly Total for Site	\$1,352					\$10,061					\$1,976				

Annual Total per Zone											\$6,330	\$4,359	\$9,208	\$7,124	\$8,076
Annual Total for Site											\$35,097				

Year 3: July 2009 -June 2010

Action	JULY					AUGUST					SEPTEMBER				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	5	10	10	10	15	5	10	10	10	15	5	10	10	10	15
Weed Control (cost)	\$216	\$432	\$432	\$432	\$648	\$216	\$432	\$432	\$432	\$648	\$216	\$432	\$432	\$432	\$648
Monthly Total per Zone	\$216	\$432	\$432	\$432	\$648	\$216	\$432	\$432	\$432	\$648	\$216	\$432	\$432	\$432	\$648
Monthly Total for Site	\$2,160					\$2,160					\$2,160				

Action	OCTOBER					NOVEMBER					DECEMBER				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	5	10	10	10	15	5	10	8	10	15	5	5	7.5	5	5
Weed Control (cost)	\$216	\$432	\$432	\$432	\$648	\$216	\$432	\$324	\$432	\$648	\$216	\$216	\$324	\$216	\$216
Order Tubestock (# tubes)	165	325	960	930	920										
Purchase Tubestock	\$211	\$416	\$1,229	\$1,190	\$1,178										
Fencing and Signage						\$3,500									
Monthly Total per Zone	\$427	\$848	\$1,661	\$1,622	\$1,826	\$3,716	\$432	\$324	\$432	\$648	\$216	\$216	\$324	\$216	\$216
Monthly Total for Site	\$4,558					\$5,552					\$1,188				

Action	JANUARY					FEBRUARY					MARCH				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	7.5	2.5	2.5
Weed Control (cost)	\$108	\$108	\$108	\$108	\$108	\$108	\$108	\$108	\$108	\$108	\$108	\$108	\$324	\$108	\$108
Monthly Total per Zone	\$108	\$108	\$108	\$108	\$108	\$108	\$108	\$108	\$108	\$108	\$108	\$108	\$324	\$108	\$108
Monthly Total for Site	\$540					\$540					\$756				

Action	APRIL					MAY					JUNE				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	5	5	5	5	10	5	5	5	5	10	5	10	10	10	15
Weed Control (cost)	\$216	\$216	\$216	\$216	\$432	\$216	\$216	\$216	\$216	\$432	\$216	\$432	\$432	\$432	\$648
Revegetation (# tubes)						165	325	960	930	920					
Revegetation (cost)						\$370	\$728	\$2,150	\$2,083	\$2,061					
Monthly Total per Zone	\$216	\$216	\$216	\$216	\$432	\$586	\$944	\$2,366	\$2,299	\$2,493	\$216	\$432	\$432	\$432	\$648
Monthly Total for Site	\$1,296					\$8,688					\$2,160				

Annual Total per Zone											\$6,349	\$4,708	\$7,159	\$6,838	\$8,530
Annual Total for Site	\$33,584														

Year 4: July 2010 -June 2011

Action	JULY					AUGUST					SEPTEMBER				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	5	10	10	10	15	5	10	10	10	15	5	10	10	10	15
Weed Control (cost)	\$224	\$448	\$448	\$448	\$672	\$224	\$448	\$448	\$448	\$672	\$224	\$448	\$448	\$448	\$672
Monthly Total per Zone	\$224	\$448	\$448	\$448	\$672	\$224	\$448	\$448	\$448	\$672	\$224	\$448	\$448	\$448	\$672
Monthly Total for Site	\$2,240					\$2,240					\$2,240				

Action	OCTOBER					NOVEMBER					DECEMBER				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	5	5	10	10	15	5	5	10	10	15	5	5	5	5	5
Weed Control (cost)	\$224	\$224	\$448	\$448	\$672	\$224	\$224	\$448	\$448	\$672	\$224	\$224	\$224	\$224	\$224
Order Tubestock (# tubes)	120	295	240	180	903										
Purchase Tubestock	\$158	\$389	\$317	\$238	\$1,192										
Monthly Total per Zone	\$382	\$613	\$765	\$686	\$1,864	\$224	\$224	\$448	\$448	\$672	\$224	\$224	\$224	\$224	\$224
Monthly Total for Site	\$4,310					\$2,016					\$1,120				

Action	JANUARY					FEBRUARY					MARCH				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Weed Control (cost)	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112
Monthly Total per Zone	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112	\$112
Monthly Total for Site	\$560					\$560					\$560				

Action	APRIL					MAY					JUNE				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	2.5	2.5	2.5	2.5	2.5	5	5	5	5	5	5	5	10	10	15
Weed Control (cost)	\$112	\$112	\$112	\$112	\$112	\$224	\$224	\$224	\$224	\$224	\$224	\$224	\$448	\$448	\$672
Revegetation (# tubes)						120	295	240	180	903					
Revegetation (cost)						\$278	\$684	\$557	\$418	\$2,095					
Monthly Total per Zone	\$112	\$112	\$112	\$112	\$112	\$502	\$908	\$781	\$642	\$2,319	\$224	\$224	\$448	\$448	\$672
Monthly Total for Site	\$560					\$5,152					\$2,016				

Annual Total per Zone											\$2,677	\$3,986	\$4,458	\$4,239	\$8,215
Annual Total for Site	\$23,574														

Year 5: July 2011 -June 2012

Action	JULY					AUGUST					SEPTEMBER				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	10	10	10	10	15	5	10	10	10	15	5	10	10	10	15
Weed Control (cost)	\$464	\$464	\$464	\$464	\$696	\$232	\$464	\$464	\$464	\$696	\$232	\$464	\$464	\$464	\$696
Monthly Total per Zone	\$464	\$464	\$464	\$464	\$696	\$232	\$464	\$464	\$464	\$696	\$232	\$464	\$464	\$464	\$696
Monthly Total for Site	\$2,552					\$2,320					\$2,320				

Action	OCTOBER					NOVEMBER					DECEMBER				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	5	5	10	10	15	5	5	10	10	10	5	5	5	5	5
Weed Control (cost)	\$232	\$232	\$464	\$464	\$696	\$232	\$232	\$464	\$464	\$464	\$232	\$232	\$232	\$232	\$232
Monthly Total per Zone	\$232	\$232	\$464	\$464	\$696	\$232	\$232	\$464	\$464	\$464	\$232	\$232	\$232	\$232	\$232
Monthly Total for Site	\$2,088					\$1,856					\$1,160				

Action	JANUARY					FEBRUARY					MARCH				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Weed Control (cost)	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116
Monthly Total per Zone	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116	\$116
Monthly Total for Site	\$580					\$580					\$580				

Action	APRIL					MAY					JUNE				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Weed Control (hours)	2.5	2.5	2.5	2.5	2.5	5	5	5	5	10	5	5	10	5	15
Weed Control (cost)	\$116	\$116	\$116	\$116	\$116	\$232	\$232	\$232	\$232	\$464	\$232	\$232	\$464	\$232	\$696
Monthly Total per Zone	\$116	\$116	\$116	\$116	\$116	\$232	\$232	\$232	\$232	\$464	\$232	\$232	\$464	\$232	\$696
Monthly Total for Site	\$580					\$1,392					\$1,856				

Annual Total per Zone											\$2,552	\$3,016	\$3,712	\$3,480	\$5,104
Annual Total for Site	\$17,864														

Glossary

accretion:	the accumulation of sand.
achene:	a dry, indehiscent, one-seeded fruit, as in the daisy family.
allelopathic:	the harmful effect of one organism on another by the release of inhibiting compounds.
alternate:	leaves or flowers inserted individually at different heights along the branches.
awn:	a needle-like appendage or stiff bristle.
axil:	angle between the upper surface of a leaf or bract and the stem to which it is attached.
bog method:	the placing of a propagating tray (with soil) into a bed of water allowing contents to remain wet without watering from above.
degradation:	any decline in the quality of natural resources or the viability of <i>ecosystems</i> , caused directly or indirectly by human activities.
depressed:	flattened from above downwards.
dioecious:	male and female flowers developing on different individuals.
drupe:	a fruit in which the pericarp consists of three layers: (1) the epicarp or skin, (2) the mesocarp or juicy layer, and (3) the bony endocarp or stone; within the endocarp lies the seed or kernel. An example is the peach or the local <i>Nitraria billardierei</i> (Nitre Bush).
edge effects (& ratio):	a consequence of habitat fragmentation whereby there is an increase in the perimeter to edge ratio. That is, as fragmentation makes patches of habitat smaller and smaller, the ratio of edge to interior increases disproportionately. The physical environment near an edge is often windier, drier and warmer in summer and cooler in the winter, thus providing for the encroachment of more invasive weed and animal species.
ellipsoid:	a 3-dimensional oval shape.
elliptic:	when a flat surface, such as that of a leaf, has rounded ends and is broadest near the middle.
endocarp:	the innermost layer of the pericarp.
enhancement:	the introduction to a place of additional individuals of one or more <i>organisms</i> , species or elements of <i>habitat</i> or <i>geodiversity</i> that naturally exist there.
foredune:	the first line of sand dunes adjacent to the beach which is characteristically colonised by grasses and herbs.
fragment	restricted areas of habitat surrounded by areas of destroyed habitat.
glaucous:	bluish-green, usually of a pale tint.
globular:	rounded like a globe or sphere (= globose).
hind dunes:	the subsequent lines of sand dunes running parallel to and on the landward side of the foredunes and colonised by low trees and shrubs.
incipient dune:	most seaward, newly forming dune of the dune system that is often changing due to coastal processes such as sand accretion and erosion.

indehiscent:	of fruits that do not split open to release their seeds.
inflorescence:	the arrangement of flowers on a stem.
lanceolate:	shaped like the head of a lance - tapering at both ends but broadest below the middle.
linear:	long and narrow, with parallel edges.
node:	the swollen part of the stem from which the leaves, branches or roots emerge.
oblanceolate:	a shape (e.g., of a leaf) with its length about five times the width, the widest part above the centre and tapering toward the base.
oblong:	much longer than broad, and rounded at both ends.
obovate:	ovate with the broadest part above the middle.
orbicular:	flat, circular or almost so.
ovate:	when a flat surface, such as that of a leaf, is egg-shaped and broader below the middle.
ovoid:	egg-shaped with the narrower end at the base (of solid organs such as fruits).
pappus:	a ring of fine hairs or scales which surround the fruit in composite plants; aids seed dispersal by the wind.
peduncle:	stalk of a solitary flower, or common stalk of an inflorescence.
pericarp:	the fruit wall, developed from the ovary wall.
phyllode:	a leaf whose blade is reduced or absent and whose petiole (stalk) assumes the function of the whole leaf.
prostrate:	lying flat on the ground.
provenance:	geographic origin of the parent plant material.
pubescent:	covered with fine hairs.
reinstatement:	to introduce to a <i>place</i> one or more species or elements of <i>habitat</i> or <i>geodiversity</i> that are known to have existed there naturally at a previous time but that can no longer be found at that <i>place</i> .
restoration:	returning existing <i>habitats</i> to a known past state or to an approximation of the natural condition by repairing degradation , by removing introduced species, or by reinstatement .
rhizome:	a perennial underground stem, which is usually horizontal.
sessile:	without a stalk.
spike:	an undivided floral axis (peduncle) bearing sessile flowers.
stratification:	the subjection of seeds to periods (usually a few weeks) of low temperatures to break seed dormancy.
swale:	the low-lying area between two sand dunes.
terate:	cylindrical.
terminal:	situated at the tip.
toothed:	of a leaf, deeply and sharply lobed.
zonation:	the arrangement of vegetation communities in zones in response to variations in environmental conditions.

References

- Auld, B.A. and Medd, R.W., 1987, *Weeds: An Illustrated Guide to the Weeds of Australia*, Inkata Press, Melbourne and Sydney.
- Australian Government, 2004, Department of the Environment and Heritage, *Revegetate*, www.deh.gov.au/land/vegetation/reveg.html;
- Australian Government, 2004, Department of the Environment and Heritage, *Threat Abatement Plans*, Available: www.deh.gov.au/biodiversity/threatened/tap/index.html
- Australian Government, 2004, Natural Resource Management (online), Available: www.nrm.gov.au.
- Black, J.M., 1986, *Flora of South Australia*, vol. 3, 4th Edition, Government of South Australia, Adelaide.
- Blood, K., 2001, *Environmental Weeds: A Field Guide for South East Australia*, CH Jerram Science Publishers, Victoria.
- Bonney, N., 1994, *What Seed is That?*, Finsbury Press Pty. Ltd., Adelaide.
- Brundtland, G. (ed), 1987, *Our Common Future: The World Commission on Environment and Development*, Oxford University Press, Oxford.
- Cleland, J.B., 'The Flora Between Outer Harbour and Sellick's Beach, South Australia', *The South Australian Naturalist* Vol. XIV, no. 2, pp. 45-48.
- Commonwealth of Australia, 1995, *Living on the Coast: The Commonwealth Coastal Policy* (online), Available: [http://www.deh.gov.au/coasts/publications/coastal - policy/index.html](http://www.deh.gov.au/coasts/publications/coastal-policy/index.html)
- Commonwealth of Australia, 2002, *Programs of the First Phase of the NHT: Coastcare* (online), Available: <http://www.nht.gov.au/nht1/programs/coastcare/#objectives>.
- Commonwealth of Australia, 2004, *Programs of the First Phase of the NHT: Coast and Clean Seas* (online), Available: <http://www.nht.gov.au/nht1/programs/ccs/>.
- Couper-Smartt, J., 2003, *Port Adelaide: Tales from a "Commodious Harbour"*, Friends of S.A. Maritime Museum, Adelaide.
- Croft, S, Milne, T. and Pedler, J., 2005, *Bushland Condition Monitoring Manual, Southern Mount Lofty Ranges Coastal Version*, Nature Conservation Society, Adelaide.
- Culver, R., 1970, *Beach Erosion Assessment Study – Summary Report*, Civil Engineering Department, University of Adelaide, Adelaide.
- Department for Environment and Heritage (DEH), 2004, *The Management of Adelaide's Beaches* (online), Available: www.environment.sa.gov.au/coasts/adelcoast.html.
- Department for Environment and Heritage (DEH), 2005, *Adelaide's Living Beaches – A Strategy for 2005-2025*, DEH, Adelaide
- Department of Environment and Planning, South Australia, 1987, *The Fragile Environment - Coastal Sand Dunes*, DEP, Adelaide.
- Dyer, J., 2003, *The West Lakes Story* (Draft), in possession of the City of Charles Sturt, Adelaide.
- Environment Protection Authority, 2003, *State of the Environment Report for South Australia 2003*, EPA, Adelaide.

- Forster, C., 1995, *Australian Cities Continuity and Change*, Oxford University Press, Melbourne.
- Gara, T., 2004, *Aboriginal Fringe-dwellers in Adelaide in the late 19th – Early 20th Centuries* (online), Available: www.history.sa.gov.au
- Gibbs, J., 2001, *Grass Identification Manual*, Native Grass Resources Group Inc., Adelaide.
- Government of Western Australia, 2003, *Coastal Planning and Management Manual: A Community Guide for Protecting and Conserving the Western Australian Coast*, Western Australian Planning Commission, Perth.
- Greening Australia (South Australia) Inc., 2002, *Rehabilitation and Management Plan for the West Beach Dune System*, Adelaide.
- Hall, F., 2003, 'Out on a limb: the meaning of isolation for remnants', *Thinking Bush*, Issue 2, pp. 6-9.
- Harvey, N. and Caton, B., 2003, *Coastal Management in Australia*, Oxford University Press, Melbourne.
- Heyligers, P.C., 1998, *Dispersal of Gladiolus Guernzii and Trachyandra divaricata in Australia* (online), Available: www.science.uts.edu.au/sasb/monocotsIIAb2.html.
- Heyligers, P.C., 2002, The occurrence of *Tetragonia decumbens* and *Trachyandra divaricata* in South Australia, *The Western Australian Naturalist*, vol. 23, No. 3.
- ID&A, 2000, *Port Adelaide Enfield Coastal Management Plan*, ID&A Natural Resource Managers, Adelaide
- Kaurna Warra, 2006, <http://kaurna.tripod.com/>
- Kinhill Pty Ltd, 2002, *City of Charles Sturt, Coastal Management Plan 2002-2007*, Kinhill Pty Ltd, Adelaide.
- Kraehenbuehl, D., 1996, *Pre-European Vegetation of Adelaide: A Survey from the Gawler River to Hallett Cove*, Nature Conservation Society of South Australia Inc., Adelaide.
- Lamp, C.A., Forbes, S.J., and Cade, J.W., 2001, *Grasses of Temperate Australia: A Field Guide*, CH Jerram Science Publishers and Bloomings Books, Melbourne.
- Laut, P., Heyligers, P.C., Keig, G., Loffler, E., Margules, C., Scott, R.M. and Sullivan, M.E., 1977, *Environments of South Australia*, Division of Land Use Research CSIRO, Canberra.
- MacArthur, R.H., Wilson, E.O., 2001, *The Theory of Island Biogeography*, Princeton University Press.
- McIntyre, S., Hobbs, R.J., 2000, Human impacts on landscapes: matrix condition and management priorities, *Nature Conservation 5, Conservation in Production Environments: Managing the Matrix*, Surrey Beatty and Sons, Chipping Norton.
- Muyt, A., 2001, *Bush Invaders of South-East Australia*, R.G and F.J. Richardson, Victoria.
- Mount Lofty Ranges Interim Integrated Natural Resource Management Group (MLR IINRM Group), 2003, *Integrated Natural Resource Management Plan for the Mount Lofty Ranges and Greater Adelaide Region*, MLR INRM Group, Adelaide.
- Natural and Cultural Heritage Department for Environment and Heritage
New South Wales Department of Land and Water Conservation, 2001, *Coastal Dune Management: A Manual of Coastal Dune Management and Rehabilitation Techniques*, Coastal Unit, DLWC, Newcastle.

- Parsons, W.T. and Cuthbertson, E.G., 1992, *Noxious Weeds of Australia*, Inkata Press, Melbourne and Sydney.
- Petherick, C.E., 2004, *Vegetation Management Plan for the Semaphore South Dune Reserve*, SA Urban Forest Biodiversity Program, Adelaide.
- Petherick, C.E., 2005, *Vegetation Management Plan for the Semaphore Dune Reserve*, SA Urban Forest Biodiversity Program, Adelaide.
- Playfair, R., 1999, *Port Adelaide Enfield- Shared-use Path Largs Jetty to North Haven: Flora, Fauna and Soils Studies*, Resource Monitoring and Planning Pty Ltd, Adelaide.
- PPK Environment and Infrastructure, 2001, *Adelaide Metropolitan Coast Park Concept Plan*, Planning SA, Adelaide.
- Ralph, M., 2003, *Growing Australian Native Plants from Seed*, Murray Ralph/Bushland Horticulture, Melbourne.
- Resource Assessment Commission, 1993, *Coastal Zone Enquiry: Final Report*, Australian Government Publishing Service, Canberra.
- Robertson, M., 1994, *Stop Bushland Weeds – A Guide to Successful Weeding in South Australia's Bushland*, The Nature Conservation Society of South Australia Inc., Adelaide.
- Selby, J., 1984, *Geology and the Adelaide Environment*, Department of Mines and Energy SA, Adelaide.
- South Australian Coast Protection Board, 1993a, 'Maintaining the Adelaide Coastline', *Coastline*, No. 28, September, Department for Environment and Heritage, Adelaide.
- South Australian Coast Protection Board, 1993b, 'The Adelaide Metropolitan Coastline', *Coastline*, No. 27, April, Department for Environment and Heritage, Adelaide.
- South Australian Coast Protection Board, 2003, 'Garden Plants that are Known to Become Serious Coastal Weeds', *Coastline*, No. 34, June, Department for Environment and Heritage, Adelaide.
- South Australian Coast Protection Board, N/D, *Seagrasses of South Australia* (brochure), Department for Environment and Heritage, Adelaide.
- Specht, R.L., 1972, *The Vegetation of South Australia*, Handbook of the Flora and Fauna of South Australia, SA Government Printer, Adelaide.
- Taylor, R., N/D, *A Handbook for Revegetation and Weed Control on the Southern Fleurieu Dunes* (CD-ROM), Coastcare.
- Telfer, S., 2001, *Vegetation Management Plan for Aldinga Beach Reserve*, EAC Ecological Evaluation, Adelaide.
- Turner, M.S., 2001, *Conserving Adelaide's Biodiversity: Resources, Urban Forest Biodiversity Program*, Adelaide.
- Urban Forest Biodiversity Program (UFBP), 2004, *The Urban Forest Biodiversity Program – Introduction to the Program* (online), Available: www.urbanforest.on.net/main.html.
- University of Delaware, 2003, *Program for the Global Conference on Oceans and Coasts at Rio +10: Toward the 2002 World Summit on Sustainable Development* (online). Available: www.udel.edu/CMS/csmp/globaloceans/pdf/Program.pdf.

Wanganeen, P., Brodie, V., O'Brien & Sparrow, S., 1996, 'The Kurna Perspective', *Environment SA*, Vol.5, No.3, pp. 24-25.

Personal Communications

Caton, Brian, 2004, Member South Australian Coast Protection Board, 27th May.

Caton, Brian, 2004, Member South Australian Coast Protection Board, 27th October.

Caton, Brian, 2005, Member South Australian Coast Protection Board, 15th January.

Cox, Stephen, 2005, Metropolitan Coast Communications Officer, 11th February.

Clutterham, Alicia, 2005, Coastal Officer, City of Charles Sturt, 12th January.

Clutterham, Alicia, 2005, Coastal Officer, City of Charles Sturt, 24th August.

Grund, Roger, 2003, Chairperson Butterfly Conservation South Australia, 21st March.

Hagan, Vicki, 2003, Bush-Anew, 5th August.

Harvey, Alison, 2004, Henley and Grange Dunecare, 5th January.

Hemmings, Pete, 2004, Owner Provenance Indigenous Plants, 19th February.

Minks, Paul, 2005, Civil Maintenance Team leader, City of Charles Sturt, 11th January.

Moore, John, 2003, Western Australian Department of Agriculture, 19th August.

Naylor, Christopher, 2006, local resident, 17th February.

Sandercock, Ron, 2003, Technical Officer – Coastal Protection Branch (DEH), 27th February.

Sandercock, Ron, 2004, Technical Officer – Coastal Protection Branch (DEH), 9th April.

