

INTERIM RECOVERY PLAN NO. 255

# SWAMP HONEYPOT

(*DRYANDRA NIVEA* SUBSP.  
*ULIGINOSA*)

INTERIM RECOVERY PLAN

2008-2013



April 2008

Department of Environment and Conservation  
Kensington



Australian Government



Department of  
Environment and Conservation

Our environment, our future



## FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos. 44 and 50. Note: the Department of CALM formally became the Department of Environment and Conservation (DEC) in July 2006. DEC will continue to adhere to these Policy Statements until they are revised and reissued.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

DEC is committed to ensuring that Threatened taxa are conserved through the preparation and implementation of Recovery Plans (RPs) or IRPs, and by ensuring that conservation action commences as soon as possible and, in the case of Critically Endangered (CR) taxa, always within one year of endorsement of that rank by the Minister.

This IRP will operate from April 2008 to March 2013 but will remain in force until withdrawn or replaced. It is intended that, if the subspecies is still ranked Endangered this IRP will be reviewed after five years and the need for further recovery actions assessed.

This IRP was approved by the Director of Nature Conservation on 30 April 2008. The allocation of staff time and provision of funds identified in this IRP is dependent on budgetary and other constraints affecting DEC, as well as the need to address other priorities.

Information in this IRP was accurate at April 2008.

This IRP was prepared with financial support from the Australian Government to be adopted as a National Recovery Plan under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

## IRP PREPARATION

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## ACKNOWLEDGMENTS

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**Cover photograph** by Anne Cochrane.

## CITATION

This IRP should be cited as:

Department of Environment and Conservation (2008). Swamp honeypot (*Dryandra nivea* subsp. *uliginosa*) Interim Recovery Plan 2008-2013. Interim Recovery Plan No. 255. Department of Environment and Conservation, Western Australia.

**SUMMARY**

<b>Scientific Name:</b>	<i>Dryandra nivea</i> subsp. <i>uliginosa</i>	<b>Common Name:</b>	Swamp honeypot
<b>Family:</b>	Proteaceae	<b>Flowering Period:</b>	September
<b>DEC Region:</b>	South West	<b>DEC District:</b>	Blackwood
<b>Shires:</b>	Busselton, Augusta-Margaret River	<b>Recovery Team:</b>	South West Region Threatened Flora and Communities Recovery Team

**Illustrations and/or further information:** Brown, A., Thomson-Dans, C. and Marchant, N. (Eds). (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management (now DEC), Western Australia; George, A.S. (1996) New taxa and a new infrageneric classification in *Dryandra*. *Nuytsia* 10(3), 399-400; Western Australian Herbarium (2008) FloraBase - Information on the Western Australian Flora. Department of Environment and Conservation, Western Australia. <http://www.calm.wa.gov.au/science/>.

**Current status:** *Dryandra nivea* subsp. *uliginosa* was declared as Rare Flora in November 1996 under the Western Australian *Wildlife Conservation Act 1950* and is currently ranked as Endangered (EN) under World Conservation Union (IUCN 2001) Red List criterion A2c due to an estimated population size reduction of over 80% and a decline in the quality of habitat. The subspecies is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The main threats are mineral exploration, changes to hydrology, dieback disease, grazing, trampling, weed invasion, road, track and firebreak maintenance, inappropriate fire regimes, powerline maintenance, recreational activities, gravel extraction and rubbish removal.

**Description:** *Dryandra nivea* subsp. *uliginosa* is a mounded shrub to 1.5 m high and 1.5 m across, with long serrate-margined leaves that are similar to those of *D. nivea*. The flowers are variable, well hidden within the bush and yellowish-brown in colour. The style is maroon and the pollen presenter is green (Brown *et al.* 1998).

**Habitat requirements:** *Dryandra nivea* subsp. *uliginosa* occurs in two areas - near Busselton on the Swan Coastal Plain and on the Scott River Plain east of Augusta, growing in red, sandy, shallow loams over ironstone in thick scrub, in winter wet southern and Scott ironstones.

**Habitat critical to the survival of the subspecies, and important populations:** Habitat critical to the survival of the subspecies includes the area of occupancy of important populations; areas of similar habitat surrounding important populations (i.e. clay over laterite in thick scrub, in winter wet southern ironstones – these provide potential habitat for natural range extension and is necessary to allow pollinators to move between populations); the local catchment of the surface and possibly ground waters that maintain the habitat of the subspecies; and additional occurrences of similar habitat that may contain the subspecies or be suitable sites for future translocations.

Given that this subspecies is listed as Endangered it is considered that all known habitat for wild and translocated populations is habitat critical to its survival, and that all wild and translocated populations are important populations.

**Benefits to other species/ecological communities:** All populations are located within Threatened Ecological Communities (TECs). Other listed and priority flora also occur in the wider habitat of populations. Recovery actions implemented to improve the quality or security of the habitat of *Dryandra nivea* subsp. *uliginosa* are likely to improve the status of the TECs in which populations are located, as well as other rare and priority flora.

**International Obligations:** This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity that was ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that Convention. The subspecies is not listed under United Nations Environment Program World Conservation Monitoring Centre (UNEP-WCMC) Convention on International Trade in Endangered Species (CITES) and this IRP does not affect Australia's obligations under other international agreements.

**Role and interests of indigenous people:** According to the Department of Indigenous Affairs Aboriginal Heritage Sites Register, no sites of Aboriginal significance are known at or near populations of the subspecies covered by this IRP. However, the involvement of the Indigenous community is currently being sought to determine whether there are any issues or interests identified in the Plan. If no role is identified for indigenous communities in the recovery of this subspecies, opportunities may exist through cultural interpretation and awareness of the species.

The advice of the South West Aboriginal Land and Sea Council (SWALSC) and Department of Indigenous Affairs is being sought to assist in the identification of potential indigenous management responsibilities for land occupied by threatened species, or groups with a cultural connection to land that is important for the species' conservation.

Continued liaison between DEC and the indigenous community will identify areas in which collaboration will assist implementation of recovery actions.

**Social and economic impacts:** The implementation of this recovery plan has the potential to have some limited social and economic impact as some populations are located on private property. There are also mineral exploration and extraction leases over the area of land containing populations 4, 11, 14, 15, and subpopulations 8a and 16a of *Dryandra nivea* subsp. *uliginosa*. Recovery actions refer to continued liaison between stakeholders with regard to these areas.

**Affected interests:** Stakeholders potentially affected by the implementation of this plan include the Shires of Busselton and Augusta-Margaret River, WestNet Rail, Western Power and the owners of private land.

**Evaluation of the Plans Performance:** DEC in conjunction with the South West Region Threatened Flora and Communities Recovery Team will evaluate the performance of this IRP. In addition to annual reporting on progress and evaluation against the criteria for success and failure, the plan will be reviewed following four years of implementation.

