Recovery Plan for Three Orchid Species in South Australia and Victoria:

Caladenia richardsiorum (Little Dip Spider-orchid)
Caladenia calcicola (Limestone Spider-orchid)
Pterostylis tenuissima (Swamp Greenhood)

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Note:

This recovery plan sets out the actions necessary to stop the decline of, and support the recovery of, the listed threatened species or ecological community. The Australian Government is committed to acting in accordance with the plan and to implementing the plan as it applies to Commonwealth areas.

Disclaimer:

The plan has been developed with the involvement and cooperation of a broad range of stakeholders, but individual stakeholders have not necessarily committed to undertaking specific actions or guarantee that the publication is without flaw of any kind. The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved. Proposed actions may be subject to modification over the life of the plan due to changes in knowledge.

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Little Dip Spider-orchid *Caladenia richardsiorum* by Andrew Pritchard, Limestone Spider-orchid *Caladenia calcicola* by Kate Vlcek and Swamp Greenhood *Pterostylis tenuissima* by Anna Murphy.

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Abbreviations

CCMA	Corangamite Catchment Management Authority
CP	Conservation Park
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVRFASC	Commonwealth and Victorian Regional Forest Agreement Steering Committee
DEH	Department of Environment and Heritage, South Australia , predecessor of DEWNR
DEWNR	Department for Environment, Water and Natural Resources, South Australia
DNRE	Department of Natural resources and Environment, Victoria (now DSE)
DPIFM	Department of Primary Industries, Fisheries & Mines, Northern Territory
DSEWPaC	Australian Government Department of Sustainability, Environment, Water, Population and Communities
DSE	Department of Sustainability and Environment, Victoria
DWLBC	Department of Water, Land and Biodiversity Conservation, South Australia
EN	Endangered
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999.*
FFG Act	*Flora and Fauna Guarantee Act 1988*, Victoria
GHCMA	Glenelg Hopkins Catchment Management Authority
GIS	Geographical Information System
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for Conservation of Nature
NP	National Park
NOSSA	Native Orchid Society of South Australia
NPW Act	*National Parks and Wildlife Act 1972*, South Australia
NSW	New South Wales
PV	Parks Victoria
RBG	Royal Botanic Gardens, Melbourne
SA	South Australia
SCC	Seed Conservation Centre of South Australia (DEWNR)
SENRMB	South-East Natural Resources Management Board of South Australia
TH	Threatened
TPAG	Threatened Plant Action Group
Vic	Victoria
VU	Vulnerable
WCMAGRC	Wimmera Catchment Management Authority Germplasm Research Centre

Definitions

The term "sub-population" is used as defined in the IUCN categories (IUCN 2001). Sub-populations are defined as "*geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less)*". The term "population" has not been used to describe geographically distinct populations, as under IUCN categories "population" is described as "*the total number of individuals in a taxon" (*IUCN 2001).

The term "Heritage Agreement" is applicable only in South Australia. It refers to a legal agreement attached to the title for a piece of privately owned land. The agreement protects existing native vegetation from clearance.

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Part A: Overview

1.1 Introduction

This recovery plan covers three nationally threatened terrestrial orchids endemic to mainland south-eastern Australia (Table 1). The nationally Endangered *Caladenia richardsiorum* (Little Dip Spider-orchid), and nationally Vulnerable *Caladenia calcicola* (Limestone Spider-orchid) and *Pterostylis tenuissima* (Swamp Greenhood) are small terrestrial orchids, which have highly fragmented and isolated sub-populations. *Caladenia richardsiorum* is endemic to the coastal vegetation of the South East NRM Region of South Australia, with an approximate population of 11,000 individuals occurring across 46 sub-populations. *Caladenia calcicola* consists of only 277 recorded individuals across eight sub-populations, which occur predominantly near Portland and Nelson, Victoria. In contrast, *P. tenuissima* has a relatively wide distribution, occurring in Silky Tea-tree (*Leptospermum lanigerum*) Scrub from near Robe in south-east South Australia, through to Wilson's Promontory National Park in eastern Victoria. There are approximately 17,700 individuals of *P. tenuissima* distributed across 57 sub-populations. Although there are a high number of sub-populations of both *C. richardsiorum* and *P. tenuissima*, only 11 and 12 sub-populations respectively, occur on land reserved for conservation. Current threats to the remaining sub-populations include vegetation clearance, isolation and hence limited opportunity for genetic exchange, grazing, weed invasion, disturbance and destruction of plants from recreational activities.

This national recovery plan is the first for these species and details their taxonomy, ecology, distribution, current and potential threatening processes, as well as the existing and intended management actions required to prevent the further decline of the species.

Table 1. List of orchids covered in this recovery plan and current conservation status.

Scientific name	Common name	Distribution	Conservation Status		
			National*	Victoria#	South Australia^
Caladenia richardsiorum	Little Dip Spider-orchid	SA endemic	EN	-	EN
Caladenia calcicola	Limestone Spider-orchid	SA, Vic	VU	TH	VU
Pterostylis tenuissima	Swamp Greenhood	SA, Vic	VU	TH	VU

Abbreviations: EN = Endangered; VU = Vulnerable; TH = Threatened
*EPBC Act 1999; #FFG Act 1988; ^NPW Act 1972

1.2 Regional Context

The region covered by this plan is predominantly described by two Interim Biogeographic Regionalisation for Australia (IBRA) bio-regions (Environment Australia 2000); 1) the Naracoorte Coastal Plain, stretching across from the Coorong in the south-east of South Australia to Portland in south-west Victoria, and 2) the South East Coastal Plain, which occurs in three distinct segments, two of which, the Warrnambool Plain and Otway Plain, occur in the context of this plan. The remainder of the regions covered by the plan includes the eastern section of the Victorian Midlands, extending from the South Australian border to the Great Dividing Range's lower inland slopes, and the eastern section of Victorian Volcanic Plain, which in its entirety stretches from Portland to west Melbourne.

The Naracoorte Coastal Plain consists of a series of low coastal and inland dunes that run parallel to the present coastline. The calcarenite inland dunes were formed from marine sands and shell fragments that were subsequently consolidated into limestone. Low-lying flats which lie between the ancient dunes were seasonally inundated, forming extensive wetlands that covered much of the region. These areas have been significantly altered through drainage and agricultural development.

The Warrnambool Plain is characterised by low calcareous dune formations overlayed with nutrient poor soils, which terminate in distinctive coastal cliffs along the coastline. Similar to the Naracoorte Coastal Plain, fertile peat swamplands exist between the calcareous dunes, which are seasonally inundated. To the east of Warrnambool the land is dominated by deeper volcanic soils over limestone. The Otway Plain consists of river valleys, coastal plains and foothills. Much of the native vegetation of these sub-regions has also been cleared for agriculture.

The Victorian Midland is defined by isolated ranges and sloping foothills of the Great Dividing Range, which supports a variety of sclerophyll forests and woodlands. The Victorian Volcanic Plain supports extensive and fertile grassland over a gently undulating basaltic plain, occasionally interrupted by large shallow lakes, stony rises, and extinct low volcanic peaks. Similar to the other bioregions encompassed in this plan, the Volcanic Plains have been intensively used since European settlement for grazing and cropping purposes.

1.3 Relationship to other Management Documents

This recovery plan relates to a range of other regional, State and Federal documents that provide specific recommendations or regional objectives regarding the management of threatened species including;

- *Our Place, Our Future, State Natural Resources Management Plan 2012 - 2017* (Government of South Australia 2012) – the recovery plan meets Objective 12 of the State NRM Plan: “Improve the conservation status of species and ecological communities”.
- *No Species Loss – A Biodiversity Strategy for South Australia* (DEH 2006) - contributes to the priority targets by eradicating or halting significant threats, reassessing the conservation status and securing key populations at priority threatened species sites.
- *Biodiversity Plan for the South East of South Australia* (Croft *et al.* 1999) - discusses the importance of conserving a range of threatened species and significant habitat in the region including *C. richardsiorum, P. tenuissima*, the highly threatened Silky Tea-tree (*Leptospermum lanigerum*) Scrub in which *P. tenuissima* occurs, and coastal systems. The plan also prioritises specific coastal areas.
- *South East Natural Resource Management Plan* (SENRMB 2010) – this recovery document supports the resource condition targets of the SENRM plan, which include: “Conservation status of threatened species and ecological communities occurring in the south-east will be maintained or improved”.
- *West Victoria Comprehensive Regional Biodiversity Assessment* (CVRFASC 2000) - provides an overview of the biodiversity of the region and identifies 63 plant taxa of high regional priority for management, including *C. calcicola*.
- *Glenelg Hopkins Regional Catchment Strategy* (GHCMA 2003) - recognises the high number of threatened plant species in the Lower Glenelg and Portland Coastal sub-catchments including *C. calcicola* and *P. tenuissima.* The strategy also sets out Interim Resource Condition Targets that aim to double the cover of depleted Ecological Vegetation Classes by 2030 and all three species are found in highly threatened ecological communities.
- *Corangamite Regional Catchment Strategy* (CCMA 2003) - identifies Silky Tea-tree Scrub (habitat for *P. tenuissima*) as a priority Ecological Vegetation Class and endeavours to protect 2,500 hectares of high priority Silky Tea-tree Scrub remnant vegetation on private land. The strategy recognises the importance of Regional Biodiversity Action Plans, National Recovery Plans and State Action Statements in the planning of threatened species recovery.

1.4 International Obligations

The implementation of this recovery plan is consistent with the following international agreements:

- *1992 United Nations Convention on Biological Diversity*
- *1992 Rio Declaration on Environment and Development (Agenda 21)*

1.5 Storage of Spatial and Other Data

Data relating to the location and management of threatened species and communities are stored in a range of information systems within the South Australian Department of Environment, Water and Natural Resources (DEWNR) and the Victorian Department of Sustainability and Environment (DSE).

The impacts of excessive visitation and illegal orchid collection, although infrequent, remains a high risk to threatened orchid taxa where population sizes are low or where the habitat is very sensitive to trampling. As a result, data relating to exact site locations are not included in this document.

Part B: General Species Information

2.1 Nomenclature

This plan uses the current nomenclature in South Australia and Victoria for *Caladenia richardsiorum* (Little Dip Spider-orchid) and follows the authority of Jones (1991), *Caladenia calcicola* (Limestone Spider-orchid), following the authority of Carr (1986) and *Pterostylis tenuissima* (Swamp Greenhood), following the authority of Nicholls (1950).

In a taxonomic review in 2001, Jones *et al.* split the genus *Caladenia* and placed *C. calcicola* and *C. richardsiorum* in the newly described *Arachnorchis* genus. Similarly Jones and Clements (2002a) split *Pterostylis* and placed *P. tenuissima* in the newly described *Diplodium* genus. However both revisions are yet to be fully accepted by the Commonwealth Heads of Australian Herbaria, so the names *Arachnorchis calcicola*, *A. richardsiorum* and *Diplodium tenuissima* remain as synonyms.

2.2 Distinguishing Morphological Features

The morphological features that distinguish each of the species are summarised in Table 2. More detailed information is provided in Part C of this plan for each species.

Table 2. Morphological features, flowering and similar species.

Species	Distinguishing Morphological Features	No. Flowers	Flowering Time	Similar Species
Caladenia richardsiorum (Little Dip Spider-orchid)	• Single lanceolate leaf 16-22 cm in length and densely hairy • Yellowish-green flower • Sepals have prominent blackish clubs 8-10 mm long • Labellum is greenish-cream with maroon calli and toothed margins	One	Sept-Nov	*C. hastata*
Caladenia calcicola (Limestone Spider-orchid)	• Single lanceolate leaf up to 15 cm long with dense hairs • Mostly red flower on a paler glossy background • Sepals are pale yellow in colour and end with prominent clubs varying in colour from yellow to red • Labellum obscurely lobed	One (rarely two)	Sept-Nov	*C. reticulata*
Pterostylis tenuissima (Swamp Greenhood)	• Non-reproductive stage form a ground-hugging rosette of three to eight dark green, glossy ovate leaves; the rosette is absent when in flowering form • Single, nodding flower, translucent white with green stripes and suffusions • Dorsal sepal extended into a long filiform, deflexed point as long as the galea itself • Lateral sepals erect, closely embracing the galea, sinus low, deeply notched, and protruding • Labellum to 10mm long green or brown	One	Oct-Mar but observed at other times throughout year	

2.3 Ecology

2.3.1 Mycorrhizae

Many orchids require the infection of an appropriate mycorrhiza (soil root fungus) to germinate under natural conditions (Rasmussen 1995). This association continues into adulthood, with the mycorrhizal fungus supplying the orchid with carbon and nitrogen (Brundrett 2002, Cameron *et al.* 2006, Girlanda *et al.* 2006). The obligate nature of their mycorrhizal associations makes them vulnerable to extinction (Rasmussen 1995). Therefore, identification and subsequent mapping of suitable fungi is desirable in threatened orchid recovery.

