



*Darwinia biflora* (Cheel) Briggs  
Myrtaceae  
Recovery Plan



October 2004



**Natural Heritage Trust**  
*Helping Communities Helping Australia*

**Department of  
Environment and  
Conservation (NSW)**

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# *Darwinia biflora* Recovery Plan

## Executive Summary

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The conservation of threatened species, populations and ecological communities is crucial for the maintenance of this State's unique biodiversity. In NSW the *Threatened Species Conservation Act 1995* (TSC Act) provides the framework to conserve and recover species, populations and communities through the preparation and implementation of recovery plans.

The preparation and implementation of recovery plans is identified by both the National Strategy for the Conservation of Australia's Biological Diversity and the NSW Biodiversity Strategy as a key strategy for the conservation of threatened flora, fauna and invertebrates. The object of a recovery plan is to document the research and management actions required to promote the recovery of a threatened species, population or ecological communities and to ensure its ongoing viability in nature.

*Darwinia biflora* is listed as vulnerable on Schedule 2 of the TSC Act and on Schedule 1 Part 2 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It is an erect or spreading shrub to 80 cm high (family Myrtaceae) that is found in the northern and north-western Sydney suburbs, in the area bounded by Maroota, Kellyville, Cowan and North Ryde, within Baulkham Hills, Hornsby, Ku-Ring-Gai and Ryde local government areas.

*D. biflora* occurs on the edges of shale-capped ridges which are also areas favoured for development. Much of the habitat of this species has been cleared for urban growth, and many current sites are at risk from further clearing and urban expansion. Only 21% of sites are within national parks. The remainder are on a variety of tenures including lands owned or managed by Councils, the Department of Lands, the Roads and Traffic Authority or in private ownership.

The major threats to the survival of *D. biflora* arise from human interference in the environment. These threats range from loss of habitat through changes in land use and urban expansion, and degradation of habitat through the implementation of inappropriate fire regimes, slashing for easement maintenance, illegal track creation and weed invasion.

This recovery plan describes our current understanding of *D. biflora*, documents the management actions and research undertaken to date, and outlines a recovery program over the next five years.

To provide for the future recovery of *D. biflora*, this recovery plan advocates a program that:

- increases the legislative protection of sites, targeting lands in public ownership;
- ensures appropriate management at sites owned by public authorities;
- increases our knowledge of the biology and ecology of *D. biflora* for management of the species;
- supports private landholders with sites of *D. biflora* and encourages community involvement.

It is intended that this recovery plan will be implemented over a five-year period. Recovery actions will largely be implemented using resources of various NSW government agencies and community groups. The total cost to implement the plan is \$240,250 over five years.



Lisa Corbyn  
**Director-General**



Bob Debus MP  
**Minister for the Environment**

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## 1 Introduction

*Darwinia biflora* (Cheel) B. Briggs (family Myrtaceae) is an erect or spreading shrub to 80 cm high. Flowers are green, surrounded by two red bracteoles, and are mostly in pairs (Harden 1991, Fairley & Moore 1989). It occurs in the northern and north-western suburbs of Sydney, from Maroota in the north, North Ryde in the south, Cowan in the east and Kellyville in the west. It occurs on the edges of shale-capped ridges, in sandstone ridgetop woodland/ open forest.

Management issues and threatening processes affecting *D. biflora* are many. One of the main threats to the species is habitat degradation, through inappropriate fire regimes, clearing for power line maintenance, illegal track creation, weed invasion and impacts from residential areas which adjoin sites. This recovery plan focuses on the need for public authorities to manage known populations under their control, and to work co-operatively with landholders in order to secure sympathetic management of populations on private land. Investigations into the biology and ecology of the species are recommended to inform management practices.

This recovery plan describes the current understanding of *D. biflora*, documents the management and research actions undertaken to date, and outlines the recovery program for this species for the next five years.

## 2 Legislative context

### 2.1 Legal status

*D. biflora* is listed as a vulnerable species on Schedule 2 of the *Threatened Species Conservation Act 1995* (TSC Act). The species is listed as a vulnerable species on Schedule 1, Part 2 of the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

### 2.2 Recovery Plan preparation

The EPBC Act 1999 (Cth) and the TSC Act 1995 (NSW) require the Commonwealth Minister for the Environment and the Director-General of the Department of Environment and Conservation to prepare recovery plans for all Commonwealth listed species and communities, and State listed species, populations and ecological communities respectively. Both legislative instruments include specific requirements for the matters to be addressed by recovery plans and the process for preparing recovery plans. This plan satisfies the provisions of both the EPBC Act 1999 (Cth) and

the TSC Act 1999 (NSW), and as such there will only be one recovery plan operating for *D. biflora*.

The TSC Act 1995 (NSW) requires that in the preparation of a recovery plan, that consideration must be given to any special knowledge or interests that indigenous people may have in the species and the measures to be contained in the plan (section 57). In addition, the EPBC Act 1999 (Cth) requires that in the preparation of a recovery plan, that regard must be had to the role and interests of indigenous people in the conservation of Australia's biodiversity (section 270(3)(e)). The indigenous community groups in the area affected by this recovery plan include the Deerubbin and Metropolitan Local Aboriginal Land Councils. These groups were not consulted prior to preparation of the plan, and no information could be found by the DEC of any specific use of *D. biflora*. However, implementation of recovery actions under this plan will include consultation with these groups and consideration of their role and interests in the region (see section 14.3.1).

### 2.3 Recovery Plan implementation

The TSC Act requires that a public authority must take any appropriate measures available to implement actions included in a recovery plan for which they are responsible. Public authorities and councils that are responsible for the implementation of recovery plan actions are required by the TSC Act to report on the measures taken to implement those actions. In addition, the Act specifies that public authorities must not make decisions that are inconsistent with the provisions of the plan.

Public authorities responsible for the implementation of this recovery plan are many, including the DEC, relevant Councils, Berowra Valley Regional Park Trust, the Department of Lands, the Roads and Traffic Authority, TransGrid and the Department of Education and Training. Consequently, these land managers must manage *D. biflora* in accordance with the approved plan.

The EPBC Act 1999 (Cth) states that Commonwealth agencies must implement a recovery plan on those areas that apply to Commonwealth lands. *D. biflora* is known to occur on one site of Commonwealth land, on the CSIRO lands at North Ryde. The EPBC Act also specifies that a Commonwealth agency must not take any action that contravenes a recovery plan.

### 2.4 Relationship to other legislation

The lands on which *D. biflora* occur include those that are owned and/or managed by the NSW DEC, Baulkham Hills Shire Council, Hornsby Shire Council, Ku-Ring-Gai Municipal Council, Berowra Valley Regional Park Trust, the Department of

Lands, the Department of Education and Training, CSIRO, the Roads and Traffic Authority, Rail Infrastructure Corporation, Deerubbin LALC and private landholders. Relevant legislation that affects the *D. biflora* populations includes:

- *National Parks and Wildlife Act* 1974 (NSW)
- *Threatened Species Conservation Act* 1995 (NSW)
- *Environmental Planning and Assessment Act* 1979 (NSW)
- *Local Government Act* 1993 (NSW)
- *Rural Fires Act* 1997 (NSW)
- *Native Vegetation Conservation Act* 1997 (NSW)
- *Environment Protection and Biodiversity Conservation Act* 1999 (Cth)
- *Rural Fires Act Amendment 2002* (NSW)

## 2.5 Critical habitat

The TSC Act makes provision for the identification and declaration of critical habitat only for those endangered species, populations and ecological communities listed on Schedule 1 of the TSC Act. As *D. biflora* is listed on Schedule 2 of the TSC Act as a vulnerable species, critical habitat cannot be declared for this species.

Under the EPBC Act 1999 (Cth), critical habitat may be identified for any nationally listed threatened species or ecological community. When adopting a Recovery Plan the Federal Minister for the Environment must consider whether to list habitat identified in the Recovery Plan as being critical to the survival of the species or ecological community. This plan describes habitat features and species distribution that would contain habitat critical to the survival of this species. However, further survey work is required to understand the full distribution of the species and so specifically identify habitat critical to the survival of this species. This work is identified as an action of this plan (see section 13.3.2).

## 2.6 Environmental assessment

The TSC Act amendments to Part 3 of the *Environmental Planning and Assessment Act* 1979 (EP&A Act) require that when draft environmental studies or environmental planning instruments are being prepared, Councils and the Department of Infrastructure, Planning and Natural Resources must consult with the DEC, if critical habitat, or threatened species, populations or ecological communities, or their habitats, will or may be affected by the instrument (termed a 'section 34A consultation'). The DEC considers that these consultations are a very useful mechanism that can minimise the inevitable problems that threatened species present in development situations.

The TSC Act amendments to the environmental assessment provisions of the EP&A Act requires that consent and determining authorities consider relevant recovery plans when exercising a decision making function under Parts 4 & 5 of the EP&A Act. Consent and determining authorities, when considering any development or activity that may affect *D. biflora*, must consider the conservation strategy outlined in this plan. These authorities may be assisted by the guidelines for environmental impact assessment that have been included as Appendix 3 of this plan. Any other actions not requiring approval under the EP&A Act, and which is likely to impact on *D. biflora* will require a licence issued by DEC under section 132(c) of the NPW Act (for scientific, educational or conservation purposes) or under section 91 of the TSC Act. Such a licence may be issued with or without conditions, or be refused.

As *D. biflora* is listed nationally under the EPBC Act, any person proposing to undertake actions likely to have a significant impact on this species should refer the action to the Commonwealth Minister for the Environment for consideration. The Minister will then decide whether the action requires EPBC Act approval. This is in addition to any State or Local Government approval requirement specified above for the NSW EP&A Act.

Administrative guidelines are available from the Department of the Environment and Heritage, to assist proponents in determining whether their action is likely to have a significant impact. In cases where the action does not require EPBC Act approval, but will result in the death of *D. biflora* and the species is in, or on a Commonwealth area, a permit issued by the Commonwealth Minister under the EPBC Act, will be required.

## 2.7 Key threatening processes

There are currently three key threatening processes listed on Schedule 3 of the TSC Act that are relevant to *Darwinia biflora*.

“High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition” is listed as a key threatening process (KTP) under Schedule 3 of the TSC Act 1995 (NSW). High frequency fire is defined as “two or more successive fires close enough together in time to interfere with or limit the ability of plants or animals to recruit new individuals into a population, or for plants to build up a seedbank sufficient in size to maintain the population through to the next fire” (NSW Scientific Committee 2000). The final determination for this KTP notes that high frequency fire has been identified as a threat to *D.*



*biflora*. Appropriate fire regimes must be considered when developing management strategies for all sites of *D. biflora*. For more details on appropriate fire regimes see section 7.3 of this recovery plan.

Bushrock removal is also listed as a KTP under the TSC Act 1995 (NSW). Bushrock Removal is defined in the final determination for this KTP as “the removal of natural surface deposits of rock from rock outcrops or from areas of native vegetation” (NSW Scientific Committee 1999). *D. biflora* is identified in this final determination as one of the threatened species which is adversely affected by this practice.

“Clearing of native vegetation” is listed as a key threatening process and is identified as a threat to *Darwinia biflora* (NSW Scientific Committee 2001). Past clearing of the habitat of this species is a major reason for its listing as vulnerable.

The DEC must prepare Threat Abatement Plans to manage these KTP with a view to their abatement or amelioration.

### 3 Conservation Status

*D. biflora* has been recorded from 253 sites and is currently known from 241 of these. Only 90 of these sites are within conservation reserves (which includes 39 sites within Berowra Valley Regional Park).

Based on the above data and the ROTAP listing, *D. biflora* has been listed as vulnerable in New South Wales (Schedule 2 of the TSC Act) and at the Commonwealth level (Schedule 1 Part 2 of the *Environment Protection and Biodiversity Conservation Act 1999*).

### 4 Description

#### 4.1 Scientific description

*Darwinia biflora* (Cheel) B. Briggs (family Myrtaceae) is an erect or spreading shrub to 80 cm high. Leaves are laterally compressed, 6-10 mm long, glabrous. Flowers are mostly in pairs, floral tube 5-8 mm long. Style straight or slightly curved, 10-14 mm long. Bracteoles persistent after flower opens, purplish-red. Hypanthium (cup-like structure around the ovary) 5-8 mm long, 1-1.5 mm diameter, with broad, rounded ribs (Harden 1991, Carolin & Tindale 1994).

#### 4.2 Distinguishing features

*Darwinia biflora* can be distinguished from other *Darwinia* spp. in the northern Sydney area by the shape of the leaves (laterally compressed, not terete) and the width of the hypanthium (<1.5 mm

diameter). The name is derived from the species having flowers mostly in pairs. Other *Darwinia* species have two or more flowers per cluster (Harden 1991).

## 5 Distribution

### 5.1 Current and historical distribution

*D. biflora* has been recorded in Ku-ring-gai, Hornsby, Baulkham Hills and Ryde local government areas (LGAs), in the Central Coast Botanical Subdivision, NSW. The northern, southern, eastern and western limits of the range are at Maroota, North Ryde, Cowan and Kellyville, respectively. There is an 1892 record from Hunters Hill that is assumed no longer exists. There are two outlier specimens in the National Herbarium of NSW - one from Linden in the Blue Mountains collected in 1914 and one from Royal National Park collected in 1933. The identification of these specimens have been verified and the collection details are considered reliable (P. Wilson, RBG, *pers. comm.*). Since the locations of the specimens are isolated from the known current distribution by a great distance, and since there have been no recent collections of *D. biflora* in these areas (despite targeted searching in the case of Royal National Park (T. Auld, DEC, *pers. comm.*)), it can be assumed that the species is no longer extant in these areas (P. Wilson, *pers. comm.*).

The species occurs on ridge-tops that are also areas favoured for clearing for urbanisation. It may have occurred more extensively in areas such as Turramurra, Hornsby Heights, Dural and St Ives where the preferred soil types occur but which have now largely been cleared. A large area of habitat was known to have been lost in the Mount Colah area during the construction of the F3 freeway.

The extant sites are listed in Appendix 1. A number of sites were not included due to inadequate location details; others have been lost due to clearing. These sites are listed in Appendix 2. Figure 1 illustrates the current and historical distribution.

Appendix 1 indicates that the species is currently known to occur at 241 sites, and it is estimated that there are 105 populations of the species (note: a population may occupy a number of sites). The number of sites in each LGA is listed in Table 1.

Note that in this recovery plan, two or more sites were defined as the one population if the distance between the sites was considered small enough for dispersal to occur between the sites (D. Keith, DEC *pers. comm.*). *Darwinia* seeds generally disperse only short distances from the parent plant. It was

assumed that dispersal was unlikely to occur at distances of greater than 500 m. Therefore, where two or more sites were within 500 m of each other, these sites were included as one population.

