Waxy-leaved Smokebush

(*Conospermum undulatum*)

RECOVERY PLAN

Department of Environment and Conservation
Kensington

Australian Government

Government of Western Australia

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This IRP will operate from April 2008 to March 2013 but will remain in force until withdrawn or replaced.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 species is still ranked Vulnerable (VU), 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 in 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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Kelly Poultney	Technical Officer - DRF Database, Species and Communities Branch, DEC
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Thanks also to the staff of the W.A. Herbarium for providing access to Herbarium databases and specimen information, and DEC's Species and Communities Branch for assistance.

Cover photographs by Val English.

CITATION

Department of Environment and Conservation (2009). Wavy-leaved smokebush (*Conospermum undulatum*) Recovery Plan. Commonwealth Department of the Environment, Water, Heritage and the Arts, Canberra.

SUMMARY

Scientific Name:	***Conospermum undulatum***	**Common Name:**	Waxy-leaved smokebush
Family:	Proteaceae	**Flowering Period:**	August-October
DEC Region:	Swan	**DEC Districts:**	Swan Coastal and Perth Hills
Shires:	Kalamunda and Gosnells	**Recovery Team:**	Swan Region Threatened Flora and Communities Recovery Team (SRTFRT)

Illustrations and/or further information: Brown, A., Thomson-Dans, C. and Marchant, N. (1998). *Western Australia's Threatened Flora*. Department of Conservation and Land Management, Western Australia. Pp 117; Bennett, E.M. (1995). *Flora of Australia Volume 16, Elaeagnaceae, Proteaceae 1*. CSIRO Australia. Melbourne. Pp 266; Department of Environment and Conservation (2007) *Western Australian Herbarium FloraBase 2 – Information on the Western Australian Flora*. Accessed December 2007. http://www.calm.wa.gov.au/science

Current status: *Conospermum undulatum* was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in 1997 and is currently ranked as Vulnerable (VU) under World Conservation Union (IUCN 1994) Red List criteria B1+2c, due to its occurrence over an area of less than 20,000 km^2, populations being severely fragmented and a continuing decline in area and quality of habitat. The main threats are further land clearing, poor habitat quality, road and firebreak maintenance, inappropriate fire regimes, weeds, recreational activities and rabbit grazing. The species is listed as Vulnerable (VU) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Conospermum undulatum is recorded from 25 populations comprising 83 subpopulations. However, only 20 populations currently contain extant plants. The species is known from the Shires of Kalamunda and Gosnells in DEC's Swan Coastal and Perth Hills Districts.

Description: *Conospermum undulatum* is an erect shrub to 1.5 m tall with distinctive fibrous, longitudinally fissured stems and hairless leaves to 12 cm long and 3.8 cm wide. Leaves taper towards the base and have three distinct, parallel veins and characteristic wavy margins. The woolly flowers have long, white hairs, and are produced in inflorescences held well above the leaves. The fruit are covered with tan orange hairs. *C. undulatum* differs from *C. triplinervium* in its smaller habit, wavy margined leaves and emergent inflorescences with longer hairs. *C. undulatum* never develops a thick trunk which is typically multi-stemmed, rather than single stemmed.

Habitat requirements: *Conospermum undulatum* occurs on sand and sandy clay soils, often over laterite, on flat or gently sloping sites between the Swan and Canning Rivers. A few records are from slightly swampy habitat.

Habitat critical to the survival of the species, and important populations: Habitat critical to the survival of *Conospermum undulatum* includes the area of occupancy of important populations; areas of similar habitat surrounding important populations (i.e. sand and sandy clay soils, often over laterite, on flat or gently sloping sites), these areas provide potential habitat for natural range extension and/or for allowing pollinators or biota essential to the continued existence of the species to move between populations; and additional occurrences of similar habitat that may contain important populations of the species or be suitable sites for future translocations or other recovery actions intended to create important populations; and the local catchment for the surface and/or groundwater that maintains the habitat of the species.

In the context of the EPBC Act's definition of population, it is considered that the collection of populations and subpopulations listed in this recovery plan are likely to constitute two "geographically distinct regional populations". These occur in two bioregions (SWA and JF). Therefore both of these "regional populations" should be considered important populations and all known habitat for wild populations considered critical to the survival of the species.

Benefits to other species or ecological communities: *Conospermum undulatum* occurs in bushland areas that contain occurrences of four Threatened Ecological Communities (TECs). In most cases the TEC 'SCP 20a' (*Banksia attenuata* woodland over species rich dense shrublands) occurs with *C. undulatum*, however occurrences of 'SCP 3c' (*Eucalyptus calophylla – Xanthorrhoea preisii* woodlands and shrublands), 'SPC 20b' (*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain) and 'SCP 8' (Herb rich shrublands in clay pans) have also been recorded. These TECs contain an assemblage of plants that are restricted in area and are only found in a few locations. Two other threatened and four priority flora species have populations in bushland areas that contain *C. undulatum* and these will benefit from recovery actions put in place to protect *C. undulatum*.

Recovery actions implemented to improve the quality or security of the habitat of *Conospermum undulatum* will also improve the status of remnant vegetation in which it is located.

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. *Conospermum undulatum* is not listed under any specific international treaty however, and therefore this recovery plan does not affect Australia's obligations under any other international agreements.

Indigenous consultation: Involvement of the Indigenous community is being sought through the Indigenous Management Advisory Group (INRMAG) of the Swan Catchment Council and the Department of Indigenous Affairs (DIA) to assist in the identification of cultural values for land occupied by *Conospermum undulatum*, or groups with a cultural connection to land that is important for the species' conservation and to determine whether there are any issues or interests identified in the plan. A search of the DIA Aboriginal Heritage Sites Register has identified that there are six registered sites of Aboriginal significance at or near populations of the species covered by this recovery plan.

The INRMAG has had the opportunity to provide culturally appropriate input into this recovery plan. Where registered sites co-occur with *Conospermum undulatum*, specific advice has been sought (INRMAG 2007).

The INRMAG recognises that the DEC through the Recovery Plan process, seeks to conserve and protect areas of natural remnant vegetation. The INRMG recognise that together we share similar goals of seeking to manage these areas for conservation and seek to include and support Aboriginal interest and involvement in the management and planning process.

Opportunities may also exist through cultural interpretation and awareness of the species. Indigenous involvement in the implementation of recovery actions will be encouraged. Continued liaison between DEC and the indigenous community will identify areas in which collaboration will assist implementation of recovery actions.

Social and economic impact: The implementation of this recovery plan has the potential to cause some social and economic impact as many populations of *Conospermum undulatum* occur on private property and their protection has the potential to affect future development on these sites. Where populations are located on private property, recovery actions refer to continued liaison between stakeholders with regards to these areas.

Affected interests: Stakeholders potentially affected by the implementation of this plan include the Shire of Kalamunda, the City of Gosnells, Main Roads WA, Water Corporation, Department of Agriculture and Food, Department for Planning and Infrastructure (DPI), Westralia Airports Corporation, Ministry for Education and owners of private property.

Evaluation of the plan's performance: DEC in conjunction with the Swan Region Threatened Flora and Communities Recovery Team (SRTFCRT) will evaluate the performance of this recovery plan. In addition to annual reporting on progress and evaluation against the criteria for success and failure, the plan will be reviewed following five years of implementation.