Sandercock, Ron, 2005, Technical Officer – Coastal Protection Branch (DEH), 18th October.

Sandercock, Ron, 2005, Technical Officer – Coastal Protection Branch (DEH), 9th March.

Tucker, Rob, 2004, Manager, Coastal Protection Branch, 23rd December.

Turner, Matt, 2004, GIS/Technical Officer, SA Urban Forest Million Trees Program, 20th February.

Wales, Val, 2003, Semaphore Park Dunecare Group, 15th October.

Appendix 1: Context

International

The importance of coastal management was internationally recognised at the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992. This conference, commonly referred to as the 'Earth Summit', was a landmark event with the concept of sustainable development¹ being brought to the forefront and the creation of Local Agenda 21 (UNCED, 1992). Agenda 21 is essentially a framework for governments to implement a program of action to achieve sustainable development.

Chapter 17 of this document addresses the protection of oceans, seas and coastal areas, and was important in that it "recognised the need for new approaches to marine and coastal area management" at the international, national, sub-regional and regional levels (Harvey and Caton, 2003). The Earth Summit led to the development of principles in sustainable development for the coastal zone, with key recommendations including the following statement:

'Each coastal State should consider establishing, or where necessary strengthening, appropriate control mechanisms...for integrated management and sustainable development of coastal and marine areas and their resources, at both the local and national levels'.

(UNCED, Chapter 17, 1992)

The Earth Summit was followed by the Council of the Organisation for Economic Cooperation and Development (OECD) and the first World Coastal Conference (1993) which adopted and developed guidelines for 'integrated coastal management' (ID&A, 2000). As Harvey and Caton (2003) note, an integrated approach to coastal management (ICM) involves comprehensive assessment, defining objectives, planning and management of coastal systems and resources, recognising traditional, cultural and historical perspectives and conflicting interests and issues.

Over a decade on from the Earth Summit, the Oceans and Coast Rio+10 Global Conference held in Paris 2001, found there has been significant international and national investment in coastal and marine management, with a major increase in the number of nations undertaking such management. According to the Centre for the Study of Marine Policy (University of Delaware, 2003), 'International entities have done extensive work in providing guidance for sustainable development of coastal and marine resources, and national governments and communities are increasingly experimenting with models of management emphasizing sustainable development, integration and the precautionary approach'. It was acknowledged however, that there is still much work to be done to ensure that environmental, social and economic outcomes in coastal zone management are achieved in a sustainable manner.

National

These International initiatives provide a framework for national, state and local action plans to address coastal management issues in Australia.

The international push for improved coastal management that gained prominence after the Earth Summit was followed by a period of significant reform in coastal management in Australia in the 1990s. This reform stemmed from pressure within Australia and Commonwealth Government initiatives that together resulted in reviews of operation at both the Commonwealth and State levels of government. Thom and Harvey (in Harvey and Caton, 2003) identify four themes/ influences they believe have been key factors in generating this reform in Australia.

¹ Sustainable development is defined as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland, 1987).

These are:

- *Global Environmental Change*: Increasing acceptance of the concept of sustainable development, awareness of the potential magnitude of climate change;
- *Sustainable Development*: The Australian approach is termed 'ecologically sustainable development' (ESD), defined as "using, conserving and enhancing the community's resources so that ecological processes, on which life depends, and the total quality of life, now and in the future, can be increased" (AGDEH, 2004);
- *Integrated Natural Resource Management* and the development of *Integrated Coastal Management* (refer to page 76 for key elements of ICM);
- *Community Participation*: The influence of community-based movements, community taking on active and responsible roles, increasingly sharing planning and decision-making responsibilities with government.

Several initiatives at the national level have been significant in shaping coastal management in Australia, namely the Resource Assessment Commission's (RAC) *Coastal Zone Inquiry Final Report* (1993), the Australian Coastal Policy entitled '*Living on the Coast*' (1995) and the *Coast and Clean Seas* program (1997).

Coastal Zone Inquiry

This report examined the coastal management responsibilities of the three tiers of government in Australia and emphasised the need for a more integrated approach to coastal management, where the environment is treated in a holistic sense rather than broken down into separate elements (Harvey and Caton, 2003). The Inquiry recommended a national approach to coastal management be adopted due to the increasing pressures from population and development.

One of the key features of the report was the recommendation to adopt a *National Coastal Action Program*. It proposed the Program "involve all government, community and industry groups with responsibility for and interests in the management of coastal zone resources" (Resource Assessment Commission, 1993). The Action Program contained the following core elements (RAC, 1993):

- [Setting and defining] national coastal zone objectives
- Arrangements for implementing and managing the Program
- Mechanisms for community and industry involvement (such as the proposed Coastcare program)
- Innovative management mechanisms (i.e. broader and more effective use of management tools).

According to Harvey and Caton (2003), the report supplied a basis "for the development of a national coastal policy, and together with the National Action Program provided the impetus for getting basic agreement on coastal issues" from the three levels of government.

Australian Coastal Policy

The Australian Coastal Policy, entitled '*Living on the Coast*' (Commonwealth Government, 1995) arose from the Coastal Zone Inquiry. In addition to endorsing the concept of ESD, the Coastal Policy also outlines a number of specific objectives and principles, including sustainable resource use, integrated assessment, the precautionary principle, resource allocation, the user-pays principle, resource conservation, community participation, knowledge and understanding (Harvey and Caton, 2003).

The Policy supported the Coastal Zone Inquiry's recommendation for the need for a *National Action Program* and set an agenda for action. This agenda was designed to

“improve community involvement in coastal management, address coastal issues such as development and pollution, raise awareness and educate the community on coastal issues and promote expertise in neighbouring regions” (Harvey and Caton, 2003). The *National Action Program* contained a number of initiatives, including the Coastcare program, Commonwealth coastal strategic planning and local water quality management plans.

Coast and Clean Seas

The first phase of Natural Heritage Trust (NHT I, 1997) saw the establishment of the *Coasts and Clean Seas* program, a \$125 million investment over a four-year period. The program had an emphasis on practical 'hands on' projects aimed at improving management of Australia's natural resources and restoring, conserving and enhancing the coastal and marine environment (Commonwealth Government of Australia, 2004). The program required collaboration between community groups and State and Local Governments. *Coast and Clean Seas* enabled the extension of the *National Action Program*, with the continuation of programs including *Coastcare*, *Marine Protected Areas* and *Coastal Monitoring and Vulnerability*. In addition, a large proportion of the program's funds were allocated to the creation of a number of new initiatives, including *Clean Seas*, *Coastal and Marine Planning*, *Marine Species Protection*, the *Coastal Resource Atlas* and the *Oceans Policy* (Harvey and Caton, 2003).

Both Coastcare and the Coast and Clean Seas programs involved the signing of *Memoranda of Understanding*, which defined the way the Commonwealth, State and Local Governments would co-operate over these programs, providing the basis for integration between governments and agencies (Caton, 2004, pers. comm.).

State

The State Government is responsible for the protection of South Australia's seas and coasts. The South Australian “coast” is defined as ‘one hundred metres inland from the mean high water mark in urban areas (550m in rural areas) to 3 nautical miles seaward of mean low water. It includes all land within any estuary, inlet, creek, bay or lake subject to the ebb and flow of the tide. The landward boundary may be varied by legislation’ (*South Australia Coast Protection Act 1972*).

A number of Acts and documents are associated with the management of coastal environments in South Australia. The Commonwealth Government has a responsibility to implement International Treaties, although the State Government undertakes many of the recommendations and actions outlined in national frameworks such as the Coastal Policy, Oceans Policy and the Coast and Clean Seas Program.

The main coastal management instrument used by the State is the *South Australia Coast Protection Act 1972*. This Act was created to make provision for the conservation and protection of beaches and the coast of South Australia. Empowered under this Act is the Coast Protection Board, an authority that advises on coastal zone development plans and applications, has power of direction over coast protection structures and excavation and filling of material in accordance with regulations under the Development Act 1993. The Board is responsible for the management of the *Adelaide's Living Beaches, A Strategy for 2005-2025*. The Board's management policies are set in the Metropolitan Coast Protection District Management Plan (gazetted in 1985) and can also be found in the consolidated Coast Protection Board Policy Document 2004. Other relevant management instruments include:

- *Aboriginal Heritage Act 1993*
- *Aquaculture Act 2001*
- *Crown Lands Act 1929*
- *Development Act 1993*
- *Environmental Protection Act 1993*
- *Fisheries Act 1982*

- *Harbours and Navigation Act 1993*
- *Heritage Act 1993*
- *Local Government Act 1999*
- *Country Fires Act*
- *National Parks and Wildlife Act 1972*
- *Native Vegetation Act 1991*
- *Natural Resource Management Act 2004*¹

The Living Coast Strategy for South Australia (Government of South Australia, 2004) outlines the State Government's environmental policy directions for sustainable management of South Australia's coastal, estuarine and marine environments. While it has an emphasis on promoting environmental stewardship, the Strategy also supports development of industries operating within sustainable frameworks. It encompasses a range of Government environmental initiatives and programs and sets out the policy directions that the State Government will be taking over the next five years to help protect and manage South Australia's coastal areas, estuaries and marine ecosystems for their conservation and sustainable use.

The Strategy identifies and addresses six key objectives for the State's coastal, estuarine and marine environments. These are to:

- Provide a legislative and policy framework for ecologically sustainable development and use of our coastal, estuarine and marine environments
- Conserve and safeguard the natural and cultural heritage of our coastal, estuarine and marine environments;
- Control pollution of our coastal, estuarine and marine environments
- Protect our coastal, estuarine and marine environmental assets
- Improve understanding of our coastal, estuarine and marine environments
- Develop and maintain partnerships between State and Local Governments, community and industry.

Regional

South Australia does not have a comprehensive system of strategic regional coastal plans, as at October 2005. In the late 1990s two regional plans were established through *Coast and Clean Seas* funding: the *South East Coastal Strategy* and *Great Australia Bight 1000* for the State's West Coast (Caton, 2004, pers. comm.). The Northern and Yorke NRM region is in the process of developing a Coast Management Plan. This will be due for public comment in the near future.

Adelaide and Mount Lofty Ranges

While governments and communities have taken a number of positive steps to protect and manage water, soils and natural biodiversity of inland, coastal and marine environments, those resources are still not being managed in a manner that ensures sustainability for future generations. Without effective action, there will be continued degradation of those assets that underpin the health and prosperity of the region.

(Mount Lofty Ranges Interim Integrated Natural Resource Management Group, 2003)

Under the second round of Natural Heritage Trust Funding (NHT 2), Australia has been divided into 56 regions for the distribution of funds for Integrated Natural Resource Management (INRM). South Australia has been divided into 8 INRM Regions: Aboriginal

¹ The *Natural Resource Management Act 2004* repeals and replaces the *Animal and Plant Control [Agricultural & Other Purposes] Act 1988*, *Soil Conservation and Landcare Act 1989* and the *Water Resources Act 1997* – refer to <http://www.nrm.sa.gov.au/nrm/legislation.html>

Lands, Eyre Peninsula, Rangelands, Adelaide Mt. Lofty Ranges (AMLR) ¹ [formerly Mount Lofty Ranges and Greater Adelaide], Kangaroo Island, Northern and Yorke, South East and Murray Darling Basin.

Each region is required to produce an INRM Plan that 'considers all environmental, social and economic impacts of natural resource decisions on a regional basis' (Australian Government, 2004). Following plan production, 'Governments, and others, will invest in regional plans based on clear targets and appropriate monitoring to ensure the best NRM outcomes' (Australian Government, 2004). Caton (2004, pers. comm.) notes the two before-mentioned regional Plans for the State's South East and West Coast provided 'valuable building blocks for their regional INRM plans'.

The Plan for the AMLR was prepared by the Mount Lofty Ranges Greater Adelaide Interim Integrated Natural Resource Management Group (MLRGA IINRM Group, 2003) with the following vision:

The natural resources of the MLRGA be managed sustainably for environmental, social and economic benefit. Regional communities be actively engaged in the management of natural resources, informed about the key issues, possessing appropriate skills, and provided with adequate support and facilitation.

A draft of the Management Plan was released for community consultation and comment in late 2002, with a final copy lodged with the Federal Government and public release occurring in late 2003. The Plan features the following components (MLRGA IINRM Group, 2003):

- Identification of main natural resource assets of the AMLR region (water, soil and natural biodiversity) and the development of sustainability objectives for those assets
- Review of the state of the natural resource assets of the AMLR region (through analysis of existing plans and strategies and targeted consultation with a variety of interest groups)
- Examination of the processes that threaten natural resources in the region, followed by a prioritised ranking of these processes
- Establishment of goals, actions and targets for dealing with priority threatening processes as they relate to the region's key assets
- Identification of opportunities for more effective management of those natural resources
- Consideration of monitoring and evaluation requirements.

The section that addresses assets of the AMLR describes the coast, marine and estuarine environments as being a rich asset of the region and notes that they are also subject to 'significant pressure' from high population density, substantial tourism and inappropriate coastal and marine developments. The following table summarises the state of coastal and marine environments in AMLR and identifies associated pressures, as described in the Management Plan (MLRGA IINRM Group, 2003).

¹ The Adelaide metropolitan coastline is situated within the AMLR Region. The AMLR coast stretches from Middle Beach in the north to Middleton/Goolwa in the south.

Section of INRM Management Plan for the AMLR Region	Comment
3.1 Introduction	Coastal and marine areas within the region are subject to a variety of uses - primary production, conservation, recreation and tourism. These uses tend not to currently have the same degree of planning or control as other land uses.
3.2.1 Marine Water Resources	Marine and estuarine water resources are under pressure from wastewater treatment effluent and contaminated stormwater discharges, which is directly linked with the extensive loss of seagrass beds and mangroves.
3.2.2 Soils	Substrates of coastal, estuarine and marine environments are included in this category. One of the pressures on sediment sources on the metropolitan coastline has been community demand for sandy beaches with implications for sand sources.
3.2.3 Natural Biodiversity	<p>The region's coastal and marine environment comprises of a range of different habitats, including sandy beaches, dunes, rocky cliffs and headlands, and coastal lakes, containing a wide range of plant communities.</p> <p>A number of Reserves along the coastline assist in protecting endangered, vulnerable and rare species. These include Deep Creek, Hallett Cove and Marino Conservation Parks, Aldinga Scrub and Torrens Island. These Reserves provide protection from impacts such as coastal development.</p> <p>While coastal development has contributed to economic growth, there is some concern with matters such as: diminished access to coastal areas, loss of biodiversity and scenic amenity through vegetation clearance, off-road vehicles, illegal dumping of waste degrading coastal areas and invasion of coastal environmental weeds.</p> <p>In addition to their intrinsic value, coastal and marine environments are an important component of the region's culture and economy, providing commercial and recreational fishing opportunities, as well as other recreational activities.</p>

While the MLRGA INRM Plan and Investment Strategy provide a basis for initiating and funding coastal conservation activities, it is hoped that future iterations will feature a more comprehensive coverage of coastal and marine issues within the Region.

The Management Plan focuses on defining actions and setting targets to address priority threatening processes. Targets are set at three distinct levels (MLRGA INRM Group, 2003):

- **Aspirational Targets (AT)** – Long-term targets with associated statements regarding the desired condition of natural resources in the longer term (i.e. 50 years).
- **Resource Condition Targets (RCT)** – Specific, time-bound and measurable resource condition targets that have a 10-20 year timeframe for target achievement. These targets must be pragmatic and achievable. For example:
 - RCT 7.2.2 *No further decline in sand resources and associated marine and dune ecosystems: by 2012*
 - RCT 8.3.2 *A halt in the decline of seagrass, reef and other estuarine and marine environments, with clear targets established: by June 2006.*
- **Management Action Targets (MAT)** – Short-term targets (1-5 years) relating to management actions or capacity building. Targets relate to management actions that will ensure progress towards the longer-term resource condition targets. For example:
 - MAT 6.2.9 *Develop... a comprehensive Risk Assessment program for marine, estuarine and coastal biodiversity, identifying areas/communities at risk, threatening processes, management strategies, baselines and targets: by Dec 2005.*

- MAT 7.2.7 *Review/investigate priorities for sand management including a review of the Metropolitan Beach Protection Strategy: by 2005.*

The Management Plan for the region is also important in that it provides a basis for the development of an Investment Strategy (prepared through the MLRGA INRM Group), through which the community can access funding support for NRM actions through programs such as the Natural Heritage Trust.

The Management Plan and Investment Strategy are designed to be core reference documents for NRM planning in the region and the development of NRM funding programs. One of the positive aspects to come out of the NRM process in the AMLR has been the recent appointment of two NRM Coast and Marine Facilitators whose aim is to support the AMLR NRM Board and community to facilitate best practice and integrated coastal management outcomes across the region.

For further information on NRM Regions, Management Plans and Investment Strategies, refer to: <http://www.nrm.gov.au>.

SA Urban Forest Biodiversity Program

The South Australian Urban Forest Biodiversity Program (UFBP) was created in 1997 to provide a coordinated approach to biodiversity management across the Adelaide metropolitan area. The vision of the Program is to:

'Redress biodiversity loss in metropolitan Adelaide by protecting remaining native flora and fauna and increasing the biomass of locally indigenous species' (Turner, 2001).'

The UFBP plays a facilitatory and funding role in coordinating linkages between local, state, national and international initiatives and strategies. A primary goal of the Program is to involve all levels of government and the community in managing biodiversity conservation, and incorporate these considerations into planning and land management in the metropolitan area.

In 2001, UFBP produced the document *Conserving Adelaide's Biodiversity: Resources* (Turner, 2001), which provides a framework for sound urban biodiversity management in the Adelaide region. This resource is designed to be a tool for planners, land managers, educators, students, politicians and community groups, and aims to improve decision-making and planning across metropolitan Adelaide.

The publication contains maps identifying priority vegetation types and remnant vegetation sites, site descriptions, threats to biodiversity, management strategies, species lists and technical information on the region's flora and fauna. Refer to the UFBP website www.urbanforest.on.net for further information.

Adelaide Metropolitan Coast

Management of the Adelaide metropolitan coast is the shared-responsibility of both State and Local Governments through a grant program provided by the South Australian Coast Protection Board, coupled with technical advice from government bodies and the Board (DEH, 2004). This management includes (DEH, 2004):

- Conservation for heritage, cultural, environmental and ecological values, including the impact of water quality on amenity, seagrasses and general coastal processes
- The use of beaches for recreation and leisure activities
- Development of a coastal dune buffer for the protection of foreshore development and maintenance of sandy beaches affected by storm erosion, including the impact of sea level rise from climate change
- Monitoring the beach system so that necessary artificial replenishment and redistribution measures can be determined and undertaken.

Coast Protection Board

The Coast Protection Board has been responsible for the maintenance of Adelaide's metropolitan beaches and minimising damage to residential properties and infrastructure through storm events since the early 1970s. The Board's management policies concentrate on beach replenishment as a successful strategy for coast protection and beach maintenance (DEH, 2004). These policies are based on research conducted in the 1970s that identified a natural erosion trend on the southern metropolitan beaches and proposed sand replenishment to address the ongoing loss of sand from the Adelaide coast and maintain the position of the coast. Ongoing data collection and research, combined with social and political pressure to maintain the city's beaches have ensured that this strategy continues (DEH, 2004).

Coast Park

Delivered through Planning SA, the Adelaide Metropolitan Coast Park is a State Government initiative involving partnerships with other State Government agencies, Local Councils, and key stakeholder groups. Essentially, Coast Park is a linear path extending approximately 70km along the Adelaide metropolitan coastline, from Sellicks Beach in the south to North Haven in the north.

As part of Coast Park, a series of Coastal Vegetation Management Plans are being produced by the SA Urban Forest Biodiversity Program (UFBP) to guide local governments with the implementation of native vegetation enhancement works in their coastal reserves. In addition, Coast Park funding delivered through UFBP is enabling the provision of technical advice and assistance to land managers to ensure these plans are implemented. Refer to page 3 for further information on this initiative.

Local

Local Government

Local Government is the most significant tier of government for on-ground management of the coast, most notably with regard to land based discharges of stormwater and sewage, the management of coastal reserves (including dunes) and in coastal planning (Caton, 2004, pers. comm.). Local Councils oversee everyday maintenance of the coast and seaside facilities, and share the responsibility of shore protection with the South Australian Government.

Councils make decisions on coastal development at the coast in two ways (Harvey and Caton, 2003):

1. Through the development and dissemination of strategic plans: in all Australian coastal councils, development plans must feature planning zones and objectives and principles for those zones. Zoning can reflect residential areas, areas subject to coastal erosion or flooding, or areas that may be potentially affected by climate change induced sea-level rise.
2. Through individual decisions in response to development applications involving the interpretation of development plans.

In South Australia, Local Governments are required to review their development plans every three years, each time seeking the approval of the Minister for Planning.

The City of Charles Sturt funds a full-time Coastal Officer position, which occurred as a result of the endorsement of Council's Coastal Management Plan in April 2002. This is a unique position as no other Council in the Adelaide metropolitan area has a full-time position dedicated to the coast. Council has been able to undertake a number of coastal initiatives through the funding of this position including the support of its coastal groups.

Community Groups

'Among the settled parts of the Australian coast...Crown coastal reserves are usually under the care and control of Council, but community groups frequently play a vital role in their management.'

(Harvey and Caton, 2003).

Community groups play a vital role in coastal management, undertaking on-ground works, vegetation surveys, campaigning and raising issues of concern, as well as educating the public and maintaining awareness. There are three active Dunecare/Coastcare groups along the City of Charles Sturt coastline; Semaphore Park Coastcare Group, Tennyson Dunes Group and the Henley and Grange Dunecare Group. The Grange and West Lakes Kiwanis also work within the Tennyson Dunes, predominantly repairing walkway fencing.

The Tennyson Dunes Group is the volunteer group that operates predominantly within this study area. The group was formed in 1995 (Sandercock, 2006, pers. comm.) and has undertaken various coastal rehabilitation works throughout the area. In conjunction with other dedicated community groups such as the West Lakes Kiwanis and with State and Local Government assistance, they have been actively involved in various projects and management of the dunes in this area. Funded initially through Coastcare these activities have included pest weed and animal control, fencing, carpark and access way maintenance, track rationalisation, nursery establishment, propagation of local native plants, revegetation projects, rare plant recovery, fire prevention, education, monitoring and interpretive signage.

Other groups who have contributed to local coastal works are Maxima Trainees and Conservation Volunteers Australia.

