APPENDIX A

DEWHA REQUEST FOR ADDITIONAL INFORMATION

Australian Government
Department of the Environment and Water Resources

Mr John Fraser
Managing Director
Jandakot Airport Holdings
16 Eagle Drive
JANDAKOT WA 6164

Date / May 2009
EPBC Ref 2009/4796
EPBC contact Katherine Shelley
(02) 6274 1893
katherine.shelley@environment.gov.au

Dear Mr Fraser

Request for additional information – Jandakot Airport expansion, commercial development and clearance of native vegetation, WA

I refer to our letter of 17 April 2009 notifying you of the decision to assess the above proposed action by preliminary documentation under section 95A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

I am writing to ask you to provide further information regarding the proposed development. Attachment A to this letter outlines the additional information required.

In any correspondence with the Department please quote the title of the action and EPBC reference, as shown on the beginning of this letter. You can send information to us:

by letter Commonwealth and Territories Section
Environment Assessment Branch
Department of the Environment and Water Resources
GPO Box 787
CANBERRA ACT 2601

or by email katherine.shelley@environment.gov.au

Once the Minister or his delegate is satisfied that you have provided the information requested, we will give you written direction to publish the information for public comment for no less than 20 business days. In accordance with section 95B of the EPBC Act, you will then be required to address any public comments prior to commencement of assessment under section 95C.

If you have any questions about the process please contact the EPBC project manager and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely

Michelle Wicks
A/g Assistant Secretary
Environment Assessment Branch

Attachment A

Additional Information Required

1. The Jandakot Airport Master Plan and Environment Strategy (the version to be published for public comment under the *Airports Act 1996*).
2. Information on the impacts of the proposal on EPBC Act listed threatened species identified as being present or potentially present in the project area, including but not restricted to:
    - The presence of listed threatened species, on the design of the proposal, mitigation measures and offsets;
    - Removal of habitat for Carnaby's Black-Cockatoo, Grand Spider-orchid (*Caladenia huegelii*), Glossy-leaved Hammer-orchid (*Drakaea elastica*), during construction and operation of the proposed development; and
    - Potential changes to the long term management of habitat for listed threatened species on the site during implementation of the master plan.
3. Further information on the impacts of the proposal on Commonwealth land, including but not restricted to:
    - The long term viability of remaining patches of woodland;
    - The ecological function of woodland before and after construction of the Jandakot Airport expansion, including edge effects;
    - Impacts on WA listed threatened species;
    - Impacts on the Jandakot Groundwater Mound; and
    - Impacts from roads and fences on connectivity in conservation areas within Jandakot Airport and with surrounding areas.
4. Detailed information on proposed mitigation measures, including but not restricted to:
    - A consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts on listed threatened species;
    - Mitigation measures to maintain connectivity between conservation areas within Jandakot Airport and with surrounding areas, including through the use of fencing;
    - Mitigation measures to avoid impacts on the Jandakot Groundwater Mound;
    - Assessment of the expected or predicted effectiveness of the mitigation measures and any outstanding risks; and
    - The cost of mitigation measures.
5. Detailed information on proposed offsets, including but not restricted to:
    - Identify potential offsets to compensate for the loss of Carnaby's Black-Cockatoo habitat. Provide details of the proposed offset and measures to ensure conservation into the future. Reference should be made to the Department's draft policy statement at http://www.environment.gov.au/epbc/publications/draft-environmental-offsets.html;
    - Expected success of vegetation rehabilitation in the proposed offset areas, including estimates of time taken for rehabilitated vegetation to become established and functional;
    - Progress of negotiations with relevant parties to acquire proposed offsets; and
    - Alternative options for offsets if negotiations to acquire proposed offsets are not successful.

APPENDIX B

MATTISKE CONSULTING - RESPONSE TO SCOPING DOCUMENTS

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June 30, 2009

Response to Scoping Documents

1. Undertaking additional work on *Drakaea elastica* through additional targeted searching within bushland areas on Jandakot Airport following discussions with Kings Park orchid specialists. This additional work to be undertaken in July/August 2009 and will include weekly checking of sites that may support the species (based on habitat preference information from Kings Park orchid specialists). In addition, a report will be prepared outlining methodology of survey and any findings (including data, tabulations and maps).

   No response necessary at this time.

2. Prepare a summary of survey effort to date including timing of field work and reporting.

   Mattiske Consulting Pty Ltd has been involved in Botanical Studies at Jandakot Airport for Jandakot Airport Corporation since 2001. The table below stipulates the time, effort , objective and Report Title.

   As indicated in the summary below the main field programs have been related to the original gridding with recordings on a 100m x 100m grid (with tree species recorded on a 20m radius from each site and understorey recorded on a 5m radius from each site). This work covered all remnant vegetation areas on the Jandakot lease area and at the time exceeded the standards as accepted in government circles.

   The more recent searching for both the *Caladenia huegelii* and *Drakaea elastica* plants was undertaken by teams of botanists traversing the remnant vegetation areas on a fine scale (keeping each other in site). The coverage was very comprehensive as indicated by the additional finds of the occasional orchid in the areas of remnant vegetation. Whilst it recognized that not every inch of ground could ever be covered, the survey effort highlighted the species in a range of additional areas not known previously and the latter reflected the survey effort.

Table 1: Botanical Studies Completed for Jandakot Airport Corporation

Survey Times	Effort	Objective	Report containing Findings
24th -26th September 2001	4 Botanists using 100x 100m grid pattern	Search for the 3 known Priority Flora in the area	"Declared Rare And Priority Flora Survey of Jandakot Airport"
		Assess the condition of the vegetation on the Jandakot Airport lease area	"Bushland Condition Survey of Jandakot Airport Lease Area"
		Map the vegetation on the Jandakot lease area utilising the Havel (1968) approach.	"Vegetation Mapping of Jandakot Lease Area"
18th July 2006	4 Botanists	Confirmation of Vegetation and Condition Values	"Review of flora, vegetation and fauna values in the Proposed Industrial Area at Jandakot Airport"
August/September 2006	4 to 6 Botanists	Search for *Caladenia huegelii* and *Drakaea elastica* in the remnant areas of bushland on Jandakot Airport. Searches were undertaken for the two Rare orchids on the area with fine gridding and searching by a team of botanists.	"Review of flora, vegetation and fauna values in the Proposed Industrial Area at Jandakot Airport"
January 2007 (one Day)	Two Botanists	Demarcation of Buffers for 4 *Caladenia huegelii* populations	Short Communication to Jandakot Airport Holdings
5th September 2008	Five Botanists	Search for *Drakaea elastica*	Short Communication to Jandakot Airport Holdings

3. Prepare a summary of effort to date on the *Caladenia huegelii* and prepare a monitoring program for future assessments, including undertaking an assessment of plants in the Spring months of 2009 (when the species is flowering).

Table 2: Studies completed in order to establish values associated with *Caladenia huegelii*

Dates	Effort	Area
24th August 2006	Reconnaissance by an Experienced Botanist	
13th September 2006	One Experienced Botanist and one Botanist	Area to the South of Hope Road
19th September 2006	One Experienced Botanist and one Botanist	Area South of Hope Road
21st September 2006	Two Experienced Botanists	Area North of Hope road
25th,26th,28th September 2006	Four Botanists	Airside areas and areas North of Hope Road
Time in Total	*5 Days by an Experienced Botanist* *14 Days by a Botanist*	

These studies for the most part consisted of the people involved walking 5 m apart in a straight line search pattern, in habitat suitable for *Caladenia huegelii.* On the 21st September 2006, this methodology was changed to checking known DEC sites for this species' status. Attachment A is a map of the results of this work.

4. Proposed Studies on the *Caladenia huegelii* and *Drakaea elastica*

Following consultation with orchid specialists from Kings Park (Dr Kingsley Dixon) the following proposed follow up work will be undertaken for the ongoing monitoring of the orchids at the site.

Caladenia huegelii – a series of permanent monitoring sites will be established in the spring of 2009 to capture approximately a third of the population (as currently known) in representative areas in different sections of the Jandakot Airport. The timing of the field work will align with the peak of flowering. The peak of flowering may vary each year as rainfall events are not consistent. Therefore inspections of current populations will be undertaken prior to the work each year to assess and determine the optimum time for the field assessments to be undertaken. These monitoring sites will be assessed on an annual basis for three years. The monitoring will include re-assessing individual plants in permanent quadrats. Every three years an audit of all plants will be undertaken. Reporting will be supplied on an annual basis.