Similarly many terrestrial Australian orchid species have highly specialised relationships with mycorrhizal fungi (Warcup 1971). *Caladenia* species are generally found growing in association with the mycorrhizal fungus *Serendipita vermifera* (formerly *Sebacina vermifera*) (Warcup 1971, 1981, 1988) or closely related fungi (Huynh 2003; Raleigh 2005, Bougoure *et al.* 2005; Bonnardeaux *et al.* 2007; Wright 2007).

Pterostylis species generally are also found growing in association with mycorrhizal fungi (Warcup 1971; Clements 1988), often *Ceratobasidium* (Warcup 1981; Irwin *et al.* 2007), and *Thanatephorus* species (Bougoure *et al.* 2005).

2.3.2 Pollination

Pollination of *Caladenia richardsiorum* and *C. calcicola* is primarily achieved by male thynnid wasps (family Tiphiidae, sub-family Thynninae), as with other *Caladenia*, Section *Calonema* species. Orchids in this group are thought to mimic the sexual pheromone produced by a female thynnid wasp, emitting a kairomone or allomone from the glandular tip of their sepals to attract the male wasp (Stoutamire 1983). As the male wasp attempts to copulate with the labellum (pseudocopulation), it collects the sticky pollinia on its body and this is then transferred to the stigma of another flower (Stoutamire 1983). *Caladenia* pollinated by sexual deception have a highly specific, usually one to one, relationship with their wasp pollinator (Bower 1992). Sexually deceptive *Caladenia* are usually odourless, with dull yellow, green, maroon, or cream and maroon flowers, with maroon calli and a hinged labellum (Stoutamire & Bates 1990).

Pterostylis tenuissima belongs to a group of *Pterostylis* that are pollinated by small gnats and mosquitoes. It is thought that they are attracted to the flower by a scent undetectable by humans (Jones 2006). The *Pterostylis* flowers achieve pollination by utilizing a hinged labellum that is triggered when an insect crawls over its surface, propelling the insect forward onto the column. The column, labellum and galea 'trap' the insect, which is then forced to push past the anther to be able to exit the flower, where a previously acquired pollinia could be deposited (Backhouse & Jeanes 1995; Jones & Clements 2002b). The labellum then resets itself after approximately five to thirty minutes, awaiting the next pollinator visit.

2.3.3 Fire Regimes

Whilst studies have investigated the response of terrestrial orchids to fire in native grasslands (Lunt 1994; Coates *et al.* 2006), the role of fire ecology for many spider-orchids and greenhoods is not well understood. However, it is likely to be an important factor, particularly for spider-orchids, many of which have been observed to flower strongly post-fire, e.g. *C. dilatata* and *C. hastata* in south-west Victoria (A. Pritchard pers. obs.1997 & 2002 respectively). In Mediterranean climates, such as southern Australia, fire is important in maintaining many ecosystems in which orchids are known to occur (Roberts 2003). Fire reduces foliage cover, thereby increasing light availability; releases phyto-active materials such as ethylene; and provides a burst of nutrients (Roberts 2003). Brundrett (2007) comments that in south-west Western Australia altered fire regimes in semi-urban and rural areas, in combination with other threats, are known to be contributing to the decline of terrestrial orchids.

Timing and frequency of fires is particularly important as it stimulates different responses from different species of terrestrial orchids. Summer fires have been observed to produce the strongest post-fire flowering events for many species (Jones & Jones 2000). It is reasoned the best time for a burn to occur in *Caladenia* sub-populations is late summer to early autumn, after seed dispersal but prior to new shoot growth (Duncan & Coates 2007).

Caladenia richardsiorum, C. calcicola and *P. tenuissima* do not require fire to flower, and the latter is found in wet habitat rarely subjected to fire. Inappropriate fire regimes are likely to threaten all three species. Further research is needed into habitat burning requirements and how various regimes influence the recruitment of these three orchid species.

Currently little attention is given to the impact of fire on orchid pollinators when planning fire regimes for threatened orchids. The impact of fire on invertebrate assemblages is variable e.g. Friend (1994) highlights that post-fire invertebrate populations do not necessarily return to pre-fire levels and that invertebrate populations in mesic conditions are particularly sensitive to fire disturbance. However, more recent research (Wittkuhn *et al*. 2008) found no significant differences between fire regimes on assemblages within a vegetation community. It is thought that fire is generally not detrimental to thynnid wasp pollinators whilst they are dormant from December to July; however, little is known about thynnids and their relationship with fire (C. Bower pers. comm. 2007; G. Brown pers. comm. 2007). No information is known regarding the potential impact of fire regimes on the pollinators of *Pterostylis* species.

Orchids and their mycorrhizae have been found to have a strong relationship with soil texture, coarse organic matter and leaf litter (Brundrett *et al.* 2003). Brundrett (2007) highlights that this relationship requires further investigation as frequent fire, as experienced in Western Australia, has the potential to reduce the amount of coarse organic material and leaf litter that mycorrhizae and orchids rely on as a key resource.

2.4 Distribution and Population Size

Caladenia richardsiorum is endemic to the coastal vegetation of South East Region, South Australia, with an approximate population of 11,075 individuals occurring across 46 sub-populations. *Caladenia calcicola* consists of only 277 recorded individuals across 8 sub-populations, which occur predominantly near Portland and Nelson, Victoria. In contrast, *P. tenuissima* has a relatively wide distribution, occurring in Silky Tea-tree (*Leptospermum lanigerum*) Scrub from near Robe in south-east South Australia, through to Wilson's Promontory National Park in eastern Victoria. There are approximately 17,700 individual *P. tenuissima* distributed across 57 sub-populations.

A summary of the distribution and sub-populations for the three species is in Table 3.

Table 3. Sub-population and individual numbers for the three orchid species.

Species	Manager	No. of sub-populations			No. of individuals		
		Reserved	*Un-reserved*	***Total***	*Reserved*	*Un-reserved*	***Total***
Caladenia richardsiorum	DEWNR, Robe District Council, Wattle Range District Council, private properties	11	35*	**46**	424	10 651	**11 075**
Caladenia calcicola	Parks Victoria, private property	7	1	**8**	276	1	**277**
Pterostylis tenuissima	DEWNR, Parks Victoria, Corangamite Shire Council, Moyle Shire Council, private properties	12	45	**57**	1,201	16,502	**17 703**

*A Heritage Agreement is currently being processed for a property, which will provide protection for six of these sub-populations.

2.5 Sub-population and Habitat Critical to Survival

Due to small and isolated populations for the three orchid species, all known sub-populations are considered important for the survival of these species. Habitat critical to survival of these species has not yet been determined for sub-populations across the total range of the species, but is proposed as a recovery action in this plan.

2.6 Decline and Threats

The species in this recovery plan are impacted by a wide range of threats. The region where the species occur provides a wide range of opportunities for primary production including grazing, cropping, viticulture and forestry. As such, 87% of the original native vegetation in the south-east of South Australia has been cleared and is continuing to decline (Government of South Australia 2012), and the majority of wetlands have been drained for these purposes. Vegetation clearance may be the cause of the decline and fragmentation of sub-populations of the three threatened orchid species. Given its coastal setting, tourism and associated developments also play an important role in the regional economy. Coastal development and inappropriate subdivision continues to have a significant impact on coastal ecosystems in South Australia and Victoria (DEH 2004; Victorian Coastal Council 2002). As a result, much of the existing habitat of the three species occurs in small isolated fragments. General information about threats affecting the three species is provided below. More specific threats for individual species are included in Part C.

2.6.1 Vegetation Clearance

Clearance of native vegetation still remains a significant threat to biodiversity in the region. The Silky Tea-tree Scrub (Swamp-Scrub) habitat of *Pterostylis tenuissima* is mostly distributed across prime agricultural land and as a result continues to be threatened by clearance. For similar reasons most *Caladenia richardsiorum* habitats are subject to potential clearance, with only 24% of known sites reserved.

2.6.2 Fragmentation and Isolation of Native Vegetation

Australian terrestrial orchids typically depend on specific pollinators and mycorrhizae. *Caladenia* and *Pterostylis* species do not support their pollinators with food rewards and as a result these pollinators require other plant species for their food supply (Bates & Weber 1990).Little research has been undertaken regarding the specific ecological needs of orchid mycorrhizae; however it is believed that *Caladenia* and *Pterostylis* species are dependent on these fungi for nutrient exchange, particularly during germination (Bates & Weber 1990). It is also known that both *Caladenia richardsiorum* and *C. calcicola* each have a highly specific relationship with a male thynnid wasp pollinator (family Tiphiidae, sub-family Thynninae) (Bower 2007), which is required for successful reproduction.

Threatening processes may lead the required fungi and pollinator species to become locally extinct (Bower 2007), which in turn leads to the local extinction of the associated orchid species. It is believed that the orchid taxa discussed in this recovery plan require intact vegetation in order to maintain these complex relationships. The edge effects associated with fragmentation and isolation of vegetation are likely to lead to a decline in habitat condition, causing flow-on effects to mycorrhizae and pollinators.

2.6.3 Grazing

Some *Caladenia richardsiorum* and *Pterostylis tenuissima* sub-populations occur on private property and are subject to the impacts of grazing by stock. Orchids may be preferentially grazed due to their palatability. Associated damage to habitat from grazing such as soil compaction, altered nutrient levels and erosion can also significantly compromise the likelihood of survival of a sub-population. Disturbance caused by grazing can also result in increased weed invasion, particularly by introduced pasture species.

Pterostylis tenuissima colonises very moist soils under dense Silky Tea-tree (*Leptospermum lanigerum),* sometimes only millimetres above the water table. These waterlogged soils tend to be very soft and easily damaged. As such, grazing can damage the orchids' sensitive microhabitat by pugging these soils, crushing and/or submerging plants.

Grazing by native herbivores (kangaroo and emu) has also been observed in many of the sub-populations. These herbivores can remove or trample orchid biomass that may prevent flowering and photosynthesis, ultimately exhausting the energy reserves of orchid tubers (Croft *et al.* 1999).

2.6.4 Weed Invasion

A large number of orchid sub-populations identified in this recovery plan are subject to weed invasion. Weed invasion is the most serious threat to *Caladenia richardsiorum.* Weeds of particular concern to all orchid species include Bridal Creeper (common form and Western Cape form) (*Asparagus asparagoides*), Myrtle-leaf Milkwort (*Polygala myrtifolia*), Bluebell Creeper (*Billardiera heterophylla),* Italian Buckthorn (*Rhamnus alaternus*), Blue Periwinkle (*Vinca major*), Dolichos pea (*Dipogon lignosus*, formerly *Dolichos lignosus*)*,* Freesia (*Freesia* sp.) and Arum Lily (*Zantedeschia aethiopica*).

Bridal Creeper and the recently recognised "Western Cape" form pose the greatest threat of any weed in south-east South Australia (Croft *et al.* 1999). It has a climbing habit and stores its energy in numerous underground tubers. Bridal Creeper smothers trees, shrubs and ground covers and is capable of preventing light from reaching herbs and geophytes such as orchids. Bridal Creeper reproduces both sexually and vegetatively, making its management extremely difficult. The introduction of pathogenic rust as a biological control has had some success. The rust can limit flowering, seed set and plant biomass by reducing the plant's photosynthetic surface (DWLBC 2006). The "Western Cape" form has been found to be resistant to all biological controls, except possibly at seedling stage, which suggests that the Western Cape form has the potential to displace Bridal Creeper affected by biological controls (DWLBC 2006). Bridal Creeper has invaded large tracts of coastal vegetation at Robe and in Little Dip and Beachport Conservation Parks and Coorong National Park, threatening sub-populations in these areas. It may also have eliminated another sub-population of *C. richardsiorum* in this region (D. Jones pers. comm. 2001). The level of infestation is so great at some sites that it is beyond the capacity of current government resources to control.

Coast Wattle (*Acacia longifolia* subsp. *sophorae*), an Australian species of debated natural distribution, has spread extensively across the coastal regions of south-west Victoria and south-east South Australia and threatens all three orchid species discussed in this plan. Its growth is dense and its presence appears to be detrimental to the survival of ground flora. Research has found a significant decline in understorey diversity of native species following invasion by Coast Wattle (McMahon *et al.* 1996). The wattle has also been known to compromise the survival of other threatened orchids in the region (Carr 1993).

The South African Orchid (*Disa bracteata*) is a potential minor threat to *C. calcicola* sub-populations, given their close proximity to pine plantations where *D. bracteata* has formed heavy infestations. Due to its relatively low profile, little is known of the ecological impact on threatened orchid populations from this species. Currently it is not considered feasible to allocate finite resources to the control of this widespread and difficult-to-control weed, when the benefits would probably be minimal.

