3 Lowland Native Grassland: Planning and Management for Conservation

3.1

Recovery Planning for Lowland Native Grassland in the ACT

The *Lowland Native Grassland Conservation Strategy* builds upon earlier initiatives for grassland conservation in the ACT and region, and incorporates those currently underway. Implementation of a four year recovery plan for natural temperate grassland in the ACT (Wildlife Research Unit 1991, 1992) commenced in 1993 with funds from the Commonwealth Endangered Species Program and the Plan was subsequently supported for a further three years. The primary goal of that Recovery Plan was to reduce the threat to the ecological community. Achievements of the recovery program included the mapping and surveying of the floristics of ACT grasslands; ecological research on grassland floristics and some threatened plant and animal species; research on impacts of herbicides on selected native grasses; development of a management plan; establishment of a long-term monitoring program; compilation of a data base; and provision of seminars and educational materials (Sharp 1997, 1999; Sharp and Shorthouse 1996).

The management plan (Wildlife Research Unit 1994) prepared as part of the Recovery Plan process provided the first holistic management framework, guidelines and prescriptions for all the known natural temperate grassland areas in the ACT and threatened species found in the grasslands. It provided the basis for conservation management while survey, monitoring and research, in the ACT and elsewhere, built the information base to refine management approaches.

The achievements of the Recovery Plan (Wildlife Research Unit 1991) provided a substantial basis for defining the objectives of the Action Plan for natural temperate grassland prepared by Environment ACT, following declaration of the ecological community as endangered in the ACT (ACT Government 1997a). New developments under the Action Plan included establishing grassland reserves at Gungahlin and Dunlop and a Special Purpose Reserve at Mugga Mugga; signing of Memoranda of Understanding between Environment ACT and Commonwealth land management agencies in the ACT; undertaking surveys that have located new populations of threatened grassland species; completion of management plans for grassland reserves; preparation of management plans by agencies with whom Environment ACT has Memoranda of Understanding; management oriented research e.g. burning experiments; regional liaison on grassland conservation; weed surveys and weed control programs; contribution to the preparation and production of a grassland flora field guide for the Southern Tablelands (Eddy *et al.* 1998).

Regionally, Environment ACT has been closely involved with the 'Joint biodiversity survey of grassy ecosystems of the South Eastern Highlands project' (Rehwinkel 1997) that culminated in the *Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands* (Fallding 2002) as well as the *National Recovery Plan for Natural Temperate Grassland of the Southern Tablelands (NSW and ACT)* (Environment ACT 2005). Objectives and actions in the 2005 National Recovery Plan are complementary to those in this *ACT Lowland Native Grassland Conservation Strategy*. As a consequence of new surveys, altered management, and continuing development of Canberra, there have been a number of changes to the inventory of ACT grasslands.

3.2

Botanical Significance Rating (BSR)

A botanical significance rating system has been applied to the remaining lowland native grassland in the ACT. This system was based initially on analyses of data from Victorian grasslands (Stuwe 1986) and has been modified over time by Environment ACT (Wildlife Research and Monitoring) and relates to the responses

of plant species to different levels of disturbance (Table 3.1). This system was applied also to the understorey of woodland sites in the *ACT Lowland Woodland Conservation Strategy* (ACT Government 2004a). A more detailed description of the ratings and of the species typical of different levels of disturbance in grassy ecosystems is provided in Appendix 1. Application of the botanical significance rating to ACT lowland native grassland sites is shown in Table 3.2.

3.3

Remaining Lowland Native Grassland in the ACT

Vegetation surveys were undertaken at all ACT native grassland sites in 2003–04 as part of the preparation of this *Strategy* and the data compared with data from surveys undertaken previously. As a result, a review of the condition, diversity and spatial extent of all sites was undertaken. Further information on the survey methods is in s. 2.1.3.

Sites may contain areas of native grassland in varying condition, and may include several floristic associations, areas of native pasture and areas of exotic vegetation (such as in drainage lines that are weedy and disturbed). Sites that contain no natural temperate grassland (native pasture and/or exotic pasture) are included in this *Strategy* where they contain populations of threatened species.

In Table 3.2 the land use, total area, the area of the major floristic associations, native pasture and the botanical significance ratings are listed for each site. At some sites, patches of grassland occur that have higher or lower botanical significance ratings than the majority of the site. The botanical significance ratings of these smaller patches are indicated in brackets. Sites that do not contain natural temperate grassland, but are known habitat for threatened species are indicated in italics.