Several *Adriana quadripartita* (Coastal Bitter-bush) community planting sites have been established within the Reserve. Follow-up plantings have occurred in subsequent years in an attempt to establish a habitat corridor for the eventual release of the Bitter-bush Blue Butterfly (*Theclinessthes albocincta*), whose population is now reduced to two isolated locations, one at Torrens Island and the other at Normanville. These planting areas are part of a larger plan initiated by the South Australian Butterfly Association to reintroduce this species to metropolitan Adelaide.

Community-based activities at Tennyson Dune Reserve have primarily been funded through the State Government, Council and Phase 1 of the Coastcare Program. Coastcare, part of the Commonwealth Government's *Coastal Action Program*, was established to assist community groups to work on schemes to promote ecologically sustainable development at the coast. Small grants were available to community groups to undertake activities including on-ground works, education and training, planning and monitoring.

The objectives of the Program were to:

- Engender in local communities (including local industries), a sense of stewardship for coastal and marine areas;
- Provide opportunities and resources for residents, volunteers, businesses and interest groups to participate in coastal management;
- Support community identification of natural and cultural heritage resources;
- Facilitate interaction between the community and bodies with responsibility for managing coastal areas.

(Commonwealth Government, 2002)

Funding of Coastcare (through NHT1) occurred over a five-year period from 1996–2001 and it was widely expected NHT2 would continue to fund this Program. Whilst Coastcare

was included in the NHT2 Bi-Lateral Agreement, it took a considerable amount of time to come on-stream.

Current funding is provided through regional Natural Resource Management Boards and the Australian Government's Envirofund. For more information concerning Coastcare under NHT 2 visit the NHT website: www.nht.gov.au/publications/framework/index.html.

The Coast Protection Board has introduced the Coastal Participation Grants program to support ongoing local community participation in coastal management. These grants are delivered through coastal councils to ensure that existing partnerships between State and Local Governments continue. The Coastal Participation Grants are intended to compliment the Australian Government Envirofund, which targets community groups with little or no previous engagement with the Natural Heritage Trust.

Appendix 2: Plant Species List for Tennyson Dune Reserve

Family	Scientific Name	Common Name	Rating SL
LEGUMINOSAE	<i>Acacia cupularis</i>	Cup Wattle	R
LEGUMINOSAE	* <i>Acacia cyclops</i>	Western Coastal Wattle	
LEGUMINOSAE	<i>Acacia ligulata</i>	Umbrella Bush	K
LEGUMINOSAE	<i>Acacia longifolia</i> ssp. <i>sophorae</i>	Coastal Wattle	
LEGUMINOSAE	* <i>Acacia saligna</i>	Golden Wreath Wattle	
EUPHORBIACEAE	<i>Adriana quadripartita</i> (formerly <i>A. klotzschii</i>)	Rare Bitterbush	U
CRASSULACEAE	* <i>Aeonium</i> spp.	Succulent	
LILIACEAE	* <i>Agapanthus africanus</i>	Agapanthus	
CASUARINACEAE	<i>Allocasuarina verticillata</i>	Drooping Sheoak	
APOCYNACEAE	<i>Alyxia buxifolia</i>	Sea Box	R
GRAMINEAE	* <i>Ammophila arenaria</i>	Marram Grass	
PRIMULACEAE	* <i>Anagallis arvensis</i>	Pimpernel	
ASTERACEAE	* <i>Arctotheca calendula</i>	Capeweed	
ASTERACEAE	* <i>Arctotis stoechadifolia</i>	White Arctotis	
ASTERACEAE	* <i>Argyranthemum frutescens</i>	Marguerite Daisy	
COMPOSITAE	* <i>Artemisia arborescens</i>	Wormwood	
LILIACEAE	* <i>Asparagus asparagoides</i>	Bridal Creeper	
CHENOPODIACEAE	<i>Atriplex cinerea</i>	Coast Saltbush	
GRAMINEAE	<i>Austrodanthonia caespitosa</i>	Common Wallaby-grass	
GRAMINEAE	<i>Austrostipa flavescens</i>	Coast Spear-grass	
GRAMINEAE	<i>Austrostipa scabra</i> ssp. <i>falcata</i>	Slender Spear-grass	
GRAMINEAE	* <i>Avena</i> sp.	Wild Oat	
CYPERACEAE	<i>Baumea juncea</i>	Bare Twig-rush	
GRAMINEAE	* <i>Briza maxima</i>	Large Quaking-grass	
GRAMINEAE	* <i>Bromus diandrus</i>	Great Brome	
CRUCIFERAE	<i>Cakile maritima</i> ssp. <i>maritima</i>	Two-horned Sea Rocket	
PORTULACACEAE	<i>Calandrinia eremaea</i>	Dryland Purslane	U
CUPRESSACEAE	<i>Callitris gracilis</i>	Southern Cypress Pine	U
AIZOACEAE	* <i>Carpobrotus edulis</i>	Hottentot Fig	
AIZOACEAE	<i>Carpobrotus rossii</i>	Native Pigface	
LAURACEAE	<i>Cassytha pubescens</i>	Downy Dodder-laurel	
COMPOSITAE	* <i>Chondrilla juncea</i>	Skeleton Weed	
RANUNCULACEAE	<i>Clematis microphylla</i>	Old Man's Beard	
RUBIACEAE	* <i>Coprosma repens</i>	Mirror Bush	
COMPOSITAE	<i>Cotula australis</i>	Common Cotula	
CRASSULACEAE	* <i>Cotyledon</i> sp.	Cotyledon	
CRASSULACEAE	<i>Crassula closiana</i>	Stalked Crassula	
CRASSULACEAE	<i>Crassula colligata</i> ssp. <i>lamprosperma</i>	Australian Stonecrop	
GRAMINEAE	* <i>Critesion</i> spp.	Barley Grass	
GRAMINEAE	* <i>Cynodon</i> spp.	Couch	
UMBELLIFERAE	<i>Daucus glochidiatus</i>	Native Carrot	
LILIACEAE	<i>Dianella brevicaulis</i>	Short-stem Flax-lily	
COMPOSITAE	* <i>Dimorphotheca pluvialis</i>	Cape Marigold	
GRAMINEAE	<i>Distichlis distichophylla</i>	Emu-grass	
AIZOACEAE	* <i>Drosanthemum candens</i>	Rodondo Creeper	
GRAMINEAE	* <i>Ehrharta calycina</i>	Perennial Veldt Grass	
CHENOPODIACEAE	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	Ruby Saltbush	
EUPHORBIACEAE	* <i>Euphorbia paralias</i>	Sea Spurge	
EUPHORBIACEAE	* <i>Euphorbia terracina</i>	False Caper	
FUMARIACEAE	* <i>Fumaria capreolata</i>	White Fumitory	
AIZOACEAE	* <i>Galenia pubescens</i>	Coastal Galenia	
COMPOSITAE	* <i>Gazania</i> sp.	Gazania	
GERANIACEAE	<i>Geranium potentilloides</i> var. <i>potentilloides</i>	Downy Geranium	Q
IRIDACEAE	* <i>Moraea setifolia</i>	Thread Iris	
COMPOSITAE	<i>Helichrysum leucopsidium</i>	Satin Everlasting	U
COMPOSITAE	* <i>Hypochaeris glabra</i>	Smooth Cat's Ear	
CYPERACEAE	<i>Isolepis nodosa</i>	Knobby Club-rush	
LEGUMINOSAE	<i>Kennedia prostrata</i>	Running Postman	
MYRTACEAE	<i>Kunzea pomifera</i>	Muntries	U
GRAMINEAE	* <i>Lagurus ovatus</i>	Hare's Tail Grass	
CYPERACEAE	<i>Lepidosperma gladiatum</i>	Sword Rush	U
MYRTACEAE	* <i>Leptospermum laevigatum</i>	Coast Tea-tree	
COMPOSITAE	<i>Leucophyta brownii</i>	Coast Cushion Bush	

Appendix 2(Cont.): Plant Species List for Tennyson Dune Reserve

Family	Scientific Name	Common Name	Rating SL
EPACRIDACEAE	<i>Leucopogon parviflorus</i>	Coast Beard-heath	
PLUMBAGINACEAE	* <i>Limonium companyonis</i>	Sea Lavender	
BRASSICACEAE	* <i>Lobularia maritima</i>	Alyssum	
GRAMINEAE	* <i>Lolium perenne</i>	Perennial Rye Grass	
LILIACEAE	<i>Lomandra leucocephala</i> ssp. <i>robusta</i>	Woolly Mat-rush	R
LEGUMINOSAE	<i>Lotus australis</i>	Austral Trefoil	U
LEGUMINOSAE	* <i>Lupinus consentii</i>	Blue Lupin	
SOLANACEAE	* <i>Lycium ferocissimum</i>	African Boxthorn	
LEGUMINOSAE	* <i>Medicago polymorpha</i> var. <i>polymorpha</i>	Burr-medic	
LEGUMINOSAE	* <i>Medicago truncatula</i>	Barrel Medic	
MYRTACEAE	<i>Melaleuca lanceolata</i> (formerly <i>Melaleuca lanceolata</i> ssp. <i>lanceolata</i>)	Dryland Tea-tree	U
MELIACEAE	* <i>Melia azedarach</i> var. <i>australasica</i>	White Cedar	
LEGUMINOSAE	* <i>Mellilotus indica</i>	King Island Mellilot	
AIZOACEAE	* <i>Mesembryanthemum crystallinum</i>	Ice Plant	
MYRTACEAE	* <i>Metrosideros excelsa</i>	New Zealand Christmas Bush	
POLYGONACEAE	<i>Muehlenbeckia gunnii</i>	Coastal Climbing Lignum	
MYOPORACEAE	<i>Myoporum insulare</i>	Common Boobialla	
ZYGOPHYLLACEAE	<i>Nitraria billardierei</i>	Nitre Bush	
ONAGRACEAE	* <i>Oenothera stricta</i>	Evening Primrose	
OLEACEAE	* <i>Olea europaea</i>	European Olive	
COMPOSITAE	<i>Olearia axillaris</i>	Coast Daisy-bush	
ASTERACEAE	* <i>Osteospermum fruticosum</i>	Seascape Daisy	
OXALIDACEAE	* <i>Oxalis pes-caprae</i>	Soursob	
GRAMINEAE	* <i>Parapholis incurva</i>	Curly Ryegrass	
URTICACEAE	<i>Parietaria debilis</i>	Smooth-nettle	
GERANIACEAE	<i>Pelargonium australe</i>	Australian Pelargonium	U
GERANIACEAE	* <i>Pelargonium</i> sp.	Pelargonium	
GERANIACEAE	* <i>Pennisetum clandestinum</i>	Kikuyu	
COMPOSITAE	<i>Picris squarrosa</i>	Squat Picris	E (R State)
THYMELAEACEAE	<i>Pimelea serpyllifolia</i> ssp. <i>serpyllifolia</i>	Thyme Riceflower	
PLANTAGINACEAE	* <i>Plantago lanceolata</i>	Ribgrass	
GRAMINEAE	<i>Poa poliformis</i>	Coast Tussock-grass	
PORTULACACEAE	* <i>Portulaca oleracea</i>	Common Purslane	
COMPOSITAE	* <i>Reichardia tingitana</i>	False Sowthistle	
CHENOPODIACEAE	<i>Rhagodia candolleana</i> ssp. <i>candolleana</i>	Sea-berry Saltbush	
RHAMNACEAE	* <i>Rhamnus alaternus</i>	Buckthorn	
LAMIACEAE	* <i>Rosmarinus officinalis</i>	Rosemary	
CHENOPODIACEAE	<i>Salsola kali</i>	Buckbush	
DIPSACACEAE	* <i>Scabiosa atropurpurea</i>	Scabious	
GOODENIACEAE	<i>Scaevola crassifolia</i>	Cushion Fanflower	R
COMPOSITAE	<i>Senecio pinnatifolius</i> (formerly <i>S. lautus</i>)	Variable Groundsel	
ASTERACEAE	* <i>Senecio tamoides</i>	Canary Creeper	
CRUCIFERAE	* <i>Sisymbrium orientale</i>	Wild Mustard	
COMPOSITAE	* <i>Sonchus asper</i>	Prickly Sow-thistle	
COMPOSITAE	* <i>Sonchus oleraceus</i>	Common Sow-thistle	
GRAMINEAE	<i>Spinifex hirsutus</i> (formerly <i>S. sericeus</i>)	Hairy Spinifex	
GRAMINEAE	* <i>Stenotaphrum secundatum</i>	Buffalo Grass	
TAMARICACEAE	* <i>Tamarix aphylla</i>	Tamarisk	
COMPOSITAE	* <i>Taraxacum officinale</i>	Dandelion	
AIZOACEAE	<i>Tetragonia implexicoma</i>	Bower Spinach	
GRAMINEAE	* <i>Thinopyrum junceiforme</i>	Sea Wheat-grass	
CHENOPODIACEAE	<i>Threlkeldia diffusa</i>	Coast Bonefruit	
ASPHODELACEAE	* <i>Trachyandra divaricata</i>	Dune Onion Weed	
JUNCAGINACEAE	<i>Triglochin tricophorum</i>	Arrowgrass	K
TROPAEOLUM	* <i>Tropaeolum majus</i>	Nasturtium	
LEGUMINOSAE	* <i>Vicia monantha</i> ssp. <i>monantha</i>	Spurred vetch	
GRAMINEAE	* <i>Vulpia</i> sp.	Fescue	
Species present as remnant			
Reinstated through revegetation program			
Uncertain provenance			
Weed Species			

SL = Southern Lofty Ranges

Total Number of Species Recorded: 120

Total Number of Indigenous Species Recorded: 52

Total Number of Introduced Species Recorded: 68

Key to Conservation Ratings

E – Endangered, rare and in danger of disappearing from the wild in the short-term

V – Vulnerable, rare and in danger of disappearing from the wild in the long-term

R – Rare, occurring infrequently, either locally abundant in a limited area or sparsely distributed over a wide area

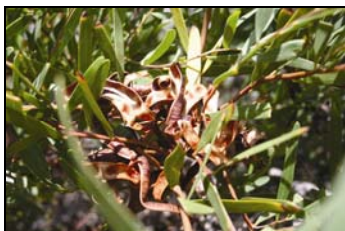
K – Status uncertain, but considered likely to be of conservation significance

Q – Not yet assessed but flagged as being of possible significance

U – Uncommon, declining and inadequately conserved, but not yet rare and vulnerable

Ratings from – Lang, P.J. & Kraehenbuehl, D.K., *Plants of Particular Conservation Significance in South Australia's Agricultural Regions* (Jan 2002) unpublished database, DEH.

APPENDIX 3: Priority Weed Species (in alphabetical order))

***Acacia cyclops* – Western Coastal Wattle****Family**

LEGUMINOSAE

Description

Western Coastal Wattle is a bushy shrub growing to 4m, although more commonly to 2m in the coastal environment. **Leaves** bright green with 3 to 5 parallel veins that meet at the tip. Yellow wattle flowers are usually arranged in clusters of three. **Seedpods** are twisted and contain seed surrounded by bright red arils. This plant can easily be confused with the indigenous species *Acacia longifolia* var. *sophorae* (Coastal Wattle), *A. cupularis* (Cup Wattle) and *A. ligulata* (Umbrella Wattle). The former has wider leaves and flowers that are arranged in a long cylinder-shaped cluster while the latter has leaves that feature a single central vein. The twisted seedpods of Western Coastal Wattle are unique to this species.

Distribution

Western Coastal Wattle is an Australian plant indigenous to the western coast of South Australia. Western Coastal Wattle is thought to have been introduced to the Southern Mount Lofty Ranges through revegetation works and escaped garden plantings.

Threat Assessment

Western Coastal Wattle competes with indigenous species and is spreading within the Reserve. It can form dense thickets that suppress native vegetation. The species is providing habitat and food for indigenous bird species in the older established plantings. For this reason, staged removal should take place and plants replaced with indigenous *Acacia* species that will also provide habitat and food for native fauna.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Spray (new seedlings)	glyphosate	1:100	water	Ensure correct identification for small plants.
Hand control	Hand weed seedlings			
Cut	Cut off at base as low to the ground as possible making sure no leaves are visible. Remove all seed bearing branches from the site and dispose			Plants provide habitat and soil stability. Remove in a staged fashion (see appendix 5).

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Acacia saligna – Golden Wreath Wattle



Family

LEGUMINOSAE

Description

A small tree or shrub 2-6m tall. **Flowers**, cylindrical, 10mm in diameter, golden yellow occurring from July through to November. **Stems** angular, flattened, smooth, and yellow-green to red-green, eventually becoming grey and rough with age. **Phyllodes** are extremely variable in size and form, featuring prominent mid veins. **Seedpods** are light brown, curved, 5-14cm long, 4-6mm wide and contain 4-10 seeds. **Fruit** matures between late spring and summer.

Distribution

Native to Western Australia, Golden Wreath Wattle is an invasive garden plant that is naturalised in most Australian states, including South Australia. It can withstand a broad spectrum of environmental conditions, including salt spray, frost and seasonal dry periods. Golden Wreath Wattle primarily occurs in disturbed habitats, but is also found in coastal woodlands and scrublands, grassy woodlands, heathlands and riparian environments.

Threat Assessment

Golden Wreath Wattle is an aggressive, highly adaptable plant once commonly used for revegetation after sand mining along the coast and highways. Capable of suckering and self-sowing, it will establish in partial shade to full-sun. An infested area may contain up to 3,500 seeds in one square metre. Seeds can remain dormant for more than a decade and frequently germinate on mass after disturbance such as a fire.

Biodiversity is reduced as native vegetation can be replaced with thick stands of Golden Wreath Wattle. Other plants are eliminated by shading and competition for resources. Golden Wreath Wattle is also nitrogen fixing and therefore indigenous plants may be affected by increased nutrient levels. This species should be gradually removed and replaced with appropriate indigenous species.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Cut and swab	triclopyr	1:30	diesel	Stage removal over 5 year period (see Appendix 5 for techniques). Replace with appropriate indigenous species, eg. <i>Acacia cupularis</i> (Cup Wattle). Monitor for new seedling growth.
	glyphosate	1:10	water	
Hand weed				Ensure correct identification for small plants.

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Arctotis stoechadifolia - White Arctotis



White Arctotis infestation, Grange.

Family

COMPOSITAE

Description

White Arctotis is a prostrate perennial plant that grows in dense clumps. **Leaves** grey-green, divided with indented margins. **Flower** petals are white, cream, pink, bronze or blue, with blue centres and are approximately 10cm in diameter. Flowering occurs late spring to early summer.

Distribution

Originates from Southern Africa and has become widespread near townships and settlements along the coast of South Australia due to its popularity as a garden plant.

Threat Assessment

White Arctotis forms dense mats that smother native vegetation and eliminate smaller indigenous plants through shading and competition for resources. This results in reduced biodiversity as native vegetation can be replaced by thick monocultures of White Arctotis. This weed can also alter dune shape by causing dunes to have a steeper slope.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Spot spray in mid winter to early Spring. Follow-up.	glyphosate	1:100	water	Add surfactant (refer to label).
Hand weed throughout the year.				Remove all parts. Dispose carefully off-site.
				Revegetate with local species eg, <i>Carpobrotus rossii</i> , <i>Threlkeldia diffusa</i> , <i>Enchylaena tomentosa</i> .

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Argyranthemum frutescens – Marguerite Daisy



Photo: Ron Sandercock



Photo: Doug Fotheringham

Above: Infestation at Beachport.

Family

COMPOSITAE

Description

Marguerite Daisy is a knee-high shrub. **Leaves** are light green and fleshy. **Flowers** are white daisies up to 3cm long with a yellow centre containing many seeds. It can be confused with the native *Senecio pinnatifolius* (Variable Groundsel) as a seedling, but once mature, Variable Groundsel can be distinguished by its yellow flowers, unlike the white flowers of Marguerite Daisy (Coast Protection Branch, 2003).

Distribution

Marguerite Daisy is native to the Canary Islands. In South Australia it is found in high rainfall areas from the South East to Eyre Peninsula. It is found as a garden escape in sandy dunes and other sunny coastal areas such as clifftops.

Threat Assessment

This species is most invasive in disturbed dune areas. It competes aggressively with less vigorous native flora. Spread and dispersal occur via seed production. Due to the low numbers presently within the Reserve and the potential for spread, it is recommended that all Marguerite Daisy plants are targeted for immediate removal.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed smaller plants				Ensure minimal disturbance to sand.
Cut and swab larger plants	glyphosate	1:10	water	
Spray smaller plants.	glyphosate	1:100	water	

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Asparagus asparagoides – Bridal Creeper



Photo: Ron Sandercock



Family

LILIACEAE

Description

Bridal Creeper is a climbing perennial herb with twisting stems that can reach 3m in length. The **root** system consists of numerous tubers arranged along a central rhizome, forming an underground mat that makes up the majority of the plant (CRC Weed Management, 2003). These tubers act as energy stores, providing water and nutrients that enable plants to survive over summer and allow new growth to commence in autumn. **Leaves** are light green, glossy and heart-shaped. **Flowers** are white and star-shaped. **Fruit** are green pea-sized berries that ripen to red.

Distribution

Native to South Africa, Bridal Creeper was introduced to Australia at the end of the 19th Century as an ornamental plant that proved to be very popular in floral arrangements and bridal bouquets (CRC Weed Management 2003). It is declared noxious in South Australia, Tasmania and parts of New South Wales, and its entry is prohibited in Western Australia. It is found throughout Victoria although is not declared. Bridal Creeper is widespread in southern South Australia, preferring areas of higher rainfall. It can grow in a variety of soil types, although is most often found close to the coast where it invades woodlands and other coastal vegetation communities (CRC Weed Management, 2003). Locally it has been noted at Largs Bay Dune Reserve, although its distribution is suspected to be considerably greater in this region.

Threat Assessment

Bridal Creeper is a Weed of National Significance and is considered to be 'one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts' (CRC Weed Management, 2003).

Bridal Creeper is a major bushland weed in temperate Australia, where it significantly impacts on biodiversity. Its creeping stems smother native vegetation while its extensive underground root system inhibits other plants' root growth and prevents seedling establishment (CRC Weed Management, 2003). It is an extremely competitive plant and there are a number of cases where rare native plants face the threat of extinction due to this weed.