Completed Recovery Actions: The following recovery actions have been completed:

1. Land managers and private land owners with populations on their property have been made aware of the threatened nature of this species, its location and their legal obligations to protect the species.
2. Declared Rare Flora (DRF) markers have been installed at Subpopulations 1b, 4j and 18m.
3. Fencing of Populations 3, 5, 6, 12 and 23, and Subpopulations 1b+c, 1i, 4a, 4b, 4d, 4q, 8a, 10d, 10e, 10f, 13a-c, 16b-j, 18g, 18h and 19e has been undertaken along with partial fencing of Subpopulations 1a, 10c, 18c-f, 18i and 18j.
4. The Department for Planning and Infrastructure's (DPI) Bush Forever program includes as regionally significant bushland thirteen sites that contain *Conospermum undulatum.*
5. Survey for *Conospermum undulatum* was undertaken between 1990 and 1996 by Wildflower Society WA members, consultant botanists, CALM staff and Department of Environmental Protection staff.
6. In 1997, survey and monitoring of all known populations was undertaken, assessing their conservation value and searching nearby areas of suitable habitat for new populations.
7. In 2005, extensive surveys of known populations and areas likely to support *Conospermum undulatum* were undertaken.
8. In 2005, research on the phenology of *Conospermum undulatum* and weed soil seed bank dynamics was completed at the Perth International Airport (PIA) site. A brief examination of genetic and morphological variation within *C. undulatum* and between *C. undulatum* and *Conospermum triplinervium* was conducted. *Ex situ* cultivation of *C. undulatum* was also investigated.
9. In 2005 research into levels of genetic variation between the PIA population, and nearby populations of *Conospermum undulatum* and *C. triplinervium* was completed.
10. Seed from *Conospermum undulatum* is stored in DEC's Threatened Flora Seed Centre (TFSC).

Ongoing and future recovery actions

11. Staff from DEC's Swan Region assess development applications for bushland containing *Conospermum undulatum* and participate in environmental impact assessment and statutory planning processes. This action is ongoing.
12. The SRTFCRT is overseeing the implementation of this recovery plan and will include information on progress in their annual report to DEC's Corporate Executive and funding bodies.

13. Staff from DEC's Swan Region regularly monitor all populations.

Recovery plan objective: The objective of this recovery plan is to maintain or improve the conservation status of *Conospermum undulatum* during the term of this plan by abating identified threats.

Criteria for success: The recovery plan will be successful if all of A, B and C are achieved.

A. The total number of mature plants and/or the area of occupancy is maintained or increased over the term of the plan.
B. There is an increase of 10% or more in the total number of mature plants and/or area of occupancy under secure conservation tenure.
C. Results of research conducted as per recommendations in this recovery plan (e.g. appropriate fire regimes, pollinator habitat, recruitment requirements, survey and monitoring) is applied in habitat management over 20% or more of the known area of occupancy of the species.

Criteria for failure: The recovery plan will be considered to have failed if either A or B are met.

A. The number of mature plants and/or the area of occupancy have decreased by ten percent or more over the term of the plan.
B. There has otherwise been a decline in the species, or worsening of the nature of threatening processes, leading to increased concern over the long term survival of the species.

Recovery actions

1. Coordinate recovery actions
2. Monitor populations
3. Liaise with relevant land managers regarding management of bushland containing *Conospermum undulatum*
4. Install DRF markers
5. Fence subpopulations
6. Collect seed and other material to preserve genetic diversity
7. Undertake weed control
8. Develop and implement a rabbit control strategy
9. Reassess population numbering and size based on tenure
10. Assess development applications for lands containing *Conospermum undulatum*
11. Increase area of *Conospermum undulatum* in the conservation estate
12. Conduct further surveys
13. Develop and implement a fire management strategy
14. Promote awareness
15. Develop and implement fire and soil disturbance trials
16. Obtain biological and ecological information
17. Map habitat critical to the survival of *Conospermum undulatum*
18. Review the plan and need for further recovery actions

1. BACKGROUND

History

Conospermum undulatum was collected by James Drummond in 1839 and described by John Lindley (1839) the same year. Further collections were made between 1901 and 2007 and the species is now known from 25 mostly small populations between Maddington and Maida Vale. Prior to European settlement it is likely to have had a continuous distribution within its current range. It is however located in an area of Perth that is rapidly being developed for housing and industry and this has resulted in the fragmentation of much of the remnant bushland in which the plant occurs. The species was declared as Rare Flora in 1997.

Description

Conospermum undulatum is an erect shrub to 1.5 m tall with distinctive fibrous, longitudinally fissured stems and hairless leaves to 12 cm long and 3.8 cm wide. Leaves taper towards the base and have three distinct, parallel veins and characteristic wavy margins. The woolly flowers have long, white hairs, and are produced in inflorescences held well above the leaves. The fruits are covered with tan orange hairs. *Conospermum undulatum* differs from *Conospermum triplinervium* in its smaller habit, wavy margined leaves and emergent inflorescences with longer hairs. *C. undulatum* never develops a thick trunk and is typically multi-stemmed, rather than single stemmed.

Distribution and habitat

Conospermum undulatum is a geographically restricted species known from 25 historical populations between the Swan and Canning Rivers**.** However, only 20 populations currently contain extant plants. Habitat is sand and sandy clay soils, often over laterite, on flat or gently sloping sites in *Banksia* and jarrah/marri woodland. A few records are from slightly swampy habitats. Species associated with *Conospermum undulatum* include *Banksia menziesii, B. attenuata, B. grandis, Eucalyptus marginata, Corymbia calophylla, Allocasuarina fraseriana, Xanthorrhoea preisii, X. gracilis, Isopogon drummondii, Hakea conchifolia, H. lissocarpha, Dryandra lindleyana, Lambertia multiflora* var. *darlingensis, Hibbertia hypericoides, Adenanthos cygnorum, Anigozanthos manglesii* and *Stirlingia latifolia*.

Table 1 - Summary of population land vesting, purpose and tenure

Pop. No. & Location	DEC District	Shire/City	Vesting	Purpose	Manager
1a. Maida Vale	Perth Hills	Kalamunda	Shire of Kalamunda	Recreation Reserve	Shire of Kalamunda
1b. Gooseberry Hill	Perth Hills	Kalamunda	Unvested Reserve	Road Reserve	Shire of Kalamunda
1c. Maida Vale	Perth Hills	Kalamunda	Unvested Reserve	Road Reserve	Shire of Kalamunda
1d. Maida Vale	Perth Hills	Kalamunda	Unvested Reserve	Road Reserve	Shire of Kalamunda
1e. Maida Vale	Perth Hills	Kalamunda	Minister for Works	Pump Station	Water Corporation
1f. Maida Vale	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
1g. Maida Vale	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
1h. Maida Vale	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
1i. Maida Vale	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
2. High Wycombe	Swan Coastal	Swan	Freehold	Private Property	Landholders
3. High Wycombe (Extinct)	Swan Coastal	Kalamunda	Shire of Kalamunda	Recreation Reserve	Shire of Kalamunda
4a. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4b. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4c. High Wycombe (Extinct)	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4d. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4e. High Wycombe (Extinct)	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4f. Maida Vale (Extinct)	Swan Coastal	Kalamunda	Unvested Reserve	Road Reserve	Shire of Kalamunda