TABLE 1. NUMBER OF *D. BIFLORA* SITES IN EACH LOCAL GOVERNMENT AREA (LGA)

Local Govt Area	Number of sites
Baulkham Hills	53
Hornsby	134
Ku-Ring-Gai	48
Ryde	6

### 5.1.1 Numbers of individuals at sites

The number of *D. biflora* individuals at a site is known to vary significantly with time since fire, with the species being most prolific soon after fire, and decreasing over time. Numbers can vary by orders of magnitude over just a few years. Therefore, it cannot be assumed that *D. biflora* exists in the same numbers today as have been previously recorded at sites.

Caution should be applied in relation to those sites where large numbers of individuals have been recorded. It is common practice in these situations to estimate the numbers of plants that are present. Since it is usually not possible to access information on the methods that were used to estimate these numbers, the reliability of the numbers cannot be assessed.

Because of these factors, the number of individuals at a site should not be used as the sole criterion to judge the relative importance of sites. Other factors, such as the area occupied by the species, the extent of available habitat, the quality of the habitat and corridor values are more appropriate measures of significance. Information on the extent of available habitat is often not recorded in surveys or in survey databases. In these cases, estimates of numbers of individuals at sites can be useful as an indication of the species extent at the site. For this reason, the sites that have been recorded as containing large numbers of individuals are included in this plan in the table below, but it is noted again that such data should be used with caution, for the reasons listed above.

It is clear from the table below that *D. biflora* is not evenly distributed across its range. The sites with the largest recorded numbers of individuals occur around the eastern part of its range.

TABLE 2. SITES THAT HAVE BEEN RECORDED AS CONTAINING >5 000 INDIVIDUALS<sup>1</sup>

Code <sup>2</sup>	Site	Tenure
KR6	Bobbin Head track	DEC
KR5c	Murrua track	DEC
KR8a	Gibberagong track	DEC
HO28b	Berowra V. RP, Dural	BVRP
HO14e	Beaumont track	DEC
HO37	Berowra V. RP, Galston	BVRP
HO47a	Mt Colah	DEC

<sup>1</sup> It should be noted that high counts of individuals have been *previously* recorded at these sites. There may be fewer individuals at these sites today given recent fire histories.

<sup>2</sup> See Appendix 1 for explanation of codes.

### 5.2 Tenure

*D. biflora* occurs in a number of tenures, listed in table 3.

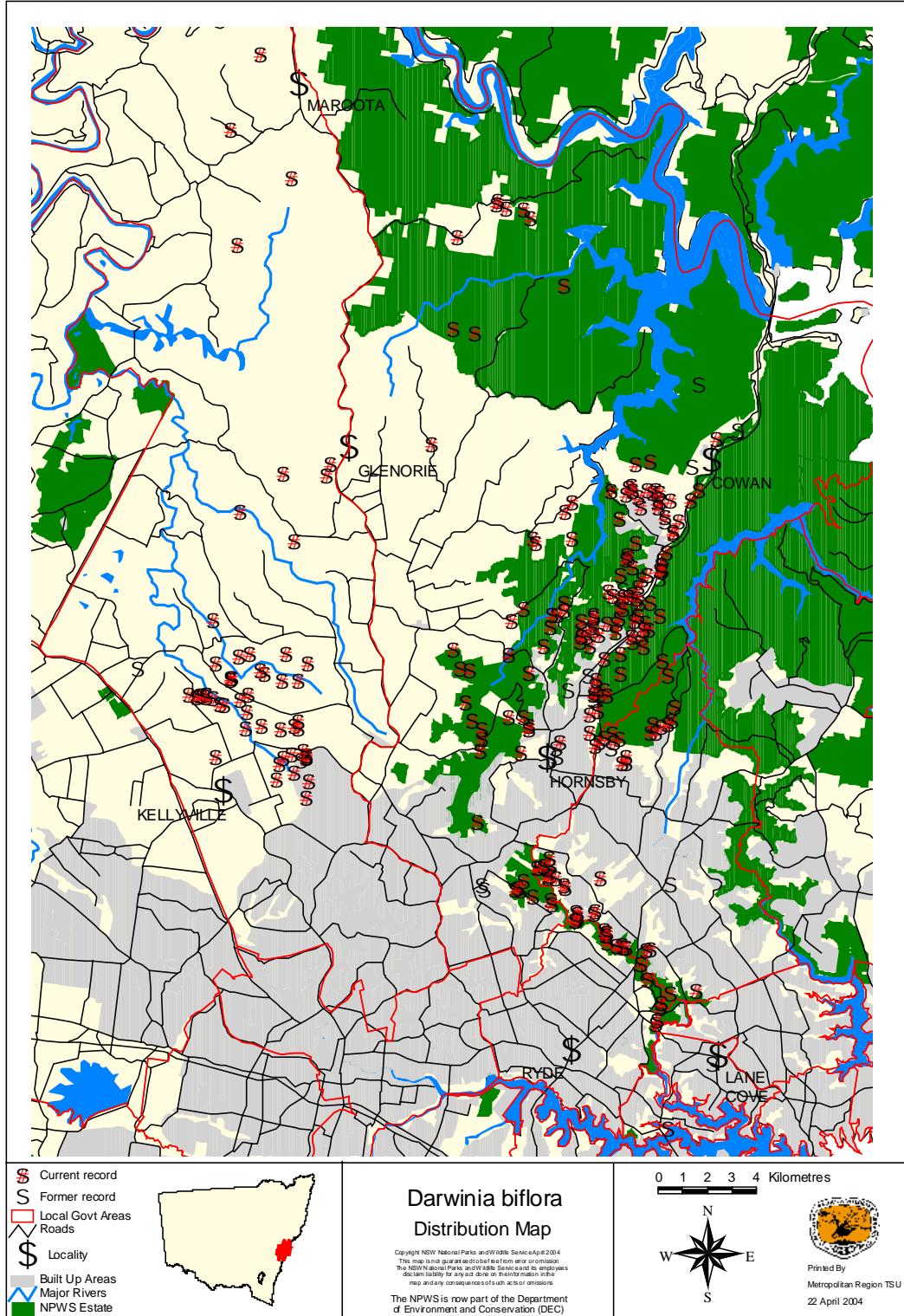
TABLE 3. TENURE OF SITES

Tenure	No. of sites (% of total)
National Park (DEC)	51 (21 %)
Council lands	58 (24 %)
Berowra Valley Reg. Pk	39 (16 %)
Other public authorities	48 (20 %)
Private ownership	45 (19 %)

The DEC and Berowra Valley Regional Park sites are on lands managed primarily for conservation. The remaining 151 sites are not within conservation zonings.

It should be noted that the sites in national parks occur in the eastern part of the range of the species. The sites in the north and west of the range are generally not conserved, and are generally in areas that have been developed (for either rural or residential development) or are susceptible to future habitat removal and degradation, given the current zonings in these areas and the growth of Sydney's population.

FIGURE 1. DISTRIBUTION OF *D. BIFLORA*



## 6 Habitat

### 6.1 Landform and geology

*D. biflora* occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone, a soil type that was formerly known as the Hammondville Association (Walker 1960). The soils that *D. biflora* occur on would now be described as being largely on the edges of residual soil landscapes where these intergrade with colluvial or erosional soil landscapes. In particular, most sites are on the Lucas Heights Soil Landscape where this intergrades with either the Gynea or the Hawkesbury Soil Landscapes. These sites are generally on gentle slopes near the crests of ridges (Chapman & Murphy 1989). In addition, the species appears to occur frequently on sheet rock which often contains moss beds (R. Doig, pers. comm.).

### 6.2 Climate

The climate is similar across the range of *D. biflora*, from Maroota in the north to North Ryde in the south. Average rainfall in this area varies from 977 mm in the north at Glenorie (Bureau of Meteorology 1998) to 1143 mm in the south at North Ryde (R. Nurse, Macquarie University pers. comm.). Most rainfall occurs in summer. Maximum daily average temperatures range from 26°C in January to 17°C in July at Hornsby (which is towards the centre of the range). Minimum daily average temperatures range from 19°C in January and 8°C in July at Hornsby (Bureau of Meteorology 1998).

### 6.3 Vegetation

The species occurs in Sandstone Ridgetop Woodland (NPWS 2002), which is equivalent to Sydney Sandstone Ridge-top Woodland/ Open Forest (community 10ar in Benson 1992) and Sydney Sandstone Scrub-heath complex (NSW NPWS 1997a). The species that are associated with *D. biflora* will depend on a number of factors, including the geology, aspect, soils, and the disturbance and fire regime of the particular site. The species appears to be most successful at sites with a canopy cover ranging from 0% (i.e. full sun) to 30% (G. Limburg, Hornsby Conservation Society, pers. comm.). Associated species often include *Eucalyptus haemastoma*, *Corymbia gummifera*, *E. sclerophylla*, *E. capitellata*, *Angophora hispida*, *Banksia ericifolia*, *Hakea teretifolia*, *Banksia spinulosa*, *Isopogon anethifolius*, *Persoonia pinifolia*, *Kunzea capitata*, *Leptospermum trinervium*, *Gompholobium grandiflorum*, *Banksia marginata*, *Grevillea buxifolia*, *Banksia*

*oblongifolia*, *Epacris pulchella*, *Kunzea ambigua*, *Actinotus minor* and *Mitrasacme polymorpha*.

## 7 Biology and Ecology

### 7.1 Habit, growth rate and longevity

*D. biflora* is an erect or spreading shrub to 80 cm high (Harden 1991). The growth rate and longevity of the species is unknown. It is thought that plants germinate after fire and live for about 15-20 years (T. Auld, DEC, pers. comm.). The primary juvenile period is 1.5 to 2 years (Auld & Scott 1995).

### 7.2 Phenology

#### 7.2.1 Breeding system

*D. biflora* has bisexual flowers. Self-pollination of flowers is thought to occur more frequently than outcrossing, due to the mode of floral development. The pollen in *D. biflora* flowers is extruded from the anthers on to the stylar hairs. The stylar hairs are close to the stigma and both structures are covered by the pollen mass. The result is that self-pollination usually occurs even before the flower opens. Furthermore, the small, inconspicuous flowers are reported to be rarely visited by insects. Outcrossing, although not entirely excluded, is probably a rare occurrence (Briggs 1962).

#### 7.2.2 Flowering and pollination

Flowering is concentrated in autumn, with mature fruits being produced from May to August. Some flowering also occurs throughout the year (Auld *et al.* 1993).

#### 7.2.3 Fruit and seed production

*D. biflora* produces flowers and fruit at 18 months after germination, though at this stage few fruits reach maturity. The fruit is released on maturity rather than being stored on the plant (Auld *et al.* 1993). Fruit production has been found to be variable and very low at sites that were less than five years old (Auld *et al.* 1993). However, plants at sites that have not been burnt for many years which have developed dense canopies of *Banksia ericifolia*, also appear to produce very low numbers of fruit (G. Limburg, pers. comm.).

The seed that is produced is stored in a soil seedbank. The unit of dispersal (diaspore) is the fruit and the seed is stored in the soil within the fruit. *Darwinia* seeds have no specialised means of dispersal (Keighery & Marchant 1993). The dispersal agent is ants (Auld & Scott 1995) which are attracted to the old petal components (T. Auld, DEC pers. comm. 1998 in Douglas & Burcher 1999). The number of seeds in the soil seedbank will depend on the time since fire. Seed numbers

appear to build rapidly after a fire, reaching a peak around 10 years post-fire, but over time after a fire there will be a decline in the number of seed being added to the soil seedbank as the number of adults in the population declines (Auld *et al.* 1993).

#### 7.2.4 Seed viability and germination factors

Seed viability is high, with up to 99% recorded as viable (Auld *et al.* 1993). Most of the seeds are released in a dormant state. The non-dormant seed fraction is generally low (0-12%). Non-dormant seed levels appear to be higher in late summer (Auld *et al.*, 2000). Fire is generally required to break dormancy, although a proportion of the dormant seed becomes non-dormant with time. There is a rapid initial depletion of the non-dormant seed in the seedbank (i.e within the first six months), but after this period, there is little depletion of the seedbank. It may be that this species produces two morphological types of seeds, persistent and short-lived (Auld *et al.*, 2000).

The amount of seed in the soil seedbank depends on a number of factors that relate to the time since fire or other disturbances. After a fire or disturbance there is a flush of germination, depending on rainfall and the degree of successful establishment of seedlings (Auld *et al.* 1991). About 20% of the seeds remain dormant after a fire or disturbance. As the germinants begin to produce fruit, the number of seeds building up rapidly in the soil, depending on adult fecundity. Plants can produce fruits 18 months after fire, with fecundity increasing as the plants grow. As stated above, most seed is released in a dormant state but most of these will progressively become non-dormant. Recruitment of further seed will depend on adult survival. As the surrounding vegetation develops, the number of adults declines due to competition for light. Some losses will also occur from seeds falling (and seedlings germinating) in unfavourable positions. The declining adult population will result in a decline in the number of seed in the soil seedbank as there is increasingly less recruitment of seed. This seedbank model was developed by Auld *et al.* (1993) from one site only, and so requires further confirmation.

Persistence of the seedbank is critical for this species as it is entirely dependent on seedling recruitment for a population's persistence through recurring fires. Maintenance of a seedbank will be dependent on continual seed inputs from fruiting of mature plants. Consequently, any factor that severely limits seed production (such as dense canopy cover) in any one or two consecutive fruiting seasons may have a significant impact on the magnitude of post-fire recruitment should a fire

occur before the seedbank can be replenished (Auld *et al.*, 2000).

#### 7.2.5 Recruitment and population structure

All plants are killed by fire and regeneration at a site after fire is entirely by germination from a soil seedbank (Auld *et al.* 1991). Recruitment after fire is generally high, depending on the number of seed in the soil seedbank and adequate rainfall. Fires are not expected to result in germination of all seed in the seedbank, depending on the intensity of the fire. Some 20% of the soil seedbank is predicted to remain unaffected. Even fires that produce high soil temperatures should not deplete the soil seedbank, as soil heating varies spatially, as well as with depth. Thus, a buffer of dormant seeds is expected following a fire. As stated above, these seeds increasingly become non-dormant over time, leading to on-going recruitment. This on-going recruitment depends on adult survival and fecundity, as described above (Auld *et al.* 1993).

The decay of seeds from a dormant to a non-dormant state results in some recruitment that is not directly a result of a fire event. However, it seems likely that seedlings that emerge in these inter-fire periods would not establish because of competitive pressure from an established cover of shrubs, herbs and grasses. Alternatively, some limited on-going establishment could be possible if seedlings were able to tolerate the existing cover of shrubs, herbs and grasses (Auld *et al.* 1993). If a site has not been burnt for some time, *D. biflora* individuals tend to be situated in places that receive relatively more light, such as at the edges of tracks (S. Burke, DEC pers. obs.).