The number of sites containing native grassland (which may or may not be assessed as natural temperate grassland) is 47, totalling 2172 hectares (Figure 2.2 and Table 3.2). Of these 47 sites, 42 (totalling 1534 ha) contain 991 hectares of natural temperate grassland (Botanical Significance Rating (BSR) 1–4, see Table 3.1). This represents about 5% of the estimated original area of 20 000 hectares. These sites also contain areas of native pasture (385 ha, BSR 5) and exotic grassy vegetation (157 ha). Vegetation on the other five sites is not assessed as natural temperate grassland because it lacks the native species diversity that is a characteristic of the ecological community in the ACT (see s. 2.1.5). These areas of native pasture (639 ha, BSR 5) provide habitat for some threatened grassland plants and animals and/or may be important buffers and corridors for native grassland species. As well as the grasslands listed in Table 3.2, there are small patches (less than 0.25 ha) of native grasses and in some instances, hardy native forbs such as the Common Everlasting *Chrysocephalum apiculatum* and

Table 3.1: Botanical Significance Rating (BSR) for Native Grassland

	BSR 1 Very High	BSR 2 High	BSR 3 Moderate	BSR 4 Low	BSR 5 Very Low	Exotic E
Diversity of native species	Very high	Very high	Medium	Low	Very low	Very low to none
Uncommon native species	Several to many	Several	Few	None	None	None
Disturbance tolerant native species	Several to many	Several to many	Many	Several (including some native forbs)	Several (mostly native grasses)	None
Cover of native grasses	High	High	High	High	High	Low to none
Cover of exotic species	Low	Low	Low to moderate	Low to moderate	Low to moderate	Moderate to high
Alteration due to disturbance	Minimal alteration	Some alteration	Moderate alteration	Much alteration	Substantial alteration	Severe to total alteration
Natural temperate grassland	Yes	Yes	Yes	Yes	No	No

Common Blue Bell *Wahlenbergia communis* scattered along some roadsides and through open space areas of Canberra.

3.3.1 Changes in Lowland Native Grassland Sites Since 1997

In spring 2003 all grassland sites were resurveyed, using a method that enables a detailed comparison between and within sites in regard to composition, condition and spatial distribution. This has resulted in a revision of the status and condition of the sites since they were reported in the original Action Plan for natural temperate grassland (ACT Government 1997a). There have been significant changes to some grassland sites in terms of size, botanical significance rating and condition. Changes to the area and number of sites identified as containing natural temperate grassland results from a number of factors. These include more accurate mapping, better information to guide the discrimination between primary grassland (natural temperate grassland) and secondary grassland (modified woodland), development of better methods of survey for identifying condition, identification of previously unknown sites and the loss of sites to development. Appendix 2 provides details of the changes that have occurred in grassland sites.

Overall, the amount of identified natural temperate grassland is about the same (approximately 1000 ha in 1997 as compared to 991 ha in 2005). A further 500 ha was identified in 1997 as being lower quality natural grassland. With further surveys having been undertaken, a total of 1180 ha of native pasture and exotic vegetation containing threatened species has been included in this *Strategy*.

Since 1997, five new areas of natural temperate grassland have been found. All are small (each less than one hectare in size), and together amount to 2.5 ha (Appendix 2 (1a)). Eight sites (97 ha) have been re-assessed as containing additional areas of natural temperate grassland (Appendix 2 (1b)). This is due to changes in condition at the site and also better application of condition analysis.

One site identified in the Action Plan as containing natural temperate grassland has been developed (GAP 4) and two other sites have been partially developed (a total loss of 8 ha (Appendix 2 (2a)). Parts of several sites have deteriorated beyond recovery through weed invasion or site disturbance resulting in a reduction in the size of the natural temperate grassland area (14 ha) (Appendix 2 (2b)). Another 145 ha have been reclassified from natural temperate grassland to native pasture or exotic vegetation as a result of the improved analyses undertaken in 2003. This has resulted in the exclusion of four sites previously identified as natural temperate grassland, and reduction in area at seven other sites (Appendix 2 (2c)). This includes two areas of grassland identified in Action Plan 1 as constituting the *Poa* floristic association. In the 2003 surveys these areas were assessed as being degraded native pasture, and therefore not representing the endangered ecological community.

Several secondary grasslands (totalling 102 ha) were previously misclassified as natural grasslands and are now included in the *ACT Lowland Woodland Conservation Strategy* (ACT Government 2004a).

3.4

Conservation Planning for Lowland Native Grassland

As noted in s. 2.1, natural temperate grassland is one of Australia's most threatened ecosystems. In this context, the conservation of the remaining areas of lowland native grassland (including natural temperate grassland) is a critical task for national biodiversity conservation. The ACT retains significant remnants of the original extent of natural temperate grassland in the region; however, the small size and fragmented nature of the remaining grassland areas pose particular difficulties for conservation planning.

Canberra's growth as a city continues to exert significant development pressures on land in and around existing urban areas. Some land that is generally regarded as available for development may still retain natural features worthy of consideration for their potential contribution to the nature conservation estate or to enhancing the natural landscape of the city. Consideration needs to be given to the ecological, landscape and other values of the land so that an informed decision can be made on its future.

Management of grassland fragments to improve habitat qualities, to enhance ecological connectivity, or to increase the effective size of remnants will be an important management priority for some time to come. Linking grasslands with other natural ecological communities such as grassy woodlands, wetland areas and forests increases the overall conservation value of areas by building habitat heterogeneity in the landscape.