Pop. No. & Location	DEC District	Shire/City	Vesting	Purpose	Manager
4g. Forrestfield	Swan Coastal	Kalamunda	Minister for Transport	Road Reserve	MainRoads WA
4h. High Wycombe	Swan Coastal	Kalamunda	WAPC	Proposed reserve	DEC
4i. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4j. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4k. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4l. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4m. High Wycombe	Swan Coastal	Kalamunda	Unvested reserve	Road Reserve	Shire of Kalamunda
4n. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4o. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4p. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4q. High Wycombe	Swan Coastal	Kalamunda	Shire of Kalamunda	Parkland and Recreation Reserve	Shire of Kalamunda
4r. High Wycombe	Swan Coastal	Kalamunda	Shire of Kalamunda	Parkland and Recreation Reserve	Shire of Kalamunda
4s. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
4t. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
5. High Wycombe	Swan Coastal	Kalamunda	Ministry for Education	School site	Department of Education
6. High Wycombe	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
7. High Wycombe (Extinct)	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
8a. Maida Vale	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
8b. Maida Vale	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
9. Forrestfield	Perth Hills	Kalamunda	Shire of Kalamunda	General Rural	Shire of Kalamunda
10a. Forrestfield	Perth Hills	Kalamunda	Shire of Kalamunda	Recreation Reserve	Shire of Kalamunda
10b. Forrestfield	Perth Hills	Kalamunda	Shire of Kalamunda	Recreation Reserve	Shire of Kalamunda
10c. Wattle Grove	Perth Hills	Kalamunda	Shire of Kalamunda	Recreation Reserve	Shire of Kalamunda
10d. Forrestfield	Perth Hills	Kalamunda	Unvested Reserve	Road Reserve	Shire of Kalamunda
10e. Wattle Grove	Perth Hills	Kalamunda	Shire of Kalamunda	Recreation Reserve	Shire of Kalamunda
10f. Forrestfield	Perth Hills	Kalamunda	Shire of Kalamunda	Recreation Reserve	Shire of Kalamunda
10g. Forrestfield	Perth Hills	Kalamunda	Shire of Kalamunda	Recreation Reserve	Shire of Kalamunda
11a. Wattle Grove	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
11b. Wattle Grove	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
11c. Wattle Grove	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
11d. Wattle Grove	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
11e. Wattle Grove	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
12. Wattle Grove	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
13a. Maddington	Swan Coastal	Gosnells	Minister for Transport	Road Reserve	Main Roads WA
13b. Maddington	Swan Coastal	Gosnells	Minister for Transport	Road Reserve	Main Roads WA
13c. Maddington (Extinct)	Swan Coastal	Gosnells	Minister for Transport	Road Reserve	Main Roads WA
14. Martin (Extinct)	Perth Hills	Gosnells	Unvested reserve	Road Reserve	City of Gosnells
14b. Martin	Perth Hills	Gosnells	Unvested reserve	Shire Reserve	City of Gosnells
15. Welshpool (Extinct)	Swan Coastal	Canning	Freehold	Private Property	Landholders
16a. Orange Grove	Perth Hills	Gosnells	Shire of Kalamunda	Regional Park	Shire of Kalamunda
16b. Orange Grove	Perth Hills	Gosnells	City of Gosnells	General Rural	City of Gosnells
16c. Orange Grove	Perth Hills	Gosnells	City of Gosnells	General Rural	City of Gosnells
16d. Orange Grove	Perth Hills	Gosnells	City of Gosnells	General Rural	City of Gosnells
16e. Orange Grove	Perth Hills	Gosnells	City of Gosnells	General Rural	City of Gosnells
16f and g. Orange Grove	Perth Hills	Gosnells	WAPC	Proposed reserve	DEC
16h. Orange Grove	Perth Hills	Gosnells	Freehold	Private Property	Landholders

Pop. No. & Location	DEC District	Shire/City	Vesting	Purpose	Manager
16i. Orange Grove	Perth Hills	Gosnells	Freehold	Private Property	Landholders
16j. Orange Grove	Perth Hills	Gosnells	Freehold	Private Property	Landholders
16k. Orange Grove	Perth Hills	Gosnells	Unvested reserve	Road Reserve	City of Gosnells
17. High Wycombe	Swan Coastal	Kalamunda	Minister for Transport	Road Reserve	Main Roads WA
18a. Forrestfield	Swan Coastal	Kalamunda	Minister for Works	Sanitary Processing	Water Corporation
18b. Forrestfield (Extinct)	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
18c. Forrestfield	Swan Coastal	Kalamunda	Freehold	Private Property	Landholders
18d. Forrestfield	Swan Coastal	Kalamunda	WAPC	Proposed Reserve	DPI
18e. Forrestfield	Swan Coastal	Kalamunda	DPI		DPI
18f. Forrestfield	Swan Coastal	Kalamunda	DPI		DPI
18g. Forrestfield	Swan Coastal	Kalamunda	FESA	Fire training school	FESA
18h. Forrestfield	Perth Hills	Kalamunda	Department of Agriculture and Food	Research Station	Department of Agriculture and Food
18i. Forrestfield	Perth Hills	Kalamunda	Shire of Kalamunda	Rubbish Tip	Shire of Kalamunda
18j. Forrestfield	Perth Hills	Kalamunda	Minister for Transport	Road Reserve	Main Roads WA
18k. Forrestfield	Perth Hills	Kalamunda	Shire of Kalamunda	Rubbish Tip	Shire of Kalamunda
18m. Kewdale	Swan Coastal	Kalamunda	Minister for Transport	Road Reserve	Main Roads WA
18n. Forrestfield	Swan Coastal	Kalamunda	Minister for Transport	Road Reserve	Main Roads WA
18o. Forrestfield	Swan Coastal	Kalamunda	Conservation Commission of Western Australia	Conservation of Flora and Fauna (Nature Reserve)	DEC
18p. Forrestfield	Swan Coastal	Kalamunda	Minister for transport	Road Reserve	Main Roads WA
19a. Wattle Grove	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
19b. Wattle Grove	Perth Hills	Kalamunda	Unallocated Crown Land	Government requirements	DPI
19c. Wattle Grove	Perth Hills	Kalamunda	WAPC	Proposed Reserve	DEC
19d. Wattle Grove	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
19e. Wattle Grove	Perth Hills	Kalamunda	Minister for Transport	Road Reserve	Main Roads WA
20a. Maida Vale	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
20b. Maida Vale	Perth Hills	Kalamunda	Shire of Kalamunda	Municipal Purposes	Shire of Kalamunda
21. Maida Vale	Perth Hills	Kalamunda	Minister for Transport	Road Reserve	Main Roads WA
22a. Forrestfield	Perth Hills	Kalamunda	Unvested reserve	Road Reserve	Shire of Kalamunda
22b. Forrestfield	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
23. Maida Vale	Perth Hills	Kalamunda	Freehold	Private Property	Landholders
24a. Perth International Airport	Swan Coastal	Belmont	Commonwealth of Australia	Perth International Airport	Westralia Airports Corp.
24b. Perth International Airport	Swan Coastal	Belmont	Commonwealth of Australia	Perth International Airport	Westralia Airports Corp.
25. Lesmurdie	Perth Hills	Kalamunda	Freehold	Private Property	Landholders

Populations in **bold text** are considered to be important populations; DPI: Department of Planning and Infrastructure.

Biology and ecology

Conospermum undulatum is a long-lived shrub that resprouts from rootstock following disturbance such as fire. Flowering is between August and October.

The species has a low seed set and appears to have poor seed dispersal, observed from the frequent clumping of plants in populations (Close and Dixon 2005). Seed viability ratios for *Conospermum undulatum* indicate significant levels of infertile seeds with ratios of non-viable to viable seed being 2.63:1. High levels of seed infertility may be due to a lack of pollinators, however low seed set and low capacity to compete for pollinators

is indicative of *C. undulatum* being a facultative seeder and is consistent with its capacity to re-sprout following fire events (Close and Dixon 2005).

The germination rate for untreated fresh seed is 11%, increasing to 33% when giberellic acid is applied and no after-ripening response is observed up to 3 months post harvest. This response to giberellic acid indicates that *C. undulatum* seed has physiological-imposed dormancy (Close and Dixon 2005).

A high degree of variability in the leaf morphology of *Conospermum undulatum* in the population at the Perth International Airport (PIA) site has lead to speculation that plants in this population are genetically distinct from other *C. undulatum* populations and that plants at the PIA site may be hybrids between *C. undulatum* and *C. triplinervium*. However, genetic analysis using amplified fragment length polymorphisms (AFLP) indicates no statistically significant differentiation between this and other populations.

Clear genetic differentiation exists between *Conospermum undulatum* at the PIA and a sampled population of *C. triplinervium* from a nearby location. This finding supports these being different species and the Perth International Airport (PIA) population of *C. undulatum* not being of hybrid origin. The high degree of morphological difference between *C. undulatum* at PIA and other nearby populations of this species is most likely due to a plastic response of this species to environmental variation not to genetic drift or hybridisation with *C. triplinervium* (Close *et. al*. 2005).

Moderate to high levels of intra population genetic diversity in *Conospermum undulatum* is consistent with an out crossing reproductive system and more generally with the strategy of plants such as *C. undulatum* that resprout following disturbance (Close *et. al*. 2005).