2.6.5 Site Disturbance

Visitor impacts from naturalists and field officers also threaten many of the sub-populations and are identified as a potential threat for all three species. The best intentions of many enthusiasts and staff can sometimes be to the detriment of these species. Excessive visitation can damage plants, cause soil compaction, and introduce and spread weeds and potential pathogens.

Potential damage to sub-populations from off-road vehicles, especially four-wheel drives and motorbikes, and pedestrian traffic on public and private land is considered a threat to the two *Caladenia* species.

2.6.6 Illegal Collection

Although there has been no evidence of illegal collection of these orchid species by plant enthusiasts, it is considered that there is a potential for illegal collection as these are attractive species, especially *C. richardsiorum*, which also has many easily accessible sub-populations.

Part C: Species Information

3.0 *Caladenia richardsiorum* D.L.Jones (Little Dip Spider-orchid)

3.1 Description

Caladenia richardsiorum is a perennial spider-orchid with a lanceolate leaf 16-22 cm in length and densely hairy on both laminae. Its generally singular yellowish-green flower, up to 40 mm wide, arises from a stem 20-40 cm in length. Sepals have prominent but short blackish clubs 8-10 mm long. The labellum is greenish-cream with maroon calli and toothed margins. Flowering occurs from late September to early November, the orchid remaining dormant when conditions are unsuitable (Jones 1991).

Caladenia richardsiorum has affinities with *C. hastata,* a nationally Critically Endangered species endemic to south-western Victoria. *Caladenia hastata* can be distinguished by a much smaller leaf, whiter flower, and slimmer sepals and petals. Both sepals and petals possess clubs 10 – 22 mm long (Jones 1991).

3.2 Conservation Status

Caladenia richardsiorum is listed as nationally Endangered under the Commonwealth EPBC Act, and as Endangered in South Australia under the *National Parks and Wildlife Act 1972* (NPW Act).

3.3 Distribution and Population Size

Caladenia richardsiorum is endemic to the South East Herbarium Region, South Australia, and is found in coastal vegetation primarily between Southend and the Coorong and no more than six kilometres from the coast (Figure 1). A new sub-population was identified and formally determined in 2004 near Meningie by D Jones (CSIRO Canberra), however, the sub-population was resurveyed in 2007 and re-determined as *C. saxatilis* (R. Bates pers. comm. 2008). Further work is needed to clarify this sub-population. The species has a distribution from Southend to Meningie of approximately 900 km^2, and occupies no more than 10 km^2.

The total estimated number of mature plants of *C. richardsiorum* is 11,075, consisting of 46 sub-populations (Table 4). The high number of sub-populations is a reflection of the highly fragmented distribution of *C. richardsiorum* habitat. A number of anecdotal records exist in addition to the sub-populations outlined in this document. The validity of these records will be investigated during the implementation of this recovery plan.

3.4 Habitat

Caladenia richardsiorum is found in several coastal and sub-coastal vegetation types along the Limestone Coast of South Australia. At Nora Creina and in Canunda National Park it occurs in Coast Daisy-bush (*Olearia axillaris*) – Coast Beard-heath (*Leucopogon parviflorus*) shrubland complex (Croft *et al.* 1999). Associated species include Thyme Riceflower (*Pimelea serpyllifolia*), Bower Spinach (*Tetragonia implexicoma*), Coast Swainson-pea (*Swainsona lessertiifolia*) and Coast Velvet-bush (*Lasiopetalum discolor*). This complex of vegetation ranges from low coastal heathland on exposed cliff tops to shrubland on the protected side of coastal fore-dunes and is significant as it supports the larger and denser sub-populations of *C. richardsiorum*.

Caladenia richardsiorum also occurs in deep leaf litter under open White Coast Mallee (*Eucalyptus diversifolia* ssp. *diversifolia*) in the Robe and Beachport regions. Associated understorey and groundcover species include Coast Beard-heath, Old Man's Beard (*Clematis microphylla*), Stinking Pennywort (*Hydrocotyle laxiflora*) and Coast Velvet-bush. At Potters Scrub, Coorong National Park, *C. richardsiorum* occurs under a dense low White Coast Mallee and Golden Wattle (*Acacia pycnantha/leiophylla*) with a sparse understorey dominated by the weed species Bridal Creeper *(Asparagus asparagoides*).

On council land at Beachport it also occurs under Dryland Tea-tree (*Melaleuca lanceolata*) – Drooping Sheoak (*Allocasuarina verticillata*) low woodland. Here, associated species include Golden Wattle, Myrtle Wattle (*Acacia myrtifolia*), Coast Beard-heath (*Leucopogon parviflorus*), Sea Box (*Alyxia buxifolia*), Coast Cherry (*Exocarpos syrticola*), Coast Pomaderris (*Pomaderris paniculosa*), Pale Turpentine Bush (*Beyeria lechenaultii*), Muntries (*Kunzea pomifera*) and Blunt Leaf Ground-berry (*Acrotriche cordata*).

Occupied habitats within the known extent of occurrence of the species are considered to be habitat critical to the survival of *C. richardsiorum.* Preventing any further fragmentation of existing vegetation that supports this species will be crucial to its long-term survival.

Table 4. Reserved and unreserved sub-populations of *Caladenia richardsiorum*.

Location	Manager	No. of individuals	No. of sub-populations	Year
Reserved Sub-populations				
Canunda National Park, Southend, SA	DEWNR	117	3	2006
Little Dip Conservation Park, Robe, SA		<107	7	2007
Coorong National Park, SA (to be validated)		200	1	2004
Total Reserved		**424**	**11**	
Unreserved Sub-populations				
Nora Creina 1, SA	Private Property	1188	1	2003
Nora Creina 2, SA		5	1	2002
Nora Creina 3, SA		50	1	2002
Nora Creina 4, SA		219	3	2002
Nora Creina 5, SA		5400	6	2002
Sunland 1, SA		49	4	2007
Robe Heritage Agreement, SA		97	1	2007
Coorong Private land		3005	6	2010
Beacon Hill Council Reserve, Robe, SA	Robe District Council	<10	1	2004
Pool of Siloam, Beachport, SA	Wattle Range District Council	30	1	2002
Lanky's Well, Beachport, SA		189	2	2007
Rivoli Bay, Beachport, SA		240	2	2007
Woolly Lake, Beachport, SA		5	3	2006
Lake George, Nora Creina, SA		49	1	2002
Roadside, Nora Creina, SA		67	2	2002
Total Unreserved		**10603**	**35**	

3.5 Ecology

3.5.1 Mycorrhizae

Currently the mycorrhizal fungi have not been isolated for *C. richardsiorum*; however, techniques for isolating mycorrhizal fungi for the propagation of other *Caladenia* species are well established.

3.5.2 Pollination

In the spring of 2000, most sub-populations were naturally pollinated and producing seedlings. The pollination rate at Nora Creina was estimated to be around five percent.

In 2006, pollinator baiting was conducted to identify the wasp pollinator of *C. richardsiorum.* Initially the pollinator was identified as *Phymatothynnus* near *pygidialis,* which was also found to pollinate the morphologically distinct *C. fragrantissima* in south-west Victoria (C. Bower pers. comm. 2007; G. Brown pers. comm. 2007). However, field pollinator choice tests have shown that two wasps with very slight morphological differences responded differently to the two orchids, suggesting the wasps have different sex pheromones and the orchids have different allomones, and indicating that the two wasps are likely to belong to two closely related cryptic species (C. Bower pers. comm. 2007). The wasp species attracted to *C. richardsiorum* was found to be relatively common in south-west Victoria (C. Bower pers. comm. 2007). It is currently assumed that the pollinator is also relatively common in South Australia as there is a comparatively good pollination rate at most sub-populations. The pollinator abundance will be confirmed in future pollinator baiting trials. Based on the results of field trials and the pollination rate at natural sub-populations, it is considered unlikely that pollinator abundance is limiting the distribution and abundance of *C. richardsiorum* (Bower 2007).

3.6 Threats

Threats common to all species are outlined earlier in this document. Threats relating specifically to this species are:

- Vegetation clearance and fragmentation. Clearance for intensive coastal development, leading to fragmentation and isolation of sub-populations.
- Environmental weed invasion by, but not limited to: the common and Western Cape forms of Bridal Creeper (*Asparagus asparagoides*), Myrtle-leaf Milkwort (*Polygala myrtifolia)*, Blue Periwinkle (*Vinca major*), Italian Buckthorn (*Rhamnus alaternus*), Coast Wattle A*cacia longifolia* subsp. *sophorae,* Coast Tea-tree (*Leptospermum laevigatum*), Gazania *(Gazania linearis)*, Freesias (*Freesia* spp.) and Bluebell Creeper (*Billardiera heterophylla*).
- Grazing. Grazing by rabbits threatens some sub-populations in the Canunda region. Warren construction and diggings can also threaten orchid sub-populations. Herbivory by exotic terrestrial snails may also threaten some sub-populations as they have been found in abundance at some coastal sites. Grazing by Western Grey Kangaroo (*Macropus fuliginosus)* has the potential to be a problem in the Nora Creina area – a reduction of kangaroo numbers is being undertaken under the licence of DEWNR. Sheep grazing also threatens one of the largest sub-populations at Nora Creina. As this site is privately owned, ongoing negotiations with the owner are critical.
- Site disturbance. Visitor impacts from recreational vehicles (e.g. four-wheel drives and motorbikes) and pedestrian traffic, including naturalists and field officers, are considered a threat for some sub-populations. Visitation is very high in the Robe district and at least one sub-population is threatened from off-road vehicles driving across sensitive coastal vegetation to gain access to the beach.
- Illegal collection. Collecting of the species by plant enthusiasts is considered a moderate threat as *C. richardsiorum* is an attractive species with many easily accessible sub-populations.

3.7 Previous Recovery Actions

Staff have been employed to plan and implement recovery of *C. richardsiorum* between 2000 and 2002 and then again between 2004 and 2010. Recovery actions have also been undertaken by DEWNR Staff.

The following management actions were undertaken:

- Baseline data collected between 2000 and 2009, including sub-population number, site and habitat descriptions.
- Monitoring plots established and surveys undertaken for additional sub-populations, including a survey with NOSSA of a property adjacent to the Coorong, in which an additional 3005 individuals were found in six sub-populations.
- Site management statements for Lanky's Well Council Reserve, Beachport; and a Heritage Agreement property near Robe were completed in 2008.
- Weed control activities carried out since 2000 on public and private land. All weed issues are on-going. Blue Periwinkle, Myrtle-leaf Milkwort, Italian Buckthorn, and Coast Teatree control has been undertaken at Lanky's Well, Little Dip CP, Canunda NP and Robe Heritage Agreement. Bluebell Creeper and Gazania control has been undertaken at Lanky's Well. Bridal Creeper control undertaken at Lanky's Well, Robe Heritage Agreement, Little Dip CP, and Coorong NP.
- Liaison and awareness-raising activities undertaken with land managers.
- Threats to sub-populations identified.
- Track re-aligned and bollards erected at sub-populations in Little Dip CP to prevent damage to sub-populations by off-road vehicles in 2007.
- Pollinator for *C. richardsiorum* identified as the thynnid wasps *Phymatothynnus* n.sp. nr *pygidialis* belonging to the *Phymatothynnus pygidialis* complex (Brown & Vleck 2010).
- Negotiation for germplasm and mycorrhizal fungi storage conducted.
- Existing data collated.
- Development of a relational database commenced, for storage of spatial, monitoring and management data.

3.8 Community engagement

The importance of community support cannot be underestimated in the conservation of *C. richardsiorum*. Two local groups, the Friends of Little Dip and Butchers Gap Conservation Parks and the Beachport District Development Corporation have made a significant effort to protect this species. Extinction of some sub-populations would have almost certainly taken place without their support. The Natural History Society of South Australia has also undertaken extensive weed control work in potential *C. richardsiorum* habitat. These works have included identification of new sub-populations, weed control and raising awareness of the significance of this species within the community and government.