### Completed recovery actions

1. Land managers have been notified of the location and threatened status of the subspecies.
2. Declared Rare Flora (DRF) markers have been installed at populations 10 and 12 and at all other road side sites .
3. Dashboard stickers and posters describing the significance of DRF markers have been produced and distributed.
4. Approximately 9.9 hectares of private property containing Subpopulation 6a was purchased by CALM (now DEC) in 1999 and is under the Care, Control and Management of the Conservation Commission. This area has been fenced to prevent access by stock.
5. One plant within Population 12 is located within an enclosure. This was built to protect other species of Declared Rare Flora against damage from roadworks.
6. In 1998 and 2000 CALM (now DEC) conducted aerial spraying of phosphite over approximately 11 hectares of land in the southern ironstone community that contains Subpopulation 8a and also sprayed Population 4 in March 2002. Which has continued on an annual basis since 2003.
7. The Botanic Gardens and Park Authority (BGPA) currently have 167 plants from four clones of *Dryandra nivea* subsp. *uliginosa* obtained from seed collected in 1995, 1996 and 1998.
8. A research proposal for the rescue of four rare and endangered species at BHP Beenup minesite was developed by the BGPA in 2003 (Dixon *et al.* 2003).
9. A genetic study was undertaken by BGPA in 2002. Several populations from the southern ironstone and Scott River ironstone areas were sampled and DNA-fingerprinting performed.
10. A translocation proposal aimed at re-introducing plants of *Dryandra nivea* subsp. *uliginosa*, *Darwinia ferricola* ms, *Grevillea brachystylis* subsp. *australis* and *Lambertia orbifolia* subsp. Scott River Plains was developed by the BGPA and BHP Billiton in 2003.
11. A fire response plan has been produced for the reserve containing Population 11 by staff from DEC's Blackwood District and Emergency Response Planning completed for all other occurrences.
12. Several collections of *Dryandra nivea* subsp. *uliginosa* seed has been made from populations 3a, 3b, 3c, 4, 5, 8, 9c, 9d and 11. These are stored in DEC's TFSC at -18°C and 4°C.
13. Liaison between local land owners and staff from the former Department of CALM (now DEC) Blackwood District has occurred and a new route for moving cattle between properties has been devised to prevent damage to the habitat at Population 5.

### Ongoing and future recovery actions

1. The South West Region Threatened Flora and Communities Recovery Team (SWTFCRT) is overseeing the implementation of this IRP and will include information on progress in their annual report to DEC's Corporate Executive and funding bodies.
2. Staff from DEC's Blackwood District regularly monitor populations of this subspecies.

**IRP Objective:** The objective of this IRP is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term preservation of the subspecies in the wild.

### Recovery criteria

**Criteria for success:** The number of populations have increased and/or individuals within populations have increased by ten percent or more over the 5 year term of this plan.

**Criteria for failure:** The number of populations have decreased or individuals within populations have decreased by ten percent or more over the 5 year term of this plan.

### Recovery actions

1. Coordinate recovery actions
2. Map habitat critical to the subspecies' survival
3. Formally notify land owners and land managers
4. Install and reassess position of Declared Rare Flora markers
5. Undertake weed control
6. Assess if fencing is required for Subpopulation 17b
7. Limit access to Subpopulation 8a
8. Rehabilitate habitat
9. Conduct further surveys
10. Remove rubbish from Population 14 and Subpopulation 8a
11. Develop and implement a fire management strategy
12. Maintain disease hygiene
13. Apply phosphite and monitor effects
14. Develop a kangaroo management strategy
15. Monitor populations
16. Achieve long-term protection of habitat
17. Promote awareness
18. Obtain biological and ecological information
19. Conduct additional genetic and taxonomic studies
20. Review the IRP and assess the need for further recovery actions

## 1. BACKGROUND

### History

The first known collection of *Dryandra nivea* subsp. *uliginosa*, housed at the Western Australian Herbarium, was made from east of Busselton in 1957 by R. Royce. Further collections have since been made, including a collection from Ruabon Nature Reserve in 1996 (Keighery *et al.* 1996). This population has yet to be relocated. Numerous surveys for the subspecies and other Scott River Plains endemics have since been undertaken by botanists and staff from DEC's Blackwood District (Gibson *et al.* 2001; Keighery *et al.* 1996; Keighery and Robinson 1992; Robinson and Keighery 1997). However, as the ironstone soils in which the subspecies is endemic are highly restricted and have been massively impacted by land clearance, new populations are likely to only be found in remnants on private property. Currently, *D. nivea* subsp. *uliginosa* is known from 18 populations that together contain around 2000 plants.

### Description

*Dryandra nivea* subsp. *uliginosa* is a mounded shrub, up to 1.5 m high by 1.5 m across, with long leaves that are similar to those of *D. nivea*. The flowers are variable, well hidden within the bush and yellowish-brown in colour. The style is maroon and the pollen presenter is green (Brown *et al.* 1998).

*Dryandra nivea* subsp. *uliginosa* is distinguished from *D. nivea* subsp. *nivea* by its larger size, mounded growth habit and longer leaves. *D. nivea* subsp. *nivea* is usually a sprawling, small shrub less than 1 m tall (Brown *et al.* 1998).

### Distribution and habitat

*Dryandra nivea* subsp. *uliginosa* occurs in two areas - near Busselton on the Swan Coastal Plain and on the Scott River Plain east of Augusta. Habitat is clay over laterite in thick scrub, in winter wet southern and Scott ironstones (George 1996).

Associated species in the southern ironstone populations include *Kunzea micrantha*, *Pericalymma ellipticum*, *Aphelia cyperoides*, *Centrolepis aristata*, *Acacia stenoptera*, *Hakea varia*, *Hemiandra pungens*, *Viminaria juncea*, *Borya scirpoidea*, *Caladenia marginata*, *Caustis dioica*, *Centrolepis drummondiana*, *Dampiera linearis*, *Drosera glanduligera*, *Drosera rosulata*, *Desmocladus fasciculata*, *Phyllangium paradoxum*, *Opercularia vaginata*, *Philydrella pygmaea*, *Utricularia multifida*, *Schoenus odontocarpus*, *Stylidium calcaratum*, *Thelymitra antennifera* and *Thysanotus thyrsoideus* (Gibson *et al.* 1994).

Associated species in the Scott River Plains populations include *Banksia littoralis*, *B. ilicifolia*, *B. grandis*, *Hakea prostrata*, *Xanthorrhoea preissii*, *Pimelea rosea*, *Isopogon formosus*, *Anthocercis littorea*, *Lysinema ciliatum*, *Melaleuca thymoides*, *Hibbertia stellaris*, *Viminaria juncea*, *Patersonia occidentalis*, *Lepidosperma* sp. (Obbens and Coates 1997).

*Dryandra nivea* subsp. *uliginosa* occurs on two Threatened Ecological Communities (TECs) (English and Blyth 1999) - the 'Scott River Ironstone Association' and 'Shrublands on southern Swan Coastal Plain Ironstones (Busselton area), Swan Coastal Plain Community type 10b (Gibson *et al.* 1994). The Busselton and Scott River ironstone soils are highly restricted in distribution. The Busselton ironstone community contains a total of 15 occurrences (140 hectares remaining uncleared) and the Scott River Plain area contains 38 occurrences (344 hectares remaining uncleared). This IRP will be implemented in conjunction with the IRPs for the 'Shrublands on southern Swan Coastal Plain Ironstones' (English 1999) and 'Scott River Ironstone Association' (Luu and English 2004).