Threats

Conospermum undulatum was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in 1997 and is ranked as Vulnerable (VU) under World Conservation Union (IUCN 1994) Red List criterion B1+2c, due to the area of occurrence being less than 20,000 km^2, the populations being severely fragmented and a continuing decline in the area and quality of habitat. The main threats are continuing land clearing, degraded natural habitat, road and firebreak maintenance, lack of fire, weeds, recreational activities and rabbit grazing. The species is listed as Vulnerable (VU) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

- **Land clearing.** The area where *Conospermum undulatum* occurs is undergoing rapid urbanization with approximately 23 percent of known plants being located on subdivided blocks and many other populations affected by clearing for urban development. Three populations and five subpopulations are now extinct due to land clearance.
- **Degradation of natural habitat.** Most plants of *Conospermum undulatum* are located in degraded natural vegetation remnants.
- **Road and firebreak maintenance.** Approximately 16% of *Conospermum undulatum* plants are located on road reserves and some others are located on or border firebreaks. These plants are threatened by road and firebreak maintenance and spraying of verge vegetation with herbicide.
- **Lack of fire.** The vegetation remnants in which some populations of *Conospermum undulatum* occur have not been burnt for a long period of time. Existing plants are senescing, causing a decline in reproductive output.
- **Weeds** are a threat to most populations of *Conospermum undulatum*. Weed species compete for resources and weed competition reduces seedling survival.
- **Recreational activities**. Horse riding, motor biking and four-wheel driving threaten several populations. These activities directly damage *Conospermum undulatum* plants and also cause soil disturbance which encourages weed invasion.
- **Rabbit grazing.** *Conospermum undulatum* is susceptible to grazing by rabbits and, while mature plants have some capacity to resprout, seedlings are particularly vulnerable.

Table 2 - Summary of population information and threats

Pop. No. & Location	Land Status	Date / No. of Plants	Condition	Threats
1a. Maida Vale	Recreation Reserve	1998 1644 2005 1592	Healthy	Uncontrolled access, weeds, firebreak maintenance
1b. Gooseberry Hill	Shire Road Reserve	1990 300 1997 120 2002 362	Healthy	Firebreak maintenance, weeds
1c. Maida Vale	Shire Road Reserve	1990 200 1998 508	Healthy	
1d. Maida Vale	Shire Road Reserve	1990 35 2002 11	Moderate	Road maintenance, weeds
1e. Maida Vale	Pump Station	1990 50 2002 57	Healthy	Uncontrolled access, weeds, land clearing
1f. Maida Vale	Private Property	1998 5 2005 33	Poor	Weeds
1g. Maida Vale	Private Property	1998 60 2006 0	Unknown	
1h. Maida Vale	Private Property	1998 80 2002 80	Healthy	Land clearing
1i. Maida Vale	Private Property	1998 90 2005 177 [1]	Healthy	Land clearing
2. High Wycombe	Private Property	1990 100 2006 139	Healthy	
3. High Wycombe	Recreation Reserve	1990 15 2006 0	Extinct	Uncontrolled access, weeds
4a. High Wycombe	Private Property	1990 100 2005 62	Moderate	Firebreak maintenance, weeds, land clearing
4b. High Wycombe	Private Property	1990 100 1997 30	Moderate	Firebreak maintenance, uncontrolled access, weeds
4c. High Wycombe	Private Property	1990 100 2006 0	Extinct	
4d. High Wycombe	Private Property	1990 100 1997 2	Poor	Land clearing, poor habitat health, weeds
4e. High Wycombe	Private Property	1997 0	Extinct	Poor habitat health
4f. Maida Vale	Shire Road Reserve	1997 0 2006 0	Extinct	Road maintenance, weeds, poor habitat health
4g. Forrestfield	MainRoads WA Reserve	1990 50 2002 2	Poor	Road and firebreak maintenance, weeds
4h. High Wycombe	WAPC	1990 130* 1997 300* 2006 76	Healthy	Weeds, firebreak maintenance, uncontrolled access
4i. High Wycombe	Private Property	1990 130* 1997 300*	Moderate	Uncontrolled access, firebreak maintenance
4j. High Wycombe	Private Property	1990 130* 1997 300*	Moderate	Uncontrolled access, firebreak maintenance
4k. High Wycombe	Private Property	1990 400 1995 400 1997 300*	Moderate	Uncontrolled access, firebreak maintenance, land clearing
4l. High Wycombe	Private Property	1990 50 2006 20	Healthy	Weeds, uncontrolled access, road maintenance
4m. High Wycombe	Shire Road Reserve	1997 3 2006 7	Healthy	Road maintenance, weeds, uncontrolled access
4n. High Wycombe	Private Property	1997 1 2005 103	Healthy	Firebreak maintenance, prescribed burns
4o. High Wycombe	Private Property	1996 30 (20) 2005 161	Healthy	Road and firebreak maintenance, weeds, land clearing
4p. High Wycombe	Private Property	2000 50 2005 142 (10)	Healthy	Weeds, firebreak maintenance
4q. High Wycombe	Shire Parkland Reserve	2003 12 2005 120	Healthy	Uncontrolled access, inappropriate fie regimes
4r. High Wycombe	Shire Parkland Reserve	2003 7		Inappropriate fie regimes
4s. High Wycombe	Private Property	2003 35		Weeds, road works
4t. High Wycombe	Private Property	-		

Pop. No. & Location	Land Status	Date / No. of Plants	Condition	Threats
5. High Wycombe	School site	1990 10 2000 15	Healthy	Weeds, land clearing
6. High Wycombe	Private Property	1990 10 1997 11	Moderate	Firebreak maintenance, uncontrolled access, weeds
7. High Wycombe	Private Property	1990 300 1997 0 2006 0	Extinct	
8a. Maida Vale	Private Property	1990 10 2001 4	Healthy	Firebreak and powerline maintenance, weeds, uncontrolled access, disease
8b. Maida Vale	Private Property	1990 10 2005 4	Healthy	Weeds, firebreak maintenance, inappropriate fire regimes
9. Forrestfield	Shire lands	1990 20 2006 0	Extinct	Land clearing and development
10a. Forrestfield	Recreation Reserve	1990 100 2000 30	Good	Road works, uncontrolled access, weeds
10b. Forrestfield	Recreation Reserve	2000 0 1990 30		Road works, uncontrolled access, weeds
10c. Wattle Grove	Recreation Reserve	1990 50 2006 331	Healthy	Road works, firebreak maintenance, weeds, uncontrolled access, grazing
10d. Forrestfield	Shire Road Reserve	1990 70 2000 80	Good	Road works, firebreak maintenance, weeds, uncontrolled access, grazing
10e. Wattle Grove	Recreation Reserve	1990 55 2006 10	Healthy	Firebreak maintenance, uncontrolled access, weeds
10f. Forrestfield	Recreation Reserve	1998 2 2006 0	Disturbed	Firebreak maintenance, drainage, weeds, uncontrolled access, chemical drift
10g. Forrestfield	Recreation Reserve	2006 13	Healthy	Weeds
11a. Wattle Grove	Private Property	1990 10 2005 0		Weeds
11b. Wattle Grove	Private Property	1990 40 2006 7	Moderate	Firebreak maintenance, uncontrolled access, weeds
11c. Wattle Grove	Private Property	1990 250 2005 100	Healthy	Firebreak maintenance
11d. Wattle Grove	Private Property	1990 250 2005 107		
11e. Wattle Grove	Private Property	1997 26* 2006 12	Healthy	Firebreak maintenance
12. Wattle Grove	Private Property	1990 50 2005 72	Moderate	Weeds, inappropriate fire regimes
13a. Maddington	MainRoads WA Reserve	1997 240 2006 655	Healthy	Road and firebreak maintenance, weeds, uncontrolled access
13b. Maddington	MainRoads WA	1997 10	Healthy	Road and firebreak maintenance, weeds, uncontrolled access
13c. Maddington	MainRoads WA	1997 0	Extinct	
14a. Martin	City Road Reserve	1990 1 2006 0	Extinct	Road maintenance, weeds
14b. Martin	Shire Reserve		Unknown	
15. Welshpool	Private Property	1997 0 2005 0	Extinct	
16a. Orange Grove	Regional Park	1990 500 2006 463	Healthy	Uncontrolled access, weeds
16b. Orange Grove	City lands	1990 150 2006 80	Healthy	Firebreak maintenance, weeds, rubbish dumping
16c. Orange Grove	City lands	1997 100* 2006 209	Healthy	Firebreak maintenance, weeds, rubbish dumping
16d. Orange Grove	City lands	1997 100* 2006 120	Healthy	Firebreak maintenance, weeds, rubbish dumping
16e. Orange Grove	City lands	1997 100* 2006 8	Healthy	Firebreak maintenance, weeds, rubbish dumping
16f and g. Orange Grove	WAPC	1990 250 2006 911	Healthy	Weeds, uncontrolled access
16h. Orange Grove	Private Property	1990 125 2006 236	Healthy	Weeds, uncontrolled access
16i. Orange Grove	Private Property	1997 300* 1990 125	Healthy	Weeds, uncontrolled access
16j. Orange Grove	Private Property	1997 10 2005 17	Poor	Weeds, uncontrolled access, grazing