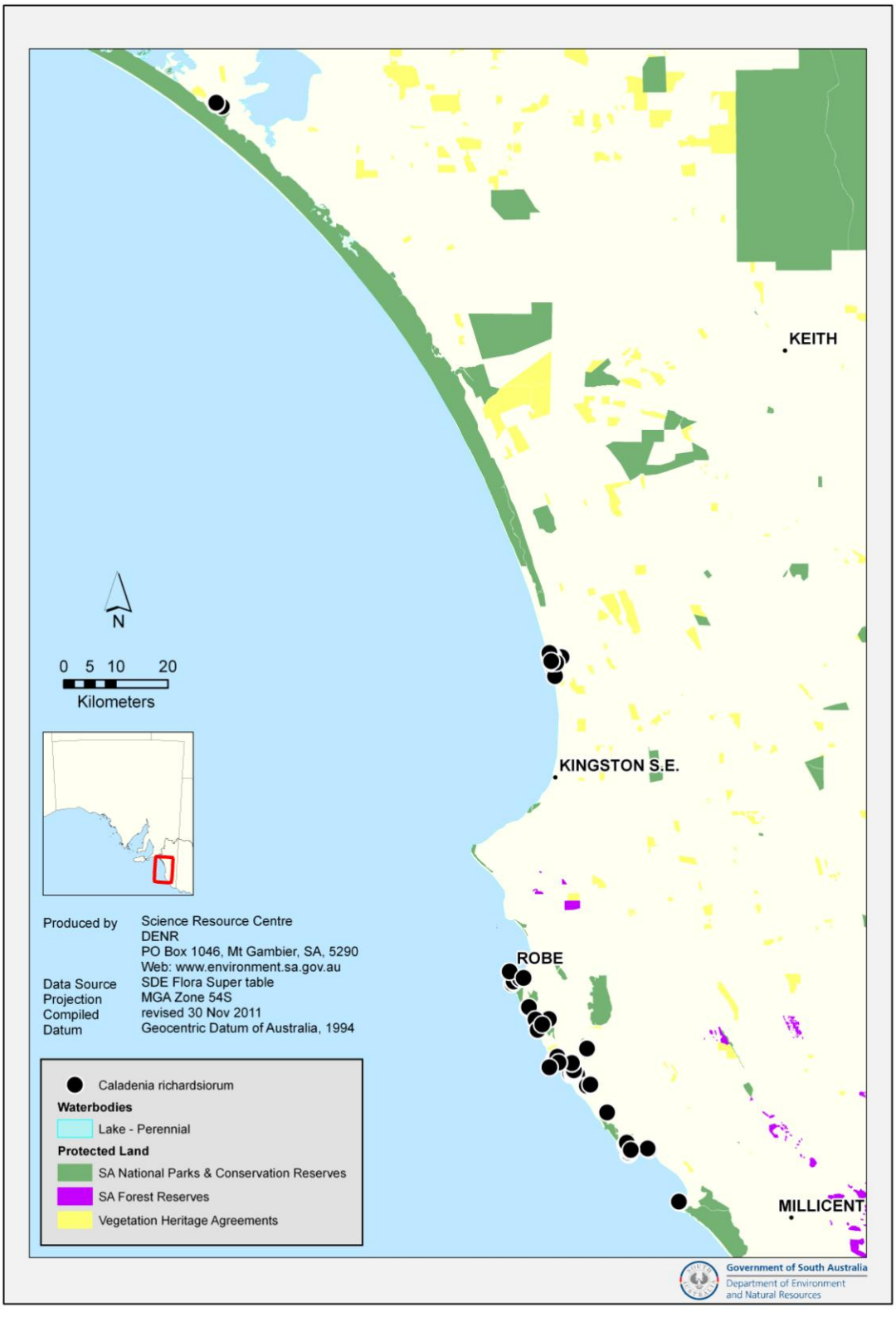

Figure 1. Distribution of *Caladenia richardsiorum*, Little Dip Spider-orchid.

4.0 *Caladenia calcicola* G.W.Carr (Limestone Spider-orchid)

4.1 Description

Caladenia calcicola is a perennial spider-orchid with a single, lanceolate leaf up to 15 cm long with dense hairs on both laminae and one or sometimes two glossy flowers, up to 40 mm in width (Backhouse & Jeanes 1995). The flowering stem is 10-28 cm in length. Petals and sepals are pale yellow in colour with up to two central maroon stripes. Sepals are up to 9 mm long and have prominent clubs varying in colour from yellow to red. Flowering occurs from mid-September to early November. The plant remains dormant when conditions are unsuitable (Bates & Weber 1990; Backhouse & Jeanes 1995; Bishop 1996; Carr 1986). For a formal description of the species see Carr (1986).

Initial investigations identified a number of plants at Padthaway that bore a strong resemblance to *C. calcicola*. Further investigation found that the individuals in question were *C. reticulata*. *Caladenia calcicola* was previously known to occur in the Mt Burr Range, South Australia; however this sub-population is now extinct and no extant sub-populations are known to exist in South Australia. *Caladenia calcicola* was also previously included in the *C. reticulata* complex.

4.2 Conservation Status

Caladenia calcicola is listed as nationally Vulnerable under the Commonwealth EPBC Act, Endangered under the South Australian NPW Act, and Threatened in Victoria under the *Flora and Fauna Guarantee Act 1988* (FFG Act).

4.3 Distribution and Population Size

Caladenia calcicola grows in shallow, terra-rossa soil on limestone ridges in south-west Victoria and south-east South Australia. Although now very restricted, it may have been more widespread prior to European settlement. The species has a distribution of approximately 90 km^2 and occupies no more than 10 km^2 (Figure 2). No suitable vegetation remains in its previous habitat around Mt. Burr Range in South Australia.

The total population of mature plants of *C. calcicola* in 2007 was 277, consisting of 211 individuals in six naturally occurring sub-populations located in Victoria, and an additional 66 plants in two translocated sub-populations (Table 5).

The sub-populations at a Wildlife Reserve near Portland are found within an area of less than 10 km^2. Surveys undertaken between 1989 and 1992 and in 2000 found the sub-populations to be in decline (DNRE 1992). Previously the largest known sub-population nearby on private land was partially destroyed by quarrying between 1980 and 1984 (Carr 1986). A sub-population was discovered in 2006 on the Wildlife Reserve, 100 m from the previously known sub-population. It is believed to be part of the original sub-population.

The sub-population on private land near Dunkeld was first reported in November 1989, when it numbered two individuals (D. Munro pers. comm. 2001).

In October 1994, five flowering plants were located in the Lower Glenelg National Park near Nelson. This number has remained constant over time.

Table 5. Reserved and unreserved sub-populations of *Caladenia calcicola*.

Location	Manager	No. of individuals	No. of sub-populations	Year
Reserved Sub-populations				
Natural				
Lower Glenelg NP, Nelson, Vic	Parks Victoria	5	1	2008
Wildlife Reserve, Portland, Vic		205	4	2007
Re-introduced				
Wildlife Reserve, Portland, Vic	Parks Victoria	66	2	2007
Total Reserved		**276**	**7**	
Unreserved Sub-populations				
Dunkeld, Vic	Private Property	1	1	2007
Total Unreserved		**1**	**1**	

4.4 Habitat

At the Bats Ridge Wildlife Reserve near Portland, *C. calcicola* occurs in Limestone Ridge Woodland. Dominant species include Manna Gum (*Eucalyptus viminalis* ssp. *cygnetensis*), Golden Wattle (*Acacia pycnantha*), Coast Wattle (*Acacia longifolia* subsp. *sophorae*), Sweet Bursaria (*Bursaria spinosa*) and Coast Beard-heath (*Leucopogon parviflorus*) (Carr 1986). In the Lower Glenelg National Park at Nelson it occurs in Limestone Woodland dominated by Drooping Sheoak (*Allocasuarina verticillata*), Swamp Gum (*Eucalyptus ovata*), Golden Wattle, Myrtle Wattle (*Acacia myrtifolia*), Common Heath (*Epacris impressa*) and Common Correa (*Correa reflexa*). On private land at Dunkeld it occurs in a Grassy Woodland/Hills Herb-rich Woodland/Damp Sands Herb-rich Woodland mosaic dominated by Manna Gum, Silver Banksia (*Banksia marginata*), and Bracken Fern (*Pteridium esculentum*).

Habitat critical to the survival of this species includes the area occupied by the sub-populations, and areas for future recruitment of sub-populations. The entire tract of vegetation in which *C. calcicola* occurs should be considered habitat critical to the survival of the species, including vegetation with the appropriate floristic composition described above. Preventing any further fragmentation of existing vegetation that currently or potentially supports this species, is crucial to its long-term survival.

To maintain a self-sustaining sub-population of *C. calcicola* it is also vital to conserve the pollinator's habitat. While the exact habitat requirements of the pollinator, *Phymatothynnus* near *nitidus,* are not well understood, it is known that Thynnids feed on a range of flowering plants, particularly from the Myrtaceae and Proteaceae families. It is important for the pollinator population that flowering food plants are available before, during and after the flowering period of *C. calcicola,* as the pollinators have been observed to be present for a few months before and after the orchid flowering period (C. Bower pers. comm. 2007). Definition of the pollinator habitat requires further investigation.

4.5 Ecology

4.5.1 Mycorrhizae

Mycorrhizal fungi have been isolated from a Victorian sub-population of *C. calcicola* and plants propagated with the fungi were reintroduced into natural habitat in 2007.

4.5.2 Pollination

Natural pollination of *C. calcicola* is very low throughout its range. Observations indicated that 5% - 10% of plants were pollinated annually at the Wildlife Reserve sub-population (DNRE 1992). However, in 2007 the natural pollination rate for all sub-populations was less than 5% (A. Pritchard pers. obs. 2007).

In 2006, pollinator baiting was conducted (Bower 2007). The pollinator of *C. calcicola* was identified as a thynnid wasp, *Phymatothynnus* near *nitidus,* by entomologist Dr. G Brown (Bower 2007). *Phymatothynnus* nr. *nitidus* was found to pollinate two other closely related orchid species, *C. reticulata and C. strigosa* (formerly *C. australis*), during the same trial period (Bower 2007). Further research is needed on the *C. reticulata* complex and its pollinator, *P* nr. *nitidus,* to identify whether the pollinator actually is comprised of separate cryptic species which each only pollinate one species of *Caladenia* or whether the *C. reticulata* complex is one biological species (Bower 2007). *Phymatothynnus* nr. *nitidus* was found to be scarce around the existing sub-populations of *C. calcicola*, but locally common throughout the rest of the Wildlife Reserve.

4.6 Threats

Threats common to all species are outlined earlier in this document. Threats relating specifically to this species are:

- Grazing. Grazing by native and introduced herbivores, including rabbits, kangaroos and emus for all sub-populations. Emus have removed tags and pins at *C. calcicola* sub-populations and may cause associated damage to individual plants as a result (A. Pritchard pers. obs. 2004).
- Weed invasion. Bridal Creeper (*Asparagus asparagoides),* Italian Buckthorn *(Rhamnus alaternus),* Arum Lilies (*Zantedeschia aethiopica*) and *Hypochaeris* sp. pose a problem at

the Wildlife Reserve site. South African Weed Orchid (*Disa bracteata)* poses a potentially high level threat to the Nelson sub-population, given its close proximity to significant outbreaks nearby.

- Site disturbance. Accidental site damage as a result of off-road activity by vehicles affects the Wildlife Reserve and the Nelson sub-populations and is considered a high risk at all public land sites.
- Inappropriate burning regimes. Optimal fire regimes for maintaining, or re-creating, the appropriate vegetation age-class and structure have not been determined, however it is recognised that many terrestrial Australian *Caladenia* species respond favourably to fire events that reduce canopy biomass. In the future the effect of inappropriate burning regimes on the pollinator and the associated mycorrhizal fungi also needs to be considered if self-sustained sub-populations are to be maintained.
- Illegal collection. Collecting of the species by plant enthusiasts is considered a potential threat at all sites, given the rarity of this species.
- Reduced pollination rates. Observations in recent years suggest that pollination rates at all sites may be too low to maintain a stable population size.

4.7 Previous Recovery Actions

An ecologist has been employed to plan and implement recovery of *C. calcicola* since 1994. Conservation measures have been undertaken by DSE, Parks Victoria (PV) and DEWNR. These activities include;

- Conservation Covenant established at the private property site in Victoria.
- Control of Italian Buckthorn (*Rhamnus alaternus*) at Wildlife Reserve, Portland.
- Management priorities incorporated into the Glenelg Hopkins Catchment Management Authority Regional Catchment Strategy.
- Information relating to the distribution of the species included in the DSE and PV's Fire Operation Plans to minimise accidental damage during fire control activities.
- 66 individuals have been re-introduced at two sites in the Wildlife Reserve at Portland.
- Monitoring has been undertaken at all public land sites since 1994 and began at the Wildlife Reserve site in 1992. Collected life history data for all sites suggests that all sub-populations are currently in decline.
- Slide baiting of soils was undertaken in 2004 to extract mycorrhizal fungi, but was unsuccessful. An alternative method undertaken by the Royal Botanic Gardens, Melbourne, of taking a slice of the orchid's collar was successful in isolating the mycorrhizal fungi. The mycorrhizal fungi are in long-term storage at the Gardens. Preliminary data have indicated that taking a slice of the plant collar has no detrimental effect on future growth and reproductive ability (M. Wright pers. comm. 2007).
- *In-situ* conservation program at the Royal Botanic Gardens, Melbourne.
- Following the discovery that pollination rates were not high enough to sustain the population, hand pollination has been performed at targeted sub-populations to enhance seed set.
- The results of a pollinator baiting experiment in the Wildlife Reserve (Portland) in 2006 (Bower 2007), indicated the Thynnid pollinator was scarce in the immediate vicinity of known sub-populations, yet locally common along adjacent tracks. Currently the adjacent area is unsuitable for *C. calcicola* as the vegetation has become very dense, predominantly due to the invasion of Coast Wattle (*Acacia longifolia* subsp. s*ophorae*) and lack of fire within the Reserve. To achieve natural pollination and create a self-sustaining sub-population of *C. calcicola,* Bower (2007) suggests potentially reintroducing C*. calcicola* to the areas of the Reserve with a good pollinator population. The reintroduction site would need to be prepared to create a more open environment suitable for the orchid. It would be possible to create the appropriate vegetation structure by conducting a prescribed burning regime during the dormancy periods of the orchid and pollinator, or by undertaking manual vegetation removal. Both methods will require ongoing management to maintain the habitat in a suitable condition for the orchid and its pollinator.