Plants produce more than 1000 berries per square metre and are readily spread by birds that feed on the berries and excrete the seeds (CRC Weed Management, 2003). In addition to distribution by birds, seed is readily spread by foxes, rabbits and via mud on animals, clothing and machinery. New plants may grow from root fragments, which may be carried by water (Transport SA, 2002).

The Reserve must be monitored for any new occurrences and control techniques implemented immediately. It is recommended that adjacent coastal reserves also be subject to this strategy should Bridal Creeper be discovered.

Control Techniques*

Method	Comments	
Hand Weed	Ensure <i>all</i> rhizomes, stems and fruit are bagged, removed from site and burnt to prevent reinfestation. Hand weeding is useful for small individual plants or as a follow-up technique after herbicide control of larger infestations.	
Spray	See table below for up-to-date herbicide type, application methods and rates details.	
Biological Control	Bridal Creeper Leaf Hopper	Monitor on a regular basis for new outbreaks.
	Rust Fungus	

Several characteristics of Bridal Creeper make it difficult to control – an underground tuber system enables the plant to survive unfavourable seasons, it has a broad germination range, and readily invades disturbed areas. It does however have some weaknesses in its biology – the seed bank is relatively short-lived (two to three years), seed production only occurs on emerging stems, and seed production in old infestations is small (CRC Weed Management, 2003).

Control with herbicide is the most effective method of controlling Bridal Creeper. CRC Weed Management (2003) recommends contacting the following Departments for up-to-date information on which herbicides are recommended to control bridal creeper in South Australia and the best application methods and dosages. Contact details are as follows:

State	Department	Phone	Email	Website
SA	Dept Water, Land and Biodiversity Conservation	(08) 8303 9500	apc@saugov.sa.gov.au	www.dwlbc.sa.gov.au
Australia wide	Australian Pesticides and Veterinary Medicines Authority	(02) 6272 5852	contact@apvma.gov.au	www.apvma.gov.au

When targeting Bridal Creeper, it is important to apply herbicides with caution due to the fact it is commonly found growing on native vegetation, and therefore there is an increased risk of off-target damage. Herbicide should be applied by spot spraying or by directly wiping on leaves when plants are isolated. In the case of larger infestations, a staged approach should occur, ensuring treated areas are not reinfested.

Biological control agents such as the Bridal Creeper Leaf Hopper (*Zigina* sp.) and Rust Fungus are having an impact on the control of Bridal Creeper in many areas. Infestations and locations where plants have been controlled should be monitored on a regular basis over several years. Frequent checks should be made for new outbreaks - it is important to note new plants are often associated with bird perching sites.

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

***Carpobrotus edulis* – Hottentot Fig****Family**

AIZOACEAE

Description

Hottentot Fig is a fleshy, ground-running succulent. **Leaves** are approximately 4-10cm long and 5-17mm wide, dull green, often with a reddish tinge and triangular in cross-section. **Stems** grow on or just below the surface of the sand. **Flowers** have many yellow petals that in time change to pink, and reach up to 8cm in diameter (CPB, 2003). **Fruit** is globular, ranges in colour from yellow to red/purple, and is 20mm in diameter.

This species can be easily confused with the native *Carpobrotus rossii* (Native Pigface). Native Pigface has a pink flower with a white base, unlike the yellow flower of Hottentot Fig. Another introduced species, *Carpobrotus aequilaterus* (Angular Pigface) has similar features to both Hottentot Fig and Native Pigface and may be hybridising with Native Pigface (Coast Protection Branch, 2003). Angular Pigface has a large purple flower and yellow/pink centre.

Distribution

Hottentot Fig is native to South Africa and widely grown as a sand stabiliser. In South Australia, the species distribution extends from the coastal areas of the South East to the Eyre Peninsula, including Yorke Peninsula, Northern Lofty and Murray regions (CPB, 2003). It is naturalised in Western Australia.

Threat Assessment

Hottentot Fig invades coastal cliffs and sand areas, displacing native plants as it forms dense mats which smother other species. The plant reduces biodiversity through hybridisation with the local native, *Carpobrotus rossii*. Spread occurs both vegetatively and by seed.

Control Techniques*

Method	Comments
Hand weed	Mark plants in spring, whilst in flower. Remove in winter. Ensure all plant parts are removed from the Reserve.
Spot spray	Limited information is available for chemical control. Trial using a licensed pest plant control operator.

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Chondrilla juncea – Skeleton Weed



Family

COMPOSITAE

Description

Erect, multi-branched perennial herb usually 60-90cm tall, but reaching up to 1.25m. Each **rosette** produces a single flowering stem. **Stems** 50–100cm long and hairless except for rigid hairs present at the base. **Leaves** are oblanceolate, 1-6cm long, 3-20mm wide, margins shallowly toothed, densely pubescent, sessile and decreasing in size up the stem. **Flowers** are yellow, daisy-like and evident from December to April (can be easily confused with a number of other weeds when not in flower).

Distribution

Skeleton Weed was first recorded in 1917 at Wagga Wagga, New South Wales, but is thought to have been introduced through animal fodder prior to 1910. It only occurs in dry environments on well drained soil, preferring temperate, sub-humid and semi-arid scrublands.

Threat Assessment

An aggressive weed, becoming established in Victoria by 1933 and in South Australia by 1947. Skeleton weed is well suited to dispersal and establishment, spreading 1,000km north and 3,000km west of Wagga Wagga in less than 50 years. Other characteristics that make it a threat include its ability to germinate on mass after disturbances such as fire. Seed viability is approximately 80%. It is most common on sandy soils. These factors make it a high priority for control, especially whilst its population is still relatively confined. Single plants may produce up to 27,000 seeds in a single season (Parsons & Cuthbertson 2001).

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed				May be difficult to control by hand, particularly after the rosette stage, due to its deep taproot and vigorous growth. Remove plants when juvenile.
Spray				Little information is available on the control of Skeleton Weed in a bushland or coastal setting. It is recommended trials are undertaken using metsulfuron methyl at the rosette stage. Trial using a licensed pest plant control operator.

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Cynodon sp – Couch



Above: Couch invading Dunes, West Lakes Shore.

Family

GRAMINEAE

Description

Couch is a prostrate, mat-forming perennial grass that is bluish-green in colour. **Leaf blades** are narrow, flat or folded and between 2-15cm in length. **Stems** are branched and creeping, featuring many nodes (Transport SA, 2002). **Flower** stems are erect, up to 25cm in height and comprised of small flowers with purple spikes. Flowering occurs late spring to early summer. The grass may be confused with native grasses *Sporobolus virginicus* (Salt Couch) and *Distichlis distichophylla* (Emu Grass) commonly found in saline areas.

Distribution

Couch is commonly used as a lawns and is found throughout Australia. It grows in a variety of soil types ranging from sand to clay (Lamp et al, 2001). Couch is native to the Kimberley region and tropics worldwide.

Threat Assessment

Couch is an invasive grass that can densely cover bare areas (Transport SA, 2002). It will out-compete native groundcover plants and continue to spread if not controlled. It will grow amongst native species, making control very difficult.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Spray in summer while plant is active.	glyphosate	1:100	water	Add surfactant (refer to label).
Spray in areas where grass is infesting native vegetation. Spray in summer.	fluazifop –p butyl	1:100	water	Be careful not to spray native grasses. Follow weed control closely with revegetation using indigenous groundcovers. Monitor for regrowth.

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Ehrharta calycina – Perennial Veldt Grass



Photo: Ron Sandercock



Photo: Ron Sandercock

Family

GRAMINEAE

Description

Tufted grass with perennial rhizomes radiating to form a circle. **Leaves** green to red-green, margins roughened, blade flat or folded, wavy toward the base. **Stems** are long and thin with hairless nodes. **Flowerhead** is a loose, purple panicle, somewhat condensed and often enclosed at the base by a leaf sheath. Spikelets have 3 florets, basal ones are hairy, without a seed and the upper seed floret has a short awn (Gibbs, 2001).

Distribution

Perennial Veldt Grass is a common coastal weed as it was often introduced as a sand stabiliser after sand mining operations (Sandercock, pers. comm. 2006). It is also common in New South Wales, Victoria, Tasmania and parts of Western Australia.

Threat Assessment

Perennial Veldt Grass is considered highly invasive, with the ability to displace virtually all indigenous ground flora (Muyt, 2001). Perennial Veldt Grass thrives on nutrient-poor, sandy or shallow soils and commonly colonises areas with open or sparse groundcover. The plant produces high quantities of viable seed which can remain dormant for several years. Large amounts of dry material produced by the plant considerably increase the fuel load of infested areas, creating favourable conditions for its proliferation.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed				Roots and rhizomes are shallow and easy to dig out. Cut and bag mature seedheads before removal. Ensure all rhizomes are removed from site safely.
Spray	glyphosate	1:100	water	Spray in late winter-early spring before flowering stems lengthen.
	fluazifop-p butyl	1:100	water	Grass specific. Take care near native grasses.

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

***Euphorbia paralias* - Sea Spurge**

Family
EUPHORBIACEAE

Description

Sea Spurge is an herbaceous perennial to 1m high with a strong, deep taproot. **Stems** are upright and woody, producing a milky sap when broken. **Flowers** are small, yellow-green and arranged in clusters at the top of stems. Flowering occurs from September through to May. **Leaves** are bluish green, fleshy, hairless and waxy, sometimes turning yellow-red due to variations in environmental conditions. A single plant can produce up to 5000 viable seeds per year (Blood, 2001).

Distribution

Sea Spurge originates from Europe and North Africa. It is found along Australia's southern coast and offshore islands from Fremantle, Western Australia, to Ulladulla, New South Wales, and Tasmania. It is widespread in South Australia, including along the Adelaide metropolitan coastline. Its entry into Australia is prohibited.

Threat Assessment

Sea Spurge can tolerate a variety of conditions including highly saline environments, sand accretion and blasting, full-sun, drought and fluctuating groundwater levels. It can rapidly colonise eroded areas with little vegetation such as blowouts, often becoming the dominant plant.

This weed is likely to be an ongoing problem given its widespread distribution, high seed production and the fact that seed can remain buoyant in sea water for at least eight years, with more than half still being viable after two years afloat (Blood, 2001). Populations within the Reserve need to be controlled to prevent further spread.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Spot spray	glyphosate	1:100	water	Add surfactant (refer to label). Monitor for regeneration.
Hand weed	Use gloves as sap may cause dermatitis reaction. Remove flowering plants from the Reserve to prevent regeneration.			

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

***Euphorbia terracina* - False Caper****Family**

EUPHORBIACEAE

Description

An erect perennial herb to 80cm high. Several **stems** with greenish-red leaf rising from a shortened crown at ground level. **Leaves** are bluish-green to yellow-green, linear/lanceolate in shape, and approximately 1.5-4cm long. **Flowers** are green, cup-shaped, producing three-lobed fruit containing grey or mottled brown-black seeds. The plant has a hardy taproot.

Distribution

False Caper is native to the Mediterranean. It is found in well-drained sandy soils with significant populations in Victoria and New South Wales. It has naturalised in coastal sand dunes near Adelaide and southern Western Australia. In South Australia, it is widely distributed in coastal and near coastal regions from the west of Eyre Peninsula through to the South East (Taylor, N/D). It is commonly found in neglected areas.

Threat Assessment

False Caper is declared noxious in South Australia, meaning *its control or destruction is required throughout the whole state*. The species competes aggressively, is very adaptable, and can create monocultures. The seed is highly viable and activates readily with disturbance (Taylor, N/D).

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed				Use gloves as sap may cause dermatitis reaction. Remove and destroy plants away from site.
Slash				Remove seed heads beforehand. Spray regrowth.
Spray	glyphosate	1:100	water	Add surfactant (refer to label).

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

***Galenia pubescens* – Coastal Galenia**



Coastal Galenia, south of Grange Jetty.

Family
AIZOACEAE

Description

Coastal Galenia is a soft grey-green groundcover. **Flowers** pinkish white. It is well established within Tennyson Dune Reserve and found in degraded areas, particularly along access paths. According to Taylor (N/D), it will die back over long dry summer periods and recover with autumn rain.

Distribution

Native to South Africa. It is widespread throughout most coastal regions.

Threat Assessment

Coastal Galenia prevents the germination of native plants due to its ground-hugging habit and also smothers established vegetation. There is a close correlation between urban development where disturbed conditions exist and the spread of this weed. Examples are pathways and property boundaries. It is problematic along the Adelaide coastline, including the City of Charles Sturt dunes.

This species may, in the absence of native vegetation, provide habitat for small reptiles. Taking this into account it is important to remove this species systematically over several seasons and replace with appropriate indigenous flora.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed				Replace with indigenous groundcover species.
Spray	glyphosate	1:100	water	Add surfactant (refer to label).
Cut and swab	glyphosate	1:10	water	

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Gazania sp. – Gazania**Family**

COMPOSITAE

Description

Gazania is a perennial garden daisy of variable colours ranging from cream to gold, with black or dark purple markings close to the petal base. Flowering occurs throughout the year, but mainly spring to autumn. It is available commercially.

Distribution

Originally from South Africa, Gazania is a garden escape that has become naturalised in all Australian states and territories except the Australian Capital Territory. Gazania is a serious weed in coastal South Australia, including the Adelaide metropolitan coastline. Major infestations are present in the City of Charles Sturt dunes.

Threat Assessment

Gazania is an aggressive plant that readily establishes in coastal environments where it significantly alters the vegetation community structure by suppressing native plants. Eradication will be an ongoing problem given the frequency of the plant's usage in residential gardens. With the support of Coast Park, the Coastal Protection Branch (Department for Environment and Heritage) and SA Urban Forest Biodiversity Program have produced a coastal weeds *Coastline* (2003) publication that addresses serious coastal weeds, including Gazania, which are still being planted in residential gardens. This, or similar publications could be distributed to coastal residents, councils and land managers to assist in raising awareness of the issue of garden escapes in the coastal environment.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed or trowel smaller plants				Ensure root system is removed and disposed of carefully.
Slashing				Repeat treatments necessary.
Spot spray	glyphosate	1:100	water	Add penetrant.
	metsulfuron	5-7g/100ml	water	

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

***Leptospermum laevigatum* - Coast Tea-tree**

Family
MYRTACEAE

Description

A large shrub to 4m high. **Leaves** up to 2cm long, grey-green in colour, flat, broad and hairless. When crushed, leaves produce a fragrance resembling eucalyptus oil (Coast Protection Branch, 2003). **Flowers** are white, solitary and approximately 15-20mm in diameter, comprising five petals and numerous stamens. Flowering occurs from August to November and is followed by the production of woody, cup-shaped capsules that release seeds when opened. It is a versatile plant that can withstand strong winds, salt and sand spray, drought, frost and periodic inundation.

Distribution

Coast Tea-tree is an Australian native that originates from Victoria, New South Wales and Tasmania. It was originally introduced to the state as a garden ornamental, possibly by early whalers and sealers (Sandercock, 2005, pers. comm.). Its weedy distribution covers South Australia, Queensland, Western Australia and Victoria (where located beyond its natural range). Coast Tea-tree grows extensively on sandy soils in South Australia and inhabits coastal dunes, headlands and scrubs.

Threat Assessment

Coast Tea-tree is known to invade disturbed dunes, significantly altering the environment by forming dense thickets that shade out other indigenous plants, reducing biodiversity and adversely affecting the habitat of native fauna.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed smaller plants				
Prune				Remove seed bearing branches and remove from site over several years. Replace with indigenous species. Monitor for regrowth and regeneration.
Spot spray small plants	glyphosate	1:80	water	
Cut	Cut off at base as low to the ground as possible making sure no leaves are visible. Remove all seed bearing branches from the site and dispose			Plants provide habitat and soil stability. Remove in a staged fashion (see appendix 5).

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

***Lupinus consentii* – Blue Lupin****Family**

LEGUMINOSAE

Description

Robust, multi-branched herb to 1.2m tall. 9-13 broad, finger-like leaflets 2-6cm long and 5-15mm wide radiate from a central point. **Flowers** are blue, 5-15mm wide occur from winter to spring and are arranged up the flower spike in whorls. Flowers may have a spicy odour. Pods are 40-60mm wide, 3.5-6cm long and contain 3-5 seeds. **Seeds** 6-9mm long and are greenish-brown in colour.

Distribution

Native to the Mediterranean and south-western Europe. Within Australia it also occurs in New South Wales and Western Australia.

Threat Assessment

A common weed of roadsides and disturbed areas. Blue Lupin is known to invade bushland, however in healthy ecosystems its population is kept in check through grazing by native fauna.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed				Blue Lupin is shallow rooted and easy to remove by hand. Ensure weeding occurs before seed set. Bag and remove seed heads from site.
Spray	Little information is available on the control of Blue Lupin in a coastal setting. It is recommended trials are undertaken using glyphosate (10ml/L), metsulfuron methyl or 2-4-DB (400g/L), wettable oils and penetrants. Trial using a licensed pest plant control operator.			
	Plants should naturally recede once immediate areas are revegetated.			

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Lycium ferocissimum - African Boxthorn



Family
SOLANACEAE

Description

African Boxthorn is a large perennial shrub that occasionally grows to 5m, although it is usually around 2m in the dune environment. **Stems** are rigid, featuring many branches and a series of long spines along the main stem. **Leaves** are flat, bright green and arranged in clusters of between 5 and 12 (Blood, 2001). **Flowers** are attractive, white and purple from two years of age, with fruit mainly occurring in summer. **Fruit** is a fleshy round orange-red berry. The plants can sometimes lose their leaves in winter, producing new growth in spring.

This species can be confused with the native *Nitraria billardiarei* (Nitre Bush), *Bursaria spinosa* (Christmas Bush) and *Lycium australe* (Australian Boxthorn - endangered in the Southern Mount Lofty Region). The following table (adapted from Taylor, N/D) describes the essential differences between these species.

Species	<i>Lycium ferocissimum</i>	<i>Lycium australe</i>	<i>Nitraria billardiarei</i>	<i>Bursaria spinosa</i>
Leaves	Flat, obovate, bright green, fleshy, obovate to elliptic.	Thick, fleshy, narrowly obovoid to ellipsoid, slightly compressed. Grey-green.	Thick, glaucous grey-green.	Linear to lanceolate or obovate to ovate.
Flower	White to lilac tube with five petals.	White to lilac with dark markings.	White, 5-6 petals with reflexed lobes.	White, five petals in clusters or large terminal.
Fruit	Bright orange-red berry, globose to broadly ovoid.	Ovoid to ellipsoid with orange-red berry.	Purple oblong grape-like.	Dry brown flat oval capsule with notch.

NB: glossary available on page 74.

Distribution

Originally from South Africa, African Boxthorn was introduced into Australia as a hedge plant. It is a weed in all states and territories, with legislation for its control in all, except the Australian Capital Territory and Western Australia. It is found throughout South Australia with the exception of extremely arid areas. Most populations are in the southern half of the state where there is higher rainfall. It is a major environmental weed in the Mount Lofty Ranges and is present locally along the Charles Sturt coast, as well as in the Adelaide Shores dunes at West Beach and the City of Port Adelaide Enfield dunes. It often occurs under roosting spots where seeds have been dropped by birds.

Threat Assessment

When left unchecked, African Boxthorn forms dense, impenetrable thickets that out-compete native species. The plant is declared noxious in South Australia – meaning its *control or destruction is required throughout the state* (Parsons and Cuthbertson, 1992). Priority for removal must be given to the least infested areas and where plants are starting to become established in patches of native vegetation.

African Boxthorn harbours pest animals such as foxes and rabbits, however it also provides safe nesting sites for indigenous bird species. While plants in Tennyson Dune Reserve are only small to medium in size, the fact that they may provide habitat for indigenous fauna needs to be taken into consideration when undertaking removal. Areas where African Boxthorn is removed will need to be replaced with vegetation of a similar structure to provide habitat for native fauna. This plant has the potential to become much more dominant in the dune system as it is highly invasive and oppressive and is readily dispersed by animals. All plants must be eradicated in the short term.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed seedlings				Monitor over several years for regrowth and regeneration. Re-treat if necessary.
Cut and swab	triclopyr	1:30	diesel	
	glyphosate	1:10	water	
Spot spray smaller plants	glyphosate	1:100	water	

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Mesembryanthemum crystallinum – Ice Plant**Family**

AIZOACEAE

Description

Ice Plant is a prostrate annual succulent. **Leaves** angular, covered in glossy wart-like glands. Growth commences from a rosette. **Flowers** are white, featuring several rows of thin delicate petals that are evident in spring and early summer. Plants turn reddish brown at maturity.

Distribution

Native to Europe and Africa.

Threat Assessment

Ice Plant is highly allelopathic, providing conditions favourable only for the survival of its own seedlings (Sandercock in Petherick, 2004, pers. comm.). It is a rampant, mat-forming plant which can smother native plants. Replace with native species such as *Disphyma crassifolium* (Round-leaf Pigface), *Threlkeldia diffusa* (Coastal Bonefruit), or *Tetragonia implexicoma* (Bower Spinach).

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed				Ensure all plant fragments are carefully removed. Monitor for re-infestation.
Spot spray	glyphosate	1:100	water	Add surfactant (refer to label).

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Oenothera stricta – Evening Primrose



Family

ONAGRACEAE

Description

Evening Primrose is an erect perennial herb to 1m that is sometimes woody. **Flowers** have four petals between 2-4cm in length, are yellow, changing to burgundy red and usually only fully open during low light conditions. **Leaves** are hairy, linear to lanceolate in shape and range from 2-6cm in length (Auld and Medd, 1987).

When juvenile, Evening Primrose and the indigenous species *Picris squarrosa* (Squat Picris) have very similar leaves. Squat Picris leaves however, are rough to the touch whereas Evening Primrose leaves are smooth.

Distribution

Evening Primrose originates from South America. Widespread throughout Australia, it is commonly found in disturbed areas along roadsides and on sandy soils. It is known to be present in sand dunes along the northern Adelaide metropolitan coast.

Threat Assessment

The species has the capacity to out-compete native species. Evening Primrose is naturalised within nearby dune systems and consequently should be controlled to ensure it does not become further established.

Control Techniques*

Method	Comments
Hand weed	Difficult to control by hand as it tends to break off at the root and regrow. Use a weed fork and ensure all roots are removed from site and destroyed.
Spray	Relatively tolerant of Glyphosate. Trials are recommended using metsulfuron methyl or 2-4-DB (400g/l), wettable oils and penetrants. Trial using a licensed pest plant control operator.