### Summary of population land vesting, purpose and tenure

Population	District	Shire	Vesting	Purpose	Manager
1. SE of Augusta	Blackwood	Augusta-Margaret River	Conservation Commission of Western Australia	National Park and Recreation	DEC
2. E of Busselton	Blackwood	Busselton	Conservation	Conservation of Flora	DEC

Population	District	Shire	Vesting	Purpose and Fauna	Manager
<b>3A. E of Busselton</b>	Blackwood	Busselton	Commission of Western Australia	Road Reserve	Shire of Busselton
<b>3B. E of Busselton</b>	Blackwood	Busselton	Unvested Reserve	Rail Reserve	WestNet Rail
<b>3C. E of Busselton</b>	Blackwood	Busselton	Public Transport Authority	Rail Reserve	WestNet Rail
<b>4. SE of Busselton</b>	Blackwood	Busselton	Public Transport Authority	State Forest	DEC
<b>5. SE of Augusta</b>	Blackwood	Augusta-Margaret River	Conservation	Road Reserve	Shire of Augusta-Margaret River
<b>6A. W of Busselton</b>	Blackwood	Busselton	Unvested Reserve	Private Property	Landholders
<b>6B. W of Busselton</b>	Blackwood	Busselton	Freehold	Road Reserve	Shire of Busselton
<b>7A. W of Busselton</b>	Blackwood	Busselton	Unvested Reserve	Private Property	Landholders
<b>7B. W of Busselton</b>	Blackwood	Busselton	Freehold	State Forest	DEC
<b>8A. W of Busselton</b>	Blackwood	Busselton	Conservation	State Forest	DEC
<b>8B. W of Busselton</b>	Blackwood	Busselton	Commission of Western Australia	Private Property	Landholders
<b>8C. W of Busselton</b>	Blackwood	Busselton	Freehold	Private Property	Landholders
<b>9A. E of Busselton</b>	Blackwood	Busselton	Unvested Reserve	Road Reserve	Shire of Busselton
<b>9B. E of Busselton</b>	Blackwood	Busselton	Public Transport Authority	Rail Reserve	WestNet Rail
<b>9C. E of Busselton</b>	Blackwood	Busselton	Freehold	Private Property	Landholders
<b>9D. E of Busselton</b>	Blackwood	Busselton	Freehold	Private Property	Landholders
<b>10. SE of Busselton</b>	Blackwood	Busselton	Unvested Reserve	Road Reserve	Shire of Busselton
<b>11. SE of Augusta</b>	Blackwood	Busselton	Freehold	Private Property	Landholders
<b>12. SE of Busselton</b>	Blackwood	Busselton	Unvested Reserve	Road Reserve	Shire of Busselton
<b>13. W of Busselton</b>	Blackwood	Busselton	Unvested Reserve	Road Reserve	Shire of Busselton
<b>14. E of Busselton</b>	Blackwood	Busselton	Department of Land Information	Unallocated Crown Land	Shire of Busselton
<b>15. E of Busselton</b>	Blackwood	Busselton	Conservation	State Forest	DEC
<b>16A. SE of Busselton</b>	Blackwood	Busselton	Commission of Western Australia	State Forest	DEC
<b>16B. SE of Busselton</b>	Blackwood	Busselton	Conservation	State Forest	DEC
<b>17A. W of Busselton</b>	Blackwood	Busselton	Commission of Western Australia	Road Reserve	Shire of Busselton
<b>17B. W of Busselton</b>	Blackwood	Busselton	Unvested Reserve	Private Property	Landholders
<b>18. E of Busselton</b>	Blackwood	Busselton	Freehold	Road Reserve	Shire of Busselton

Populations in **bold text** are considered to be Important Populations.

## Biology and ecology

The subspecies is named from the Latin *uliginosa* (waterlogged) alluding to its winter-wet habitat (George 1996).

*Dryandra nivea* subsp. *uliginosa* seed may remain on the plant for a long time, although some follicles do open occasionally (Norrish 2003). Prescribed burns and wildfires that burnt populations and subpopulations in 1992, 1993 and 1999 (populations 4, 8 in 1992; subpopulations 3a, 3b, 9a, 9b, 9c and 9d in 1993; Population 15 and Subpopulation 16a in 1999), resulted in the death of adult plants and the subsequent germination of seedlings.

*Dryandra nivea* subsp. *uliginosa* has populations in two widely separated areas (Beenup and Busselton). DNA-fingerprinting, performed by Amplified Fragment Length Polymorphism (AFLP) found that a highly significant level of genetic differentiation existed between the Busselton and Beenup populations, warranting possible taxonomic recognition of plants from the two regions (Krauss and Alacs 2003).

A study in germination response of a number of threatened *Dryandra* species found that there was an increase in the germination percent of *Dryandra nivea* subsp. *uliginosa* seed after storage for one year at -20°C and at

moisture content of  $5\pm 1\%$ . This indicates that *ex situ* seed storage under low moisture and temperature conditions is a possible means of long term maintenance of threatened *Dryandra* seed (Cochrane *et al.* 2002).

*Dryandra nivea* subsp. *uliginosa* has been found to be susceptible to the plant pathogen *Phytophthora cinnamomi* (dieback) following 66 individuals being tested (C. Crane<sup>1</sup> personal communication).

A high level of insect predation on seed has been observed at populations 3, 4, 9, 11 in 1995, 1997 and 1998 (A. Cochrane<sup>2</sup> personal observation).

## Threats

*Dryandra nivea* subsp. *uliginosa* was declared as Rare Flora in November 1996 under the Western Australian *Wildlife Conservation Act 1950* and is currently ranked as Endangered (EN) under World Conservation Union (IUCN 2001) Red List criterion A2c due to the severe fragmentation of populations and a continuing decline in the quality of habitat and the number of mature plants. The subspecies is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The main threats are mineral exploration, changes to hydrology, dieback disease, grazing, trampling, weed invasion, road, track and firebreak maintenance, inappropriate fire regimes, powerline maintenance, recreational activities, gravel extraction and rubbish removal.