- Fencing has been undertaken at the Wildlife Reserve to exclude rabbits and on private land at Dunkeld to exclude stock. A fence has also been erected at Nelson to prevent machinery from creating further damage to the site. Additional plants have also been caged at a number of sites to protect them from both native and exotic herbivores.
- Mapping and searching of potential habitat has been undertaken by both DSE and DEWNR. Two new sub-populations were located in 2006 by DSE in Victoria and can be attributed to the habitat mapping undertaken.
- Re-examined taxonomy of the sub-population at Padthaway Conservation Park, South Australia – now considered to be *C. reticulata* complex.
- A multi-species recovery team has been set up by DSE for threatened flora in South West Region, Victoria, and a number of meetings with regional stakeholders have taken place to manage the recovery of these species, including *C. calcicola.*

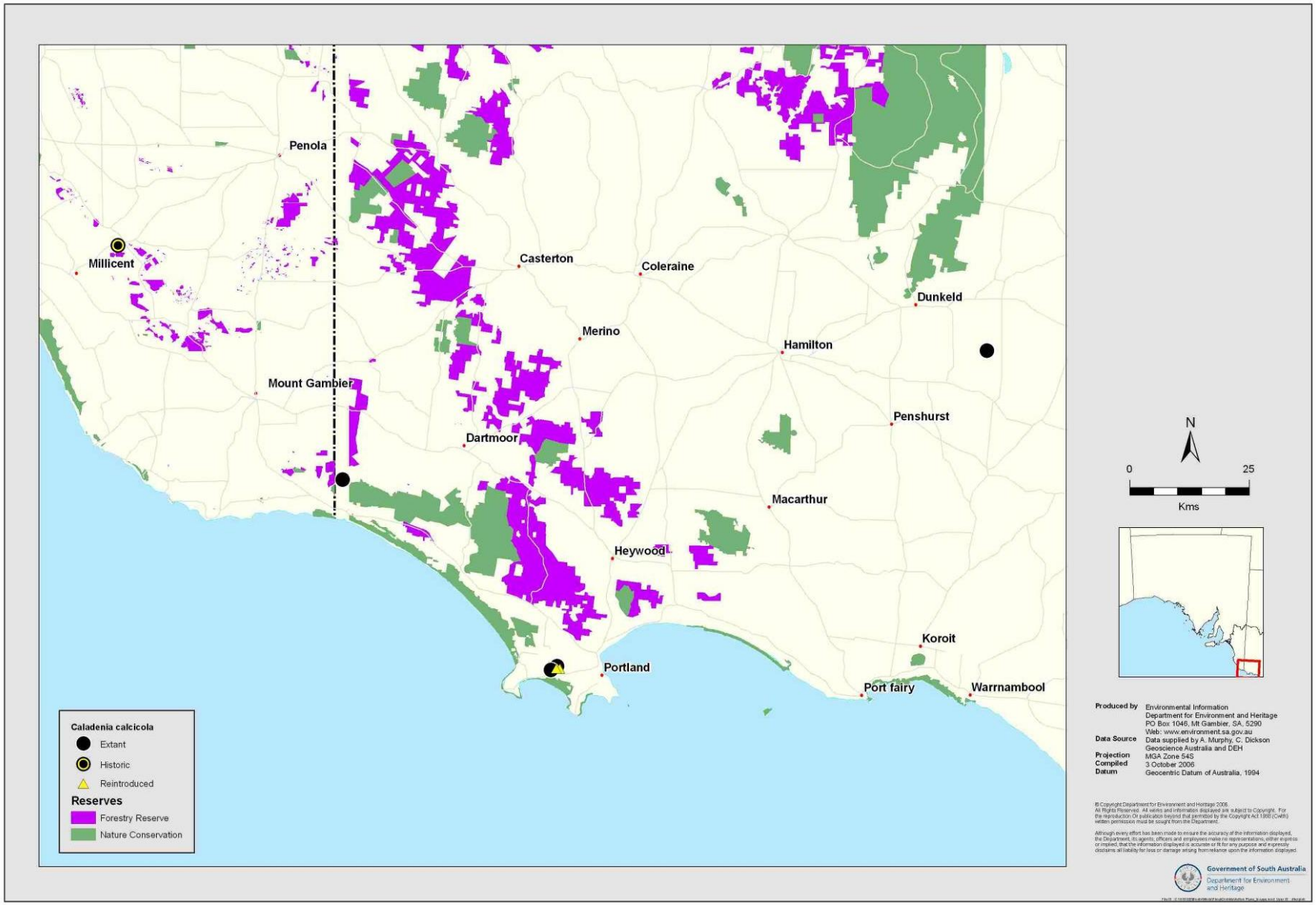

Figure 2. Current and historic distribution of *Caladenia calcicola*, Limestone Spider-orchid.

5.0 *Pterostylis tenuissima* Nicholls (Swamp Greenhood)

5.1 Description

Pterostylis tenuissima is a perennial terrestrial greenhood orchid. When in the non-reproductive stage it appears as a rosette, however, the rosette is absent when in flowering form. The flowering form has up to five stem-sheathing leaves (10-30 mm long) along its flower stem. The stem reaches up to 300 mm in length and supports a single, nodding flower. The modified sepal, known as the hood, is translucent white in colour with pale green stripes ranging in length from 15-20 mm. Lateral sepals are held erect, with long fine tips up to 20 mm rising above the hood. Flowering occurs mainly between October and March but is frequently observed at other times throughout the year. Non-flowering plants form a ground-hugging rosette of three to eight dark green, glossy ovate leaves. *Pterostylis tenuissima* can remain dormant as an underground tuber when conditions are unsuitable (Bates & Weber 1990; Backhouse & Jeanes 1995; Jessop & Toelken 1986).

5.2 Conservation Status

Pterostylis tenuissima is listed as nationally Vulnerable under the Commonwealth EPBC Act, Vulnerable in South Australia under the NPW Act and Threatened under the Victorian FFG Act.

5.3 Distribution and Population Size

Pterostylis tenuissima is found between Wilsons Promontory National Park in eastern Victoria and West Dairy Range in south-east South Australia (Figure 3). The species is mainly restricted to the coastal plains of south-east South Australia and south-west Victoria, with one sub-population recorded 90 km inland near Poolaijelo in Victoria. Although widespread, the habitat for this species has been significantly depleted, resulting in a significant reduction in numbers across its range. The species is known from 55 sites. Given the historical distribution of suitable habitat across south-east South Australia and south-west Victoria, it is likely that the species was once far more widespread and abundant than it is today. *Pterostylis tenuissima* is distributed across approximately 1,000 km^2 and occupies no more than 10 km^2.

The estimated total number of mature plants of *P. tenuissima* is 17,703, consisting of 57 sub-populations located in Victoria and South Australia (Table 6). The high number of sub-populations reflects the highly fragmented nature of the distribution of this species. Five sub-populations are protected within National Parks in Victoria and one in a Wildlife Reserve near Princetown. Three sub-populations have been recorded at Piccaninnie Ponds Conservation Park, South Australia, including at least one within the recent addition to the park (Pick Swamp). It is likely that this number will increase, following searches of these newly reserved sites. The density of plants at Pick Swamp was reasonably high and as such the total number of plants could be in excess of 1,000. The total number of plants and sub-populations at this site is currently unknown but will be investigated in future years.

Currently 46 of the 57 known sub-populations are found on private property, most of which are subject to agricultural land uses. Only one of these properties is protected by a Conservation Covenant on the land title. In Victoria four sub-populations occur on roadsides managed by local government and one occurs in a council reserve.

Table 6. Reserved and unreserved sub-populations of *Pterostylis tenuissima*.

Location	Manager	No. of individuals	No. of sub-populations	Year
Reserved sub-populations				
Piccaninnie Ponds CP, SA	DEWNR	1,039	3	2004
Discovery Bay Coastal Park, Nelson, Vic	Parks Victoria	24	1	2004
Lower Glenelg NP, Nelson, Vic		22	2	2004
Port Campbell NP, Port Campbell, Vic		<10	1	2004
Serpentine Ck Wildlife Reserve, Princetown, Vic		<50	2	2004
Wilsons Promontory NP, Vic		15	2	2006
Trust for Nature Sanctuary, Naringal East, Vic	Private Property	41	1	2004
Total Reserved		**1,201**	**12**	
Unreserved sub-populations				
Blackfellows Caves, SA	Private Property	53	1	2004
Nene Valley, SA		22	1	2004
West Dairy Range 1, Robe, SA		1,750	2	2004
West Dairy Range 2, Robe, SA		56	1	2004
Brucknell 1, Vic		200	1	2004
Brucknell 2, Vic		420	1	2004
Chappel Vale, Vic		20	1	2004
Curdie Vale 1, Vic		500	2	2004
Curdie Vale 2, Vic		4,000	7	2004
Curdie Vale 3, Vic		Data Deficient	2	
Curdie Vale 4, Vic		>4,500	5	2007
Curdie Vale 5, Vic		90	2	2004
Curdie Vale 6, Vic		300	1	2004
Curdies River 1, Vic		200	1	2004
Curdies River 2, Vic		180	1	2004
Curdies River 3, Vic		122	1	2004
Curdies River 4, Vic		70	1	2004
Curdies River 5, Vic		223	1	2004
Curdies River 6, Vic		117	1	2004
Curdies River 7, Vic		1,500	1	2004
Narringal East, Vic		> 200	1	2004
Poolaijello, Vic		200	1	2004
Princetown, Vic		300	1	2004
Red Cap Creek, Vic		24	1	2004
Terang, Vic		7	1	2004
Tyrendarra, Vic		< 50	1	2004
Princetown Recreation Reserve, Princetown, Vic	Corangamite Shire Council	1,000	1	2004
Roadside 1, Lower Heytesbury, Vic		46	1	2004
Roadside 2, Lower Heytesbury		30	1	2004
Roadside, Brucknell, Vic	Moyle Shire Council	300	1	2004
Roadside, Curdie Vale, Vic		22	1	2004
Total Unreserved		**16,502**	**45**	

5.4 Habitat

Pterostylis tenuissima occurs exclusively in Silky Tea-tree (*Leptospermum lanigerum*) Scrub, known as Swamp Scrub in Victoria. Habitat critical for the survival of this species is defined as all remaining areas of Silky Tea-tree Scrub.

Silky Tea-tree Scrub occurs on delicate, alkaline soils in swamps and along the edges of rivers and creeks. Seasonal inundation can occur within these communities, however in South Australia these wetlands are predominantly fed by freshwater springs with minor seasonal variation. Co-dominant canopy species often include Scented Paper-bark (*Melaleuca squarrosa)* and Tree Daisy (*Ozothamnus ferrugineus)* (Backhouse & Jeanes 1995; Croft & Carpenter 2000).

The extent of Silky Tea-tree Scrub has been heavily depleted through extensive clearance and drainage for agriculture in both South Australia and Victoria. Remnants on private land are often subject to grazing by cattle and sheep. Stock often force their way through the dense understorey, opening up the overstorey and damaging the soil structure. Small sub-populations are found under mature Silky Tea-tree plants only millimetres above the water table. These delicate, waterlogged soils are highly susceptible to pugging. Significant changes in canopy cover can lead to the invasion of more light tolerant species (often exotic pasture species) that can out-compete *P. tenuissima.* They may also lead to increased water loss from the soil through evaporation (Bachmann 2002). Silky Tea-tree Scrub is adapted to relatively stable environmental conditions and responds very poorly to clearance and stock disturbance.

In Victoria Silky Tea-tree Scrub occurs along the Curdies and Gellibrand Rivers, their associated tributaries, and coastal wetlands in the far south-west of the State, primarily on private land that is used for dairy, beef or sheep production. Currently the largest and most intact remnants occur in the South West coastal region of Victoria. South-west Victoria also contains the only areas of reserved coastal Silky Tea-tree Scrub in Victoria, at Snape Reserve Princetown and Ralph Illiage Trust for Nature Sanctuary.