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

***Olea europaea* – European Olive****Family**

OLEACEAE

Description

European Olive is an evergreen tree growing up to 5-10m in height and width. The species is not likely though to reach such proportions in a coastal environment. **Leaves** are opposite, with a glossy upper surface, darker than the underside, which is often silvery-grey. **Flowers** small, 4 petals, creamy-white. **Fruit** is a drupe, 15-25mm long, oval, initially green ripening through to black in autumn-winter. **Roots** are woody and branched.

Distribution

European Olive is native to the Mediterranean Region and Northern Africa. It is the most common and serious woody weed in the Adelaide Hills but is also common in other parts of South Australia, New South Wales and Victoria.

Threat Assessment

European Olive is slow growing but extremely hardy, able to withstand low winter temperatures and hot dry summers in harsh exposed sites (Muyt, 2001). The species regenerates readily by seed and is dispersed by birds and mammals that eat the seed. Plants may live for up to several hundred years and can form dense, mixed age thickets preventing nearly all regeneration. (Muyt, 2001)

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed small plants				Replace with indigenous vegetation that will fulfil similar habitat roles.
Cut and swab	triclopyr	1:30	diesel	
	glyphosate		neat	
Spray seedlings	glyphosate	1:80	water	Add penetrant.

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

***Osteospermum fruticosum* - Seascape Daisy****Family**

COMPOSITAE

Description

Seascape Daisy is a perennial herb growing to 30-45cm high. **Foliage** is green and fleshy. **Flowers** are either purple or white with purple centres.

Distribution

The extent of Seascape Daisy distribution in Australia is not known. It is a garden escape and weed of coastal areas in South Australia, including the Adelaide metropolitan coastline.

Threat Assessment

Seascape Daisy can readily establish in coastal environments, where it significantly alters the vegetation community structure by suppressing native plants. It is important to eradicate this species while populations are low. It may be an ongoing problem if it is planted in nearby residential and Council gardens.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed				Ensure root system is removed. Dispose of carefully.
Spray	glyphosate	1:80	water	Add surfactant (refer to label).

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

***Pennisetum clandestinum* – Kikuyu**

Above: Kikuyu infesting a stormwater outlet at Grange Jetty

Family
GRAMINEAE

Description

Kikuyu is a robust, mat-forming perennial grass with creeping stems to 3m long. **Leaf blades** are between 5-40cm in length, flat, bright green to yellow-green and either hairless or slightly hairy (Lamp et al, 2001). **Flowers** are concealed (except for thread-like filaments) and occur from January to April.

Distribution

Kikuyu originates from East Asia and is commonly used in Australia as a pasture and lawn grass. Naturalised in all states and territories, it is also listed as one of the 'World's Worst Weed of Crops' (Blood, 2001). Locally, it is present in stormwater outlets which discharge into dunes along the Charles Sturt coastline.

Threat Assessment

Kikuyu will be a problem in all Management Zones, where there is sufficient moisture available (excluding the foredune). It aggressively out-competes native plants and is often introduced to dune systems via dumped garden clippings. Kikuyu also releases allelopathic substances that inhibit the growth of other plants. It should be removed and replaced with appropriate indigenous species.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed				Ensure whole plant (including roots) is removed.
Spray in summer while plant is active.	glyphosate	1:100	water (add surfactant).	Follow-up revegetation using indigenous groundcovers. Monitor for regrowth.
Spray in areas where grass is infesting native vegetation. Spray in summer.	fluazifop-p butyl	1:100	water	Take care near native grasses.

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

***Rhamnus alaternus* – Buckthorn****Family**

RHAMNACEAE

Description

Buckthorn is a large shrub or small tree which grows to 5m high. It is densely branched from ground level with smooth upper stems (Robertson, 1994). **Leaves** are 2-7cm in length, broad, leathery, oval-shaped and alternate with a dark green upper surface and a pale, glossy underside. **Flowers** are fragrant, yellow-green, 3-4mm in diameter, with 5 petals. **Fruit** is an egg shaped, smooth, firm berry 5mm long, which begin as green, through red, and ripening to black with several seeds (Robertson, 1994 and Blood, 2001). **Roots** are woody and branched. This species can be confused with the indigenous *Alyxia buxifolia* (Sea Box). Refer to Appendix 7 for details.

Distribution

Buckthorn is native to the Mediterranean Region. In South Australia, the species distribution extends from the South East to the Eyre Peninsula near the coast. Other areas include the Northern and Southern Lofty Ranges, Murray and Yorke Peninsula regions. Also found in Victoria, Tasmania, Western Australia and New South Wales.

Threat Assessment

Buckthorn competes aggressively and has a rapid growth rate. It can tolerate disturbed, exposed and polluted environments, as well as drought, frost and wind exposed conditions (Blood, 2001). It invades dry coastal vegetation, grassland and grassy woodlands. The species regenerates readily by seed and is dispersed via birds and mammals that eat the seed.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed small plants				Replace with indigenous vegetation that will fulfil similar habitat roles.
Cut and swab large plants	triclopyr	1:30	diesel	
	glyphosate	1:10	water	

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

***Stenotaphrum secundatum* – Buffalo Grass****Family**

GRAMINEAE

Description

Perennial grass to 40cm high, extending laterally through trailing stolons and rhizomes. **Leaf** blades are grey to green, broad and flat. **Flowers** present between December and February. **Seed** head is thick and occurs on a fleshy stalk. Mainly reproduces vegetatively. **Flowers** occur in a tight, flat spike. The chief growth periods occur when conditions are cool to warm.

Distribution

Originates from tropical and subtropical regions of Africa and the Americas. It is naturalised in all Australian states and territories, within New Zealand and elsewhere overseas.

Threat Assessment

Commonly used for residential lawns, it is a weed of watercourses, cultivation, roadsides, coastal areas and disturbed sites. Buffalo grass has the ability to smother groundcover vegetation, therefore inhibiting regeneration and greatly altering natural habitat. In Tennyson Dune Reserve it is spreading through the deliberate extension of lawns and dumped clippings.

Control Techniques*

Method	Chemical	Rate	Mix	Comments
Hand weed				Ensure whole plant (including roots) is removed.
Spray	glyphosate	1:100	water	Spray in summer while plant is active Follow-up revegetation using indigenous groundcovers. Monitor for regrowth.
	fluazifop -p butyl	1:100	water	Spray in areas where grass is infesting native vegetation. Spray in summer. Take care near native grasses.

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Succulent/Cacti spp.



Above: Succulent infestation at West Beach.

Family
VARIOUS

Description

This group of plants feature numerous Succulent and Cacti species. The terms ‘succulent’ and ‘cacti’ are broadly used to define plants with thick, fleshy, water-storing leaves. Species in this grouping include *Opuntia* sp. (Prickly Pear), *Aloe* spp., *Crassula* spp., *Agave* spp. and various other garden escapes that prosper in the dune environment.

Distribution

Succulents and Cacti often originate from tropical and dry subtropical regions. They have been introduced to the coastal environment as garden escapes through deliberate plantings, dumped garden refuse and natural spread from private gardens.

Threat Assessment

Succulents and Cacti are often promoted in the media and generalist gardening books as being environmentally appropriate plants because of their tolerance of low water conditions. Coastal conditions in a Mediterranean climate such as Adelaide provide the perfect environment for these species to become invasive.

These species increase nutrient levels, resulting in conditions favourable to other weeds that would not usually be able to grow in low nutrient conditions experienced in the coastal environment. Succulents and cacti species alter dune formation, harbour rabbits and rodents and significantly alter the visual amenity of an area (CPB, 2003). These species require immediate removal.

Control Techniques*

Method	Comments
Removal techniques will vary with plant species.	It is important to ensure all material is removed from the dunes as Succulents and Cacti reproduce vegetatively. Resources such as Parsons and Cuthbertson (1992) and Taylor (N/D) should be consulted for removal techniques for specific species. Coastal and Environmental Officers may be able to provide further information.

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant operator.

Trachyandra divaricata - Dune Onion Weed



Photo: Vicki Hagan

Infestation at Semaphore South Dune Reserve.

Family

- ASPHODELACEAE

Description

Dune Onion Weed is a tufted perennial herb to knee-high. **Leaves** flat, shiny, hairless. It flowers from winter to late spring, although several plants were noticed flowering after summer rainfall. **Flowers** have white petals with a pair of yellow spots near the base. Flower stems detach and blow as "tumbleweeds", dispersing seeds. Mature plants produce up to 50,000 seeds by the end of the flowering period (Heyligers, 2002). Flowering stems are buoyant when dry.

The Western Australian Department of Agriculture (Moore in Petherick, 2004, pers. comm.) made the following comments:

- Seed is believed to be short-lived. If mature plants are killed and seed set prevented, then very few plants will be present. Monitoring should occur for four years;
- Root fragments will regrow and occasionally stem fragments take root;
- Individual plants live for between three and six years, however this is confused by some plants suckering from the base or falling over and rooting from the stem which makes the life of some individuals many years. However, in healthy vegetation the lifespan of the plant is suspected to not exceed six years.
- There may be some confusion between Dune Onion Weed and the native *Dianella brevicaulis* (Short-stem Flax-lily). The main differences are that the leaves of *Dianella brevicaulis* are indented and neither fleshy nor shiny, the inflorescence is much more delicate than that of Dune Onion Weed, and that *Dianella brevicaulis* features purple/white fruits and flowers.

Distribution

This plant is a major problem in coastal Western Australia and New South Wales. There are two known populations in metropolitan Adelaide – serious infestation are present in the Port Adelaide Enfield dunes and a small population exists in the Port Noarlunga dunes. Recently, plants have been observed at Brighton, Henley Beach, Grange and Semaphore Park dunes on the central metropolitan coast.

Threat Assessment

Dune Onion Weed is the highest priority weed for the Reserve as it is highly invasive and capable of rapidly establishing in the dunes, potentially becoming a monoculture. It is critical the species does not become further established in the Reserve and that it does not spread further south to other sand dune systems. It is toxic to some animals.

Follow-up control will need to be ongoing for several years, as the life of the seed bank is unknown and dry flower stalks can float for several months. In addition, CSIRO research has found that some seeds submerged in seawater remain viable after eight months (Heyligers, 2002). Monitoring of the Reserve and adjacent dune systems will be of utmost importance to prevent new outbreaks.

Control Techniques*

Method	Chemical	Rate	Mix	Additive	Comments
Wick, blanket or sponge glove application in winter or spring (prior to flowering) when plants are actively growing.	glyphosate	1:2	water	2.5ml wetting agent	Apply in sensitive areas.
Spray in winter or spring.	chlorsulfuron	0.4g	10L water	25ml wetting agent	Apply to large areas. Will kill most annual legumes and the seedlings of some native species.
Hand weed smaller plants. Larger plants will require a fork or trowel to loosen sand.					Ensure roots and seed heads are removed and disposed off site. Dumped plants have been observed growing months after removal in the Port Noarlunga dunes (Hagan in Petherick, 2004, pers. comm.).

* Every effort has been made to ensure this information is accurate. The techniques suggested have proven to be effective, however feedback on alternative techniques is welcome. Chemical applications should only be conducted by a certified pest plant control operator.

Appendix 5: Common Weed Removal Techniques *

(from Robertson, 1994)

Hand Pulling

- Hand pulling of smaller plants is easiest in wetter months of the year when the soil is soft and seedlings are therefore much easier to remove.
- Seedlings: take hold of the plant at ground level and pull. If you pull at any point higher on the stem it may break and the plant will then require swabbing with herbicide.
- Small woody plants: take hold of the stem at ground level and gently rock the plant back and forth until it comes out cleanly.
- If possible place either feet or fingers on either side of the plant when pulling out. This helps keep the soil in place and avoids unnecessary disturbance of the soil. Press down disturbed soil with hands or feet.
- Remove and dispose of all seeds and vegetation propagules off site.

Cutting and Swabbing

- The most effective time of the year to cut and swab plants is when they are actively growing, which varies between species.
- Remove all branches and trunk to a safe and manageable height (around 0.5m).
- Cut off all stems as low as possible using a chainsaw or pruning saw, secateurs or long-handled loppers. Make sure the cut is horizontal so herbicide rests on the cut area while being absorbed, rather than running down the side of the stem.
- Remove all stems and green shoots from the stump, so that no green leaves remain, no matter how small they are.
- Make additional cuts into the stump surface to provide more surface area for the chemical to penetrate.
- For trees with a lignotuber such as olives, it helps to cut the stump deeply at an angle with an axe or machete.
- Swab all cut surfaces immediately with a liberal amount of herbicide mixture. Add a dye to the herbicide mixture to help indicate where swabbing has already occurred. Swabbing must be done preferably within 15 seconds, or as soon as is practical to ensure optimum translocation. The cut surface cannot be allowed to dry out; otherwise the herbicide will be much less effective. Use a paintbrush or squeeze bottle to apply herbicide mixture.
- As the tissues which take up and move the poison are in the cambium layer (located immediately under the bark layer), it is best to concentrate on applying poison around the outer rim of the stump.
- Follow-up your work. If the stumps reshoot, (a common occurrence with some species) then cut and swab or spray the new regrowth with herbicide.
- Repeat until the plant dies. *Large trees of certain species can take several poisonings before they are killed.*

* It is not within the scope of this Management Plan to make specific Occupation Health, Safety and Welfare recommendations. When undertaking works outlined in this Plan, ensure that all Occupational Health, Safety and Welfare requirements are met.

Spraying

- The most effective time of year to spray is when plants are actively growing.
- Coastal environments are characteristically very windy - spraying is often best done first thing in the morning when conditions tend to be calmer. *Under no circumstances should spraying be conducted when there are moderate to strong winds as the risk of off-target damage is too high.*
- Spray in weather with temperatures between 15°C-30°C. Spraying outside of this range is ineffectual.
- Look for native plants and cover them with upturned buckets or sheeting while spraying. *If there are too many native plants amongst the weeds then this method should not be used.*
- Add dye to the herbicide mixture, to indicate where spraying has already occurred.
- If spraying regrowth near creeks or other water bodies such as stormwater outlets, do not spray herbicide in or near the water, as it can have a negative effect on aquatic fauna such as frogs. In such cases, using chemicals without a surfactant is essential as these are designed to have a lesser impact on aquatic fauna. It is preferable to use more accurate methods such as cutting and swabbing adjacent to water bodies.
- Surfactants can also be used when spraying plants such as Bridal Creeper (*Asparagus asparagoides*) which have a waxy leaf surface. A surfactant can be added to the herbicide mix to increase the uptake of poison through the waxy leaf surface. Surfactants should not be used on or near plants growing in water as they are suspected of affecting frogs.
- Sprayable oils are also a very useful additive. These reduce spray drift, enhance pesticide uptake with many plant species, (particularly those with hairy leaves) and makes the herbicide rain fast within minutes, compared to the several hours required for normal applications without oil.
- Treat bulb plants when they are old and exhausted and before new bulbs have formed (generally just before and during flowering). Poisoning at this stage will minimise the chances of the plant reshooting in the next growing season.
- Where weeds have narrow vertical leaves, spraying might result in herbicide running off or drifting onto native plants. In this situation, wipe on herbicide mixture with a weed wand, sponge or wick applicator.

For more detailed information on weed control methods consult Robertson (1994).

Staged Removal of Larger Weeds that Provide Habitat	
Year 1	Remove 1 in 5 mature plants and replace with appropriate species.
Year 2	Remove 1 in 4 mature plants and replace with appropriate species.
Year 3	Remove 1 in 3 mature plants and replace with appropriate species.
Year 4	Remove 1 in 2 mature plants and replace with appropriate species.
Year 5	Remove all remaining plants and replace with appropriate species.

Appendix 6: Bushland Weeding Code

(from Robertson, 1994)*

The following code is designed to aid effective weeding in coastal zones:

- Know what weed you are targeting and which native species the weed may be confused with.
- Look before you weed – know where native plants are situated.
- Choose the most effective and selective weeding technique for the plant and the location.
- Adapt to the season and weather conditions. Don't pull or grub weeds when the soil is dry and roots break off when pulled, or tramp through when soil is so soft that your feet damage plants at each step.
- Minimise trampling over the site and scatter workers so they do not form a new trail. Wear soft-soled shoes and clothes which do not carry weed seeds or drag on foliage. Wear gloves.
- Before you pull, grub or poison large weeds, pull any small weeds growing underneath.
- Avoid damage to native plants. Don't drop or fell large weeds onto native plants or drag boughs through the bush.
- Disturb the soil as little as possible. Replace any disturbed soil, press it down and replace plant litter.
- Remove from the Reserve any parts of weeds which could regrow, including ripe fruits, seed heads, bulbs, rhizomes and runners. Break up the rest into small pieces and leave them scattered to form mulch, especially over the spots where weeds have been removed.
- Undertake follow-up work before moving to a new area.
- Remove weed seeds or bulbils, which could scatter into the weeded zone.
- Where native plants are regenerating among dense weeds, clear some growing space for them but do not create large openings.

* It is not within the scope of this Management Plan to make specific Occupation Health, Safety and Welfare recommendations. When undertaking works outlined in this Plan, ensure that all Occupational, Safety and Welfare requirements are met.

Appendix 7: Coastal Indigenous Species

Information from:

Black (1986), Bonney, (2003), Dashorst and Jessop (1998), Prescott, (1994), Ralph, (2003), Bagust and Tout-Smith (2005), Urban Forest Biodiversity Program staff

Acacia cupularis - Cup Wattle



Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

LEGUMINOSAE

Description

A bushy shrub to 2m high and 4-6m wide. **Phyllodes** are narrow to 7cm in length. **Flowers** deep yellow, globular, several on each peduncle.

Distribution

Coastal areas within South Australia. Also grows in Victoria and Western Australia.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Using gloves, run hands through branchlets to remove dry pods. Alternatively, place sheet under bush, shake branchlets to dislodge seeds and pods. Trample over collected material and sieve out clean seed. Finding seed after flowering has been limited within Tennyson Dune Reserve, possibly due to gall infestation.

Propagation Techniques

Pour very hot water (just off the boil) over seeds, allow to cool and soak overnight, strain off water. Seeds which are swollen are mostly viable, discard seeds which float. Sow seed 3-5mm under soil. Keep moist until germination. Can be used in direct seeding projects.

Habitat and Ecology

Cup Wattle secretes nectar from glands on the phyllode edge which attracts ants that prey on gall producing wasps and flies. Birds are also attracted to the nectar. The bright red arils attract birds which eat the seeds. Ants transport seed to their nests to eat the arils. Wattles are nitrogen fixing, which makes them useful in revegetation projects. Important shelter plant for softer species.

Uses in Landscape

Screening plant. Large garden beds. Full-sun.

Similar Species

The indigenous *Acacia ligulata* (Umbrella Bush) is found further inland with seed near double the size of Cup Wattle.

***Acacia longifolia* var. *sophorae* - Coastal Wattle**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

LEGUMINOSAE

Description

Large spreading shrub to 3m high by 5m wide. **Phyllodes** obovate to 10cm in length by 3-4cm wide. **Flowers** yellow, rod shaped, 2-4cm long on short peduncles.

Distribution

Mostly found on calcareous soils and coastal dunes. Also found in Queensland, New South Wales, Victoria and Tasmania.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Using gloves, run hands through branchlets to remove dry pods. Alternatively, place sheet under bush, shake branchlets to dislodge seeds and pods. Trample over collected material and sieve out clean seed. Heat of the day is best time to collect seed.

Propagation Techniques

Pour very hot water (just off the boil) over seeds, allow to cool and soak overnight, strain off water. Seeds which are swollen are mostly viable, discard seeds which float. Sow seed 5mm under soil. Keep moist until germination. Can be used in direct sowing projects.

Habitat and Ecology

Seed is sought after by emus, pigeons and other birds. Wattlebirds, silvereyes, honeyeaters and ants are active with seed dispersal. Very good habitat species for larger mammals and birds. Nitrogen fixing, which makes it useful in revegetation projects. Important shelter plant for softer species.

Uses in Landscape

Screening plant. Large backdrop species. Large garden beds. Full-sun.

Similar Species

Similar to the weed *Acacia cyclops* (Western Coastal Wattle), which has phyllodes shorter in length, flowers in globular heads and bright red arils around seeds. Western Coastal Wattle seedpods are curled (see Appendix 3 for details).

***Adriana quadripartita* - Rare Bitterbush**

Above left: female flower

Photo: Ron Sandercock



Above right: male flower

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

EUPHORBIACEAE

Description

Medium spreading shrub 1-2m high by 1-2m wide. **Leaves** are opposite, ovate to lanceolate in shape, up to 9cm in length, dark green and glossy above, white beneath. The leaf margins are toothed. Red tinge. Rare Bitterbush is **dioecious**. **Female flowers** comprised of three sets of forked red threads. **Male spikelets** reddish 5-10cm long.

Distribution

Found in many regions and associated with limestone and calcareous soils.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Cut off mature fruits, place in sunny position to fully dry. Valves will open to release seeds. Sieve to clean. Seed is often not viable.

Propagation Techniques

No treatment necessary. Sow seed directly into containers. Place seed 5mm under propagating mix. Keep moist. Mostly grown from cuttings.

Habitat and Ecology

Can be difficult to establish in dune environments. Host plant for the larvae of the Bitterbush Blue Butterfly (*Theclinesthes albocincta*). Male and female plants need to be mixed to ensure pollination.

Uses in Landscape

Low screening plant. Unique, attractive flowers. Large garden beds. Full-sun to semi-shade.

***Alyxia buxifolia* - Sea Box**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

APOCYNACEAE

Description

Woody medium shrub to 2m high by 3m wide. **Leaves** paired, thick, dark green and shiny on top. **Flowers** in groups. **Petals** have a lopsided 'windmill' appearance, waxy white. **Fruit** a swollen red or orange berry 6-10mm long, becoming black with age.

Distribution

Found mostly along the coast or inland in mallee.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Use gloves, pick off mature fruits. Skin is very firm when ripe. Alternatively, place sheet under bush and shake branches to dislodge fruit. Store away in dry area until sowing.

Propagation Techniques

Sow fresh seed. Fruit skin can be peeled off before sowing. Sow seed 5mm beneath propagating mix. Keep moist in an open position. Various acids, including Gibberellic and Hydrochloric have been used as a pre-treatment to help induce germination. Germination may take several months. Can also be grown from cuttings, but is slow.

Habitat and Ecology

Long lived plant, useful for revegetation projects. Seeds are dispersed by birds such as silvereyes (*Zosterops* spp.).