Planning for, and management of conservation areas in the ACT must take into account the potential impact of land uses and other activities on adjacent land and in some instances, on the same land. Compatible land uses or management practices will help to moderate

Table 3.2: Native Grassland in the ACT: List of Sites Grouped by Geographic Location

Name of each site by geographic area	Site No. (GAP)	Land use	Area (ha)	Floristic Association (NTG) Dominant grasses (native pasture)	Flor. Assn Area (ha)	BSR
GUNGAHLIN—Total native grassland area: 410.1 ha. Area of natural temperate grassland: 179.2 ha.						
Mulanggari Nature Reserve	GU01 (GAP 6)	Reserve	68.5	*Austrodanthonia* Wet *Themeda* Native pasture (*Austrodanthonia*) Native pasture (*Austrostipa*) Exotic vegetation	51.1 7.5 0.9 8.5 0.5	2(3)
Gungaderra Nature Reserve	GU02 (GAP 9)	Reserve	187.3	*Austrodanthonia* *Austrostipa* Wet *Themeda* Native pasture (*Austrodanthonia*) Native pasture (*Austrostipa*) Native pasture (*Poa*) Exotic vegetation	4.3 21.9 15.7 0.1 109.3 5.8 30.2	5 (2,4)
Crace Nature Reserve	GU03 (GAP 13)	Reserve	136.0	*Austrodanthonia* Dry *Themeda* Wet *Themeda* Native pasture (*Austrostipa*) Exotic vegetation	35.9 3.1 22.5 41.1 33.3	3(5)
North Mitchell	GU04 (GAP 10)	Vacant	15.9	*Austrodanthonia* *Austrostipa* Exotic vegetation	1.4 13.4 1.2	3(4)
Mitchell	GU05 (GAP 10)	Rural (agisted)	1.6	Dry *Themeda*	1.6	3
Belconnen Pony Club	GU06 (GAP 14)	Rural	0.3	*Austrodanthonia*	0.3	4
Wells Station Road	GU07	Roadside	0.2	*Austrostipa*	0.2	4
Nicholls	GU08 (GAP 8)	UOS	0.3	*Austrostipa*	0.3	4
MAJURA VALLEY—Total native grassland area: 641.3 ha. Area of natural temperate grassland: 208.9 ha.						
Majura Training Area	MA01 (GAP 28)	Defence	126.6	*Austrodanthonia* Wet *Themeda* Native pasture (*Austrostipa*) Exotic vegetation	106.9 6.8 5.8 7.1	2(1)
Air Services Beacon	MA02 (GAP 28)	Airport Services	10.7	Wet *Themeda*	10.7	2(4)
Canberra International Airport	MA03 (GAP 28)	Airport	203.6	*Austrodanthonia* Native pasture (*Austrostipa*) Exotic vegetation	73.6 62.9 67.1	3(1, 2,5)
'Malcolm Vale'*	MA04	Rural lease	155.4	Native pasture (*Austrostipa*)	155.4	5
Campbell Park	MA05 (GAP 27)	Defence	11.7	*Austrodanthonia* Exotic vegetation	10.9 0.8	3(2)
Majura West*	MA06	Rural lease	133.3	Native pasture (*Austrostipa*)	133.3	5
JERRABOMBERRA VALLEY—Total native grassland area: 697.1 ha. Area of natural temperate grassland: 267.4 ha.						
'Mugga Mugga'	JE01 (GAP 39)	Reserve	15.0	*Austrodanthonia* *Austrostipa*	1.4 13.7	4(3)
'Callum Brae'*	JE02 (GAP 36)	Rural lease/ Reserve	162.7	Native pasture (*Austrodanthonia*) Native pasture (*Austrostipa*)	89.3 73.4	5
'Woden Station'/ Jerrabomberra West Reserve	JE03 (GAP 36)	Reserve	116.9	*Austrodanthonia* *Austrostipa* Native pasture (*Austrostipa*)	62.8 52.4 1.7	3
Woods Lane	JE04 (GAP 37)	Roadside	10.3	Dry *Themeda*	10.3	3
'Woden Station' East/ Jerrabomberra East Reserve	JE05 (GAP 37)	Reserve	72.0	*Austrodanthonia* *Austrostipa* Native pasture (*Austrostipa*) Exotic vegetation	44.2 18.0 7.8 2.0	4(3)
Harman Bonshaw South *	JE06 (GAP 37)	Defence, Rural lease	105.7	Native pasture (*Austrostipa*)	105.7	5
Harman Bonshaw North	JE07 (GAP 37)	Defence, Rural lease	114.6	*Austrodanthonia* Native pasture (*Austrostipa*)	46.3 68.3	5(4)
'Cookanalla'*	JE08	Rural lease	81.5	Native pasture (*Austrostipa*)	81.5	5
Amtech	JE09 (GAP 35)	Vacant	18.0	*Austrodanthonia*	18.0	4
Tennant St, Fyshwick	JE10	Agisted	0.3	Dry *Themeda*	0.3	3

