SEMAPHORE SOUTH DUNE RESTORATION PROJECT

DETAILED PLANTING PLAN

MAY 2020

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1. Introduction

The Department for Environment and Water (DEW) is restoring a section of dunes at Semaphore South, from approximately Arthur Street at the southern end to Hart Street in the north (see Figure 1). DEW will re-build a dune buffer of sufficient volume to cope with mild-moderate weather/storms and maintain sufficient width for the rear swale to stabilise and revegetate. Between 25,000 to 30,000 cubic metres (m^3) of sand from north of the Largs Bay jetty will be moved to rebuild the Semaphore South dunes. In the narrower mid-sections more sand will be required than towards the northern and southern limits where some dune persists.

The deposited sand will be shaped to keep a narrow corridor clear along the landward edge, adjacent to the fence and grassed reserve. Then it will be shaped into a wide fore-dune to correspond to/blend in with the established dune to the north and south of the project area. Drift fencing will be installed along the 600m extent to mitigate wind-blown sand as much as possible.

This document provides a detailed revegetation/planting plan which is part of the dune restoration project. This is based upon a combination of historical records, consultation with local coastal experts, a survey of the vegetation present on surrounding dunes both to the north and south of the project site[1] and life form sampling. Note a narrow landward corridor, approximately 4m in width, will be kept clear of vegetation to enable the installation and maintenance of a new fence between the dune and the grassed reserve.

[1] T&M Ecologists Pty Ltd, 2020. *Flora survey of dunes – Semaphore South to Largs North*, Report to SA Department for Environment and Water, March 2020.

