

Action Plan for Mount Compass Swamp Gum (*Eucalyptus paludicola*)



Prepared by Joe Quarmby

2011-2016



Government of South Australia
Department of Environment
and Natural Resources

Acknowledgements

The author would like to thank Ron Taylor, Dean Nicole, Jason Van Weenen, Tim Vale, Rosemary Taplin, Barb St John, Guy Fishlock-Smith, Anthony Abley and Robyn Molsher for providing information on the location of populations. Luke Price, Charlie Bensen, Steve Bellamy, Jackie Crampton, Tim Jury, Ron Taylor, Kylie Moritz, Peter Tucker, Sue Bradstreet, Rob Bates and Jason Van Weenen also provided assistance with surveys and population assessments. Jason Van Weenen, Dan Duval, Doug Bickerton, Martin O’Leary, Kym Ottewell, Dean Nicole and Peter Copley provided technical information and advice. Recovery team members also provided general comments on the content of the plan. The maps were produced by Darcy Peters.

The Adelaide & Mount Lofty Ranges Natural Resource Management Board provided the funding for the preparation of this plan.

Summary

Eucalyptus paludicola is a nationally endangered gum tree, endemic to the Fleurieu Peninsula and Kangaroo Island in South Australia. It generally grows in low-lying eucalypt woodland with a heathy understorey, usually along watercourses or near the margins of swamps in sandy loam soils. It is often associated with Swamps of the Fleurieu Peninsula. It is currently known from 34 sub-populations, with a total population size of approximately 720- 750 individuals. Most sub-populations are very small and comprise entirely of mature trees.

The majority of sub-populations occur in degraded remnant vegetation or as isolated paddock trees, and are subject to a range of threats which are causing population decline. The main threats to the species are vegetation clearance, livestock grazing, herbicide spraying, road works, and weed invasion.

It is vital that all existing populations of *E. paludicola* are protected, and measures are taken to maintain and enhance populations. This plan aims to improve the conservation status of *E. paludicola* by increasing the size and number of populations, and improving the protection and condition of habitat.

The priority actions in this plan include:

- inform key stakeholders to ensure awareness of the species
- collect and preserve seed from all sub-populations
- fence off habitat from stock
- undertake surveys for additional populations
- undertake targeted weed control programs at priority sites
- install roadside markers and implement protective measures
- investigate population genetics
- propagate and plant seedlings into existing sub-populations
- introduce populations into reserves, and
- establish a recovery team to coordinate implementation

Population augmentation will be an integral part of the recovery program for this species. There is limited evidence of seedling recruitment in most populations, and it is therefore planned to propagate and plant seedlings into existing populations. A translocation plan has been prepared and is included in Appendix 1 of this document.

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1. Species Information

1.1 Description

Eucalyptus paludicola is a gum tree 5-12 m tall, which usually has smooth grey to cream bark, but can have rough fibrous bark on the lower trunk especially on larger trees. The buds and fruits occur in clusters of up to seven on individual stalks. The flowers are white, and are produced from July - November (Nicolle, 1995).



Figure 1: *Eucalyptus paludicola* fruits



Figure 2: *E. paludicola* buds and flowers

The taxonomic validity of *E. paludicola* has previously been questioned, with it speculated to be a hybrid between *E. cosmophylla* and *E. ovata* var. *ovata*. However, recent genetic studies support it being a distinct species (Ottewell et al 2011, Steane et al 2007). It is morphologically distinguished by the size, shape and number of buds and fruits. *E. cosmophylla* has larger ovoid buds and fruits in clusters of three, and *E. ovata* var. *ovata* has much smaller pointed buds and conical fruits.

1.2 Conservation status

Eucalyptus paludicola is listed as endangered in Australia under the *Environment Protection and Biodiversity Conservation Act 1999*. The species is listed because its geographic distribution is restricted and precarious for its survival (TSSC, 2006eg). It is also listed as endangered in South Australia under the *National Parks and Wildlife Act 1972*.

1.3 Distribution

Eucalyptus paludicola is endemic to South Australia. It occurs predominantly on the Fleurieu Peninsula between Mount Magnificent and Tunkalilla. It also occurs in several locations on Kangaroo Island between Flinders Chase and Stokes Bay (refer to Map 1). Its current distribution is highly fragmented, and is predominantly limited to small isolated remnants.

1.4 Population size

There are currently 34 known 'populations'¹ of *E. paludicola* (refer to Table 1). The total population size is estimated to be between 720-750 individuals, however it is possible that this is an over-estimate due to difficulties in differentiating individuals with multiple trunks. The majority of sub-populations are very small (<10 trees) and are under severe threat. Only four populations of *E. paludicola* currently contain more than 50 individuals, with the largest population occurring in Kuitpo Forest near Nangkita (180 trees).

¹ 'Populations' were spatially defined by grouping individuals within a 250 metre radius. Some populations have been further divided into 'sub-populations' for management purposes.