(Continued) ▶

Table 3.2: *(Continued)*

Name of each site by geographic area	Site No. (GAP)	Land use	Area (ha)	Floristic Association (NTG) Dominant grasses (native pasture)	Flor. Assn Area (ha)	BSR
BELCONNEN—Total native grassland area: 387.5 ha. Area of natural temperate grassland: 300.1 ha.						
Ginninderra Experimental Station	BE01 (GAP 2)	Research	19.4	Dry *Themeda* Exotic vegetation	18.9 0.5	4
Dunlop Nature Reserve	BE02 (GAP 3)	Reserve	81.9	*Austrodanthonia* Wet *Themeda*	77.0 4.9	3(2)
'Jarramlee'	BE03 (GAP 15)	Rural (agisted)	52.0	*Austrostipa* Wet *Themeda*	47.3 4.7	4(3)
Umbagong Park, Florey	BE04 (GAP 16,17)	UOS	15.5	*Austrodanthonia* *Austrostipa* Dry *Themeda* Native pasture (*Austrodanthonia*) Native pasture (*Themeda*) Exotic vegetation	0.8 0.2 8.0 1.2 0.6 4.7	4 (3,5)
Evatt Powerlines	BE05 (GAP 18)	UOS	1.1	Dry *Themeda*	1.1	3
Lake Ginninderra	BE06 (GAP 19)	UOS	1.9	*Austrodanthonia* Dry *Themeda*	0.1 1.7	3
Lawson Territory	BE07 (GAP 20)	Rural (agisted)	59.2	*Austrodanthonia* Dry *Themeda* Native pasture (*Austrostipa*) Exotic vegetation	2.2 1.1 46.9 9.1	5(3)
Lawson Commonwealth	BE08 (GAP 20)	Defence	120.3	*Austrodanthonia* *Austrostipa* Dry *Themeda* Wet *Themeda*	91.2 9.8 16.5 2.9	2 (3,4)
Kaleen east paddocks	BE09 (GAP 21)	Rural (agisted)	28.2	*Austrodanthonia* Native pasture (*Austrostipa*)	4.0 24.2	5(3)
Caswell Drive	BE10 (GAP 22)	UOS	5.8	Dry *Themeda* Wet *Themeda*	3.5 2.3	2
Glenloch interchange	BE11 (GAP 23)	UOS	2.2	Dry *Themeda*	2.2	2
CANBERRA CENTRAL and TUGGERANONG—Total native grassland area: 36.5 ha. Area of natural temperate grassland: 35.8 ha.						
CSIRO Headquarters, Campbell	CC01 (GAP 25)	CSIRO	3.0	Dry *Themeda*	3.0	3
Constitution Ave, Reid	CC02 (GAP 26)	UOS	0.7	Dry *Themeda*	0.7	3
St Johns Church, Reid	CC03	Urban Lease	0.9	*Austrodanthonia*	0.9	4
ACCC, Barton	CC04 (GAP 33)	Urban Lease	1.9	Dry *Themeda*	1.9	1
York Park, Barton	CC05 (GAP 34)	UOS	0.4	*Austrodanthonia*	0.4	4
Yarramundi Reach	CC06 (GAP 24)	UOS	21.2	*Austrostipa* Dry *Themeda*	16.4 4.8	4(3)
Lady Denman Drive, Yarralumla	CC07 (GAP 29)	Roadside	0.4	*Austrodanthonia*	0.4	3
Dudley St, Yarralumla	CC08 (GAP 30)	UOS	2.2	*Austrodanthonia* Wet *Themeda* Exotic vegetation	0.6 0.9 0.7	3
Kintore St, Yarralumla	CC09	Vacant	0.8	Dry *Themeda*	0.8	3
Novar St, Yarralumla	CC10 (GAP 31)	UOS	0.2	*Austrostipa*	0.2	4
Black St, Yarralumla	CC11 (GAP 32)	UOS	3.6	Dry *Themeda*	3.6	3
Isabella Pond, Monash	TU01 (GAP 38)	UOS	1.2	Dry *Themeda*	1.2	2
Total			**2172**			

Notes: (1) Site No: In the *Strategy*, site numbers have been assigned to all native grassland sites (including sites containing natural temperate grassland and native pasture) to identify the geographic region in which they occur. The 'Site No.' column shows the GAP (Grassland Action Plan) location numbers from Action Plan 1 (ACT Government 1997a). The Site Numbers supersede the GAP numbers.

(2) UOS = Urban Open Space

(3) Floristic association: for explanation, refer to section 2.1.4.

(4) Natural Temperate Grassland (NTG) contains areas with a Botanical Significance Rating (BSR) of 1 to 4. Native Pasture has a BSR of 5 and does not meet the definition of the endangered ecological community (refer to section 2.1.8, Table 3.1). Where a site contains small patches of vegetation with a higher or lower BSR than the majority of the site, these ratings are indicated in brackets.

(5) *—Denotes native grassland sites that do not contain natural temperate grassland.

adverse external influences on nature conservation values. Conservation management supported by research, monitoring and community participation are identified as key actions for this *Strategy* (Table 4.1).