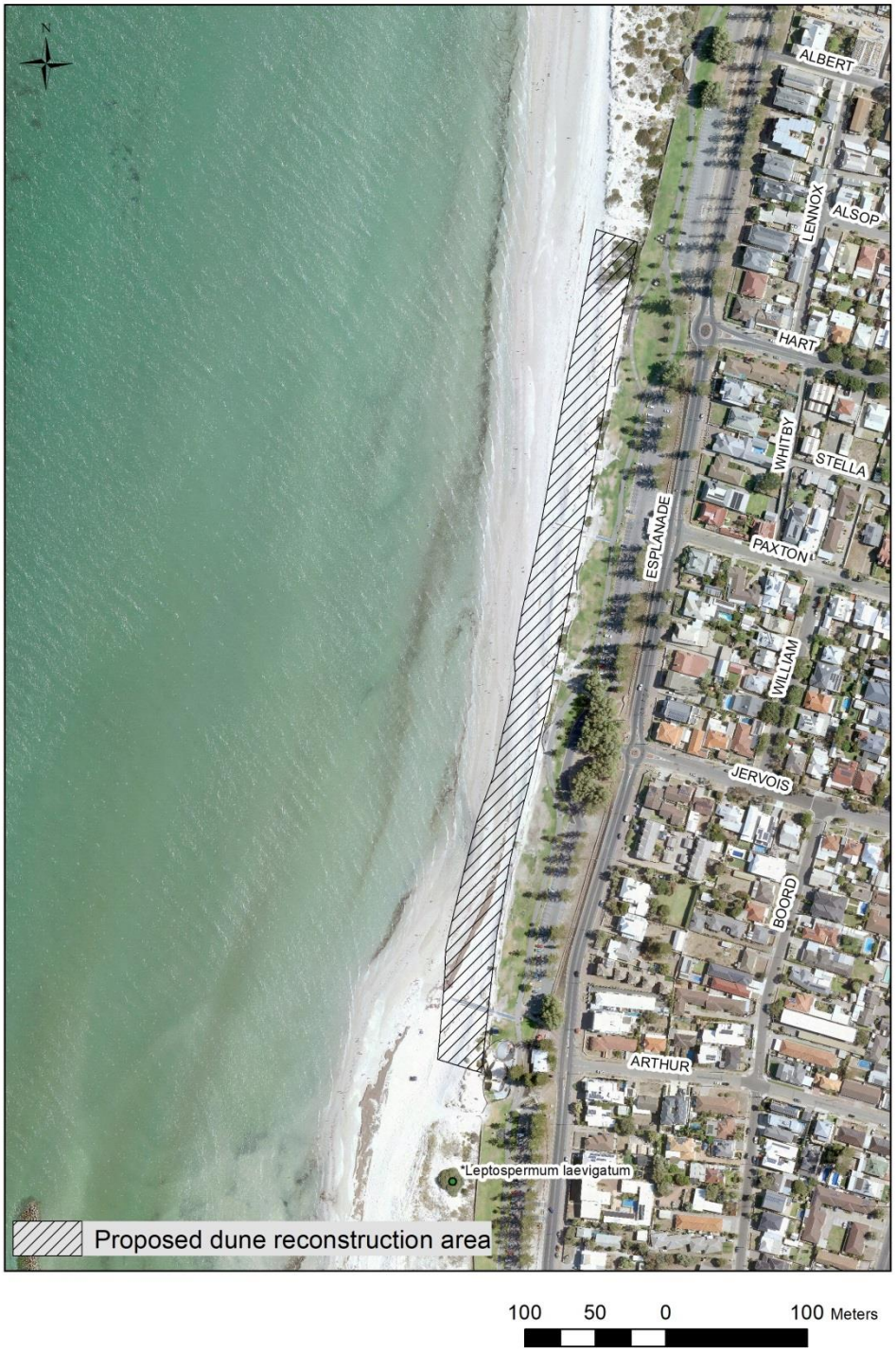

Figure 1: Section of dunes at Semaphore South being restore – Autumn 2020

2. Planting plan for Autumn 2020 (Stage 1)

Figure 2 provides an indicative cross-section of the dune profile that will be shaped and is expected to form or evolve over time. This cross-section is based upon the contours provided by DEW and taken from a representative section of dune approximately midway between Jervois Road and Paxton Street. An initial planting plan was developed for autumn 2020, based upon initial dune construction plans provided by DEW and revegetation stock readily available from plant nurseries. This initial plan focussed upon two planting zones -

- Fore-dune - approximately 3000m^2 (600m by 5m), but from crest of foredune was 2000m^2.
- Swale/hind-dune is approximately 10,800m^2 (600m by 18m).

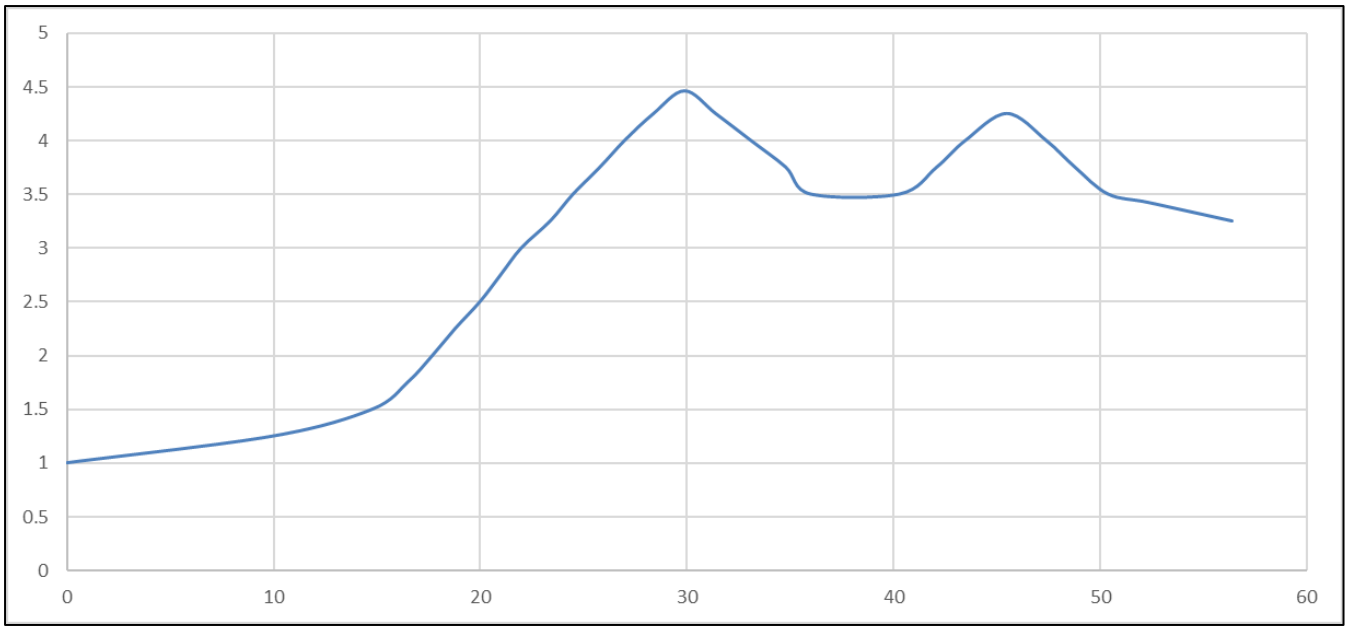

Figure 2: Indicative dune cross section – dune restoration at Semaphore South.

Table 1 provides details of the plant species recommended to be planted as part of Stage 1 (Autumn 2020). This list is based upon both species that are likely to be robust colonisers, but also upon those that are currently available for planting in 2020 (supplied by Provenance Indigenous Plants).

it was not recommended that plastic mesh guards are used as there is not likely to be any grazing issues (ie. rabbits). Also guards are an added expense which may cause future problems if they are blown or washed away.

It was also noted that supplementary watering will be undertaken 4 times during the first summer (2020 – 2021) and the City of Port Adelaide Enfield will install irrigation. Weed control will also be undertaken.

[2] Based on estimate provided by Moji Karbasi, Coastal Engineer, Department for Environment and Water via email 10/2/20

Table 1: Details of the plant species which will be planted as part of Stage 1 (Autumn 2020).