After three years the monitoring program will be reviewed in consultation with orchid specialists and

Drakaea elastica – additional targeted searching will be undertaken in consultation with orchid specialists from Kings Park in potentially preferred habitats. This approach is based on the current detailed knowledge of this species habitat preference (which is unlikely or restricted within the Airport area). This work will be undertaken on a regular basis (fortnightly in early spring to late spring). As the basal leaf if quite distinctive this work does not need to align totally with the flowering period of this species. If any plants are located then a detailed monitoring program (along similar lines to that for *Caladenia huegelii*) will be determined in consultation with Kings Park orchid specialists.

5. Review the occurrence of other Western Australian Rare and Priority species that have been recorded in or near the Jandakot Airport. This will include an updated search of DEC databases and DEWHA databases and the preparation of a brief report with associated tables, maps and text.

A DEWHA Protected matters search was conducted for Jandakot Airport with a 5 km buffer (Attachment B). Three Endangered plant species have been recorded in this area. The first two *Caladenia huegelii* and *Drakaea elastica* , have already been addressed previously. The third,

Lepidosperma rostratum is a Cyperaceae that occurs further east on the Swan Coastal Plain in winter wet flats. This type of habitat is not present at Jandakot Airport.

A search of DEC databases is still in progress.

6. Review the previous data to access whether *Lomandra hermaphrodita* is present on the Airport or likely to be present on the Airport (in view of the sun moth).

   This species has been found in Banksia woodlands to the east of the Jandakot Airport (Mattiske Consulting Pty Ltd 1995). The habitat for this species is described in Flora of Australia (Lee and Macfarlane 1986) as "Grows in laterite in eucalypt forest or sand in eucalypt or Banksia woodland or in heath". This type of habitat occurs at Jandakot Airport, therefore this species may occur in the Jandakot area and further searches for this species are recommended at the time of the *Drakaea elastica* work in coming months.

   This species is widespread in the southwest and therefore its presence in Jandakot Mound is less significant in a local and regional context (Department of Environment and Conservation 2009).

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APPENDIX C

MATTISKE CONSULTING - SUMMARY OF *CALADENIA HUEGELII* DISTRIBUTION ON JANDAKOT AIRPORT AND A WAY FORWARD: THE MANAGEMENT OF THIS RARE FLORA

SUMMARY OF

CALADENIA HUEGELII DISTRIBUTION

ON JANDAKOT AIRPORT

AND A WAY FORWARD

THE MANAGEMENT OF THIS RARE FLORA

Prepared for:

Department of Transporet and Regional Services
and
Department of Environment and Water Resources

Prepared by:

Mattiske Consulting Pty Ltd

On behalf of

Jandakot Airport Holidings

May 2007

MATTISKE CONSULTING PTY LTD

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Attachments

1. SUMMARY

Extensive ranges of studies have been undertaken on the Rare flora species - *Caladenia huegelii.* In recent years a range of botanical studies have been undertaken near the Jandakot Airport. These studies have highlighted the potential conflict between the expansion of the Jandakot Airport and the presence of patches of the *Caladenia huegelii.*

This summary provides an overview of the findings to date and a potential way forward to resolving the potential conflicts between conservation of the species and the development of Jandakot Airport.

One Declared Rare species (*Caladenia huegelii*) pursuant to Subsection 2 of Section 23F of the Wildlife Conservation Act 1950 and listed by the Department of Environment and Conservation (2006a) has been recorded in the south-eastern corner of the L2 area, south of Hope Road. This taxon is listed as Endangered pursuant to s179 of the Environmental Protection and Biodiversity Conservation Act 1999. No Priority flora species as defined by the Department of Environment and Conservation (2007a) were located during the survey in the Stage 1 area south of Hope Road.

The populations around Jandakot Airport include the main concentrations of the orchid species (Attachment 1). The occurrence of the higher population numbers of the orchid at Jandakot Airport and Ken Hurst Park highlight the significance of the plants at the Jandakot Airport.

In the past, this orchid has been translocated with some success, however the research is still in the early phases of development due to the complexities of the mycorrhizal association. Nevertheless this research provides a good basis for the potential to translocate some plants from the proposed disturbance area.

2. JANDAKOT AIRPORT BACKGROUND AND HISTORY

Jandakot Airport is the principle general aviation airport in Western Australia and is therefore strategically important to the growth and development of Western Australia's tourism, business and leisure industries.

The Jandakot Airport Master plan, prepared in accordance with the Airports Act 1996, was approved by the Minister for Transport and Regional Services on 3 January 2006. This master plan which provides the framework for development on the airport land, included the construction of a fourth runway and the development of 148 hectares of non-aviation land (Attachment 3).

Jandakot Airport Holdings have progressed the planning for the fourth runway and the 148 hectare development. As part of this process, flora surveys have identified a number of grand spider orchids (*Caladenia huegelii*) on site (Attachment 2) some of these are within the development area (Attachment 1).

Furthermore, Jandakot Airport Holdings has identified that additional access roads are required for emergency vehicle access, emergency egress and to service growth at the airport.

Jandakot Airport Holdings have therefore prepared a plan to show the proposed roads and the creation of an orchid park to protect the majority of orchids (Attachment 4).

Three major options for the preservation of the orchids were considered.

A. Retain orchids and develop around them.
B. Translocate all orchids within the development area, to Ken Hurst Park.
C. Retain the bulk of orchids in situ in an orchid park, and translocate the scattered and isolated occasional orchids into this park.

Although Ken Hurst Park are happy to accept the translocation of the orchids from Jandakot Airport, it was decided in consultation with Kings Park and Botanic Gardens, that the best option would be option C. The proposal is therefore, to swap the 10 ha of dieback infested bush for 10 ha of non-aviation development area. These 10 ha will protect 120 orchids in situ and 80 scattered orchids (beyond the main pockets of orchids) will be translocated into the orchid Park.

3. EXISTING ENVIRONMENT

The vegetation on the Jandakot Airport was mapped at the site-vegetation type level, utilizing the approach used by Havel (1968) on the northern Swan Coastal on the Bassendean and Spearwood dune systems (Mattiske Consulting Pty Ltd). The main structural formations within the survey area are (see Attachment 4):

- Woodland of *Eucalyptus marginata* with *Banksia* species (H1)
- Open Woodland of *Banksia attenuata – Banksia menziesii* (H2)
- Woodland of *Banksia ilicifolia* with *Banksia* species (J1)
- Open Forest of *Eucalyptus rudis* with *Melaleuca preissiana* (K1)
- Woodland of *Melaleuca preissiana* (K2)
- Largely cleared or disturbed areas

The underlying site conditions influenced the resulting vegetation types on the survey area. The soils are dominated by grey leached sands. As a result of considering both structural and floristic compositions and the site conditions, some four vegetation types were recorded in the L2 survey area. Of the four types within the L2 area, all but K1 are represented in other sections of the Jandakot Airport which are to be maintained as areas of native vegetation. The K1 community is represented in other reserves south and south-east of Jandakot Airport.

The percentage of this complex remaining as native vegetation within the Perth Metropolitan Region is 24% (Government of Western Australia 2000). The Jandakot Airport is located on the deeply leached sands of the Bassendean dune system. Jandakot Airport occurs on the Bassendean Complex - Central and South as defined by Heddle et al. (1980). This vegetation complex is represented by 24% native vegetation on the Swan Coastal Plain (Bush Forever, Government of Western Australia 2000). Since 2000, sections of the Banksia woodlands on the Swan Coastal Plain south of Perth have been cleared, so this estimate of extent left in native vegetation is possibly an over-estimation of the extent of the Banksia woodland left in the local and regional context.

The condition of the vegetation varies from completely degraded to very good (Attachment 6). The western end of the area is completely degraded and the condition ratings have declined since the earlier studies on the same area in 2001 (Mattiske Consulting Pty Ltd 2001a). The condition of a small section of the eastern dune supports a range of species. The condition of the vegetation also places additional impacts on the range of native species (both in terms of habitats and food supplies).

Deleted: eastern dune

4. BACKGROUND INFORMATION ON *CALADENIA HUEGELII*

The following background information on *Caladenia huegelii* was provided by Dr Kingsley Dixon from Kings Park and Botanic Garden:

"Distribution status and genetic diversity:
- Limited to approximately 1400 individuals, *C. huegelii* is restricted to *Banksia* woodlands on the Bassendean Sand System along the Swan Coastal Plain.
- The adjacent bushlands of Jandakot Airport and Ken Hurst Park contain almost two thirds the total number of known *C. huegelii*.
- *C. huegelii* is part of a broader phylogenetic group comprising eight species with *C. huegelii* closely aligned with the *C. thinicola, C. arenicola* and *C. georgeii* complex.

Mycorrhizal relationships:
- *C. huegelii* has a strictly obligate relationship with a fungal endophyte (Genus *Sebacina*) for germination, growth and development.
- The endophyte is functionally linked to the orchid in terms of nutritional needs for the life history of the plant.
- The endophyte of *C. huegelii* is rare and restricted in the natural environment and may be one of the principal causes of rarity in the species.

