Department of
Environment and
Conservation (NSW)

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Approved Recovery Plan

Pimelea spicata R. Br.
Recovery Plan

January 2006

Australian Government

Department of
Environment and
Conservation (NSW)

The NPWS is part of the Department of Environment and Conservation

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Cover photograph: *Pimelea spicata* in flower growing amongst grasses at Mt Warrigal in the Illawarra
Photographer: Martin Bremner

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Pimelea spicata Recovery Plan

Executive summary

This document constitutes the formal Commonwealth and New South Wales State Recovery Plan for the small shrub *Pimelea spicata* (Thymelaeaceae), and as such considers the conservation requirements of the species across its known range. It identifies the future actions to be taken to ensure the long-term viability of *P. spicata* in nature and the parties who will carry out these actions.

Pimelea spicata is listed as endangered in the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and as endangered in the schedules of the NSW *Threatened Species Conservation Act 1995*. The species is a NSW endemic with a relatively scattered distribution occurring in two disjunct areas, the Cumberland Plain (western Sydney) and coastal Illawarra (south of Sydney). There are 30 known extant populations of *P. spicata*, 25 within the Cumberland Plain and five within the Illawarra coastal region. The majority of populations are small and isolated and the species possesses a restricted area of occupancy of only 17ha. The local extinction of at least two populations has been recorded and there are an additional four populations that may be extinct.

In western Sydney, *P. spicata* is associated with the endangered ecological community Cumberland Plain Woodland and in the Illawarra associated vegetation includes coastal grasslands and tall open forest.

Extensive clearing of the Cumberland Plain and coastal Illawarra for urban and rural development has destroyed much of the natural habitat of the species and the remaining habitat is restricted, degraded and highly fragmented. The main threats to the survival of the species are further habitat loss as a result of residential development and habitat degradation, particularly from weed invasion. Other threats include; roadside and parkland maintenance activities (slashing and spraying of herbicide), inappropriate fire regimes, dumping of rubbish and garden waste, and grazing and associated trampling.

The overall objective of this recovery plan is to ensure the continued and long-term survival of *P. spicat*a in the wild by promoting the *in-situ* conservation of the species across its natural range. Specific recovery objectives include:

- conserve *P. spicata* using land-use and conservation planning mechanisms;
- identify and minimise the operation of threats at sites where *P. spicata* occurs;
- develop and implement a survey and monitoring program that will provide information on the extent and viability of *P. spicata*;
- provide the community with information that assists in conserving the species;
- raise awareness of the species and involve the community in the recovery program; and
- conduct research that will assist future management decisions.

It is intended that this recovery plan will be implemented over a five year period. The total cost to implement the Plan is $49,000 over five years, although this does not include site management costs or the costs associated with the preparation and implementation of management plans for community land, as these costs are yet to be determined.

Lisa Corbyn
Director General
Department of Environment and Conservation (NSW)

Bob Debus MP
Minister for the Environment

Acknowledgements

This recovery plan is based on a previous Conservation Research Statement and Recovery Plan for *Pimelea spicata* (NSW NPWS 1993) and incorporates the outcomes of recovery actions implemented under the draft plan (Nash and Matthes 1995; NSW NPWS 1997; Tozer and Robertson 1998). A number of people contributed significantly to the 1993 plan and the implementation of recovery actions, including; Maria Matthes, Sharon Nash, Geoff Robertson, Merin Tozer, Dessalegn Ayallew, and Janelle Brooks.

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1. Introduction

Pimelea spicata is a small spreading or erect shrub belonging to the Thymelaeaceae family. It is a NSW endemic restricted to two disjunct areas, the Cumberland Plain (western Sydney) and coastal Illawarra, south of Sydney. Extensive clearing of these areas for urban and rural development has destroyed much of the natural habitat of the species and the remaining habitat is restricted, degraded and highly fragmented. There are 30 known extant populations of *P. spicata*, including 25 within the Cumberland Plain and five within the Illawarra coastal region. The local extinction of at least two populations has been recorded and there are an additional four populations that may be extinct. The main threats to the survival of the species are habitat degradation, particularly from weed invasion, and further habitat loss as a result of residential development.

This document constitutes the formal NSW and national recovery plan for *P. spicata* and as such considers the requirements of the species across its known range. The recovery plan outlines the current status of the species, identifies threats to persistence, details past and current management initiatives, and details the recovery program for the species over the next five years and identifies the parties responsible for implementing recovery actions.

2. Legislative context

2.1 Conservation status

Pimelea spicata is listed as an endangered species in Schedule 1 of the NSW *Threatened Species Conservation Act 1995* (*TSC Act 1995*) and as an endangered species under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*). In addition, Cumberland Plain Woodland, the habitat of *P. spicata* in western Sydney, is listed as an endangered ecological community in Schedule 1, Part 3 of the *TSC Act 1995* and as an endangered ecological community under the *EPBC Act 1999*.

A review of the current conservation status of *P. spicata* found that the species is appropriately listed as endangered (Appendix 1). *Pimelea spicata* currently meets the requirements for endangered due to the extent of habitat loss as a result of residential and rural development.

The consequences of listing a species under the *TSC Act 1995* are outlined throughout the remainder of Section 2. Briefly, among the consequences of listing are the following:

- a recovery plan must be prepared for the species;
- consideration must be given to the species when assessing the impacts of developments and activities, with the aim of minimising adverse impacts; and
- other actions that are likely to result in the harming or picking of that species or damage to its habitat must be licensed.

2.2 Recovery plan preparation

The *EPBC Act 1999* and the *TSC Act 1995* require the Australian Government Minister for the Environment and the Director-General of the Department of Environment and Conservation (DEC) 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 has been prepared to satisfy the requirements of both the *TSC Act 1995* and the *EPBC Act 1999* and therefore there will only be one plan operating for *Pimelea spicata*. It is the intention of the Director-General of DEC to forward this recovery plan to the Australian Government Minister for the Environment and Heritage for adoption.

2.3 Recovery plan implementation

The *TSC Act 1995* requires that public authorities must take any appropriate measures available to implement actions included in a recovery plan for which they have agreed to be responsible. Public authorities identified as responsible for the implementation of recovery plan actions are required by the *TSC Act 1995* to report on 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.

The public authorities responsible for actions in this plan are: Department of Environment and Conservation (DEC), Department of Planning (DoP), Roads and Traffic Authority (RTA), and the councils of Kiama, Shellharbour, Campbelltown, Liverpool, Camden, Bankstown, Fairfield, Holroyd, Blacktown, Hawkesbury, Baulkham Hills and Penrith. Consequently, the actions outlined for each of these public authorities must be implemented as described in the plan and public authorities that manage land that supports *P. spicata*, must as the responsible land manager, manage the site in accordance with this plan. Relevant land management issues include weed control, fire management and habitat management.

The *EPBC Act 1999* specifies that a Commonwealth agency must not take any action that contravenes a recovery plan and states that the Commonwealth must implement a recovery plan on those areas that apply to Commonwealth lands. One of the largest populations of *Pimelea spicata* occurs on Commonwealth land at Narellan in western Sydney.

2.4 Relationship to other legislation and planning instruments

Pimelea spicata currently occurs on both private and public lands within the council areas of Kiama, Shellharbour, Campbelltown, Liverpool, Camden, Bankstown, Fairfield, Holroyd, Blacktown, Hawkesbury, and Penrith. There is also an unconfirmed record of the species occurring in the Baulkham Hills Local Government Area. There are a considerable number of land managers involved (see Table 3 and Appendix 2). Briefly, the lands on which *P. spicata* occurs include those that are owned or managed by: Department of Environment and Conservation, Commonwealth Government, Sydney Catchment Authority, Department of Lands, Roads and Traffic Authority, Botanic Gardens and Domain Trust, Killalea State Park Trust, eight local councils (see Section 4.4) and private landholders.

Relevant NSW and Commonwealth legislation includes:

- *Threatened Species Conservation Act 1995*;
- *Threatened Species Conservation Amendment Act 2002;*
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999;*
- *National Parks and Wildlife Act 1974;*
- *Environmental Planning and Assessment Act 1979;*
- *Local Government Act 1993;*
- *Native Vegetation Act 2003;*
- *Rural Fires Act 1997;* and
- *Rural Fires and Environmental Assessment Legislation Amendment Act 2002.*

The interaction of these Acts with the *TSC Act 1995* is varied. The most significant implications are described below and in Section 2.5.

A large proportion of the known populations of *P. spicata* occur on community land managed by local government (see Section 4.4). The approval of this recovery plan will have implications upon the management of these lands under the *Local Government Act 1997*. For community lands directly affected by this recovery plan (i.e. *P. spicata* present), the affected land must be categorised as a natural area and the plan of management for the area must incorporate council's obligations under this recovery plan. The core objectives for management of land categorised as a natural area include to conserve biodiversity and maintain ecosystem function and to provide for the restoration and regeneration of the land.

2.5 Environmental assessment

2.5.1 State environmental assessment

The New South Wales *Environmental Planning and Assessment Act 1979* (*EP&A Act 1979*) requires that consent and determining authorities, and the Director-General of DEC, as a concurrence authority, consider relevant recovery plans when exercising a decision-making function under Parts 4 and 5 of the Act. Decision-makers must consider known and potential habitat, biological and ecological factors and the regional significance of individual populations. The following public authorities have a decision making function in relation to *P. spicata* and must consider the conservation strategy outlined in this plan when considering any activity which may affect the species.

- Department of Planning (DoP) as a consent authority, and in the making of Environmental Planning Instruments under the *EP&A Act 1979*;
- Department of Environment and Conservation (DEC) as a land manager, licensing authority and in a concurrence role under the *EP&A Act 1979*;
- Kiama, Shellharbour, Campbelltown, Liverpool, Camden, Bankstown, Fairfield, Holroyd, Blacktown, Hawkesbury, Baulkham Hills and Penrith councils as land managers and/or consent and determining authorities, and in the making of Environmental Planning Instruments under the *EP&A Act 1979*; and
- The Rural Fire Service when issuing Bush Fire Hazard Reduction Certificates.

The Minister for Planning is the consent authority for State significant development under Part 3A of the EP&A Act 1979. In this capacity he takes advice from DoP, who in turn seek advice from DEC.

Additional public authorities may have responsibilities if the species is located in other areas in the future.

Any activity not requiring development consent under the *EP&A Act 1979*, and which is likely to affect *P. spicata*, requires a Section 91 licence under the provisions of the *TSC Act 1995* or a Section 132C licence under the *NPW Act 1974*. The type of licence required will depend upon the activity proposed. If the activity is for scientific,

conservation or educational purposes, a Section 132C licence is required. For example, any rehabilitation works, including weed control, in the habitat of *P. spicata* will require a Section 132C licence if no other approvals are required under the *EP&A Act 1979*.

2.5.2 Commonwealth environmental assessment

The *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999)* regulates actions that may result in a significant impact on nationally listed threatened species and ecological communities. It is an offence to undertake any such actions in areas under State or Territory jurisdiction, as well as on Commonwealth-owned areas, without obtaining prior approval from the Commonwealth Minister for the Environment and Heritage. As *P. spicata* is listed nationally under the *EPBC Act 1999*, 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 and Heritage for consideration (in addition to the State consent or determining authority). The Minister will then decide whether the action requires *EPBC Act 1999* approval.

Administrative guidelines are available from the Department of the Environment and Heritage (DEH; previously Environment Australia) 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 1999* approval, but will result in the death or injury to *P. spicata* in a Commonwealth area, a permit issued by the Commonwealth Minister for the Environment and Heritage under the *EPBC Act 1999* will be required.

The Commwealth Minister for the Environment and Heritage can also delegate the role of assessment and approval to other Commonwealth Ministers under a Ministerial Declaration and to the States and Territories under bilateral agreements. The development of a bilateral agreement between NSW and the Commonwealth is not complete at the date of this publication, but when in place will avoid the need for duplication of environmental assessment.

Further information concerning the operation of the *EPBC Act 1999* environmental assessment requirements can be obtained from the Commonwealth DEH.

2.6 Key threatening processes

The *EPBC Act 1999* and the *TSC Act 1995* provide for the identification and listing of key threatening processes. A key threatening process (KTP) is a process that threatens, or has the capability to threaten, the survival or evolutionary development of species, populations or endangered ecological communities.

2.6.1 New South Wales

Six key threatening processes currently listed under the *TSC Act 1995* are likely to, or potentially, threaten *P. spicata*.

- *'Clearing of native vegetation'*, as defined by NSW Scientific Committee (2001), has drastically reduced the habitat of *P. spicata* (Section 8.2.1).
- '*Invasion of native plant communities by exotic perennial grasses'* is also a major threat to the survival of *P. spicata*, with *Pennisetum clandestinum* (Kikuyu) competing with *P. spicata* at the majority of sites (Section 8.2.2).
- '*High frequency fire resulting in the disruption of life cycle process in plants and animals and loss of vegetation structure and composition*', is likely to threaten the viability of *P. spicata* populations (Section 8.2.4).
- '*Invasion of native plant communities by Chrysanthemoides monilifera*' may also threaten the viability of the coastal Illawarra populations. *Chrysanthemoides monilifera* (Bitou Bush) has been recorded at all headland coastal Illawarra populations of *P. spicata* (Section 8.2.2).

Other KTPs that may affect *P. spicata* include: 'Infection of native plants by *Phytopthora cinnamomi*' and '*Anthropogenic climate change*'. In addition to these listed key threatening processes, a range of other processes are generally recognised as threatening the survival of *P. spicata* (Section 8.2).

2.6.2 Commonwealth

Three KTPs currently listed under the *EPBC Act 1999* are likely to, or potentially, threaten *P. spicata*. These KTPs are similar to *TSC Act 1995* listed KTPs and include: dieback caused by the root-rot fungus (*Phytophthora cinnamomi*), land clearance, and loss of climatic habitat caused by anthropogenic emissions of greenhouse gases.

2.7 Critical habitat

The *TSC Act 1995* makes provision for the identification and declaration of critical habitat. Under the *TSC Act 1995*, critical habitat may be identified for any endangered species, population or ecological community occurring on NSW lands. Once declared, it becomes an offence to damage critical habitat (unless the action is exempted under the provisions of the *TSC Act 1995*) and a species impact statement is mandatory for all developments and activities proposed within declared critical

habitat, unless the impact is deemed trivial or negligible by the Director-General of the DEC.

To date, critical habitat has not been declared for *P. spicata* under the *TSC Act 1995*. However, this recovery plan identifies the habitat features and locations (Sections 4, 5 and Appendix 2) that would contain habitat that is critical to the survival of the species, as required by the *EPBC Act 1999*. It is not currently considered a high priority to nominate critical habitat for *P. spicata*, as no demonstrable conservation outcome would accompany its identification and declaration. Action 1.6 of this recovery plan provides a mechanism for reconsidering the need for critical habitat nomination during the third year of implementation of the plan.

3. Taxonomy and description

The genus *Pimelea* belongs to the family Thymelaeaceae. The genus occurs in Australia, Lord Howe Island, New Zealand and Chatham Island. The genus contains 108 species, with 90 of these being endemic to Australia (Rye 1990). The genus is represented in all states of Australia, with 27 species recorded from NSW (Harden 2000). Six *Pimelea* taxa are listed as threatened nationally (*EPBC Act 1999*) and five are listed as threatened in NSW (Schedules 1 and 2 of the NSW *TSC Act 1995*).