Map 1 - Distribution of *Eucalyptus paludicola*



- *Eucalyptus paludicola* Population
- Major Roads
- Minor Roads
- DENR Reserves



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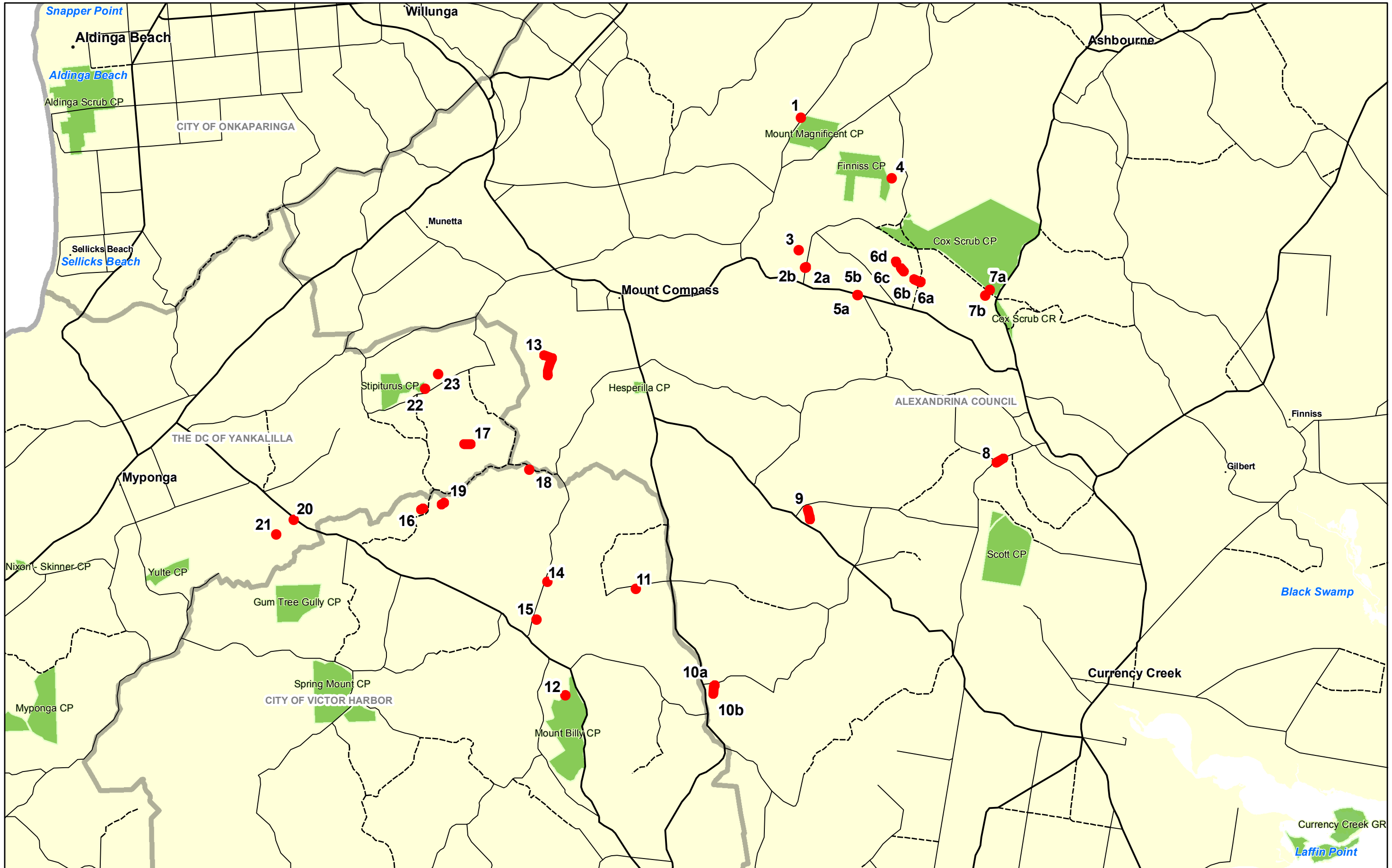


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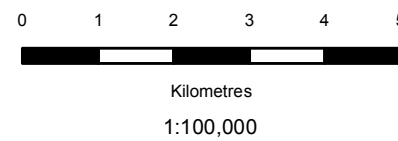
Table 1: List of current sub-populations of <i>Eucalyptus paludicola</i>.					
Pop. No.		Sub-population Name	Year last recorded	Number of individuals	Land tenure
1		Blackfellows Creek	2011	5	Private (Heritage Agreement)
2	a	Stones Ford Rd	2011	11	Roadside (Alexandrina Council)
	b	Stones Ford Rd	2011	10	Private
3		Stones Ford Rd	2011	30-35	Private (Heritage Agreement)
4		Cole Crossing Rd	2011	4	Private
5	a	Nangkita Rd	2011	3	Roadside (Alexandrina Council)
	b	Nangkita Rd	2011	4	Private
6	a	Griggs Rd	2011	5	Roadside (Alexandrina Council)
	b	Kuitpo Forest	2011	70	ForestrySA
	c	Kuitpo Forest	2011	90	ForestrySA
	d	Kuitpo Forest	2011	15	ForestrySA
7	a	Cox Scrub Conservation Park	2011	22	DENR
	b	Bonds Rd	2011	24	Private
8		Deep Creek Rd	2011	2	Roadside (Alexandrina Council)
9		Kokoda Rd	2011	50-60	Private
10	a	Mosquito Hill Rd	2011	17	Roadside (Alexandrina Council)
	b	Cloverlea Dairy	2011	8	Private
11		Leane Rd	2011	1	Roadside (City of Victor Harbour)
12		Mount Billy Conservation Park	2011	38	DENR
13		Minko Vineyard	2011	35-40	Private (Heritage Agreement)
14		Haskett Rd	2011	4	Roadside (City of Victor Harbour)
15		Haskett Rd	2011	7	Private
16		Mt Cone	2011	30	Private (Heritage Agreement)
17		Mt Cone	2011	25	Private
18		Mt Cone	1997	1	Private
19		Mt Cone	2011	50-60	Private
20		Hindmarsh Valley Rd	2011	4	Private
21		Hindmarsh Valley Rd	2011	3	Private
22		Stipiturus Conservation Park	2011	1	DENR
23		Bear Lane	2011	3	Private
24		Cartwright Rd	2011	5	Private
25		Range Rd	2009	5	Private
26	a	Koolah	2011	1	Private (Heritage Agreement)
	b	Koolah	2011	2	Private
27		Gold Diggings Swamp	2011	2	Private (Heritage Agreement)
28		Gold Diggings Swamp	1997	<5	Private
29		Parawa Rd	2011	2	Private
30		Kelly Hill Conservation Park/Cape Bouger Wilderness Area (KI)	2010	100	DENR
31		Flinders Chase National Park (KI)	2010	8	DENR
32		Gosse-Ritche Rd (KI)	2010	12	Private
33		Stokes Bay Rd (KI)	2010	1	Private
34		Coopers Rd (KI)	2010	1	Private
			Total	720-750	

Note: All populations occur on the Fleurieu Peninsula, except for those marked with KI (Kangaroo Island)