If bushland regeneration is planned in an area that potentially contains a soil seedbank of *D. biflora*, it should be noted that germination of *D. biflora* in large numbers has been observed at very weedy sites that have been treated with Roundup® 1:100 or 1:200 (G. Limburg, pers. comm.).

*D. biflora* can also be found in temporarily high numbers at sites that have been subject to disturbances other than fire, such as sites under power lines that have been cleared, and along tracks - wherever the amount of light reaching the ground layer is increased.

Therefore, the number of individuals at a site varies greatly, depending on the time since disturbance. The number of individuals at a site is highest soon after the disturbance, and this number will decline over time. This is an important point to consider when assessing the significance of sites. The number of individuals at a particular site is one of the factors that is widely used when assessing the

significance of a site. Since the number of *D. biflora* individuals can vary dramatically over time, this criterion should be used with caution. If a site has a large number of individuals, any assessment of its significance should include an assessment of whether those numbers can be maintained through the application of a suitable fire regime. If a site appears to have a small number of individuals, an assessment of the potential number of individuals at the site should be done, taking into account (from previous studies of the site and the fire history) the possible size of the soil seedbank and the size of the habitat.

As numbers of *D. biflora* are greatest after disturbance, this would suggest that sites should be disturbed frequently (e.g. by burning) to maximise the conservation of the species, since this will result in the maximum number of individuals at a site. However, such a disturbance regime could lead to the eventual extinction of *D. biflora* at a site. Frequent fires will deplete the soil seedbank, since there will not be enough time between fires for individuals to mature and replenish the stock of seed in the soil. Also, such a disturbance regime may lead to the decline of other species in the community, which is an undesirable result in itself and which may also be detrimental to *D. biflora*.

### 7.3 Fire Ecology

Fire is a very important factor in the long-term persistence of the species at a site, as indicated above. Four aspects of fires are important for germination of seeds - frequency, intensity, duration and seasonality (Auld 1986). These aspects are discussed separately.

- Fire frequency:

The interval between fires should be long enough to allow post-fire seedlings to reach maturity and sufficiently replenish the seedbank with fruit from several fruiting seasons (Auld & Scott 1995). From studies carried out by Auld *et al.* (1991, 1993), recommendations are that the interval between fires should be greater than 5 years and preferably greater than 10 years. Occasional short interval fires may be tolerated but this should not occur on a repeated basis, i.e. no sequence of three fires at less than 5-year intervals should be permitted (Auld 1996). The maximum fire-free interval is estimated at 20-30 years (Auld & Scott 1995).

- Fire intensity and duration:

Studies by Auld *et al.* (1991, 1993) have examined the optimal fire temperatures for germination by using heating trials, i.e. seed is first heated to a particular temperature for ten minutes and then it is germinated. The heating trials, conducted at a range of temperatures, mimic the effects of the passage of fires of different intensities. These studies have

shown that the effect of heating on seed dormancy in *D. biflora* is variable. Significant differences existed between populations in the response of seed to heat and in the one population across successive years. The dormancy of seed from one site was broken over a very narrow range of temperatures (80-90°C), while at a second site, seed dormancy was broken over a wide range of temperatures (40-110°C). At a third site, seed dormancy was unaffected by heating in two years but in the third year seed dormancy was broken by temperatures of 100°C only. At all sites, seeds were killed at a temperature of 120°C.

The intensity of fires is usually linked to the level of fuel consumption, i.e. high fuel consumption will often, but not always, occur in relatively high intensity fires. The results from the heating trials suggest that, to promote significant germination after a fire, fires need to produce moderate to high levels of fuel consumption. Fires where little ground fuel consumption occurs will not produce high enough soil temperatures to break seed dormancy and hence, are likely to lead to population declines.

- Fire seasonality:

The most appropriate season for fire has not been examined for *D. biflora*. Since the seeds in the soil seedbank are persistent, it is not necessary for fires to occur after the fruiting season to germinate the maximum number of seeds. It can be assumed that late summer and autumn fires would be advantageous, since the seedlings at these times should encounter favourable moisture conditions for growth (Auld 1996). In addition, fires in summer are also more likely to produce the higher intensity fires that are required for germination.

- Recommendations for fire management:

The interval between fires should be greater than five years and preferably greater than ten years. Occasional short interval fires may be tolerated but this should not occur on a repeated basis, i.e. no sequence of three fires at less than five year intervals should be permitted. The maximum fire-free interval is estimated at 20-30 years (Auld & Scott 1995). To promote seed germination, fires need to have high levels of fine ground fuel consumption and this is usually associated with moderate to high fire intensity. Repeated fires of low intensity are likely to be detrimental to germination.

It appears that sites older than 6 years are very rare, since virtually all sites with *D. biflora* have been burnt in the last 2-5 years (Auld 1996). When fire management plans are prepared, the regimes that are imposed should vary between sites so that there is a variety of age structures in the wild.



Where fuel reduction is necessary but moderate to high intensity fire at a suitable frequency and season cannot be achieved, the use of "turbo-mowing" or manual fuel removal is recommended. If turbo-mowing is to be used, blade height should be such that *D. biflora* is not significantly affected eg 30 cm. Mowing should not occur during the flowering or fruiting period or when the soil is moist and susceptible to erosion (Douglas & Burcher 1999).

## **8 Previous Management Actions**

### **8.1 Ecological Research**

The DEC has studied the effects of fire regimes on a number of rare plant species in NSW, including *D. biflora*. Several sites within national parks were monitored for a number of years. From these studies, a model has been developed for germination and recruitment after fire, which has led to the development of recommendations for management of *D. biflora* with regard to fire (Auld *et al.* 1991, Auld *et al.* 1993).

### **8.2 Surveys**

An inventory of all sites where *D. biflora* had been previously found, was completed as part of this Recovery Plan, using data from a number of sources. Sites that had large numbers of individuals were surveyed in 1997-98 by S. Burke, DEC to assess the status of populations and the threats acting on sites. Hornsby Shire Council has surveyed Berowra Valley Regional Park to identify sites of *D. biflora* and other threatened species. A number of other records have been obtained from environmental consultants, as a result of environmental impact assessments.

### **8.3 Recovery Team**

A Recovery Team was established in 1998 as part of the preparation of this Recovery Plan. The membership of the team included representatives from the DEC, Hornsby Shire Council, Baulkham Hills Shire Council, Ku-Ring-Gai Municipal Council, Hornsby Conservation Society, the Urban Development Institute of Australia and the Australian Plants Society. The Recovery Team was established to provide advice to the DEC to assist in the preparation of this Recovery Plan.

### **8.4 Preparation of species profile and EIA guidelines**

The DEC has prepared a species profile and environmental impact assessment guidelines for use by public authorities, consultants and private landholders to assist in the assessment and management of *D. biflora* on lands under their control. These documents are also designed to assist consent and determining authorities in the

assessment of impacts on the species, and for members of the public who are interested in becoming involved in conservation of the species. Copies of the species profile and EIA guidelines have been distributed to consent authorities and consultants and have also been attached as an appendix to this plan (Appendix 3).

## **9 Management Issues**

The following sections identify our current understanding and/or limitations of the biology and ecology of *D. biflora*, the threats operating on populations and a consideration of the social and economic factors that affect the success of the recovery program.

### **9.1 Level of current understanding**

At present a number of assumptions have been made about the biology and ecology of *D. biflora*. An increased understanding of these aspects of *D. biflora* will improve the finer scale approach to the recovery of the species. A greater understanding of its habitat requirements and its lifecycle processes (most particularly, the conditions needed for recruitment and long-term responses to fire) will increase the likelihood of successful recovery of *D. biflora* and our ability to manage the species in the future. The actions listed in sections 11-15 aim at investigating these essential aspects.

### **9.2 Threatening processes**

The threats and reasons for decline that are occurring at *D. biflora* sites can be separated into two categories - those that lead to habitat loss, and those that are degrading habitat at existing sites. These are discussed below.

#### **9.2.1 Habitat loss**

Ten sites are known to no longer contain *D. biflora*. These are listed in Appendix 2 of this Recovery Plan. Six of the sites have been developed for residential or industrial purposes. The remaining four were lost during construction of the F3 freeway. Approximately 25000 plants were lost during construction of the freeway (Burkitt *et al.* 1984).

As well as reducing the numbers of individuals, loss of habitat also fragments populations. The distributional information in section 5 of this plan demonstrates this fragmentation. Fragmentation creates sub-populations of species, isolates those sub-populations from one another and often disrupts ecological processes, such as pollination, dispersal and gene flow. In doing so it increases the risk of extinction. Smaller populations are more likely to suffer local extinction and more isolated habitat fragments are less likely to be re-colonised



if local extinction does occur (Margules *et al.* 1993).

The planned clearing of habitat for urbanisation can also be considered as a potential threat to the species. A large number of sites, particularly in the Berowra area and in Baulkham Hills Shire, are planned for residential development. In many cases there may be the opportunity to allow development to proceed while retaining *D. biflora* on the site. However, if the development is not designed in sympathy with the species, it may introduce impacts onto the site which degrade the habitat and so in the long-term lead to the local extinction of the species.

### 9.2.2 Habitat degradation

Several threats are acting at existing sites of *D. biflora* that are likely to be reducing the capacity of the species to survive in the long term. These threats include inappropriate fire regimes, clearing for power line maintenance, illegal track creation, weed invasion and impacts from residential areas.

- Inappropriate fire regimes:

Fire has been highlighted in section 7 of this plan as an essential factor in the long-term survival of *D. biflora* at a site. The degree of fire management that is occurring at sites is variable. In general, the sites that are on privately owned lands are not being managed with fire. Some fire management is occurring at sites that are owned by public authorities, especially where a hazard reduction burn is required. However, for some of the sites that do not require hazard reduction burning for asset management, it is likely that an appropriate fire regime is not being implemented.

The impact of a lack of fire was seen at a site next to the golf course at Mount Colah, (lot 14). A survey of this site was completed in 1984 (Burkitt *et al.* 1984). The density of *D. biflora* in some sections of this site was reported to be high, and an estimated 7000 plants were present. A 1989 survey found 6 650 plants (Atlas of NSW Wildlife, NSW NPWS 1997b). This site was revisited in 1997 as part of this recovery plan, and no plants were seen. This appeared to be due to a lack of fire, as most of the shrubs at the site that are characteristic of sandstone woodlands (such as *Banksia ericifolia*) were senescing, and being replaced by an overstorey of *Pittosporum undulatum*.

In contrast, fires that are of insufficient intensity have also been observed to affect site numbers. A site at the end of Stokes Ave, Asquith, was reported in 1989 to contain 1500 plants. During the surveys in 1997 there were only 5 plants seen. It appears that a fire that had recently occurred was a cool

burn and that the site had either not been burnt for some time prior to this, or that it had only previously been cool-burnt (S. Douglas, environmental consultant, pers. comm.).

- Clearing for maintenance of easements:

A number of *D. biflora* sites are located under electricity transmission lines, for example in Kuring-gai National Park, at the Lady Davidson Hospital site, North Turrumurra and at Emperor Place, Kenthurst. It is likely that the species flourished in these areas after clearing occurred, due to the extra light available. However, the clearing of vegetation under transmission lines may be too frequent to allow replenishment of the seedbank, similar to a too frequent fire regime.

- Track creation:

Illegal track creation was seen as a potential threat at some sites, such as at the site at Lane Cove National Park (Pennant Hills Park). Although initially the creation of more tracks may lead to an increase in the numbers of *D. biflora* due to the increase in light to the ground layer, tracks can also lead to degradation of habitat through mechanical damage to plants, by compacting the soil, introducing weeds and creating further edge effects. Tracks can also encourage dumping and arson and allow access for horses, which themselves introduce weeds and compact the soil.

- Weed invasion:

Weed invasion is a potential threat to *D. biflora* at a number of sites (S. Burke, DEC, pers. obs.). Weeds were commonly present at sites in parks that were used for active recreation (such as Lane Cove National Park (Pennant Hills Park) and Woods St Oval) and at sites near residential development (such as a number of sites in Berowra), but less common in the sites within national parks.

- Impacts from developed areas

Sites that are adjacent to developed areas are subject to a number of impacts, including runoff from sewage and stormwater, track creation and dumping of rubbish and garden waste. Regular maintenance of service lines in these areas usually disturbs habitat. High frequency fire regimes are often required for hazard reduction. These impacts are a potential threat as they increase the opportunity for weed invasion and physical damage to plants and can lead to the species being out-competed.

## 9.3 Social and economic consequences

### 9.3.1 Social consequences

The DEC recognises that actions within this plan may have some adverse impacts on public

authorities and private landholders that own or manage lands on which the species occurs. Some landholders (both public and private) are reluctant to conserve habitat and view the recovery effort as an intrusion on their rights to manage their land. While these opinions are in the minority, they certainly constitute a challenge for the recovery effort. Personal and regular contact with landholders is a key strategy in encouraging awareness and involvement in the recovery effort.

It is considered that the plan will result in some positive impacts on sections of the community. For example, implementation of the plan will result in increased preservation of habitats, which will improve the aesthetic value and the recreational and educational potential for residents in areas where *D. biflora* occurs. However, preservation of habitats may also require that public access is restricted at some sites. As this would not occur without public consultation (e.g. through the public exhibition of draft Plans of Management for sites), any negative social consequences of restricted access should be minimised.

### 9.3.2 Economic consequences

The DEC recognises that the implementation of the actions of this Recovery Plan will result in some degree of economic impact. The proposed recovery strategy seeks to minimise these impacts through the prioritisation and targeting of recovery efforts to those populations on private land. Without a strategic approach to managing this vulnerable species, and with the continuation of current practices, it is likely that the species will be reduced to a level where it is at risk of becoming endangered or possibly extinct at many localities, given current rates of loss and degradation of habitat.

The negative economic consequences of the recovery of *D. biflora* are those costs associated with the implementation of this plan. One of the main actions of the plan is to increase security of tenure of sites (see section 11.3). This may reduce development potential of some sites, and therefore result in financial losses. The exact value of these losses is difficult to estimate, due to the number of sites where the species occurs. However, an attempt has been made to minimise any direct impacts on individuals by concentrating efforts on preservation of land in public ownership, which is not zoned for residential or commercial development.

Actions involving on-ground management programs and the long-term monitoring of sites will also have economic consequences for land managers. However, it is considered that these management programs involve recurrent activities

that are required for the normal management of the land, such as weed control and rubbish removal. Costs can be minimised by seeking funding from external sources and by adopting a co-operative approach to management, which involves the DEC, other relevant landholders and the community.