Pimelea spicata R. Br (Thymelaeaceae) is described by Harden (2000) as a slender decumbent or erect shrub to 50 cm high with glabrous stems. Leaves narrow-elliptic to elliptic, 5-20 mm long, 2-8 mm wide, acute to obtuse. Flowers in racemes compact when young, elongated and interrupted at maturity; peduncle to 14 mm long at maturity, glabrous; pedicels glabrous. Bracts absent. Involucre often apparently present in the bud owing to the closeness of stem leaves. Flowers bisexual, white often tinged with pink, 7-10 mm long, sepals sparsely hairy. Fruit c. 2.5 mm long, green.

4. Distribution, abundance and land tenure

4.1 Current distribution

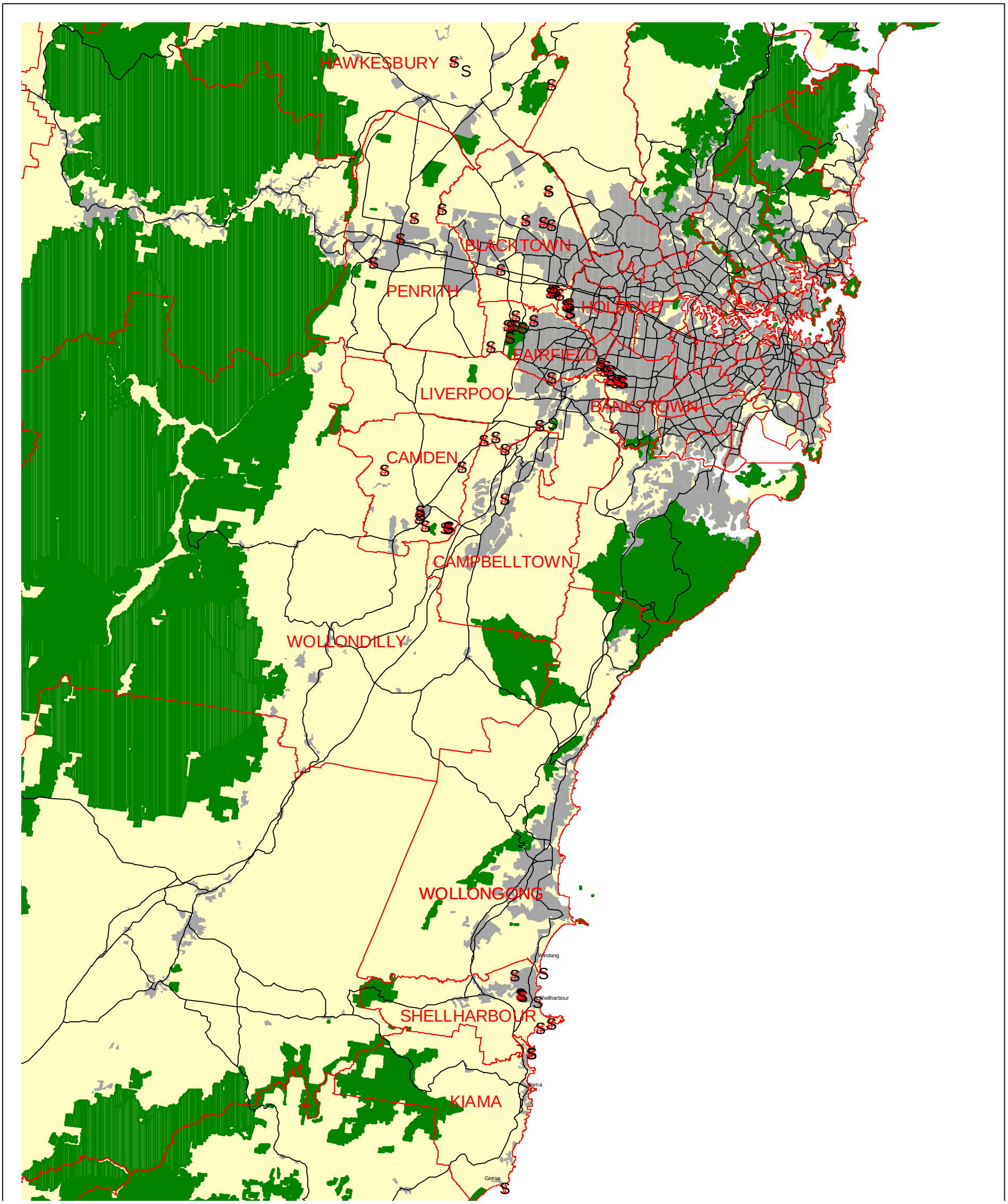
Pimelea spicata has a relatively scattered distribution occurring in two disjunct areas, the Cumberland Plain (western Sydney) and coastal Illawarra, south of Sydney (Figure 1). There are 30 known extant populations[1] of *P. spicata*, including 25 within the Cumberland Plain, and five within the Illawarra coastal region. In addition, the existence (or otherwise) of an additional eight populations in western Sydney and three in the Illawarra requires verification.

Population specific locational information is provided in Appendix 2. Given concerns that the publication of exact location details for populations of *P. spicata* may compromise conservation, a complete Appendix 2 will not to be released to the public (detailed location descriptions and grid refs are excluded). Public authorities, land managers, or others with genuine reasons for requiring the data, may request the entire Appendix 2 by contacting the Biodiversity Conservation Unit (contact details provided on inside front cover). References to site numbers throughout this plan correspond to Appendix 2.

In western Sydney, the species' current known distribution extends from Mount Annan and Narellan Vale in the south to Freemans Reach in the north and from Penrith in the west to Georges Hall in the east. In the Illawarra, the species is associated with coastal headlands and hill tops from Mount Warrigal in the north to Minnamurra and potentially Gerroa in the south.

[1] Populations are recognised in this recovery plan as 'geographically or otherwise distinct groups between which there is little demographic or genetic exchange (typically one successful migrant individual)' (IUCN 2000). Given the absence of information on gene flow in *P. spicata*, populations have been delineated using the 'rule of thumb' provided by Keith et al. (1997) of geographic discontinuity of more than 1 km. Groups of plants not separated by >1 km are referred to as sub-populations.

Figure 1: The known distribution of *Pimelea spicata* within western Sydney and the Illawarra.



The species' current known distribution equates to a linear range of approximately 125km and an extent of occurrence[2] of approximately 930km^2. The species possesses a restricted area of occupancy[3] of less than 17ha.

4.2 Historical distribution

Pimelea spicata is likely to have been relatively abundant across the Cumberland Plain and areas of coastal Illawarra before European settlement, however, clearing and development have destroyed much of its habitat. For example, the endangered ecological community Cumberland Plain Woodland, which provides habitat for *P. spicata* across western Sydney, has been reduced to only 8.5% of its pre-European settlement extent, with a further 13 percent remaining as scattered trees across the landscape (NSW NPWS 2002).

The local extinction of two populations (BA2 and HA2) and two sub-populations (CD1e and HO1b) of *P. spicata* has been recorded (Map 1, Appendix 2). The two populations and one of the sub-populations (CD1e) were lost to residential development and the second sub-population (HO1b) was lost to industrial development. An additional four populations (K1, L2, S2 and S5) may be extinct as a result of habitat degradation and weed invasion. These potentially extinct populations have been surveyed in recent years but no mature plants have been located. It is possible these populations still exist as soil stored seed banks (Section 6.3). In addition, three populations of *P. spicata* have been reduced in size and area due to the construction of a major road in western Sydney (BL2, BL3 and F3).

4.3 Population size and area

The total number of mature *P. spicata* individuals across all 30 known populations is estimated to be as low as 4300. Population size varies from only a few individuals to hundreds of plants, although the majority of populations support a low number of plants (Table 1). More than half of all populations support less than 50 individuals, with only six populations supporting >200 plants and only four populations supporting greater than 500 plants. In addition, the majority of populations occur over a small area, with 80% of all populations occupying an area of less than 0.5ha (Table 2). Only three populations possess an area of occupancy greater than 1ha.

It is difficult to accurately estimate population size and extent of occurrence for *P. spicata* given that the species is cryptic and difficult to detect, particularly when not in flower, and may not be apparent aboveground during drought conditions. In addition, the above ground mature plants may not accurately indicate the actual area, or potential size, of a population given that the number of mature plants is likely to be influenced by disturbance history (Section 6). Long undisturbed sites, or sites that are subject to high levels of weed infestation, may exhibit very few mature plants, but the presence of a large soil stored seed bank may result in considerable recruitment following disturbance. In addition, a soil stored seed bank may exist in areas where mature plants are no longer apparent. For example, Willis *et al.* (2003) found viable *P. spicata* seed beneath infestations of Bridal Creeper and African Olive where no mature *P. spicata* were apparent (Section 6.3). Consequently, estimates of above ground abundance should be viewed with caution and may be a poor indicator of the potential abundance of *P. spicata* at a site.

Table 1: Size class distribution for the 30 known extant populations of *Pimelea spicata*

Size class[#]	Number of populations*	% of total no. of popns
≤ 10	7	23
11 ≤ 50	8	27
51 ≤ 100	4	13
101 ≤ 200	5	17
201 ≤ 500	2	6
≥ 501	4	13

[#]number of mature individuals
*using lowest (pessimistic) estimate of population size

Table 2: Area of occupancy (AOO)* class distribution for the 30 known extant populations of *Pimelea spicata*.

AOO (ha)	Number of populations	% of total no. of popns
≤ 0.01ha	10	33
0.011 ≤ 0.1	6	20
0.11 ≤ 0.5	8	27
0.51 ≤ 1	3	10
≥ 1ha	3	10

*AOO calculated as defined in IUCN 2000.

4.4 Land tenure and zoning

The survival of the species has been largely dependent on the protection of public lands that have not been subject to intensive land use or clearing. Almost 1/3 of all known populations occur on public lands and another 1/3 occur entirely or partly on private property (Table 3). The two definitely locally extinct populations (BA2 and HA2) occurred on private property and the majority of unconfirmed populations or populations of unknown status also occur on private property. The

[2] Extent of occurrence is the 'area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of a taxon…' (as defined by IUCN (2000)).
[3] Area of occupancy is defined as the area within its 'extent of occurrence' which is actually occupied by a taxon (IUCN 2000).

majority of known extant populations occur on community land managed by Local Government (Table 3). Eight different Local Governments manage community land supporting *P. spicata.*

The zoning of areas supporting *P. spicata* is described in Table 4. The majority of populations occur in areas zoned for recreation, with 13 of the extant 30 populations possessing a recreation or open space zoning. Of the remaining populations, the most common zonings include; rural-environmental protection and road reserve.

Pimelea spicata is inadequately represented in conservation reserves. Protected populations occur within a regional parkland managed by DEC (F3: Western Sydney Regional Park); regional parklands managed by the Sydney Catchment Authority (BL1: Prospect Reservoir) and within the Woodland Conservation Area within Mount Annan Botanic Gardens (CD1). In addition, a population occurs within the St Marys ADI site within an area that will become a regional parkland to be managed by DEC (BL5).

Additional site-specific detail is provided in Appendix 2.

Table 3: Tenure and land managers for all known *Pimelea spicata* populations.

Tenure-Land manager*	Extant	Definite extinct	Possible extinct	Unknown[#]
Private	12	2	1	7
Community Land-sub total across all LGAs	11		2	
(Community Land - Bankstown City Council)	(3)			
(Community Land - Shellharbour City Council)	(2)		1	
(Community Land - Kiama City Council)	(1)		1	
(Community Land - Camden Council)	(1)			
(Community Land - Blacktown City Council)	(1)			
(Community Land - Fairfield City Council)	(1)			
(Community Land - Holroyd City Council)	(1)			
(Community Land - Penrith City Council)	(1)			
Road Verge- sub total across all land managers	4			
(Road Verge - RTA)	(3)			
(Road Verge - Campbelltown City Council)	(1)			
Crown Land- Sub total across all land managers	2			
(Crown Land - Killalea State Park Trust)	(2)			
(Crown Land - Lake Illawarra Authority)	(1)			
Western Sydney Regional Park - (DEC)	1			
Commonwealth – Camden Golf Club	1			
Mount Annan Botanic Garden	1			
Sydney Catchment Authority	1			

*Where a population occupies two different tenures it has been recorded as two separate populations.
[#]Existence unconfirmed or current status unknown.

Table 4. Land-use zoning for all known *Pimelea spicata* populations.

Zoning*	Extant	Definite extinct	Possible extinct	Unknown[#]
Recreation/Public open space	13		3	
Rural - Environmental protection	4			
Road reserve/utility	3			1
Residential	3	2	1	1
Rural	2			2
Environmental protection - public lands	2			
Industrial	2			1
Regional Parklands - DEC estate	1			
Regional parklands - Sydney Catchment Authority	1			
Regional Parklands - other tenure				1
Special Uses: Botanic Garden	1			
Cemetery	1			
Unknown (uncertain locational information)				2

*Where a population occupies two different land-use zonings it has been recorded as two separate populations.
[#]Specific location and existence unconfirmed or current status unknown.

5. Habitat

5.1 Landform, geology and soils

In western Sydney, *P. spicata* occurs on an undulating topography of well structured clay soils, derived from Wianamatta shale.

In the Illawarra region, *P. spicata* occurs generally in close proximity to the coast on hills or coastal headlands. Geology and soil type is more variable than for the western Sydney populations, with *P. spicata* occurring on a range of soil types derived from the Permian Shoalhaven group, including; siltstone, sandstone and latite.

5.2 Associated vegetation

5.2.1 Cumberland Plain populations

In western Sydney, *P. spicata* is restricted to areas supporting, or that previously supported, the Cumberland Plain Woodland (CPW) vegetation community. This community is listed as an endangered ecological community under both the NSW *TSC Act 1995* and the Commonwealth *EPBC Act 1999*. Vegetation mapping of the Cumberland Plain (NSW National Parks and Wildlife Service 2002) identifies two forms of CPW, Shale Hills Woodland and Shale Plains Woodland. *Pimelea spicata* has been recorded from both Shale Hills and Shale Plains Woodland. *Pimelea spicata* has also been recorded from highly degraded areas that no longer support native vegetation, but that would have supported CPW previously (e.g. a mown cemetery dominated by exotic grasses).

Shale Hills Woodland occurs mainly on the elevated and sloping southern half of the Cumberland Plain. The dominant canopy trees include Grey Box (*Eucalyptus moluccana*), Forest Red Gum (*E. tereticornis*) and Narrow-leaved Ironbark (*E. crebra*). It has a shrub layer dominated by Blackthorn (*Bursaria spinosa*), with other shrubs, such as *Acacia implexa*, *Indigofera australis* and *Dodonaea viscosa ssp cuneata*.

Shale Plains Woodland is the most widely distributed form of CPW. *Bursaria spinosa* is the dominant shrub species and canopy trees include *E. moluccana*, *E. tereticornis*, Spotted Gum (*Corymbia maculata*) and Thin-leaved Stringybark (*E. eugenioides*).