Map 2 - Distribution of *Eucalyptus paludicola* - Mt Compass



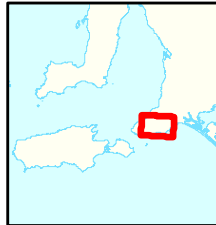
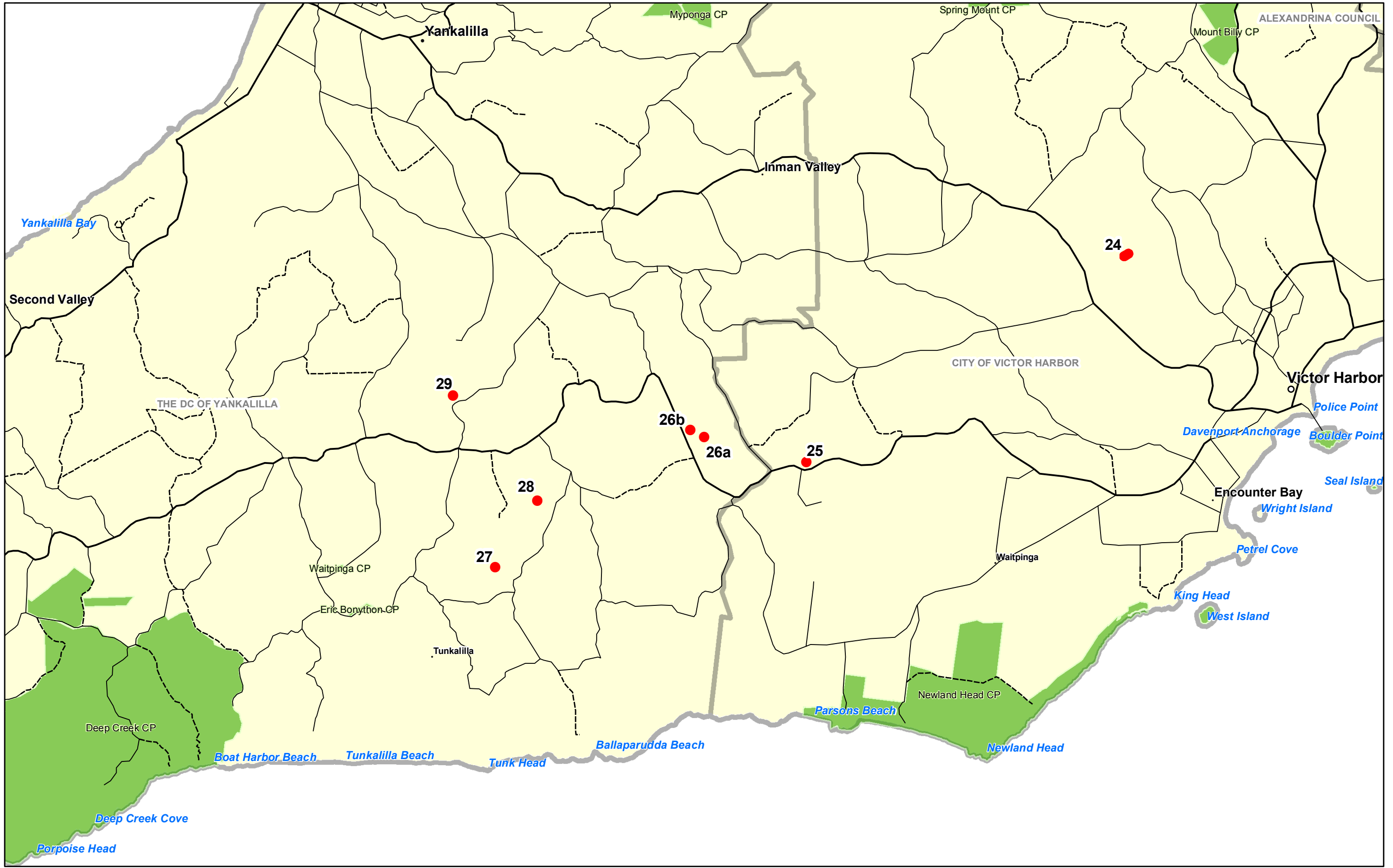
- *Eucalyptus paludicola* Population
- DENR Reserves
- Local Govt Areas (LGA)
- Main Road
- Minor Road
- Track



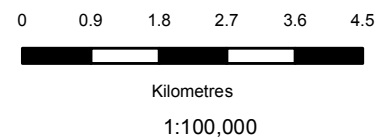
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Map 3 - Distribution of *Eucalyptus paludicola* - Fleurieu South