It is considered that some positive economic consequences will also result from the implementation of the plan. For example, it will result in more efficient resource use, as management of the species will be more co-ordinated and strategic. In addition, economic benefits should also be gained by consent and determining authorities, as the information contained in the Recovery Plan should assist in their decision making processes in relation to *D. biflora*.

## 9.4 Translocation

Translocation is defined as the deliberate transfer of plants or animals from one place to another, including existing or new sites or where the species is now extinct (Vallee *et al.* 2004).

The booklet 'Guidelines for the Translocation of Threatened Plants in Australia', (Vallee *et al.* 2004) provides a discussion of the issues involved in translocation. This booklet also discusses several reasons why attempts to translocate often fail, such as not removing the original threats affecting the habitat, not properly considering the biological and ecological requirements of the species, neglecting to assess the genetic variability and not providing an ongoing commitment to monitoring and maintenance.

At this stage, translocation of *D. biflora* is not considered necessary for the continued existence of the species in the wild, given the distribution and abundance of the species (based on current knowledge). Translocation is also not recommended for this species as it is usually unsuccessful in the long term (i.e. most plants may survive initially but survival rates about a year after the translocation are usually very low) (R. Doig, APS, *pers. comm.*).

For those land managers and organisations interested in improving the conservation status of *D. biflora*, there are two alternatives to translocation that should be attempted - ensuring conservation of areas where the species currently exists, and *in situ* regeneration of the species. These alternatives are likely to be more successful than translocation programs and will not affect the genetic integrity of the species.

## 9.5 Ability to Recover

The original distribution of *D. biflora* is likely to have been reduced by urbanisation, given that large areas of what would have been suitable habitat have been cleared. It is therefore highly unlikely that *D. biflora* could recover to its original distribution and numbers.

‘Recovery’ in the context of this plan will be targeted towards maintaining the current vulnerable status of *D. biflora* and preventing it from becoming endangered. It will not be possible to recover the species to its former distribution, given the degree of urbanisation across its original habitat. In fact, unless actions are taken to reduce threats, it is likely that reductions will continue to occur in the current number of sites and the species will become locally extinct in some areas. The likelihood of local extinctions are quite high for this species given the percentage of sites that are small, fragmented and unprotected, and the number of threats acting on sites (see section 9.2). To prevent the species from becoming endangered, actions are needed to maximise the conservation of the species.

The actions that can be undertaken at sites should aim to halt local extinctions and improve the quality of habitat. The threats identified in section 9.2 are manageable and solutions are straightforward. Implementation of on-ground works will slow the current rate of habitat loss and will lead to the enhancement of existing populations. However, the majority of sites occur on lands outside National Park estate. Thus, the DEC will need to negotiate with relevant landholders for implementation of appropriate on-ground works. If negotiations could be successful in protecting a majority of sites of *D. biflora*, this would greatly improve the conservation status of the species. Given that a large proportion of the sites (over 80 %) are on land that is in public ownership, there is a high likelihood that successful negotiations could occur in relation to a large percentage of sites. Negotiations to ensure management of sites is included as an action in this plan (see section 12).

## 10 Overall recovery aim and recovery strategy

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### 10.1 Overall objective

The overall objective of the recovery plan is to prevent the status of *D. biflora* from becoming endangered, by reducing the continual loss of populations and by implementing management regimes aimed at maintaining representative populations across the species’ range.

## 10.2 Overall performance criteria

The overall performance criterion of the recovery plan is that the risk of the species becoming endangered is reduced, through the implementation of recovery actions.

## 11 Reservation /protection status

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To ensure the survival of the species in the long term, it is essential that the species is well represented in conservation reserves or on lands where conservation is the primary management objective. Although 37 % of sites are on lands managed for conservation, these sites are concentrated in the south and east of the species’ range, thus it is likely that the genetic variation is not adequately represented in reserves. The aim will be to increase the reservation/protection status of sites in areas where there are few conservation reserves, especially in the north and west of the range. Sites on public land will be targeted for reservation, given the land management role of public authorities and given socio-economic considerations. Private landholders will also be approached to increase the protection status of sites on private land.

### 11.1 Objective

To ensure that a representative sample of *D. biflora* populations occurring on public and private lands are protected from habitat loss and managed for conservation.

Legislative protection of sites may be achieved through a number of mechanisms, such as acquisition by DEC, rezoning for conservation, entering into voluntary conservation agreements or memoranda of understanding, preparing development control plans or placing covenants over lands to prevent clearing of habitat.

### 11.2 Criteria

The number of sites that are afforded legislative protection is increased from 90 sites to 110\* sites (47 %) by 2009. Protection of sites will be concentrated in parts of the range that are currently under-represented in conservation reserves (especially those in the north and west of the range).

\* This target is based on the number of sites that the DEC believes could be afforded legislative protection within the first 5 years, as they have high conservation significance, provide a realistic opportunity for protection (based on tenure) and are located in areas that are currently under-represented in terms of protected sites. It does not represent the minimum number of sites required to ensure the survival of the species or indicate

the only sites that should be managed or indicate that other sites are not significant.

### 11.3 Recovery Action

#### 11.3.1 Identify sites that are a high priority to protect

The DEC will identify sites that are of high conservation significance and that also provide opportunities for protection. To undertake this action, the distribution of the species should first be divided into regions, based on (for example) water catchment or LGA boundaries. The proportion of conserved sites within each region should be calculated. For regions that are identified as having relatively few sites within reserves, an assessment will be undertaken of the significance of sites within that region, to identify sites that may be protected. The assessment of significance should be

based on features such as size of habitat, numbers of individuals recorded, quality of habitat and the corridor value of the site.

This action should be undertaken once there is a clearer indication of the distribution of the species (i.e. after survey work has been carried out in accordance with section 13).

Based on current knowledge, the sites that would be targeted for protection would include (but not be restricted to):

The sites in the above table that occur in Ku-Ring-Gai LGA have been referenced by the DEC as proposed National Park estate or as additions to National Park estate. The DEC will progress the addition of these lands as a matter of priority.

Code <sup>1</sup>	Site	Landowner
BH1a	Annangrove; Annangrove Park	BHSC
BH1b	Annangrove; Annangrove Park	BHSC
BH3	Annangrove; N side of Annangrove Rd	BHSC
BH21	Kenthurst; N of Annangrove Rd	BHSC
BH30	Maroota; ridge near Jackson's Swamp	Dept Lands
BH8	Glenorie; at the end of Schwebel Lane	Dept Lands
BH12j	Kellyville; Crown Land at Heath Rd	Dept Lands
BH15b	Kenthurst; Holland Reserve	Dept Lands
BH15c	Kenthurst; Holland Res, Pony Club site	Dept Lands
BH29	Maroota; end of Haerses Rd	Dept Lands
BH11	Kellyville; near Cattai Creek	private
BH7h	Kellyville; Roseberry Rd, around Cattai Ck	private
BH17	Kenthurst; Robson Rd	private
BH19	Kenthurst; end of Emperor Pl under powerlines	private
BH31	South Maroota; Paulls Rd	private
HO4c	Berowra Heights; residential A	private
HO5	Berowra; about 500m along fire trail N of Turner Rd	Dept Lands
KR1a	Fox Valley; along fire trail SW of Leuna Ave	KMC
KR13b	West Pymble; S of Combe Pl	KMC
KR13d	West Pymble; fire trail off Wallalong Cr	KMC

<sup>1</sup>see appendix 1 for explanation of codes

#### 11.3.2 Carry out negotiations with public authorities to protect sites

Once action 11.3.1 is completed, the DEC will carry out negotiations with the relevant public authorities to increase the protection of identified sites on public land.

#### 11.3.3 Liaise with private landholders to protect sites

The DEC will liaise with private landholders to emphasise the conservation significance of populations of *D. biflora* occurring on or adjacent to their properties. The DEC will also seek to achieve greater protection of populations on private

land, using a variety of mechanisms (eg. property management plans, voluntary conservation agreements). The precise nature of management arrangements will depend largely on the circumstances and co-operation of private landholders.

## 12 Threat and Habitat Management

To achieve the goal of *in situ* protection of *D. biflora*, requires not only a reduction in the risk of habitat loss (as addressed in section 11), it also requires that the threats that lead to habitat degradation are addressed. Threats that have been observed at sites have been described in section 9.2 of this plan. Lack of knowledge about the species is

an additional threat that may be affecting the species.

### 12.1 Objective

To reduce the impacts of threats at sites and to ensure that any planning and management decisions that are made that may affect the species, are based on information within this recovery plan.

### 12.2 Criteria

Threat and habitat management programs have been prepared and are being implemented at 117 sites\* (49%) by 2009. The level of protection for *D. biflora* populations is increased through informed conservation planning and land use decisions.

\* This target is based on the number of sites that the DEC believes could be actively managed, given their tenure. In addition, sites have been included because they have high conservation significance and are located in areas that are currently under-represented in terms of site management. The target does not represent the minimum number of sites required to ensure the

survival of the species or indicate the only sites that should be managed or indicate that other sites are not significant.

### 12.3 Recovery Actions

#### 12.3.1 Threat and habitat management programs will be implemented by public authorities on public lands

A large percentage of sites are on lands owned by public authorities. Proper management of these lands by public authorities will therefore be essential for the conservation of the species. Relevant public authorities will be encouraged to prepare management plans (or other similar documents) which will stipulate that certain actions will be carried out by the authority to protect the species *in situ*.

Any sites owned by public authorities that are identified in section 11 above will be included in these negotiations, to ensure that threats are being managed at the most significant sites.

Council	Code	Location
BHSC	BH1a & 1b	Annangrove; Annangrove Park (2 sites)
BHSC	BH3	Annangrove; N side of Annangrove Rd
BHSC	BH4	Castle Hill; behind Citadel Crescent
BHSC	BH5	Castle Hill; Chainmail Crescent
BHSC	BH7a	Glenhaven; Annie Pryor Reserve
BHSC	BH7b	Glenhaven; Council reserve on Temora Rd
BHSC	BH9a	Glenorie; Les Shaw Reserve, Old Northern Rd
BHSC	BH21	Kenthurst; N of Annangrove Rd
HSC	HO3	Berowra Heights; open space A
HSC	HO4a	Berowra Heights; open space A
HSC	HO47b	Mt Colah; Berry Park
HSC	HO53	Mt Ku-Ring-Gai; Mt Ku-Ring-Gai Park
KMC	KR1a	Fox Valley; along fire trail SW of Leuna Ave
KMC	KR13c	West Pymble; S of Combe Pl
KMC	KR13d	West Pymble; fire trail off Wallalong Cr

The DEC will liaise with other public authorities (state and federal) to prepare and implement threat and habitat management programs at the following sites:

Agency	Code	Location
Dept Education	BH6	Castle Hill; land adjacent to Samuel Gilbert Public School
Dept Lands	BH10	Glenorie; Crown Land
Dept Lands	HO5	Berowra Hts; about 500m along fire trail N of Turner Rd
Dept Lands	BH30	Maroota; ridge near Jackson's Swamp
Dept Lands	BH8	Glenorie; at the end of Schwebel Lane
Dept Lands	BH12j	Kellyville; Crown Land at Heath Rd
Dept Lands	BH15b	Kenthurst; Holland Reserve
Dept Lands	BH15c	Kenthurst; Holland Res, Pony Cub site
Dept Lands	HO24a	Canoelands; Blakes Ridge track
RTA	HO47d	Mt Colah; end of fire trail opp. Colah Rd

Baulkham Hills Shire Council, Hornsby Shire Council and Ku-Ring-Gai Municipal Council will prepare and implement Plans of Management in

accordance with the *Local Government Act 1993*, for the following community lands that contain sites of *D. biflora*. These plans will include actions

that specifically address any threats that are acting on populations of *D. biflora* at sites, eg weed invasion, inappropriate fire regime, inappropriate access, stormwater runoff, monitoring, etc.

Berowra Valley Regional Park Trust will prepare and implement a Plan of Management for Berowra Valley Regional Park, which will protect the 39 known sites of *D. biflora* within the Regional Park. The plan will include actions that specifically address any threats that are acting on populations of *D. biflora* at sites, eg weed invasion, inappropriate fire regime, inappropriate access, stormwater runoff, monitoring, etc.

Actions may include that public authorities will:

- identify existing and potential threats;
- develop and implement weed control programs;
- realign any tracks that are allowing inappropriate access;
- carry out any other necessary actions to minimise and manage threats; and
- monitor populations on a regular basis to assess the effectiveness of threat and habitat management programs and report to DEC Recovery Planning Co-ordinator.

For DET lands, the recovery actions may identify learning opportunities for students resulting from the management of the school grounds. This is in line with the DET Environmental Education Policy for Schools.

For lands within National Park estate, the DEC (Parks and Wildlife Division) will also prepare Plans of Management and Operational Plans in accordance with *National Parks and Wildlife Act 1974* that:

- identify existing and potential threats;
- incorporate information on fire ecology of the species into fire management plans for parks;
- consider the fire ecology of the species before undertaking hazard reduction or emergency fire activities at sites, where possible;
- develop and implement weed control programs;
- realign any illegally created tracks that are leading to population declines;
- carry out any other necessary actions to minimise and manage threats; and
- monitor populations on a regular basis to assess the effectiveness of threat and habitat management programs.

There are 51 sites on lands managed by DEC, in Ku-Ring-Gai Chase, Lane Cove and Murrumbidgee National Parks and Muogamarra Nature Reserve.

The CSIRO has prepared a Plan of Management for the site at North Ryde. The DEC will provide support and advice to the CSIRO as required to

assist in implementation of this Plan of Management.

It may be appropriate to seek the assistance of community groups for implementing threat and habitat management programs or monitoring their success, particularly where resources are limited.

### **12.3.2 Easement maintenance activities will not affect the long term survival of populations of *D. biflora***

As indicated in section 9.2.2 of this Recovery Plan, clearance of vegetation within easements (particularly under electricity transmission lines) may lead to the decline of *D. biflora*. To minimise this threat, TransGrid will ensure that the ecological requirements of *D. biflora* and its habitat are considered in the planning and implementation of maintenance activities within such easements, and so ensure that the long-term survival of *D. biflora* at these sites is not affected by maintenance activities.

### **12.3.3 Informed environmental assessment and planning decisions will be made**

The DEC and all relevant Councils (Baulkham Hills, Hornsby, Ku-Ring-Gai and Ryde) will ensure that the assessment of rezoning and development applications and the assessment of activities, will be considered with reference to this recovery plan and any further advice from the DEC regarding the distribution and biology of this species.

## **13 Research**

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It is clear from the information in this Recovery Plan that more research needs to be undertaken on the biology and ecology of *D. biflora*. A more accurate picture of the distribution of the species is also essential. Management of *D. biflora* will be improved once there is a better understanding of these aspects.