Uses in Landscape

Screening plant. Large garden beds. Full-sun to semi-shade.

Similar Species

The native *Beyeria lechenaultii* (Pale Turpentine Bush) has similar but thicker leaves. Pale Turpentine Bush is also smaller and lacks the colourful fruit.

***Atriplex cinerea* – Grey Saltbush**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

CHENOPODIACEAE

Description

Spreading erect shrub to 1.5m high. **Leaves** are thin, grey-green with shiny scaly patches, narrow elliptic to elliptic or ovate in shape. **Male flowers** are yellow and clustered at the ends of stems. **Female flowers** are green, small and occur singly along the stem. **Fruit** is spongy and dry, pale buff, somewhat triangular with a rounded base. **Seed** is circular, to 2mm and found within the fruit.

Distribution

Predominantly found along the coast growing on beach dunes or calcareous soils. Remnants exist at Tennyson and Minda Dunes. Also present in Western Australia, New South Wales, Victoria and Tasmania.

Location in the Dune System

Seed is naturally distributed by the sea and is predominantly found along the foredune.

Seed Collection Techniques

Using gloves, pick off mature fruits or shake fruiting branches in containers. Collect as dried fruits in warm dry weather. Clean to remove dust and twigs. Store away in dry area until ready to sow.

Propagation Techniques

To grow from seed, leach out salt from fruit by soaking or rinsing in running water. Can plant whole fruit or seed. Place fruit or seed just under soil and cover lightly with fine gravel, keep moist. Adding a small amount of soil from collection site into propagating mix can be beneficial. Cuttings are often a more reliable method of propagation.

Habitat and Ecology

Fruit are sought after by a wide range of native birds. Various lizards have been known to eat the seeds.

Uses in Landscape

Low screening plant. Large garden beds. Full-sun to semi-shade.

***Baumea juncea* - Bare Twig-rush**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

CYPERACEAE

Description

Perennial rush growing up to 30-100cm tall. Spikelets 4-5mm long, reddish brown and densely clustered. Long rhizome. Leaves reduced to points. Seed 2-3mm long, 1.5-2mm wide. Varies from dark red-brown to black. Smooth with numerous pits.

Distribution

Widespread on sandy soils in coastal environments, and in brackish or saline swamps. It can also occasionally be found in rocky gullies. Its distribution within South Australia includes Lake Eyre, Eyre Peninsula, Murray, Yorke Peninsula, Kangaroo Island and the South East. Occurs in all Australian states except the Northern Territory.

Location in the Dune System

Always found in protected areas but appears quite hardy.

Seed Collection Techniques

Seeds are released within 3-7 days after reaching maturity.

Propagation Techniques

Difficult to propagate from seed. Large seed set but little viable seed, providing often erratic and poor results. Bog method recommended. Some stands do not produce viable seed due to fact they are likely to be genetic copies of the same parent plant, making cross-pollination impossible. Propagating by division of rootstock is a more reliable technique.

Habitat and Ecology

The root mass assists sand stabilisation and plays an important role in dune formation processes.

Uses in Landscape

Its slender, upright form makes it an attractive and architectural plant that can be used in formal and informal gardens alike.

***Carpobrotus rossii* - Native Pigface**

Photo: Ron Sandercock

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

AIZOACEAE

Description

Thick fleshy, ground-running plant. **Leaves** triangular in cross section. **Flowers** have hundreds of pink 'petals' that are white at the base. Flower support is globe shaped. **Fruit** is a grey capsule, **seeds** within are tiny and red-brown in colour.

Distribution

Grows along the coast.

Location in the Dune System

Highly adaptable plant that will grow in most areas from the rear of the foredune to the protected hind dunes and swales.

Seed Collection Techniques

Cut off mature capsules with secateurs. To determine ripeness, squeeze capsules upside-down over your hand and the tiny seeds will release if mature. To extract seed, soak capsules in warm water which causes seed to be released, or manually by squeezing capsules. Can harvest seeds when wet.

Propagation Techniques

Either sprinkle seed over propagating trays and prick out into tubes once germinated, or sow directly into tubes. Cover lightly and keep moist in a warm sunny position. Seed has good results over three months. Grown easily from cuttings. Heel runners in late autumn/winter.

Habitat and Ecology

Fruits are edible. Flowers provide nectar for a range of insects. Soil stabiliser. Important species in revegetation programs. Sensitive to trampling.

Uses in Landscape

Attractive groundcover. Small to large gardens. Full-sun.

Similar Species

The weed, Hottentot Fig (*Carpobrotus edulis*), is very similar but with yellow 'petals' (refer to Appendix 3).

Clematis microphylla - Old Man's Beard



Photo: Ron Sandercock



Photo: Ron Sandercock

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

RANUNCULACEAE

Description

Scrambling perennial vine or climber growing to several metres. **Leaves** pale green, occur oppositely up the stem, and are divided into 3 lance shaped leaflets 1-3cm long. **Branches** narrow and flexible. Acquires a woody appearance with age.

Old Man's Beard is dioecious. **Flowers** are cream and comprised of four narrow petals 1.5-2.5cm long. Old Man's Beard is named after the **fruit**, which resembles cotton wool at maturity. **Seeds** light brown, ovate, 4mm long and attached to elongated style with fine hairs up to 5cm long.

Distribution

Widespread in woodland and mallee areas from the coast to inland. Occurs in all Australian states except the Northern Territory.

Location in the Dune System

Grows in protected areas to the rear of the dune system and found scrambling amongst other shrubs.

Seed Collection Techniques

Collection by hand is simple due to seeds being bunched together on the plant. Seeds remain on foliage for several weeks. Store in container until ready to sow.

Propagation Techniques

Sow from spring when propagating in containers, or direct seed mid-winter (drier areas) to spring (wetter areas). Sow seed to 5mm and cover with soil or fine gravel. Keep moist in an open, sunny position. Remove awn prior to planting for improved results. Slow to germinate.

Habitat and Ecology

Birds use the fruit as a nest lining. Indigenous peoples pounded the plant to obtain high levels of starch contained within the tuber-like root.

Uses in Landscape

Climber, light screen over trellis.

***Dianella brevicaulis* - Short-stem Flax-lily**

Photo: Ben Moulton



Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Division	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

LILIACEAE

Description

Small clumping plant to shin high. **Leaves** blue-green, stiff and strap-like. **Flowers** occur on wiry branched stalks within foliage line. **Petals** blue, upturned. **Stamens** are dark purple with an orange base.

Distribution

Mostly found on calcareous soils and coastal dunes. Occurs in Queensland, New South Wales, Victoria and Tasmania.

Location in the Dune System

Grows in protected swales and hind dune areas. Also grows behind the foredune and can tolerate minor sand burial.

Seed Collection Techniques

Collect fruits that are losing their colour or drying off. Place in warm dry place. Once dry, rub firmly to dislodge shiny black seeds. Store in cool dry place.

Propagation Techniques

Propagating from seed can have erratic results and may take several months to germinate. Smoke treatment can improve results. Treatments that have been reported to improve results include peeling (after soaking in water for 24 hours), nicking the seed coat or rubbing lightly with fine sandpaper. Soaking seed in soapy water prior to sowing (velvet soap is recommended) may help. Use fresh seed.

Habitat and Ecology

Flowers are insect pollinated. Fruits are taken by various native birds. Sleepy Lizards (*Teliqua rugosus* ssp. *asper*) and Eastern Bluetongues (*Teliqua scincoides*) have been known to eat ripe fruits. Edible fruits.

Uses in Landscape

Attractive for borders, mass planting, small groups, pots, indoor, small to large gardens. Full-sun to shade.

Similar Species

The indigenous *Dianella revoluta* (Black-anther Flax-lily) carries its flowers above the foliage and is located further inland.

Enchylaena tomentosa - Ruby Saltbush



Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

CHENOPODIACEAE

Description

Low shrub to 1m high by 1.5m wide. **Leaves** blue-green, small, fleshy, cylindrical, to 2cm long with a covering of fine hairs. **Flowers** are insignificant. **Fruit** is fleshy, berry-like to 5mm in diameter, depressed-globular and flat to sunken in the centre. Berries are predominantly red, orange or yellow.

Distribution

Widespread along Australian coast and inland where slightly saline conditions exist or on calcareous soils. All states except Tasmania.

Location in the Dune System

Grows in protected swales and hind dune areas. Often a bird driven plant and found under shrubs or along fencelines.

Seed Collection Techniques

Pick berries by hand or shake branchlets to dislodge fruit onto a small sheet. Fully dry in warm position. Flesh withers away to leave mostly the seed. Can extract seed from moist berry. Store in cool, dry area.

Propagation Techniques

Propagated from seed. Usually good results in 2-3 weeks. Use fresh seed. Cover seed to approximately 5mm and keep moist. May benefit from using smoked water. Adding a small amount of salt or sand from collection site to the propagating mix may also be beneficial to germination.

Habitat and Ecology

Offers food for most of the year. Many bird species along with ants and lizards are attracted to the berries. Berries are also suitable for human consumption and plants were used as a food source by Indigenous people.

Uses in Landscape

Groundcover, small shrub. Full-sun to semi-shade.

Similar Species

Similar to the natives *Threlkeldia diffusa* (Coastal Bonefruit), *Maireana enchylaenoides* (Wingless Fissure-plant) and *Suaeda australis* (Austral Seablite).

***Geranium potentilloides* – Downy Geranium**

Photo: Ron Sandercock



Photo: Ron Sandercock

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

GERANIACEAE

Description

Perennial herb to ankle high. **Stems** are delicate to 50cm long with inconspicuous hairs. **Stem leaves** 1.5-3cm long, 5cm wide, opposite with 5-7 lobes that make the leaves circular in outline. **Basal leaves** are larger and absent in summer. **Flowers** chiefly solitary. **Petals** 5-6cm long, pink with translucent veins. Anthers yellow. Fruit is 12-14mm long. Seeds are black with small pits.

Distribution

Occurs in grassland and woodland communities throughout the Flinders Ranges, Northern Lofty, Yorke Peninsula, Kangaroo Island and South East. Also widespread in Victoria, New South Wales, Tasmania and New Zealand.

Location in the Dune System

Grows in the protected swales and rear dunes where moisture levels are higher and there is greater protection from winds and salt.

Seed Collection Techniques

Collect by hand.

Propagation Techniques

Lightly cover seed or surface sow, as light will aid germination. Germination is slower in the absence of treatment due to hard seed coat. Trial soaking the seed at 60°C for 30 minutes. Germinates readily after treatment.

Habitat and Ecology

Little is known about the habitat and ecology of Downy Geranium. As populations are dwindling along the Adelaide metropolitan coast, it is possible its natural seed dispersal mechanism is missing. Plant on the leeward side of more robust species in protected swales or hind dune areas.

Uses in Landscape

Attractive herbaceous species for small coastal gardens. Plant in groups.

***Helichrysum leucopsideum* - Satin Everlasting**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

COMPOSITAE

Description

Erect perennial herb 15-50cm high. **Stems** are purple-brown, smooth, wiry and either branched or unbranched. **Leaves** 2-5cm long, 1-5mm wide, linear to elliptic and woolly with a white underside. Woody rhizome. **Flowers** are white, 25-35mm in diameter. Numerous, bisexual florets. The achene (**seed**) is light brown, 2mm long, smooth, oblong and square in cross-section.

Distribution

Found in mallee or coastal scrub on deep sand. Occurs in all states except Northern Territory and Queensland.

Location in the Dune System

Grows in protected swales and rear dunes where moisture levels are higher and there is greater protection from winds and salt.

Seed Collection Techniques

Easy to collect. Cut off mature seed heads. Keep seed heads in a paper bag until they fall apart. Store in a cool dry place with a small amount of insecticide (Naphthalene flakes are useful).

Propagation Techniques

Grow from seed or cuttings. Propagation is most successful when temperatures are around 15-20°C. Lightly cover seeds or sow on surface, as light is thought to aid germination. Germinates in 2-5 weeks, but results are erratic. Capillary watering method is recommended due to vulnerability of seeds to damping off.

Habitat and Ecology

Seeds are eaten by ants and other insects. Flowers are insect pollinated.

Uses in Landscape

Can be used in low drifts. Small gardens.

Isolepis nodosa - Knobby Club-rush



Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Division	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

CYPERACEAE

Description

Perennial rush growing up to 1.5m high, from a creeping woody rhizome. **Leaves** are reed-like cylindrical to slightly flattened, approximately 3-4mm in diameter, dark green with a sharp tip. **Fruiting head** is a spiky ball to 1.5cm across, russet coloured and held below the tip of the leaf. **Seeds** are shiny brown, 1mm long.

Distribution

Coastal environments and on saline soils inland. Prefers seasonally wet sites.

Location in the Dune System

Grows throughout the dunes to the rear of the foredune. Prefers the moist environment of swales.

Seed Collection Techniques

Cut seed heads with secateurs, rub together to dislodge seed. Store in a cool dry area.

Propagation Techniques

Sprinkle seeds into tubes or trays. Lightly cover with sand or gravel. Keep moist - the bog method is recommended. Division to be carried out in autumn and spring. Take part of plant with juvenile root growth.

Habitat and Ecology

Adapted to saline situations. Very important for sand stability. Tussock beds provide good habitat for birds.

Uses in Landscape

Useful accent plant, group plantings, pots, birdbaths. Full-sun to semi-shade.

Similar Species

May be confused with the serious weed *Juncus acutus* (Spiny Rush) which has extremely sharp leaf tips. The seed heads of Spiny Rush are also attached to one side of the stem and not spherical in shape.

***Kennedia prostrata* – Running Postman**



Photo: Ron Sandercock



Photo: Ron Sandercock

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

LEGUMINOSAE

Description

A vigorous, ground-hugging perennial with runners extending up to 2 metres from the central root. **Leaves** trifoliate with dark, wavy edges. **Flowers**, prominent red peas 2.0-2.5cm long with a striking yellow centre occur along stems in spring. 1-2 flowers on each inflorescence. **Fruit** is an oblong-ovoid leathery pod growing up to 4cm long. The pod is initially green, turning maroon and eventually to brown at maturity. Pods dry, twist and split open at maturity to reveal 5-8 seeds. **Seeds** are smooth, 4mm long and brown-black in colour.

Distribution

Once common in a variety of environments from the coast through to woodlands of the foothills, its population is now restricted to various reserves around Adelaide.

Location in the Dune System

Found in semi-shaded areas in protected swales and hind dune areas.

Seed Collection Techniques

Pods dry, twist and spilt open at maturity. Pods may also split once pressure is applied or upon the onset of hot weather. Pods can be collected when they begin to dry out and turn brownish-red.

Propagation Techniques

Several techniques will procure successful results. Easily grown from seed using hot water or scarifying methods. Pour hot water (just off the boil) over seeds and soak overnight. Dry then sow. Seeds can be sown from spring onward and need to be kept moist in an open, sunny position. Germination will occur in several weeks if kept moist in potting mix. Smoke treatment is reported to render best results.

Habitat and Ecology

Flowers and seeds are an important food source for fauna, including the Pea Blue Butterfly (*Lampedes boeticus*) which relies on Running Postman for food during its larval stage. Nitrogen fixing.

Uses in Landscape

Attractive groundcover. Can be used in small to large garden pots. Prefers light shade.

***Kunzea pomifera* - Muntries**



Photo: Ben Moulton



Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

MYRTACEAE

Description

A prostrate shrub, with spreading branches over several metres. **Leaves** bright green, thick, to 5mm long **Flowers** are white, fluffy and borne in terminal clusters. **Fruit** is an edible purple berry approximately 1cm in size.

Distribution

Grows along sandy coasts.

Location in the Dune System

Found in protected swales and hind dune areas.

Seed Collection Techniques

Collect drying berries and place on material to complete drying process. As fruit shrinks seeds fall out from base. Pass through fine sieve to clean.

Propagation Techniques

Cuttings are the preferred method of propagation. Sprinkle seed over propagating mix and cover with fine gravel. Keep moist in a warm area. Muntries is usually difficult to propagate by seed.

Habitat and Ecology

Fruits are edible and were a food source for Indigenous people. Fruits attract birds and lizards. Small insects and ants attend to the flowers. May provide habitat for Sleepy Lizards (*Teliqua rugosus* ssp. *asper*).

Uses in Landscape

Groundcover. Pots, hanging baskets. Full-sun to semi-shade.

Lepidosperma gladiatum - Coastal Sword Sedge



Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Division	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

CYPERACEAE

Description

Stems are rigid, up to 1m high by 2cm wide, with sharp edges. **Spikelet**, pale brown to 15cm. **Seed** is located within an ovate shaped nut, 2mm long by 1mm wide, brown.

Distribution

Widespread in South Australian coastal regions. Distribution is low on the Adelaide metropolitan coast. All states except Northern Territory and Queensland.

Location in the Dune System

Grows in protected swales and hind dune areas. Several patches of remnant Sword Sedge exist within the Reserve.

Seed Collection Techniques

Cut off fruiting spikes. Use strong gloves as foliage is extremely sharp. Remove seeds by firmly smacking fruiting spike against a flat surface, many seeds will easily dislodge.

Propagation Techniques

Propagation by seed has proved to be very difficult. Trials using heat, smoke, older seed, and various combinations of these have all returned erratic results (Ralph, 2003), but may be worth further trials. Division in winter months has proved to be the most reliable, but plants often die back and are slow to recover. May need to trim back the foliage when dividing.

Habitat and Ecology

An important plant in sand dune ecology. Established clumps form good habitat for small native animals. Birds, including finches, are known to eat the seeds.

Uses in Landscape

Good accent plant. Foliage contrast. Borders. Pots.

Leucophyta brownii - Coast Cushion Bush



Photo: Ron Sandercock



Photo: Ron Sandercock

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

COMPOSITAE

Description

A compact, rounded shrub to 1m high and wide. **Branches** are silver-grey, mesh-like and covered with small white hairs. **Leaves** are 1.5-14mm long, pale green, occurring alternatively up the stem. Leaves are pressed closely to the stems. **Flowers** are compact, globular, pale yellow balls of florets 1-1.5mm across. **Seed** (achenes) 1-2mm long and attached to the pappus, with numerous bristles at the base.

Distribution

Widespread on dunes and limestone cliffs in coastal environments. Also occurs in Western Australia, Victoria and Tasmania.

Location in the Dune System

Found on or near the foredune. Can tolerate exposed positions.

Seed Collection Techniques

Collect seeds by running fingers through fruiting heads. If seed heads fall apart upon collection, this is an indication of maturity. Store in a container.

Propagation Techniques

Sprinkle fresh seeds over coastal sands or propagating mix. Lightly cover seeds to encourage anchorage. Place in a warm, open position and keep moist. Coast Cushion Bush will grow from seed and cuttings on sand or clay based soils.

Habitat and Ecology

A suitable species for revegetation. Coast Cushion Bush is an important habitat plant for insects and small skinks.

Uses in Landscape

The structural form makes it popular in garden settings.

***Leucopogon parviflorus* - Coast Beard-heath**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

EPACRIDACEAE

Description

Densely foliated, upright shrub to 2m high and 5m wide. **Leaves** thick, oblong, 3cm long and tapering to a pointed tip. Longitudinal veins present on underside of leaf. New growth is bright green in colour. Clusters of white **flowers** are arranged in spikes at the end of branches. **Fruit** is a drupe, round and produces one stone-like seed less than 1cm across. Fruit is initially green, changing to bright white upon maturity.

Distribution

Widespread in coastal environments. Also found in Queensland, New South Wales, Victoria and Tasmania.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Seeds are ready for collection when the fruit is bright white, and can be removed from the branches with ease. After collection, completely dry out then clean – storing in an area that is cool, dark and dry.

Propagation Techniques

Can propagate from seed or cuttings. Sow fresh seed between April and early winter. Sow seed just below the soil surface, which is where they would germinate in natural conditions. Alternatively, place seeds onto propagation mix and cover with 4mm of soil gathered from under parent plant. Place in cool position with partial shade, keeping moist. Germination time varies from 3-12 months. Stratification of seed is thought to break seed dormancy.

Habitat and Ecology

Fruits are eagerly sought by various fauna, including native birds, lizards, skinks, rats and ants. Coast Beard-heath also provides habitat for small birds. The fruit has a pleasant lemon taste, and for this reason was often eaten by Indigenous peoples.

Uses in Landscape

Medium shrub, screen, bird attracting. Full-sun. Hardy.

***Lotus australis* - Australian Trefoil**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

LEGUMINOSAE

Description

Perennial herb to 30cm. **Stems** are stiff and hollow, erect at the ends and either upright or growing along the ground. **Leaves** of five similar leaflets, two of which are at the junction of the leaf and stem. Rosy pink to white pea-like **flowers** occur in clusters of 3-8 on stalks longer than the leaves with three leaflets just under the flowers. **Seed** pods terate in shape 50mm long by 4mm wide. Seed round in shape 2mm in size, dark brown in colour. Up to 15 seeds per pod.

Distribution

Found on coastal calcareous sands, dry hills and grasslands. Most states except central Australia.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Mature pods can be picked when brown in colour. Place in paper bag in a warm area to finish drying. Seedpods are explosive, therefore be careful when collecting and drying out to ensure seed is not lost.

Propagation Techniques

Place seed in potting soil and cover lightly with fine gravel. Keep moist and place in an open sunny position.

Habitat and Ecology

Offers a source of nectar and pollen to insects and birds. Parts of the seed provide food for ants, which in turn help disperse the seed. Weevil type beetles use the seed to lay eggs on, which, once hatched, drill into the seed to seek out the protein.

Uses in Landscape

One of the more colourful local plants. Useful for small garden, pots and hanging baskets. Full-sun to semi-shade.

Melaleuca lanceolata – Dryland Tea-tree

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

MYRTACEAE

Description

The form of Dryland Tea-tree is influenced by local conditions; in coastal areas it is a densely foliated shrub, however further inland it is a tree reaching up to 10m in height. **Leaves** are characteristic of the Myrtaceae family, and dark green, small, 0.5-1cm long, lance-shaped and oppositely arranged up the stem. Rough bark. Attractive cream to white 'bottle-brush' **flowers** occur along the stem. **Fruit** is a globular, woody capsule 4-5mm in diameter, occurring in clusters along the stem of each year's new growth. **Seeds** are minute and pale brown in colour.

Distribution

Grows in rocky gorges, mallee and coastal environments. Once commonly found behind foredunes and further inland on old sand and loams.

Location in the Dune System

Grows in the rear dunes where conditions are more stable and protected.