The diverse understorey layer is similar for both forms of CPW. It is common to find grasses, such as Kangaroo Grass (*Themeda australis*), Weeping Meadow Grass (*Microlaena stipoides var stipoides*) and herbs, such as Kidney Weed (*Dichondra repens*), Blue Trumpet (*Brunoniella australis*) and *Desmodium varians*.

Additional information on the vegetation of the Cumberland Plain can be found in NSW National Parks and Wildlife Service (2002).

5.2.2 Illawarra populations

In the Illawarra region, *P. spicata* is found in similar woodland habitat (to the Cumberland Plain) and also in coastal grassland communities with emergent shrubs. Dominant species within the woodland habitat include *Eucalypyus tereticornis*, *E. eugenioides*, *Themeda australis* and *Lomandra longifolia.* Associated species in the coastal grasslands include *Themeda australis, Lomandra longifolia, Imperata cylindrica, Acacia sophorae*, *Banksia integrifolia* and *Westringia fruiticosa.*

6. Biology and ecology

6.1 Habit, growth rate and longevity

Pimelea spicata is a small slender decumbent or erect shrub that possesses an underground tap-root. The carrot-like tap-root has been recorded to be up to 24mm in diameter and 18cm in length (Nash and Matthes 1995). This underground tap-root confers on *P. spicata* an ability to re-sprout after defoliation caused by fire, drought, mechanical damage (such as mowing or slashing), or herbicide application (NSW National Parks and Wildlife Service 1997; Matarczyk *et al*. 2002). For example, *P. spicata* can survive periods of drought stress by dying back to the tap-root and re-sprouting from its base when favourable conditions return (NSW National Parks and Wildlife Service 1997). It is not known what proportion of plants typically survive such disturbance events, nor it is known at what age the tap-root is of sufficient size to facilitate re-sprouting. NSW National Parks and Wildlife Service (1997) estimate it is greater than three years and Matarczyk *et al*. (2002) found plants less than six moths old were not capable of re-sprouting. *Pimelea spicata*'s ability to recover following disturbance is discussed in more detail in Section 6.6.

Plants vary in size from one or two stems to up to 50 stems (S. Nash and M. Matthes unpubl. data). Disturbance appears to stimulate the production of stems, with older plants that have not been subject to recent disturbance having significantlyfewer stems (Nash and Matthes 1995). Plants have an increasingly sprawling habit with maturity. With increasing maturity the stems lose most of the leaves along their length and retain leaves and flowers only at the tips. Older stems are many branched and intertwine with the surrounding

grasses and herbs (NSW National Parks and Wildlife Service 1993).

Pimelea spicata has been noted to grow actively during winter (P. Hogbin pers. obs.) and can exhibit rapid growth when conditions are favourable. When conditions are favourable, *P. spicata* can flower, fruit and produce seed from re-sprouting stems within two months of a fire (NSW National Parks and Wildlife Service 1997). Re-sprouting after fire may take longer when conditions are not so favourable. For example, an ecological burn implemented at Mt Annan Botanic Gardens in September of 2003 was followed by drought conditions. *Pimelea spicata* did not re-sprout until the following April (7 months after the fire) (D. Benson and J. Howell pers. comm.). Plants have been observed to set seed 1.5-2 years after germination (NSW National Parks and Wildlife Service 1997).

The ability to re-sprout enables plants to persist in harsh conditions and therefore individual plants are likely to be long-lived. Some adult plants tagged ten years ago in 1993/4 with permanent metal tags (Section 7.4) are still alive in 2004. Matarczyk (1999) suggests, based on the size of several root stocks observed in the field, that the life span of an individual plant could be as long as 20 to 30 years or more.

6.2 Flowering, pollination, and seed production

Pimelea spicata is not capable of vegetative spread (Benson and McDougall 2001) and hence is dependent upon seed production for recruitment of new individuals. *Pimelea spicata* flowers sporadically throughout the year, with flowering likely to depend upon climatic conditions, particularly rainfall. Flowering times recorded for *P. spicata* vary. Rye (1990) noted flowering period as May - Jan; Benson and McDougall (2001) noted peak flowering period as March – April; and P. Hogbin (pers. obs) noted abundant flowering in Winter and Spring (June-September) of 2003 after the break of a drought. It is likely that *P. spicata* flowers opportunistically and hence peak flowering time may vary from year to year.

Flowers occur in a raceme of umbels, which continue to produce flowers as the fruit matures. Native bees have been observed visiting flowers (P. Hogbin pers. obs), and T. Willis (pers. com) suggests moths may contribute to pollination. The mating system of *P. spicata* is uncertain; however, the species may be capable of self-pollination. T. Willis (pers. com.) observed seed set in glass-house plants more than likely isolated from pollinator activity and flower morphology suggests self-pollination could occur.

Fruit production is extremely variable within and between populations, and also between years, and is probably associated with environmental conditions such as rainfall and disturbance history (NSW National Parks and Wildlife Service 1997). Seed viability has been recorded as relatively high, with viability ranging from 83% (Willis *et al.* 2003) to 86% (Nash and Matthes 1995). A small proportion of seeds sampled in 1994 exhibited insect predation (<5%). Although exit holes were observed, no predator was seen (NSW National Parks and Wildlife Service 1997).

6.3 Seed dispersal and seed bank dynamics

The mechanism of seed dispersal, if any, are unknown. The species has no obvious adaptations to aid seed dispersal (Willis *et al.* 2003) and observations of seedling emergence following fire suggest seed dispersal is likely to be very low, with the majority of seedlings being within 30cm of adult plants (P. Hogbin pers. obs).

Pimelea spicata is capable of maintaining a soil stored seed bank. Willis *et al.* (2003) investigated the existence and extent of a soil stored seed bank at two locations in western Sydney and two in the Illawarra. They sampled a total of 148 10 x 10cm plots within the habitat of *P. spicata* and found *P. spicata* germinants in 48% of samples. They found no significant difference in the number of germinable seed from the upper 2.5cm vs 2.5-5cm depth of soil. Willis *et al.* (2003) also found that 'the *P. spicata* seed bank appears to be about as extensive beneath infestations of Bridal Creeper and African Olive as it is in relatively weed free areas. As *P. spicata* has no obvious adaptations to aid seed dispersal, this result may suggest that extant individuals have been displaced from invaded habitats, leaving only the soil seed bank as evidence of their previous occurrence.' This information suggests that not only is the species capable of maintaining a long-lived persistent soil seed bank, but also that there may be populations in existence that are represented only by a soil stored seed bank.

Germination from the soil stored seed bank has been observed following fire, slashing/mowing, grazing and soil disturbance (NSW National Parks and Wildlife Service 1997; Willis *et al.* 2003; P. Hogbin pers. obs). Occasional seedlings have also been observed in areas that had not experienced recent disturbance (NSW National Parks and Wildlife Service 1997). It appears seedling emergence is not a rare event. Of 10 populations monitored in 1997, seven populations had seedlings present (NSW National Parks and Wildlife Service 1997). Monitoring of seedlings following a fire

revealed 80% survival in the first year after fire (NSW National Parks and Wildlife Service 1997).

E*x-situ* germination trials have found that smoke application (via both smoke water and aerial smoke) significantly increases seed germination (Tozer and Robertson 1998; Willis *et al.* 2003). However, Willis *et al.* (2003) found that despite any promotive treatments, the proportion of seeds germinating in any trial was consistently low (20-30% under optimal conditions).

6.4 Disturbance ecology

The frequency of disturbance is of particular importance for the management and conservation of *P. spicata*. It is likely that too frequent disturbance, and also a long-term absence of disturbance, may be detrimental to the persistence of *P. spicata*.

As outlined in section 6.1, adult *P. spicata* are capable of re-sprouting following defoliation. It is expected that some mortality of adult individuals occurs after disturbances such as fire; however, the extent of individuals lost in any one disturbance event is unknown. Additionally, as outlined in Section 6.3, seed germination is promoted by disturbance events such as fire, slashing/mowing, grazing and soil disturbance.

It can be reasonably assumed that frequent disturbances (as a consequence of grazing, slashing, fire or other activities that destroy the above ground parts of the plant and prevent seed production) may lead to local extinctions of the species in the long term. Repeated disturbance events in close succession are likely to exhaust resources stored within the tap-root and decrease a plant's ability to re-sprout following subsequent disturbance (Nash and Matthes 1995; NSW National Parks and Wildlife Service 1997; Matarczyk *et al*. 2002). Matarczyk *et al* (2002) observed a significant reduction in tap root size for individuals re-sprouting after disturbance (in this case herbicide application). It is likely that re-allocation of resources stored in the tap root enabled re-sprouting. High frequency disturbance is also going to decrease the rate of recruitment if disturbance occurs at intervals too small to enable seedlings to mature to a stage where they are capable of producing seed and/or capable of resprouting. Seed production has been observed in plants 1.5-2 years after germination (NSW National Parks and Wildlife Service 1997). It is not known at what age the tap-root is of sufficient size to facilitate re-sprouting. NSW National Parks and Wildlife Service (1997) estimate it is greater than three years and Matarczyk *et al*. (2002) found plants less than six moths old were not capable of re-sprouting.

A long-term absence of disturbance may also be detrimental to population persistence given that growth, flowering, seed production, seed germination, and seedling survival all appear to be enhanced by disturbance events or canopy gaps (NSW National Parks and Wildlife Service 1997; Matarczyk 1999). Disturbance appears to stimulate the production of flowers and fruits due to the increased production of stems following disturbance (Matthes *et al.* 1996; NSW National Parks and Wildlife Service 1997). Disturbance that creates canopy gaps is required to maximise potential for recruitment. Matarczyk (1999) found that increased shading increased mortality and decreased seedling root growth in *P. spicata*.

The critical fire or physical disturbance frequencies for survival have not yet been determined. In the absence of this information, a precautionary approach should be taken and disturbance should not be actively implemented at less than 10 year intervals.

7. Previous recovery actions

7.1 Preparation and implementation of a draft recovery plan

A Conservation Research Statement and National Recovery Plan was prepared by the NSW National Parks and Wildlife Service in 1993 (NSW National Parks and Wildlife Service 1993) prior to the commencement of the *TSC Act 1995*. The implementation of the draft plan was funded by DEH from 1993 until 1997. Works carried out during the implementation of the draft recovery plan included: liaison with landholders/managers, research into the seed germination ecology of *P. spicata*, survey and monitoring (Nash and Matthes 1995; NSW National Parks and Wildlife Service 1997; Tozer and Robertson 1998).

7.2 Profile and environmental impact assessment guidelines

A species profile and environmental impact assessment guidelines were prepared for *P. spicata* in May 2002 and revised in December 2003 (Appendix 3). The aim of these documents is to assist the assessment of potential impacts on the species during the preparation and review of assessments under Parts 4 and 5 of the *EP&A Act 1979* and Part 6 of the *TSC Act 1995*.

7.3 In-situ protection

A conservation agreement under the *Endangered Species Protection Act 1992* (*ESP Act 1992*) was signed in March 1994 for two parcels of Commonwealth land at Camden Golf Course in

Narellan. The agreement is between the Commonwealth Government and Camden Golf Club Limited (lessee of land) and is still valid despite the *ESP Act 1992* being superseded by the *EPBC Act 1999*. The conservation agreement provides for the conservation and management of *P. spicata* and its habitat to ensure the species long term survival at the site. The population at this location (CD3) is of particular significance as it is one of the largest known populations of *P. spicata.* A fence was erected around the boundary of the conservation areas in 1995 and public meetings were held with nearby residents in 1996 and 1997 to discuss the implications of the agreement. A plan of management (POM) was prepared for the site in 1997 by the NSW NPWS for DEH (Tozer and Robertson 1997). The POM proposed actions for 1998–2001 and outlined active management of the site in the form of weed control, fire management and management of site usage. The POM was not funded or implemented.

Threat abatement works including fencing and other forms of protection, bush regeneration, and rubbish removal, have been implemented at several *P. spicata* sites with the assistance of land managers and volunteer groups. For example, sites that appear to be currently managed appropriately for the conservation of *P. spicata* include CD1 within the Woodland Conservation Area at Mount Annan Botanic Garden and BL1 at Prospect Reservoir. Mount Annan Botanic Garden is undertaking weed control activities within the habitat of *P. spicata* and has undertaken ecological burns. Although the Prospect Reservoir population hasn't been specifically managed to conserve *P. spicata*, the site is fenced to exclude public access and weed invasion does not currently appear to be a major threat to this population.

7.4 Survey and monitoring

The majority of known *P. spicata* populations (at that time) were surveyed in 1992-93 (NSW National Parks and Wildlife Service 1993). For each site, population size and area was estimated and potential threats were noted. In addition, many of the known sites were surveyed in 2003 when preparing this recovery plan.

In 1993-1995, six western Sydney populations and three Illawarra populations were monitored for survival, and flower, fruit and seed production. Up to 50 plants within each of the nine populations monitored were permanently tagged with fire-proof tags. The current status of these permanent tags has not been assessed; however, numerous tags have been relocated at two of the nine sites.

Seedling survival for *P. spicata* is currently being monitored at Mount Annan Botanic Garden following an experimental burn implemented in September 2002.

7.5 Research

7.5.1 Ecological

As part of the implementation of the 1993 Conservation Research Statement and Recovery Plan (NSW National Parks and Wildlife Service 1993), research was conducted into the ecology of *P. spicata* (NSW National Parks and Wildlife Service 1997; Tozer and Robertson 1998). Particular aspects investigated included seed viability and germinability and seed dormancy mechanisms.

In addition, the Co-operative Research Centre (CRC) for Weed Management Systems undertook investigations into the reproductive ecology *of P. spicata* while investigating the impact of environmental weeds on *P. spicata* (Matarczyk 1999; Matarczyk *et al.* 2002; Willis *et al.* 2003) (see Section 7.5.2).

7.5.2 Impact of weeds and integrated weed control

The CRC for Weed Management Systems, based at CSIRO Plant Industry Canberra, has conducted research into the impact of environmental weeds on *P. spicata* and investigated integrated weed control measures for *P. spicata* habitat (Matarczyk 1999; Matarczyk *et al.* 2002; Willis *et al.* 2003).

In particular, Julie Matarczyk and others (Matarczyk 1999; Matarczyk *et al.* 2002) investigated the impact of competition with environmental weeds on the growth and survival of *P. spicata* and also investigated the impact of the herbicide glyphosate on *P. spicata.* Tony Willis and others (Willis *et al.* 2003) investigated the impact of Bridal Creeper on *P. spicata.*

7.5.3 Potential habitat mapping

Kearnes and Simpson (1999) mapped potential habitat for *Pimelea spicata* in the Georges River catchment, western Sydney.

7.6 Amelioration for road construction

The construction of the M7 motorway in western Sydney resulted in a loss of *P. spicata* individuals and habitat at three of the 30 known extant populations (listed in Appendix 2 as BL2, BL3 and F3 (a&b) (see Section 8.2.7). As part of the approval for road construction, the RTA is required to implement a range of amelioration measures, as outlined in Sinclair Knight Merz 2000), including;

- preparation of long term management plans for remaining vegetation including *P. spicata*;

- funding of the on-going management of the remaining *P. spicata* plants; and
- provision of funding towards research on *P. spicata.*

7.7 Ex-situ collection

Mount Annan Botanic Garden is currently creating and maintaining an *ex-situ* seed collection for *P. spicata* as part of the Millenium Seed Bank Project (Richard Johnstone, pers. comm).