### **13.1 Objective**

To increase knowledge of the biology, ecology and distribution of the species to assist management decisions.

### **13.2 Criteria**

A greater understanding of biology and ecology is achieved through the commencement of a research program and this information is used in management of the species.

### 13.3 Recovery Actions

#### 13.3.1 Investigate aspects of the ecology of the species

Although much information on the species is already known, some research is still required to fill in some of the gaps in knowledge. In particular, research should be aimed towards (i) investigating which disturbances other than fire are required for recruitment and (ii) further investigating the impact of fire frequency on population persistence. This should include identification of an upper threshold inter-fire interval.

The DEC will encourage universities, other research institutions and trained members of the community to take part in these research programs. The DEC will be responsible for the co-ordination of research programs and dissemination of results.

#### 13.3.2 Identify and survey potential habitat

It is likely that our current understanding of the distribution of *D. biflora* is not complete. Potential habitat should be identified utilising environmental data from known sites. Sites that have not been visited for some years should also be re-investigated, including investigation of the Linden record.

This action will be undertaken by the DEC.

## 14 Community education, awareness and involvement

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### 14.1 Objective

To raise awareness about the conservation status of the species and involve the community in the recovery program.

### 14.2 Criteria

Stakeholders are informed about the species and involvement of stakeholders in conservation programs is increased.

### 14.3 Recovery Actions

#### 14.3.1 Encourage community involvement

The community includes members of community groups (such as conservation groups, Catchment Management Authorities, Bushcare groups) and private landholders as well as public authorities such as the DEC and Councils. This action is designed to involve all interested parties in the conservation of the species, including those people outside of government. This shall include indigenous community groups. Involvement of public authorities may be required, at least initially,

to co-ordinate and authorise any actions. Interested stakeholders will benefit from an increased knowledge about management of threatened species and the satisfaction of participating in a conservation program. The involvement of stakeholders will also advantage the species, as actions can be undertaken in areas where resources may be limited.

The community may become involved in a variety of programs, depending on the particulars of the site and the stakeholders concerned. A potential area of involvement of the community is in the implementation of threat and habitat management programs and the monitoring of their success, which is an action that public authorities will undertake (see 12.3.1). A monitoring sheet that can be used by community groups is included as Appendix 4.

This action will be co-ordinated by relevant public authorities as determined by sections 11 and 12 of this plan.

#### 14.3.2 Provide advice and assistance to private landholders

A number of significant sites may occur on private land. The DEC will liaise with interested private landholders of these sites, to identify actual and potential threats and to negotiate the implementation of on-ground works to mitigate or reduce threats. Where possible and appropriate, the DEC will encourage landholders to enter into Voluntary Conservation Agreements (see action 11.3.3). The sites will also be monitored by the DEC on a regular basis to assess the success of any on-ground works that have been implemented.

This action will be undertaken by the DEC in conjunction with private landholders.

## 15 Re-assess conservation status

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### 15.1 Objective

To re-assess the conservation status of the species.

### 15.2 Criteria

Assessment of the conservation status is undertaken, based on accurate information about the distribution of the species, its management and threats to its survival.

### 15.3 Recovery Actions

#### 15.3.1 DEC to be advised of any consents or approvals that affect *D. biflora*

When planning decisions are made by consent or determining authorities that affect populations of *D.*

*biflora*, this information will be forwarded to the Recovery Program Co-ordinator, DEC. This includes information on decisions that protect habitat, as well as those that lead to reduction of habitat and/or individuals.

This action will be undertaken by all consent and determining authorities.

### **15.3.2 Re-assess conservation status of species**

Once the reservation/protection status of sites is increased and threat and habitat management programs are being implemented, a re-assessment of the conservation status of *D. biflora* using the criteria developed by Keith *et al.* (1997) or other appropriate criteria, and is to be carried out at the review of the plan, taking into account the actions achieved and any further loss or degradation of habitat.

This action will be undertaken by the DEC and referred to the NSW Scientific Committee.



## 16 Implementation and Costs

### 16.1 Implementation Schedule

Table 4 allocates responsibility for the implementation of recovery actions specified in this plan to relevant agencies. Refer to sections 11-15 for further details about these actions.

TABLE 4 IMPLEMENTATION OF ACTIONS

Action	Description	Priority	Responsibility	Year of implementation				
				1	2	3	4	5
11.3.1	Identify sites that are a high priority to protect	1	DEC	✓	✓			
11.3.2	Carry out negotiations to protect sites	1	DEC	✓	✓	✓	✓	
11.3.3	Liaise with private landholders to protect sites	1	DEC	✓	✓	✓	✓	
12.3.1	i. negotiate with public authorities ii. implement threat and habitat mgmt programs on public lands	1	i. DEC	✓	✓			
		1	ii. public authorities	✓	✓	✓	✓	✓
12.3.2	Undertake sensitive easement maintenance activities	1	TransGrid	✓	✓	✓	✓	✓
12.3.3	U/take informed assessment and planning decisions	2	consent and determ. authorities	✓	✓	✓	✓	✓
13.3.1	Investigate aspects of the ecology	2	DEC to contract			✓	✓	✓
13.3.2	Identify and survey potential habitat	1	DEC	✓	✓			
14.3.1	Encourage community involvement	2	DEC	✓	✓			
14.3.2	Provide advice and assistance to private landholders	1	DEC	✓	✓	✓	✓	✓
15.3.1	DEC advised of decisions that affect species	2	consent and determ. authorities	✓	✓	✓	✓	✓
15.3.2	Re-assess conservation status	2	DEC					✓

## 16.2 Implementation Costs

Table 5 outlines implementation costs for the recovery actions identified in this plan.

TABLE 5. IMPLEMENTATION COSTS

Action	Description	Cost of Implementation						Source of funding				
		Yr 1	2	3	4	5	Total	DEC		Public authorities (combined)	Unfunded <sup>5</sup>	
								recurrent funds	program funds			
11.3.1	Identify sites that are a high priority to protect	2000	2000	-	-	-	4000	4000				
11.3.2	Carry out negotiations to protect sites	2000	2000	2000	2000	-	8000	8000				
11.3.3	Liaise with private landholders	1000	1000	1000	1000	-	4000		4000			
12.3.1	i. negotiate with public authorities ii. implement threat and habitat mgmt programs on public lands <sup>1</sup>	2000	1000	-	-	-	3000	3000				
		58500	58500	29250	29250	29250	204750	89250		115500 <sup>4</sup>		
12.3.2	Undertake sensitive easement maintenance activities	✓ <sup>2</sup>	✓	✓	✓	✓	-			✓		
12.3.3	U/take informed planning decisions	✓	✓	✓	✓	✓	-	✓	-	✓		
13.3.1	Investigate aspects of the ecology	-	-	1500	1500	1500	4500	-	-	-	4500	
13.3.2	Identify and survey potential habitat	3000	3000	-	-	-	6000	-	-	-	6000	
14.3.1	Encourage community involvement	x <sup>3</sup>	x	-	-	-	-	x	-	x		
14.3.2	Provide advice and assistance to private landholders	1000	1000	1000	1000	1000	5000	-	5000	-		
15.3.1	DEC advised of decisions that affect species	✓	✓	✓	✓	✓	-	-	-	✓		
15.3.2	Re-assess conservation status	-	-	-	-	1000	1000	1000	-	-		
	<b>TOTAL COSTS</b>	69500	68500	34750	34750	32750	240250	105250	9000	115500	10500	

<sup>1</sup> see section 12 for relevant public authorities. Costs are based on estimated \$500 per site p.a. for years 1 and 2, and \$250 per site p.a. for years 3-5.

<sup>2</sup> ✓ = no direct cost <sup>3</sup> x = no additional costs. These activities are recurrent activities for public authorities

<sup>4</sup> based on those components of POMs that relate to *D. biflora* only. Average \$16 500 per authority. <sup>5</sup> These actions are yet to receive secure funding

## 17 Preparation details

This Recovery Plan was prepared by Sarah Burke, DEC Senior Threatened Species Officer, Central Directorate, in consultation with the *D. biflora* Species Recovery Team.

### 17.1 Date of last amendment

No amendments have been made to date.

### 17.2 Review date

This plan will be reviewed and updated 5 years from the date of publication.

## 18 Contacts

### 18.1 Threatened Species Recovery Team

The Threatened Species Recovery Team for *D. biflora* is coordinated by Threatened Species Unit, Conservation Programs and Planning Division, DEC, PO Box 1967, Hurstville, NSW 2220. Telephone (02) 9585 6678.

### 18.2 Other useful addresses

#### DEC Lower Hawkesbury Area Office

PO Box 3056 Asquith NSW 2077.  
Phone (02) 9457 9322

#### DEC Lane Cove Area Office

Lady Game Drive, Chatswood NSW 2067.  
Phone (02) 9412 1811

#### Botanic Gardens Trust, Sydney

Mrs Macquaries Rd, Sydney NSW 2000.  
Phone (02) 9231 8111.

#### Hornsby Shire Council

PO Box 37 Hornsby NSW 2077.  
Phone (02) 9457 9322

#### Ku-Ring-Gai Municipal Council

818 Pacific Highway Gordon NSW 2072.  
Phone (02) 9424 0844

#### Baulkham Hills Shire Council

PO Box 75 Castle Hill NSW 2154.  
Phone (02) 9843 0555

#### Ryde City Council

Locked Bag 2069 North Ryde NSW 1670.  
Phone (02) 9952 8222

#### Hornsby Conservation Society

PO Box 1643 Northgate 1635  
Phone (02) 9476 6972  
Email: [saltnacl@msn.com.au](mailto:saltnacl@msn.com.au)

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**APPENDIX 1: EXTANT POPULATIONS OF *Darwinia biflora*<sup>1</sup>**

LGA	CODE	LOCATION	REFERENCE	E	N	TENURE	YEAR
Baulkham H	BH1a	Annangrove; Annangrove Park	SSMB97100801	310650	6272400	BHSC	1995-97
Baulkham H	BH1b	Annangrove; Annangrove Park	SJALI0007104	310580	6272370	BHSC	2001
Baulkham H	BH1c	Annangrove; Annangrove Park, rear of facilities, off Currie Ave.	SJALI0007133	310611	6272350	BHSC	2001
Baulkham H	BH2	Annangrove; Dural-Rouse Hill Rd	1319R	309998	6273002	private	1961
Baulkham H	BH3	Annangrove; N side of Annangrove Rd, betw. Annangrove Rd & an unnamed rd	SDMP97012302	311300	6271750	BHSC	1995
Baulkham H	BH4	Castle Hill; behind 39 Citadel Crescent (Council land)	Council	313800	6268200	BHSC	?
Baulkham H	BH5	Castle Hill; Council land opposite 15 Chainmail Crescent	Council	313200	6268500	BHSC	?
Baulkham H	BH6	Castle Hill; adjacent to Samuel Gilbert Public School	SPXEI0140014	313700	6267500	Dept Ed & Tng	1996
Baulkham H	BH7a	Glenhaven; Annie Pryor Res, Mills Carindal Rd	SMCE9704031M	313098	6269269	BHSC	1997
Baulkham H	BH7b	Glenhaven; Council reserve on Temora Rd (Annie Prior Res)	Council	313700	6269150	BHSC	?
Baulkham H	BH7c	Glenhaven; Annie Prior Res, Temora Rd	SJJI0037796-805; 80	313668	6269159	BHSC	2002
Baulkham H	BH7d	Glenhaven; Annie Prior Res, Temora Rd	SJJI0037806; 808-81	313688	6269177	BHSC	2002
Baulkham H	BH7e	Glenhaven; Annie Prior Res, Temora Rd	SJJI0037811-25	313722	6269214	BHSC	2002
Baulkham H	BH7f	Glenhaven; Glenhaven Rd	SDMPI0014566	313560	6269375	?private	2000
Baulkham H	BH8	Glenorie; at the end of Schwebel Lane	SSMB9710070K	312750	6280750	Dept Lands	1994
Baulkham H	BH9a	Glenorie; Les Shaw Reserve, Old Northern Road	Council	314700	6281150	BHSC	?
Baulkham H	BH9b	Glenorie; 9 Sermelfi Drive	SVLU990712AM	314500	6280700	private	1998
Baulkham H	BH10	Glenorie; on freehold and adjoining CL	SSMB97100702	313200	6277998	various	1997
Baulkham H	BH11	Kellyville; near Cattai Ck	NSW373633	310000	6269200	private	1995
Baulkham H	BH12a	Kellyville; Hillview Rd near bend/verge	SPXEI0139494	308900	6271700	BHSC	1996
Baulkham H	BH12b	Kellyville; Western side of Heath Road Reserve, east of Stringer Road	SJJI0074887	309230	6271620	BHSC	2003
Baulkham H	BH12c	Kellyville; Heath Rd Reserve, along rd res adj to 38 Stringer Rd	SJJI0037831-34	309309	6271662	BHSC	2003
Baulkham H	BH12d	Kellyville; Heath Rd Reserve, along rd res adj to 38 Stringer Rd	SJJI0037829-30	309412	6271651	BHSC	2003
Baulkham H	BH12e	Kellyville; Heath Rd Reserve, along rd res adj to 38 Stringer Rd	SJJI0037827-28	309592	6271750	BHSC	2003
Baulkham H	BH12f	Kellyville; North-west section of Heath Road Reserve, above smaller creek	SJJI0075054	309620	6271620	BHSC	2003
Baulkham H	BH12g	Kellyville; Central section of Heath Road Reserve	SJJI0074888; SJJI0075049	309900	6271550	BHSC	2003
Baulkham H	BH12h	Kellyville; Heath Road Reserve	SJJI0074889	310150	6271350	BHSC	2003
Baulkham H	BH12i	Kellyville; intersection Heath Rd and Foxall Rd	SPXEI0139588	310300	6271300	private	1996
Baulkham H	BH12j	Kellyville; Crown Land at Heath Rd (wrong E/N in Atlas?)	SPXEI0139592; S. Douglas	311000	6271500	Dept Lands	1996
Baulkham H	BH13	Kellyville	SSYK01020919	312500	6268250	private	1999
Baulkham H	BH14	Kellyville; on plateau and slope draining to Cattai Creek, access off Foxall Rd	SDMP9908250S	311190	6270360	private	1999
Baulkham H	BH7g	Kellyville	SSXK9911240A	312750	6269125	private	1999
Baulkham H	BH7h	Kellyville; Roseberry Rd, in bush around Cattai Ck	NSW395287; Gunninah report; SSMB97100802; SPXEI0139805	312600	6268900	private	1995-96
Baulkham H	BH15a	Kenthurst; Bannerman Rd road verge c.100 m W of Holland Reserve	Council	313200	6270450	BHSC	?
Baulkham H	BH15b	Kenthurst; Holland Reserve	SSMB97102709	313350	6270350	Dept Lands	1997