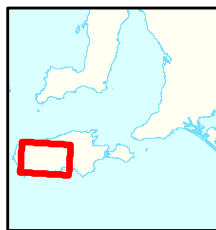
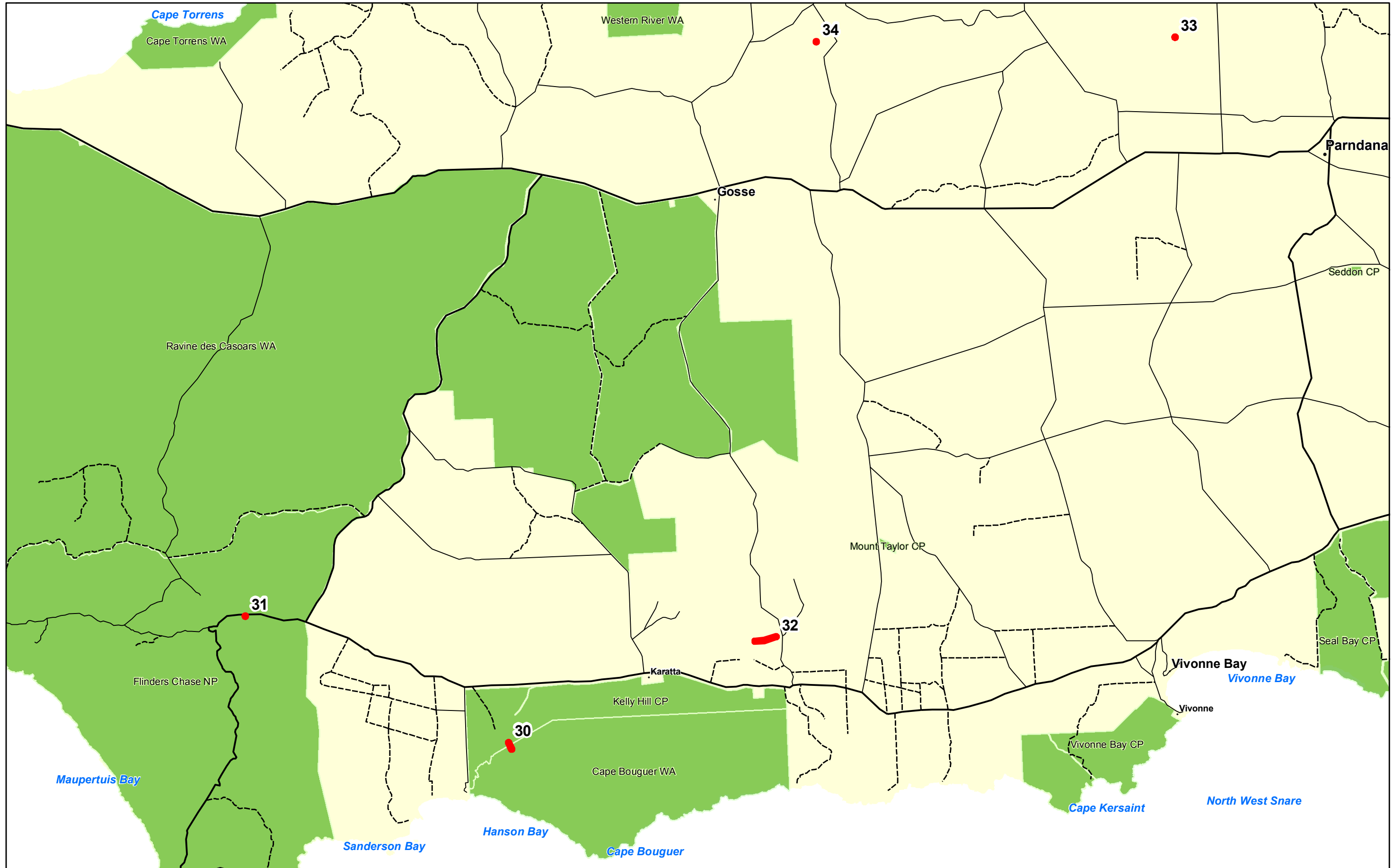
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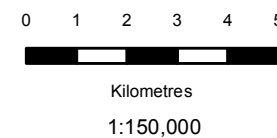
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Map 4 - Distribution of *Eucalyptus paludicola* - Kangaroo Island



- Eucalyptus paludicola* Population
- DENR Reserves
- Main Road
- Minor Road
- Track



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There are also several unverified records from Cleland Gully, Nangkita, Yundi, Currency Creek and Macgillivray (R. Taplin pers obs., D. Nicole pers obs., T. Vale pers obs., B. St John pers obs.) which require further investigation.

It is likely that the population size of *E. paludicola* has declined significantly over the last 50-100 years, largely as a result of vegetation clearance. The current population of *E. paludicola* is also at risk of continued decline. Most sub-populations comprise of mature trees, and there is limited evidence of seedling recruitment in most populations. Many populations are under serious threat (e.g. from vegetation clearance, stock grazing, road works, dieback, weed invasion etc), which is likely to cause population loss and decline.

1.5 Habitat

Eucalyptus paludicola typically grows in wet eucalypt woodland with a heathy understorey on low-lying flats, broad gullies or occasionally on hillsides, usually in or near creeks and swamps. It usually grows with *E. ovata* var. *ovata* and *E. cosmophylla*, and more occasionally with *E. baxteri* and *E. fasciculosa*. Understorey species include *Leptospermum continentale*, *Xanthorrhoea semiplana*, *Banksia marginata*, *Melaleuca decussata*, *Acacia provincialis*, *Gahnia sieberiana*, *Pteridium esculentum* and *Leptocarpus tenax*. The soils are typically sandy loams high in organic matter, and waterlogged in winter. Some populations occur in Swamps of Fleurieu Peninsula, which are listed as critically endangered under the EPBC Act.

1.6 Biology

1.6.1 Growth and longevity

There is no empirical information about the longevity of *Eucalyptus paludicola*, however it is thought to be a long-lived species. Most populations comprise of mature trees and seedling recruitment is generally very limited. Little is known about the conditions or requirements for seedling establishment of this species. However, it is likely that episodic disturbance events (e.g. fire or prolonged inundation) may be important for recruitment.

1.6.2 Reproductive biology

Eucalyptus paludicola usually flowers in spring (Aug - Nov), and flowering is often prolific. Pollinators are likely to include a variety of insects and birds. Fruits are likely to ripen within a few months, and seed is generally retained in the canopy for several years. Seed dispersal in eucalypts is generally by wind and gravity, and virtually all seed is deposited around the base of the tree, however longer seed dispersal events may occasionally occur (e.g. storms, floods, and fire updrafts). Seed fall in eucalypts is usually highest in spring and summer, and is often increased by drought or fire. It is possible that water may also act as a vector for seed dispersal in *E. paludicola*, given its often close proximity to watercourses. Eucalypts do not accumulate a persistent soil seed bank.

1.6.3 Fire response

E. paludicola can resprout from the base after fire, however tree deaths have also been observed after fire (e.g. Cox Scrub CP). It is possible that seedling recruitment may be facilitated by fire, similar to other eucalypts, but this requires seed to survive in the canopy and then be released into the post-fire environment.

1.6.4 Genetics

E. paludicola is genetically distinct from *E. ovata* var. *ovata* and *E. cosmophylla* (Ottewell et al 2011, Steane et al 2007), however there is some evidence of hybridisation with *E. cosmophylla* (Ottewell et al 2011). *E. paludicola* has slightly higher levels of genetic diversity than *E. ovata* var. *ovata* and *E. cosmophylla* (Ottewell et al 2011). Genetic diversity was highest within the Finnis-Tookayerta

catchment (incl. Kuitpo Forest and Cox Scrub CP populations), suggesting this area is important for the conservation of genetic diversity within the species.