Pollination syndromes:
- The *C. huegelii* complex comprises orchid species characterized by a highly specific pollinator requirement involving native Thynnine wasps using a system of sexual deception for pollination.
- With an average of 4% of flowers successfully pollinated, natural seed set in this orchid is one of the lowest recorded for a sexually deceptive species.
- Little is known of the factors influencing the pollinating wasp abundance, distribution and pollinator activity.

Translocation and propagation knowledge:
- A specific fungal agent is required to germinate *C. huegelii* seed under *in situ* and *in vitro* conditions.
- Successful transfer to soil for seedlings of *C. huegelii* and other *Caladenia* species is low and erratic indicating a limitation in plant or fungal vigour.
- Natural recruitment of *C. huegelii* is low and rarely observed, balanced by adult plants surviving for 25 years or longer.

Germplasm conservation (*Ex situ* conservation)
- Seed and endophyte have been successfully stored in the cryogenic facilities at Kings Park for *Caladenia* species, however, long term viability of the collection needs to be established.
- Risk-management of the off-site germplasm collection has been established with the Millennium Seed Bank (MSB) at the Royal Botanic Gardens, Kew.

- A DNA bank for *Caladenia* including *C. heugelii* has been established at Kings Park and Botanic Garden as part of a national DNA bank for rare species.

5. PROPOSED WAY FORWARD

The way forward appears to require a compromise between the protection of some of the main occurrences of the orchid and the proposed development at site. The Jandakot Airport Holdings intends to set aside 10 hectares of bushland area that supports the rare orchid (*Caladenia huegelii*) and maintain the conservation zones as already established under the Jandakot Airport Master Plan. The latter conservation areas include some areas that support *Caladenia huegelii.*

It is intended that a research and management program for *Caladenia huegelii* will be undertaken by Kings Park and Botanic Gardens researchers through funding and on site assistance and management activities by the Jandakot Airport Holdings Pty Ltd. The specific aim of this research will be to ensure the longevity and increase the numbers of Caladenia huegelii. This approach will not only assist in improving the research of *Caladenia huegelii,* but will also assist in our understanding of other threatened and endangered *Caladenia* species in Western Australia.

As indicated in the attached research proposal by Kings Park and Botanic Gardens (Attachment 5) and as extracted below:

1. *Genetic fingerprints of targeted C. huegelii plants and indicative rare and threatened taxa (benchmarked as appropriate with common spider orchid taxa for comparative purposes).*
2. *Determination of key individuals or groups of plants considered genetically significant.*
3. *Optimisation of the propagation of orchids from seed through ex situ and in vitro methodologies.*
4. *Optimisation of the reintroduction and survival of orchid seedlings to field sites through scientific research and monitoring.*
5. *Ex situ conservation of genetically significant material (orchid seed and mycorrhizal fungi), identified from molecular genetics work.*
6. *Development of conservation initiatives for Caladenia pollination agents: thynnid wasps and host plants*
7. *Development of a Caladenia phylogeny with an extension to Arachnorchis sub-genus and resolution of species complexes in problematic species.*
8. *Collection and maintenance of the rescued plant material will be undertaken in summer 07/08 with plants to be maintained as a seed orchard for conservation production of seed for both reintroduction and long term seed banking.*

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The Jandakot Rare Orchid Research Program

***Integrated Conservation and Translocation of* Caladenia huegelii –**

***Key Concepts in the Development of an Integrated Conservation Program for Western Australian* Caladenia**

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BACKGROUND

Orchids have a high proportion of threatened species with orchid research having an increasing focus on their management and conservation (IUCN 1996). Conservation of terrestrial orchids, particularly in highly endemic floras, often lacks a thorough research background due to difficulties associated with researching their unique fungal associations and the lack of horticultural competency to propagate plants for translocation programs (Dixon *et al.* 2003). Seed germination is an effective method of propagating terrestrial orchids and allows genetic variability to be maintained (Zettler *et al.* 1995; Zettler 1997). However, terrestrial orchids, especially rare taxa, are often difficult to propagate and transfer to soil on a large scale (Clements *et al.* 1986; Anderson 1991; Zelmer and Currah 1997). This may be due to the high degree of seedling dependency on mycorrhizal fungi for germination and growth (Rasmussen 1992; Peterson *et al.* 1998).

Kings Park and Botanic Garden has an internationally renowned orchid research and conservation program. The research team has expertise in propagation, translocation and *ex situ* (off-site) storage of seed and associated mycorrhizal fungi. The research program is focused on establishing a sound research basis for understanding biological and ecological factors that influence the rarity and conservation of native Western Australian orchids.

Following a detailed review and analysis of the information relating to the conservation and distributional status of *Caladenia huegelii* key research areas have been identified that will assist in the development of an integrated and sustainable program for conservation for *Caladenia huegelii* from the Jandakot airport site. The thematic research areas include:

- Protocols for propagation from seed.
- Seedling transfer to soil in the glasshouse or field sites.
- Long-term storage of orchid seed and associated fungi.

- DNA-fingerprinting to define and ensure protection of the genetic diversity of orchid plants and mycorrhizal fungi.
- Sustainable conservation of the pollination agents.

A key aspect of the program will be the development of a state-wide conservation initiative for *Caladenia* arising out of the Jandakot program. This initiative will benchmark knowledge generated from the *C. heugelii* program for improving understanding and conservation of other rare and threatened Western Australian spider orchids. This aspect of the Jandakot program is envisaged to comprise:

- Testing of genetic diversity principles – geographical clines both in plants and their endophytes.
- Development of a subgenus *Arachnorchis* phylogeny and resolution of species complexes in problematic species.
- Secure, long-term off-site germplasm banking of seed, DNA and associated endophytes for all rare and threatened taxa.
- For indicative taxa testing of translocation principles including germination ecology, pollination biology and propagation science.

The research program will require five years to enable full appraisal of seasonal influences on the conservation of the species and to assess and monitor translocation outcomes. The Jandakot program will be linked and will dovetail onto the current *C. heugelii* program underway as part of the Roe 7 Highway development.

PROJECT SCOPE

A key aspect of the Jandakot program is understanding the impact of fragmentation on the conservation of *Caladenia huegelii.*

1. Genetic analysis: DNA fingerprinting of all plants to retain a library of the genetic diversity of the Jandakot population in the event that reinforcement plantings are required and to determine genetically significant individuals (keystone plants to be targeted for conservation planning) in the path of development.
2. Ex situ conservation of genetically significant material (incorporating long-term cryogenic storage of orchid seed and mycorrhizal fungi): Seed from individual plants and associated mycorrhizal fungi essential for germination and plant development is collected during the flowering season (October). Fungi will be tested for efficacy (ability to germinate seed) prior to use in the research program and long-term storage.
3. Propagation and tuberisation: Expand research program to propagate and experimentally tuberise seedlings of *C. huegelii* to produce plants for research translocations and reinforcement plantings particularly focused on individuals with high genetic value

(genomes of genetically unique or rare individuals or individuals with high reproductive competence).

4. Mapping of fungal distribution and developing an understanding of the relationship between fungal presence and distribution and plant establishment.
5. Determine the abundance and factors limiting thynnid wasp pollinating agents in sites to be set aside as reserves for *C. huegelii* both within and adjacent to the Jandakot site. Seasonal factors including flowering host plants would be investigated to ensure that wasp populations are maintained at effective levels for continued effective pollination of the orchid.

It is anticipated that this program would require a full time research scientist position for five years with leveraging of PhD and Honours programs included in the responsibilities of the position. The research scientist would be responsible for management and execution of the research program, delivery of 6-monthly and annual reports, provision of liaison point for *C. heugelii* monitoring program and link to recovery operations for all rare *Caladenia* species by being a member of Department of Conservation and Environment recovery teams.

Operating costs and materials associated with the project are expected to total approximately $15,000 p.a. indexed at 5% annually. Travel to sites and site specific consumables for laboratory, glasshouse and site trialling are included.

KEY PROJECT OUTCOMES

9. Genetic fingerprints of targeted *C. huegelii* plants and indicative rare and threatened taxa (benchmarked as appropriate with common spider orchid taxa for comparative purposes).
10. Determination of key individuals or groups of plants considered genetically significant.
11. Optimisation of the propagation of orchids from seed through *ex situ* and *in vitro* methodologies.
12. Optimisation of the reintroduction and survival of orchid seedlings to field sites through scientific research and monitoring.
13. *Ex situ* conservation of genetically significant material (orchid seed and mycorrhizal fungi), identified from molecular genetics work.
14. Development of conservation initiatives for *Caladenia* pollination agents: thynnid wasps and host plants
15. Development of a *Caladenia* phylogeny with an extension to *Arachnorchis* sub-genus and resolution of species complexes in problematic species.
16. Collection and maintenance of the rescued plant material will be undertaken in summer 07/08 with plants to be maintained as a seed orchard for conservation production of seed for both reintroduction and long term seed banking.