Pop. No. & Location	Land Status	Date / No. of Plants		Condition	Threats
16k. Orange Grove	City of Gosnells	2006	31	Healthy	Road maintenance
17. High Wycombe	MainRoads WA Reserve	1998 2006	14 94	Healthy	Rubbish dumping, uncontrolled access, firebreak maintenance
18a. Forrestfield	Sanitary Processing	1990 1997 2006	700 265 1159	Healthy	Firebreak maintenance, uncontrolled access, road works, weeds
18b. Forrestfield	Private Property	1990 1997	50 0	Extinct	
18c. Forrestfield	Private Property	1990 2006	150 97	Healthy	Firebreak maintenance, uncontrolled access, weeds, rubbish dumping
18d. Forrestfield	WAPC	1990 2006	75 15	Healthy	Uncontrolled access, inappropriate fire regime
18e. Forrestfield	DPI	1990 2006	100 42	Healthy	Uncontrolled access, inappropriate fire regime
18f. Forrestfield	DPI	1990 2006	75 134	Healthy	Uncontrolled access, inappropriate fire regime
18g. Forrestfield	FESA fire training school	1990 1997 2002	750 770 750		
18h. Forrestfield	Dept. of Agriculture and Food Experimental Farm	1990 1997	125 200	Healthy	Inappropriate fire regime
18i. Forrestfield	Shire Rubbish Tip	1990	50	Healthy	Firebreak maintenance, weeds
18j. Forrestfield	MainRoads WA Reserve	1990 2002	200 61	Moderate	Road and firebreak maintenance, weeds
18k. Forrestfield	Shire Rubbish Tip	1990 1997	600 90		Firebreak maintenance, uncontrolled access, weeds
18m. Kewdale	MainRoads WA Reserve	1990 2000	2 7	Healthy	Road maintenance, weeds
18n. Forrestfield	MainRoads WA Reserve	1990 2006	100 232	Healthy	Road maintenance, uncontrolled access, rubbish dumping, inappropriate fire regime
18o. Forrestfield	Nature Reserve	2006	416	Healthy	Uncontrolled access, rubbish dumping, inappropriate fire regime
18p. Forrestfield	MainRoads WA Reserve	2006	151	Healthy	Uncontrolled access, inappropriate fire regime
19a. Wattle Grove	Private Property	1990 2001	10 0		Urban development, firebreak maintenance, uncontrolled access, poor habitat, weeds
19b. Wattle Grove	Unallocated Crown Land	1990 2005	50 63	Healthy	Firebreak and powerline maintenance, uncontrolled access, weeds
19c. Wattle Grove	WAPC	2005	25	Healthy	
19d. Wattle Grove	Private Property	2005	12	Moderate	Firebreak maintenance, weeds, disease
19e. Wattle Grove	MainRoads WA Reserve	2005	7	Healthy	Firebreak maintenance, weeds
20a. Maida Vale	Private Property	2000	28	Healthy	
20b. Maida Vale	Shire Municipal Purposes	2000	2		
21. Maida Vale	MainRoads WA Reserve	2001	1		
22a. Forrestfield	Shire Road Reserve	2003	3*		
22b. Forrestfield	Private Property	2003	3*		
23. Maida Vale	Private Property	2005	39	Moderate	
24a. Perth International Airport	International Airport	1990 2004	21 0		uncontrolled access
24b. Perth International Airport	International Airport	2005	200	Healthy	Rabbit grazing
25. Lesmurdie	Private Property	2005	13 (3)	Healthy	Land clearing

Populations in **bold text** are considered important populations; Note: * = total for all subpopulations, ( ) = number of seedlings

Guide for decision-makers

Table 2 provides details of current and possible future threats. Developments in the immediate vicinity of the populations or within the defined habitat critical to the survival of *Conospermum undulatum* require assessment for the potential for a significant level of impact.

Habitat critical to the survival of the species, and important populations

Habitat critical to the survival of *Conospermum undulatum* includes the area of occupancy of important populations; areas of similar habitat surrounding important populations (i.e. sand and sandy clay soils, often over laterite, on flat or gently sloping sites), as these areas provide potential habitat for natural range extension and/or for allowing pollinators or biota essential to the continued existence of the species to move between populations; and additional occurrences of similar habitat that may contain important populations of the species or be suitable sites for future translocations or other recovery actions intended to create important populations; and the local catchment for the surface and/or groundwater that maintains the habitat of the species.

All known plants of *Conospermum undulatum* are found in fragmented remnant bushland in an area that is around 9 km by 8 km (72 km^2). The populations and subpopulations referred to in this recovery plan are a reflection of this fragmentation, and often reflect changes in ownership or tenure of land across otherwise contiguous groups of plants, and are not analogous to a 'population of a species' as defined under the EPBC Act.

In the context of the EPBC Act's definition of population, it is considered that the collection of populations and subpopulations listed in this recovery plan are likely to constitute two "geographically distinct regional populations" that occur in two bioregions (SWA and JF). Therefore both of these "regional populations" should be considered important populations and all known habitat for wild populations considered critical to the survival of the species.

However, given that *Conospermum undulatum* is ranked as VU, and the very high level of fragmentation of this species (including subpopulations containing very low numbers of plants, small area, and containing highly disturbed habitat) there is a decision making, or operational, value in recognizing that some of the populations and subpopulations (as listed in the recovery plan) provide a greater contribution to the long term survival of the species than others.

Using relatively simple selection criteria including size of population, connectedness to adjacent sub-populations and position in the species range identifies the following populations and subpopulations as the most important: 1a, 1b, 1c, 1d, 1f, 1g, 1h, and 1i; 2; 4a, 4b, 4d, 4h, 4i, 4j, 4k, 4m, 4n, 4o, 4p, 4q, and 4s; 10a, 10c, 10d, and 10e; 11 c, and 1d; 12; 13a, and 13b; 16a, 16b, 16c, 16d, 16e, 16f, 16g, 16h, 16i, and 16k; 17; 18a, 18c, 18d, 18e, 18f, 18g, 18h, 18i, 18j, 18k, 18m, 18n, 18o and 18p; 19b, 19c, 19d, and 19e; 23; 24a, and 24b; and 25.

This list provides initial guidance on the relative importance of populations and subpopulations and in future may be modified based on new or specific site information. Similarly decisions on protection or management of any population or subpopulation should be based on site-specific information in conjunction with a whole of species consideration.

Benefits to other species or ecological communities

Conospermum undulatum occurs in bushland areas that contain occurrences of four Threatened Ecological Communities (TECs). In most cases it is TEC 'SCP 20a', however occurrences of 'SCP 3c', 'SCP 20b' and 'SCP 8' have also been recorded. These TECs are listed in the table below and contain an assemblage of plants that are restricted in area and are found in very few locations.

TECs recorded within bushland areas in which *Conospermum undulatum* occurs

Community type	TEC Title	Ranking (Western Australia)
SCP 20a	*Banksia attenuata* woodland over species rich dense shrublands	Endangered
SCP 3c	*Eucalyptus calophylla – Xanthorrhoea preisii* woodlands and shrublands	Critically Endangered
SCP 20b	*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain	Endangered
SCP 8	Herb rich shrublands in clay pans	Vulnerable

SCP – Swan Coastal Plain. For a description of the TEC categories see DEC (2007)

Recovery actions implemented to improve the quality or security of the habitat of *Conospermum undulatum* will also improve the status of remnant *Banksia* and jarrah/marri woodland in which it is located. Two other threatened and four priority flora species occur in bushland that contains *C. undulatum*. These are listed in the table below.