There is a high level of genetic differentiation between the Fleurieu Peninsula populations and the Kelly Hill CP population on Kangaroo Island. However differentiation between populations on the Fleurieu Peninsula was moderate (Ottewell et al 2011). There was a high relatedness amongst individuals sampled at scales of 0-4 km but that relatedness decreases at approximately 14-16 km. The one exception was the Mosquito Hill Rd population which appeared to be highly differentiated from the remaining Fleurieu Peninsula subpopulations (Ottewell et al 2011). However, this result is based on a small number of samples, so further investigation is required.

1.7 Threats

1.7.1 Habitat loss and fragmentation

Broad-scale vegetation clearance across the species' range has resulted in significant loss and fragmentation of *E. paludicola* habitat. Remaining *E. paludicola* populations are largely confined to paddocks, roadsides, or small remnants which are often highly modified and infested with weeds. Incremental habitat loss still occurs in many roadside and paddock remnants.

1.7.2 Livestock grazing

Many populations of *E. paludicola* occur on agricultural land are under threat from livestock grazing (e.g. Bonds Rd, Kokoda Rd, Cloverlea, Haskett Rd, Hindmarsh Valley Rd, Bear Ln, Range Rd and Parawa Rd). Over-grazing can inhibit seedling recruitment and degrade habitat. It can also degrade soils, alter nutrient levels, and increase weed incursion. The health of mature trees in paddocks is often poor and numerous tree deaths have occurred in recent years.

1.7.3 Road works and track management

Road works and track management are a threat to a number of *E. paludicola* populations (e.g. Stonesford Rd, Nangkita Rd, Griggs Rd, Deep Creek Rd, Mosquito Hill Rd, Mount Billy CP, Cox Scrub CP, Leane Rd and Haskett Rd) Felling and pruning of *E. paludicola* trees along roads and tracks has occurred in several locations in recent years. Activities such as road widening, surfacing, grading, infrastructure development (guard rails, culverts, bridges etc), stock piling materials, and vegetation grooming can directly impact on *E. paludicola*, and can also remove and degrade habitat. These activities can also increase the spread of weeds and plant pathogens.

1.7.4 Utilities management

Many roadsides containing *E. paludicola* (see 1.7.3) are also used as electricity, telecommunication and water easements and are regularly subject to vegetation pruning and earthworks, which have the potential to impact on *E. paludicola*. Pruning of trees under powerlines is of particular concern.

1.7.5 Weed invasion

Most *E. paludicola* habitat is severely infested and highly modified by weeds. Competition from weeds is likely to impede seedling recruitment, and may also impact on the growth and health of *E. paludicola*. Weeds of most concern include Phalaris, Kikuyu, Cocksfoot, Sweet Vernal-grass, Pines, Gorse, Blackberry, Montpellier Broom and Watsonia.

1.7.6 Herbicide spraying

Indiscriminate herbicide spraying is a potential threat to *E. paludicola*, especially to roadside populations. Off-target damage to *E. paludicola* from herbicide spraying has been observed in several locations in recent years, usually related to Blackberry control. Seedlings and trees with low hanging branches are particularly at risk. It can also impact on associated native understorey species.

1.7.7 Herbivory

Kangaroo numbers are very high in some areas containing *E. paludicola*, and consequently over-browsing is likely to be impeding seedling regeneration. Rabbits, hares and deer are also present in many sites, and may also impacting on seedling regeneration. Herbivory is also likely to be significant issue for survivorship of planted seedlings in some sites.

1.7.8 Hydrological impacts

Activities which alter hydrological conditions (eg water extraction, construction of dams and drains) have the potential to impact on *E. paludicola* and associated habitat.

1.7.9 Dieback

Dieback is a potential threat to *Eucalyptus paludicola*. There are many factors that may contribute to or directly cause dieback in eucalypts, including insect infestation, drought, salinity, disease, Phytophthora, and mistletoes.

2. Recovery objectives and criteria

2.1 Overall objective

The overall objective of this action plan is to improve the conservation status of *E. paludicola* by increasing the number and size of populations, and improving the protection and condition of habitat.

2.2 Specific objectives

Recovery objective 1. Maintain or increase the current number of *E. paludicola* sub-populations

Performance Criteria

- 1a. All currently known sub-populations are extant in 2016
- 1b. At least two additional sub-population are established by 2016

Recovery objective 2. Increase the size of *E. paludicola* sub-populations

Performance Criteria

- 2a. The total population size of the species totals at least 1000 individuals by 2016
- 2b. At least 75 percent of sub-populations have increased in size by 2016

Recovery objective 3. Preserve and maintain the genetic diversity of the species

Performance Criteria

- 3a. A representative collection of seed from all sub-populations is in long-term storage by 2013
- 3b. Genetic diversity of all small populations is enhanced with diverse plantings by 2014

Recovery objective 4. Improve the quality of *E. paludicola* habitat

Performance Criteria

- 4a. The condition of habitat is maintained or improved for all sub-populations by 2016

Recovery objective 5. Increase the area and protection of *E. paludicola* habitat

Performance Criteria

- 5a. At least two additional sub-populations are formally protected by 2015
- 5b. All roadside sub-populations have markers and adequate protective measures in place by 2012

Recovery objective 6. Involve the community and government agencies in the recovery program

Performance Criteria

- 6a. Community and local and state government agencies are actively involved in the recovery program by 2012

3. Recovery actions

3.1 Previous actions

Previous recovery actions for *E. paludicola* include:

- Seed was collected from the Kelly Hill Conservation Park population for the Millennium Seed bank in 2006.
- Several new populations were discovered by the Fleurieu Peninsula Swamps Recovery Program in 2007, and on-ground works (eg fencing and weed control) have been implemented.
- A genetic study was conducted in 2009 to investigate the taxonomic validity and genetic diversity of *E. paludicola*.
- Targeted surveys and population assessments were conducted on the Fleurieu Peninsula between 2009 and 2011, resulting in the discovery of nine new populations.
- Seed was collected from 18 sub-populations on the Fleurieu Peninsula in 2011.