3.4.1 Conservation Planning Principles

In developing a systematic approach to conservation planning and strategic options for native grassland conservation in the Gungahlin area of the ACT, Williams et al. (1995, pp. 8–18) set out a number of steps each with associated conservation planning principles.

The steps are:

- set goals and objectives;
- assess knowledge of the species, communities and sites of concern;
- delineate possible areas for conservation and consider environmental inter-linkages;
- develop strategy options and management guidelines.

The conservation planning principles include:

- areas that have the highest conservation values should be protected;
- consideration of size (viability), diversity, representativeness, distinctiveness (rarity) and naturalness is required;
- replication of conservation areas in fragmented habitats is necessary as a precaution against catastrophic and/or unpredictable local extinction;
- integration of smaller systems within broader conservation systems increases their conservation value; and
- regional conservation planning based on remnants must consider the constraints and opportunities provided by the present and future land use patterns.

The ACT Government adopted this approach in 1995 when reviewing the planning for Gungahlin Town Centre. The principles and associated methodology were used to identify high priority areas for grassland conservation, based on vegetation qualities and habitat for threatened species. Subsequently three nature reserves were established in the Gungahlin area with the primary aim of protecting natural temperate grassland and habitat for the Striped Legless Lizard (*Delma impar*). Grazing management in these reserves has been altered to promote conservation values, with some success (see s. 3.6.3).

The *Lowland Native Grassland Conservation Strategy* recognises the importance of addressing the conservation needs of threatened, declining and/or uncommon plants and animals in an integrated way, and not separated from consideration of the ecological communities of which they are a part. An understanding of the key life history properties and habitat requirements of species, the dynamic processes operating within ecosystems, and the importance of connectivity in making fragmented communities more viable across a variety of local and regional scales are accepted as being essential to sound conservation planning. For highly fragmented communities such as natural temperate grassland, connectivity can often only be considered in terms of links to other ecological communities, which together build a network.

In order to bring together the information on grassland type, vegetation condition, habitat features and occurrences of threatened and declining flora and fauna species with the relevant conservation planning and management issues, the following attributes, derived from the principles outlined above, have been incorporated into the material that is the basis for Chapters 3 and 4 of the *Strategy*:

- **Regional context:** regional biodiversity conservation significance;
- **Ecological characteristics:** vegetation condition; resident populations(s) of threatened species; habitat heterogeneity;
- **Physical data:** size; area/perimeter ratio;
- **Landscape context:** connectivity with other native vegetation; altitudinal range; and
- **Planning and management:** compatible land uses within and adjacent to sites; potential for regeneration and restoration management.

3.4.2 Survey, Monitoring and Research

Williams *et al.* (1995) list the following additional principles for sound conservation planning:

(a) knowledge of key life history properties of species and dynamic processes within the ecological communities is essential (Principle 3);

(b) spatial scale is important when assessing the value of published knowledge of species and communities (Principle 4);

(c) common as well as rare species have a bearing on conservation planning (Principle 5);

(d) the quality of available data and therefore its value to conservation planning varies depending on its taxonomic and spatial resolution, seasonal biases and temporal representation (Principle 6).

SURVEYS

As described in s. 2.1.3 extensive vegetation surveys have been undertaken in native grassland sites in the ACT since 1991. While the majority of lowland native grassland sites in the ACT have been documented and surveyed, there may be smaller sites or more degraded sites that have not yet have been investigated. If new sites are identified, they will be surveyed, information added to the database of sites and actions undertaken that are consistent with this Strategy. The majority of sites have been surveyed on several occasions, providing information about changes resulting from seasonal conditions and management. Additionally, vegetation surveys have also been undertaken in conjunction with reptile trapping sites to provide more detailed information about immediate habitat.

All known threatened plant populations have been mapped and surveyed on several occasions, providing information on fluctuations in distribution and abundance.

While many sites in the Southern Tablelands in NSW have also been surveyed, these have been mainly restricted to government land. Consequently, there is incomplete information on which to make regional comparisons. However, there have been few areas of grassland of the same size as the larger ACT sites found to date in NSW.

Extensive fauna surveys were also undertaken in this period, focussing on threatened and uncommon grassland species, particularly reptiles (summarised up to 1996 in Rehwinkel 1997, pp. 48–53). Edwards (1994) surveyed lowland grassland sites for the Golden Sun Moth (*Synemon plana*). These surveys resulted in a good knowledge base for threatened species, but there is still limited knowledge of other species, especially invertebrates. More recent surveys include those for *Keyacris scurra* (Rowell and Crawford 1999) and grassland canopy insects (Farrow 1999) (see s. 2.3.3). Surveys carried out in association with annual monitoring have found new populations of some threatened species e.g. (a) Perunga Grasshopper at West Belconnen, Yarramundi Reach, Crace Nature Reserve, Campbell Park and Jerrabomberra West; (b) Button Wrinklewort at Crace Grassland Reserve and a more extensive population at Campbell Park.