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LGA	CODE	LOCATION	REFERENCE	E	N	TENURE	YEAR
Baulkham H	BH15c	Kenthurst; Holland Res, N side off Bannerman Rd, Pony Club site	SDMP97012206	313350	6270600	Dept Lands	1995
Baulkham H	BH16	Kenthurst; 5 Ivy Pl, rear of house and driveway	SDMP9707180F	313750	6273000	private	1997
Baulkham H	BH17	Kenthurst; 9 Robson Rd	SSMB97051400	311870	6270440	private	1997
Baulkham H	BH18	Kenthurst; along road verge at 39 Sedger Rd	SPXEI0139978; Council	313340	6272300	BHSC	1997
Baulkham H	BH19	Kenthurst; end of Emperor Pl under the powerlines	SSMB97100800	312850	6273400	private	1994-97
Baulkham H	BH20	Kenthurst; end of Porters Rd, around Pistol Club.	S. Douglas #2	311000	6279200	private	1990s
Baulkham H	BH21	Kenthurst; on 4WD track, N of Annangrove Rd at start of descent to creek crossing	SDMP97012205	309898	6274753	BHSC	1995
Baulkham H	BH22	Kenthurst; S side of road 100 m from Raym Rd on Ashwood Rd	SPXEI0139804	312700	6272300	BHSC	1996
Baulkham H	BH23a	Kenthurst; Crown Reserve end of Murray Park Rd (wrong E/N in Atlas)	SPXEI0140138	312000	6272580	Deerubb. LALC	1996
Baulkham H	BH24b	Kenthurst; end of Murray Park Rd	S. Douglas #3	311800	6272700	Deerubb. LALC	1990s
Baulkham H	BH25a	Kenthurst; Annangrove Pk. Nth, off Campbell Rd	SJALI0007131	310921	6273283	BHSC	2001
Baulkham H	BH25b	Kenthurst; freehold subject to proposed rural residential development.	SDMPI0001716	311350	6273400	private	1997
Baulkham H	BH26	Kenthurst; edge of Colbran Avenue; u/neath powerpole and in adjoining front yard	SDMPI0001823	311268	6270986	private	2000
Baulkham H	BH27	Kenthurst; E end of dirt section, Bannerman Rd (wrong E/N in Atlas)	SDMP96121205	312620	6270300	BHSC	1996
Baulkham H	BH28	Maroota; Blaker's Rd on ridge top	NSW273496	310600	6294800	private	1991
Baulkham H	BH29	Maroota; end of Haerses Rd, Crown Land.	S. Douglas #1	313100	6292800	Dept Lands	1990s
Baulkham H	BH30	Maroota; Ridge near Jacksons Swamp, c.3.2 km NW of Maroota	NSW394261	311800	6297900	Dept Lands	1995
Baulkham H	BH31	South Maroota; Paulls Rd.	Council	310850	6290100	private	1990s
Hornsby	HO1	Asquith; end of Stokes Ave	1314R,30-HO	325300	6270200	prop. Landcom	1984-97
Hornsby	HO2a	Asquith; near fire trail (off Queens Rd?)	SDMPI0001766	325314	6270875	?Dept Educ	1999
Hornsby	HO2b	Asquith; on edge of cutting N of phone 429 on W side of F3 fwy near Asquith GC.	SDMPI0001775	325638	6271047	?RTA	1999
Hornsby	HO3	Berowra Heights; open space A	D. Coombes Db5	326200	6280000	HSC	1994-95
Hornsby	HO4a	Berowra Heights; open space A	D. Coombes Db4	328200	6279600	HSC	1994-95
Hornsby	HO4b	Berowra Heights; Wanda Cr	SDMP97080607	328050	6279600	prop. Landcom	1997
Hornsby	HO4c	Berowra Heights; residential A	D. Coombes Db3	328000	6280100	private	1994-95
Hornsby	HO4d	Berowra Heights; Wideview Rd and W side xtn and edge of Cliffview	SDMP9708050L	327900	6279980	prop. Landcom	1997
Hornsby	HO4e	Berowra Heights; Wideview Rd and W side xtn and edge of Cliffview	SDMP9708050M;8482-HO	328170	6279940	prop. Landcom	1993-97
Hornsby	HO4f	Berowra Heights; end of Alan Ave	SDMP97080602	328100	6279350	prop. Landcom	1997
Hornsby	HO4g	Berowra Heights; end of Lonsdale Ave	SDMP9708050C; SBPJ97041600	327670	6280060	prop. Landcom	1997
Hornsby	HO4h	Berowra Heights; end Warrina Rd	SDMP9708060E	328650	6279630	prop. Landcom	1997
Hornsby	HO4i	Berowra Heights; 300 m N of locked gate end of Woodcourt Rd	SDMP9708050J	327410	6279330	prop. Landcom	1997
Hornsby	HO4j	Berowra Heights; E of Turner Rd near Gooraway Pl, Landcom site 129	SDMP9708050N	326820	6279920	prop. Landcom	1997
Hornsby	HO4k	Berowra Heights; fire trail between Woodcourt and Turner Rd	8480-HOR	327000	6280220	prop. Landcom	1993
Hornsby	HO4l	Berowra Heights; Turner Rd	SMCE9704293J	326900	6280200	prop. Landcom	1997
Hornsby	HO4m	Berowra Heights; Lot 8 Bushview Place (near Woodcourt Rd)	SDMP0101053I	327280	6279780	private	2000

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LGA	CODE	LOCATION	REFERENCE	E	N	TENURE	YEAR
Hornsby	HO4n	Berowra Heights; Gooraway Place Fire Trail	SJTI0052064	327100	6280000	?prop Landcom	2001
Hornsby	HO5	Berowra Heights; about 500m along fire trail N of Turner Rd at intersection with Great North Walk	8481-HOR	327200	6281110	Dept Lands	1993
Hornsby	HO6	Berowra Heights; near S boundary of Muogamarra, south of Joe Crafts Creek	SDMPI0047858	327823	6281257	NPWS(Muog)	2002
Hornsby	HO7	Berowra; Lonsdale Road, firetrail, Berowra Valley RP	SRXLI0000761; SRXLI0000893	326500	6278900	BVRP	2000
Hornsby	HO8	Berowra; Gully Rd xtn from Mary Wall Cr on E side	SDMP9708060C	328940	6278820	prop. Landcom	1997
Hornsby	HO9a	Berowra; between Gully Rd and PHwy, 30-50 m above Gully Rd	SDMP9708060D	328740	6278300	prop. Landcom	1997
Hornsby	HO9b	Berowra; 54 Gully Road	SDMP0101053J	328750	6278350	?private	2000
Hornsby	HO10	Berowra; both sides of fire trail NW of Cumbora Cct, Berowra Valley RP	8479-HOR	327200	6277900	BVRP	1993-97
Hornsby	HO11	Berowra; bush opp 12, 21, 23 Koloona Rd	SDMP9708060K	328425	6278980	prop. Landcom	1997
Hornsby	HO12	Berowra; edge of F3 fwy Cutting S17	SDMP9908250Y	328439	6277525	RTA	1999
Hornsby	HO13a	Berowra; edge of cutting along western side of F3 fwy north of Phone 439.	SDMPI0001777	328181	6276784	RTA & RIC	1999
Hornsby	HO13b	Berowra; edge of F3 fwy Cutting N16	SDMP9908250X	328234	6277010	RTA & RIC	1999
Hornsby	HO13c	Berowra; scatted along F3 Freeway cutting.	SPXEI0279620	328221	6276778	RTA	1998
Hornsby	HO14a	Berowra; between caravan pk and Greenview Pde under powerlines	SDMP9708050Q	327490	6276430	prop. Landcom	1997
Hornsby	HO14b	Berowra; Crown land downslope of La Mancha Caravan Park.	SDMPI0001837	327684	6276587	Dept Lands	2000
Hornsby	HO14c	Berowra; environmental protection B	D. Coombes Db10	327300	6276100	BVRP	1994-95
Hornsby	HO15a	Berowra; Berowra Valley Regional Park	D. Coombes Db7	326900	6277300	BVRP	1994-95
Hornsby	HO15b	Berowra; firetrail off Ti Tree Crescent	SJEH98021104; SJEH98021105	326830	6277430	BVRP	1997
Hornsby	HO15c	Berowra; offshoot track to NW of trail from Titree Cres	SDMPI0001715	326800	6277250	BVRP	1997
Hornsby	HO15d	Berowra; slope above end of Hamley Road on E side	SJTI0023553	327100	6276900	BVRP	2003
Hornsby	HO16a	Berrilee; rural A	D. Coombes Db43	323000	6278100	private	1994-95
Hornsby	HO16b	Berrilee; rural A	D. Coombes Db42	323100	6277900	private	1994-95
Hornsby	HO17	Berrilee; rural A/environmental protection B	D. Coombes Db44	324600	6278100	private	1994-95
Hornsby	HO18a	Berrilee; special use B	D. Coombes Db45	324300	6279200	HSC	1994-95
Hornsby	HO18b	Berrilee; special use B	D. Coombes Db46	324600	6279600	HSC	1994-95
Hornsby	HO19	Brooklyn; edge of F3 fwy near drainage basin at phone 446.	SDMPI0001782	329439	6279608	RTA	1999
Hornsby	HO20	Brooklyn; edge of F3 fwy.	SDMPI0001781	329802	6280051	RTA	1999
Hornsby	HO21	Canoelands; Canoelands Rd and firetrail	SAQFI0000368	319900	6290400	HSC?	1999
Hornsby	HO22	Canoelands; Marramarra & Smugglers Ridge firetrails	SAQFI0002016	324279	6288439	NPWS(Marra)	2002
Hornsby	HO23a	Canoelands; adj to Blakes Trig Track between Canoelands Ridgeand Big Bay	1298R	322900	6291200	NPWS (Marra)	1987
Hornsby	HO23b	Canoelands; Canoelands Rd	20-HOFL	322600	6291500	NPWS (Marra)	1989
Hornsby	HO24a	Canoelands; Blakes Ridge track, c. 0.25 km beyond the bldgs	NSW201512	321900	6291600	Dept Lands	1986
Hornsby	HO24b	Canoelands; Canoelands Rd off Old Nthn Rd	SDMP9708050A	321530	6291880	prop. Landcom	1997
Hornsby	HO24c	Canoelands; 52 Canoelands Rd	SDMP0101054M	321500	6291750	private	2000
Hornsby	HO25a	Cheltenham; Devlins Ck, Lane Cove NP (Pennant Hills Pk)	1317R; NSW250747; NSW77196	322500	6263700	NPWS (LCNP)	1965-91

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LGA	CODE	LOCATION	REFERENCE	E	N	TENURE	YEAR
Hornsby	HO26	Cowan; Muogamarra NR in heathy woodland with ironstone/clayey soils	SDMPI0001768	330500	6282200	NPWS (Muog)	1999
Hornsby	HO27	Dural; Berowra Valley Regional Park	D. Coombes Db36	320500	6270700	BVRP	1994-95
Hornsby	HO28a	Dural; Quarry Rd, around trig column	SPXE9612125A	320822	6269416	BVRP	1996
Hornsby	HO28b	Dural; Berowra Valley Regional Park	D. Coombes Db35	320900	6269900	BVRP	1994-95
Hornsby	HO28c	Dural; Quarry Road firetrail, in Berowra Valley RP	SRXLI0008082	320911	6270278	BVRP	1998
Hornsby	HO29	Dural; rural B	D. Coombes Db38	320200	6271400	private	1994-95
Hornsby	HO30	Fiddletown; Fagan Ridge	SVG198091409	318810	6281935	?HSC	1998
Hornsby	HO31	Fiddletown; Smuggler's Ridge	19-HOFL	320600	6286500	NPWS (Marra)	1989
Hornsby	HO32	Fiddletown; Smugglers Ridge trail	SDMP9707212N	319726	6286653	NPWS (Marra)	1997
Hornsby	HO33	Galston Ridge; open space A	D. Coombes Db40	322100	6274700	BVRP	1994-95
Hornsby	HO34	Galston Ridge; rural A/Berowra Valley Regional Park	D. Coombes Db41	322600	6275200	BVRP/private	1994-95
Hornsby	HO35a	Galston; part of large pop'n extending along unnamed ridge N of Cabbage Tree Hollow.	SPXEI0279617	320000	6272775	BVRP	1998
Hornsby	HO35b	Galston; along ridgetop fire trail.	SPXEI0279618	320376	6272717	BVRP	1998
Hornsby	HO36	Galston; behind RSL retirement village.	SPXEI0279619	319738	6273576	BVRP	1998
Hornsby	HO37	Galston; Berowra Valley Regional Park	D. Coombes Db39	321980	6273300	BVRP	1994-95
Hornsby	HO38	Hornsby Heights; Heather Place to Waninga Road firetrail	SAQFI0007393	323722	6274467	BVRP	1998
Hornsby	HO39	Hornsby Heights; Berowra Valley Regional Park	D. Coombes Db30	322800	6272600	BVRP	1994-95
Hornsby	HO40a	Hornsby Heights; Berowra Valley Regional Park	D. Coombes Db29	324000	6275000	BVRP	1994-95
Hornsby	HO40b	Hornsby Heights; Cootamundra Rd, Landcom proposed extension	SDMP9708050S	324280	6275500	prop. Landcom	1997
Hornsby	HO40c	Hornsby Heights; 315 X Somerville Road	SJAL0107023D	324240	6275130	?private	2001
Hornsby	HO40d	Hornsby Heights; Somerville Road, Berowra Valley RP	SDMPI0060871	323750	6275000	BVRP	2002
Hornsby	HO41	Hornsby Heights; proposed Landcom extension of Montview Pde	SDMP9708050U	323410	6273700	prop. Landcom	1997
Hornsby	HO42	Hornsby; approx 1km north of Hornsby	SDMP9908100A	324100	6269810	?HSC	1999
Hornsby	HO43	Hornsby; Elouera Res, W of Hornsby (=Berowra Valley Regional Park)	1321R	322496	6269348	BVRP	1966
Hornsby	HO44	Hornsby; rural B	D. Coombes Db37	321970	6270800	Dept Lands	1994-95
Hornsby	HO45a	Hornsby; end of Stewart Ave (near Rifle Range)	22-HO	322800	6270450	BVRP	1989-97
Hornsby	HO45b	Hornsby; special use A	D. Coombes Db32	322800	6270300	HSC	1994-95
Hornsby	HO45c	Hornsby; Stewart Road, Berowra Valley RP	SDMPI0061004	322600	6270800	BVRP	2000
Hornsby	HO46	Mt Colah; Myall Track, KCNP	SAQFI0002356	326559	6272570	NPWS (KCNP)	2003
Hornsby	HO47a	Mt Colah; east of expressway corridor (still there??)	1301R	325700	6271700	NPWS (KCNP)	1984
Hornsby	HO47b	Mt Colah; Myall Rd (= Berry Park)	21-HO; RDoig; Smith&Sm '96	325500	6271750	HSC	1997
Hornsby	HO47c	Mt Colah; between Ku-ring-gai Chase Rd and powerline track	Ross Doig	325900	6271870	NPWS (KCNP)	1997
Hornsby	HO47d	Mt Colah; end of fire trail opposite Colah Rd alongside expressway	Ross Doig	325550	6272100	RTA	1997
Hornsby	HO47e	Mt Colah; on south side of Ku-Ring-Gai Chase Rd just west of Chase Trail	Ross Doig	326000	6271650	NPWS (KCNP)	1998
Hornsby	HO47f	Mt Colah; edge of F3 fwy Cutting S27 Approx. 100 north of KCNP Rd overpass	SDMP9908250V	325607	6272312	RTA	1999
Hornsby	HO48	Mt Colah; behind Kalkari Info Centre	24-HO	328300	6273100	NPWS (KCNP)	1989-97