Seed Collection Techniques

Seed production is prolific. Seed can be collected throughout the year, however summer is the optimal time as woody capsules shrink and completely expel all seeds. If collecting seed at other times of the year, remove capsule from the branches and lay out to dry. Seed will release naturally after several years. Once released, pass seeds through a sieve to remove unwanted material. Store in an airtight container in a cool, dry position.

Propagation Techniques

Easily grown from seed. Sprinkle seeds over propagation mix and cover with fine gravel. Place in a warm position and keep moist. If using in revegetation projects, sow seeds directly into lightly tilled soil and press firmly into the ground in mid to late winter.

Habitat and Ecology

Dryland Tea-tree is an important habitat plant, providing nectar for insects and birds throughout the year, but especially in summer when many other plants are dormant. The flowers were also sought after by Indigenous people for their nectar, whilst its bark was utilised for wrapping food as part of the meal preparation. Early settlers used its leaves as a tea substitute.

Uses in Landscape

Large gardens. Structural plant. Large screening.

***Muehlenbeckia gunnii* - Coastal Climbing Lignum**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

POLYGONACEAE

Description

Climbing plant, twining onto nearby shrubs or trees. **Leaves** round to egg-shaped with crisped edge. **Flowers** waxy, yellow-green, five petals, small, to about 5mm diameter. **Fruit** is yellow with a black nut.

Distribution

Grows along the coast as well as in the foothills and mallee areas.

Location in the Dune System

Found in protected swales and hind dune areas, scrambling amongst shrubs.

Seed Collection Techniques

Collect ripe fruits, squeeze off flesh and dry in warm place.

Propagation Techniques

Sow as normal, not very reliable.

Habitat and Ecology

The fruit is a source of food for lizards and birds. Its scrambling nature over other plants provides valuable habitat.

Uses in Landscape

Twiner, pots. Full-sun to semi-shade.

Myoporum insulare - Common Boobialla



Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

MYOPORACEAE

Description

Large shrub to small tree up to 5m. Leaves thick and fleshy to 7cm, light-green, sparsely toothed. **Flowers** have five petals and are white with purple spots. **Fruit** is a drupe, succulent, ripening to a bluish-purple at maturity, round in shape to 6mm in diameter. **Fruits** dry with a blackish dry skin over a woody stone-like cover with rarely more than one seed fully developing.

Distribution

Common on damp sandy soils along the coast. Also found in Western Australia, New South Wales and Victoria.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Dislodge ripe fruits into a bucket or container. Place fruits in dry sunny position to completely dry (this may take several weeks). Once dry, store in cool, dark, dry area until ready to sow.

Propagation Techniques

Soak seeds in warm water overnight before sowing. Sow into sandy compost propagating mix 2-3mm deep. Cover surface with fine gravel to 4mm thick. Keep moist. Place out in open. Provide fifty percent shade on hot days. Easily grown from cuttings.

Habitat and Ecology

Many different bird species are attracted to the fruit as a food source, which in turn helps to disperse the seed. Provides habitat for small birds and ground-dwelling mammals.

Uses in Landscape

Large shrub to small tree, screening plant. Full-sun.

Nitraria billardierei - Nitre Bush



Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

ZYGOPHYLLACEAE

Description

Medium to large, dense, spreading shrub up to 3m high, sometimes spiny. **Leaves** flat, glaucous and partially succulent. **Flowers**, white with five petals, up to 4mm in length. **Fruits** are a drupe 1.5cm in diameter. Green, ripening through to red or purple. **Seed** (endocarp) is a hard woody pip 5-7mm in length, pale brown in colour, surface pitted, pale lemon-like seed within.

Distribution

Widespread where saline flats occur. Also occurs in coastal dunes.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Pick fruits by hand. Squeeze off fruit straight away, then dry in a warm area.

Propagation Techniques

The hard woody pip (endocarp) can be gently cracked with a nutcracker. The seed can then be carefully removed, so as not to cause damage. Sow carefully into propagating mix. Cover lightly, keep moist, place in sunny open position. Woody pips have been sown into soils after fermenting in a plastic bag with wet soil for two months prior to sowing. Sow in warmer months. Often grown from cuttings.

Habitat and Ecology

Ripe fruits are consumed by a wide variety of birds. Can tolerate high salinity. An important habitat plant for birds. Fruit is edible but can be salty.

Uses in Landscape

Large gardens, bird attracting. Full-sun.

Similar Species

Can be confused with the weed *Lycium ferocissimum* (Boxthorn), and the natives *Lycium australe* (Australian Boxthorn) and *Bursaria spinosa* (Sweet Bursaria). Refer to information on African Boxthorn in Appendix 3 for comparisons.

***Olearia axillaris* - Coast Daisy-bush**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

COMPOSITAE

Description

Medium to tall shrub to 3m. Many branches, **stems** white when young. **Leaves** dark-green or bluish above, white underneath. **Flowers** daisy-like, crowded along stems in the axils, whitish to dull. **Seed** (achenes) to 1mm in length, pale brown, attached to a pappus with many bristles to 3mm in length, off-white in colour.

Distribution

Grows along coastal dunes and nearby scrub. Also found in Western Australia, New South Wales and Victoria.

Location in the Dune System

Grows in protected swales and hind dune areas. Grows from the rear of the foredune to the hind dunes.

Seed Collection Techniques

To dislodge seed rub gloved hands through branches or bend branch over into container. Shake branch and ripe seeds will fall out. Be careful in windy conditions. Store in a cool, dry, dark position.

Propagation Techniques

Use fresh seed. Sprinkle over propagating mix. Cover seed just enough to anchor. Keep moist, leave in open position as light enhances germination. Also grown from cuttings.

Habitat and Ecology

A primary coloniser and key habitat plant in the dune environment. Seed is eaten by several bird and insect species.

Uses in Landscape

Rounded shrub will cope with clipping. Medium to large gardens, screen plant, foliage contrast. Full-sun to semi-shade.

Similar Species

The indigenous *Olearia ramulosa* (Twiggy Daisy-bush) has leaves half the length of Coast Daisy-bush and is usually found on heavier soil further inland.

***Pelargonium australe* - Native Pelargonium**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

GERANIACEAE

Description

Perennial herb to 50cm high. **Stems** and leaves have a velvety texture. **Leaves** are ovate to obicular, growing to 9cm in length. Leaf edges wrinkled. **Flowers** in closely clustered group of about ten, pale pink with purple stripes. **Seed** to 2mm in length, with an awn attachment.

Distribution

Found on poor calcareous sands and granite outcrops.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Collect by pinching off ripe heads, place into a container. Gently rub seed from the fluff. Storing in cool, dry and dark area.

Propagation Techniques

Sprinkle seed over trays or direct into tubes. Lightly cover to anchor seed, keep moist, sow from autumn onwards.

Habitat and Ecology

Birds often eat the seed. Ants carry seed away to consume in their nests. Seeds that are not eaten germinate away from the parent plant. Seed dispersal occurs via wind. Flowers are insect pollinated.

Uses in Landscape

One of the more colourful local plants. Useful in small gardens and pots. Full-sun to semi-shade.

***Pimelea serpyllifolia* ssp. *serpyllifolia* – Thyme Riceflower**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

THYMELAEACEAE

Description

Erect shrub to 1.5m tall. In exposed environments its form is stunted or prostrate. **Stem leaves** 1.5cm long, 2-4mm wide, elliptic to obovate (concave when dry). The four **floral leaves** are larger than the stem leaves. **Flowers** 4mm long with four green-yellow petals fused into a short tube. **Flowers** grouped in small clusters at tip of branchlets. Long hairs occur at flower base. Male and female flowers occur on separate plants. **Seeds** black, 5-6mm long, enclosed within the fruit, which is green in colour. Seeds are situated within the flower heads.

Distribution

Often occurs on calcareous soil in scrub and woodlands. Also found in heaths and forests. Occurs also in New South Wales, Victoria, Western Australia and Tasmania.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Hand pick. Seeds are released when mature, and often occurs concurrently with hot weather. Seeds are often tedious to collect. Found at the terminal end of branches.

Propagation Techniques

Frequently grown from cuttings. Propagation from seed is often difficult (although simpler than for other *Pimelea* spp.) and slow. Sow fresh seed late summer to autumn into sandy propagating soil. Cover lightly with fine gravel. Place in open sunny area. Keep moist. Seeds retain viability for long periods.

Habitat and Ecology

Insects and butterflies frequent this species.

Uses in Landscape

Useful small, hardy shrub in any garden. Rounded form. Attracts butterflies.

***Rhagodia candolleana* ssp. *candolleana* - Sea-berry Saltbush**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

CHENOPODIACEAE

Description

Sprawling shrub approximately 1m high to several metres wide. **Leaves** alternate, dull green with white underside, fleshy. **Flowers** are small, whitish and clustered in branched sprays. **Fruits** are pale green, ripening through to deep red in late summer to autumn, succulent, translucent, globular, depressed, to 4mm in diameter. **Seed** is black and 1.5-2.5mm in diameter.

Distribution

Often found on poor soils along the South Australian coast. Also found in Western Australia, New South Wales, Victoria, and Tasmania.

Location in the Dune System

Found almost anywhere rear of the foredune. Often a bird driven plant and found under shrubs or along fencelines.

Seed Collection Techniques

Collect when fruits are deep maroon in colour. Cut off terminal fruiting spikes. Can squeeze off flesh when moist. Place in warm dry area to dry. Once dry, the seeds are easily observable. Sieve to give final clean.

Propagation Techniques

Seeds propagate easily without treatment. Use fresh seed under 12 months old. Sow into tray and prick out or sprinkle direct into tubes. Cover with layer of fine gravel. Keep moist in an open position.

Habitat and Ecology

Important plant in coastal ecology. Fruits are sought after by honeyeaters and a wide range of other bird species. Lizards also eat the fruits, aiding seed dispersal. Provides habitat for various native birds and lizards.

Uses in Landscape

Sprawling groundcover for medium to large gardens. Full-sun to semi-shade.

***Scaevola crassifolia* - Cushion Fanflower**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

GOODENIACEAE

Description

Spreading robust shrub up to 1.5m high by 2m wide. **Leaves** are broadly ovate to orbicular with slightly serrated edges and up to 4cm long by 1cm wide. **Flowers** are bright blue, fan shaped. **Fruit** globose to 3mm, seed within a dry, thin covering called a mesocarp. **Seed** to 1.5mm in size.

Distribution

Found along coast on limestone and calcareous soils and sands. Also found in Western Australia.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Cut off drying flowering stems (not the branches), lay out in a dry warm area to fully dry. Place contents over fine screen and rub hands over foliage to dislodge seed. Seed is fine and small.

Propagation Techniques

Sprinkle over propagating mix, cover lightly and keep moist. Seed can take several months to germinate. Smoke treatment may improve germination rates. Often grown from cuttings.

Habitat and Ecology

Flowers attract butterflies. Flowers are pollinated by insects. Provides habitat for lizards and small mammals.

Uses in Landscape

Large groundcover or sprawling shrub, attractive flowers. Full-sun.

***Senecio pinnatifolius* (formerly *S. lautus*) - Variable Groundsel**

Photo: Ben Moulton

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

COMPOSITAE

Description

Branched herb to 80cm high and 75cm wide. **Leaves** are bright-green divided into lobes and usually fleshy (sometimes almost flat). Bright yellow, composite **flowers** (daisy), about 25mm in diameter. **Seeds** are tiny and buff-coloured and clustered together in daisy-like 'fuzz balls'.

Distribution

Widespread from uplands to the coast.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Seed heads become fluffy and seeds come away easily from the plant when mature.

Propagation Techniques

Mostly grown from cuttings, which strike easily if taken in the winter months. Erratic results from seed. Sprinkle seed into trays and prick out into tubes or sprinkle seed direct into tubes. Surface sow and cover with propagating mix (just enough to anchor), as light may enhance germination. Keep moist in an open, sunny aspect.

Habitat and Ecology

Pioneer plant which readily germinates in dunes.

Uses in Landscape

One of the more colourful native plants. Useful in small gardens and pots. Plant in drifts. Full-sun to semi shade.

Similar Species

Do not confuse with the weeds *Chrysanthemoides monilifera* ssp. *monilifera* (Boneseed), *Sonchus* spp. (Sow Thistles) or *Reichardia tingitana* (False Sow-thistle).

***Spinifex hirsutus* - Hairy Spinifex**

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

POACEAE

Description

Large robust perennial, with stout, creeping stems. **Leaves** are very hairy. Leaf sheaths swollen at the base. Plants produce both male and female spikelets. Bisexual spherical **seed heads** (pictured above right) are up to 20-50cm in diameter and composed of many straw-coloured papery spikes. Smaller male flowers are also produced.

Distribution

Coastal sand dunes and beaches above high tide. Widespread throughout coastal areas in Australia and Asia.

Location in the Dune System

Grows along the foredune and occasionally, to the rear dune.

Seed Collection Techniques

Seed along the Adelaide Metropolitan coastline is affected by a fungal rust and is not generally collected.

Propagation Techniques

Mainly propagated by cuttings. Take fresh runners with 3-4 nodes that have not quite set new roots. Bury these in moist sand with a few leaves above ground.

Habitat and Ecology

Primary dune forming plant and sand binder. Will tolerate mobile sand.

Uses in Landscape

Groundcover in coastal gardens. Full-sun.

***Tetragonia implexicoma* - Bower Spinach**

Photo: Ben Moulton



Photo: Ron Sandercock

Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

AIZOACEAE

Description

Large scrambling plant, climbing onto nearby shrubs. **Leaves** large, fleshy and thick. **Flowers** are small, to about 1cm, white, with four petals. **Fruit** is a red to blackish berry.

Distribution

Grows along most of the South Australian coast. Also found in Western Australia, Victoria and Tasmania.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Pick fruits by hand. Squeeze off fruit straight away, then dry seeds. Dry in warm area.

Propagation Techniques

Use fresh seed. Remove the flesh before sowing as it may contain chemical inhibitors. Predominantly grown from cuttings.

Habitat and Ecology

The fruit is a source of food for lizards and birds. It is often seen scrambling over other plants, which provides valuable habitat for fauna.

Uses in Landscape

Groundcover or scrambling plant.

Similar Species

Do not confuse with the weed *Tetragonia decumbens* (Sea Spinach). Refer to Appendix 3 for a description of this weed species.

Threlkeldia diffusa - Coast Bonefruit



Flowering	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Collect Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Seed	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Propagate Cuttings	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec

Family

CHENOPODIACEAE

Description

Small shrub to 20cm high. **Leaves** club-shaped, fleshy, often with a purple tinge. **Flowers** are insignificant. **Fruit** is a fleshy, oval reddish or purple berry with a hard bony centre.

Distribution

Grows along most of the South Australian coast. Also found in Western Australia, Victoria and Tasmania.

Location in the Dune System

Grows in protected swales and hind dune areas.

Seed Collection Techniques

Pick off ripe fruits or shake branch over a plate or bowl. Dry in a warm position.

Propagation Techniques

Sow as normal. Cover seed with thin layer of gravel. Keep moist in a warm, open position. Can be unreliable. Take cuttings in late winter to early spring.

Habitat and Ecology

Many bird species are attracted to the berries, along with a variety of ant and lizard species.

Uses in Landscape

Small groundcover. Full-sun.

Similar Species

Similar to the native *Enchylaena tomentosa* (Ruby Saltbush). See descriptions detailed in this Appendix for further information on differences between the species.

Appendix 8: Priority Actions for Indigenous Species Within Tennyson Dune Reserve (courtesy of Ron Sandercock)

Botanical Name	Common Name	Abundance/Location	Action Required	Propagation/Comment
<i>Acacia cupularis</i> 2	Cup Wattle	Sparsely scattered on hind dune. Conservation rating.	Moderate – At risk Need to maintain and boost existing population.	Finding seed after flowering has been difficult, possibly due to gall infestation. Useful rehabilitation plant. See Appendix 7.
<i>Acacia ligulata</i> 4	Umbrella Bush	Sparsely scattered on hind dune, found more in the West Lakes dunes.	Nil Concentrate on <i>A. cupularis</i> - the coastal form.	Uncertain if growing naturally in dunes. See Appendix 7.
<i>Acacia longifolia</i> ssp. <i>sophorae</i> 2	Coastal Wattle	Natural population a co-dominant understorey in Zone 2 (inter-dune corridor). Widely planted in revegetation projects.	Moderate Continued rehabilitation planting.	Easy from seed – needs pre-treatment. Useful rehabilitation plant. See Appendix 7.
<i>Adriana quadripartita</i> (formerly <i>A. klotzschii</i>) 1	Rare Bitterbush	Limited and scattered on hind dune. Conservation rating.	High – At risk Boost natural population. Butterfly recovery project. Source from outside to help improve genetic integrity.	Relatively easy from cuttings and seed. Mix male and female plants. See Appendix 7.
<i>Allocasuarina verticillata</i> 3	Drooping Sheoak	Reintroduced in revegetation projects at rear of dunes. Uncommon on coastal Adelaide Plains.	Low Further planting to boost woodland in carpark areas.	Easy – source seed from Semaphore 3-par Golf Course or Grange Golf Course.
<i>Alyxia buxifolia</i> 3	Sea Box	Moderately abundant in on seaward face of hind dunes. Planted in butterfly recovery project in swale areas. Conservation rating.	Low - Boost natural populations in alternative locations. Source from outside to improve genetic integrity.	Difficult – Seed not always viable due to seed predator. See Appendix 7.
<i>Atriplex cinerea</i> 3	Coast Saltbush	Limited and scattered on the foredune.	Low – Boost natural population. Replace after dune scarping – try deep planting.	Limited natural specimens. Easy from seed. See Appendix 7.
<i>Austrodanthonia caespitosa</i> 2	Common Wallaby Grass	Traces in rear dune. Uncommon on coastal Adelaide Plains.	Moderate – Boost natural populations. Butterfly recovery project.	Attention to seed collection and propagation.
1 High Priority				
2 Moderate priority				
3 Low Priority				
4 No action required				
5 Reinstate from other remnant sites along metropolitan coast				

Appendix 8 (cont.) Priority Actions for Indigenous Species Within Tennyson Dune Reserve

Botanical Name	Common Name	Abundance/Location	Action Required	Propagation/Comment
<i>Austrostipa flavescens</i> 2	Coast Spear-grass	Traces in sheltered areas. Uncommon on coastal Adelaide Plains.	Moderate – Boost natural populations. Butterfly recovery project.	Attention to seed collection and propagation.
<i>Austrostipa scabra</i> ssp. <i>falcate</i> 2	Slender Spear-grass	Traces in sheltered areas. Uncommon on coastal Adelaide Plains.	Moderate – Boost natural populations. Butterfly recovery project.	Attention to seed collection and propagation.
<i>Baumea juncea</i> 4	Bare Twig-rush	Significant populations either side of hind dune crest. Uncommon on coastal Adelaide Plains.	Nil – Natural populations strong.	Useful to develop propagation technique – known to be difficult. See Appendix 7.
<i>Calandrinia eremaea</i> 4	Dryland Purslane	Limited specimens in swale and rear dune slope. Conservation rating.	Nil – Actual spread uncertain. Limit weed competitors.	Seed drops quickly once mature. Easy from seed and cuttings.
<i>Callitris gracilis</i> (formerly <i>C. preissii</i>) 4	Southern Cypress Pine	Reinstated through revegetation projects at rear of dunes. Uncommon on coastal Adelaide Plains.	Nil Planted to demonstrate lost species.	Easy. Seed sources Grange Golf Course or Torrens Island.
<i>Carpobrotus rossii</i> 3	Native Pigface	Sparse but widespread.	Low Good infill for stabilisation projects.	Easy from seed. Heel runners in winter. See Appendix 7
<i>Cassytha pubescens</i> 2	Downy Dodder-laurel	Parasite - in one location only. Uncommon on coastal Adelaide Plains.	Moderate – At risk Boost natural population.	Sow fresh seed with harsh pre-treatment.
<i>Clematis microphylla</i> var. <i>microphylla</i> 2	Old Man's Beard	Limited and isolated specimens only in hind dune. Uncommon on coastal Adelaide Plains.	Moderate – At risk. Appears to be slowly naturally regenerating. Boost natural populations. Source from outside to improve genetic integrity.	Easy if seed is available. See Appendix 7.
<i>Cotula australis</i> 4	Common Cotula	Open grassy areas.	Nil – Actual spread is uncertain. Limit weed competition.	Easy from fresh seed. Also grown from cuttings or division.
<i>Crassula closiana</i> 4	Stalked Crassula	Small annual, widespread and abundant. Associated with other <i>Crassula</i> spp.	Nil – Limit weed competition.	Seed collection is time consuming. Mostly grown from cuttings.
<i>Crassula colligata</i> ssp. <i>lamprosperma</i> (formerly <i>C. sieberiana</i>) 4	Crassula	Small annual, widespread and abundant in bare sunny and shaded areas.	Nil – Limit weed competition.	As above.
1 High Priority				
2 Moderate priority				
3 Low Priority				
4 No action required				

Appendix 8 (cont.) Priority Actions for Indigenous Species Within Tennyson Dune Reserve

Botanical Name	Common Name	Abundance/Location	Action Required	Propagation/Comment
<i>Daucus glochidiatus</i> 4	Native Carrot	Widespread and common annual. Uncommon on coastal Adelaide Plains.	Nil – Limit weed competition.	Grown from seed with no treatment.
<i>Dianella brevicaulis</i> 3	Short-stem Flax-lily	Sparse but widespread.	Low – Naturally regenerating. Useful infill plant for rehabilitation projects.	Easy from seed. See Appendix 7.
<i>Distichlis distichophylla</i> 4	Emu-grass	Landward slope of hind dune near walkway.	Nil – Limit weed competition.	Division of creeping stems.
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i> 3	Ruby Saltbush	Limited, isolated along fence-lines.	Low – Bird driven. Boost natural population.	Easy from seed. See Appendix 7.
<i>Geranium potentilloides</i> var. <i>potentilloides</i> 1	Downy Geranium	Very limited. Only in swale. Uncommon on coastal Adelaide Plains.	High – At risk. Source from outside to help improve genetic integrity.	Careful attention. See Appendix 7.
<i>Helichrysum leucopsideum</i> 1	Satin Everlasting	Very limited. Only one small patch in swale. Conservation rating.	High – At risk. Limit weed competition . Buffer existing populations. Reinstate in other areas of Dune Reserve. Source from outside to improve genetic integrity.	Seed highly variable. Cuttings. could be more reliable. See Appendix 7
<i>Isolepis nodosa</i> 3	Knobby Club-rush	Common in all locations behind the foredune.	Low. Very useful revegetation plant.	Easy from seed. See Appendix 7.
<i>Kennedia prostrata</i> 2	Running Postman	Very limited and declining. Only in hind dune. Uncommon on coastal Adelaide Plains.	Moderate – At risk. Boost natural populations. Source from outside to improve genetic integrity.	Easy to propagate – need local seed. See Appendix 7.
<i>Kunzea pomifera</i> 2	Muntries	Isolated and limited. Uncommon on coastal Adelaide Plains.	Moderate – At risk. Useful alternative Legless Lizard habitat in <i>Arctotis stoechadifolia</i> and <i>Galenia pubescens</i> removal project. Source from outside to improve genetic integrity.	Easy to propagate from seed and cuttings. See Appendix 7.
1 High Priority				
2 Moderate priority				
3 Low Priority				
4 No action required				