8. Management issues

8.1 Introduction

The management and conservation of *Pimelea spicata* requires the development of a recovery program which considers: (i) the factors that threaten the survival of *P. spicata*; (ii) limits to current knowledge; (iii) the social, political and organisational parameters that may affect the success or otherwise of the program; and (iv) the economic factors which may influence the plan's implementation. As such, this section discusses these management issues.

8.2 Threatening processes

The main threats to the survival of *P. spicata* are habitat loss due to clearing for development and habitat degradation, particularly from weed invasion. Other threats include: roadside and parkland maintenance activities (mowing, slashing and spraying of herbicide), inappropriate fire regimes, dumping of rubbish and garden waste, and grazing and associated trampling.

8.2.1 Habitat loss due to clearing for development

The key threatening process *'Clearing of native vegetation'* is one of the major threats to the survival of *P. spicata* (Section 2.6.1). Clearing of the Cumberland Plain and coastal Illawarra has occurred over many years and continues to occur for rural, residential and industrial development (Section 4.2). At least two populations and an additional two sub-populations are known to have become locally extinct following clearing of native vegetation for residential and industrial development.

Given that very few *P. spicata* populations occur on land zoned for conservation, and that at least 11 populations occur on private property, habitat loss is likely to continue for *P. spicata*. Particularly concerning is the potential loss of currently unknown populations. *Pimelea spicata* is cryptic and difficult to detect, particularly when not in flower, and may not be apparent aboveground during drought conditions. The species could therefore potentially be missed during flora surveys conducted as part of the development assessment process. For example, part of a known population of *P.spicata* was lost to industrial development because it was not detected during flora surveys. It is important that all consent and determining authorities are aware of the need for targeted survey for *Pimelea spicata* when assessing the impact of a development in potential habitat for *Pimelea spicata*.

8.2.2 Weed invasion

One of the main consequences of habitat loss and urbanisation is weed invasion. The viability of remnant populations of *P. spicata* is threatened by competition from a variety of environmental weeds (Table 5). Different sites are affected by different species and the degree of weed invasion varies among sites.

The key threatening process, '*Invasion of native plant communities by exotic perennial grasses'* (Section 2.6.1) is a particular threat to the survival of *P. spicata*, with *Pennisetum clandestinum* competing with *P. spicata* at the majority of sites.

Table 5: The major environmental weeds invading the habitat of *Pimelea spicata.*

Scientific Name	Common name
Weeds of National Significance:	
Asparagus asparagoides	Bridal Creeper
Chrysanthemoides monilifera ssp. *rotundata*	Bitou Bush
Lantana camara	Lantana
Rubus fruticosus	Blackberry
Other:	
Pennisetum clandestinum	Kikuyu
Olea africana ssp. africana	African Olive
Ligustrum lucidum	Broad-leaved Privet
Lycium ferocissimum	African Boxthorn
Eragrostis curvula	African Lovegrass
Freesia sp.	Freesias

Given the herb-like habit of *Pimelea spicata* it is particularly susceptible to displacement by environmental weeds, particularly those that can form a dense ground-cover, such as *Asparagus asparagoides*, *Pennisetum clandestinum*, *Eragrostis curvula* and *Freesia* sp. It is likely that adults can persist for some time when competing with weeds due to the presence of an underground storage organ (Section 6.1). However, weed invasion is likely to reduce the reproductive capacity of adult plants; reduce the ability of adult plants to resprout following disturbance; and inhibit seedling recruitment (T. Willis pers. com; NSW National Parks and Wildlife Service 1997; Matarczyk 1999), leading to eventual local extinction. Kikuyu is of most concern and is likely to cause the local extinction of *P. spicata* at a number of sites if it is not controlled (Matarczyk 1999). Unfortunately, very little is known about

how to control non-woody weeds without impacting upon *P. spicata*.

It is important land managers are aware that weed control measures have the potential to impact negatively on *P. spicata* if not implemented with caution. Given that *P. spicata* is cryptic it may inadvertently be destroyed or damaged during mechanical weed control. Caution should also be applied when using herbicides to control environmental weeds within or near the habitat of *P. spicata*. Matarczyk *et al.* (2002) found that *P. spicata* has a low tolerance to the herbicide glyphosate. A single application of glyphosate was found to cause the death of all seedlings and young plants <6 months old. Older plants with a well-developed tap root died back, with only 43% re-sprouting. Those adults that re-sprouted exhibited a significant decrease in tap root diameter, implying that further disturbance, including repeated treatment with glyphosate, would kill plants by impairing their potential for recovery. Wind-drift of herbicide to *P. spicata* populations during weed control programs is likely to kill adult plants that have been recently disturbed (e.g. by previous herbicide spraying or fire), since re-sprouting associated with the disturbance will have depleted storage reserves and limited their capacity to tolerate the herbicide (Matarczyk *et al.* 2002). Wind-drifted herbicide will also remove from the population young, newly recruited individuals lacking a well developed tap root. (Matarczyk *et al.* 2002).

Weed control will require targeted bush regeneration efforts. Given the diverse range of weeds impacting upon *P. spicata*, weed control methods will need to be determined on a site-by-site basis and will need to be implemented in an experimental manner to gain further insight into the control of environmental weeds in *P. spicata* habitat. Fire deserves investigation as a potential tool to control weeds within the habitat of *P. spicata* (Matarczyk 1999; Willis *et al.* 2003). Matarczyk (1999) also suggests research into the effects of monocot-specific herbicides for the control of Kikuyu.

8.2.3 Mowing and slashing

Slashing and mowing are common practice at many of the locations supporting *P. spicata*, particularly within the council reserves and road verges. Given the species ability to resprout (Section 6.1), *P. spicata* will tolerate infrequent mowing, but will not be able to tolerate repeated mowing (see Section 6.4). Repeated mowing will not only cause the death of adult plants, but may decrease seed production and will decrease recruitment through the death of young plants that do not possess a well developed tap-root.

Mowing has ceased within the immediate habitat of *P. spicata* within many council managed reserves. It is important that mowing remains excluded from these areas and all staff responsible for mowing areas adjacent to *P. spicata* habitat are made aware of the occurrence of the species. It is important that mowing ceases, or is managed, within those areas supporting *P. spicata* that are still subject to mowing.

8.2.4 Inappropriate fire regimes

As outlined in Section 6.4, *P. spicata* is threatened by both frequent and infrequent fire. Due to its urban setting, arson is a major problem in the bushland remnants of western Sydney, increasing the frequency of fire. In addition, many of the smaller remnants have been excluded from fire for long periods.

The critical fire frequencies for survival have not yet been determined. The *Threatened species Hazard Reduction List* for the *Bush Fire Environmental Assessment Code* states that fire should not occur more than once every five years in the habitat of *P. spicata*. However, given that the critical fire frequencies for survival have not yet been determined this plan advocates a precautionary approach and suggests fire frequencies of less than 10 years should be avoided within the habitat of *P. spicata*.

Pimelea spicata is listed on the *Draft Threatened Species Hazard Reduction List* (TSHRL) and consequently, if a particular site is identified as supporting *P. spicata* in the TSHRL, or a certifying authority determines the species is likely to be present at a site, then the management actions identified within the schedule of that list must be incorporated as a condition of the bush fire hazard reduction certificate. Management actions identified in the TSHRL include: no fire more than once every five years; and no slashing, trittering or tree removal. For these procedures to protect *P. spicata* from frequent fire it is vital that the NSW Wildlife Atlas (source of TSHRL records) contains records for all 'known' *P. spicata* sites.

8.2.5 Intensive grazing

As for slashing and mowing, *P. spicata* will tolerate low levels of infrequent grazing, but will not be able to tolerate intense and continuous grazing. Stock can also contribute to the spread of weed seeds.

Given that six known sites are zoned for rural activities, grazing can, and does, occur within the habitat of *Pimelea spicata*. It is important that land managers are made aware of the presence of *P. spicata*; the potential impact of intense grazing; and are provided with advice on how to conserve *P. spicata*.

8.2.6 Dumping of rubbish and garden waste

Dumping of rubbish and garden waste also threatens the survival of *P. spicata.* Rubbish and garden clippings have on occasion been dumped directly on top of *P. spicata* plants. In particular, a population of *Pimelea spicata* within Kangara Reserve in Penrith LGA is threatened with extinction by the dumping of grass clippings at the base of trees.

The impact of dumping could be minimised through community education and regular removal of rubbish and garden waste from *P. spicata* habitat.

8.2.7 Direct and indirect impacts of road construction

The construction of the M7 motorway in western Sydney, which commenced in 2003, resulted in a loss of *P. spicata* individuals and habitat for three populations (BL2, BL3 and F3). All three populations are still extant, but are now located directly adjacent to a 4-6 lane motorway. The long-term impact of the loss of individuals is unknown, as is the extent of indirect impacts.

It is vital that the survival and condition of these three populations is monitored and that all measures are taken to ensure the long-term survival of these populations. As outlined in Section 7.6, the RTA is required to implement a range of ameliorative measures at each of these sites.

8.3 Limits to current knowledge

Our ability to manage a threatened species is dependent on our knowledge of the ecological requirements of that species and the circumstances that threaten population persistence. As outlined in Section 6, we currently have a general understanding of the reproductive biology and population ecology of *P. spicata*. However, greater understanding of a number of aspects will assist in the effective management of *P. spicata*, particularly if we are to conserve the species in the long-term. In addition, increased understanding will assist the decision making of consent and determining authorities. High priority questions; the potential means of investigating these questions; and the benefits of such investigations are identified in Table 6.

8.4 Translocation/Ex-situ conservation

8.4.1 Translocation

Translocation, defined as the deliberate transfer of plants or regenerative plant material, from an *ex-situ* collection or natural population, to a location in the wild, including existing or new sites or those where the taxon is now locally extinct (Vallee *et al.* 2004), is often raised as a possible method of conserving threatened flora. However, given the high cost and risk associated with the technique, translocation should only be considered as a last resort when all other management options are deemed inappropriate or have failed. As stated by Vallee *et al.* (2004), 'where possible, resources will be more effective when directed towards conserving existing populations *in-situ* through habitat protection and/or habitat rehabilitation measures and through the control of threatening processes'.

Translocation is not currently considered necessary for the survival of *P. spicata* as the *in-situ* conservation measures proposed in this recovery plan are expected to meet the conservation needs of the species. Further, primarily due to the uncertainty of success and the risks associated with translocation, the technique should not be considered by consent/determining authorities to be an appropriate means of ameliorating the impact of a proposal on the species (Vallee *et al.* 2004). In addition, the use of translocation as an ameliorative measure should not be considered when determining the potential impact of a development (i.e. translocation does not decrease the significance of an impact) (Vallee *et al.* 2004).

8.4.2 Ex-situ collection

As outlined in Section 7.7, Mount Annan Botanic Garden is currently creating and maintaining an *ex-situ* seed collection for *P. spicata.* There are no plans to expand the *ex-situ* collection beyond that planned by Mount Annan.

8.5 Ability to recover

'Recovery' in the context of this plan, is to ensure the continued and long-term survival of *P. spicata* in the wild. The likelihood of recovery of *P. spicata* in this context is high provided the recovery actions outlined in this recovery plan are implemented, monitored and amended as required.

Table 6. Limits to current knowledge. Research questions that will assist in the effective conservation of *Pimelea spicata*. The justification for the research and the methodology that may be used to address each question is broadly identified, as are the potential benefits of the increased knowledge.

Question	Justification	Potential methodology	Benefits of increased knowledge
6.1 How viable are small and geographically isolated populations of *Pimelea spicata*?	23% of known populations support <10 mature individuals and 50% of all populations support <50 mature individuals (Section 4.3).	Investigate mating system and ability to self-pollinate. Investigate the level of gene-flow within and among populations to gain insight into effective population size. Investigate soil-stored seed bank dynamics. What proportion of the population is apparent at any one time?	Land managers would have greater information to enable determination of whether to actively manage small populations to increase population size. Consent and determining authorities would have greater information to enable them to effectively determine the impact of a proposed development on the species.
6.2 How can weeds be controlled in the habitat of *P. spicata* without adversely impacting *P. spicata*?	Weed invasion is one of the major threats to *P. spicata* and control methods can potentially impact the survival and recruitment of *P. spicata* (Section 8.2.2).	Experimental investigation of weed control methodologies. Investigate in particular the use of fire and monocot-specific herbicides (Section 8.2.2)	Land managers would know how to effectively control weeds in the habitat of *P. spicata* without adversely impacting *P. spicata.* Potential prevention of local extinction at a number of sites.
6.3 How frequently should fire or physical disturbance (e.g. mowing) occur in the habitat of *P. spicata*?	*P. spicata* is potentially threatened by both frequent and infrequent disturbance (Sections 6.4 , 8.2.3, 8.2.4 and 8.2.5).	Experimental investigation of the impact of disturbance frequency on the survival, reproduction and recruitment of *P. spicata.*	Land managers would know when to exclude and when to implement fire or physical disturbance.
6.4 How is the total genetic diversity of *P. spicata* distributed within and among populations? How much genetic diversity would be lost with the loss of any one population?	Conserving genetic diversity is an important criterion for ensuring the long-term survival of a species. Twelve of the 30 known extant populations occur on private property. All of these populations are likely to be subject to development pressures in the near future (at least three populations are currently subject to Development Applications).	Evaluation of the distribution of genetic diversity within and among all known extant populations.	Consent and determining authorities would have greater information to enable them to effectively determine the impact of a proposed development on the species.

8.6 Social and economic consequences

8.6.1 Social consequences

Negative social impacts are not envisaged as the implementation of this recovery plan is not expected to affect public land usage to any great extent, and modification of private land management patterns will occur at the land managers discretion. Continued liaison with the local community, affected landholders and government agencies will address and minimise any unforeseen negative social impacts arising from the conservation of *P. spicata.*

It is expected that the implementation of this recovery plan will have positive social impacts on the local communities and in particular the owners and managers of *P. spicata* habitat. The implementation of recovery actions (including bush regeneration, fencing, site monitoring and surveys) will provide benefits to the environment and/or enhance the general well being of the community and individuals involved.

Increased awareness regarding the conservation of threatened species in an urban setting will help to bring about changes in social behaviour. These changes relate to the recognition of the value of remnant vegetation and responsibility for habitat management. Personal and regular contact with landholders and community groups is a key

strategy in encouraging awareness and involvement in the recovery effort.

8.6.2 Economic consequences

The economic consequences of this recovery plan are those costs that are associated with its implementation. These include on-ground habitat management, conducting survey and monitoring, community education and participation, and on-going recovery program coordination. These costs can be off-set and minimised by:

- implementing a long-term strategic framework for managing the species and its habitat;
- seeking funds from external sources;
- maintaining accurate information on the distribution and status of sites; and
- adopting a cooperative approach to management, involving the relevant land managers and the community.

The improved environmental impact assessment that will result from mechanisms established in this recovery plan will assist consent and determining authorities to meet their statutory responsibilities. The production of this recovery plan will decrease the costs associated with collating available information on *P. spicata* when undertaking impact assessment.