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LGA	CODE	LOCATION	REFERENCE	E	N	TENURE	YEAR
Hornsby	HO49a	Mt Colah; Berowra Valley Regional Park	D. Coombes Db23	325000	6274400	BVRP	1994-95
Hornsby	HO49b	Mt Colah; Berowra Valley Regional Park	D. Coombes Db21	325500	6274400	BVRP	1994-95
Hornsby	HO49c	Mt Colah; Berowra Valley Regional Park	D. Coombes Db17	325500	6275000	BVRP	1994-95
Hornsby	HO49d	Mt Colah; on edge of Berowra Valley Regional Park at Flinders Place	Smith & Smith in Gunninah	325300	6273700	BVRP	1990
Hornsby	HO49e	Mt Colah; Flinders Road Firetrail	SAQFI0002211	324930	6273868	BVRP	2000
Hornsby	HO49f	Mt Colah; open space A	D. Coombes Db25	325200	6274100	BVRP	1994-95
Hornsby	HO49g	Mt Colah; open space B	D. Coombes Db26	325000	6274100	BVRP	1994-95
Hornsby	HO49h	Mt Colah; Oxley Drive Firetrail Complex, Berowra Valley RP	SAQFI0002536	325432	6274463	BVRP	2004
Hornsby	HO49i	Mt Colah; residential A/Berowra Valley Regional Park	D. Coombes Db22	325000	6274700	private/BVRP	1994-95
Hornsby	HO49j	Mt Colah; 53-57 Excelsior Rd	Council	325700	6274150	private	1997
Hornsby	HO49k	Mt Colah; residential A	D. Coombes Db20	325500	6274900	private	1994-95
Hornsby	HO50	Mt Colah; edge of F3 fwy cutting S26	SDMP9908250W	325940	6273150	RTA	1999
Hornsby	HO14d	Mt Colah; residential a	D. Coombes Db18	326000	6274600	private	1994-95
Hornsby	HO51	Mt Kuring-gai; Kuring-gai Chase NP, Harwood Rd	SAQFI0004668	328162	6274910	NPWS (KCNP)	2001
Hornsby	HO14e	Mt Kuring-gai; Beaumont Track	1308R,23-HO	327800	6275500	NPWS (KCNP)	1984-97
Hornsby	HO52	Mt Kuring-gai; Berowra Valley Regional Park	D. Coombes Db9	326600	6276600	BVRP	1994-95
Hornsby	HO53	Mt Kuring-gai; Mt Ku-ring-gai Pk	1315R,31-HO	326600	6273400	HSC	1984-89
Hornsby	HO54a	Mt Kuring-gai; 200 m N of Merrilong Ave	SPXEI0279625	327560	6274680	NPWS (KCNP)	1997
Hornsby	HO54b	Mt Kuring-gai; behind houses on St Helens Ave, near King St end	SPXEI0279636	327100	6273900	NPWS (KCNP)	1998
Hornsby	HO54c	Mt Kuring-gai; between Seaview St and F3 fwy	SPXEI0279633	327280	6274950	NPWS (KCNP)	1997
Hornsby	HO54d	Mt Kuring-gai; E end of Church St	SPXEI0279639	327485	6274050	NPWS (KCNP)	1998
Hornsby	HO54e	Mt Kuring-gai; E end of Harwood Ave	SPXEI0279637	327758	6274375	NPWS (KCNP)	1998
Hornsby	HO54f	Mt Kuring-gai; E end of Harwood Ave, not within park	SPXEI0279638	327500	6274380	?private	1998
Hornsby	HO54g	Mt Ku-ring-gai; E of King St, 700 m along track (SE) to small plateau	SYXM01102308	327500	6273650	NPWS (KCNP)	1997
Hornsby	HO54h	Mt Kuring-gai; edge of trail around drainage basin at phone 435, W side of F3	SDMPI0001776	327143	6274710	RTA	1999
Hornsby	H54i	Mt Kuring-gai; on western side of F3 fwy, above cutting	SDMP9908250L	326998	6274125	?RTA	1999
Hornsby	HO14f	Mt Ku-ring-gai; environmental protection B	D. Coombes Db11	327100	6275800	BVRP	1994-95
Hornsby	HO14g	Mt Kuring-gai; Berowra Valley Regional Park	D. Coombes Db19	326400	6274600	BVRP	1994-95
Hornsby	HO14h	Mt Kuring-gai; Berowra Valley Regional Park	D. Coombes Db16	326500	6274800	BVRP	1994-95
Hornsby	HO14i	Mt Kuring-gai; industrial B	D. Coombes Db13	326100	6275900	private	1994-95
Hornsby	HO14j	Mt Kuring-gai; industrial B	D. Coombes Db14	326600	6275600	private	1994-95
Hornsby	HO14k	Mt Kuring-gai; industrial B and Berowra Valley Regional Park	D. Coombes Db15	326600	6275300	private/BVRP	1994-95
Hornsby	HO14l	Mt Ku-ring-gai; Portion 852, Tatala Rd Industrial Area, adjacent BVRP RP	SDMP0009260X	326700	6275200	private	1998
Hornsby	HO14m	Mt Kuring-gai; Hamley Road	SDMP99081003	326710	6275710	private	1998
Hornsby	HO14n	Mt Kuring-gai; 8-20 Mundowi Rd	SDMP9909210Z	326250	6275750	private	1999
Hornsby	HO14o	Mt Kuring-gai; edge of F3 fwy near drainage basin at phone 438.	SDMPI0001783	327362	6275466	RTA	1999

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LGA	CODE	LOCATION	REFERENCE	E	N	TENURE	YEAR
Hornsby	HO14p	Mt Kuring-gai; Lot 1 & 2 Hamley Rd	SDMP0009260Y	326900	6275700	private	1998
Hornsby	HO14q	Mt Kuring-gai; Glenview to Fairview Roads, Berowra Valley RP	SAQFI0004770	326371	6274278	BVRP	2002
Hornsby	HO14r	Mt Ku-ringgai; near rwy access bridge to Materials Rehandling site	B. Salt	327219	6275623	HSC	?
Hornsby	HO55	North Epping; 1 km NE of Cheltenham Railway Station	SFAF01032101	323000	6263500	NPWS (LCNP)	2000
Hornsby	HO56a	North Epping; just E of oval on Woods St	1307R;NSW228640	323700	6263300	NPWS (LCNP)	1984-87
Hornsby	HO56b	North Epping; 30 m from houses between end of Downes St and Woods St Res.	SPXEI0279627	323780	6263130	?NPWS(LCNP)	1998
Hornsby	HO25c	Pennant Hills; Blackbutt Ave near power towers (wrong E/N in Atlas)	SPXEI0279626	322260	6263760	NPWS(LCNP)	1998
Hornsby	HO25d	Pennant Hills; Blackbutt Ave.	SPXEI0279630	322380	6263840	NPWS (LCNP)	1998
Hornsby	HO57	Pennant Hills; edge of Elouera Res	1320R	320704	6266508	BVRP	1965
Hornsby	HO25b	Pennant Hills; Lane Cove NP (Pennant Hills Pk), in bushland around archery range	NSW8938; NSW362211; NSW 77197;NSW242130;1306R;1316 R; SSMB99070900-03	322600	6264100	NPWS (LCNP)	1965-97
Ku-ring-gai	KR1a	Fox Valley; along fire trail SW of Leuna Ave	Council	323700	6264300	KMC	1998
Ku-ring-gai	KR1b	Fox Valley; ridge SW of Leuna Ave	7929-HOR	323600	6264250	KMC	1992
Ku-ring-gai	KR1c	Fox Valley; W end of Aleta Cr	7930-HOR	323700	6264700	NPWS (LCNP)	1992
Ku-ring-gai	KR1d	Fox Valley; W of George Christie Oval	7931-HOR	323170	6264620	NPWS (LCNP)	1992
Ku-ring-gai	KR1e	Fox Valley; c. 100 m SW of Leuna Ave	KMC3	323600	6264300	KMC	1992
Ku-ring-gai	KR1f	Fox Valley; c. 120 m WNW of Yanilla Ave	KMC8	323250	6264650	KMC	1992
Ku-ring-gai	KR1g	Fox Valley; c. 80 m W of Yanilla Ave	KMC9	323400	6264700	KMC	1992
Ku-ring-gai	KR1j	Fox Valley; Morona Ave Reserve - proposed extension to LCNP	SVLU99060703	323900	6264200	KMC	1999
Ku-ring-gai	KR1k	Fox Valley; end of Fox Valley Rd behind houses	SPXEI0279634	323670	6265020	NPWS (LCNP)	1998
Ku-ring-gai	KR2a	Killara; 50 m behind boundary of 21 Blaxland Rd	SPXEI0279631	327770	6261340	?NPWS(LCNP)	1998
Ku-ring-gai	KR2b	Killara; behind Blaxland Rd houses near Allen Park	SPXEI0279629	327650	6261280	NPWS (LCNP)	1998
Ku-ring-gai	KR3	Lindfield; end Bradfield Rd, behind last house	SPXEI0279628	328600	6259500	NPWS (LCNP)	1998
Ku-ring-gai	KR4	Lindfield; UTS Ku-Ring-Gai Campus	Parramatta rail link SIS	329660	6259640	private	2000
Ku-ring-gai	KR5a	North Turramurra; between Bobbin Head track and Sphinx Track	SSMB98121100	328700	6270700	NPWS (KCNP)	1997
Ku-ring-gai	KR5b	North Turramurra; KCNP	KMC37	327800	6270200	NPWS (KCNP)	?
Ku-ring-gai	KR5c	North Turramurra; KCNP, Murrua Track and on or near other service trails	KMC35;1302R;17-HOFL; 1303R	327900	6270500	NPWS (KCNP)	?
Ku-ring-gai	KR5d	North Turramurra; E/N edge of The Landings retirement village	KMC7	328250	6270400	private	1996
Ku-ring-gai	KR5e	North Turramurra; E/N edge of The Landings retirement village	KMC4	328500	6270500	private	1996
Ku-ring-gai	KR5f	North Turramurra; W of Kirkpatrick St, behind houses	SPXEI0279635	328040	6270200	NPWS (KCNP)	1998
Ku-ring-gai	KR6	North Turramurra; Bobbin Head track	1304R; 16-HOFL	328800	6271200	NPWS (KCNP)	1984-97
Ku-ring-gai	KR7	North Turramurra; 2.5km north of township, E of creekline	SDMP9908201F	328500	6272500	NPWS (KCNP)	1997
Ku-ring-gai	KR8a	North Wahroonga; Grosvenor St or Gibberagong track	1305R&18-HOFL	326500	6269900	NPWS (KCNP)	1984-97
Ku-ring-gai	KR8b	North Wahroonga; KCNP	KMC34	326250	6270100	NPWS (KCNP)	?
Ku-ring-gai	KR8c	North Wahroonga; N end of Curtin Ave	SPXEI0279640	325900	6269970	NPWS (KCNP)	1998
Ku-ring-gai	KR8d	North Wahroonga; near edge of F3 fwy northbound, S of phone 427	SDMPI0001774	325707	6269770	RTA	1999
Ku-ring-gai	KR8e	North Wahroonga; on edge of trail to drainage basin S of cutting N2 of F3.	SDMPI0001773	325543	6269639	?RTA	1999

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LGA	CODE	LOCATION	REFERENCE	E	N	TENURE	YEAR
Ku-ring-gai	KR9a	North Wahroonga; bushland between Daly ave and E of Cliff Oval	KMC21	326825	6268910	KMC	1998
Ku-ring-gai	KR9b	North Wahroonga; bushland W side of Cliff Oval	KMC19	326650	6268900	KMC	1998
Ku-ring-gai	KR9c	North Wahroonga; just N of Cliff Oval (Cliff Ave)	KMC1	326800	6269200	KMC	1996
Ku-ring-gai	KR10a	South Turramurra; 29 Ashburton Ave	Council	324770	6262800	private	1998
Ku-ring-gai	KR10b	South Turramurra; 2.5km NE of Epping Railway Station	SSYK01032001	324700	6262500	NPWS (LCNP)	2000
Ku-ring-gai	KR10c	South Turramurra; ESE of Ashburton Ave	KMC12	324800	6262600	KMC	1992
Ku-ring-gai	KR10d	South Turramurra; fire trail between Kissing Point Rd and Koombala Ave	KMC17	324750	6262500	KMC	1997
Ku-ring-gai	KR10e	South Turramurra; Kissing Pt Rd. Below houses off Ashburton Ave.	SDMPI0001720	324825	6262750	private	1997
Ku-ring-gai	KR11a	South Turramurra; fire trail between Koombala Ave and The Comenarra Pkwy	KMC18	325500	6262750	KMC	1997
Ku-ring-gai	KR11b	South Turramurra; SE of Robin Ave	KMC13	325550	6262900	KMC	1992
Ku-ring-gai	KR1h	South Turramurra; Canoon Rd, at jnct with Barwon Ave	7928-HOR	324300	6263800	KMC	1992
Ku-ring-gai	KR1i	South Turramurra; off Canoon Rd	KMC2	324250	6263900	KMC	1992
Ku-ring-gai	KR12	Turramurra; adjacent Mimosa Oval in Mimosa Road reserve	KMC15	325740	6264220	KMC	1996
Ku-ring-gai	KR13a	West Pymble; Lane Cove NP (in Quarry Ck area)	7927-HOR	326630	6261500	NPWS (LCNP)	1992
Ku-ring-gai	KR13b	West Pymble; S of Combe Place	Council	325950	6262000	KMC	1998
Ku-ring-gai	KR13c	West Pymble; SW of Combe Pl	7932-HOR	325900	6262100	KMC	1992
Ku-ring-gai	KR13d	West Pymble; fire trail off Wallalong Cr, SE of Combe Pl	SSMB98112500	326000	6262000	KMC	1998
Ku-ring-gai	KR13e	West Pymble; 1km NE of Macquarie University	SFAF01032102	326000	6261600	NPWS (LCNP)	2000
Ku-ring-gai	KR13f	West Pymble; behind 26 Hampshire Ave, c. 100 m in	SPXEI0279632	326800	6261400	NPWS(LCNP)	1998
Ku-ring-gai	KR13g	West Pymble; c. 10 m SW of Hampshire Ave	KMC10	326700	6261400	KMC	1992
Ku-ring-gai	KR13h	West Pymble; Gloucester Ave, over Quarry Ck to Hampshire Ave	SPXEI0279624	326410	6261420	NPWS (LCNP)	1998
Ku-ring-gai	KR13i	West Pymble; off Wallalong Cr (previous Optus tower site)	KMC14	325950	6261900	KMC	1996
Ryde	RY1a	Chatswood West; 1.2km E of Fullers Bridge (E/N doesn't match description)	SSYK01032000	328200	6258900	NPWS (LCNP)	2000
Ryde	RY2	Macquarie Park; 300m South of De Burgh's Bridge	SFAF01032100	327400	6260700	NPWS (LCNP)	2000
Ryde	RY1b	Macquarie Park; Lane Cove NP	SJBL96042906	328250	6259100	NPWS (LCNP)	1996
Ryde	RY3	Macquarie Park; Lane Cove NP	SSMB98112501	327680	6260050	NPWS (LCNP)	1998
Ryde	RY4a	North Ryde; Epping Road	SSYK01071902	328000	6258300	?CSIRO	2000
Ryde	RY4b	North Ryde; CSIRO Riverside Corporate Park lots 8&9	Council; SPXEI0424682	328060	6258400	CSIRO	1999

<sup>1</sup> list of sites known to the DEC. There are likely to be additional sites.