BUDGET

	2007/8	2008/9	2009/10	2010/11	2011/12
Staffing (Research scientist incl. 27% statutory on-costs)	90 000	92 000	94 000	96 000	98 000
PhD Leveraging	9 000	9 000	9 000	9 000	9 000
Operating costs (consumables, travel)	15 000	17 000	19 000	21 000	23 000
Sub total	114 000	118 000	122 000	126 000	130 000
GST	11 400	11 800	12 200	12 600	13 000
TOTAL	**$125 400**	**$129 800**	**$134 200**	**$138 600**	**$143 000**

NOTE: This grant is eligible for the 175% Research and Development tax concession for the Australian Tax Office

REPORTING

An annual progress report, presentation of work to date and discussion of the following years objectives will be provided. In addition a six month summary of research highlights will also be provided. A Jandakot Program research management committee would be formed to review on a regular (6 monthly) basis progress towards attainment of research milestones.

A key outcome of the program is the development of a detailed recovery plan for *Caladenia huegelii*. This plan would incorporate the ongoing research outcomes focussing on key operational outcomes to ensure long-term protective actions are implemented.

DETAILED WORKING PLAN

1. Genetics

Leaf samples will be taken from target individuals for DNA extraction and analysed to determine the level of genetic diversity and to identify genetically significant individuals and groups of individuals at the site. Information gained from this study will be essential for targeting key plants for future re-introductions to ensure maximum genetic diversity is maintained both for *C. heugelii* and other indicative rare taxa.

Fungal isolates from *C. huegelii* and indicative rare taxa and individuals will be screened for levels of genetic diversity across the population. This information will be critical for assessing essential isolates for propagation, long-term storage and translocation. Material will be collected at the same time as leaf material.

2. Fungal baiting

Fungal baiting technology will be used to assess the habitat for areas containing suitable fungi to sustain *C. huegelii* plants both within the external to the Jandakot study area. This information will be important in locating sites for the translocation of existing plants and for the translocation research program for *C. huegelii* and other rare taxa.

3. Ex situ conservation and seed/fungi collection

Locate and pollinate target plants – Pollination rates are typically very low for *Caladenia* species in natural systems and therefore will require hand pollination to secure seed from target plants of *C. huegelii* and indicative rare species. Target plants will be outcrossed with other plants within the population thus maximising genetic diversity of the seed to be collected. Flowers successfully pollinated will develop over a 6-8 week period when mature seed will be ready for collection. Given the dust-like nature of orchid seed special seed bags will be placed over the developing seed capsules to prevent loss of seed to the surrounding habitat thus ensuring maximum seed collection.

Isolate fungi from target plants – The specific soil fungi essential for the germination of orchid seed and development of *C. huegelii* seedlings and seedlings of other indicative rare species of *Caladenia* will be extracted from a small section of the underground stem of mature plants. This will occur at a stage when correct identification of the plants can be determined, usually at the time of flowering. Fungal cultures will be maintained in the laboratory at Kings Park and Botanic Garden.

4. Propagation and tuberisation

Once seed has been collected and efficacious fungal isolates have been obtained seed will be sown during December/January for propagation trials. Existing symbiotic germination technology will be used for seed germination and propagation. Resulting seedlings will be used to confirm and optimise

seedling tuberisation in glasshouse research trials at Kings Park and Botanic Garden and to optimise transfer to soil in the field.

5. Pollinator Studies

Detailed investigations will be undertaken into the seasonal abundance, pollination activity and preferred host plants for the thynnid wasp and other pollinators of the *C. huegelii* and indicative other rare taxa (as appropriate and subject to time availability due to this task being labour intensive). Impacts of site disturbance on abundance and pollination activity of the orchid will be undertaken and benchmarked against control sites without disturbance. Artificial manipulation of the pollinating agent will be undertaken including captive breeding and reintroduction where measures of wasp abundance indicate low or sub-optimal presence in terms of pollination success for *Caladenia huegelii* and other indicative rare taxa.

6. Extension to *Caladenia*

Leaf material will be collected for all *Caladenia* species and DNA extractions sequenced using a variety of available primers to develop a phylogeny and resolve difficult species complexes within the genus and subgenus *Arachnorchis*. The transferability of previously developed *C. huegelli* microsatellite loci will be tested on a range of *Caladenia* species in order to complete population studies on other rare taxa.

Fungal endophytes of a wide range of *Caladenia* species will be isolated from adult plants in the same way as described above for *C. huegelii* and sequenced using fungal specific primers to establish a reciprocal *Caladenia* endophyte phylogeny, testing genetic diversity concepts such as identifying significant genetic units, geographical diversification and co-evolution of both plants and their associated endophytes.

Using developed pollinator baiting methods, throughout the flowering seasons over consecutive seasons we will determine the abundance, success and types of *Caladenia* pollinators and factors limiting both pollination and pollinator requirements such as food plants. Seasonal factors including flowering of orchids, host plants and suitable weather conditions for pollinator activity would be investigated to ensure that pollination efficacious invertebrate populations are maintained at effective levels for continued pollination of the orchid.

INDICATIVE TIMELINES

YEAR ONE

Research area	J	F	M	A	M	J	J	A	S	O	N	D
1. Genetics												
Collect leaf samples from target species												
Extract DNA & determine fingerprints												
2. Ex situ Conservation												
Locate & pollinate target species												
Monitor and collect seeds												
Isolate fungi from target species												
Test efficacy of fungal isolates												
Long-term storage of seed & fungi												
3. Propagation tuberisation research												
4. Translocation research												
Survey habitat for likely sites												
Intensive soil sampling												
Establish *ex situ* baiting trials												

Years 2 to 5

Research area	J	F	M	A	M	J	J	A	S	O	N	D
1. Genetics												
Micro-satellite array cross-application												
Apply genetic criteria to research planning												
2. Ex situ Conservation												
Collection of additional seed as required												
Long-term storage of seed & fungi												
3. Propagation tuberisation research												
Germinate seed of research species												
Trial tuberisation treatments												
Assess outcomes of research trials												
4. Translocation research												
Establish field plantings												
Monitor seedling survival												
5. Natural Pollination Agent Research												
Research natural abundance of pollinators												
Assess seasonal variation in pollinators.												
Investigate captive breeding options												

APPENDIX D

JAH - DRAFT DIEBACK MANAGEMENT PLAN

JANDAKOT
AIRPORT

DIEBACK MANAGEMENT PLAN

November 2007

Contents

1 Background

Jandakot Airport is managed by Jandakot Airport Holdings Pty Ltd (JAH) under a lease agreement with the Commonwealth Government. The airport site contains 410ha of land set aside for aviation and commercial development and 210ha of remnant bushland. JAH is regulated by the Commonwealth *Airports Act 1996* (Airports Act) and the associated *Airports (Environment Protection) Regulations 1997*.

The Airports Act requires JAH to prepare and implement an Environment Strategy every five years to outline its environmental management of the airport. The current Environment Strategy was prepared in 2004 and approved in 2005. This Strategy includes a commitment to prepare and implement a management plan for dieback disease.

Dieback is caused by an introduced soil and water borne pathogen known as *Phytophthora cinnamomi* which infects the roots of plants causing roots and foliage to die off. This often leads to the eventual death of the infected plant. Many local native plants are susceptible to dieback and its spread can have devastating effects on the ecology of remnant bushland areas. Death of susceptible species in large numbers can encourage weed infestation and impact on fauna habitat and feeding sources. Areas identified as containing dieback can not be cured once infested, however appropriate management can minimise the spread of the disease (Dieback Working Group, 2005). As Jandakot Airport is adjacent to two other conservation bushland areas – Ken Hurst Park and the Jandakot Regional Park – it is important that the spread of dieback is minimised.

Six dieback infestations have been identified and mapped at Jandakot Airport, and these are mostly associated with dampland areas (see Figures 1 and 2). Jandakot Airport contains regionally significant bushland, which includes two declared rare flora species, one rare fauna species and other priority fauna species. JAH is committed to protecting these areas and by implementing the actions described in this Dieback Management Plan.

Armillaria luteobubalina (Honey Fungus) has also been identified at Jandakot Airport. Honey Fungus is a mushroom producing fungus which is probably native to Western Australia, but which also infects the roots of many native plants leading to death of plants. Honey Fungus can be spread by soil, water and air which makes it more difficult to manage than *Phytophthora cinnamomi* (Glevan Consulting, 2000).