8.7 Roles/Interests of Indigenous People

The *TSC Act 1995* requires that, when preparing a recovery plan, 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. In addition, the *EPBC Act 1999* requires that in the preparation of a recovery plan, regard must be had to the role and interests of indigenous people in the conservation of Australia's biodiversity.

There are four Local Aboriginal Land Councils in the area affected by this recovery plan, including Tharawal, Deerubbin, Gandangarra, and Illawarra. These groups were provided with a copy of this draft plan and given the opportunity to comment prior to exhibition. DEC is not aware of any specific indigenous interest in, or use of, *P. spicata* and indigenous communities with an interest in the actions proposed in this recovery plan have not yet been identified. Implementation of recovery actions under the plan will include consideration of the roles and interests of indigenous communities in the region.

8.8 Biodiversity benefits

The conservation and study of *Pimelea spicata* will benefit other threatened species that share the same habitat, particularly the Cumberland Plain Land Snail (*Meridolum corneovirens*). It will also help to conserve areas of the endangered ecological community Cumberland Plain Woodland.

The raised awareness of *P. spicata* created during the implementation of this recovery plan will raise the profile of all threatened species amongst the general community. This in turn will lead to greater opportunities for the conservation of threatened species and increased protection of biodiversity.

8.9 International obligations

In making a Commonwealth recovery plan, regard must be had to meeting Australia's obligations under relevant international agreements, which include;

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Convention on Biological Diversity, ratified by Australia in 1993
- The Global Strategy for Plant Conservation.

Pimelea spicata is not listed in the CITES Schedules. The actions proposed within this plan are consistent with Australia's obligations under these international agreements.

9. Proposed recovery objectives, actions and performance criteria

Overall recovery objective

The overall objective of this recovery plan is to ensure the continued and long-term survival of *P. spicata* in the wild by promoting the *in-situ* conservation of the species across its natural range.

This plan consists of six specific recovery objectives that will each contribute to the overall objectives:

- conserve *P. spicata* using land-use and conservation planning mechanisms;
- identify and minimise the operation of threats at sites where *P. spicata* occurs;
- implement a survey and monitoring program that will provide information on the extent and viability of *P. spicata*;
- provide the community with information that assists in conserving the species;
- raise awareness of the species and involve the community in the recovery program; and
- promote research questions that will assist future management decisions.

Specific recovery actions and performance criteria follow.

Specific Objective 1: To conserve P. spicata using land-use and conservation planning mechanisms

Very few populations of *P. spicata* occur on lands managed primarily for conservation purposes. This objective aims to increase the legislative protection afforded populations.

Action 1.1: *The Department of Environment and Conservation will advise landholders of the opportunities and advantages of entering into conservation agreements and covenants.*

The DEC will notify landholders of the presence of *P. spicata* on their land and will inform them of the opportunities and advantages of entering into conservation agreements/covenants. Opportunities for such agreements include Voluntary Conservation Agreements (VCAs) under the *NP&W Act 1974*, Joint Management Agreements and Property Management Plans under the *TSC Act 1995*, and appropriately worded covenants under the *Conveyancing Act 1919*.

Performance Criterion 1.1: *All owners of private land supporting P. spicata notified, within one year, of the presence of the species and of the advantages of entering into a conservation agreement or covenant.*

Action 1.2: *Councils and the Department of Planning are to ensure that adequate targeted surveys for P. spicata are conducted (by the proponent) prior to assessing development or rezoning applications that affect potential habitat for the species.*

Pimelea spicata is cryptic and difficult to detect, particularly when not in flower, and may not be apparent aboveground during drought conditions. The species could easily be missed during general flora surveys and therefore any potential habitat (i.e. in western Sydney, Cumberland Plain Woodland (CPW), or an area that was likely to previously support CPW; see Section 5.2) should be subject to targeted survey during the species flowering period. As outlined in Section 6.2 the flowering period may vary and hence survey of other known nearby sites supporting *P. spicata* should be used as an indicator of flowering time. Additional guidelines regarding what constitutes an adequate targeted survey for *P. spicata* are provided in the Environmental Impact Assessment Guidelines for the species (Appendix 3).

Performance Criterion 1.2: *Adequate targeted survey for P. spicata is conducted for all development or rezoning applications that affect potential habitat for the species.*

Action 1.3: *Councils and the Department of Planning will ensure that all relevant Environmental Planning Instruments are prepared, or reviewed, with reference to this recovery plan and any future advice from the Department of Environment and Conservation regarding the distribution, ecology and management of the species.*

In particular, when lands containing *P. spicata* are being considered for rezoning, it is recommended that areas supporting *P. spicata* and its habitat, where possible, be re-zoned to a conservation zoning to provide an extra level of protection and to attract more appropriate management.

Performance Criterion 1.3: *The level of protection afforded P. spicata populations is increased through conservation planning decisions.*

Action 1.4: *Councils and the Department of Planning will assess developments and activities with reference to this recovery plan, environmental impact assessment guidelines (Appendix 3) and any future advice from the Department of Environment and Conservation regarding the distribution, habitat, threats, biology and ecology of the species.*

Performance Criterion 1.4: The level of protection afforded P. spicata populations is increased through land-use decisions.

Action 1.5: *The Department of Environment and Conservation will reconsider the need for a recommendation of critical habitat by the final year of implementation of this Plan.*

Performance Criterion 1.5: *Need for recommendation of critical habitat re-evaluated in year five.*

Specific Objective 2: To identify and minimise the threats operating at sites where the species occurs

Threats operating at *P. spicata* sites (in addition to land clearing) include: weed invasion; mowing and slashing; spraying of herbicide; dumping of rubbish and garden waste; inappropriate disturbance regimes; and grazing and associated trampling. Actions under this objective aim to manage these threats through the implementation of appropriate *in-situ* threat abatement measures in accordance with management plans and site management statements.

Action 2.1: *The Department of Environment and Conservation will prepare site management statements for sites located on DEC estate.*

The DEC will assess the condition of all sites that are located on DEC estate. The DEC will then

prepare site management statements (following the proforma in Appendix 4) that detail the specific threat abatement measures required at each site and a timetable to implement these measures.

Performance Criterion 2.1: *Site management statements for relevant sites prepared within one year.*

Action 2.2: *The Department of Environment and Conservation will implement threat abatement measures in accordance with the site management statements prepared under Action 2.1.*

Performance Criterion 2.2: *Threat abatement measures for relevant sites implemented in accordance with site management statements as required.*

Action 2.3: *Councils will incorporate site specific threat abatement measures for P. spicata into Plans of Management for community land*

The councils of Blacktown, Kiama, Shellharbour, Camden, Bankstown, Fairfield, Holroyd, and Penrith will incorporate site specific *in-situ* protection measures for the species into Plans of Management for community land where the species occurs. As outlined in Appendix 2, relevant community land currently includes Mirambeena Regional Park, Amaroo Reserve, Crest of Bankstown Reserve, and Belview Reserve in Bankstown LGA; Faulkland Crescent Reserve in Blacktown LGA; Gundungurra Reserve in Camden LGA; Prout Park in Fairfield LGA, Alpha Road Park in Holroyd LGA, Black Point Reserve and Minnamurra Headland in Kiama LGA, Kangara Reserve in Penrith LGA, and Grey Park, Blackbutt Reserve and Warrigal Hill in Shellharbour LGA.

Site specific information to be incorporated into these plans includes:

- an estimate of the number of *P. spicata* individuals and location details (specific location details not to be included in the public document);
- an assessment of existing and potential threats to *P. spicata* at the site;
- details of threat abatement measures to be implemented to address these threats; and
- details of a monitoring program that (i) assess the effectiveness of threat abatement measures and (ii) provides information on the viability of *P. spicata* within the reserve.

Where a Plan of Management has already been prepared that does not address the matters listed above, an addendum to the plan will be prepared to address these matters.

Performance Criterion 2.3: *In-situ protection measures for the species incorporated into Plans of Management for council managed community land within three years.*

Action 2.4: *Councils will implement threat abatement measures in accordance with the site specific recommendations incorporated into the Plan of Management prepared under Action 2.3.*

Performance Criterion 2.4: *Threat abatement measures for relevant sites implemented in accordance with Plan of Management by year five.*

Action 2.5: *The Department of Environment and Conservation will liaise with the Killalea State Park Trust to facilitate the implementation of threat abatement measures at sites within Killalea State Park*

Performance Criterion 2.5: *Threat abatement measures implemented at all sites within Killalea State Park within five years.*

Action 2.6: *The Department of Environment and Conservation, in consultation with landholders, will prepare site management statements for sites located on freehold land.*

The DEC, in consultation with landholders, will assess the condition of sites located on freehold land and prepare site management statements (following the proforma in Appendix 4) that detail the specific threat abatement measures required at those sites.

Performance Criterion 2.6: *Site management statements prepared for sites on freehold land within three years, subject to landholder approval.*

Action 2.7: *The Department of Environment and Conservation will encourage landholders in the implementation of threat abatement measures on freehold land in accordance with the site management statements prepared under Action 2.6.*

Performance Criterion 2.7: *Threat abatement measures for relevant sites implemented in accordance with site management statements within five years, subject to landholder approval.*

Specific Objective 3: Develop and implement a survey and monitoring program that will provide information on the extent and viability of P. spicata.

Action 3.1: *The Department of Environment and Conservation to facilitate surveys of the populations that were permanently tagged in 1993 to gain insight into P. spicata longevity.*

As outlined in Section 7.4, plants within six western Sydney populations (BL2, BA5, BA1, BL1, CD3, CD1) and three Illawarra populations (S3, K2, and S4) were tagged with fire-proof permanent tags in 1993. Re-survey of these tagged plants (or tags where plant has died) will provide insight into the longevity of *P. spicata*.

Performance Criterion 3.1: *A survey for permanent tags at all nine populations conducted within three years.*

Action 3.2: *The Department of Environment and Conservation Environment Protection and Regulation Division to design and facilitate a long-term monitoring program that will enable long-term monitoring of the viability of selected populations.*

Performance Criterion 3.2: *A long-term monitoring program designed by year two and implemented by year three.*

Action 3.3: *The Department of Environment and Conservation to continue seedling survival monitoring at Mount Annan.*

Performance Criterion 3.3: *Seedling survival at Mt Annan monitored from year one onwards.*

Action 3.4: *The Department of Environment and Conservation to facilitate surveys of potential habitat on public lands and to promote community involvement in the surveys*

Performance Criterion 3.4: *At least one survey conducted annually for P. spicata.*

Action 3.5: *The Department of Environment and Conservation will liase with managers of the four sites supporting potentially extinct populations and promote annual targeted survey for P. spicata.*

Recent surveys of the previously recorded populations at Black Point (K1), Grey Park (S2), All Saints Catholic Senior College (L2), and Windang Island (S5), have failed to locate any *P. spicata* plants. These populations may be locally extinct or may persist as soil stored seed banks (see Section 6.3). Annual surveys during the flowering period, or following disturbance events that may stimulate seedling recruitment (e.g. fire), will provide greater insight into the status of these populations.

Performance Criterion 3.5: *All four sites surveyed at least once every year for five years.*

Specific Objective 4: To provide the community with information that assists in conserving the species

The prompt and effective distribution of information on *P. spicata* and its habitat is an important component of ensuring that the conservation requirements of the species are appropriately considered in land-use planning decisions. Actions under this objective use the following mechanisms to aid the dissemination of information about the species:

- verification and prompt distribution of accurate location records to relevant parties; and
- updated species profiles and environmental impact assessment guidelines prepared.

Action 4.1: *The Department of Environment and Conservation will coordinate the prompt distribution of site records through the Atlas of NSW Wildlife.*

Performance Criterion 4.1: *Location records available on the Atlas of NSW Wildlife within four months of verification.*

Action 4.2: *The Department of Environment and Conservation will update the profile and environmental impact assessment guidelines for the species to incorporate information acquired during the implementation of this recovery plan*

Performance Criterion 4.2: *Profile and environmental impact assessment guidelines for the species updated as required.*

Action 4.3: *Councils and the Department of Planning (DoP) will inform the Department of Environment and Conservation of decisions (made under the EP&A Act 1979) that may affect P. spicata.*

Councils and DoP will inform the DEC if planning or development decisions are made that may affect *P. spicata* or its known habitat. This includes information on decisions that protect habitat, as well as those that lead to a reduction in habitat and/or individuals. This information will assist the DEC in the coordination of the species' recovery program.

Performance Criterion 4.3: *The Department of Environment and Conservation informed of land-use and planning decisions that affect P. spicata or its habitat.*

Specific Objective 5: To raise awareness of the species and involve the community in the recovery program

In order to enhance the social benefits of the recovery program for *P. spicata* and assist in its

implementation, actions under this objective aim to raise awareness of the recovery plan and involve the community in its implementation.

Action 5.1: *The Department of Environment and Conservation will distribute information on the progress of the recovery program to raise awareness of the recovery program and encourage community involvement in its implementation.*

The DEC will prepare an annual newsletter on threatened species recovery planning in western Sydney and will include information on the progress of the *P. spicata* recovery program. The newsletter will be distributed to affected landholders, public authorities, community groups and interested individuals.

Performance Criterion 5.1: *Newsletter produced and distributed annually.*

Action 5.2: *The Department of Environment and Conservation and Councils who manage community land that supports P. spicata will raise awareness of, and encourage community involvement in, the recovery program.*

Under this action, the DEC, and Bankstown, Blacktown, Camden, Fairfield, Holroyd, Kiama, Penrith and Shellharbour Councils, will raise awareness of the recovery program amongst community groups and interested individuals, and will encourage involvement in the implementation of recovery actions including survey, monitoring and bush regeneration.

Performance Criterion 5.2: *At least two community groups are actively involved in the implementation of recovery actions each year.*

Action 5.3: *The Department of Environment and Conservation will assist community groups and local government in preparing funding applications to undertake recovery actions in the habitat of P. spicata.*

Community groups, if provided adequate funding, would be able to assist in the implementation of threat abatement works (Specific Objective 2) within the habitat of *P. spicata*.

Performance Criterion 5.3: *At least two funding applications prepared annually by community groups and/or local government to undertake threat abatement works within the habitat of P. spicata.*

Specific Objective 6: To promote research projects that will assist future management decisions

As outlined in Section 8.2 and Table 6, there are a number of potential research questions that could assist in the management of *P. spicata*. However, given the absence of funds to conduct this research, this plan advocates the promotion of potential research questions rather than funding the actual research.

Action 6.1: *The Department of Environment and Conservation to promote potential research projects as identified in this recovery plan*

The DEC will encourage tertiary and research institutions to conduct research into the species consistent with the priorities outlined in Section 8.2.

Performance Criterion 6.1: *All major tertiary and research institutions within the Sydney/Illawarra regions contacted regarding potential research areas by year 3.*

10. Implementation

The total cost to implement this plan is estimated to be at least $49,000 over five years. This amount does not include site specific threat abatement costs (which are yet to be determined) or the costs associated with the preparation and incorporation of site specific threat abatement measures into plans of management for community land. This amount also does not include the cost of conducting any research on *P. spicata*.

A total of $19,250 will be provided as in-kind contributions with an additional $29,750 required to implement some currently unfunded actions. Additional funds for unsecured actions and site specific threat abatement works will be sought from various sources including the Natural Heritage Trust, Environmental Trust, industry sponsors, Threatened Species Network, and DEC annual provisions for implementation of threatened species programs.