3.2 Specific recovery actions

Action 1. Protect and manage populations

1.1 Inform landholders of *E. paludicola* populations

All relevant landholders and local and state government agencies need to be made aware of the presence and management requirements of *E. paludicola*. Landholders adjacent to roadside populations should also be notified of relevant populations. Landholders and other relevant bodies should be encouraged to participate in the recovery program where possible.

Delivery groups: DENR (TFE), AMLR NRM, MDB NRM

1.2 Collect seed from all sub-populations

Seed should be collected from all sub-populations for long-term storage at the Adelaide Botanic Gardens. Additional seed should be collected for translocation purposes. The immediate priority should be to collect seed from small sub-populations that are at imminent risk of extinction.

Ideally seed should be sourced from all trees in sub-populations containing less than 20 individuals. In larger sub-populations seed should be sourced from as many trees as possible, with the aim of capturing the majority of genetic diversity represented within the sub-population.

Delivery groups: DENR (TFE), ABG (SSC)

1.3 Install fencing and exclude livestock

Populations currently subject to livestock grazing (e.g. Bonds Rd, Kokoda Rd, Cloverlea, Haskett Rd, Hindmarsh Valley Rd, Bear Ln, Range Rd and Parawa Rd) should be fenced off where possible. Priority should be given to fencing around populations in sites with restoration/translocation potential.

Delivery groups: AMLR NRM, MDB NRM, TPAG, CCSA (FPSRP), GWLAP

1.4 Undertake targeted weed control programs at priority sites

Weed control programs should be implemented at priority sites (e.g. Kuitpo Forest, Mount Cone and Minko Vineyard). In the short-term works should be targeted towards controlling weeds that pose the most immediate threat to *E. paludicola*. The long-term aim should be to improve and maintain habitat condition, by preferentially increasing native species abundance and diversity. Considerable care must be taken to avoid off-target herbicide damage to *E. paludicola* and other native species when undertaking weed control.

Delivery groups: DENR (TFE), AMLR NRM, MDB NRM, CCSA (FPSRP), GWLAP, CVH, AC, FSA, TPAG, FOP, TFL

1.5 Install roadside markers and implement protective measures

Roadside markers should be installed for all unmarked roadside populations (e.g. Griggs Rd, Deep Creek Rd, Nangkita Rd, Mosquito Hill Rd and Stonesford Rd) and sites should be included in relevant databases, plans and GIS layers. All staff and contractors should be made aware of the presence of *E. paludicola* to prevent accidental damage to plants (eg herbicide spray drift, road grading, slashing etc).

Delivery groups: DENR (TFE), CVH, AC

1.6 Identify and nominate areas to be protected under Heritage Agreement

Opportunities to protect *E. paludicola* populations under Heritage Agreement should be identified and discussed with landholders and management authorities.

Delivery groups: DENR (TFE), AMLR NRM, MDB NRM

Action 2. Search for additional sub-populations

2.1 Undertake targeted surveys in areas of suitable habitat

Targeted surveys should be conducted in areas of potential habitat within the known range of the species. It is likely that additional populations exist on the Fleurieu Peninsula, especially on private land in the Parawa area. There is also potential for discovering additional populations on Kangaroo Island.

Delivery groups: DENR (TFE), CCSA (FPSRP), AMLR NRM

Action 3. Augment existing sub-populations

3.1 Propagate and plant seedlings into existing sub-populations

E. paludicola seedlings should be propagated and planted into remnant populations to supplement natural recruitment. Priority should be given to small sub-populations that are at highest risk of extinction. There are also opportunities to expand some sub-populations by planting into suitable habitat in adjoining areas or adjacent properties. All translocation activities should be in accordance with the Translocation Proposal (refer to Appendix 1), and in consultation with DENR.

Delivery groups: DENR (TFE), FSA, CVH, AC, TFL, AMLR NRM, MDB NRM, CCSA (FPSRP), TPAG, FOP

Action 4. Establish additional populations

4.1 Identify additional locations to establish populations

Areas of suitable habitat for establishing new planted populations should be identified. Ideally these areas would be substantial enough to support larger populations, and would need to be appropriately managed and protected. The translocation plan should be amended to include any additional sites.

Delivery groups: DENR (TFE), CCSA (FPSRP), CVH, AC, AMLR NRM, MDB NRM, TPAG

Action 5. Investigate population genetic genetics

5.1 Undertake further genetic study

Further research is required to investigate the genetic identity of the Mosquito Hill population. It would also be beneficial to examine the genetic relationship of recently discovered populations on the Fleurieu Peninsula and Kangaroo Island. This is of particular importance to ensuring the appropriateness of mixed provenance planting.

Delivery groups: DENR (TFE), TPAG, UA

Action 6. Involve the community

6.1 Establish a recovery team

A recovery team should be established, comprising of representatives from relevant local and state government agencies, landholders, non-government organisations, and community groups. The team should oversee the management of the species and the implementation of this plan.

Delivery groups: DENR (TFE, Fleurieu District), AMLR NRM, MDB NRM, CCSA (FPSRP), CVH, AC, FSA, TPAG, FOP, TFL

6.2 Encourage and support community participation

The recovery program should be promoted, and community involvement in activities such as weed control, translocation and monitoring should be encouraged and supported.