<sup>2</sup> 'a','b','c' etc indicates sub-populations; populations within 500 m of one another are considered part of same population.

**APPENDIX 2: *Darwinia biflora* populations that can no longer be found**

LGA	REFERENCE	E	N	LOCATION	NUMBER	YEAR
<b>OLD RECORDS WITH UNSPECIFIC LOCATION DETAILS</b>						
Ku-Ring-Gai	NSW84507	330322	6256600	Lane Cove		1913
Ku-Ring-Gai	NSW7225	328600	6264000	Gordon West		1948
Hornsby	NSW51991&92	323900	6269500	Hornsby		1917
Hornsby	NSW362209	329800	6284400	Cowan		1921
Hornsby	NSW51988	331400	6282500	Peat's Rd		1884
Hornsby	1977R	320996	6263751	Beecroft		1917
Hornsby	1975R	329502	6281001	Cowan		1915
Baulkham H	1318R	313499	6268999	Glenhaven		1950
Baulkham H	NSW77632	306800	6272800	Annangrove		1964
Hornsby	NSW362158	320900	6263900	Cheltenham		1965
Hornsby	1978R; NSW53472	325248	6272505	Mt Colah (probably equivalent to other locations in area)		1961
Hornsby	1976R	324000	6269200	Near Mt Quarries, Hornsby		1926
Hornsby	NSW362219	328400	6278800	Berowra		1965
Hunters Hill	1979R	328502	6253993	Hunters Hill		1892
<b>SITES KNOWN TO BE CLEARED</b>						
Hornsby	1313R,29-HO	325000	6274400	end of Beryl Ave, Mt Ku-ring-gai (cleared for housing)	3000	1984-89
Hornsby	NSW267742	324400	6271900	Mount Colah; Kalang Rd (cleared for housing)	large	1993
Hornsby	1312R,28-HO	326700	6276000	Berowra; W of Beaumont Rd (now largely developed for factories)	500	1984-89
Hornsby	1300R;NSW215648	325600	6271500	Mount Colah; expressway corridor (lost during construction of F3)	25000	1984
Hornsby	1299R; 32-HO; NSW215648	325500	6271500	Mount Colah; lot 14 (habitat still present but species no longer found here)	6650-7000	1984-89
Hornsby	1311R,27HOFL	328200	6276500	Berowra; SE of Berowra Stn (lost during construction of F3)	20-40	1984-89
Hornsby	1310R,26-HO	328300	6276800	Berowra; SE of Berowra Stn (lost during construction of F3)	20-40	1984-89
Hornsby	25-HO & 1309R	328300	6277200	Berowra; SE of Berowra Stn (lost during construction of F3)	20	1989
Kuring-gai	NSW395677; SDMP9701101N; SVGI9906022X	326200	6269500	North Wahroonga; Cooks Trig (cleared for residential development)		
<b>POPULATIONS LIKELY TO BE GONE (due to lack of recent collections in area)</b>						
Sutherland	1323R	315999	6221009	near Waterfall in Royal NP		1933
Blue Mtns	1322R	266998	6267003	Linden Woodford		1914
<b>DUBIOUS RECORDS</b>						
Singleton	SDMP9911300D; SVGI9906280S	315000	6380000	Observer has no knowledge of species from that area; perhaps N figure incorrectly entered and should be 6280000 (within BHSC LGA)		1998

## APPENDIX 3: SPECIES PROFILE AND EIA GUIDELINES

**THREATENED SPECIES INFORMATION**

Department of  
Environment and  
Conservation (NSW)

# *Darwinia biflora*

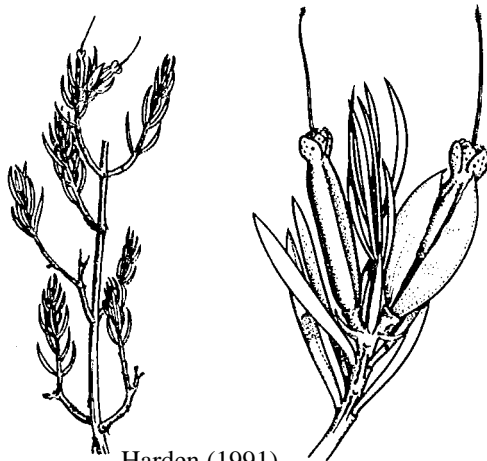
(Cheel) Briggs

## Conservation Status

*Darwinia biflora* is listed as a **vulnerable species** on Schedule 2 of the *Threatened Species Conservation Act* 1995. *Darwinia biflora* is also listed as a **vulnerable species** on Schedule 1 Part 2 of the Commonwealth *Endangered Species Protection Act* 1992.

## Description

*Darwinia biflora* is in the family Myrtaceae. It is an erect to spreading shrub to 80cm high. Flowers are green, surrounded by two red bracteoles, and are mostly in pairs.



Harden (1991)

## Distribution

*Darwinia biflora* occurs at 241 sites in the northern and north-western suburbs of Sydney, in the Ryde, Baulkham Hills, Hornsby and Ku-Ring-Gai local government areas.

## Recorded occurrences in conservation reserves

Ninety of the 241 known sites (37%) occur in Ku-Ring-Gai Chase, Marramarra and Lane Cove National Parks and Berowra Valley Regional Park.

## Habitat

*Darwinia biflora* occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone. Most sites are on the Lucas Heights Soil Landscape where this intergrades with either the Gynea or the Hawkesbury Soil Landscapes (NSW NPWS 2003). The overstorey often includes *Eucalyptus haemastoma*, *Corymbia gummifera* and/or *E. squamosa*. The vegetation structure is usually woodland, open forest or scrub-heath (NSW NPWS 1997).

## Ecology

Plants are thought to live for 15-20 years. Flowering occurs throughout the year but is concentrated in autumn, with mature fruits being produced from May to August (Auld *et al.* 1993). Self-pollination is the usual form of pollination. Flowers and fruit are produced 18 months after germination, though at this stage few reach maturity. Maturation rates are higher for plants older than 5 years. Seed viability is high (up to 99%).

Fire is an important factor in the life cycle of this species. Fire kills all plants, but also produces a flush of germination from seed stored in the soil. The number of individuals at a site then declines with time since fire, as the surrounding vegetation develops (Auld *et al.* 1991).

## Threats

Known threats include habitat loss (from urbanisation) and habitat degradation (from inappropriate fire regimes, slashing for easement maintenance, illegal track creation and weed invasion).

## Management

Management actions should involve increasing the security of sites, especially

in those parts of the species' range where few sites are in conservation reserves. Management should also involve amelioration of threats at sites, e.g. weed control, prevention of mechanical

damage and implementation of appropriate fire regimes.

### **Recovery Plans**

A Recovery Plan has been prepared for *Darwinia biflora*.

### **For Further Information contact**

Threatened Species Unit, Conservation Planning and Programs Division, Department of Environment and Conservation PO Box 1967, Hurstville NSW 2220 Phone 02 9585 6678 [www.nationalparks.nsw.gov.au](http://www.nationalparks.nsw.gov.au)

### **References**

Auld T.D., Bradstock R.A. & Keith D.A. (1991). *Germination of rare plants in relation to fire*. Project P154 Final Report for World Wide Fund for Nature Australia. NSW National Parks and Wildlife Service, Hurstville.

Auld T.D., Bradstock R. & Keith D. (1993). *Fire as a threat to populations of rare plants*. Australian National Parks and Wildlife Service Endangered Species Program. Report for Endangered Species Project No. 31. NSW National Parks and Wildlife Service, Hurstville.

Harden G.J. (1991). *Flora of New South Wales*. University of N.S.W. Press, Kensington, N.S.W.

NSW NPWS (1997) *Urban Bushland Biodiversity Survey. Stage 1: Western Sydney*. NSW NPWS, Hurstville.

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**ENVIRONMENTAL IMPACT ASSESSMENT GUIDELINES**

# *Darwinia biflora*

## **(Cheel) Briggs**

The following information is provided to assist authors of Species Impact Statements, development and activity proponents, and determining and consent authorities, who are required to prepare or review assessments of likely impacts on threatened species pursuant to the provisions of the *Environmental Planning and Assessment Act 1979*. These guidelines should be read in conjunction with the NPWS *Information Circular No. 2: Threatened Species Assessment under the EP&A Act: The '8 Part Test' of Significance* (November 1996).

### **Survey**

Surveys for *D. biflora* can be conducted at any time of the year, though it is easier to detect when flowering. It can be distinguished from other Darwinias in the region by the shape of the leaves (laterally compressed, not terete) and the width of the hypanthium (<1.5 mm diameter) (Harden 1991).

### **Life cycle of the species**

Fire is an important factor in the life cycle of this species. If a proposal is likely to result in frequent fires, then this may lead to declines in the population, since an adequate seedbank will not be able to develop between fire events.

### **Threatening processes**

Bushrock Removal, high frequency fire and clearing of native vegetation are the only processes to be listed that are relevant to this species. However, other more general threatening processes that have been identified as relevant to this species should also be considered. These include habitat loss and habitat degradation through inappropriate fire regimes, slashing for easement maintenance, illegal track creation and weed invasion (NSW NPWS 2004).

### **Viable local population of the species**

Any individuals of *D. biflora* within 500 m of each other can be considered part of the same population. It is difficult to determine whether a population can be considered viable. *D. biflora* can be quite tolerant of occasional disturbances (such as fire or slashing) but may not survive intensive weed invasion. Isolation and fragmentation may also reduce viability. Small population size should not be used as an indicator of non-viability without an assessment of the potential amount of seed stored in the soil. The time since fire may give an indication of the size of the seedbank - i.e. after a long fire interval (say >20 years), the number of adults in the population declines and the size of the seedbank increases.

Fire is one of the most important factors that affects the viability of a population. A population may not be viable in the long term if a proposal is likely to reduce the opportunity for an appropriate fire regime to be imposed.

### **A significant area of habitat**

The largest and most significant areas of habitat occur around the North Turramurra - North Wahroonga areas. Whether other areas of habitat could be classified as significant is difficult to determine. It should be noted that the species is not evenly distributed across its range, so the significance of populations should be assessed relative to other populations in the local area. The size of the population and the extent security and quality of habitat of the subject site and other sites in the locality, are factors that can be used to determine significance of a site. Sites that are vegetatively linked to other areas or are at the edge of the range are also significant. Population size should not be used as a sole indicator of the significance of a site, since numbers

of individuals at a site vary dramatically with time since fire.

### **Isolation/fragmentation**

The threat of inbreeding depression (resulting from isolation of sites) may not be an issue for *D. biflora*, as the species usually self-pollinates.

Fragmentation is a significant issue in the west of the species range, especially in Baulkham Hills Shire, where sites generally have very small population numbers. Management of *D. biflora* habitat and any proposals that affect the species should aim to maintain the continuity of habitat between individuals within sub-populations, and avoid artificially creating new sub-populations.

### **Regional distribution of the habitat**

The distribution of *D. biflora* is confined to the Sydney Basin Bioregion.

### **Limit of known distribution**

#### **For further information contact:**

Threatened Species Unit, Environment Protection and Regulation Division, NSW DEC, PO Box 1967, Hurstville NSW 2220. Phone: 9585 6678.  
[www.nationalparks.nsw.gov.au](http://www.nationalparks.nsw.gov.au)

### **References**

- Harden G.J. (1991). *Flora of New South Wales*. N.S.W. University Press, Kensington, N.S.W.  
NSW NPWS (2004). Recovery Plan for *Darwinia biflora*. NSW NPWS, Hurstville.

The known northern, southern, eastern and western limits of the species are at Maroota, North Ryde, Cowan and Kellyville, respectively. Further survey may identify additional sites outside these areas.

### **Adequacy of representation in conservation reserves or other similar protected areas**

At this stage, *D. biflora* is not considered to be adequately represented in conservation reserves, since the populations that occur in conservation reserves occur only around the east of the species' range, and so are not representative of the range of genetic diversity of the species.

### **Critical habitat**

Critical habitat cannot be declared for this species, as it is not listed on Schedule 1 of the TSC Act. Therefore, this issue does not need to be considered.

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## APPENDIX 4: Monitoring sheet for *Darwinia biflora*

Date:	Site code (from Recovery Plan):
Recorder(s):	
Location:	

### Population details:

Number of adults:
Number of seedlings:
Area covered by population:
Changes from last visit:
Breeding status: buds    flowering    fruiting

### Fire management:

Time since last fire:	
If a fire has occurred recently: extent of population burnt:	
intensity:	season:
Recommendations re fire regime at site:	

### Other threats and habitat management:

Weeds:    abundance:    main species:
Other threats present:
Previous management actions undertaken:
Success of actions:
Further actions required:

Other comments:



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