Table 7 details the costs and identifies the parties responsible for the implementation of specific recovery actions.

Table 7: Estimated costs, funding sources and responsible parties for implementing the actions identified in the *Pimelea spicata* Recovery Plan.

Action No.	Description	Responsible party[1]	Priority[2]	Fund source[3]	Estimated cost/yr[4]					Total Cost
					Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	
1.1	Advise regarding conservation agreements and covenants	DEC	1	In kind	$350	-	-	-	-	$350
1.2	Adequate targeted survey during impact assessment	DoP, and Local Government	1	-	#	#	#	#	#	-
1.3	Preparation and review of EPIs	DoP, and Local Government	1	-	#	#	#	#	#	-
1.4	Environmental impact assessment	DoP, and Local Government	1	-	#	#	#	#	#	-
1.5	Consider critical habitat	DEC	3	In kind	-	-	-	-	*	*
2.1	Site management statements for DEC sites	DEC	1	In kind	$1050	-	-	-	-	$1050
2.2	Threat abatement for DEC sites	DEC	1	Unsecured	*	*	*	*	*	*
2.3	Plans of Management for community land	KMC, SCC, CC, BACC, BLCC, FCC & PCC	1	In kind	*	*	*	-	-	*
2.4	Threat abatement on community land	KMC, SCC, CC, BACC, BLCC, FCC & PCC	1	Unsecured	*	*	*	*	*	*
2.5	Liase with Killalea State Park Trust	DEC	1	In kind	√	√	√	√	√	-
2.6	Site management statements for freehold sites	DEC	1	Unsecured	$1750	$1750	$1750	-	-	$5250
2.7	Encourage threat abatement for freehold sites	DEC	1	Unsecured	$1750	$1750	$1750	$1750	$1750	$8750
3.1	Facilitate surveys of permanently tagged sites	DEC	3	Unsecured	$1750	$1750	*	-	-	$3500
3.2	Design and implement long-term monitoring	DEC	1	Unsecured	$1750	$1750	$1750	$1750	$1750	$8750
3.3	Monitor seedling survival	DEC	2	In kind	$1400	*	*	*	*	$1400
3.4	Facilitate surveys of potential habitat	DEC	2	Unsecured	$700	$700	$700	$700	$700	$3500
3.5	Promote targeted survey of potentially extinct populations	DEC	1	In-kind	$1400	$1400	$1400	$1400	$1400	$7000
4.1	Distribution of site records	DEC	1	In kind	√	√	√	√	√	-
4.2	Update species profile and EIA guidelines	DEC	1	In kind	-	-	$700	-	-	$700
4.3	DEC informed of planning and land-use decisions	DoP, Local Government	1	-	#	#	#	#	#	-
5.1	Prepare and distribute annual newsletter	DEC	2	In kind	$350	$350	$350	$350	$350	$1750
5.2	Encourage community involvement in recovery program	DEC, KMC, SCC, CC, BACC, BLCC, FCC & PCC	-	-	#	#	#	#	#	-
5.3	Assist with community funding applications	DEC	1	In kind	$700	$700	$700	$700	$700	$3500
6.1	Promote Research Projects	DEC	1	In kind	$700	$700	$700	$700	$700	$3500
	Annual and total cost			Unsecured	$7,700	$7,700	$5,950	$4,200	$4,200	$29,750
				In kind	$5,950	$3,150	$3,850	$3,150	$3,150	$19,250
				TOTAL	$13,650	$10,850	$9,800	$7,350	$7,350	$49,000

[1] **DEC**: Department of Environment and Conservation; **DoP**: Department of Planning; and '**Local Government**' refers to the Kiama Municipal Council (KMC), Shellharbour City Council (SCC), Campbelltown City Council, Liverpool City Council, Camden Council (CC), Bankstown City Council (BACC), Blacktown City Council (BLCC), Fairfield City Council (FCC), Holroyd City Council, Hawkesbury City Council, Baulkham Hills City Council, and Penrith City Council (PCC).

[2] **Priority ratings are: 1** - Action critical to meeting plan objectives, **2** - Action contributing to meeting plan objectives, **3** – Desirable but not essential action.

[3] **In kind** funds represent the salary component of permanent staff and recurrent resources. Salary for in-kind contributions is calculated at $350 per day, which includes officer salary and on-costs, provision of office space, vehicles, administration support and staff management. **Unsecured** funds will be sought from sources including DEC annual provisions for the implementation of threatened species programs, the Natural Heritage Trust, Environmental Trust, industry sponsors, the NSW State Biodiversity Program, Threatened Species Network, Threatened Species Appeal and DEC annual provisions for implementation of threatened species programs.

[4] **#** - No direct cost (either cost of action is negligible or action is a statutory responsibility of the responsible party), **√** - No additional costs (included in the cost of other actions), ***** - Amount to be determined by the responsible party.

11. Preparation details

This recovery plan was prepared by Patricia Hogbin of the DEC Threatened Species Unit, Metropolitan Region. This plan is a revision of a Conservation Research Statement and Recovery Plan prepared for the Australian Nature Conservation Agency (ANCA - now Department of the Environment and Heritage) and the NSW National Parks and Wildlife Service in 1993 (NSW National Parks and Wildlife Service 1993). The Conservation Research Statement and Recovery Plan was authored by Maria Matthes and Sharon Nash, and incorporated information provided by Dessalegn Ayallew and Janelle Brooks.

12. Review date

This recovery plan is to be formally reviewed and updated by DEC five years from the date of its publication.

13. References

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14. Acronyms used in this document

CPW - Cumberland Plain Woodland

DEC – NSW Department of Environment and Conservation

DEH – Australian Government Department of the Environment and Heritage

DoP – NSW Department of Planning

EP&A Act 1979 – NSW *Environmental Planning and Assessment Act 1979*

EPBC Act 1999 – Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

ESP Act 1992– Commonwealth *Endangered Species Protection Act 1992*

KTP – Key Threatening Process

NPW Act 1974 – NSW *National Parks and Wildlife Act 1974*

NPWS – NSW National Parks and Wildlife Service

TSC Act 1995 – NSW *Threatened Species Conservation Act 1995*

15. Appendices

Appendix 1: Review of the conservation status of *Pimelea spicata*
Appendix 2: *Pimelea spicata* general location details and population specific information
Appendix 3: Revised species profile and environmental impact assessment guidelines
Appendix 4: Site management statement

Appendix 1: Review of the conservation status of Pimelea spicata

A review of the conservation status of *Pimelea spicata* found that the species is appropriately listed as **Endangered**. Assessment of the current conservation status of *P. spicata* was conducted using two internationally accepted risk assessment schemes; the IUCN Red List Criteria Version 3.1 (2000) (IUCN 2000) and the Endangered Flora Network (EFN) modified IUCN criteria (Keith *et al.* 1997; Keith 1998; Keith *et al.* 2000) (Table 1).

Table A1. Summary of the EFN Modified IUCN Red List Criteria and IUCN Version 3.1 assessment for *Pimelea spicata* as assessed 20/10/03. P = pessimistic assessment, B = best estimate, and O = optimistic assessment.

	Overall			**Rule A**			**Rule B**			**Rule C**			**Rule D**			**Rule E**			**Rule F**		
Assessment scheme	**P**	**B**	**O**	**P**	**B**	**O**	**P**	**B**	**O**	**P**	**B**	**O**	**P**	**B**	**O**	**P**	**B**	**O**	**P**	**B**	**O**
EFN Modified IUCN Red List Criteria (1998)	**EN**	**VU**	**VU**	EN	LR	LR	VU	VU	VU	VU	VU	LR	LR	LR	LR	DD	DD	DD	VU	VU	LR
IUCN Red List Criteria 3.1 (2000)	**CR**	**CR**	**CR**	EN	LR	LR	CR	CR	CR	VU	VU	LR	LR	LR	LR	DD	DD	DD	na	na	na

From the current information available, the conservation status for *P. spicata* was assessed as **Endangered** through rule A using the 1998 EFN modified IUCN Assessment Scheme and Critically Endangered through rule B using the 2000 (v 3.1) IUCN Red List Criteria. The contrast between the two schemes is due to modifications made to the EFN modified IUCN criteria to make them more applicable to sessile plants (in contrast to mobile animals). The main factor that influences the species' current status as endangered is habitat loss as a result of residential and rural development.

Summary of the pessimistic assessment using EFN Modified IUCN Red List Criteria (1998)

A. Endangered. A suspected rate of decline of greater than 50% over the last 3 generations given that over 90% of the habitat of *P. spicata* has been lost to clearing for rural or residential development since 1950 (NSW National Parks and Wildlife Service 2002) and that at least two populations (and potentially greater than eight) and two subpopulations have been lost to habitat loss or degradation over the past 20 years. In addition, individuals have been lost from at least three populations due to development.

B. Vulnerable. Extent of occurrence estimated to be c. 930km^2 (<2000 km^2); area of occupancy estimated to be c. 17ha (<50 ha), and the following conditions exist:
1. At least 90% of mature individuals are known to exist at no more than 10 locations.
2. Continuing declines are predicted in extent of occurrence, area of occupancy, area and extent of habitat, number of subpopulations and the number of mature individuals.

C. Vulnerable. Total population may be as low as c. 4000 mature individuals (<10000) and the following conditions exist:
1. At least 90% of mature individuals are known to exist at no more than 10 locations.
2. Continuing declines are predicted in extent of occurrence, area of occupancy, area and extent of habitat, number of subpopulations and the number of mature individuals.

D. Low risk. There are greater than 1000 individuals. Area of occupancy or number of subpopulations are not considered to be acutely restricted.

E. Data deficient. No information on the quantitative analysis of extinction probability.

F. Vulnerable. 90% of all individuals contained within only 10 subpopulations, none of which are free of both Class I and Class II threats.

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Appendix 2: **Pimelea spicata** *general location details and population specific information*

Given concerns that the publication of exact location details for populations of *P. spicata* may compromise conservation, a complete Appendix 2 will not to be released to the public. Specific location information is excluded. Public authorities, land managers, or others with genuine reasons for requiring the data, may request the entire Appendix 2 by contacting the Threatened Species Unit or may obtain the information via the NPWS Wildlife Atlas.

Pop code	LGA	General Location	Sub-popn code	Previous site numbers	Specific Location	Easting	Northing	Last survey	Current status	No. mature individs	AOO (m2)	Tenure	Zoning	Land Manager
BA1	Bankstown	Mirambeena Regional Park, Lansdowne	BA1a	Site 1, 62, 233R				1992	Extant	20-52	120	Community Land	6 (a) Open Space	Bankstown City Council
			BA1b	na				2003	Extant	3-10	25			
			BA1c	na				2003	Extant	7-20	100			
			BA1d	na				2003	Extant	25-57	100			
			BA1e	na				2003	Extant	?	?			
BA2	Bankstown	Wendy Av, Lansdowne	BA2a	64				1969	EXTINCT	0	0	Private	Residential	Private
BA3	Bankstown	Amaroo Reserve, Georges Hall	BA3a	Site 6				2003	Extant	37-40	25	Community Land	6 (a) Open Space	Bankstown City Council
BA4	Bankstown	Rex Rd, Georges Hall.	BA4a	SSMB97 081202, RP SITE 5, 8382 - HOR				2003	Extant	21-75	25	Private	2 (a) Residential	Private Property
BA5	Bankstown	Crest of Bankstown Reserve & Belview Reserve, Georges Hall	BA5a	7757R				1992	Prob Extant	119	360	Community Land	6 (a) Open Space	Bankstown City Council
			BA5b	7758R				1992	Prob Extant	48	200			
			BA5c	Site 4, 7759R				2003	Extant	6-17	16			
			BA5d					?	unknown	?	?			
			BA5f					2003	extant	>6	15			
			BA5g					2003	extant	1	1			
			BA5h					1998	extant	30	400			
BH1	Baulkham Hills,	Rouse Hill	BH1a					1989	Unknown	?	?	?	?	?
BL1	Blacktown	Northeastern section Prospect Resevoir Catchment.	BL1a	Site 13, SPXE101 39357				2003	Extant	501-2500	60000	Sydney Catchment Authority	Regional Parklands under SREP31 (to be transferred to DEC at some point in time)	Sydney Catchment Authority
BL2	Blacktown	North of Donohue Street, Kings Park	BL2a	Site 12, 512R				2003	Extant	473-550	100	RTA Road Corridor/Blacktown CC utility land.	5(a) Special uses -Drainage)	RTA/Blacktown City Council
BL3	Blacktown	Quakers Hill	BL3a	Site 22, SDMP99 07260				2003	Extant	45-55	35000	RTA Road Corridor/DoP	1(a) General rural and 5(b) Arterial Road and Arterial Road widening	RTA/DoP
BL4	Blacktown	Near Second Ponds	BL4a	58				2001	Extant	2	1	Private: Landcom	1(a) General rural	Landcom

Pop code	LGA	General Location	Sub-popn code	Previous site numbers	Specific Location	Easting	Northing	Last survey	Current status	No. mature individs	AOO (m2)	Tenure	Zoning	Land Manager
		Creek, Schofields												
			BL4b					2002	Extant	1	1	Private: landcom	1(a) General rural	Landcom
BL5	Blacktown	St Marys, ADI Site	BL5a	57				2004	Extant	5-25	?	St Marys Land Ltd	Regional Park under SREP 30	Within proposed Regional Park: currently St Marys Land Ltd. DEC in future
BL6	Blacktown	Pinegrove	BL6a	site 36				No plants seen 2003.	Unknown. Reliability of orig. collection uncertain.	0-2	?	Blacktown City Council. Utilities	5(a) Special uses - Drainage	Blacktown City Council
BL7	Blacktown	Faulkland Crescent Reserve, Kings Langley	BL7a					2004	Extant	100-150	5000	Blacktown City Council	6 (a) Open Space	Blacktown City Council
CD1	Camden	Mt Annan Botanic Gardens (& surrounds)	CD1a	site 7, 232R, 7761				2003	Extant	8-10	10	Mount Annan Botanic Gardens	Special Uses 5 (c) Botanic gardens	Botanic Gardens and Domain Trust
			CD1b					2003	Extant	20-40	400			
			CD1c					2003	Extant	10-30	400			
			CD1d					2003	Extant	51-70	400			
			CD1e					2003	Extant	10-20	25			
			CD1f	Site 8				Plants destroyed 1992-93	EXTINCT	0	0	Private	Residential	Was landcom prior to extinction.
			CD1g					2004	Extant	3	3	Mount Annan Botanic Gardens	Special Uses 5 (c) Botanic gardens	Botanic Gardens and Domain Trust
CD2	Camden	Gundungurra Reserve, Narellan Vale	CD2a	52				2003	Extant	32-40	90	Community Land	Residential 2(d) and Rural 1(a). Proposed 7(a) Environmentally sensitive land under Camden LEP No. 121 (awaiting gazettal).	Camden Council
CD3	Camden	Camden Golf Club, Narellan	CD3a	7762, Site 9				1992	Unknown-May be extinct	0-40	24	Commonwealth, leased by golf club	Open Space Private 6 (c)	Camden Golf Club (lease from Commonwealth Government)
			CD3b	Site 10, 241R				1993	Extant	300-2000	6000			
			CD3c	Site 11, 240R				1993	Extant	300-1000	5000			
CD4	Camden	Camden Lakes Country Club	CD4a	na				2004	Extant	55-100	200	Private	?????	