5.5 Ecology

5.5.1 Mycorrhizae

The fungi that form mycorrhizal relationships with *P. tenuissima* have not yet been isolated; however the techniques for isolation are well established for similar species. As there is little knowledge available regarding the mycorrhizal associations of this particular species, identification and subsequent mapping of suitable fungi is desirable for its recovery.

5.5.2 Pollination

The pollinator(s) of *P. tenuissima* have not been identified.

There are no data on the pollination rates for most sites; however field observations indicate that rates are higher in larger sub-populations. Observations have determined that the ratio of flowering plants to non-flowering rosettes is frequently low. *Pterostylis tenuissima* is able to reproduce vegetatively from underground tubers (A. Pritchard pers. obs. 2005), which may reduce its dependence on sexual reproduction. Consequently asexual reproduction may be an important factor in building population size.

5.6 Threats

Threats common to all species are outlined earlier in this document. Threats relating specifically to this species are:

- Vegetation clearance and fragmentation: In South Australia the distribution of Silky Tea-tree Scrub has been reduced from 10,740 to 2,380 hectares as a result of extensive drainage, clearance and increasing salinity (Croft *et al.* 1999; Croft & Carpenter 2000). *Leptospermum lanigerum* shrubland (Silky Tea-tree Scrub) is rated as regionally Vulnerable in South East Region, South Australia (Croft *et al*. 1999).

  In western Victoria, this community is considered Endangered as only 2,415 of the original 53,649 hectares of this habitat remains (CVRFASC 2000). Native vegetation clearance continues to threaten sub-populations found on private property at Gellibrand Creek and Curdies River. Some remnants along creek lines in Victoria are subject to increased levels of groundwater salinity as a result of vegetation clearance.

- Grazing: Grazing by livestock at most sites on private property is a major threat and can lead to vegetation degradation, initially along the edges of remnants and ultimately across the entire habitat. The fragile habit of *P. tenuissima* plants makes them highly susceptible to trampling and grazing.
- Drainage works: Numerous large wetlands once stretched across the Lower South East Region of South Australia (Bachmann 2002). In 1863, construction of the first of many large drains began at Kingston (South East Wetlands Committee 1984), eventually leading to an extensive drainage system that has converted the majority of wetlands to pasture. Wetland drainage continues to pose a serious threat to these communities, particularly on private land where small remnants are under considerable pressure from adjacent agricultural land. Surface drainage works, combined with extensive vegetation clearance, have resulted in the loss and degradation of large areas of habitat in the Nene Valley and at Blackfellows Cave in South Australia. Ongoing drainage and clearance of *P. tenuissima* habitat near Blackfellows Caves will likely lead to an extinction of the species at this site in future years. Drainage began in the early 1990's and resulted in almost complete desiccation of this swamp for the first time during the summer of 2000-01. By then, remaining areas of available water supported only 53 *P. tenuissima* plants, down from 92. Under the current drainage regime, this sub-population may not survive another dry event.
- Changes to the hydrology: In recent decades, a drop in the level of the unconfined aquifer in the lower south-east of South Australia has led to a reduction of flow to near-coastal springs. This may be the result of a number of factors, including below average rainfall, an increase in groundwater extraction for irrigated agriculture and a reduced recharge to the watertable, as a result of the establishment of plantation forests and widespread surface drainage (L. Schmidt pers. comm. 2001). Consequently, many springs that previously provided a regular flow of water to Silky Tea-tree swamps throughout the year now have reduced flow during summer, making the habitat unsuitable for the moisture-dependent, summer-flowering *P. tenuissima*. This threatens some sub-populations at Piccaninnie Ponds CP, and has led to the gradual invasion of Coast Wattle (*Acacia longifolia* subsp. *sophorae*). Efforts to reverse the effects of this water loss are ongoing; however extreme caution is required to prevent the inundation of existing sub-populations. Consequently, actions to reinstate the hydrology of the wetlands should take into account this species and its requirements.
- Weeds: A variety of weed species threaten Swamp Greenhood sub-populations, including Blackberries (*Rubus* spp.), Buffalo Grass (*Stenotaphrum secundatum*), Arum Lilies (*Zantedeschia aethiopica*), New Zealand Mirror-bush (*Coprosma repens),* Cotoneaster (*Cotoneaster symondsii*) and various pasture species. At Spring and Whiskey Creeks in Victoria, the long, narrow shape of remnant *P. tenuissima* habitat results in a higher ratio of edge to core area and an increased susceptibility to external influences such as weed invasion.
- Erosion: This is particularly a problem at Spring and Whiskey Creeks in Victoria. Plants growing along the water's edge are vulnerable to advancing erosion, and the potential to be washed away.
- Site disturbance: Visitor impacts from naturalists and field officers also threaten some sub-populations. Monitoring activities are often time consuming and can lead to damage, particularly of the soft soils of *P. tenuissima* habitat.

5.7 Previous Recovery Actions

Staff have been employed by DEWNR and DSE since 2000 to plan and manage the recovery of *P. tenuissima.* Liaison with private landholders has been undertaken both in Victoria and South Australia to locate and protect Silky Tea-tree Scrub.

Through the *Silky Tea-tree & Cutting Grass Wetland Rehabilitation Project* in South Australia (Bachmann 2002), assistance was provided to landholders to fence remnants on private property. The success of rehabilitation works was also evaluated and additional searches undertaken to locate new sub-populations of threatened flora, including *P. tenuissima*. Incentives will continue to be available for fencing the remaining patches of *P. tenuissima* habitat.

Ongoing drainage and damage by stock threatened one sub-population on private land in South Australia until recently, when the property was purchased by DEWNR. This has led to benefits to a range of other rare and threatened species at the site and contributed to the development of a wetland corridor in the Lower South East of South Australia.

Several known *P. tenuissima* sub-populations on private properties in the Curdies and Gellibrand River systems have been fenced to protect the *P. tenuissima* sub-populations and the Silky Tea-tree Scrub from grazing.

The following management actions have also been undertaken since 2000:

- Baseline data collected at all sites, including number of individuals and site description.
- Collection of demographic life history data at sites in Victoria and South Australia: at two sites in South Australia the reproductive state of individuals has been monitored, and at 15 sites in Victoria the number of flowering and non-flowering plants has been monitored every two to three years.
- Threats to sub-populations identified, the primary threats have included change in hydrology, weed invasion, and grazing.
- Recovery strategies to mitigate threats have been developed and implemented at key sub-populations. Mitigation activities include fencing, weed control, hydrological restoration and inclusion in fire planning.
- Surveys and mapping of *Leptospermum lanigerum* shrubland to locate additional sub-populations.
- Collation of data and development of Threatened Orchid Database.
- A total of 250 ha of land purchased in South Australia to protect *P. tenuissima* and a range of other threatened flora and fauna.
- Landholder liaison and subsequent threat abatement at sites on private property in both South Australia and Victoria.
- Investigations to protect *P. tenuissima* sub-populations in relation to the reinstatement of hydrology in Piccaninnie Ponds wetland complex in south-east South Australia. Mapping of some of the most vulnerable sub-populations has been undertaken however further work is still required. A weir and levy were installed in 2006 and 2008 respectively and further works are proposed.
- Control of weeds at priority sites within Curdies River - Gellibrand Management zone.
- Fencing undertaken on three private land sites in South Australia, protecting four sub-populations.
- Management priorities incorporated into the GHCMA and CCMA Regional Catchment Strategies.
- Information relating to the distribution of the species included in both DSE and PV Fire Operation Plans to minimise accidental damage during fire control activities.
- Victorian Regional Recovery Team coordinated by DSE.
- South Australian Regional Recovery Team coordinated by DEWNR.

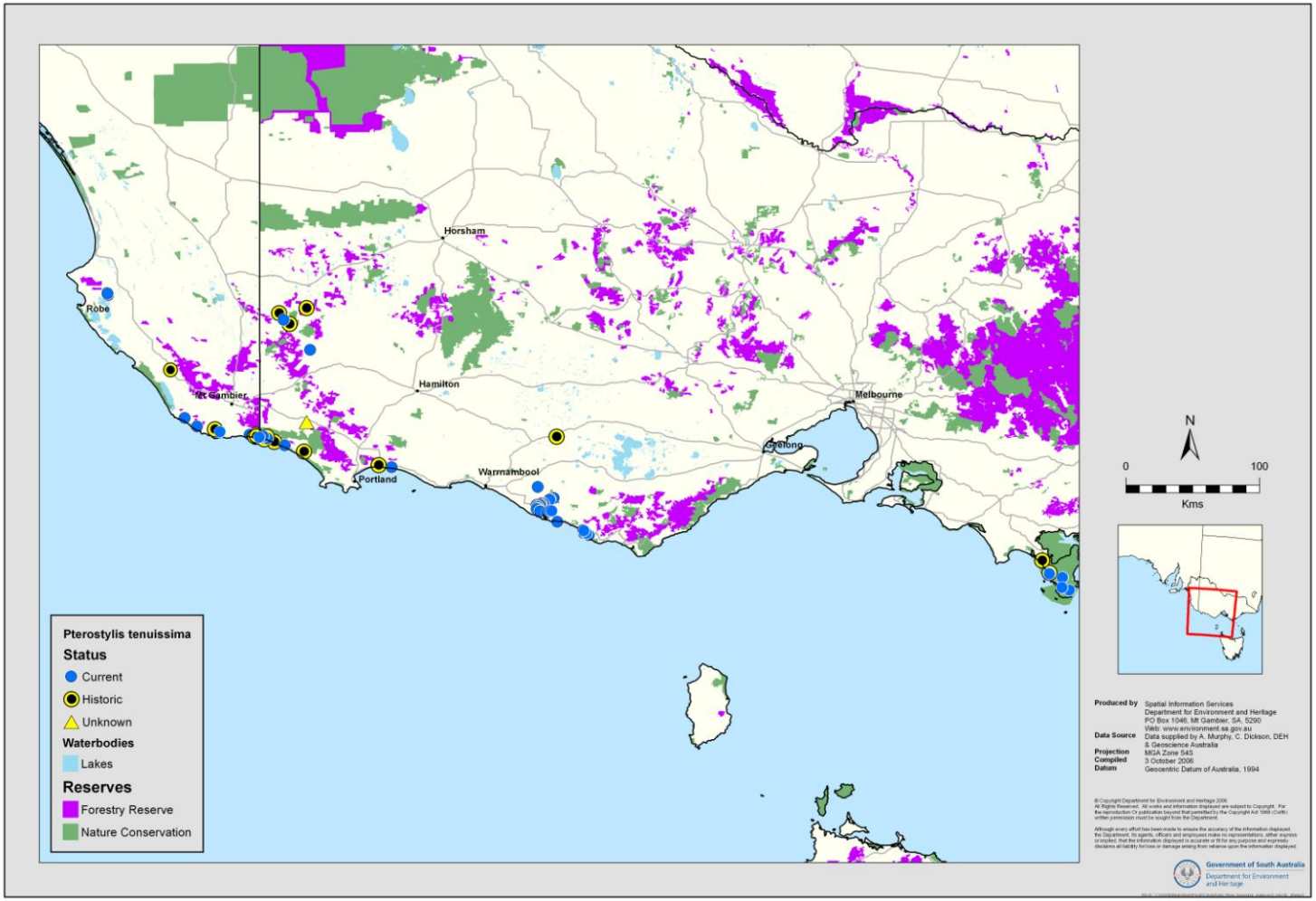

Figure 3. Current and historic distribution of *Pterostylis tenuissima*, Swamp Greenhood

Part D: Objectives, Performance Criteria and Actions

6.1 Recovery Objectives and Performance Criteria

The primary objective of the recovery program is to maximise the chances of survival of all three species. This will be achieved through the process of recovery by ensuring that the most viable sub-populations across the range are self-sustaining.

Progress towards the primary objective is intended to be made over the life of this recovery plan through the achievement of the following objectives as demonstrated by the associated performance criteria (refer to Table 7).

1. Acquire accurate information for conservation status assessments.
2. Identify critical, common and potential habitat for the orchids and their pollinators.
3. Conserve targeted sub-populations on private land.
4. Manage threats to sub-populations.
5. Determine growth rates and viability of sub-populations.
6. Develop and undertake fine-scale site management practices.
7. Establish/maintain sub-populations in cultivation.
8. Establish new and re-stock sub-populations from cultivated plants or seed stock.
9. Build a network of government and non-government organisations and individuals.
10. Cooperate in bioregional policy implementation and manage recovery plan implementation.

6.2 Program Implementation and Evaluation

This recovery plan guides recovery actions for the three threatened orchid species and will be implemented and managed by the DEWNR and DSE supported by other agencies, educational institutions, regional natural resource management authorities and community groups as appropriate (Table 8). Technical, scientific, habitat management or education components of the recovery plan will be referred to specialist groups on research, *in situ* management, community education and cultivation as required.