- **Mineral exploration** and extraction leases exist over land containing populations 4, 11, 14, 15, and subpopulations 8a and 16a.
- **Changes to hydrology** may become a threat to all populations as ground water extraction for agricultural, urban and other purposes is likely to result in a lowering of the water table. Adjacent mining also has the potential to alter hydrological processes and threaten the populations.
- **Dieback disease**, which causes roots to rot and results in plants dying of drought stress, is a threat to all populations and testing has shown that both the subspecies and its ironstone habitat are susceptible. The presence of the disease and deaths caused by it has been confirmed at populations 4, 11 and 16.
- **Grazing and trampling** by stock (cattle), rabbits (*Oryctolagus cuniculus*) and kangaroos is a threat to populations 5, 11 and 13 and subpopulations 6a, 7b and 8b. As well as grazing *Dryandra nivea* subsp. *uliginosa* plants animals impact on the habitat by digging, trampling and breaking foliage and also have the potential to spread dieback. An increased nutrient level in the soil from droppings is also likely and may encourage weed invasion. Grazing would have an impact on the establishment of young plants of *D. nivea* subsp. *uliginosa* thereby limiting natural recruitment.
- **Weed invasion** is a threat to most populations. The major weeds include *Babiana angustifolia*, *Watsonia* sp., *Eragrostis curvula* (African lovegrass), *Leptospermum laevigatum* (Victorian tea-tree), *Zantedeschia aethiopica* (arum lily), *Asparagus asparagoides* (bridal creeper), *Ehrharta* sp. (veldt grass) and *Sparaxis bulbifera* (harlequin flower). Weeds suppress early plant growth by competing for soil moisture, nutrients and light. They also exacerbate grazing pressure and increase the fire hazard due to the easy ignition of high fuel loads that are produced annually by many weed species.
- **Road, track and firebreak maintenance activities** threaten most populations. Threats include grading, chemical spraying, construction of drainage channels and the mowing of roadside vegetation. Several of these actions also encourage weed invasion.
- **Inappropriate fire regimes** would affect the viability of the populations, as *Dryandra nivea* subsp. *uliginosa* appears to germinate from seed following fire. If this is the case, the soil seed bank would rapidly be depleted if fires recurred before regenerating or juvenile plants reached maturity and replenished the soil seed bank. However, occasional fires or other disturbances are likely to be required for the subspecies to propagate from soil stored seed.

<sup>1</sup> Colin Crane, Senior Technical Officer, DEC's Science Division

<sup>2</sup> Anne Cochrane, Senior Research Scientist, DEC's Threatened Flora Seed Centre



- **Powerline maintenance** is a potential threat to Population 5. Disturbance during maintenance may encourage weed invasion and also directly damage plants. The relevant authority will be notified of the population.
- **Recreational activities** such as illegal firewood cutting and collection (Population 14 and Subpopulation 8a), and recreational motorbike and 4x4 vehicle use (Population 14) are a threat to the subspecies. These activities increase the risk of damaging the subspecies through trampling, as well as increase the spread of dieback disease through the area. A works submission between the Department of Planning and Infrastructure and DEC is in place to reduce access to the area containing Population 14, to prevent further impacts from recreational use.
- **Gravel extraction** is a threat to Population 14. The taxon may be damaged or completely removed during this process, and the risk of increasing the spread of dieback disease through the area is increased.
- **Rubbish dumping** is a threat to Population 14 and Subpopulation 8a. While being unsightly, it possibly may contribute to more rubbish at the site. It also encourages weeds and provides habitat for rabbits.

### Summary of population information and threats

Pop. No. & Location	Land Status	Year/No. plants	Condition	Threats
1. SE of Augusta	National Park			
2. E of Busselton	Nature Reserve	2000 0		
3A. E of Busselton	Shire Road Reserve	1995 *100 (20+) 1997 *100+	Moderate	Road maintenance, dieback, weeds, inappropriate fire regimes, hydrological changes
3B. E of Busselton	Rail Reserve	1995 *100+ (20+) 1997 *100+	Moderate	Dieback, weeds, inappropriate fire regimes, hydrological changes
3C. E of Busselton	Rail Reserve	2000 26 (3) [5]	Healthy	Dieback, weeds, firebreak maintenance, inappropriate fire regimes, hydrological changes
4. SE of Busselton	State Forest	1995 100+ (50) [20] 1996 100+ 2002 100+ [10]	Poor	Mining, dieback, weeds, inappropriate fire regimes, firebreak maintenance
5. SE of Augusta	Shire Road Reserve	1995 150 1996 100+ 2003 300+	Healthy	Road maintenance, stock disturbance, weeds, dieback, inappropriate fire regimes, hydrological changes, powerline maintenance
6A. W of Busselton	Nature Reserve	1995 10+ 1997 *100+ 2003 280+ [50-100]	Healthy	Dieback, inappropriate fire regimes, grazing (kangaroos), weeds, hydrological changes
6B. W of Busselton	Shire Road Reserve	1997 7 2003 10	Poor	Road maintenance, dieback, inappropriate fire regimes, weeds, hydrological changes
7A. W of Busselton	Private Property	1995 0 2003 0	Cleared	
7B. W of Busselton	State Forest	1996 0 2003 (10??)	Cleared (but regenerating)	Firebreak maintenance, dieback, grazing, inappropriate fire regimes, hydrological changes
8A. W of Busselton	State Forest	1995 200+ (50+) 1996 100+ 1998 100+ [100+]	Moderate	Mining, dieback, inappropriate fire regimes, rubbish dumping, hydrological changes, illegal firewood collection
8B. W of Busselton	Private Property	1997 ?	Previously cleared	Grazing (cattle), weeds, dieback
8C. W of Busselton	Private Property			
9A. E of Busselton	Shire Road Reserve	1995 *200+ (100+) 1997 *100+	Moderate	Road maintenance, dieback, inappropriate fire regimes, hydrological changes
9B. E of Busselton	Rail Reserve	1995 *200+ (100+) 1997 *100+	Healthy	Dieback, inappropriate fire regimes, hydrological changes
9C. E of Busselton	Private Property	1995 *200+ (100+)	Moderate	Dieback, inappropriate fire regimes, hydrological changes
9D. E of Busselton	Private Property	1995 *200+ (100+)	Moderate	Dieback, inappropriate fire regimes,

Pop. No. & Location	Land Status	Year/No. plants	Condition	Threats
				hydrological changes
<b>10. SE of Busselton</b>	Shire Road Reserve	1996 6 (2) 1997 6 [2] 2003 6	Poor	Road maintenance, weeds, dieback, inappropriate fire regimes, hydrological changes
<b>11. SE of Augusta</b>	Private Property	2003 95 [16]	Moderate	Mining, grazing (kangaroos), inappropriate fire regimes, dieback, weeds (minor), hydrological changes
<b>12. SE of Busselton</b>	Shire Road Reserve	1996 3 (8) 2000 2	Poor	Road maintenance, dieback, weeds, inappropriate fire regimes, hydrological changes
<b>13. W of Busselton</b>	Shire Road Reserve	1997 15 2000 10+ 2003 37	Moderate	Weeds, road maintenance, stock disturbance, inappropriate fire regimes, dieback, hydrological changes
<b>14. E of Busselton</b>	Unallocated Crown Land	1998 50+(4+) [1]	Moderate	Mining, gravel extraction, dieback, rubbish dumping, inappropriate fire regimes, hydrological changes, illegal firewood collection, recreational use
<b>15. E of Busselton</b>	State Forest	1999 2 (8) [9]	Healthy	Mining, dieback, inappropriate fire regimes, hydrological changes
<b>16A. SE of Busselton</b>	State Forest	1999 14 (12) [10] 2001 14 (50+)	Moderate	Mining, dieback, inappropriate fire regimes, hydrological changes
<b>16B. SE of Busselton</b>	State Forest	2002 5	Moderate	Dieback, inappropriate fire regimes, hydrological changes
<b>17A. W of Busselton</b>	Shire Road Reserve	2002 40+ 2003 79 [24]	Moderate	Road maintenance, inappropriate fire regimes, weeds, dieback, hydrological changes
<b>17B. W of Busselton</b>	Private Property	2003 2	Moderate	Dieback, inappropriate fire regimes, hydrological changes
<b>18. E of Busselton</b>	Shire Road Reserve	2003 25+	Moderate	Road maintenance, dieback, weeds, inappropriate fire regimes, hydrological changes

Populations in **bold text** are considered to be Important Populations, Note: \* = total for both subpopulations, ( ) = number of seedlings, [ ] = number dead

### Guide for decision-makers

Section 1 provides details of current and possible future threats. Proposed developments and on-ground works (clearing, firebreaks etc) in the immediate vicinity of habitat critical to the survival of *Dryandra nivea* subsp. *uliginosa* will require assessment. Works should not be approved unless the proponents can demonstrate that they will not have a significant impact on the subspecies, its habitat or potential habitat, or the local surface or ground water hydrology.