Pop code	LGA	General Location	Sub-popn code	Previous site numbers	Specific Location	Easting	Northing	Last survey	Current status	No. mature individs	AOO (m2)	Tenure	Zoning	Land Manager
CD5	Camden	Cobbity	CD5a					2001	Unknown	?	?	?	?	?
CP1	Campbelltown	Denham Court Road, Leppington.	CP1a	site 14				2003	Extant	50-800	1600	Road Reserve and Freehold	Zone 7 (d1)—Environmental Protection 100 hectares Minimum Zone + Road reserve	Private landholder and Camden Council
CP2	Campbelltown	Minto Industrial Estate	CP2a					2004	Original population destroyed and translocated to buffer area.	?	?	Private	Industrial	Australand
F1	Fairfield	Prout Park, Mount Pritchard.	F1a	Site 34, 8485-HOR				2003	Extant	4-30	2003	Community Land	Zone 6 (a) Existing and Proposed Recreation	Fairfield City Council
F2	Fairfield	Cecil Road.	F2a	59				2000	Unknown	?	?	?	1 (a) non urban residential	????
F3	Fairfield	Western Sydney Regional Park (WSRP) & surrounds, Horsley Park.	F3a	28, SSMB98 120800				2003	Extant	200-400	3000	?	Zone 5 (b) Special Uses—Arterial Road and Arterial Road Widening and Zone 1 (a) Non Urban—Residential,	?
			F3b	29, SDMP99 072700				1999	Likely to be extant	50-70	400	RTA & WSRP	Zone 5 (b) Special Uses—Arterial Road and Arterial Road Widening and 6 (c) Recreation Corridor	RTA/DEC
			F3c	48				1996	Likely to be extant	100-200	200	WSRP & Private Property	6 (c) Recreation Corridor	DEC
			F3d	49				No plants seen 2003. Plants last seen in 2003	Unknown	0-70	200	WSRP	6 (c) Recreation Corridor	DEC (but leased by landholder)
			F3e	na				2003	Extant	10-20	400	WSRP	6 (c) Recreation Corridor	DEC (but leased by landholder)
F4	Fairfield	Between Redmayne Rd and The Horsely Dve, Horsely Park.	F4a	30, SPXE101 39214				1996	Unknown	10	?	Unknown	6 (c) Recreation Corridor or 6 (d) Recreation tourism	?
F5	Fairfield	Wetherill Park	F5a					? UBBS	Unknown	?	?	Unknown	4 (c) Special Industrial or 4 (a) General Industrial	?
HA1	Hawkesbury	Maraylaya	HA1a	51				1993	Unknown	?	?	Private	Rural 1(c)	Private landholder
HA2	Hawkesbury	Freemans Reach	HA2a					?	EXTINCT	0	0	Private	Residential	Private
HA3	Hawkesbury	Freemans Reach	HA3a					2003	Extant	7-8	10	Private	7(d1) Environmental	Private landholder

Pop code	LGA	General Location	Sub-popn code	Previous site numbers	Specific Location	Easting	Northing	Last survey	Current status	No. mature individs	AOO (m2)	Tenure	Zoning	Land Manager
													Protection (Scenic)	
HO1a	Holroyd	Alpha Road Park, Greystanes	HO1a	Site 23, 8733-HOR, SPXE10139486, SPXE10139484				2003	Extant	8-40	15	Community Land & Private Property	6 (a) Public Open Space for community land and No development zones for PP.	Holroyd City Council
		Tarlington Place, Smithfield	HO1b	Site 24				1995	EXTINCT	0	0	Private	Industrial	Private
HO2a	Holroyd	Boral quarries, Greystanes	HO2a	SPXE10139450				1996	Prob extant	?	?	Private	SEPP No. 59: Residential	Boral Resources (will eventually be under the control and care of Holroyd City Council)
			HO2b	SPXE10139430				1996	Prob extant	?	?			
			HO2c	Site 35, SPXE10139420				1996	Prob extant	?	?			
			HO2d	na				2001	Prob extant	?	?			
K1	Kiama	Black Point, Gerroa	K1a	F, 27, SDMP99081701				No plants seen 2003. Plants last seen in 1999.	No above ground plants.	0	0-10	Community Land	6A - Existing Recreation	Kiama Municipal Council
K2	Kiama	Minnamurra Headland	K2a	F, Site 16, 224R				2003	Extant	10-200	170	Community Land	6A - Existing Recreation	Kiama Municipal Council
			K2b	n/a				2003	Extant	4-2	4			
L2	Liverpool	All Saints Catholic Senior College, Casula	L2a	Site 15, 7917-HOR				No plants seen in 2003. Plants last seen in 1992.	No above ground plants.	0	0-500	Private	2(a) Residential (Part of lot marked as Environmentally Significant Land).	Catholic School
L3	Liverpool	Denham Court	L3a	na				2003	Extant	500-700	2000	Private	1 C Rural- Environmental Protection	Private
L4	Liverpool	Denham Court, Leppington.	L4a	na				2003	Extant	4	10	Private	1 C Rural- Environmental Protection	Private developer
L5	Liverpool	Casula	L5a	na				2004	Extant	>100	5000	Private	?	Private
P1	Penrith	Sir John Jamison Cemetery, Penrith	P1a	Site 28				2003	Extant	2	100	Private	?	Penrith Catholic Church
P2	Penrith	Kangara Reserve,	P2a					2003	Extant	7	46	Community Land	6A - public	Penrith City Council

Pop code	LGA	General Location	Sub-popn code	Previous site numbers	Specific Location	Easting	Northing	Last survey	Current status	No. mature individs	AOO (m2)	Tenure	Zoning	Land Manager
		Kingswood											recreation/community use	
P3	Penrith	Twin Creeks Resort, Luddenham Road, Orchard Hills	P3a	?				?	Extant but requires confirmation	?	?	Private	?	Private: Crown Lands Development
P4	Penrith	St Marys, ADI Site	P4a					2004	Extant	5		St Marys Land Ltd	Unkown	St Marys Land Ltd
S1	Shellharbour	Killalea State Park	S1a	Site 26, 17, 7769				2003	Extant	142-173	300	Crown Land (declaired as a State Park)	7F2- Environmental Protection (foreshore) zone	Killalea State Park Trust
S2	Shellharbour	Grey Park, Shellharbour	S2a	B, 18, 514,				No plants seen since 1987 despite surveys	No above ground plants.	0	0	Community Land	6a - Public open space	Shellharbour Council.
S3	Shellharbour	Blackbutt Reserve, Shellharbour	S3a	24, Rec Plan 19D				1993	Prob Extant	20-24	?	Community land	6a - Public Open Space Zone	Shellharbour City Council.
			S3b	19, 8387-HOR				1993	Prob Extant	10-17	?			
			S3c	22, 8386 - HOR				1993	Prob Extant	23-52	?			
			S3d	23, 8385 _ HOR				1993	Prob Extant	17	?			
S4	Shellharbour	Warrigal Hill, Mount Warrigal. Alex Hoffman Park.	S4a	D, 20, 8384_HOR				2003	Extant	750-920	10000	Community land	6a - Public Open Space Zone	Shellharbour City Council.
S5	Shellharbour	Windang Island Shellharbour.	S5a	65, 8388_HOR				No plants seen in 2003. Plants last seen in 1999.	Unknown	0	0	Crown Land	6a - Public Open Space Zone	Lake Illawarra Authority
S6	Shellharbour	Bass Point Quarry/Killalea State Park	S6a	Site 25, 53, 56, prog rep				2003	Extant	162-198	150	Predom Private with some in Crown Land declared as a State Park	7F2- Environmental Protection (foreshore) zone	Pioneer Construction Materials and Killalea State Park Trust

Appendix 3: Revised species profile and environmental impact assessment guidelines

THREATENED SPECIES INFORMATION

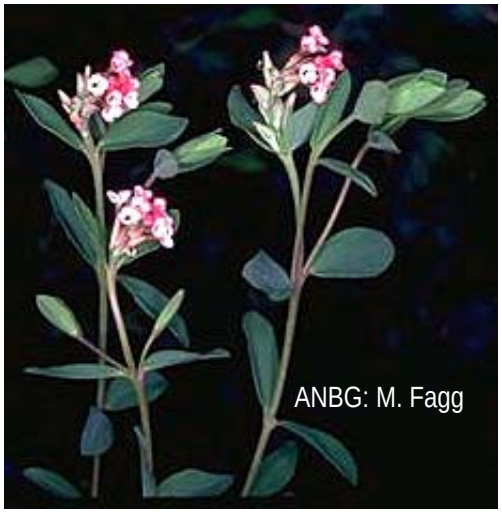
Pimelea spicata R. Br.

Conservation status

Pimelea spicata is listed as an **endangered species** on Schedule 1 of the NSW *Threatened Species Conservation Act* 1995 and as an **endangered species** under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999.

Description

Pimelea spicata (Thymelaeaceae) is a small spreading or erect shrub growing to 50cm. It has smooth hairless stems and opposite narrow-elliptic to elliptic leaves 5–20mm long. Flowers are predominantly white but are sometimes pinkish (Harden 2000; Fairley and Moore 1989).



Distribution

Pimelea spicata has a relatively scattered distribution occurring in two disjunct areas, the Cumberland Plain (western Sydney) (Map 1) and coastal Illawarra, south of Sydney (Map 2). There are 30 known extant populations of *P. spicata*, including 21 within the Cumberland Plain and five within the Illawarra (Department of Environment and Conservation 2005). In addition, the existence of an additional nine populations in western Sydney and three in the Illawarra require verification.

In western Sydney, the species' current known distribution extends from Mount Annan and Narellan Vale in the south to Freemans Reach in the north and from Penrith in the west to Georges Hall in the east. In the Illawarra, the species is associated with coastal headlands and hill tops from Mount Warrigal in the north to Minnamurra and potentially Gerroa in the south.

The local extinction of at least two populations and two sub-populations of *P. spicata* has been caused by residential and industrial development. An additional four populat ions may be extinct as a result of habitat degradation and weed invasion. These potentially extinct populations have been surveyed in recent years but no mature plants have been located. It is possible these populations still exist as soil stored seed banks.

Occurrences in conservation reserves

Only one population of *P. spicata* occurs within a formal conservation reserve: Western Sydney Regional Park. Selected other populations are afforded various levels of environmental protection.

One population on Commonwealth land is the subject of a Conservation Agreement between the Commonwealth and the lessee established under the Commonwealth Endangered Species Protection Act 1992. A large population occurs within the Prospect Reservoir catchment, which is managed by the Sydney Catchment Authority, and another population occurs within Mount Annan Botanic Garden. In addition, a population occurs within the St Marys ADI site within an area that will become a regional parkland to be managed by DEC.

Habitat

In western Sydney, *P. spicata* occurs on an undulating topography of substrates derived from Wianamatta Shale in areas supporting, or that previously supported, the Cumberland Plain Woodland Vegetation Community. The NPWS vegetation mapping of the Cumberland Plain (NSW National Parks and Wildlife Service 2002) identifies two forms of Cumberland Plain Woodland, shale hills woodland and shale plains woodland. *Pimelea spicata* has been recorded from both shale hills and shale plains woodland. Associated species include: Grey Box

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

(*Eucalyptus moluccana*), Forest Red Gum *(E. tereticornis)*, Narrow-leaved Ironbark (E. *crebra*), Blackthorn (*Bursaria spinosa*), and Kangaroo Grass (*Themeda australis*).

In the Illawarra region, *P. spicata* is found in open woodland and also in coastal grassland communities with emergent shrubs. Dominant species within the woodland habitat include *Eucalypyus tereticornis, E. eugenioides, Themeda australis,* and *Lomandra longifolia.* Associated species in the coastal grasslands include *Themeda australis, Lomandra longifolia, Imperata cylindrica, Acacia sophorae, Banksia integrifolia* and *Westringia fruiticosa*.

Ecology

Pimelea spicata possesses an underground tap-root that enables mature plants to re-sprout after defoliation caused by fire, drought, mechanical damage, or herbicide application (Department of Environment and Conservation 2005; Matarczyk *et al.* 2002). It is not known what proportion of plants typically survive such disturbance events, nor it is known at what age the tap-root is of sufficient size to facilitate re-sprouting.

Pimelea spicata flowers sporadically throughout the year, with peak flowering likely to depend upon climatic conditions, particularly rainfall. The mating system of *P. spicata* is uncertain, however anecdotal evidence and flower morphology suggests the species may be capable of self-pollination.

Fruit production is extremely variable within and between populations, and also between years, and is probably associated with environmental conditions such as rainfall and disturbance history (NSW National parks and Wildlife Service 1997).

The mechanism of seed dispersal, if any, are unknown. The species has no obvious adaptations to aid seed dispersal (Willis *et al.* 2003) and observations of seedling emergence following fire suggest seed dispersal is likely to be very low, with the majority of observed seedlings being within 30cm of adult plants (T. Hogbin pers. obs).

Pimelea spicata is capable of maintaining a soil stored seed bank. Germination from the soil stored seed bank has been observed following fire, slashing/mowing, grazing and soil disturbance (Department of Environment and Conservation 2005; Willis *et al.* 2003). It is likely that too frequent disturbance, and also a long-term absence of disturbance, may be detrimental to the persistence of *P. spicata.*

Threats

The main threats to the survival of *P. spicata* are habitat loss due to clearing for development and habitat degradation, particularly from weed invasion. Other threats include; roadside and parkland maintenance activities (mowing, slashing and spraying of herbicide), an inappropriate fire regime, dumping of rubbish and garden waste, and grazing and associated trampling.

Management

Management should be aimed at minimising habitat loss and also controlling habitat degradation through site specific measures such as weed control and fencing. Other management initiatives should include: survey and monitoring; community education and awareness; and also conducting research that will assist future management decisions.

Recovery Plans

A Recovery Plan is currently being prepared for *P. spicata*.

For further information contact

Threatened Species Unit, Central Directorate, NSW NPWS, PO Box 1967, Hurstville NSW 2220. Phone (02) 9585 6678 or visit our website www.npws.nsw.gov.au.