There are also a number of other *Phytophthora* species which can lead to dieback, however *Phytophthora cinnamomi* is the most common and virulent species in Western Australia at this time (Dieback Working Group, 2005). These other *Phytophthora* species are managed in the same way as *Phytophthora cinnamomi*.

2 Identification

Dieback infestation is usually identified via two methods – interpretation and laboratory testing. These are discussed in detail in Sections 2.1 and 2.2.

During dieback surveys, all bushland areas are assigned one of the following categories:

- Dieback infested – dieback is present
- Dieback uninfested – dieback does not appear to be present at the time of the survey
- Dieback uninterpretable – the presence or absence of dieback can not be determined as the bushland is too degraded or does not contain plant species which are susceptible to dieback

These categories are used to determine appropriate management measures in each area. Management measures are discussed in Section 3.

2.1 Interpretation

Dieback interpretation is undertaken by an appropriately qualified dieback interpreter who is accredited by the WA Department of Environment and Conservation. Reassessment is recommended every two to three years.

Dieback interpretation involves a visual assessment of the plant species present in a given area. Deaths of susceptible species and their approximate age are noted as well as the general health of non-susceptible species. Deaths of a number of different aged susceptible species may indicate the presence of dieback. Deaths of non-susceptible species may indicate an alternative cause of death such as drought, fire or other disturbance (Glevan Consulting, 2005).

A combination of interpretation and laboratory testing methods give the most reliable method of dieback identification.

The first dieback interpretation undertaken at Jandakot Airport was in completed in November 2000 (Glevan Consulting, 2000). A reassessment was undertaken in November 2005 (Glevan Consulting, 2005) and the results are shown in Figure 1. Areas shown in red are dieback infested, yellow indicates dieback uninterpretable areas and all other areas are considered to be dieback uninfested.

The 2005 reassessment showed that dieback spread was minimal over the fire year period. This is likely due to the sandy soils present at the airport which allow free drainage, and also the management measures which have been implemented since the 2000 survey. For these reasons, JAH propose to

undertake dieback reassessment at Jandakot Airport every three years. The next dieback survey will be conducted in November 2008.

2.2 Laboratory Testing

Laboratory testing is usually undertaken in conjunction with dieback interpretation and can consist of soil and/or plant tissue samples collected from areas interpreted as dieback infested. There are two main methods of laboratory testing in use – baiting and DNA analysis.

Baiting involves placing the soil or tissue sample and a germinated seed under laboratory conditions which promote the growth of *Phytophthora cinnamomi*. The samples are left for a period of up to two weeks and the seedling assessed for *Phytophthora cinnamomi* infection (Glevan Consulting, 2005).

DNA analysis is a relatively new technique which is quicker and more accurate, however it is also more expensive. Medical technology is used to detect the DNA of *Phytophthora cinnamomi* in soil or plant tissue samples. This method detects *Phytophthora cinnamomi* even if it is in a dormant state, which the baiting method may not detect (Murdoch University, 2006).

In both testing methods it should be noted that a negative result does not mean that an area is free of dieback. This is because relatively small amounts of soil and tissue are collected for samples and *Phytophthora cinnamomi* is not evenly spread within infested soil. Anecdotal evidence suggests that tissue samples collected from suspected dieback infected plants have a higher rate of positive *Phytophthora cinnamomi* detection.

Soil and tissue samples were collected in both the 2000 and 2005 surveys and sampled using the baiting method. Five of twelve samples collected in 2000 were confirmed to contain *Phytophthora cinnamomi*, while only one of thirteen samples collected in 2005 were confirmed.

In December 2006 Murdoch University's Centre for Phytophthora Science and Management conducted DNA analysis on ten soil and one plant tissue samples collected from an uninterpretable area within the Stage 1 commercial area. The plant tissue sample tested positive but all the soil samples tested negative for *Phytophthora cinnamomi*.

JAH propose to continue soil and tissue testing as part of the triennial reassessment of dieback interpretation. The laboratory testing method to be used will be based on the advice of the relevant consultant contracted to undertake the interpretation at the relevant time.

3 Management

As previously stated, dieback infested areas can not be cured and so the main management focus is to minimise its spread. The proposed management measures to be implemented at Jandakot Airport are detailed in the following sections.

Effective management of dieback spread is assisted by identifying areas of high conservation or those which are vulnerable to spread. JAH has identified the following as its priority areas for dieback management:

1. Areas containing the declared rare flora species *Caladenia huegelii* and *Drakaea elastica*
2. Conservation areas identified in the 2004 Environment Strategy
3. Dieback uninfested areas adjacent to infested areas

3.1 Access

Restricting access to dieback areas, and particularly across dieback category boundaries is the most effective method to minimise dieback spread. Jandakot Airport is surrounded by a chain mesh security fence which minimises unauthorised access to bushland areas by trail bikes and the like. This fence is inspected daily and repaired immediately to ensure security.

Limestone has been laid over the airport perimeter road to provide a barrier across dieback category boundaries. This enables bushfire response and daily fence inspections to occur without fear of spreading dieback. Access to other sand tracks and firebreaks is restricted to JAH approved personnel. All dieback infested areas are signposted as a reminder to vehicles and pedestrians to keep away, unless access into these areas is necessary. Pedestrian access into dieback infested areas is minimal in wet weather, which is when there is the greatest risk of dieback spread from footwear.

JAH will continue to implement these access restriction measures.

Access across dieback category boundaries by wallabies and other animals is not currently restricted at Jandakot Airport. Kangaroos are known to spread dieback in southern WA, however as habitat in Perth becomes more fragmented, JAH does not believe that restricting wallaby access is appropriate at this time. If triennial dieback reassessments indicate significant dieback spread in the future, this issue may be reconsidered.

3.2 Construction/Earthmoving

During construction or earthmoving activities which necessitate crossing dieback category boundaries, JAH has implemented strict hygiene measures involving the clean down of all machinery and vehicles. Dieback can be spread during these activities through the movement of infested soil or plant material or via infested soil attached to vehicles and machinery.

Construction/earthmoving vehicles and machinery must be cleaned down in the following circumstances:

- Prior to entering Jandakot Airport in case machinery has come from a dieback infested area offsite.
- Prior to entering dieback uninfested areas.
- Prior to entering dieback uninterpretable areas if coming from a dieback infested area.
- Prior to leaving dieback infested areas.

Clean down should be undertaken in designated areas and may involve the use of water or stiff brushes to remove soil. Wastewater and removed soil must be contained within the relevant dieback category. Guidelines provided by JAH to its contractors are included in Appendix 9.3.

Unnecessary movement across dieback category boundaries should be minimised. The installation of limestone access tracks to act as a barrier across dieback category boundaries may be appropriate.

Dieback infested soil and mulch should not be moved or stockpiled in dieback uninfested areas.

3.3 Drainage

Water can easily spread dieback via surface or groundwater flows. There is no standing water at Jandakot Airport, although there are a number of areas which have been identified as damplands (see Figure 2). Stormwater flows are minimal due to the highly sandy soils present.

There is one artificial infiltration basin sump in the conservation area which receives stormwater from the developed parts of the airport. The basin has been mapped as dieback uninfested, although it is directly adjacent to a dieback infested area. It is at high risk of being subject to dieback spread, however it is significantly disturbed and was identified as “completely degraded” (as per the Bush Forever scale) in a 2005 vegetation survey (Cardno BSD, 2005).

Most of the dieback infested sites at Jandakot Airport are associated with damplands and appear to coincide with low points across the airport. This means that stormwater runoff would tend to run towards these areas, thereby minimising dieback spread away from these areas. JAH will ensure that there is no stormwater discharge from dieback infested or uninterpretable areas into uninfested areas.

The groundwater at Jandakot Airport flows in an approximately north to north-westerly direction. This means that areas north to north-west of dieback infested areas are high risk areas which may be subject to natural dieback spread via the groundwater. JAH will target these areas as part of its phosphite treatment described in the next section.

3.4 Phosphite Application

Phosphite (phosphonate) treatment has been identified as successful in boosting the defence mechanisms of dieback susceptible plants and minimising the spread of dieback (Dieback Working Group, 2005). Phosphite can be applied by injection directly into susceptible tree species, or by aerial or ground based spraying. Phosphite is taken up by the leaves or roots of the plant and accumulated in the plant's tissue (Dieback Working Group, 2005).

JAH has implemented an aerial spraying program due to the relatively large areas of the site and isolation of dieback infested areas. Aerial spraying was last undertaken in December 2006 and reapplication is recommended every one to two years (Dieback Working Group, 2005). JAH propose to reapply every two years, as the rate of dieback spread has been minimal thus far. The next round of spraying will be conducted in December 2008.