MONITORING

Monitoring is vital to understanding trends in grassland communities and is an essential component of a sound approach to conservation management of native grassland. Long-term monitoring of the flora of the ecological community in the ACT commenced in 1993 under the Recovery Plan program (Sharp and Shorthouse 1996) and continues on an annual basis. Fourteen permanent monitoring sites have been established that include the main floristic associations and the range of land uses and management practices in the ACT. This long term monitoring is designed to identify slow, largely imperceptible changes in the flora of the ecological community. The monitoring results are entered into the grassland database held by Wildlife Research and Monitoring (Environment ACT), reported to the Flora and Fauna Committee, and are essential to devising and refining the management regimes for grassland areas.

Populations of threatened plant species are monitored annually and their condition assessed. In addition, Button Wrinklewort and Ginninderra Peppercress populations are assessed for abundance and distribution at two to five year intervals.

Populations of threatened animal species are monitored for their continued presence at grassland sites. Annual monitoring surveys are conducted for Grassland Earless Dragon, Striped Legless Lizard and Golden Sun Moth. In addition to monitoring the distribution of these species in grasslands, techniques are currently under trial to assess the feasibility of quantitatively monitoring changes in abundance. The lack of a practical field method for monitoring the presence/absence or abundance of the threatened Perunga Grasshopper means that information on the distribution of this species is obtained from incidental observations.

RESEARCH

The original Action Plan for Natural Temperate Grassland (ACT Government 1997a, p. 13) noted that the emphasis of ACT grassland research to date had been to improve knowledge of the distribution and ecology of grassland and selected (plant and animal) species. Implementation of the Action Plan required management-oriented research. There was also a need for research on the basic ecological requirements of selected grassland plants and animals, including threatened species. Subsequently, some research in both these directions has been undertaken and management has also drawn on research from grasslands elsewhere. A literature review on the role of grazing for conservation management of native grasslands has been prepared (Lunt 2005).

Research has been undertaken in the ACT and region on the ecology, taxonomy, survey methodology, management and conservation of grassland threatened species, especially reptiles (Rehwinkel 1997). The following is a brief summary of the research undertaken:

- Grassland Earless Dragon (*Tympanocryptis pinguicolla*): A reasonably good, basic knowledge of this species has been developed through research over the last decade including genetics/taxonomy (Scott and Keogh 2000; Smith 1994; Smith *et al.* 1999), ecology and conservation (Benson, 1999; Langston, 1996; Nelson 2004).
- Striped Legless Lizard (*Delma impar*): There has been less research on *Delma impar* and its life history remains largely unknown (Smith and Robertson 1999). Research on the biology/ecology of the species has been mostly undertaken in Victoria (Melbourne Zoo and University of Technology). ACT studies on the ecology of the species include those by Nunan (1995) and Osmond (1994).
- Perunga Grasshopper (*Perunga ochracea*): The behaviour and biology of this species has been documented by Rentz (1996). Stephens (1998) also studied aspects of its ecology. The dietary requirements of the species are not fully understood and no research has been undertaken on population sizes or specific predators.
- Golden Sun Moth (*Synemon plana*): Edwards (1994) documented ACT populations of this species and a population at York Park, Barton was surveyed over the period 1992–3 to 1994–5 (Cook and Edwards 1993, 1994; Harwood *et al.* 1995) (see Appendix 5.3). While the life history of *Synemon plana* is not fully understood, genetic research by Clarke (1999) has helped identify and determine the conservation significance of moth populations in the ACT. This research shows that ACT populations are genetically very similar, probably reflecting recent fragmentation. Maintaining or increasing population sizes is a major conservation issue for this species and this is directly related to maintaining and increasing the cover of the larval food plant, *Austrodanthonia*. Clarke and Dear (1998) documented the regional distribution of the species and their survey has also provided insights into the ecological parameters determining that distribution.
- Button Wrinklewort (*Rutidosis leptorrhynchoides*): Due to its high conservation profile within an endangered ecosystem, and its amenability as a research model, *Rutidosis leptorrhynchoides* has been the subject of considerable ecological and genetic research aimed at understanding the factors that limit population viability. Most of this is reviewed in Young *et al.* (2000). Issues and options for the genetic conservation of the species are contained in Young (2001).
- Ginninderra Peppercress (*Lepidium ginninderrense*): Almost nothing is known about the general biology of *Lepidium ginninderrense*, and there is a need for research into this basic information. Based on extrapolation from other genetic studies of rare plants and evidence of good seed set, Young (2001) suggests that the species may still contain significant genetic variation for broadly based seed collections to form the basis of a conservation strategy.