References

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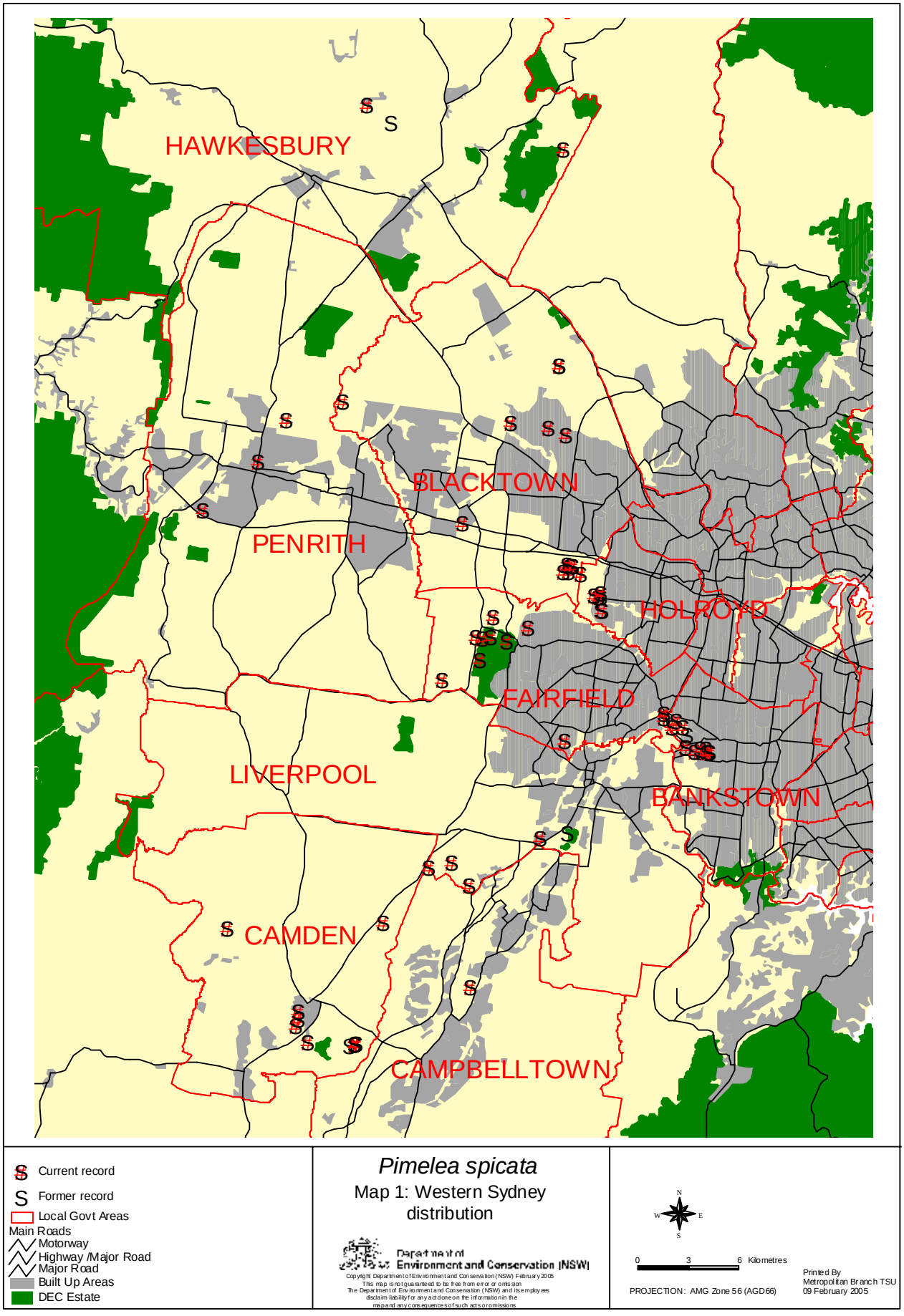

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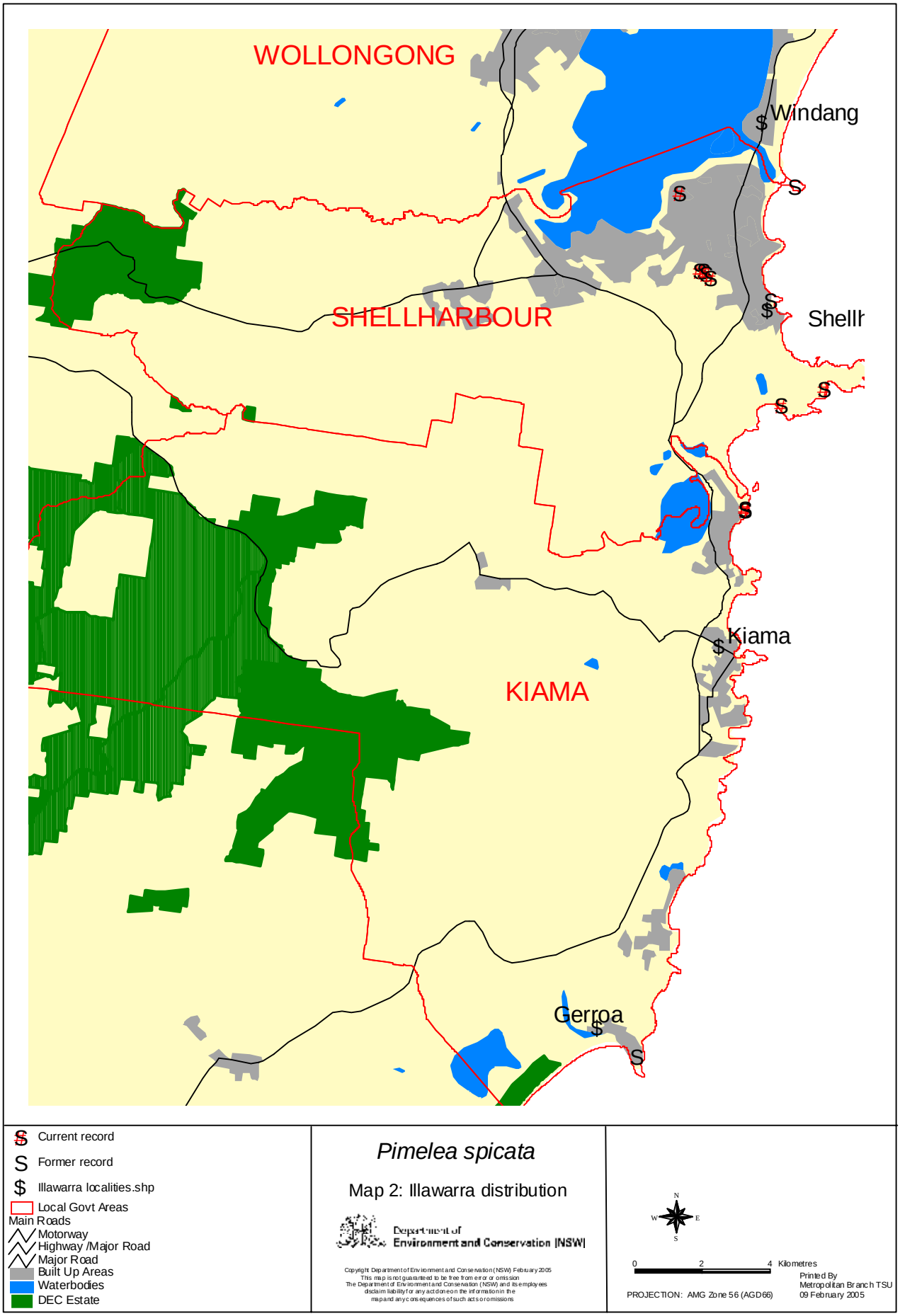

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ENVIRONMENTAL IMPACT ASSESSMENT GUIDELINES

Pimelea spicata R.Br.

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) and with the accompanying "Threatened Species Information" sheet.

Survey

Pimelea spicata is cryptic and difficult to detect, particularly when not in flower, so surveys should not be relied upon unless undertaken whilst the species is flowering. *Pimelea spicata* flowers sporadically throughout the year, with flowering likely to depend upon climatic conditions, particularly rainfall. Flowering times recorded for *P. spicata* vary. Rye (1990) noted flowering period as May - January; Benson and McDougall (2001) noted peak flowering period as March – April; and P. Hogbin (pers. obs) noted abundant flowering in Winter and Spring (June-September) of 2003 after the break of a drought. Given that P. spicata flowers opportunistically and peak flowering time may vary from year to year, survey of other known nearby sites supporting P. spicata should be used as an indicator of flowering time.

Surveys should not necessarily be restricted to the species' known distribution. In particular, suitable habitat in western Sydney and along coastal Illawarra, outside of the species current known distribution.

Given that the species is small and cryptic, when surveying potential habitat, *P. spicata* needs to be the subject of a specific targeted survey. The targeted survey should be undertaken using the random meander method, favouring suitable habitat areas (ie. open areas), and survey effort should be at least one hour per hectare of suitable habitat.

Surveys should aim to determine species presence and, when presence is confirmed, an estimate of population size and area should be obtained.

Life cycle of the species

Proposals which are likely to effect the life cycle of the species, such that a local population is put at risk of extinction would include proposals that:

- result in total destruction of habitat;
- result in a partial destruction or modification of habitat (including changes to hydrology and nutrification of the soil substrate) which may result in changes to vegetation community structure;
- result in a requirement for frequent fire hazard reduction, so that tap roots are unable to develop or seed banks cannot develop;
- increase vehicular, bike, pedestrian, or other, access to a population; or
- increase rubbish dumping and associated weed invasion or arson (for example, through adjacent residential development).

Threatening processes

Six key threatening processes currently listed under the *TSC Act 1995* are likely to, or potentially, threaten *P. spicata*.

- *'Clearing of native vegetation'*, has reduced the habitat of *P. spicata* and resulted in the loss of at least two known populations.
- '*Invasion of native plant communities by exotic perennial grasses'* is also a major threat to the survival of *P. spicata*, with *Pennisetum clandestinum* (Kikuyu) competing with *P. spicata* at the majority of sites.
- '*High frequency fire resulting in the disruption of life cycle process in plants and animals and loss of vegetation structure and composition'*, is likely to threaten the viability

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of *P. spicata* populations.

- '*Invasion of Native Plant Communities by Chrysanthemoides monilifera*' may also threaten the viability of the coastal Illawarra populations. *Chrysanthemoides monilifera*' (Bitou Bush) has been recorded at all headland coastal Illawarra populations of *P. spicata*.
- Other KTPs that may affect *P. spicata* include: 'Infection of native plants by *Phytopthora cinnamomi'* and '*Anthropogenic climate change'*. In addition to these listed key threatening processes, a range of other processes are generally recognised as threatening the survival of *P. spicata* as outlined in the accompanying threatened species information profile.

Viable local population of the species

Very little is known of what constitutes a viable population of *P. spicata*. In the absence of such information the DEC considers that all known populations of *P. spicata* should be considered viable.

It appears the species is capable of persisting at very small population sizes. Half of all populations support less than 50 individuals, with only six populations supporting >200 plants (Department of Environment and Conservation 2005) (Table 1).

Table 1: Size class distribution for the 30 known extant populations of *Pimelea spicata*

Size class[#]	Number of populations*	% of total no. of popns
≤ 10	7	23
11 ≤ 50	8	27
51 ≤ 100	4	13
101 ≤ 200	5	17
201 ≤ 500	2	6
≥ 501	4	13

[#]number of mature individuals
*using lowest estimate of population size

A significant area of habitat

The majority of populations occur over a small area, with 80% of all populations occupying an area of less than 0.5ha (Table 2). Only three populations possess an area of occupancy greater than 1ha. Thus consideration of population area as the only criterion for assessing significance would result in a large percentage of populations being considered insignificant, and ultimately lost. This would result in unacceptable loss of habitat for this species.

Important considerations are the size and condition of other, nearby, populations, whether those populations are secure, and the condition and security of the population and habitat being assessed.

Using these criteria, the NSW NPWS considers that most *P. spicata* populations should be considered as occupying a significant area of habitat.

Table 2: Area of occupancy (AOO)* class distribution for the 30 known extant populations of *Pimelea spicata*.

AOO (ha)	Number of populations	% of total no. of popns
≤ 0.01ha	10	33
0.011 ≤ 0.1	6	20
0.11 ≤ 0.5	8	27
0.51 ≤ 1	3	10
≥ 1ha	3	10

*AOO calculated as defined in IUCN 2000.

Isolation/fragmentation

Pimelea spicata occurs within a highly fragmented urban or urban fringe environment. Given the species' likely restricted pollination and seed dispersal mechanisms, the loss of even small areas of vegetation from currently interconnecting or proximate areas of habitat supporting *P. spicata* is likely to cause isolation. In addition, isolation may be caused not only by vegetation loss, but also by vegetation degradation and weed invasion.

Regional distribution of the habitat

Pimelea spicata has a relatively scattered distribution occurring in two disjunct areas, the Cumberland Plain (western Sydney) and coastal Illawarra, both entirely within the Sydney Basin Bioregion.

Limit of known distribution

In western Sydney, the species' current known distribution extends from Mount Annan and Narellan Vale in the south to Freemans Reach in the north and from Penrith in the west to Georges Hall in the east. In the Illawarra, the species is associated with coastal headlands and hill tops from Mount Warrigal in the north to Minnamurra and potentially Gerroa in the south.

Adequacy of representation in conservation reserves

Pimelea spicata is not adequately represented within conservation reserves. Only one of the 25 known extant populations of P. spicata occurs within a formal conservation reserve: Western Sydney Regional Park. Selected other populations are afforded various levels of environmental protection. A large population occurs within the Prospect Reservoir catchment, managed by the Sydney Catchment Authority. A population also occurs within the Woodland Conservation Area at Mount Annan Botanic Garden. In addition, a population occurs within the St Marys ADI site within an area that will become a regional parkland to be managed by DEC. Eleven populations occur within community land managed by local government. The majority of these sites are currently managed primarily for their recreation rather than conservation values.

Critical habitat

No critical habitat has been declared for *P. spicata.*

For further information contact

Threatened Species Unit, Central Directorate, NSW NPWS, PO Box 1967, Hurstville NSW 2220. Phone (02) 9585 6678 or visit our website www. npws.nsw.gov.au.

References

Benson, D. & McDougall, L. (2001) Ecology of Sydney plant species Part 8: Dicotyledon families Rutaceaae to Zygophyllaceae. Cunninghamia 7(2): 241-462.

IUCN (2000) IUCN Red List Categories, Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, U.K.

Department of Environment and Conservation (2005) Pimelea spicata Recovery Plan. Department of Environment and Conservation, Hurstville NSW.

Rye, B. L. (1990) Thymelaeaceae, Flora of Australia 18:122-215.

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Appendix 4: Site Management Statement

Site Management Statement

Prepared by:

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Date:

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Site details:

Site Name:

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Site Code:

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Location: ……..

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Easting: ……..…..…..Northing: ……...……..AMG Zone: …….…..……..

Landowner/Landmanager contact details

Name: ……..

Phone number: …….

Postal address: …….

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Parcel details:

LGA: ……

Portion/Lot: ……..

Street address: ……..

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Zoning: ……

Tenure: …….

Current landuse:……...

Population details:

No. adults: Count: [ ] Estimate: [ ]
Lowest estimate =…….…...….Best estimate =…….…….Upper estimate =…….…….…

No. seedlings: Count: [ ] Estimate: [ ]
Lowest estimate =…….…...….Best estimate =…….…….Upper estimate =…….…….…

Area of Occupancy: …….…….Accurate: [ ] Estimate: [ ]

Detailed site map attached: Yes/No

Reproduction: Buds: [ ] Flowers: [ ] Fruit: [ ]

Habitat: ……..

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Dominant Associated species: ……..

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Threats: ……...

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Predominant weed species and abundance: ……..

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Previous management actions (describe apparent success): ……

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Th**reat abatement actions required:** …….

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Recommended monitoring and evaluation program: …….

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Timetable for implementation of actions and monitoring: ……

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Appendix 5: Summary of Scientific Committee's comments on draft recovery plan.

This summary is required by Section 66A of the *Threatened Species Conservation Act 1995* The only comment by the Scientific Committee concerned typographic errors, which have been corrected.