Recovery actions are being achieved through the work of departmental staff and local individuals and groups involved in the management of sub-populations. For the life of this Plan, the overall direction for recovery of the species will be coordinated by DEWNR, DSE and representatives from community groups, as appropriate, through multi-species regional threatened species recovery teams. Where sub-populations occur on private property, landholders will be invited to become involved in the recovery process. Members of community groups and interested landholders may be trained in habitat management and monitoring of sub-populations in accordance with prescribed management actions.

6.3 Duration and Cost of Recovery Process

The recovery plan is intended to run for five years from the date of its adoption under the EPBC Act, and will be reviewed within five years by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) with support by other agencies as appropriate. However, the recovery of each of the species will be a long-term process to ensure that the most viable sub-populations across the range become self-sustaining.

The estimated cost for the five year life of this plan is in Table 9 and will be met through various direct and indirect funding activities undertaken by the DEWNR and DSE and supported by other agencies, educational institutions, regional natural resource management authorities and community groups.

6.4 Management Practices

Any management practices undertaken in, or directly adjacent to, essential or potential habitat of the nationally threatened plant species in this plan, that are likely to have a significant adverse impact, should be considered carefully. Any activities that may promote or contribute to the threats identified in this plan should be avoided where possible. Examples of such activities and potential management practices that may limit the success of threatened plant recovery are listed below but are not exclusive and should be treated as a guide.

- Clearance of vegetation within or near essential or potential threatened species habitat.
- Vehicle access through essential or potential threatened species habitat.
- Grazing of livestock in essential or potential threatened species habitat.
- Inadequate control of vertebrate pests in essential threatened species habitat.
- Inadequate control of weed species in essential or potential threatened species habitat.
- Inappropriate fire regimes.
- Continued slashing or burning of essential or potential threatened species habitat during the growth period of the species.
- Roadside vegetation maintenance in essential or potential threatened species habitat.
- Construction or maintenance of management tracks or recreational trails through essential or potential threatened species habitat.
- Construction of drains that impact on essential or potential threatened species habitat.
- Activities that contribute to excessive foot traffic through essential or potential threatened species habitat.
- Activity that promotes soil disturbance in or near areas of essential habitat susceptible to soil erosion.
- Activity that reduces the size and increases the isolation of threatened plant sub-populations further.
- Excessive collection of plant material from the wild including flowers, tubers and seeds.

Examples of activities that may either mitigate adverse impacts on, or indirectly benefit, the target species include:

- Revegetation programs adjacent to threatened orchid sites, using indigenous species and designed to buffer and extend the area of suitable habitat.
- Fencing of areas of native vegetation to exclude feral or domestic grazing animals.
- Control of vertebrate pests such as goats and deer.
- Prescribed burning programs conducted outside the growing season of the species.

6.5 Biodiversity Conservation Benefits

The implementation of this recovery plan will have broad biodiversity conservation benefits through the protection and management of habitats and increase community awareness and involvement. It is unlikely to have any negative impacts on any species or ecological communities.

The Coast Daisy-bush (*Olearia axillaris)* – Coast Beard-heath (*Leucopogon parviflorus)* shrubland in which *Caladenia richardsiorum* is found also provides habitat for a number of national and state listed species, some of which are Endangered. Nationally Endangered taxa include Sand Ixodia (*Ixodia achillaeoides* ssp. *arenicola)* and the Critically Endangered Orange-bellied Parrot *(Neophema chrysogaster),* which was flushed from near a sub-population of *C. richardsiorum* at Nora Creina (E. Lawson pers. comm. 2007). South Australian species listed as Vulnerable under the NPW Act are Dune Fanflower (*Scaevola calendulacea)* and Slender Speedwell (*Veronica gracilis*). The Rufous Bristlebird (*Dasyornis broadbenti)* is also found in this habitat and is listed as Vulnerable in South Australia.

Common Caladenia (*C. vulgaris*), listed as Rare in South Australia, has also been found growing in association with *C. richardsiorum* in *Eucalyptus diversifolia* ssp*. diversifolia* habitat. Many actions that improve the habitat for the target species at these sites may also advantage associated species such as *C. vulgaris*. Such outcomes are consistent with the priorities of the Biodiversity Plan for the South East of South Australia (Croft *et al.* 1999), as this habitat falls into the "priority coastal area" outlined in the plan.

Two of the vegetation communities in which *C. calcicola* occurs (Limestone Ridge Woodland and Limestone Woodland) are considered Rare in the West Victoria Region. A third community, Grassy Woodland/Hills Herb-rich Woodland/Damp Sands Herb-rich Woodland mosaic is Endangered within

this region (CVRFASC 2000). Any actions that improve the habitat for *C. calcicola* will also benefit these communities.

Habitat protection and restoration work on Silky Tea-tree Scrub in which *P. tenuissima* occurs, will benefit this threatened ecological community. The habitat also supports sub-populations of many plant species of high conservation significance at the State and regional level (Croft & Carpenter 2000). Some benefits have already been made as a result of fieldwork associated with this project; for example new records have been made for three orchid taxa previously unrecorded in South Australia, namely *P. lustra*, *Corybas* sp. aff. *diemenicus* and *Microtis* sp. aff. *rara*. Any restoration of *P. tenuissima* habitat will benefit these significant species.

Orchids have the potential to act as 'flagship species' and be used to provide an important public education role for highlighting broader nature conservation and biodiversity issues such as land clearing, grazing, weed invasion and habitat degradation.

6.6 Affected Interests

Sub-populations for all three species occur on a variety of land tenure, including parks and reserves, unreserved public land (such as roadsides) and private land (refer to Table 3). A range of land managers are involved in managing these areas including DEWNR, DSE, Parks Victoria, Catchment Management Authorities, District Councils, Shires and private landholders.

Implementation of this recovery plan will require a co-ordinated approach involving partnership arrangements with the various affected and interested parties.

6.7 Role and Interests of Indigenous People

The role and interests of Indigenous communities in the region should be taken into consideration in the implementation of recovery actions. Consultation with the relevant South Australian Indigenous groups has been undertaken by DEWNR's Aboriginal Partnerships Unit, who circulated a fact sheet summary of the plan to relevant Indigenous groups, and made follow-up contact to invite comment. No comments have been received from Indigenous groups to date. Victorian Indigenous communities involved in the region affected by this plan include the Gunditjmara. Implementation of recovery actions under this plan will include consideration of the role and interests of Indigenous communities in the region.

When implementing any recovery actions in this plan, the relevant provisions of the *Native Title Act* 1993 should be considered before undertaking any future acts that might affect Native Title. Nothing in the plan is intended to affect Native Title and the recovery plan will be adopted subject to any Native Title rights and interests that may continue in relation to the land.

6.8 Social and Economic Impacts

Sub-populations for all three species occur on a range of land tenures. Actions outlined in this plan are unlikely to significantly affect any party unfavourably, either socially or economically. Recovery actions outlined in this plan on public land will occur after negotiation with the relevant public land manager. It is not anticipated that any commercial or recreational activities will be adversely affected by implementing any recovery actions (e.g. loss of access, fencing or signage). Most sub-populations covered by this multi-species recovery plan occur on private land. Where applicable, voluntary agreements will be sought with private landholders to secure protection for sub-populations.

Table 7. Recovery objectives, actions and performance criteria. Management Priorities: 1 = high, 2 = moderate, 3 = low

Action	Description	Species Targeted	Performance Criteria	Priority
1: Acquire accurate information for conservation status assessments				
1.1	Continue to acquire baseline data. **Responsibility: DEWNR, DSE**	All 3 species	• Updated records in departmental files and databases (Years 1-5) • Accurate information and maps of all sub-population locations (Partially achieved in writing Recovery Plan) (Year 1) For *C. richardsiorum & P. tenuissima* • Updated regional IUCN and EPBC conservation status assessment (Years 1 & 2) • Development of Threatened Orchid relational database completed (Year 2) For *C. richardsiorum* & *C. calcicola* • Identity of pollinator clarified and pollinator abundance confirmed (Years 1-3) For *C. richardsiorum* • Taxonomic status of Meningie sub-population clarified (Year 2)	2
2: Identify critical, common and potential habitat for orchid and pollinator				
2.1	Survey and assess known habitat in spring. Determine the presence of species for unconfirmed records. **Responsibility: DEWNR, DSE**	All 3 species	• Habitat critical to survival mapped and added to Threatened Orchid relational-database and disseminated to relevant land managers including councils (Years 1-3) For *C. richardsiorum* • Recently recorded site near Meningie assessed (Year 1) • Anecdotal records validated / refuted (Years 1 & 2) For *P. tenuissima* • Annual or biennial censuses of selected sub-populations completed (Years 1-5) • Soil testing undertaken at selected sub-populations to identify potential threat of salinity (Year 3) • Sub-populations located and mapped at Piccaninnie Ponds CP (Years 3 & 4)	1

2.2	Identify and survey potential habitat using geospatial habitat modelling. **Responsibility: DEWNR, DSE**	All 3 species	• Potential habitat identified and surveyed. For *C. richardsiorum* including targeted sites between Robe and Meningie; Southend and Port MacDonnell (Years 1-5) For *P. tenuissima* at Piccaninnie Ponds CP • Potential habitat mapped and recorded as GIS layers and added to Threatened Orchid relational-database (Years 2 & 3)	2
3: Conserve targeted sub-populations on private land				
3.1	Protect sub-populations on private land. **Responsibility: DEWNR, DSE, landholders**	*Caladenia richardsiorum* *Pterostylis tenuissima*	• Protection negotiated with private land manager, and Heritage Agreement or Conservation Covenants initiated where possible (Years 1-4)	1
4: Manage threats to sub-populations				
4.1	Control pest plants using site- and species-appropriate methods **Responsibility: DEWNR, DSE**	All 3 species	• Integrated weed management strategy developed for sites where weed invasion threatens sub-populations (Years 1-5) • A weed-free buffer established around priority sub-populations (Years 1-5) For *C. richardsiorum* • Measurable decline (via mapping using GPS and GIS) in extent of *Asparagus asparagoides, Polygala myrtifolia, Acacia longifolia* subsp. *sophorae* and *Vinca major* at Heritage Agreement at Robe (Years 1-5) • Measurable decline (via mapping using GPS and GIS) in extent of *Polygala myrtifolia, Freesia* spp., *Gazania linearis*, *Rhamnus alaternus*, *Leptospermum laevigatum, Billardiera heterophylla, Asparagus asparagoides* and *Vinca major* in the council reserve at Beachport (Years 1-5)	1
4.2	Investigate and control grazing impacts. **Responsibility: DEWNR, DSE**	All 3 species	For *C. richardsiorum* • Grazing impacts investigated/quantified at 4 sites (Years 1-3) • Negotiations undertaken regarding a change in grazing regimes at Nora Creina private land site if appropriate (Year 2) • Rabbit control strategies developed and implemented where appropriate (Years 2-5) • Impacts of exotic terrestrial snails investigated and controlled if necessary (Years 2-5) For *C. calcicola* • Individual target plants caged to protect from grazing (Year 1) For *P. tenuissima* • Measurable seedling recruitment in affected private land sub-populations (Years 3-5)	1

4.3	Control site disturbance. **Responsibility: DEWNR, DSE**	All 3 species	For *C. richardsiorum* • Protective barriers constructed at Little Dip Conservation Park, council owned roadside at Robe and other sites if required (Years 1-3) • Signage erected to ensure visitors keep to the walking tracks (Year 1) For *C. calcicola* • Fences maintained at all sites (Years 1-5) For *P. tenuissima* • Continued liaison undertaken with land managers at West Dairy Range, Blackfellows Cave and Curdies River (Years 1-5) • Measurable reduction in damage to plants in affected sub-populations (Years 3-5)	1
4.4	Investigate and implement appropriate fire regimes. **Responsibility: DSE**	*Caladenia calcicola*	• Optimal fire regimes determined for Lower Glenelg National Park site, Nelson and Wildlife Reserve, Portland (Years 1-3) • Burn plan developed and implemented at Lower Glenelg National Park site, Nelson and Wildlife Reserve, Portland (Years 4-5)	2
5: Determine the growth rates and viability of sub-populations				
5.1	Measure population trends and responses to recovery actions. **Responsibility: DEWNR, DSE**	All 3 species	• Demographic information collected, including recruitment and mortality, timing of life history stages and morphological data (Years 1-5) • Population Viability Analysis completed for selected sub-populations (Year 5)	2
5.2	Collate, analyse and report on census data and compare with management histories. **Responsibility: DEWNR, DSE, Recovery Team**	All 3 species	• Threatened Orchid relational-database maintained using updated census records (Years 1-5) • Management assessed and prescriptions revised if necessary (Year 5)	3
6: Develop and undertake fine-scale site management practices				
6.1	Manage microhabitat for seedling recruitment at all sub-populations. **Responsibility: DEWNR, DSE**	All 3 species	• Measurable increase in recruitment at target sub-populations in 5 years (Year 5) • No decline in recruitment at remaining sub-populations in 5 years (Year 5) For *C. calcicola* and *P. tenuissima* • Mycorrhizal fungi mapped at selected sites when seed available (Years 1-5)	3