Appendix 8 (cont.) Priority Actions for Indigenous Species Within Tennyson Dune Reserve

Botanical Name	Common Name	Abundance/Location	Action Required	Propagation/Comment
<i>Lepidosperma gladiatum</i> 1	Coast Sword-sedge	In clumps, prominent in low wet depressions and hind dune seaward slope.	High. Use in similar aspects in disturbed areas.	Very difficult to propagate – Investigate dormancy factors. Important to learn propagation technique.
<i>Leucophyta brownii</i> 1	Coast Cushion Bush	Limited natural specimens in the foredune. Uncommon on coastal Adelaide Plains.	High – At risk. Once very common. Source from outside to improve genetic integrity.	Easy to propagate from seed and cuttings – careful attention. Plant into unstable areas.
<i>Leucopogon parviflorus</i> 1	Coast Beard-heath	Dominant over-storey of hind dune crest. Uncommon on coastal Adelaide Plains.	High – No natural regeneration Boost natural populations. Source from outside to improve genetic integrity.	Careful attention – Difficulty collecting seed– investigate propagation technique – cuttings possible.
<i>Lomandra leucocephala</i> ssp. <i>robusta</i> 1	Woolly Mat-rush	Fair populations on rear dune crests. Conservation rating.	High – No natural regeneration Boost natural populations	Sow seed with pre-treatment.
<i>Lotus australis</i> 2	Austral Trefoil	Sparse isolated specimens. Some replanting but not as successful as natural regeneration. Conservation rating.	Moderate. Short lived and limited. Boost natural populations and establish more widespread alternative populations.	Easy from seed.
<i>Melaleuca lanceolata</i> 3	Dryland Tea-tree	Natural population a limited patch at landward slope of hind dune. Some recovery planting to boost this population. Conservation rating.	Moderate – numbers have been increased through revegetation. Use as dominant species in Zone 5.	Easy from seed.
<i>Muehlenbeckia gunnii</i> 4	Coastal Climbing Lignum	Widespread and abundant.	Nil – Bird driven.	Develop a proven propagation method. Flowers throughout year.
1 High Priority				
2 Moderate priority				
3 Low Priority				
4 No action required				

Appendix 8 (cont.) Priority Actions for Indigenous Species Within Tennyson Dune Reserve

Botanical Name	Common Name	Abundance/Location	Action Required	Propagation/Comment
<i>Myoporum insulare</i> 3	Common Boobialla	Scattered individuals in swale and on dune slopes.	Low – Little natural regeneration evident. Boost natural populations.	Easy from seed and cuttings.
<i>Nitraria billardierei</i> 2	Nitre-bush	Sparsely scattered in the first swale.	Moderate. No natural regeneration evident. Need to boost numbers and establish more widespread populations as important habitat corridor plant.	Difficult – care with seed. Also cuttings.
<i>Olearia axillaris</i> 4	Coast Daisy-bush	Dominant over-storey in the swale and dune slopes either side.	Nil. Ready coloniser and regenerating naturally.	Easy from seed - collect seed for direct seeding rear dunes in veldt grass badlands. Cuttings are more reliable.
<i>Parietaria debilis</i> 1	Smooth-nettle	Traces only in shaded and humus areas. Uncommon on coastal Adelaide Plains.	High. Extra attention to increase numbers by limiting weed competition.	Unknown propagation methods.
<i>Pelargonium australe</i> 4	Australian Pelargonium	Common and widespread throughout the dunes.	Nil – Naturally regenerating.	Develop a proven propagation method.
<i>Picris squarrosa</i> 4	Squat Picris	Several communities in low-lying depressions. Conservation rating.	Nil – PROHIBITED SEED COLLECTION Regenerating readily periodically.	
<i>Pimelea serpyllifolia</i> ssp. <i>serpyllifolia</i> 1	Thyme Riceflower	Several small patches in northern interdune corridor. Uncommon on coastal Adelaide Plains.	High – No natural regeneration noted. Source from outside to improve genetic integrity.	Need to develop a propagation method. Known to be difficult from seed. Cuttings very slow.
<i>Poa poiformis</i> var. <i>poiformis</i> 2	Coast Tussock-grass	Wide spread in hind dunes. Uncommon on coastal Adelaide Plains.	Moderate. Butterfly food source.	Attention to collection and propagation.
<i>Rhagodia candolleana</i> ssp. <i>candolleana</i> 4	Sea-berry Saltbush	Widespread and dominant understorey in the swales.	Nil – Bird driven.	Easy from seed.
1 High Priority				
2 Moderate priority				
3 Low Priority				
4 No action required				

Appendix 8 (cont.) Priority Actions for Indigenous Species Within Tennyson Dune Reserve

Botanical Name	Common Name	Abundance/Location	Action Required	Propagation/Comment
<i>Salsola kali</i> 3	Buckbush	Single plant noted in landward face of rear dune.	Low. Plant away from pathways.	Easy to propagate.
<i>Scaevola crassifolia</i> 3	Cushion Fanflower	Co-dominant understorey of rear dune slopes. Conservation rating.	Low. Important shelter for reptiles. Boost numbers to promote continuity.	Moderately easy from cuttings – difficult from seed.
<i>Senecio pinnatifolius</i> (formerly <i>S. lautus</i>) 4	Variable Groundsel	Widespread and abundant.	Nil – Naturally regenerating.	Develop a proven propagation method.
<i>Spinifex hirsutus</i> (formerly <i>S. sericeus</i>) 3	Hairy Spinifex	Common in foredune and co-dominant understorey of interdune corridor.	Low. Plant in disturbed sites.	Easily propagated. Running tips healed in during winter as required or pot runners in mid autumn.
<i>Tetragonia implexicoma</i> 4	Bower Spinach	Widespread and abundant, particularly along fence-lines.	Nil – Bird driven.	Develop a proven propagation method.
<i>Threlkeldia diffusa</i> 4	Coast Bonefruit	Widespread and abundant, particularly along fence-lines.	Nil – Bird driven.	Develop a proven propagation method flowers most of the year.
<i>Triglochin trichophorum</i> 2		Limited traces in shaded areas containing humus. Conservation rated.	Moderate. Limit weed competition.	Unknown – may need intervention.
1 High Priority				
2 Moderate priority				
3 Low Priority				
4 No action required				

Appendix 9: Seed Collection Techniques and Propagation Methods*

Information from: Australian Government, DEH, (2004), Bonney (1994), Ralph (2003)

Collection of Native Plant Materials

Native seed and cuttings from remnant species along Adelaide's metropolitan coastline are an extremely precious resource. Corporately and individually we have a responsibility to foster a culture of conservation and respect toward the environment in general and in this case, dwindling remnant vegetation.

It is not within the scope of this Management Plan to give detailed information on various propagation techniques, however, the publications mentioned above are highly recommended for reading prior to undertaking such activities. Before carrying out collection of native materials, there are several principles and guidelines important to be aware of. These are detailed below.

Native seed management principles appropriate for coastal dune situations:

- Adhere to legislative and regulatory requirements when collecting and planting native seed.
 - The collection of native plant materials is controlled under Section 49, *National Parks and Wildlife Act, 1972*.
 - A permit from the Minister for Environment and Conservation is required to collect native plant materials from Forest Reserves, National Parks and Wildlife Reserves, Crown Land and any other land reserved for, or dedicated to public purposes (such as roadsides and local council reserves). Written approval from the management authority responsible for the land must also be obtained prior to collection of native plant materials. Applications are available at:
www.environment.sa.gov.au/biodiversity/pdfs/seed_collect.pdf
- Collect native seed and cuttings sustainably – to ensure native vegetation continues to regenerate and provide valuable food sources for local fauna:
 - Collect only what you need (i.e. less than 10% of the available seed).
 - Collect from as many different plants of the same species in one given area (provenance) as possible.
 - Collect seed and cuttings from all parts of the plant, not just the easily accessible areas.
 - Avoid altogether collecting seed from shrubs and trees which only have a few plants left in a particular area.
 - Reduce seed wastage. Match seed requirements to the biological and functional needs and objectives of the revegetation project.
 - Use valuable local provenance seed to enhance remnant vegetation.
 - Improve efficiency of native seed collection by better forecasting revegetation needs and improving the skill level of seed collectors.

* It is not within the scope of this Management Plan to make specific Occupation Health, Safety and Welfare recommendations. When undertaking works outlined in this Plan, ensure that all Occupational, Safety and Welfare requirements are met.

- Encourage participation of commercial native seed suppliers in seed management. Ensure they are aware of needs well in advance, and whether they can supply local seed species and particular genetic provenances if required.
- Increase the diversity of local species used in revegetation projects (particularly understorey species), to improve biodiversity benefits.
- Use quality assurance systems to ensure that the highest quality seed (physical and genetic) is used for revegetation activities.
- Promote research into native seed, e.g. plant propagation, sustainable seed harvesting and methods of maintaining genetic and species diversity.
- Refer to relevant guidelines, including the FloraBank Model Code of Practice for community-based collectors and suppliers of native plant seed and the FloraBank.

These guidelines are available at:

www.florabank.org.au/support/guidelines/MCOPWeb%20version.pdf

Appendix 10: Revegetation Methods*

Revegetation Objectives

The New South Wales Department for Land and Water Conservation (2001) outlines the two major objectives for revegetating degraded dune systems as being:

1. *To restore and maintain biodiversity through establishing native coastal vegetation appropriate to its geographical area and its position within the dune system – vegetation that is self sustaining with minimal maintenance required once fully established.*

A healthy dune ecosystem will feature a variety of plant communities and locally native species that reflect the geographical distribution of species along the coast, zonation within the dune system (refer to Figure 19) and the age of the dunes. These communities provide habitat and resources such as food, nesting sites, protection from predators for a diverse range of native fauna including birds, reptiles and insects.

2. *To provide sufficient plant cover to protect fragile dunes against wind erosion. Species that are native to coastal dunes are adapted to survive the hostile environment of drifting sand, strong winds, salt spray and infertile soils. They provide long-term stability.*

Revegetation projects in environmentally sensitive areas must be of the highest ecological standard (Greening Australia, 2002) and the ultimate goal must be to restore the original or pre-European vegetation cover.

When attempting to re-establish a range of locally indigenous plants within the dune environment, there are a number of methods to consider. *Natural regeneration* and *assisted regeneration* are the two major methods and are described as follows by the New South Wales Department for Land and water Conservation (2001):

1. *Natural Regeneration: Remnant native plants already in the system can usually regenerate after the removal of weeds that compete for light, water and nutrients.*

The aim of this approach is to restore and maintain an ecosystem in which natural regeneration can occur.

2. *Assisted Regeneration: On highly disturbed sites, natural regeneration may occur too slowly to prevent erosion, or too few species may be represented. Planting species that are suited to the geographical area and dune zone may speed the regeneration process.*

Many projects utilise a combination of both natural and assisted regeneration.

Using Locally Indigenous Species

Locally indigenous species are characterised by the slight variations that occur between plants of the same species from area to area. These variations are a response to different local physical conditions (e.g., micro-climate or soil type) to which the plants have adapted. The use of locally indigenous species has many benefits in a revegetation project, including:

- Plants have adapted to local conditions over time and are able to germinate, survive, grow and reproduce more effectively in one area compared to another
- They are hardier, more wind-firm, will grow at optimum speed

* It is not within the scope of this Management Plan to make specific Occupation Health, Safety and Welfare recommendations. When undertaking works outlined in this Plan, ensure that all Occupational, Safety and Welfare requirements are met.

- More resistant to local pests, diseases and local climatic extremes
- Complement other native plants and animals in the area and are thought to promote genetic and ecological sustainability in local vegetation.

It is important to collect seed and other plant material (such as cuttings) from remnant vegetation sites as close to the rehabilitation site as possible.

What to Plant Where?

When selecting species to plant, it is helpful to examine historical records (written and photographic) to determine which plants were present before degradation. This information will supplement species selection information based on the recognition of geographical areas, zones, and plant succession. Darrell Kraehenbuehl's *'Pre-European Vegetation of Adelaide: A Survey from the Gawler River to Hallett Cove'* provides a good summary of historical records and pre-European vegetation communities present in the Adelaide metropolitan area, including the City of Charles Sturt coast.

The various zones of dunes are vegetated by plants that are suited to the different conditions experienced in these areas. There are generally three zones that grade into one another. These are:

- An unstable incipient foredune zone of colonising herbs and grasses;
- A semi-stable foredune zone of shrubs and associated ground plants;
- A stable hind-dune zone dominated by trees, with an understorey of shrubs and groundcovers. (New South Wales Department for Land and Water Conservation, 2001).

There are distinct combinations of plants and zones that represent the typical assemblages that are encountered. For example, *Spinifex hirsutus* (Hairy Spinifex) is characteristic of the foredune, while other plants such as *Myoporum insulare* (Common Boobialla) can generally only establish and grow in the more sheltered area of the middle and hind dunes.

Plant succession occurs when plants change growing conditions over time (such as altering soil composition) and compete with each other for resources. Where topography permits, a tall shrubland may eventually develop to represent a climax community with a complex structure of shrub, climber and ground layer species (New South Wales Department for Land and Water Conservation). In the case of the foredune, where conditions are very harsh, typically the only surviving species are *Spinifex hirsutus* (Hairy Spinifex) *Cakile maritima* (Sea Rocket) and the introduced *Thinopyrum junceiforme* (Sea Wheat Grass) - these species form the climax community for that site and zone.

Although it is desirable to initially establish a high diversity of species in a dune revegetation project, Greening Australia (2002) suggests to "only plant early successional plants from the vegetation community that once grew on the site." By approaching revegetation in this manner, it assists the natural regeneration process and enables the process of succession to occur.

Planting Tube-stock

Planting with nursery-raised tubestock is the most common method of establishing plants within dune systems. The optimal planting time is from May through to August, as this provides an opportunity for some growth following planting, followed by settling-in during winter.

When undertaking revegetation works, try to plant species in proportion and position to how they would occur naturally. Do not plant in straight rows, as this does not occur naturally. Dense plantings will increase competition for weed species and suppress

regeneration. A good rule of thumb is to 'pull one plant, plant another', i.e. when removing weeds make sure you put an indigenous plant back in its place.

Water seedlings some hours before planting out, ensuring roots are moist. Without damaging native vegetation or moss layer, scrape aside surface litter then dig a hole, creating a large water bowl that will catch any rainfall throughout the following year. If the soil is not moist, fill the hole with water and let it drain.

Remove the plant from its tube and position it so that it is in the centre of the hole. Ensure the plant is not situated higher than the sand. Plants will grow much better when planted in positions that gain maximum sunlight.

Backfill the hole to just over the level of the top of the soil in the tube. A layer of sand will prevent root exposure. Replace any surface organic matter to act as mulch on the surface and carefully water in with a bucket of water.

To aid successful plant establishment it is important that weed species are controlled. It is good practice to brush-cut or spray weeds at recommended rates prior to and after planting to reduce competition from weeds.

Appendix 11: Revegetation Implementation schedule (2007-2011)

Management Zone	Year 1							Year 2							Year 3							Year 4							Grand Total								
	MZ 1	MZ 2	MZ 3a	MZ 3b	MZ 4a	MZ 4b	MZ 5	Total	MZ 1	MZ 2	MZ 3a	MZ 3b	MZ 4a	MZ 4b	MZ 5	Total	MZ 1	MZ 2	MZ 3a	MZ 3b	MZ 4a	MZ 4b	MZ 5	Total	MZ 1	MZ 2	MZ 3a	MZ 3b		MZ 4a	MZ 4b	MZ 5	Total				
Botanical Name																																					
<i>Acacia cupularis</i>		5	10	10	5	10	20	60		5		10		10	20	45		5				10	20	35		5					20	25	135				
<i>Acacia longifolia</i> ssp. <i>sophorae</i>		10			5	10	15	40						10	15	25						10	15	25						15	15	105					
<i>Acacia pycnantha</i>						40	40	40						20	20	20						10	10	20						10	10	80					
<i>Adriana quadripartita</i>		10	10	20	10	20	10	80		10	10	20		20	10	70				20		20	10	50				10		20	10	40	240				
<i>Alyxia buxifolia</i>			10	10	10	30		60			10	10		10		30				10		10		20				10				10	110				
<i>Atriplex cinerea</i>	10							10	15							15	15							15	10							10	50				
<i>Austrodanthonia caespitosa</i>			30	60	10	60	40	200			20	50	10	60	40	180			20	50	10	50	40	170				40		30	70	610					
<i>Austrostipa flavescens</i>			30	50	10	70	40	200			20	50	10	50	40	170			20	50	10	50	40	170				50		30	80	610					
<i>Austrostipa scabra</i> ssp. <i>falcata</i>			30	50	10	70	40	200			20	50	10	50	40	170			20	50	10	50	40	170				50		30	80	610					
<i>Baumea juncea</i>			10	10	5	10	20	55				10		10	20	40				10			10	20							0	115					
<i>Carpobrotus rossii</i>	10	100	20	60	10	20	25	245	10	100	20	60		10	25	225	10	50	20	60		10		150		50				10		60	680				
<i>Cassutha pubescens</i>					1			1						7		7								0						3	3	11					
<i>Clematis microphylla</i>			10	20	10	30	10	80			10	20		30	20	80				20		30	40	90				20		50	70	320					
<i>Dianella brevicaulis</i>		15	10	50	10	30	30	145		15	10	30		30	30	115		15	10	20		30	10	85		15	10				25	370					
<i>Distichlis distichophylla</i>							10	10						10	10	10						30	30							60	60	110					
<i>Enchylaena tomentosa</i>			10	40	10	30	15	105			10	20		10	15	55				20		10	10	40						10	10	210					
<i>Geranium potentilloides</i> var. <i>potentilloides</i>			10	60	10	80	20	180			10	20	10	80	20	140			10	20	10	50	20	110						20	20	450					
<i>Helichrysum leucopsidium</i>			10	60			20	90			10	20			20	50			10	20				30						0	170						
<i>Isolepis nodosa</i>		30	10	60	10	60	20	190		20	10	10		20	20	80		20	10			20	20	70		20				10	30	370					
<i>Kennedia prostrata</i>			10	30	10	30		80			10	10		10	10	40				10		10	10	30						20	20	170					
<i>Kunzea pomifera</i>			10	30	10	30	10	90			10	10		10	10	40				10		10	10	30						10	10	170					
<i>Lepidosperma gladiatum</i>			10	30	10	40	10	100				10	10	20	10	50						20	20	40					20	20	40	230					
<i>Leucophyta brownii</i>	5	20						25	5	10						15	5	10						15	5	10					15	70					
<i>Leucopogon parviflorus</i>			10	40	20	100	30	200			10	30	20	100	30	190				20	10	100	30	160						30	30	590					
<i>Lomandra leucocephala</i> ssp. <i>robusta</i>			10	20			10	40			10	20			10	40				10			10	20					20	20	20	120					
<i>Lotus australis</i>			30	200	10	90	20	350			30	50	10	60	20	170			30	50	10	60	20	170						20	20	710					
<i>Melaleuca lanceolata</i>						300	300	300						200	200	200							100	100						130	130	730					
<i>Muehlenbeckia gunnii</i>		10	10	10	10	50	20	110				10		50	30	90				20		10	30	60						40	40	300					
<i>Myoporum insulare</i>						20	20	20						20	20	20							20	20					20	20	80						
<i>Nitraria billardiarei</i>		20	10	30	10	20	10	100		10	10	10		20	10	60		10		10		10	10	40		10		10		10	30	220					
<i>Olearia axillaris</i>	10	20	10	40	20	50	50	200	10	20	10	30	10	50	50	180	5	15		20		50	50	140	5	15				50	50	650					
<i>Parietaria debilis</i>			10	10				20				10				10				10				10				10			10	50					
<i>Pelargonium australe</i>			30	200	20	200	50	500			30	50	20	100	50	250			30	50	20	100	50	250					10	30	50	1090					
<i>Pimelea serpyllifolia</i> ssp. <i>serpyllifolia</i>			10	20	10	10	10	60			10	20		10	10	50				10		10	10	30					10	10	20	180					
<i>Poa poliformis</i>			30	100	10	80	40	260			20	50	10	40	40	160			20	50	20		40	130						30	30	570					
<i>Rhagodia candolleana</i> ssp. <i>candolleana</i>		40	10	20	10	20	30	130		40	10	20		20	30	120		40		10		10	30	90		30				30	60	400					
<i>Salsola kali</i>			10	5			5	20						5	5	5							5	5						5	5	60					
<i>Scaevola crassifolia</i>		15	10	30	10	60	20	145		15	10	20	10	40	20	115		10		20		20	20	70		10			20	20	50	410					
<i>Senecio pinnatifolius</i>			10	20	5	10	20	65			10	20		10	10	50				20		10	10	40				20		10	30	185					
<i>Spinifex hirsutus</i>	150	110	20	100	5	10	20	415	150	110	20	50		10	10	350	130	110	20	50		10	10	330	100	110	10				220	1305					
<i>Tetragonia implexicoma</i>		20	10	20	10	40	100	200		20	10	20		40	100	190		20		10		40	100	170					10	70	80	640					
<i>Threlkeldia diffusa</i>		40	10	30	10	20	20	130			20	10	30		20	100		20		10		10	20	60		20				10	30	320					
Totals	185	465	440	1550	316	1390	1170	5551	190	395	370	860	130	1017	1060	4032	165	325	240	770	100	830	920	3300	120	295	10	210	10	170	903	1738	14621				