SPECIES	COMMONNAME	LIFEFORM	DIAMETER MATURE PLANTS (m)	TREE GUARDS	FOREDUNE	SWALE/ HIND-DUNE	NOTES
Olearia axillaris	Coast Daisy-bush	TS	2-4	Y	50	500	Dominant overstorey species. Plant scattered individuals on dune crests. More dense plantings on hind-dune and in swale.
Scaevola crassifolia	Cushion Fanflower	MS	2-4	Y	-	100	
Threlkeldia diffusa	Coast Bonefruit	LS	1-4	N	-	100	
Rhagodia candolleana	Sea-berry Saltbush	MS	1-2	Y	-	250	
Pelargonium australe	Austral Stork's-bill	FO	0.2-0.5	Y	-	200	
Senecio pinnatifolius var.	Variable Groundsel	FO	0.1-0.2	Y	-	200	
Carpobrotus rossii	Native Pigface	GC	0.5-2.0	N	-	100	
Disphyma crassifoliium	Rounded Pig-face	GC	0.5-1	N	-	100	
Kunzea pomifera	Muntries	GC	1-2	N	-	100	Plant on more landward side of dune
Austrostipa flavescens	Coast Spear-grass	TG	0.1-0.2	N	-	500	
Poa poiformis	Coast Tussock-grass	TG	0.1-0.2	N	-	500	
Spinifex hirsutus	Rolling Spinifex	LG	0.2-2.0		2000	1000	Will spread to cover more extensive areas over time, but is a critical plant for foredune stability. Plant on the crest of the foredune and runners should establish along dune frontage. Will also be an important plant to stabilise hind dune area.
Dianella brevicaulis	Short-stem Flax-lily	TSE	0.5-1	Y	-	500	
Ficinia nodosa	Knobby Club-rush	TSE	0.1-0.2	N	2000	500	
Lepidosperma gladiatum	Coast Sword-sedge	TSE	0.5-1	N	-	12	Twelve only available at this stage

Key to Codes: Lifeform

CR	Creeper	**LSE**	Low sedge <60cm	**LS**	Low shrub <0.6m
GC	Groundcover	**TSE**	Tall sedge >60cm	**MS**	Medium shrub 0.6-1.2m
FO	Forb	**LG**	Low grass <60cm	**TS**	Tall shrub > 1.2m
		TG	Tall grass > 60cm	**TR**	Tree

3. Drift fencing

Drift fencing will be installed in order to reduce the amount of wind-blown sand and to assist with the build up/stabilisation of sand dunes. This should be placed towards the leeward side of the dune crest. Installation will occur once the dunes have been built and will be undertaken by the City of Charles Sturt on behalf of City of Port Adelaide Enfield, as they have experience with similar projects. The final exact alignment will be left to their expertise.

4. Detailed planting plan

4.1 Planting zones

Based on topographic survey information of the desired dune profile provided by DEW (May 2020), the project area has been divided into five distinct planting zones (Figures 3 and 4).

The revegetation/planting zones are described below.

1. **Foredune** – Also known as the 'pioneer zone' of coastal dunes, this planting zone has been delineated adjacent to the beach, from an elevation of 2.75 metres up to 4 metres. The foredune is typically subjected to severe and constant environmental stresses of high winds, waves, tides, storms and seasonal change. Species diversity in this zone is naturally very low and it is recommended that at Semaphore South the foredune be planted with Rolling Spinifex (*Spinifex hirsutus)* which is a rapid coloniser that will bind the sand, whilst withstanding salt spray and sand blasting. Runners should establish to lower sections of the dune profile. This zone is considered important for colonising species to help stabilise this section of the dunes and reduce impacts of storm events (if they occur). The Spinfex is likely to help to stabilise and build the foredune between storm events. It is recognised that a significant storm event may result in loss of some of these plants, and it is not recommended that irrigation to be established in this area.
2. **Primary crest** – the crest of the foredune, which is at an elevation of 4 - 5 metres. This zone is also subjected to severe environmental conditions and so only a limited array of plants will survive and prosper in this environment. It is recommended that Rolling Spinifex (*Spinifex hirsutus)* be planted across the area, as well as scattered low shrubs such as Coast Saltbush (*Atriplex cinerea*), Coast Daisy Bush (*Olearia axillaris*) and Coast Cushion Bush (*Leucophyta brownii*).
3. **Back of primary crest** – descends from 4 metres to 3.25 metres at its lowest point. This zone provides a more 'sheltered' environment due to the protection provided by the foredune. Hence, it is recommended that a wider variety and density of species and plant life forms are planted, including Coast Daisy Bush (*Olearia axillaris*) which is a dominant overstorey shrub in surrounding established dunes.
4. **Secondary crest** –behind the first dune. The secondary crest may potentially form over time. This zone is not quite as exposed as the primary crest, however it will still be impacted by strong winds and salt spray, and thus only a limited array of species is appropriate for this area.
5. **Back-dune** – this is the most protected zone at the back of the project area and adjacent to the reserve and car park. It descends from an elevation of 4-5 metres. As well as the species that survive in more exposed dune environments, it is recommended that other species generally found in more sheltered swale areas of dunes are planted, such as Muntries

(*Kunzea pomifera*) and Coast Sword-sedge (*Lepidosperma gladiatum*). These species will not survive in areas highly exposed to wind and salt spray. Note that there will be a landward corridor of approximately 4m in width which will be kept clear of vegetation to enable erection and maintenance of a new fence between the dune and the grassed reserve. Also note that there are several beach access tracks throughout the project area which should be avoided when revegetating.