### Habitat critical to the survival of the subspecies, and important populations

Habitat critical to the survival of the subspecies includes the area of occupancy of important populations, areas of similar habitat that surround populations (i.e. clay over laterite in thick scrub in winter wet southern and Scott ironstones) that provide potential habitat for natural range extension and are necessary to allow pollinators to move between populations, the local catchment of the surface and possibly ground waters that maintain the habitat of the subspecies and additional occurrences of similar habitat that may contain the subspecies or be suitable sites for future translocations.

Given that this subspecies is listed as Endangered it is considered that all known habitat for wild and translocated populations is habitat critical to its survival, and that all wild and translocated populations are important populations.

### Benefits to other species/ecological communities

*Dryandra nivea* subsp. *uliginosa* is endemic to the 'Shrublands on southern Swan Coastal Plain Ironstones (Busselton area), Swan Coastal Plain Community type 10b, Gibson *et al.* 1994'. This community is listed as Critically Endangered in Western Australia and Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The subspecies also occurs in the TEC 'Scott River

Ironstone Association' Threatened Ecological Community (TEC), which is listed as Endangered in Western Australia. Other listed and priority flora also occur in the wider habitat of the populations include *Andersonia ferricola* (Priority 1), *Calothamnus crassus* (Priority 4), *Chamelaucium roycei* ms (Vulnerable under the Western Australian *Wildlife Conservation Act 1950* and EPBC Act), *Chordifex isomorphus* (Priority 4), *Darwinia ferricola* ms (Endangered under the Western Australian *Wildlife Conservation Act 1950* and EPBC Act), *Darwinia* sp. Williamson (Critically Endangered under the Western Australian *Wildlife Conservation Act 1950* and Endangered under the EPBC Act), *Dryandra squarrosa* subsp. *argillacea* (Endangered under the Western Australian *Wildlife Conservation Act 1950* and Vulnerable under the EPBC Act), *Gastrolobium modestum* (Vulnerable under the Western Australian *Wildlife Conservation Act 1950* and EPBC Act), *Gastrolobium papilio* (Critically Endangered under the Western Australian *Wildlife Conservation Act 1950* and Endangered under the EPBC Act), *Grevillea brachystylis* subsp. *australis* (Endangered under the Western Australian *Wildlife Conservation Act 1950* and Vulnerable under the EPBC Act), *Grevillea elongata* (Endangered under the Western Australian *Wildlife Conservation Act 1950* and Vulnerable under the EPBC Act), *Grevillea manglesioides* subsp. *ferricola* (Priority 2), *Grevillea mccutcheonii* (Critically Endangered under the Western Australian *Wildlife Conservation Act 1950* and Endangered under the EPBC Act), *Hakea oldfieldii* (Priority 3), *Hakea tuberculata* (Priority 3), *Lambertia echinata* subsp. *occidentalis* (Critically Endangered under the Western Australian *Wildlife Conservation Act 1950* and Endangered under the EPBC Act), *Lambertia orbifolia* subsp. Scott River Plains (Endangered under the Western Australian *Wildlife Conservation Act 1950* and the EPBC Act), *Loxocarya magna* (Priority 3), *Petrophile latericola* (Critically Endangered under the Western Australian *Wildlife Conservation Act 1950* and Endangered under the EPBC Act) (Gibson *et al.* 2000). Recovery actions implemented to improve the quality or security of the habitat of populations of *Dryandra nivea* subsp. *uliginosa* are likely to improve the status of the TEC in which the populations are located, as well other rare and priority flora.

### **International Obligations**

This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that convention. The subspecies is not specifically listed under any specific international treaty, and therefore this plan does not affect Australia's obligations under any other international agreements.

### **Role and interests of indigenous people**

According to the Department of Indigenous Affairs Aboriginal Heritage Sites Register, no sites of Aboriginal significance are known at or near populations of the subspecies that is covered by this IRP. However, the involvement of the Indigenous community is currently being sought to determine whether there are any issues or interests identified in the Plan. If no role is identified for indigenous communities in the recovery of this subspecies, opportunities may exist through cultural interpretation and awareness of the species.

The advice of the South West Aboriginal Land and Sea Council (SWALSC) and Department of Indigenous Affairs is being sought to assist in the identification of potential indigenous management responsibilities for land occupied by threatened species, or groups with a cultural connection to land that is important for the species' conservation.

Continued liaison between DEC and the indigenous community will identify areas in which collaboration will assist implementation of recovery actions.

### **Social and economic impacts**

The implementation of this recovery plan is unlikely to cause significant adverse social or economic impacts. However, as some populations are located on private property and in areas leased for mining activities (populations 4, 11, 14, 15 and subpopulations 8a, 16a), their protection may potentially affect farming and mining activities. Actions will involve liaison and cooperation with all stakeholders with regard to these areas.

### **Affected interests**

Stakeholders potentially affected by the implementation of this plan include the Shires of Busselton and Augusta-Margaret River as the manager of the road reserve habitat of populations 5, 10, 12, 13, and 18, and subpopulations 3a, 6b, 9a and 17a. WestNet Rail as the manager of rail reserves containing subpopulations 3b, 3c and 9b; Western Power as the manager of the power line that intersects Population 5; and the owners of private land that contains Population 11 and subpopulations 8b, 8c, 9c, 9d and 17b.

### **Evaluation of the Plans Performance**

DEC in conjunction with the South West Region Threatened Flora and Communities Recovery Team will evaluate the performance of this IRP. In addition to annual reporting on progress and evaluation against the criteria for success and failure, the plan will be reviewed following four years of implementation.

## **2. RECOVERY OBJECTIVE AND CRITERIA**

**IRP Objective:** The objective of this IRP is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term preservation of the subspecies in the wild.

### **Recovery criteria**

**Criteria for success:** The number of populations have increased and/or individuals within populations have increased by ten percent or more over the 5 year term of this plan.

**Criteria for failure:** The number of populations have decreased or individuals within populations have decreased by ten percent or more over the 5 year term of this plan.

## **3. RECOVERY ACTIONS**

### **Completed recovery actions**

Relevant land managers have been formally notified of the presence and threatened nature of *Dryandra nivea* subsp. *uliginosa* on their land. The notification details the Declared Rare status of the subspecies and the associated legal responsibilities.