JAH uses a product called Agri-fos 600 which is non toxic to humans and animals, and is readily biodegradable. It is applied at the following rate:

- 30L Agrifos
- 15L water
- 20mL wetting agent Synertrol

Phosphite spraying is only undertaken in dry weather conditions to maximise plant uptake and minimise runoff which may enter the groundwater table. All dieback infested areas as well as the areas directly north to north west of these areas are sprayed.

3.5 Landscaping/Revegetation

JAH regularly undertake landscaping (in development areas) and revegetation (in conservation areas) projects across Jandakot Airport. These need to be managed carefully to minimise dieback spread and ensure successful growth of

plants. It is JAH policy that all revegetation of conservation areas use only plant species which grow naturally onsite. Landscaping works must consist mostly of plants occurring onsite, with other Swan Coastal Plain species allowed to supplement. Unfortunately, nearly half of the species occurring onsite are susceptible to dieback (see Appendix 9.5) and many of the tree species are susceptible.

It is preferable that plants used are grown onsite either from collected seed or transplants. Transplants should not be collected from dieback infested or uninterpretable areas as the risk of spreading dieback into uninfested areas is too great. Seed can be collected from dieback infested and uninterpretable areas as long as appropriate dieback clean-down procedures are implemented for all shoes, vehicles and tools.

Plants grown offsite should be purchased from NIASA (Nursery Industry Accreditation Scheme Australia) accredited nurseries, to ensure that appropriate dieback hygiene measures have been implemented and minimise the risk of introducing further dieback infections onto Jandakot Airport.

Seedlings are known to be particularly susceptible to death from dieback, even if they are not of a dieback susceptible species. In dieback infested areas, it may be appropriate to revegetate using direct seeding instead of planting seedlings.

In dieback areas only dieback resistant species (See Appendix 9.4) should be planted. In areas adjacent to dieback infestations or high risk areas for dieback spread e.g. areas subject to significant earthmoving, mostly dieback resistant species should be planted.

Eucalyptus marginata (Jarrah) is particularly susceptible to dieback, however some dieback resistant populations have been identified in South West WA. JAH will collect some Jarrah seed from healthy trees in dieback infested areas to see if they have developed dieback resistance. If they have, the seed could be used for revegetation in dieback infested areas.

Topsoil and mulch may be collected from cleared areas for reuse in landscaping as long as materials from dieback infested areas are kept within the infestation boundaries. JAH generally does not reuse topsoil or mulch from clearing activities for revegetation in conservation areas as the risk of spreading dieback and weeds is too great. An exception to this may be in cases of clearing within conservation areas, such as for firebreak maintenance.

3.6 Bushfire Management

JAH have in place a draft Bushfire Management Plan which outlines the planning for and response to fire incidents at Jandakot Airport. Fire access is provided as described in Section 3.1. Current dieback mapping is included in the Bushfire

Management Plan, along with the following points to address dieback spread during fire response and recovery:

- Try to keep all machinery operations in one area, either in dieback infested or uninfested areas.
- Minimise the entry of machinery or vehicles into bushland areas, or stick to marked access tracks.
- During earthworks take care not to push dieback infested soil into uninfested areas.
- Avoid areas where soil can be picked up e.g. muddy or wet areas, or clean soil off vehicles.

4 Monitoring

JAH will monitor the effectiveness of this Dieback Management Plan in minimising the spread of dieback via the proposed triennial surveys described in Section 2.1.

5 Communication

JAH communicates the contents of this Dieback Management Plan to its stakeholders via the following methods:

- JAH staff – internal meetings
- JAH contractors – contract documentation and inductions
- Jandakot Airport tenants and other airport users – newsletters and environment bulletins

6 Research

JAH recognises that research is an important part in improving dieback identification and management measures. JAH is a member of the Dieback Working Group, which is made up of local government authorities, community environmental groups, universities and state environmental agencies. The Working Group is facilitated by the Swan Catchment Council and provides a forum for sharing the latest information on dieback identification and control measures. Over the years JAH has supported a number of dieback related projects conducted by Murdoch University students. Murdoch University share the results of these projects by providing copies of research reports.

7 Review

JAH will review this Dieback Management Plan every three years to ensure that it is up to date and its control measures are effective.

8 References

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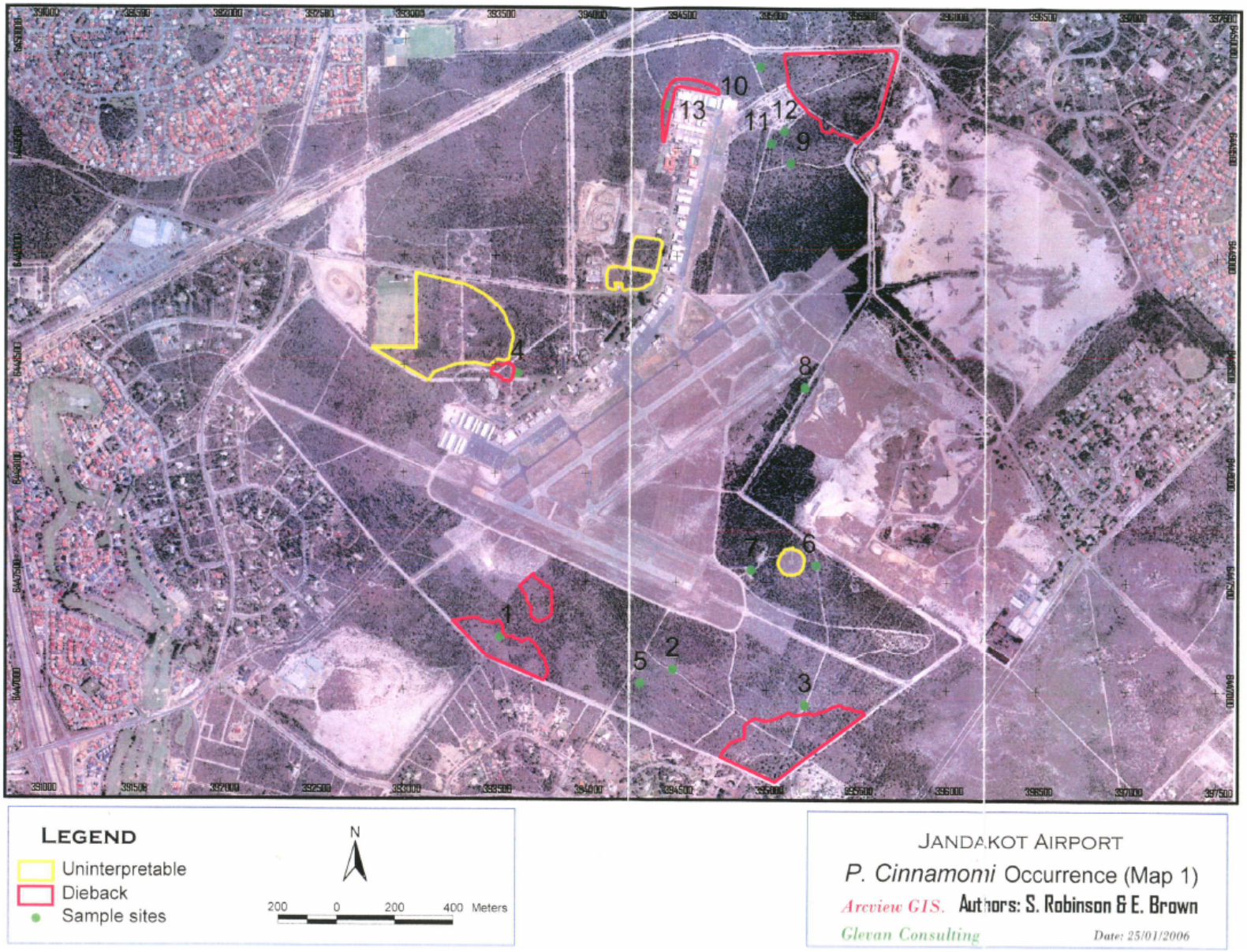
9 Appendices