3.4.3 Protection

A primary objective of the *Strategy* is the establishment of a comprehensive, adequate and representative system of protection for grassland in reserves or by other measures where reservation is not practicable or desirable (see s. 4.2 and s. 4.3.1). Generally these areas will be those with the highest value in terms of meeting local, regional and national objectives. Assessment of conservation value includes concepts of size (viability), diversity, representativeness, distinctiveness (rarity), naturalness and habitat value. Given the small proportion of the estimated original extent of natural temperate grassland that still remains in the ACT, it is not possible for a comprehensive, adequate and representative system to conserve a predetermined proportion of the original ecological community. However, the principles can be adapted to the circumstances regarding ACT native grasslands and used to guide decisions relating to protection.

The objective is to establish, as far as is practicable, a system of reserves and other protected areas that is:

1. **Comprehensive:** It will include the full range of the five floristic associations identified for ACT natural temperate grassland.
2. **Adequate:** It will replicate ecologically viable natural grassland communities, species and populations.
3. **Representative:** It will reasonably reflect the biological diversity of the ecological community.

The conservation planning principles derived from Williams *et al.* (1995) (see s. 3.4.1) complement the above.

MEASURES FOR PROTECTION

Adequate protection of lowland native grassland sites in the ACT, including those that may be of low botanical significance rating but important animal habitat is critical to attaining the goals of this *Strategy*.

Sites with remnant native grassland in the ACT occur on land under a variety of tenures, including urban open space (generally Public Land under *The Territory Plan*),

rural leasehold Territory Land, unleased Territory Land, and Commonwealth-owned and managed National Land. Grassland remnants are often small in size, and may be isolated from one another by areas used for urban, agricultural or other purposes. For some sites, the combination of small size, isolation and the impacts of adjacent land uses may preclude or severely limit prospects for their long-term viability, irrespective of protection or other conservation measures. Other sites may have good prospects for long-term viability, but are unavailable for formal inclusion in a reserve system due to land ownership or use.

Protection of sites on Territory land containing native grassland is achieved through the provisions of the *Land (Planning and Environment) Act 1991* and the *Territory Plan*. For National Land, Memoranda of Understanding with Commonwealth Government agencies have been established, however, these do not provide the same level of statutory protection afforded to those areas that are formally recognised by reservation as part of the nature conservation estate. The existing Memoranda of Understanding aim to ensure that sites with high conservation value are managed so as to maintain their conservation values in perpetuity while other compatible land uses, defined in each MOU, continue. There is also an obligation to consult if any change in land ownership or land use is contemplated. The provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) also apply where Commonwealth actions may have a significant impact on nationally listed threatened species or ecological communities (see s. 1.5.2)

Environment ACT will continue to work with the ACT Planning and Land Authority and the National Capital Authority to promote land uses in areas adjacent to grassland areas that are compatible with conservation objectives and to minimise any adverse impacts. In the context of the strategic objectives for protection set out in Table 4.1, the following are specific objectives:

- a core set of Territory Land sites that have the highest priority for conservation are protected in nature reserves (including the grassland reserves already established);
- Memoranda of Understanding (MOU) between Environment ACT, Department of Environment and Heritage, Department of Defence, National Capital Authority, and CSIRO for the protection and management of high conservation value native grassland on National Land, under the control of these Commonwealth agencies, are maintained; and MOUs with the National Transmitting Authority and Canberra International Airport are prepared and maintained;
- management agreements with the lessees of small sites with high conservation value are prepared and/or maintained (e.g. Australian Centre for Christianity and Culture, Barton).

3.4.4 Management

Management activities in grassland sites require a long-term strategic approach based on clear objectives that are developed from scientific principles. These principles are identified from scientific studies of the ecology of the native grassland community and of component species undertaken in the ACT and elsewhere in Australia. The basis for managing an area of grassland is a management plan (Eddy 2002) regardless of whether or not the preparation of such a plan is a statutory requirement e.g. for Public Land in the ACT. For more detail on native grassland management, see s. 3.7.

Development of a management plan is based on the identification of the dominant grassland and weed species at a site or location, information about any species of conservation concern, an understanding of drainage, soil patterns and past management of the site, activities that will be undertaken aimed at biodiversity conservation, and monitoring programs. There is limited knowledge about the long-term effects of management practices on grassland biodiversity, including the most appropriate forms of defoliation management. An adaptive management approach is therefore necessary (see s. 3.7).

Some investigation of the impacts of management practices on the biodiversity and dynamics of grasslands is being undertaken in the ACT. In general, previous management practices are continued at a site until alternative practices are deemed to better fulfil objectives. Options for management of plant biomass include grazing by domestic stock, mowing, slashing or burning. Herbicides are the main control method for weeds.

Native grassland sites may have other values in addition to the natural values associated with the ecological community. Examples of other values include Aboriginal and European cultural values. Management of other values is integrated into statutory management plans, and in some instances, may require separate protection or joint management arrangements. An important aspect of management planning for native grassland is the identification of community interest in both the grassland and the places where it occurs (AHC 2003). This *Strategy* identifies the Conservation Management Network approach as being the means to connect all those with an interest in the conservation management of native grassland (see s. 3.8.3 and Table 4.1).