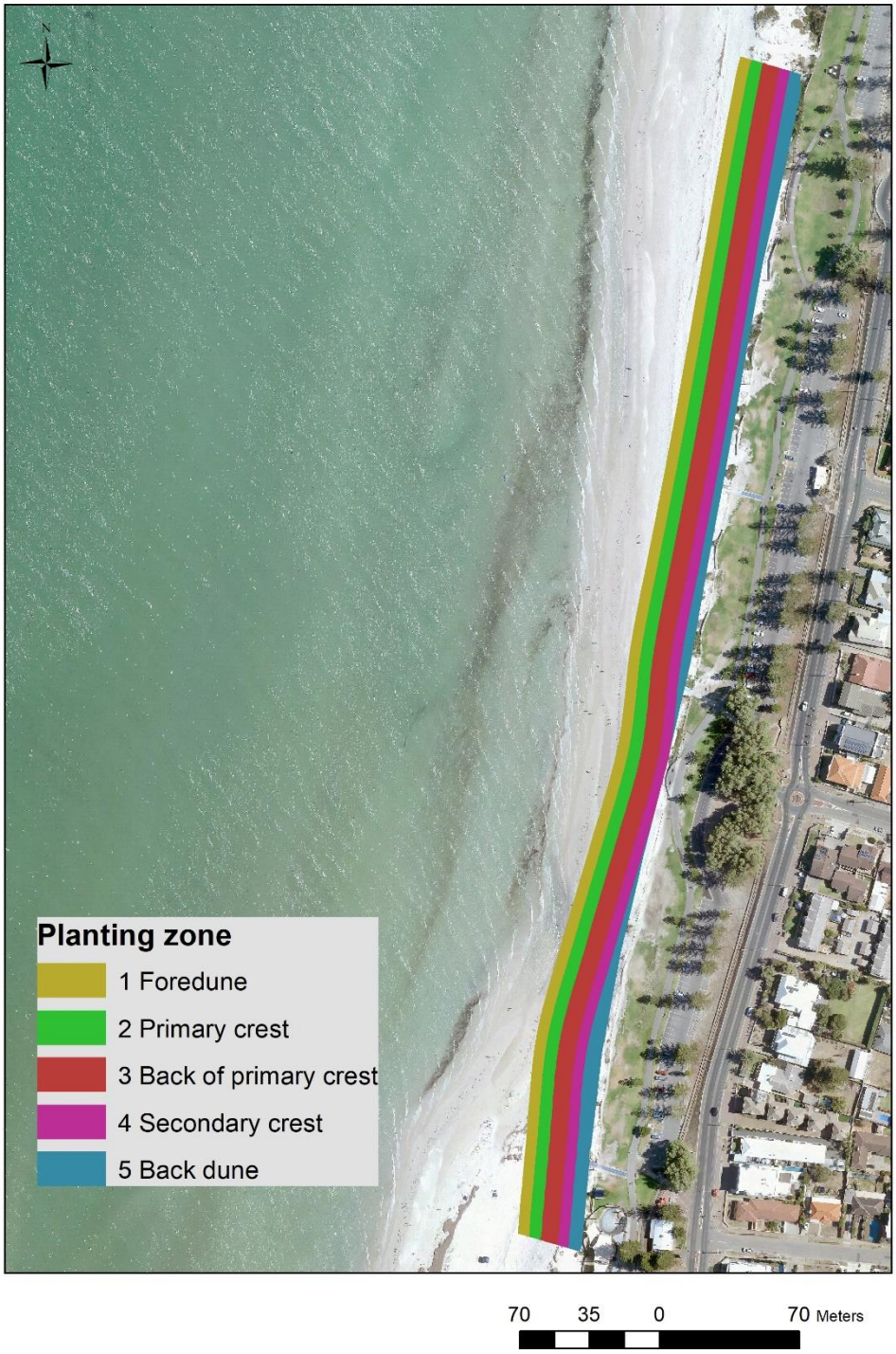

Figure 3: Proposed planting zones – Semaphore South

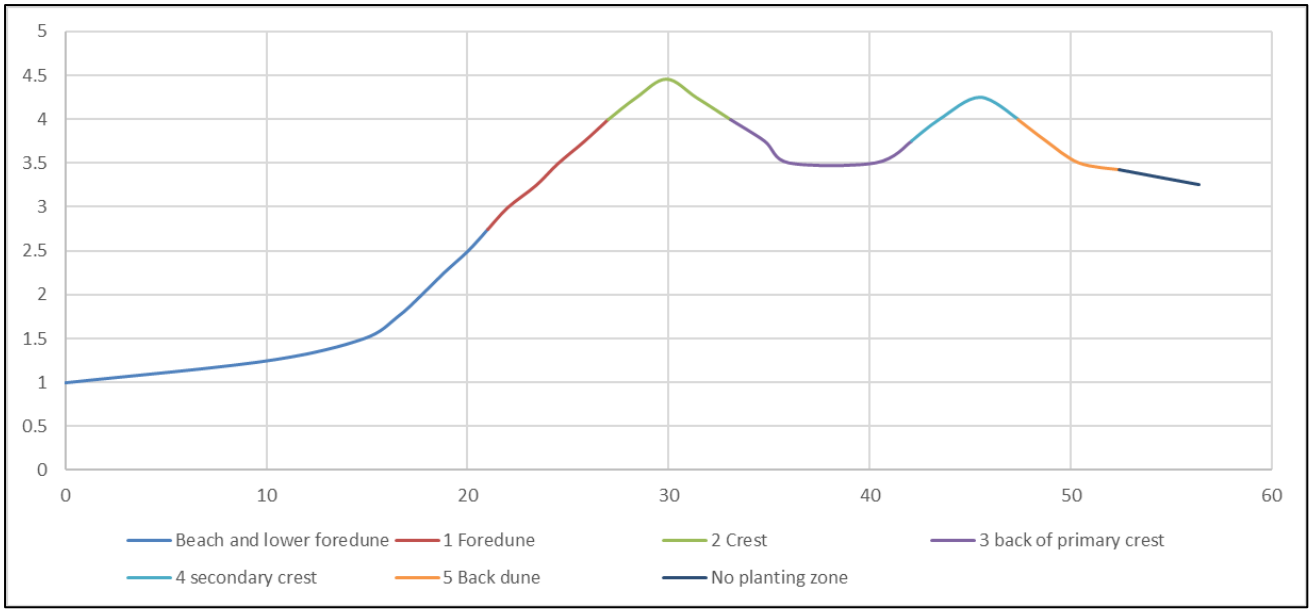

Figure 4: Proposed planting zones shown on an indicative dune profile – Semaphore South

4.2 Planting densities

In order to gain a clearer indication of which species to plant and at what densities, sampling of both overstorey and understorey were undertaken in more intact coastal vegetation which occurs nearby to the south at Fort Glanville and at Tennyson Dunes Conservation Reserve. The results are summarised below and a description of the methodology and more detailed results are included in Appendix 1.

The sampling indicated that the dominant **overstorey (shrub) species** along this part of the coastline is Coast Daisy-bush (*Olearia axillaris*). The target density of overstorey shrubs was calculated to be in the vicinity of 250 mature shrubs/hectare. Other tall shrub species such as Coastal Wattle (*Acacia longifolia* var. *sophorae*) and Common Boobialla (*Myoporum insulare*) only occur as occasional individuals and only low numbers of these species is recommended at Semaphore South.

In the **understorey**, the highest density lifeforms in the sample sites were tussocks, herbs and mat plants. Low (understorey) shrubs also occurred at about ten times the density of the dominant overstorey tall shrubs. Species richness/diversity was relatively low. Overall, understorey density was calculated to be approximately 22,130 plants per hectare which equates to approximately two plants per square metre.