9.1 Summary of Commitments in this Dieback Management Plan

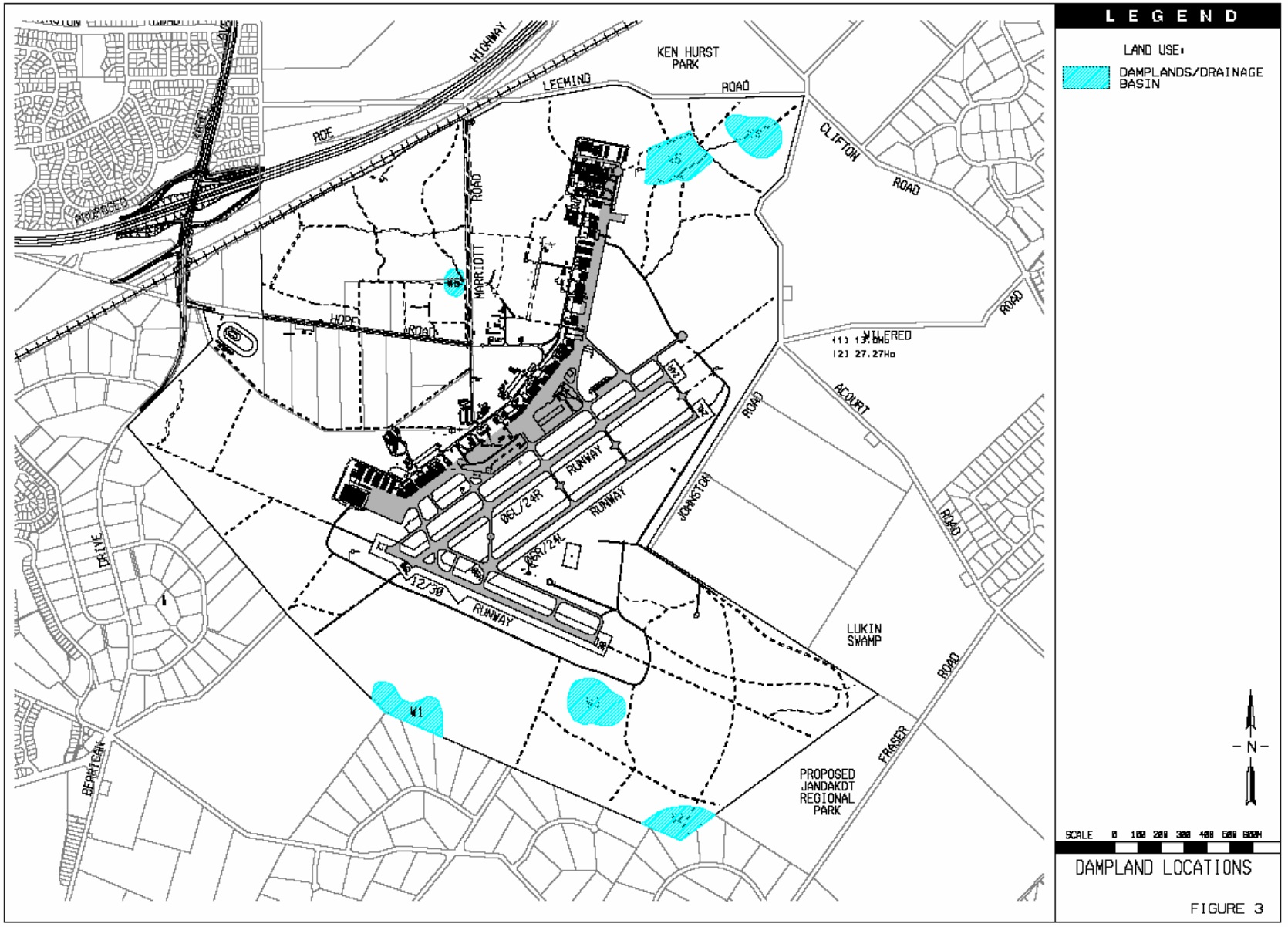
Action No.	Description of Action	Timing for Implementation
1.	Dieback reassessment to be undertaken.	November 2008
2.	Laboratory soil testing to be undertaken as part of dieback reassessment.	November 2008
3.	Inspect security fencing daily and repair immediately if necessary.	Daily
4.	Pedestrian access into dieback infested areas to be minimised in wet weather.	As required
5.	Reconsider issue of dieback spread via wallabies.	If required
6.	Construction/earthmoving vehicles and machinery must be cleaned down as per the requirements of Section 3.2.	As required
7.	Unnecessary movement across dieback categories should be minimised.	As required
8.	Limestone access tracks may be installed to act as a barrier across dieback category boundaries as appropriate.	If required
9.	Dieback infested soil and mulch should not be moved or stockpiled in dieback uninfested areas.	At all times
10.	Target dieback infested areas and high risk areas which may be subject to natural dieback spread via groundwater for phosphite treatment.	Biennial phosphite spraying
11.	Reapply aerial phosphite spray treatment on dieback infested areas and areas directly to the north or north east of these sites.	December 2008
12.	Plants to be used in revegetation/landscaping works preferably to be grown onsite or obtained offsite from NIASA accredited nurseries.	As required
13.	Plant only dieback resistant species in dieback infested areas.	As required
14.	Plant mostly dieback resistant species in high risk areas for dieback.	As required
15.	Collect seed from healthy *Eucalyptus marginata* trees in dieback infested areas for revegetation in dieback infested areas.	December 2008
16.	Topsoil and mulch material collected from cleared areas for reuse in landscaping must be kept within the relevant dieback boundaries.	During clearing activities
17.	Topsoil or mulch from clearing activities should not generally be used for revegetation in	If appropriate

	conservation areas as the risk of spreading dieback and weeds is too great.	
18.	All machinery operations should be kept in one dieback category area.	During bushfire response and recovery
19.	Entry of machinery or vehicles into bushland areas should be minimised by sticking to marked access tracks.	During bushfire response and recovery
20.	During earthworks care should be taken not to push dieback infested soil into uninfested areas.	During bushfire response and recovery
21.	Areas where soil can be picked up e.g. muddy or wet areas should be avoided, or soil should be cleaned off vehicles.	During bushfire response and recovery
22.	Monitor the effectiveness of the Dieback Management Plan via triennial surveys.	Triennially commencing November 2008
23.	Communicate the contents of the Dieback Management Plan to JAH staff, contractors, tenants and other airport users.	Ongoing

Appendix 9.2 Phytophthora cinnamomi occurrence map January 2006



Appendix 9.3: Damplands Mapped at Jandakot Airport 2001



9.4 JAH Contractor Dieback Hygiene Policy

DIEBACK HYGIENE POLICY

BACKGROUND

Phytophthera cinnamomi, commonly known as dieback disease, belongs to the fungus Family Pythiacae and attacks a wide variety of Australian native and exotic plant species. It is currently a grave problem in a number of areas in Western Australia where it has infected large portions of native forest and heathland. Unfortunately, a number of native species are extremely sensitive to the *Phytophthora* disease and are at extreme risk.

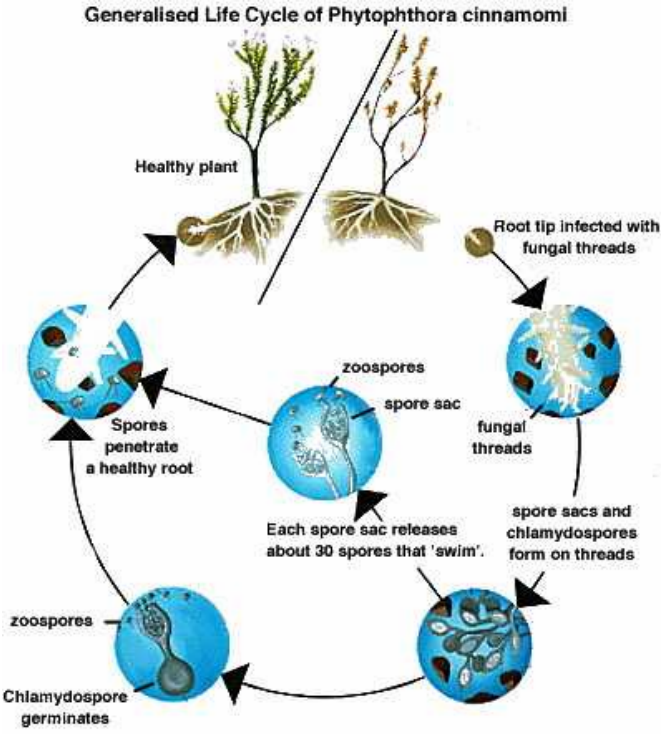
SYMPTOMS

Above ground:

- A general dying off or yellowing of foliage as the disease finally leading to death eliminates the plants structural elements.
- Leaves can develop brown patches at the tips and margins.
- When the bark is removed at ground level, stem tissues should appear brown as the disease attacks the lower stem and the trunk.
- Stem may be mushy near the root zone.
- Wilting, stunting, general dieback of foliage.

Below ground:

- Roots are dead and decayed,
- Root system much reduced in size.
- Roots may be slimy.



SPREAD

Spores and mycelium may spread:

- by water (as drain off or irrigation),
- in soil (transported by containers, shoes, tools, vehicles and other equipment)
- By the movement of infected plant materials.

GUIDE LINES FOR CLEANING AND STERILISING

FIGURE 1: VEHICLE WASH DOWN STATION

All water used should be obtained from the Mains supply or sterilised by adding 6ml of pool chlorine to every 10L of water.