Delivery groups: DENR (TFE, Fleurieu District), AMLR NRM, MDB NRM, CCSA (FPSRP), CVH, AC, FSA, TPAG, FOP, TFL

4. Delivery groups

ABG – Adelaide Botanic Gardens

AC – Alexandrina Council

AMLR NRM – Adelaide & Mount Lofty Ranges Natural Resource Management Board

CCSA – Conservation Council of South Australia

CVH – City of Victor Harbour

DENR - Department for Environment and Natural Resources

FTE – Threatened Flora Ecologist

FOP – Friends of Parks

FPSRP – Fleurieu Peninsula Swamp Recovery Program

FSA – Forestry SA

GWLAP – Goolwa to Wellington Local Action Plan Association

MDB NRM – Murray Darling Basin Natural Resource Management Board

SCC – Seed Conservation Centre

TFL - Trees for Life

TPAG – Threatened Plant Action Group

UA – University of Adelaide

5. References

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Appendix 1. Translocation Proposal for *Eucalyptus paludicola*

Summary

This translocation proposal aims to augment existing sub-populations of *E. paludicola* on the Fleurieu Peninsula with planted seedlings, and to establish additional planted populations in suitable recipient sites. Translocation is intended to occur in conjunction with other recovery actions for the species (as outlined in the main body of this plan). This translocation proposal has been prepared following the Guidelines for the Translocation of Threatened Plants in Australia (Vallee et al 2004).

Detailed information about the species' distribution, biology and ecology, threats, and recovery actions are outlined in the main body of this plan.

Translocation objectives

- To prevent the extinction of small isolated *E. paludicola* sub-populations
- To increase the size and area of existing *E. paludicola* sub-populations
- To increase the number of sub-populations
- To improve the age structure and viability of existing sub-populations

Justification for translocation

Translocation is considered necessary to achieve the stated objectives of this proposal. The majority of sub-populations on the Fleurieu Peninsula are extremely small and confined to paddocks and roadsides, and many are at risk of extinction. Most sub-populations are cohorts of mature trees, and natural seedling recruitment is limited or non-existent. Threat abatement, habitat protection and restoration, while being important for the long-term recovery of the species, are unlikely to prevent immediate loss and decline of small populations. The use of fire to stimulate seedling recruitment requires investigation, but is not a feasible management option for most populations.

Whilst many existing sub-populations are subject to a range of threats and habitat is often in poor condition and limited in area, translocation into these sites is still likely to be successful. *E. paludicola* is relatively easy to propagate from seed, and seedling establishment is expected to be high with adequate site preparation and management (similar to other eucalypts). Once seedlings are established they should be able to compete with weed growth, and are expected to be long-lived.

Translocation Methodology

Seed collection and storage

Mature unopened fruits will be collected from numerous trees in all known sub-populations. An attempt will be made to source seed from all trees in sub-populations containing less than 20 individuals. In larger sub-populations, seed will be collected from as many trees as possible, with the aim of capturing the majority of genetic variability represented within the population. Seed from each sub-population will be kept in separate bags, and clearly labelled (including the sub-population name, date, and number of source plants).

Seed collection can occur at any time of year, but is probably best in autumn. After collection, the fruits will be kept in dry, warm conditions to release the seed. Seeds will then be cleaned and dried until appropriate moisture content is achieved, and enclosed in air-tight packets. Seed packets will be stored in cool, dry conditions until required for propagation.

Seedling propagation

Eucalyptus paludicola seed germinates readily without pre-treatment. Seeds will be sown into tubes with a pasteurised potting mix. This should occur in November-December to be ready for planting out in June-July the following year. Seedlings from each sub-population will be grown and labelled separately. Strict phytosanitary procedures will be followed throughout propagation.

Recipient sites and population targets

Augmenting existing sub-populations

E. paludicola seedlings will be planted into recipient sites in the vicinity of existing sub-populations. The target number of individuals for each sub-population is outlined in Table 1. It is intended to stage the planting over several years. This will create a multi-aged structure in the translocated populations, and should also reduce the chance that the translocation should fail due to an unfavourable season or event.

Establishing additional populations

It is also proposed to establish additional planted populations in new locations in the future, however suitable sites have not yet been identified. This translocation proposal will be amended when suitable sites have been selected (refer to action plan).

Source populations for augmentation

It is planned to include multiple provenances in translocated populations in an attempt to increase genetic diversity, especially within smaller isolated populations. Preliminary genetic analysis of *E. paludicola* populations on the Fleurieu Peninsula found high genetic relatedness between populations up to 4 kms apart, but that relatedness dropped off at approximately 15 kms. Therefore the genetic neighbourhood for translocation could be considered as 15 kms. The one exception is the Mosquito Hill Rd population, which appears to be highly differentiated genetically from all other populations on the Fleurieu Peninsula.

Following the Composite Provenancing model, seed should be sourced as follows:

- 1) ***50% of plants for any one site to come from seed collected from that site (except for Mosquito Hill which should be 100%)
- 2) **30-40% of plants to come from other sites within 4-6 kms
- 3) *10-20% from 6-15 kms away

Note: It is recommended that seed for the first year's plantings (in 2012) be sourced largely from parent populations. Other provenances should be introduced in future years based on the outcomes of further genetic studies.

Table: Target number of transplants per population and recommended seed sources					
Pop. No.		Sub-population Name	Current no. plants	#Target no. transplants	Recommended source population/s
1		Blackfellows Creek	5	20	***1, **[2, 3, 4, 5, 6], *[7, 11, 13, 14, 17, 18, 19, 22, 23]
2	a	Stones Ford Rd	11	5	***2, **[1, 3, 4, 5, 6, 7], *[8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23]
	b	Stones Ford Rd	10	5	***2, **[1, 3, 4, 5, 6, 7], *[8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23]
3		Stones Ford Rd	30-35	10	***2, **[1, 3, 4, 5, 6, 7], *[8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23]
4		Cole Crossing Rd	4	30	***4, **[1, 2, 3, 5, 6, 7], *[8, 9, 11, 14, 18, 19, 22, 23]
5	a	Nangkita Rd	3	5	***5, **[1, 2, 3, 4, 6, 7], *[8, 9, 11, 12,