Based upon this information, combined with field survey data gathered from vegetation present on surrounding dunes both to the north and south of the project site (undertaken as part of Stage 2 of this project in March 2020[3]), Table 2 provides details of the proposed plant species and the overall target densities for Year 1 (as plants per hectare). Note that it is recommended that an inventory of survival of the plantings from Year 1 is undertaken, and the densities adjusted to suit based upon survival rates.

[3] [3] T&M Ecologists Pty Ltd, 2020. *Flora survey of dunes – Semaphore South to Largs North*, Report to SA Department for Environment & Water, March 2020.

4.3 Monitoring and evaluation for supplementary planting in subsequent years

Revegetation survival rates will depend on factors such as rainfall and temperature, weed competition and possible anthropogenic impacts, such as trampling by humans and dogs. It may be necessary to undertake supplementary planting in Years 2 and/or Year 3. Some species, such as the climbers *Muehlenbeckia gunnii* and *Clematis microphylla*, should not be planted until shrubs have developed to a sufficient size to support these climbing species, likely to be in years 2 and 3. Indicative densities shown in Table 2 can be used as a guide for ongoing evaluation of progress towards target plant densities. The Point-centred-quarter technique detailed in Appendix 1 would provide a simple method to estimate density on an annual basis. In addition, it is recommended that photopoints are established to provide a visual illustration of change over time.