1. Cleaning Vehicles and Machinery

- Try to remove soil and mud when it is dry.
- Remove as much mud and soil as possible with a brush and minimise the amount of water used.
- Use a brush or a stick to remove compacted soil
- Wash down on a hard, well-drained surface and on ramps if possible.
- Do not allow mud or wash down effluent to drain into bushland
- Do not drive through wash down effluent
- Pay particular attention to mud flats and tyres.

2. Cleaning Footwear

- Try to remove all mud and soil when it is dry.
- Remove as much mud and soil as possible with a brush and minimise the amount of water used.
- Collect all mud and soil removed into a bag or a bucket and do not allow it to enter bushland.

3. Sterilising Equipment, Tools and Footwear

- Methylated spirits is suitable for sterilising small hand tools and footwear in the field. Place the methylated sprits in a spray bottle, spray to cover all surfaces, and allowed a few minutes to dry.
- Other equipment can be sterilised by soaking in a disinfectant such as bleach (containing the active ingredient sodium hypochlorite).

9.5 Jandakot Airport Flora Species Dieback Susceptibility

S = Dieback Susceptible; R = Dieback Resistant

R	Acacia huegelii		Boronia ramosa		Conostephium minus
R	Acacia pulchella	S	Bossiaea eriocarpa	S	Conostephium pendulum
R	Acacia saligna		Brachyloma preissii		Conostephium preisii
S	Acacia stenoptera	R	Burchardia umbellata	R	Conostylis aculeata
	Acacia willdenowiana		Burtonia conferta		Conostylis aurea
S	Adenanthos cygnorum		Burtonia scabra		Conostylis caricina
S	Adenanthos obovatus		Caladenia discoidea		Conostylis juncea
S	Allocasuarina fraseriana		Caladenia flava	R	Conostylis setigera
	Allocasuarina humilis		Caladenia gemmata var. gemmata		Crassula colorata
	Amphipogon laguroides		Caladenia huegelii		Croninia kingiana
	Amphipogon turbinatus		Caladenia longicauda	R	Cryptostylis ovata
	Anigozanthos humilis		Caladenia patersonii	R	Cyathochaeta avenacea
R	Anigozanthos manglesii		Calectasia cyanea	R	Dampiera linearis
	Aotus procumbens		Calectasia cyanea		Danthonia occidentalis
	Arnocrinum preissii		Calytrix angulata		Danthonia pilosa
R	Astartea fascicularis	R	Calytrix flavescens		Dasypogon bromeliifolius
S	Astroloma xerophyllum		Calytrix fraseri		Daviesia gracilis
	Austrodanthonia occidentalis		Calytrix strigosa	S	Daviesia incrassata
R	Baeckea camphorosmae	R	Cassytha flava		Daviesia juncea
S	Banksia attenuata	R	Cassytha glabella		Daviesia nudiflora
S	Banksia grandis		Cassytha racemosa	S	Daviesia physodes
S	Banksia ilicifolia		Centrolepis aristata		Daviesia triflora
S	Banksia littoralis		Centrolepis drummondiana	R	Desmocladus fasciculatus
S	Banksia menziesii		Centrolepis drummondii	R	Desmocladus flexuosus
	Baumea articulata		Centrolepis humillima	S	Dianella revoluta
	Beaufortia elegans		Chamaescilla corymbosa		Dielsia stenostachya
	Beaufortia squarrosa		Chordifex microcodon		Diuris emarginata
	Boronia busselliana	R	Comesperma calymega		Diuris laxiflora
R	Boronia crenulata	S	Conospermum triplinervium		Diuris longifolia
R	Drosera		Hibbertia subvaginata		Leucopogon insularis

	erythrorhiza				
	Drosera macrantha		Homalosciadium homalcarpum		Leucopogon kingianus
	Drosera menziesii	R	Hovea trisperma	S	Leucopogon nutans
	Drosera paleacea	R	Hypocalymma angustifolium	S	Leucopogon oxycedrus
	Drosera pulchella	S	Hypocalymma robustum	R	Leucopogon pendulus
S	Dryandra nivea		Hypolaena exsulca	S	Leucopogon polymorphus
	Eremaea asterocarpa		Hypolaena pubescens	S	Leucopogon propinquus
	Eremaea pauciflora	S	Jacksonia furcellata	S	Leucopogon pulchellus
R	Eriostemon spicatus	S	Jacksonia sternbergiana		Leucopogon racemulosus
R	Eucalyptus gomphocephala		Juncus kraussii		Leucopogon strictus
S	Eucalyptus marginata	R	Kennedia prostrata		Levenhookia stipitata
R	Eucalyptus rudis	S	Kunzea ericifolia		Lobelia tenuior
S	Eucalyptus todtiana		Laxmannia ramosa		Lomandra caespitosa
	Euchilopsis linearis		Laxmannia squarrosa		Lomandra endlicheri
	Eutaxia virgata	R	Lechenaultia biloba		Lomandra hermaphrodita
	Gnaphaluim sphaericum		Lechenaultia expansa		Lomandra micrantha
	Gompholobium confertum		Lechenaultia floribunda	R	Lomandra nigricans
	Gompholobium scabrum		Lepidosperma angustatum	S	Lomandra odora
R	Gompholobium tomentosum		Lepidosperma effusum	R	Lomandra preissii
	Gonocarpus pithyoides		Lepidosperma longitudinale		Lomandra purpurea
	Goodenia pulchella	R	Lepidosperma scabrum		Lomandra suaveolans
R	Haemodorum paniculatum	R	Lepidosperma squamatum	S	Loxocaryx cinerea
	Haemodorum spicatum	R	Lepidosperma tenue		Loxocarya oubescens
R	Hardenbergia comptoniana	R	Leporella fimbriata		Loxocarya pubescens
R	Hemiandra pungens		Leptocarpus canus		Loxycarya fasciculata
	Hensmania turbinata		Leptocarpus tenax		Loxycarya flexuosa
	Hibbertia aurea		Leptomeria empetriformis	R	Lyginia barbata
S	Hibbertia huegelii	R	Leptospermum erubescens		Lyperanthus nigricans
S	Hibbertia hypericoides		Lepyrodia muirii	S	Lysinema ciliatum
	Hibbertia pachyrrhiza	S	Leucopogon australis		Lysinema elegans
R	Hibbertia racemosa	S	Leucopogon constephioides	S	Macrozamia riedlei
	Meeboldina cana		Podotheca angustifolia		Stylidium repens

	Melaleuca acerosa		Podotheca chrysantha	S	Stylidium schoenoides
	Melaleuca incana		Poranthera microphylla		Synaphea spinulosa
R	Melaleuca preissiana		Prasophyllum parvifolium	S	Tetratheca setigera
S	Melaleuca scabra		Pterostylis nana		Thelymitra campanulata
R	Melaleuca seriata		Pterostylis pyramidalis		Thelymitra crinita
	Melaleuca systena		Pterostylis recurva		Thelymitra fuscolutea
S	Melaleuca thymoides		Pterostylis vittata		Thysanotus arbuscula
	Mesomelaena pseudostygia		Pultenaea reticulata		Thysanotus manglesianus
R	Mesomelaena stygia		Quinetia urvillei		Thysanotus multiflorus
R	Mesomelaena tetragona		Regelia ciliata		Thysanotus patersonii
	Microtis media		Regleia inops		Thysanotus sparteus
R	Millotia tenuifolia		Restio microcodon	S	Thysanotus thyrsoideus
	Mitrasacme paradoxa		Restio stenostachyus		Thysanotus triandrus
	Monotaxis grandiflora		Ricinocarpus glaucus		Trachymene pilosa
	Nemcia capitata		Scaevola paludosa		Tricoryne elatior
R	Nuytsia floribunda		Scaevola repens		Tricoryne tenalla
	Oxylobium capitatum		Schoenus brevisetis		Tripterococcus brunonis
S	Patersonia occidentalis	R	Schoenus curvifolius		Verticordia drummondii
S	Perricalymma ellipticum		Schoenus globifer		Wahlenbergia preissii
R	Persoonia saccata		Schoenus rodwayanus		Waitzia suaveolens
S	Petrophile linearis	S	Scholtzia involucrata	S	Xanthorrhoea preissii
	Philotheca spicata		Siloxerus humifusus	R	Xanthosia huegelii
R	Phlebocarya ciliata		Sowerbaea laxiflora		
	Phlebocarya filifolia		Stackhousia mongyna		
	Pimelea angustifolia	R	Stipa compressa		
	Pimelea imbricata	S	Stirlingia latifolia		
	Pimelea rosea	R	Stylidium brunonianum		
	Pimelea sulphurea		Stylidium carnosum		
	Pithocarpa pulchella		Stylidium guttatum		
S	Platysace compressa	S	Stylidium junceum		
	Platytheca galioides	R	Stylidium piliferum		