Conservation-listed flora species occurring in habitat of *Conospermum undulatum*

Species name	Conservation Status and ranking (Western Australia)	Conservation Status (EPBC Act)
Macarthuria keigheryi	DRF, Endangered	Endangered
Dryandra mimica	DRF, Vulnerable	Endangered
Isopogon drummondii	Priority 3	
Olax scalariformis	Priority 3	
Stachystemon axillaris	Priority 4	
Verticordia lindleyi subsp. *lindleyi*	Priority 4	

DRF – Declared Rare Flora; for a description of Priority categories see Atkins (2008)

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. *Conospermum undulatum* is not listed under any specific international treaty and this recovery plan does not affect Australia's obligations under any other international agreements.

Indigenous consultation

Involvement of the Indigenous community is being sought through the Indigenous Management Advisory Group (INRMAG) of the Swan Catchment Council and the Department of Indigenous Affairs (DIA) to assist in the identification of cultural values for land occupied by *Conospermum undulatum*, or groups with a cultural connection to land that is important for the species' conservation and to determine whether there are any issues or interests identified in the plan. A search of the DIA Aboriginal Heritage Sites Register has identified that there are six registered sites of Aboriginal significance at or near populations of the species covered by this recovery plan (see table below).

The INRMAG has been consulted and subsequently has had the opportunity to provide culturally appropriate input into this recovery plan. Where registered sites co-occur with *Conospermum undulatum*, specific advice has been sought (INRMAG 2007).

The INRMAG recognises that the DEC, through the Recovery Plan process, seeks to conserve and protect areas of natural remnant vegetation. The INRMG recognise that together we share similar goals of seeking to manage these areas for conservation and seek to include and support Aboriginal interest and involvement in the management and planning process.

Opportunities may also exist through cultural interpretation and awareness of the species. Indigenous involvement in the implementation of recovery actions will be encouraged. Continued liaison between DEC and the Indigenous community will identify areas in which collaboration will assist implementation of recovery actions.

Sites of Aboriginal significance containing populations of *Conospermum undulatum*

Site ID	Site Name	Site Type	Aboriginal Clan	Populations of *Conospermum undulatum* affected
3719	Munday Swamp	Ceremonial, Mythological, Artefacts / Scatter	Bibbulmun - wadjuk	Subpopulation 4r
4033	High Wycombe: Wittenoom Rd.	Artefacts / Scatter	Bibbulmun - wadjuk	Subpopulation 4r
3773	Welshpool Reserve	Camp	Bibbulmun - wadjuk	Subpopulations 10a, b, c, e and f
3264	White Road, Orange Grove	Skeletal material / Burial, Artefacts / Scatter	Bibbulmun - wadjuk	Subpopulation 16f, g, h and i
4081	Roe Freeway – Wattle Grove	Artefacts / Scatter	Bibbulmun - wadjuk	Subpopulation 18m
3644	Midland Road, Maida Vale	Artefacts / Scatter	Bibbulmun - wadjuk	Population 21 and 23

Social and economic impact

The implementation of this recovery plan has the potential to cause some social and economic impacts, as many populations of *Conospermum undulatum* occur on private property and their protection has the potential to affect future development on these sites. Where populations are located on private property, recovery actions refer to continued liaison between stakeholders with regards to these areas, and where development is proposed on private property containing *C. undulatum*, the aim is to protect the populations through the statutory land use planning and environmental impact assessment processes.

Affected interests

Stakeholders potentially affected by the implementation of this plan include the Shire of Kalamunda and the City of Gosnells, Main Roads WA, Water Corporation, Department of Agriculture and Food and Department for Planning and Infrastructure (DPI), Westralia Airports Corporation, Ministry for Education and owners of private property.

Evaluation of the plan's performance

DEC in conjunction with the Swan Region Threatened Flora and Ecological Communities Recovery Team (SRTFCRT) will evaluate the performance of this recovery plan. 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

Recovery plan objective

The objective of this recovery plan is to maintain or improve the conservation status of *Conospermum undulatum* during the term of this plan by abating identified threats to populations.

Criteria for success

The recovery plan will be successful if all of A, B and C are achieved.

A. The total number of mature plants and/or the area of occupancy is maintained or increased over the term of the plan.
B. There is an increase of 10% or more in the total number of mature plants and/or area of occupancy under secure conservation tenure.
C. Results of research conducted as per recommendations in this recovery plan (e.g. appropriate fire regimes, pollinator habitat, recruitment requirements, survey and monitoring) is applied in habitat management over 20% or more of the known area of occupancy of the species.

Criteria for failure

The recovery plan will be considered to have failed if either A or B are met.

A. The number of mature plants and/or the area of occupancy has decreased by ten percent or more over the term of the plan.
B. There has otherwise been a decline in the species, or worsening of the nature of threatening processes, leading to increased concern over the long term survival of the species.

3. RECOVERY ACTIONS

Completed recovery actions

All land managers and landowners have been made aware of the threatened nature of the species, its location and their legal obligations to protect it.

Declared Rare Flora (DRF) markers have been installed at Subpopulations 1b, 4j and 18m.

Fencing of Populations 3, 5, 6, 12 and 23 and Subpopulations 1bc, 1i, 4a, 4b, 4d, 4q, 8a, 10d, 10e, 10f, 13a-c, 16b-j, 18g, 18h and 19e, and partial fencing of Subpopulations 1a, 10c, 18c-f, 18i and 18j has been undertaken.

Populations 2 and 6 and Subpopulations 1a-c, 1e, 1h-i, 4e-f, 4h-k, 4r, 10a-f, 13a-c, 16f-i, 18a, 18d-i, 18k, 18o, 19a and 24b are in sites identified by the DPI Bush Forever program.

Between 1990 and 1997, surveys for *Conospermum undulatum* were undertaken in areas of suitable habitat on the Swan Coastal Plain, resulting in the discovery of two new subpopulations.

In 2005, further surveys of areas likely to support *Conospermum undulatum* were undertaken by CALM staff and members of the Wildflower Society of Western Australia (WSWA). These surveys resulted in the discovery of seven new populations.

In 2005, research into the biological and ecological parameters affecting the conservation of *Conospermum undulatum*, genetic differentiation between the Perth International Airport (PIA) population and nearby populations and the degree of genetic divergence between *C. undulatum* and *C. triplinervium* was undertaken for Westralia Airports Corporation.

DEC's Threatened Flora Seed Centre (TFSC) has 159 seeds in storage that were collected from Subpopulation 18g in 2001.

Ongoing and future recovery actions

Staff from DEC's Swan Region assess development applications for bushland containing *Conospermum undulatum* and participate in environmental impact assessment and statutory planning processes. This action is ongoing.

The SRTFCRT is overseeing the implementation of this recovery plan and will include information on progress in their annual reports to DEC's Corporate Executive and funding bodies.

Staff from DEC's Swan Region regularly monitor all populations.

Where recovery actions are implemented on lands other than those managed by DEC, permission has been, or will be, sought from appropriate land managers prior to actions being undertaken. The following recovery actions are roughly in order of descending priority, influenced by their timing over the term of the plan. However this should not constrain addressing any recovery action if funding is available and other opportunities arise.

1. Coordinate recovery actions

The Swan Region and Swan Coastal District, under the general guidance of the SRTFCRT, will continue to coordinate the implementation of recovery actions for *Conospermum undulatum* and will include information on progress in their annual reports to DEC's Corporate Executive and funding bodies.

Action: Coordinate recovery actions
Responsibility: DEC Swan Region under the general guidance of the SRTFCRT
Cost: $1,600 annually

2. Monitor populations

Monitoring of factors such as population stability (expansion or decline), weed invasion, habitat degradation, pollinator activity, seed production, recruitment, and longevity is essential. Significant and "at risk" populations will be inspected annually and rare flora report forms completed. Other populations will be inspected on an as-needs basis and at least every five years. This action is particularly relevant to populations on private property where rates of owner turnover can be high. Monitoring information will be provided to DEC's Species and Communities Branch (SCB).

Location descriptions, including GPS points, for many populations require reassessment as many are outdated or appear incorrect. Where possible, accurate GPS polygons should be taken for each population and subpopulation.

Information gained from this monitoring will be used in the review of population and subpopulation identification and numbering in Action 9, mapping of critical habitat in Action 18, and in determining priorities for recovery action for this species.