Table 2: Target plant species and densities (per hectare) for revegetation zones in the Semaphore South dune restoration.

SPECIES	COMMONNAME	LIFEFORM	PLANTS PER HECTARE					NOTES
			Zone 1 - Foredune	Zone 2 - Primary crest	Zone 3 - Back of primary crest	Zone 4 - Secondary crest	Zone 5 - Back-dune	
Muehlenbeckia gunnii	Coastal Climbing Lignum	CR					100	Plant in Years 2-3 when shrubs which this species climb on have become established.
Clematis microphylla	Old Man's Beard	CR					100	Plant in Years 2-3 when shrubs which this species climb on have become established.
Lotus australis	Austral Trefoil	FO			100		100	Found in swale environments at Tennyson Dunes. Plant in sheltered areas only.
Pelargonium australe	Austral Stork's-bill	FO			1000		1000	Attractive and prominent species in hind-dune habitats both to the north and south of this area.
Picris squarrosa	Squat Picris	FO					100	A rare species which occurs in similar habitat at Tennyson Dunes in very low numbers. Plant at back of dune.
Senecio pinnatifolius var.	Variable Groundsel	FO			2000		3000	Found in higher densities in hind-dune habitats at Tennyson, but likely to self-seed and spread naturally once established so planting density is lower.
Carpobrotus rossii	Native Pigface	GC		1000	5000		2000	A prostrate plant which can spread to 2 metres or more - will provide sand binding and protection from erosion.
Disphyma crassifoliium	Rounded Pig-face	GC			100		100	Generally less common than Native Pigface, and considered more likely to thrive in more sheltered areas.
Kunzea pomifera	Muntries	GC					200	This species has a dense growth habit and can be used as an effective weed-suppressing ground cover. Plant on landward side of dune. Monitor for success and modify planting to suit in subsequent years.

SPECIES	COMMONNAME	LIFEFORM	PLANTS PER HECTARE					NOTES
			Zone 1 - Foredune	Zone 2 - Primary crest	Zone 3 - Back of primary crest	Zone 4 - Secondary crest	Zone 5 - Back-dune	
Spinifex hirsutus	Rolling Spinifex	LG	6000	6000	6000	6000	1000	Will spread to cover more extensive areas over time, but is a critical plant for foredune stability. Also plant on the crest of the foredune and runners should establish along dune frontage. Will also be an important plant to stabilise hind dune area.
Enchylaena tomentosa	Ruby Saltbush	LS			60		60	Plant in Years 2-3, under canopy of larger shrubs, once they have become established.
Leucophyta brownii		LS		100	100	100	100	Noted in similar habitat at Tennyson Dunes in very low numbers - naturally more common towards the seaward side of dunes. Plant as scattered individuals on foredune areas – can cope with exposure.
Threlkeldia diffusa	Coast Bonefruit	LS			1000			Whilst densities noted at Tennyson were higher, it is considered likely that this species will naturally spread and proliferate, so higher planting densities are not required.
Pimelea serpyllifolia		MS			100		100	Noted in similar habitat at Tennyson Dunes in very low numbers.
Rhagodia candolleana	Sea-berry Saltbush	MS		200	1200	1200	500	Prominent understorey species. Scattered only on top of primary dune.
Scaevola crassifolia	Cushion Fanflower	MS			100		100	Noted in similar habitat at Tennyson Dunes in very low numbers - individual plants can cover several square metres.
Austrostipa flavescens	Coast Spear-grass	TG					1000	May be advantageous to plant in clumps of individuals.
Poa poiformis	Coast Tussock-grass	TG					1000	May be advantageous to plant in clumps of individuals.
Acacia cupularis	Coastal Umbrella Bush	TS					100	May need trimming if individuals become too tall in the back-dune area adjacent the reserve.

SPECIES	COMMONNAME	LIFEFORM	PLANTS PER HECTARE					NOTES
			Zone 1 - Foredune	Zone 2 - Primary crest	Zone 3 - Back of primary crest	Zone 4 - Secondary crest	Zone 5 - Back-dune	
Acacia longifolia var. sophorae	Coast Wattle	TS			100		100	Low numbers only – scattered. May need trimming if individuals become too tall in the back-dune area adjacent the reserve. In unmodified coastal environments generally <2m tall.
Atriplex cinerea		TS		100				Widely scattered plantings only on foredune. Can be prominent on lee or crest of foredune.
Myoporum insulare	Common Boobialla	TS			100		100	Noted in similar habitat at Tennyson Dunes in very low numbers. Plant as scattered individuals on foredune areas – can cope with exposure. May need trimming if individuals become too tall in the back-dune area adjacent the reserve.
Olearia axillaris	Coast Daisy-bush	TS		250	500	500	250	Dominant overstorey species in surrounding dunes at Fort Glanville and Tennyson. Plant scattered individuals on dune crests, more dense plantings on hind-dune and in swale. Evenly spaced. Numbers allow for 50% survival.
Dianella brevicaulis	Short-stem Flax-lily	TSE			400		400	Attractive species for dune areas. Suggested planting densities slightly higher than observed at Tennyson.
Ficinia nodosa	Knobby Club-rush	TSE		500	550	500	550	A good colonising and sand-binding species.
Lepidosperma gladiatum	Coast Sword-sedge	TSE					200	Most commonly occurs in dune swale areas. If surviving well in Zone 5, could consider planting into zone 3.
TOTAL			**6000**	**8150**	**18410**	**8300**	**12260**	