Declared Rare Flora (DRF) markers have been installed at populations 10 and 12. These serve to alert people working in the vicinity to the presence of the DRF and the need to avoid work that may damage plants or their habitat. Dashboard stickers and posters describing the significance of DRF markers have been produced and distributed.

Approximately 9.9 hectares of private property containing Subpopulation 6a was purchased by CALM (now DEC) in 1999 and is under the Care, Control and Management of the Conservation Commission of Western Australia. This area has been fenced to prevent access by stock.

Subpopulation 8c was fenced by the landowner to prevent the subspecies unintentionally being destroyed during gravel extraction works.

One plant within Population 12 is located in an enclosure. This was built to protect other species of Declared Rare Flora against damage from roadworks. Another plant is located outside the enclosure.

In 1998 and 2000 CALM (now DEC) undertook aerial spraying of phosphite over approximately 11 hectares of the southern ironstone community that contains Subpopulation 8a and in March 2002 also sprayed Population 4. An aerial spraying program of a number of populations of the subspecies was undertaken between March 2002 and March 2005 with most sites sprayed every year.

The Botanic Gardens and Park Authority (BGPA) currently have 167 plants from four clones of *Dryandra nivea* subsp. *uliginosa*, with plants grown from seed collected in 1995, 1996 and 1998 (A. Shade<sup>3</sup> personal communication).

A research proposal for the rescue of four rare and endangered species at BHP Beenup Mine site was developed by the BGPA in 2003 (Dixon *et al.* 2003). This proposal is a pilot study and aims to:

- Contribute to a better understanding of post mining rehabilitation;
- Increase biodiversity within the site;
- Contribute to the knowledge base of rare and endangered species through genetic analysis, propagation research and cultural techniques;
- Improve understanding of the biology and plants;
- Reduce the threat of extinction by learning how to establish new populations in post mining situations or pre mined areas.

As part of this research project, a genetic study was also undertaken by BGPA in 2002. Several populations from both the southern ironstone and Scott River ironstone areas were sampled and DNA-fingerprinting was performed (Krauss and Alacs 2003).

A translocation proposal aimed at re-introducing plants of *Dryandra nivea* subsp. *uliginosa*, *Darwinia ferricola* ms, *Grevillea brachystylis* subsp. *australis* and *Lambertia orbifolia* subsp. Scott River Plains was developed by the BGPA and BHP Billiton in 2003. One hundred and sixty plants from two populations were planted on a previously mined area and surrounds in July 2003. Soil type and irrigation were included as two variables in the experimental design. The site was also fenced to reduce the threat of grazing by rabbits and kangaroos. Monitoring will include the number of surviving plants, height and width of crown, reproductive state, number of inflorescences and fruits, presence of second generation plants and general health of plants (Norrish 2003).

A fire response plan has been produced for the reserve containing Population 11 by staff from DEC's Blackwood District.

There have been a number of seed collections made from *Dryandra nivea* subsp. *uliginosa*, including 560 from subpopulations 3a, 3b and 3c in February 1995, 3703 from Population 4 between December 1994 and January 1996, 1614 from Population 5 in February 1995, 881 from Population 8 in February and April 1997, 1072 from subpopulations 9c and 9d in February 1998 and 420 from Population 11 in February 1997. All are stored in DEC's TFSC at -18°C and 4°C. The TFSC test the viability of the seed initially and after one year in storage. The initial germination rate of *D. nivea* subsp. *uliginosa* seed was found to range from 70 to 98%, and after one year in storage from 55 to 100% (A. Cochrane unpublished data). A small amount of seed (140) from Population 8 was transferred to the BGPA in 1998 for storage.

Liaison between local land owners and staff from CALM's Blackwood District has occurred and a new route for moving cattle between properties has been devised to prevent damage to the habitat of Population 5.

### **Ongoing and future recovery actions**

The South West Region Threatened Flora and Communities Recovery Team (SWTFCRT) is overseeing the implementation of this IRP and will include information on progress in their annual report to DEC's Corporate Executive and funding bodies.

Staff from DEC's Blackwood District regularly monitor populations of this subspecies.

Where populations occur on lands other than those managed by DEC, permission has been or will be sought from appropriate land managers prior to recovery actions being undertaken.

### **1. Coordinate recovery actions**

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<sup>3</sup> Amanda Shade, Horticulturalist, BGPA

The South West Region Threatened Flora and Communities Recovery Team (SWRTFCRT) will continue to coordinate recovery actions for *Dryandra nivea* subsp. *uliginosa* and other Declared Rare Flora and threatened ecological communities in their region. They will include information on progress in their annual report to DEC's Corporate Executive and funding bodies.

**Action:** Coordinate recovery actions  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$2,100 per year

## 2. Map habitat critical to the subspecies' survival

It is a requirement of the EPBC Act that spatial data relating to habitat critical to the subspecies' survival be determined. Although this habitat is described in Section 1, it has not yet been fully mapped and this will be addressed under this action. If additional populations are located, their habitat will also be determined and mapped.

**Action:** Map habitat critical to the subspecies' survival  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$4,000 in the first year

## 3. Formally notify land owners and land managers

Land owners adjacent to land containing populations 10 and 13 and Subpopulation 6b, need to be formally notified of the presence of *Dryandra nivea* subsp. *uliginosa*. In addition, Western Power will also be notified as the subspecies is located under a powerline on an access track.

**Action:** Formally notify land owners and land managers  
**Responsibility:** DEC (Species and Communities Branch)  
**Cost:** \$500 in first year

## 4. Install and reassess position of Declared Rare Flora markers

Declared Rare Flora (DRF) markers are required for all road reserve populations and the firebreak at Subpopulation 7b. Their positioning may also need reassessing to ensure that all plants are covered. The purpose of DRF markers is to alert road and other workers to the presence of DRF.

**Action:** Install and reassess position of DRF markers  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$700 in first year

## 5. Undertake weed control

Weed control will be undertaken in consultation with the land managers. Appropriate methods of weed control are found in Brown and Brooks (2002) and may include hand weeding or localised application of herbicide. All weed control actions including details of method, timing and success of the treatment against weeds will be recorded in district weed databases. Routine inspections will monitor the effect on *Dryandra nivea* subsp. *uliginosa* and associated native plant species. It is anticipated that native species will regenerate after weed competition is removed.

**Action:** Undertake weed control  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$1,600 per year

## 6. Assess if fencing is required for Subpopulation 17b

If fencing is required for Subpopulation 17b on private property, an agreement with the owners will be sought and will include a buffer of surrounding habitat to protect *Dryandra nivea* subsp. *uliginosa* from potential

grazing and other disturbances. Funding assistance for this fencing may be obtained through the Remnant Vegetation Protection Scheme as part of the covenanting process.

**Action:** Assess if fencing is required for Subpopulation 17b  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$3,000 in first year

#### 7. Limit access to Subpopulation 8a

To limit access, gates need to be installed at entry points into State Forest containing Subpopulation 8a.

**Action:** Limit access to Subpopulation 8a  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$3,000 in first year

#### 8. Rehabilitate habitat

The habitat containing Population 14 should be deep ripped and allowed to regenerate naturally.