Action: Monitor populations
Responsibility: DEC (Perth Hills and Swan Coastal Districts, Swan Region)
Cost: $10,000 annually

3. Liaise with relevant land managers regarding management of bushland containing *Conospermum undulatum*

Staff from DEC's Swan Regional Office will continue to liaise with staff from the Shire of Kalamunda and the City of Gosnells, Main Roads WA, Water Corporation, Department of Agriculture and Food and DPI, Westralia Airports Corporation, Ministry for Education and private property owners. This is to ensure that plants are not accidentaly damaged or destroyed and to provide advice on how best to manage the species on their lands. Liaison is required with Westralia Airports Corporation to ensure the continued implementation of rabbit control within the Perth International Airport Conservation Area and to ensure that control is conducted in a manner that maximises its effectiveness in the protection of *Conospermum undulatum*.

Input and involvement will also be sought from any Aboriginal groups that have an active interest in areas that are habitat for *Conospermum undulatum*.

Action: Liaise with relevant land managers
Responsibility: DEC (Perth Hills and Swan Coastal Districts, Swan Region)
Cost: $12,000 annually

4. Install DRF markers

Declared Rare Flora (DRF) markers provide discrete signage of populations, especially alongside roads, to alert people managing these areas to the presence of the DRF, so as to prevent accidental damage to the plants or their habitat. DRF markers are required at Populations 14, 17 and 23 and Subpopulations 1c-e, 4g, 4k, 4l, 4o, 8b, 10a+d, 11b, 16b-i, 13a-b, 18i, 18j, 18n and 22a and b. DRF markers at Subpopulation 16a need replacing. The installation of these markers will be undertaken during the flowering period of *Conospermum undulatum* to ensure that all plants on road verges and firebreaks are between the markers.

Action: Install DRF Markers
Responsibility: DEC (Perth Hills and Swan Coastal Districts)
Cost: $8,200 in the first year. $2,000 for maintenance in years 3 and 5.

5. Fence subpopulations

Fencing is required at Subpopulation 1d, 4g, 4k, 8b and 10a. Subpopulations 1a, 1i, 18c-f, 18i, 18j are only partially fenced and require further fencing to be installed. Fenced areas will ideally include a buffer of surrounding habitat. Liaison with land managers will be undertaken by district staff to determine the type of fencing. Funding assistance may be sought from various sources.

Actions: Fence subpopulations
Responsibility: DEC (Perth Hills and Swan Coastal Districts)
Cost: $8,100 annually in the years 1-4.

6. Collect seed and other material to preserve genetic diversity

DEC's TFSC has a small accession of seed from *Conospermum undulatum*. However, further collections are required. Collections should aim to sample and preserve the maximum range of genetic diversity (which should be determined by an appropriate molecular technique such as genetic fingerprinting). The "Germplasm Conservation Guidelines for Australia" produced by the Australian Network for Plant Conservation (ANPC) should be used to guide to collection (ANPC 1997).

Actions: Collect seed and other material to preserve genetic diversity
Responsibility: DEC (TFSC), and BGPA
Cost: $2,300 annually in years 1-5.

7. Undertake weed control

Weeds are a threat to several populations of *Conospermum undulatum*. Weeds reduce population health and reproductive output, and increase the frequency and intensity of fire. The following actions will be implemented:

1. Determine which weeds are present and develop a prioritized weed control program;
2. Select appropriate herbicides;
3. Control invasive weeds by hand removal or spot spraying around *Conospermum undulatum* plants when weeds first emerge; and
4. Schedule weed control to include spraying at other threatened flora populations within the Swan Region.

The tolerance of most native plant species to herbicides is not known and weed control programs will need to be undertaken in conjunction with research, or in an adaptive management framework.

Action: Undertake weed control
Responsibility: DEC (Perth Hills and Swan Coastal Districts, Science Division)
Cost: $18,600 annually

8. Develop and implement a rabbit control strategy

Rabbit control is being conducted at *Conospermum undulatum* Subpopulations 24a and b by Westralia Airports Corporation. However, it is recommended that a rabbit control strategy be developed and implemented for all populations.

Action: Develop and implement a rabbit control strategy
Responsibility: DEC (Perth Hills and Swan Coastal Districts, Swan Region)
Cost: $12,000 in the first year; $9,800 annually in years 2-5.

9. Reassess population numbering and size based on tenure

Populations and subpopulations are based on clustering of occurrences, and land tenure. However, location descriptions for many sites are outdated or incorrect, and in some cases changes to tenure and ownership are not recorded. It is recommended that populations of *Conospermum undulatum* are reassessed to ensure that tenure boundaries are accurately reflected.

Action: Reassess population numbering and size based on tenure
Responsibility: DEC (Swan Region, SCB, and SRTFCRT)
Cost: $5,000 in years 1 and 2.

10. Assess development applications for lands containing *Conospermum undulatum*

DEC staff will continue to assess development proposals for lands containing *Conospermum undulatum* and participate in environmental impact assessment and statutory planning processes.

Action: Assess development applications for lands containing *Conospermum undulatum*
Responsibility: DEC (Swan Region and Environmental Assessment Branch)
Cost: $5,000 annually in years 1-5.

11. Increase the number of populations of *Conospermum undulatum* in the conservation estate

Currently, only one subpopulation of *Conospermum undulatum***,** accounting for 7.3% of the total number of plants, is located in protected conservation tenure (Nature Reserve). Bush Forever has identified thirteen sites of regionally significant vegetation that contain *Conospermum undulatum* and it is possible that other sites containing populations of the species could be acquired for conservation.

Action: Increase the number of populations of *Conospermum undulatum* in the conservation estate
Responsibility: DEC (Swan Region) with the WAPC
Cost: $1,800 in the first year; $500 annually in years 2-5 (this does not include purchase price)

12. Conduct further surveys

It is recommended that areas of potential habitat be surveyed for the presence of *Conospermum undulatum* during its flowering period. All surveyed areas will be recorded and the presence or absence of *C. undulatum* documented to increase survey efficiency and reduce unnecessary duplicate surveys. Where possible, volunteers from the local community, wildflower societies and naturalists clubs could be involved in surveys supervised by DEC staff.

Action: Conduct further surveys
Responsibility: DEC (Perth Hills and Swan Coastal Districts, Swan Region)
Cost: $4,300 in years 2 and 4.

13. Develop and implement fire and soil disturbance trials

DEC's Swan Regional staff will, in consultation with private landowners, relevant shires and government departments, conduct research into the effectiveness of fire and mechanical soil disturbance in stimulating germination of soil-stored *Conospermum undulatum* seed. The results of research trials will be monitored and will be used to develop fire management strategies.

Action: Develop and implement fire and soil disturbance trials
Responsibility: DEC (Science Division, Perth Hills and Swan Coastal District, Swan Region)
Cost: $6,500 in years 1, 3 and 5

14. Develop and implement a fire management strategy

A fire management strategy should be prepared and implemented to reduce the impact of prescribed and wildfire in areas that are habitat for *Conospermum undulatum*. It is recommended that this strategy include advice to landowners on how best to manage asset protection measures while conserving *C. undulatum*. A fire management strategy will include site specific wildfire response.

Action: Develop and implement a fire management strategy
Responsibility: DEC (Perth Hills and Swan Coastal Districts, Swan Region) with relevant authorities.
Cost: $6,000 once, in the first year; $4,300 in years 2-5

15. Promote awareness

The importance of biodiversity conservation and the protection of *Conospermum undulatum* will be promoted to the public. This will be achieved through an information campaign using local print and electronic media and by setting up poster displays. An A4 sized information sheet that provides a description of the species and information about threats and recovery actions will be developed for *C. undulatum* and distributed to local land owners, relevant authorities and volunteer organizations, libraries and schools within targeted areas. It is hoped that the poster will result in the discovery of new populations. Formal links with local naturalist groups and interested individuals should also be encouraged.

To minimize the risk of deliberate destruction, it is recommended that the exact location of *C. undulatum* be kept from the general public. Such information should, however, be given to relevant landowners, Shire and City staff and government authorities to prevent accidental destruction of plants.