Key to Codes: Lifeform

CR	Creeper	**LSE**	Low sedge <60cm	**LS**	Low shrub <0.6m
GC	Groundcover	**TSE**	Tall sedge >60cm	**MS**	Medium shrub 0.6-1.2m
FO	Forb	**LG**	Low grass <60cm	**TS**	Tall shrub > 1.2m
		TG	Tall grass > 60cm	**TR**	Tree

Appendix 1: Analysis of life form densities in Tennyson Dunes and Fort Glanville

1. Methods

1.1 Desktop quadrat sampling for overstorey shrub species

Large shrub species were detectable and could be differentiated on high resolution aerial photography. A 20m by 20m polygon was created on Arcmap, then used to sample the number of overstorey shrubs in 10 samples from *Olearia axillaris* shrubland habitats on the rear slope of the primary dunes in Tennyson Conservation Reserve using this high resolution aerial photography. As a test, a similar process was repeated in similar habitats in Fort Glanville, but due to the limited area only 4 samples were taken in this area.

1.2 Point Centred Quarter (PCQ) field sampling – understorey species

Samples were gathered within locations on the rear slope of the primary dunes at Tennyson, as this is considered to be analogous to the relatively exposed habitats on the back of the proposed dune to be created at Semaphore South. Field assessors chose areas that were considered to be representative of the broader vegetation type, without significant disturbance being present (eg major tracks through the dunes). The specific assessment point around which the four quadrant samples were gathered was randomly chosen by throwing a steel tent peg approximately 10 metres without looking at the assessment area. Each assessment site was located at least 30 metres from the previous site. Data was gathered at ten points in the Tennyson Dunes. Figure 1 shows the locations of the sample points.

At each point the steel tent peg was pushed into the ground. From this point, the distance to the nearest individual within each of the four quadrants (starting in the NE quadrat and working clockwise) was measured, and the species noted. Data was gathered for five different lifeforms – mat plants, tussock grasses, sedges, herbs/forbs and low shrubs. Only native species were included in the scoring. Where the plant had a sprawling or running habit (like *Spinifex hirsutus* or *Carpobrotus rossii*), the distance to the primary base of the plant, rather than the runners, was measured. If no individual was observed within 10 metres, no data was recorded for that quadrant. Field data were gathered on 28/4/2020.

Data analysis

Data analysis follows the Point-centred quarter method formula of Mitchell (2007)[4] with the modification to allow for missing data proposed by Dahdouh-Guebas and Koedam (2006)[5].

2. Results

2.1 Desktop quadrat sampling

The mean number of overstorey shrubs in the 400m^2 sample in Tennyson Dunes was 9.3, with a 95% confidence interval of 1.57. The mean number of overstorey shrubs in Fort Glanville was 8.5, which is within the 95% confidence interval of the Tennyson sample (meaning overstorey shrub density

[4] Mitchell, K. (2007). Quantitative Analysis by the Point Centred Quarter Method.

[5] Dahdouh-Guebas, F. and Koedam, N. (2006). Empirical estimate of the reliability of the use of the Point_Centred_Quarter Method (PCQM): Solutions to ambiguous field situations and description of the PCQM+ protocol. Forestry Ecology and Management 228: 1-18.

was not significantly different). Target density of overstorey shrubs would therefore be in the vicinity of 250 shrubs/hectare (232.5 based on the Tennyson sample).

2.2 Point Centred Quarter (PCQ) field sampling

Table 1 shows the results from the Point Centred Quarter technique. The highest density lifeforms were tussocks, herbs and mat plants. Low shrubs also occurred at about ten times the density of the dominant overstorey tall shrubs. Species richness was relatively low (although note that this method is likely to only sample the dominant species of each lifeform). Overall density, at 22,130 plants per hectare equates to approximately two plants per square metre.