**Action:** Rehabilitate habitat  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$1,500 in first year

#### 9. Conduct further surveys

Further surveys by DEC staff and community volunteers will be conducted during the flowering period of this subspecies (September). Records of areas surveyed will be sent to Species and Communities Branch and retained at the District even if the subspecies is not found.

**Action:** Conduct further surveys  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$2,600 per year

#### 10. Remove rubbish from Population 14 and Subpopulation 8a

Garden waste and other rubbish has been dumped at Population 14 and Subpopulation 8a. Rubbish removal will need to be carried out by a contractor and/or DEC staff during summer to avoid spreading disease and increase soil disturbance, with careful supervision from DEC Blackwood District staff to ensure that disturbance to surrounding plants is minimized. Signs to warn the public about the illegality of rubbish dumping will be erected where needed.

**Action:** Remove rubbish from Population 14 and Subpopulation 8a  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$10,000 in the first year

#### 11. Develop and implement a fire management strategy

*Dryandra nivea* subsp. *uliginosa* appears to be an obligate seeder, with germination occurring following fire. Fire will be prevented from occurring in the habitat of populations, except where it is being used experimentally as a recovery tool. A fire management strategy will be developed by the completion date of this plan that recommends fire frequency, intensity, season, and control measures.

**Action:** Develop and implement a fire management strategy  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$2,500 in first year and \$1,000 in subsequent years

#### 12. Maintain disease hygiene

The ironstone habitat in which *Dryandra nivea* subsp. *uliginosa* occurs is inundated over the winter months and favours the establishment and spread of *Phytophthora*. Many plant species in the ironstone community, including *D. nivea* subsp. *uliginosa*, are presumed to be susceptible to this disease. Dieback hygiene (outlined in CALM 2003 (now DEC)) will therefore be followed for activities such as installation and maintenance of firebreaks and walking into the population in wet soil conditions. Purpose built signs advising of the dieback risk and high conservation values of the sites will be installed where required.

**Action:** Maintain disease hygiene  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$800 per year

### 13. Apply phosphite and monitor effects

Phosphite will be applied to areas where dieback is present and has the potential to threaten the *Dryandra nivea* subsp. *uliginosa*. The impact of the application of phosphite on the subspecies and in the control of *Phytophthora* spp. will be monitored.

**Action:** Apply phosphite and monitor effects  
**Responsibility:** DEC (Blackwood District, Dieback Disease Coordinator) through the SWRTFCRT  
**Cost:** \$55,200 in first, third and fifth years (\$345/ha x 160 ha for southern and Scott ironstone)

### 14. Develop a kangaroo management strategy

A management strategy will be developed in areas where kangaroos are having an impact on populations of *Dryandra nivea* subsp. *uliginosa* through trampling and breaking of foliage. The strategy will include a survey to determine kangaroo density, monitoring of impacts on the subspecies, and recommendations to reduce the impact.

**Action:** Develop a kangaroo management strategy  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$2,000 in first year (cost of monitoring included under action 15)

### 15. Monitor populations

Annual monitoring of factors such as habitat degradation (including weed invasion and plant diseases), population stability (expansion or decline), pollinator activity, grazing, seed production, recruitment, longevity and predation is essential. All populations will be inspected annually with special attention given to impacts from changes to hydrology.

**Action:** Monitor populations  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$2,000 per year

### 16. Achieve long-term protection of habitat

Ways and means of improving the security of populations and their habitat will be investigated. On private land, this may include conservation covenants with a range of agencies, or registration through the Land for Wildlife Scheme.

**Action:** Achieve long-term protection of habitat  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$1,500 per year

### 17. Promote awareness



The importance of biodiversity conservation and the need for the long-term protection of wild populations of *Dryandra nivea* subsp. *uliginosa* will be promoted to the community through poster displays and the local print and electronic media. Formal links with local naturalist groups and interested individuals will also be encouraged. An information sheet will be produced, and will include a description of the plant, its habitat, threats, recovery actions and photos. This will be distributed to the public through DEC's Blackwood District Office and at the offices and libraries of the Shires of Busselton and Augusta-Margaret River. Such information distribution may lead to the discovery of new populations.

**Action:** Promote awareness  
**Responsibility:** DEC (Blackwood District) through the SWRTFCRT  
**Cost:** \$1,300 in first year; \$600 per year thereafter

## 18. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Dryandra nivea* subsp. *uliginosa* will provide a scientific basis for its management in the wild. An understanding of the following is necessary for effective management:

1. Soil seed bank dynamics, including seedbank location and viability.
2. The role of various disturbances (including fire), competition, rainfall and grazing in germination and recruitment.
3. The pollination biology of the subspecies.
4. The requirements of pollinators.
5. The reproductive strategies, phenology and seasonal growth of the subspecies.
6. The population genetic structure, levels of genetic diversity and minimum viable population size.
7. Investigation of the impacts of dieback disease and control techniques on *Dryandra nivea* subsp. *uliginosa* and its habitat.

**Action:** Obtain biological and ecological information  
**Responsibility:** DEC (Science Division, Blackwood District) through the SWRTFCRT  
**Cost:** \$45,000 pa for three years

## 19. Conduct additional genetic and taxonomic studies

Rapid DNA analysis of *Dryandra nivea* subsp. *uliginosa* shows that a significant level of genetic differentiation exists between the Busselton and Beenup populations (Krauss and Alacs 2003). Additional genetic and taxonomic studies are required.

**Action:** Conduct additional genetic and taxonomic studies  
**Responsibility:** DEC (Science Division) through the SWRTFCRT  
**Cost:** \$10,000 in first year

## 20. Review the IRP and assess the need for further recovery actions

At the end of the five-year term this IRP will be reviewed and the need for further recovery actions assessed.

**Action:** Review the IRP and assess the need for further recovery actions  
**Responsibility:** DEC (Species and Communities Branch, Blackwood District) through the SWRTFCRT  
**Cost:** \$4,000 in the fifth year (if required)

## Summary of recovery actions

Recovery Actions	Priority	Responsibility	Completion date
Coordinate recovery actions	High	DEC (Blackwood District) through the SWRTFCRT	2013
Map habitat critical to the subspecies' survival	Med	DEC (Blackwood District) through the SWRTFCRT	2008
Formally notify land owners and land managers	High	DEC (Species and Communities Branch)	2008
Install and reassess position of	High	DEC (Blackwood District) through the SWRTFCRT	2008