					13, 14, 15, 16, 17, 18, 19, 22, 23]
	b	Nangkita Rd	4	5	***5, **[1, 2, 3, 4, 6, 7], *[8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23]
6	a	Griggs Rd	5	-	n/a
	b	Kuitpo Forest	70	40	***6, **[1, 2, 3, 4, 5, 7, 8], *[9, 11, 12, 13, 14, 15, 17, 18, 19, 22, 23]
	c	Kuitpo Forest	90	10	***6, **[1, 2, 3, 4, 5, 7, 8], *[9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23]
	d	Kuitpo Forest	15	40	***6, **[1, 2, 3, 4, 5, 7], *[8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23]
7	a	Cox Scrub Conservation Park	22	10	***7, **[2, 3, 4, 5, 6, 8], *[1, 9, 11, 13, 14, 19]
	b	Bonds Rd	24	20	***7, **[2, 3, 4, 5, 6, 8], *[1, 9, 11, 13, 14, 18, 19]
8		Deep Creek Rd	2	10	***8, **[6, 7, 9], *[1, 2, 3, 4, 5, 11, 12, 13, 14, 15, 18, 19]
9		Kokoda Rd	50-60	50	***9, **[8, 11], *[1, 2, 3, 4, 5, 6, 7, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23]
10	a	Mosquito Hill Rd	17	5	***10
	b	Cloverlea Dairy	8	20	***10
11		Leane Rd	1	20	***11, **[12, 14, 15, 17, 19], *[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 16, 17, 18, 20, 21, 22, 23, 24]
12		Mount Billy Conservation Park	38	-	n/a
13		Minko Vineyard	35-40	50	***13, **[16, 17, 18, 19, 22, 23], *[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 20, 21]
14		Haskett Rd	4	10	***14, **[11, 12, 13, 15, 16, 17, 18, 19], *[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 21, 22, 23, 24]
15		Haskett Rd	7	20	***15, **[11, 12, 13, 14, 16, 17, 18, 19], *[2, 3, 5, 6, 7, 8, 9, 10, 20, 21, 22, 23, 24]
16		Mount Cone	30	20	***16, **[13, 14, 15, 17, 18, 19, 20, 21, 22, 23], *[2, 3, 5, 6, 9, 10, 11, 12, 24]
17		Mount Cone	25	50	***18, **[13, 14, 15, 16, 17, 19, 20, 21, 22, 23], *[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 24]
18		Mount Cone	1	20	***19, **[11, 13, 14, 15, 16, 17, 18, 22, 23], *[1, 2, 3, 5, 6, 9, 10, 12, 20, 21, 24]
19		Mount Cone	50-60	50	***17, **[13, 14, 15, 16, 18, 19, 20, 21, 22, 23], *[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 24]
20		Hindmarsh Valley Rd	4	10	***20, **[16, 17, 18, 19, 21, 22, 23]. *[9, 10, 11, 12, 13, 14, 15, 24]
21		Hindmarsh Valley Rd	3	20	***21, **[16, 17, 18, 19, 20, 22], *[9, 10, 11, 12, 13, 14, 15, 23, 24]

22		Stipiturus Conservation Park	1	30	***22, **[13, 16, 17, 18, 19, 20, 21, 23], *[1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 14, 15]
23		Bear Lane	3	50	***23, **[13, 16, 17, 18, 19, 20, 22], *[1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 14, 15]
24		Cartwright Rd	5	20	***24, *[11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 25, 26]
25		Range Rd	5	10	***25, **26, *[24, 27, 28, 29]
26	a	Koolah	1	20	***26, **[24, 28], *[25, 27, 29]
	b	Koolah	2	30	***26, **[24, 28], *[25, 27, 29]
27		Gold Diggings Swamp	2	30	***27, **[28, 29], *[25, 26]
28		Gold Diggings Swamp	<5	10	***28, **[26, 27, 29], *25
29		Parawa Rd	2	10	***29, **[27, 28], *[25, 26]
			594	765	TOTAL = 1359

#The target number of transplants is only an indicative figure, which may be altered based on landholder agreement, success rates and resource availability.

Site preparation

Most sites will require some preparation prior to planting. This is likely to involve spot-spraying introduced perennial grasses and other weeds with herbicide in the locations selected for tube-stock planting. It may be beneficial to slash introduced perennial grasses a few weeks prior to spraying in some sites to reduce the risk of off-target damage. Spraying will occur 6-8 weeks prior to planting, when the introduced grasses are actively growing. Extreme care will be taken to avoid off-target damage on native species when undertaking site preparation. Additional threats to the recipient sites will also be addressed in conjunction with the translocation (as outlined in the action plan).

Translocation logistics

Timing of planting

It is aimed to plant seedlings into at least 10 sub-populations in the first year, and the remainder in the following years (2013-2015). Seed for the first years plantings will be sourced from parent populations, with other provenances to be introduced in future years based on the outcomes of further genetic studies in 2012-13. Planting will occur in early winter (June-July), However, it is not expected that all seedlings will survive the first year, and therefore additional plantings will be required in subsequent years to achieve target numbers. Initial priority will be given to augmenting small populations.

Planting

Seedlings will be laid out in the recipient sites prior to planting, taking advantage of natural gaps in the vegetation (particularly canopy), and according to where pre-treatment of perennial weed grasses has occurred. Holes will be dug in a way that inflicts minimal damage on the surrounding vegetation and soil structure. Seedlings are not expected to require watering in after planting, however watering may be necessary if soil moisture is insufficient. Strict disease hygiene measures will be followed throughout the translocation.

Guarding

Plastic tree guards will be placed around all seedlings to protect them against herbivores, frost and competition from weeds. These will be removed when the plants have achieved sufficient size and woody growth to survive grazing and competition from perennial weed grasses.

Maintenance

Ongoing control of introduced perennial grasses and other weeds around the transplants will be undertaken as necessary. Slashing weed growth around plants may be necessary in some sites to reduce biomass in the short-term. Follow-up herbicide spraying may also be beneficial in some sites.

Monitoring and evaluation

Detailed records will be kept of all planting activities including planting dates, numbers of plants, site maps etc. It is also planned to monitor the survival and condition of planted individuals. In general this will involve regular assessments of the number of transplants that have survived, their health, and whether flowers or fruits have been produced.

Permits

An application for a Scientific Research Permit will be submitted, including all activities related to this translocation.

Resources and funding

Funding for this project will be sought from a range of sources including the AMLR NRM Board, MDB NRM Board, Native Vegetation Council, and Urban Forest Biodiversity Project.