Table 1: Density of different plant lifeforms in hind-dune habitats at Tennyson

Lifeform	Total density (/ha.)	Species	Density (/ha.)
Mat Plants	4960	*Carpobrotus rossii*	4960
Herbs	8050	*Senecio pinnatifolius ssp.*	7200
		Pelargonium australe	850
Tussocks	5560	*Spinifex hirsutus*	5560
Sedges	760	*Ficinia nodosa*	550
		Dianella brevicaulis	140
		Lepidosperma gladiatum	80
Low shrubs	2580	*Threlkeldia diffusa*	1350
		Rhagodia candolleana	1160
		Enchylaena tomentosa	60
Tall shrubs*	230	*Olearia axillaris*	230
Total			**22130**

* Tall shrubs data based upon desktop quadrat sampling

3. Discussion

The field and desktop sampling undertaken provides a broad indication of the density of different lifeforms in the relatively exposed habitats at the rear of the primary dune within Tennyson Dunes. This will help provide context to revegetation densities for plantings at Semaphore South. Some species, such as the herb *Senecio pinnatifolius*, are likely to proliferate rapidly from plantings, and so may not need to be planted at such a high density. It should also be noted that *Enchylaena tomentosa* was only observed under the canopy of *Olearia axillaris* in the areas sampled, and may need this habitat component to be developed before it will grow in relatively exposed primary dune habitats. Much of the *Threlkeldia diffusa* in the survey sites at Tennyson comprised young, regenerating seedlings, therefore the final density per hectare should probably be modified somewhat.

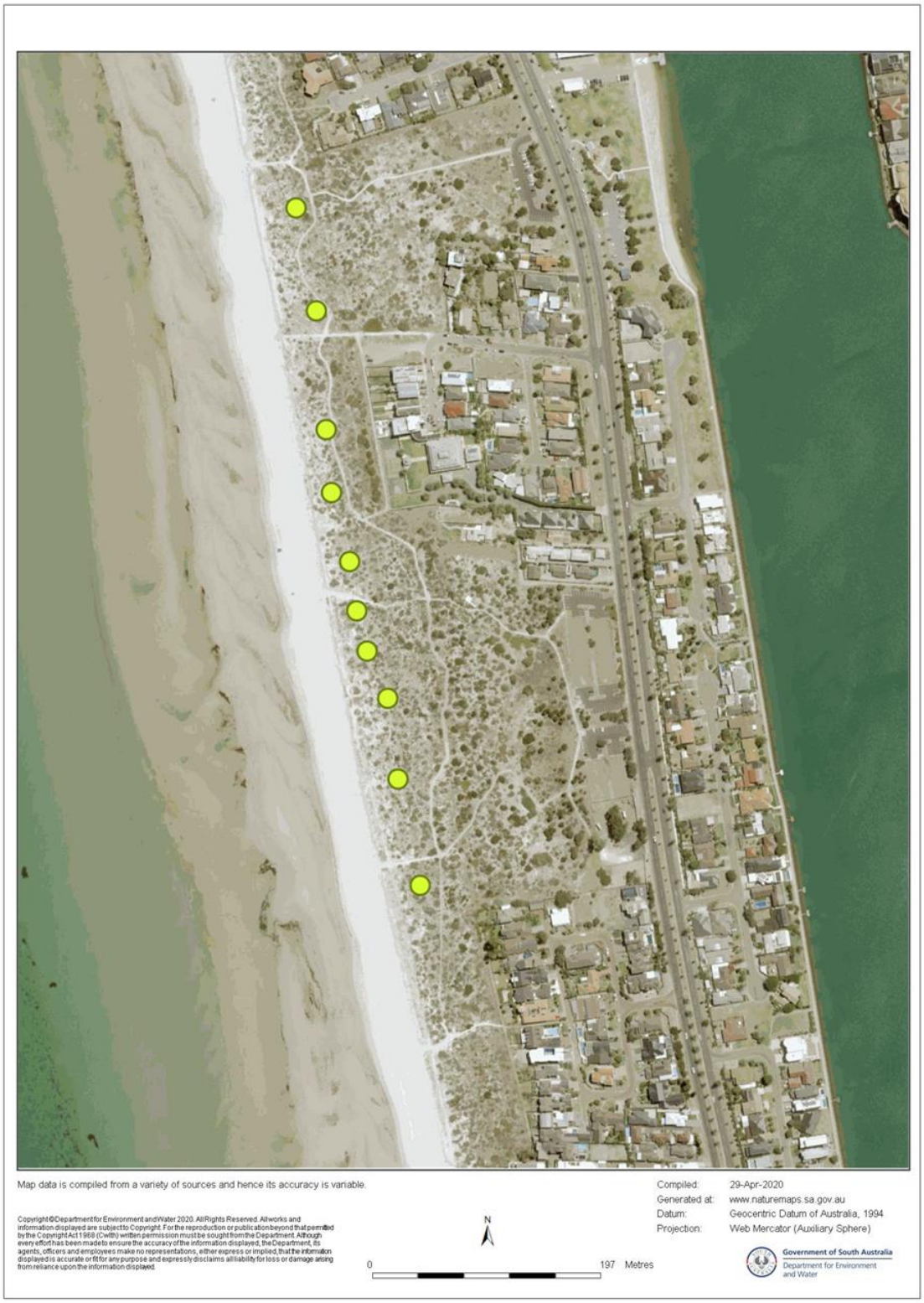

Figure 1: Location of Point Centred Quarter survey points in Tennyson Dunes