Action: Promote awareness
Responsibility: DEC (Perth Hills and Swan Coastal District, Swan Region, SCB and Strategic Development and Corporate Affairs Division)
Cost: $1,600 in the first year; $600 annually thereafter

16. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Conospermum undulatum* will provide a better scientific basis for its management and should include:

1. Optimal fire and mechanical disturbance regime to maximise population size and health.
2. Appropriate herbicides for weed control that will not adversely affect *Conospermum undulatum.*
3. Seed and germination biology, such as rate of seed set and size of soil seed banks.
4. Age structure of *Conospermum undulatum* populations.
5. Susceptibility to *Phytophthora* spp.
6. Hybridisation between *Conospermum undulatum* and *Conospermum stoechadis* and *Conospermum triplinervium.*
7. Genetic differentiation between *Conospermum undulatum, Conospermum stoechadis* and *Conospermum triplinervium* using a higher number of genetic markers and with sampling from a broader range of populations of *C. undulatum* than in previous investigations by Close *et al.* 2005.

Action: Obtain biological and ecological information
Responsibility: DEC (Science Division, Perth Hills and Swan Coastal District, Swan Region)
Cost: $7,500 in year 2, $27,300 in year 3 and $18,800 in year 4

17. Map habitat critical to the survival of *Conospermum undulatum*

Although habitat critical to the survival of the species is described in Section 1, the area has not yet been mapped and this will be addressed under this action.

Where possible, monitoring of populations under Action 2, and description of any new populations under Action 12, should include GIS mapping.

Action: Map habitat critical to the survival of *Conospermum undulatum*
Responsibility: DEC (Swan Region Swan Coastal District and Perth Hills District)
Cost: $3,000 in the third year

18. Review the plan and need for further recovery actions

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

Action: Review the plan and need for further recovery actions
Responsibility: DEC (Perth Hills and Swan Coastal District, Swan Region) through the SRTFCRT
Cost: $1,500 in the fourth year

Summary of recovery actions

Recovery Actions	Priority	Responsibility	Completion date
Coordinate recovery actions	High	DEC Swan Region	Ongoing
Monitor populations	High	DEC (Perth Hills and Swan Coastal Districts, Swan Region)	Ongoing
Liaise with relevant land managers regarding management of bushland containing *C. undulatum*	High	DEC (Perth Hills and Swan Coastal Districts, Swan Region)	Ongoing
Install DRF Markers	High	DEC (Perth Hills and Swan Coastal Districts)	2008
Fence subpopulations	High	DEC (Perth Hills and Swan Coastal Districts)	2012
Collect seed and other material to preserve genetic diversity	High	DEC (TFSC), and BGPA	2013
Undertake weed control	High	DEC (Perth Hills and Swan Coastal Districts, Science Division)	Ongoing
Develop and implement a rabbit control strategy	High	DEC (Perth Hills and Swan Coastal Districts, Swan Region)	Develop by 2008 with implementation ongoing
Reassess population numbering and size based on tenure	High	DEC (Swan Region, SCB) through the SRTFCRT	2010
Assess development applications for lands containing *Conospermum undulatum*	High	DEC (Swan Region and Environmental Assessment Branch) through the SRTFCRT	Ongoing
Increase area of *Conospermum undulatum* in the conservation estate	High	DEC (Swan Region) with the WAPC	2013
Conduct further surveys	High	DEC (Perth Hills and Swan Coastal Districts, Swan Region)	Ongoing
Develop and implement fire and soil disturbance trials	High	DEC (Science Division, Perth Hills and Swan Coastal District, Swan Region)	2013
Develop and implement a fire management strategy	High	DEC (Perth Hills and Swan Coastal Districts, Swan Region) with relevant authorities.	Develop by 2008 with implementation ongoing
Promote awareness	Moderate	DEC (Perth Hills and Swan Coastal District, Swan Region, SCB and Strategic Development and Corporate Affairs Division)	Ongoing
Obtain biological and ecological information	Moderate	DEC (Science Division, Perth Hills and Swan Coastal District, Swan Region)	2012
Map habitat critical to the survival of *Conospermum undulatum*	Moderate	DEC (Swan Region Swan Coastal District and Perth Hills District)	2011
Review the plan and need for further recovery actions	Moderate	DEC (Perth Hills and Swan Coastal District, Swan Region) and the SRTFCRT	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 taxon is still ranked VU (WA) 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

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6. TAXONOMIC DESCRIPTION

Excerpt from: Lindley, I. (1839 - 1840). *A Sketch of the vegetation of the Swan River Colony*. In: Appendix to the first 23 Volumes of Edwards Botanical Register, London.

Erect *shrub* to 1.5 m tall. *Leaves* ascending, oblanceolate to spathulate, 1.4-12 cm long 4-38 mm wide, glabrous; *margins* undulate; *apex* acute; central and marginal *veins* prominent. *Inflorescence* an interrupted, spicate panicle; *peduncle* 25.5-40 cm long puberulous to villous; *branchlets* ovate, 2-3.1 mm wide; base and sides densely tomentose; apex ± velutinous. *Perianth*, white-woolly; tube 2.8-4.5 mm long; upper lip ovate, 1.8-2.4 mm long, 1-1.2 mm wide, glabrous, with an acute apex, lower lip united for 1-1.8 mm, woolly lobes narrowly oblong, 1.5-1 mm long, 0.2-0.3 mm wide, woolly with an acute apex. *Nut* approx. 2.5 mm long, approx. 3 mm wide, dark tan, velutinous, circumference hairs approx. 1.8 mm long, orange; *central tuft* 1.8-2 mm long, pale orange.

SUMMARY OF RECOVERY ACTIONS AND COSTS

	Year 1			Year 2			Year 3			Year 4			Year 5		
Recovery action	**DEC**	**Other**	**Ext.**	**DEC**	**Other**	**Ext.**	**DEC**	**Other**	**Ext.**	**DEC**	**Other**	**Ext.**	**DEC**	**Other**	**Ext.**
Coordinate recovery actions	1,000	500	100	1,000	500	100	1,000	500	100	1,000	500	100	1,000	500	100
Monitor populations	8,500		1,500	8,500		1,500	8,500		1,500	8,500		1,500	8,500		1,500
Liaise with relevant land managers	9,500		2,500	9,500		2,500	9,500		2,500	9,500		2,500	9,500		2,500
Install DRF markers	400		7,800						2,000						2,000
Fence subpopulations	1,500		6,600	1,500		6,600	1,500		6,600	1,500		6,600			
Collect seed and other material to preserve genetic diversity	2,000		300	2,000		300	2,000		300	2,000		300	2,000		300
Undertake weed control and follow up with regular monitoring and additional control if required	15,000		3,600	15,000		3,600	15,000		3,600	15,000		3,600	15,000		3,600
Develop and implement a rabbit (*Oryctolagus cuniculus*) control strategy	9,000		3,000	8,500		1,300	8,500		1,300	8,500		1,300	8,500		1,300
Reassess population numbers based on tenure and update population location information	5,000			5,000											
Assess development applications for lands containing *Conospermum undulatum*	5,000			5,000			5,000			5,000			5,000		
Increase area of *Conospermum undulatum* on secure tenure	1,500		300	300		200	300		200	300		200	300		200
Conduct further surveys				3,500		800				3,500		800			
Develop and implement a fire management strategy	3,500	1,000	1,500	3,300		1,000	3,300		1,000	3,300		1,000	3,300		1,000
Promote awareness	1,000		600	600			600			600			600		
Develop and implement fire and recruitment trials	5,500		1,000				5,500		1,000				5,500		1,000
Obtain biological and ecological information				1,000		6,500	7,000		20,300	5,000		13,800			
Map habitat critical to the survival of *Conospermum undulatum*							900		2,100						
Review the need for further recovery actions													1,500		
Total	68,400	1,500	28,800	64,700	500	24,400	68,600	500	42,500	63,700	500	31,700	59,200	500	13,500
Yearly Total	**98,700**			**89,600**			**111,600**			**95,900**			**74,200**		

Ext. = External funding (funding to be sought), Other = in kind contribution by landholders, local government etc, DEC = in kind contribution by various DEC divisions.

Total DEC:	$324,600
Total Other:	$3,500
Total External Funding:	$141,900
Total Costs:	**$470,000**