Declared Rare Flora markers			
Undertake weed control	High	DEC (Blackwood District) through the SWRTFCRT	2013
Assess if fencing is required for Subpopulation 17b	High	DEC (Blackwood District) through the SWRTFCRT	2008
Limit access to Subpopulation 8a	High	DEC (Blackwood District) through the SWRTFCRT	2008
Rehabilitate habitat	Med	DEC (Blackwood District) through the SWRTFCRT	2008
Conduct further surveys	High	DEC (Blackwood District) through the SWRTFCRT	Ongoing
Remove rubbish from Population 14 and Subpopulation 8a	Med	DEC (Blackwood District) through the SWRTFCRT	2008
Develop and implement a fire management strategy	High	DEC (Blackwood District) through the SWRTFCRT	Develop by 2008 with implementation ongoing
Maintain disease hygiene	High	DEC (Blackwood District) through the SWRTFCRT	Ongoing
Apply phosphite and monitor effects	High	DEC (Blackwood District, Dieback Disease Coordinator) through the SWRTFCRT	2013
Develop a kangaroo management strategy	High	DEC (Blackwood District) through the SWRTFCRT	2010
Monitor populations	High	DEC (Blackwood District) through the SWRTFCRT	Ongoing
Achieve long-term protection of habitat	Medium	DEC (Blackwood District) through the SWRTFCRT	Ongoing until achieved
Promote awareness	Medium	DEC (Blackwood District) through the SWRTFCRT	Ongoing
Obtain biological and ecological information	Medium	DEC (Science Division, Blackwood District) through the SWRTFCRT	2010
Conduct additional genetic and taxonomic studies	Medium	DEC (Science Division) through the SWRTFCRT	2008
Review the IRP and assess the need for further recovery actions	Medium	DEC (Species and Communities Branch, Blackwood District) through the SWRTFCRT	2013

#### 4. TERM OF PLAN

##### Western Australia

This IRP will operate from April 2008 to March 2013 but will remain in force until withdrawn or replaced. If the subspecies is still ranked Endangered after five years, the need for further recovery actions and an update of this IRP will be assessed.

##### Commonwealth

In accordance with the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) this adopted recovery plan will remain in force until revoked.

The recovery plan must be reviewed at intervals of not longer than 5 years.

#### 5. REFERENCES

- Atkins, K. (2008) *Declared Rare and Priority Flora List for Western Australia*. Department of Environment and Conservation, Western Australia.
- Brown, A., Thomson-Dans, C. and Marchant, N. (Eds). (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management (now DEC), Perth, Western Australia.
- Brown, K. and Brooks, K. (2002) *Bushland weeds; a practical guide to their management*. Environmental Weeds Action Network (Inc), Western Australia.
- Cochrane, A., Brown, K. and Kelly, A. (2002) Low temperature and low moisture storage of seeds of rare and threatened taxa in the endemic Western Australian genus *Dryandra* (R.Br.) (Proteaceae). *Conservation Science Western Australia* 4(1), 1-12.
- Department of Conservation and Land Management (2003) *Phytophthora cinnamomi* and disease caused by it Volume 1 – Management Guidelines. Department of Conservation and Land Management, Western Australia.
- Department of Conservation and Land Management (1994) Policy Statement No. 50 *Setting Priorities for the Conservation of Western Australia's Threatened Flora and Fauna*. Department of Conservation and Land Management, Western Australia.

- Department of Conservation and Land Management (1992) Policy Statement No. 44 *Wildlife Management Programs*. Department of Conservation and Land Management, Western Australia.
- Dixon, K.D., Dixon, B. and Krauss, S. (2003) Kings Park and Botanic Garden (BGPA) Science Directorate research proposal for the rescue of four rare and endangered species at BHP Beenup minesite. Botanic Gardens and Parks Authority, Perth.
- English, V. (1999) Shrubland Association on southern Swan Coastal Plain ironstone (Busselton area) (southern ironstone association). *Interim Recovery Plan Number 44*, 1999-2002. Department of Conservation and Land Management, Western Australia.
- English, V. and Blyth, J. (1999) Development and application of procedures to identify and conserve threatened ecological communities in the South-west Botanical Province of Western Australia. *Pacific Conservation Biology* 5, 124-138.
- George, A.S. (1996) New taxa and a new infrageneric classification in *Dryandra*. *Nuytsia* 10(3), 399-400.
- Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994) *A floristic survey of the Southern Swan Coastal Plain*. Unpublished report for the Australian Heritage Commission prepared by Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).
- Gibson, N., Keighery, G. and Keighery, B. (2000) Threatened plant communities of Western Australia. 1. The ironstone communities of the Swan and Scott Coastal Plains. *Journal of the Royal Society of Western Australia* 83, 1-11.
- Gibson, N., Keighery, G.J. and Lyons, M.N. (2001) Vascular flora of Scott National Park, Camping Reserve 12951 and Gingilup Swamps Nature Reserve, Western Australia. *CALMScience* 3(4), 411-432.
- Keighery, G.J., Keighery, B.J. and Gibson, N. (1996) Floristics of reserves and bushland areas in the Busselton region (System 1). Part III: Floristics of Ruabon Nature Reserve. Wildflower Society of WA (Inc.), Nedlands.
- Keighery, G. and Robinson, C. (1992) *A survey of Declared Rare flora and other plants in need of special protection of the Scott Plains*. A report to the Australia National Parks and Wildlife Service prepared by Department of Conservation and Land Management (now DEC), Perth, Western Australia.
- Krauss, S. and Alacs, E. (2003) Population genetic analysis of the DRF *Dryandra nivea* subsp. *uliginosa* and *Grevillea brachystylis* subsp. *australis*. *BGPA Genetics Laboratory report* No. 16.
- Luu, R. and English, V. (2004) Scott River Ironstone Association. *Draft Interim Recovery Plan*, 2004-2009. Department of Conservation and Land Management (now DEC), Perth, Western Australia.
- Norrish, R. (2003) *Translocation proposal for four species of Declared Rare Flora from the Scott Coastal Plain Ironstone Communities to the BHP Billiton Beenup Rehabilitation Project*. GHD Pty Ltd, Bunbury.
- Obbens, F.J. and Coates, D.J. (1997) Conservation Biology and Management of Endangered *Lambertia* Species. Department of Conservation and Land Management, Western Australia.
- Robinson, C. and Keighery, G. (1997) Vegetation and flora of Scott National Park and adjacent recreation reserves. *The Western Australian Naturalist* 21(4), 213-233.
- Western Australian Herbarium (1998) FloraBase – Information on the Western Australian Flora. Department of Environment and Conservation, Western Australia. <http://www.calm.wa.gov.au/science/>
- World Conservation Union (2001) *IUCN red list categories 3.1* prepared by the IUCN Species Survival Commission, as approved by the 51st meeting of the IUCN Council. Gland, Switzerland.

## 6. TAXONOMIC DESCRIPTION

George, A.S. (1996) New taxa and a new infrageneric classification in *Dryandra*. *Nuytsia* 10(3), 399-400.

*Dryandra nivea* (Labill.) R.Br. subsp. *nivea* A.S. George is a dense shrub to 1.5m tall. Leaves deeply pinnatipartite; lamina 20-45cm long, 7-10mm wide; lobes 60-80 each side, obliquely triangular, obtuse, the upper margin convex, lower convex or shallowly S-shaped; sinuses curved-V-shaped, 2-5mm across, the margins contiguous in lower half; petiole 1-3cm long. Inflorescence terminal; involucre bracts ovate to oblong, sparsely pubescent to glabrous except ciliate margins, the innermost ones to 20mm long; receptacle rounded; flowers c.70 per head; floral bracts linear, obtuse, 4-5mm long, white-hirsute, the apex papillose. Perianth 29-38mm long, hirsute; limb 3mm long, coarsely hirsute. Pistil 41-45mm long, glabrous; pollen presenter not thickened, 0.7-0.9mm long.