6.2	Hand-pollinate to boost recruitment, collect seed and test viability **Responsibility: DEWNR (SE Region and Seed Conservation Centre (SCC)), Wimmera Catchment Management Authority Germplasm Research Centre (WCMAGRC), DSE & RBG**	All 3 species	• Hand pollination protocol developed and selected individuals hand pollinated in selected sub-populations (Years 1-5) • Seed collected from selected sub-populations and tested. Seed held in storage (Years 1-5) • Seed viability analysis undertaken (Years 1-5)	1
6.3	Enhance pollinator habitat. **Responsibility: DEWNR, DSE**	*Caladenia richardsiorum* *Caladenia calcicola*	• Site rehabilitation works undertaken if necessary, and subject to native vegetation clearance approval, to support pollinator sub-populations at selected sites if necessary (Year 4-5)	2
7: Establish/maintain sub-populations in cultivation				
7.1	Establish cultivated plants *ex situ* to safeguard from the unforeseen destruction of the wild population. **Responsibility: DEWNR (SE Region and SCC), WCMAGRC, DSE & RBG**	*Caladenia richardsiorum* *Pterostylis tenuissima*	• Representative 40 mature individuals of each species in cultivation (Years 4-5)	3
7.2	Maintain cultivated plants *ex situ* to safeguard from the unforeseen destruction of the wild population. **Responsibility: SCC, WCMAGRC and RBG**	*Caladenia calcicola*	• At least 50 mature plants maintained in cultivation at a number of locations (Years 4-5)	1
7.3	Establish a threatened orchid seed and fungi bank and determine seed viability. **Responsibility: SCC & WCMAGRC**	*Caladenia richardsiorum* *Pterostylis tenuissima*	• Collars collected from selected sub-populations and fungi isolated (Year 1) • Seed from selected sub-populations in long term storage in 5 years (Years 1-5)	1
7.4	Maintain the established threatened orchid seed and fungi bank and determine seed viability. **Responsibility: DSE and RBG**	*Caladenia calcicola*	• Isolated fungi maintained in storage (Years 1-2) • Seed from selected sub-populations in long-term storage in 5 years (Years 1-5)	3
7.5	Establish and maintain a database of threatened plants in cultivation. **Responsibility: DEWNR & WCMAGRC**	*Caladenia richardsiorum* *Pterostylis tenuissima*	• Seed bank database established within five years (Years 1-5)	2
7.6	Maintain a seed and fungi bank database. **Responsibility: DSE and RBG**	*Caladenia calcicola*	• Relevant details entered in seed and fungi bank database and maintained (Years 1-5)	3

8: Establish new and restock sub-populations from cultivated plants or seed stock				
8.1	Restock selected sub-populations using plants cultivated *ex-situ* **Responsibility: DEWNR & WCMAGRC**	*Caladenia richardsiorum* *Pterostylis tenuissima*	• Long-term survival of, and recruitment from, plants used for restocking at selected sites (Years 3-5) • For *P. tenuissima*, re-stocking undertaken at Piccaninnie Ponds CP (Years 3-5)	3
8.2	Investigate the historic site at Mt Burr SA for a potential reintroduction. **Responsibility: DEWNR**	*Caladenia calcicola*	• Consultation undertaken with Forestry SA (Year 1) • Preparation of a site reintroduction plan if FSA consultation positive (Years 2 & 3) • Successful pollinator baiting trials (Year 2)	3
8.3	Prepare site, subject to native vegetation clearance approval if needed, and maintain to achieve maximum survival of plants and/or germination of seed **Responsibility: DEWNR and DSE**	*Caladenia calcicola*	• Techniques implemented as described in the site reintroduction plan in action 8.2. at Mt Burr and within Wildlife Reserve (Portland) to successfully reintroduce mature individuals (Years 3-4)	3
8.4	Reintroduce and monitor plants at Wildlife Reserve (Portland) and Mt Burr Range sites. **Responsibility: DEWNR & DSE**	*Caladenia calcicola*	• Measurable sub-population increase at Wildlife Reserve (Portland) and Mt Burr Range sites (Years 4-5)	3
9: Build a network of government and non-government organisations and individuals				
9.1	Undertake community extension by encouraging individuals to report sightings of *C. richardsiorum* to regional DEWNR personnel, as well as promoting threatened flora conservation and organising searches if required. **Responsibility: DEWNR**	*Caladenia richardsiorum*	• Community members have been encouraged to report sightings of *C. richardsiorum* or, in the case of NOSSA have actively searched for *C. richardsiorum* if deemed necessary (Years 1-5)	3
9.2	Continue to liaise with industry and government stakeholders to ensure the protection of *Caladenia calcicola*. **Responsibility: DSE**	*Caladenia calcicola*	• Information provided to relevant private and public management bodies as well as State and Australian Governments (Years 1-5)	3

9.3	Encourage and support research by Higher Education Institutions and other research partners. **Responsibility: DEWNR, DSE & Research partner(s)**	All 3 species	• Collaborative research partnerships formed and funding applications prepared (Years 1-3)	3
10: Cooperate in bioregional policy implementation and manage recovery plan implementation				
10.1	Facilitate the Regional Recovery Teams for these species and other regional threatened flora. **Responsibility: DEWNR, DSE**	All 3 species	• For *C. richardsiorum* & *C. calcicola,* one Threatened Orchid Recovery Team meeting held annually (Years 1-5) • For *P. tenuissima*, two Regional Recovery Team meetings held annually (Years 1-5) • Annual work plans prepared (Years 1-5)	1
10.2	Coordinate recovery and exchange knowledge with government agencies. **Responsibility: DEWNR, DSE**	All 3 species	• Regular communication with State, interstate and Australian Government agencies maintained to advance management and implement legislation and policies (Years 1-5)	3

Table 8: List of national, state and regional stakeholders.

National Stakeholders
Australian National Herbarium
Australian Native Orchid Society
Australian Network for Plant Conservation
Department of Sustainability, Environment, Water, Population and Communities (Australian Government)
General Public
State Stakeholders
Conservation Council of South Australia
Department of Environment, Water and Natural Resources (SA Government) *
Department of Sustainability and Environment (Victorian Government) *
Flinders University
ForestrySA (South Australian Government)
General public
Native Orchid Society of South Australia
Natural History Society of South Australia
Parks Victoria *
Royal Botanic Gardens, Melbourne
SA Country Fire Service
South Australian Seed Conservation Centre, Botanic Gardens of Adelaide, DEWNR (SA Government)
State Herbarium of South Australia
University of Adelaide
University of South Australia
Regional Stakeholders
Beachport District Development Corporation *
Coorong District Council
Corangamite Shire Council *
Friends of Canunda and Beachport Conservation Parks*
Friends of Little Dip and Butchers Gap Conservation Parks *
Friends of Mount Gambier Area Parks*
General Public
Grant District Council
Kingston District Council
Limestone Coast and Coorong Coastal Management Group
Moyle Shire Council *
Private Landholders *
Robe District Council *
South East Natural Resource Management Board
Southern Ocean Coastcare
Wattle Range District Council *
** Group directly owns and/or manages land supporting sub-populations and habitat of one of the orchid species*

Table 9. Estimated costs of implementing the recovery actions. Management Priorities: 1 = high, 2 = moderate, 3 = low

Action	Description	Priority	Responsibility	Species	Cost estimate ($)					
					Year 1	Year 2	Year 3	Year 4	Year 5	Total
1: Acquire accurate information for conservation status assessments										
1.1	Acquire baseline population data	**3**	**DEWNR, DSE**	All 3 species	4 500	5 500	2 000	1 000	1 000	**14 000**
2: Identify critical, common and potential habitat for orchid and pollinator										
2.1	Survey and assess known habitat	**1**	**DEWNR, DSE**	All 3 species	4 500	3 500	4 500	2 000	1 000	**15 500**
2.2	Identify and survey potential habitat	**2**	**DEWNR, DSE**	All 3 species	2 500	5 000	5 000	2 500	2 500	**17 500**
3: Conserve targeted sub-populations on private land										
3.1	Protect sub-populations on private land	**1**	**DEWNR, DSE, landholders**	C. richardsiorum P. tenuissima	3 000	6 000	1 000	1 000	0	**11 000**
4: Manage threats to sub-populations										
4.1	Control pest plants	**1**	**DEWNR, DSE**	All 3 species	12 000	11 500	10 500	10 500	10 500	**55 000**
4.2	Investigate and control grazing impacts	**1**	**DEWNR, DSE**	All 3 species	1 500	3 000	3 500	2 500	2 500	**13 000**
4.3	Control site disturbance	**1**	**DEWNR, DSE**	All 3 species	2 000	1 500	2 000	1 500	1 500	**8 500**
4.4	Investigate and implement appropriate fire regimes	**2**	**DSE**	*C. calcicola*	1 000	1 000	1 000	3 000	3 000	**9 000**
5: Determine the growth rates and viability of sub-populations										
5.1	Measure population trends	**2**	**DEWNR, DSE**	All 3 species	2 500	2 500	2 500	2 500	5 000	**15 000**
5.2	Collate, analyse and report on census data	**3**	**DEWNR, DSE, Recovery Team**	All 3 species	1 500	1 500	1 500	1 500	1 500	**7 500**
6: Develop and undertake fine-scale site management practices										
6.1	Manage microhabitat	**3**	**DEWNR, DSE**	All 3 species	6 000	6 000	3 000	3 000	3 000	**21 000**
6.2	Hand-pollinate to boost recruitment, collect seed and test viability	**1**	**DEWNR, WCMAGRC, DSE & RBG**	All 3 species	1 500	1 500	3 000	4 000	4 500	**14 500**
6.3	Enhance pollinator habitat	**2**	**DEWNR, DSE**	*C. richardsiorum* *C. calcicola*	1 000	1 000	1 000	5 000	6 000	**14 000**
7: Establish/maintain sub-populations in cultivation										
7.1	Establish cultivated plants *ex situ*	**3**	**DEWNR, WCMAGRC, DSE & RBG**	*C. richardsiorum* *P. tenuissima*	4 000	4 000	5 000	5 000	5 000	**23 000**

7.2	Maintain cultivated plants *ex situ*	**1**	**SCC, WCMAGRC, RBG**	*C. calcicola*	2 000	2 000	2 000	2 000	2 000	**10 000**
7.3	Establish a threatened orchid seed and fungi bank	**1**	**SCC, WCMAGRC**	*C. richardsiorum* *P. tenuissima*	6 000	4 000	2 000	2 000	2 000	**16 000**
7.4	Maintain the established threatened orchid seed and fungi bank	**3**	**DSE, RBG**	*C. calcicola*	1 000	1 000	1 000	1 000	1 000	**5 000**
7.5	Maintain a database of threatened plants in cultivation	**2**	**DEWNR, WCMAGRC**	*C. richardsiorum* *P. tenuissima*	1 500	1 000	1 000	1 000	1 000	**5 500**
7.6	Maintain a seed and fungi bank database	**3**	**DSE, RBG**	*C. calcicola*	500	500	500	500	500	**2 500**
8: Establish new and restock sub-populations from cultivated plants or seed stock										
8.1	Restock selected sub-populations using plants cultivated *ex-situ*	**3**	**DEWNR, WCMAGRC**	*C. richardsiorum* *P. tenuissima*	1 000	1 500	2 000	1 500	1 500	**7 500**
8.2	Investigate the historic site	**3**	**DEWNR**	*C. calcicola*	500	1 500	500	0	0	**2 500**
8.3	Prepare site	**3**	**DEWNR, DSE**	*C. calcicola*	0	0	2 000	1 000	0	**3 000**
8.4	Reintroduce and monitor plants	**3**	**DEWNR, DSE**	*C. calcicola*	0	0	0	3 000	2 000	**5 000**
9: Build a network of government and non-government organisations and individuals										
9.1	Undertake community extension	**3**	**DEWNR**	*C. richardsiorum*	1 000	1 000	1 000	1 000	1 000	**5 000**
9.2	Continue to liaise with stakeholders	**3**	**DSE**	*C. calcicola*	500	500	500	500	500	**2 500**
9.3	Encourage and support research	**3**	**DEWNR, DSE & Research partners**	All 3 species	1 000	2 000	2 500	1 000	1 000	**7 500**
10: Cooperate in bioregional policy implementation and manage recovery plan implementation										
10.1	Facilitate Regional Recovery Team	**1**	**DEWNR, DSE**	All 3 species	1 500	1 500	1 500	1 500	1 500	**7 500**
10.2	Coordinate recovery and exchange knowledge	**3**	**DEWNR, DSE**	All 3 species	1 500	1 500	1 500	1 500	1 500	**7 500**
Total					**65 500**	**71 500**	**63 500**	**62 500**	**62 500**	**325 500**

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