As noted in s. 1.7, the *Lowland Native Grassland Conservation Strategy* is not a management plan and the forms that management plans take will vary according to land tenure, use and ownership. For nature reserves, grassland conservation is formally incorporated into the statutory management plans (see s. 1.7). For leased land, management advice is provided to landholders where native grassland is present on their land. Under the MOUs with Commonwealth agencies, it is the responsibility of landholders to prepare management plans that incorporate the conservation requirements for threatened species and the ecological community. Canberra Urban Parks and Places have developed management guidelines for all unleased urban sites that contain grasslands or threatened species, with the aim of maintaining their conservation values.

The remaining ACT grassland sites require management arrangements appropriate to their tenure and conservation goals. Management plans for individual sites need to take into consideration factors such as historical and current land uses and management, size, weed infestations, presence of threatened or uncommon species, surrounding land uses and vegetation (see s. 3.7.1). Priority for the development of management plans should be based on the significance of sites and the potential for threats to reduce conservation values. Management plans are being implemented at all grassland Nature Reserves (managed by the ACT Parks and Conservation Service), all sites managed by Canberra Urban Parks and Places, and land managed by the Department of Defence. The Capital Airport Group has prepared a grassland management strategy for the Canberra International Airport. Management actions being undertaken include weed control at sites managed by Commonwealth and Territory agencies. This is based on a priority list of weed species and areas developed by the ACT Weeds Working Group. Environment ACT regularly provides advice on grassland management to managers of grasslands on all tenures.

3.4.5 Ecological Restoration

Restoration means returning existing habitats to a known past state or to an approximation of the natural condition by repairing degradation, by removing introduced species or by reinstatement (AHC 2002). The success of restoration activities is likely to be inversely related to the degree of degradation of particular grasslands. Where grassland is fragmented, restoration may be considered as a means of increasing overall size, buffering and interconnection (Williams *et al.* 1995, p. 15, Principle 14). In particular, it is now possible to establish native grass swards, though establishment of other grassland species is less well understood. Weed control is a key management problem for restoration activities and supply of seed or plants of suitable provenance to maintain genetic integrity is an ongoing issue (Eddy 2002, p. 19).

It is not yet possible to recreate the grassland ecological community in areas where it has been wholly or mostly removed, nor is it possible to move a grassland community from one site to another.

The comments by Ross (1999, p. 8) on grassland restoration are pertinent:

> The uninformed view that native grasslands are relatively simple systems can encourage the notion that they can be easily re-created as a substitute for conservation of existing remnants. While there clearly is a role for restoration of existing remnants as part of overall management strategies, the 're-creation' of native grasslands is impossible (or at least unfeasible) with current funding, knowledge and technology. Accordingly, projects that attempt to 're-create' native grasslands are of low value in pursuing current conservation goals and objectives.

Restoration of the natural integrity of existing grassland areas is a higher priority than widespread replanting; however, replanting may be undertaken on a limited scale, for example:

- at sites where weed removal or other management has caused extensive bare areas;
- in areas designated as buffer zones;
- at selected roadside sites e.g. where adjacent land contains native grassland of conservation value and the road corridor could be a source of weed invasion; and
- at sites where there is an identified need to increase the population size of particular species of plants and/or animals for conservation purposes e.g. increasing the cover of suitable *Austrodanthonia* spp. in areas supporting *Synemon plana*.

This is an area for further research with economic opportunities. In particular there is scope to establish seed orchards in rural areas for species of both natural temperate grassland (grasses and forbs) and lowland woodland species.

Revegetation guidelines that provide information on the development of work programs appropriate to the types of revegetation that occur are currently being drafted (Butler, in prep.).

3.4.6 Key Characteristics of ACT Lowland Native Grassland Sites

In relation to conservation planning, key characteristics of the 47 remaining lowland native grassland sites in the ACT are:

(a) sites range from those that are small and isolated to large areas with high heterogeneity of habitat;

(b) sites are fragmented; and

(c) weeds have invaded all sites and this is a major on-going threat.

SIZE OF GRASSLAND REMNANTS

Native grassland sites range in size from less than one hectare to approximately 200 ha. Although 40% of the native grassland sites are small (19 are less than five hectares and nine of these, or 19% of sites, are less than one hectare), there are eleven sites (23%) over 100 hectares in size (Table 3.2).

Eight sites contain natural temperate grassland in moderate to good condition (mainly BSR 1–3) and are over 50 ha in size (Table 3.2). They are:

- Canberra International Airport (MA06) 204 ha
  BSR 3(1, 2, 5, E)
- Crace Nature Reserve (GU03) 136 ha
  BSR 3(5)
- Majura Training Area (MA01) 127 ha
  BSR 2(1)
- Lawson (Commonwealth) (BE08) 120 ha
  BSR 2(3, 4)
- 'Woden Station'/Jerrabomberra West Reserve (JE03) 117 ha
  BSR 3
- Dunlop Nature Reserve (BE02) 82 ha
  BSR 3(2)
- Mulanggari Nature Reserve (GU01) 69 ha
  BSR 2(3)
- 'Woden Station'/Jerrabomberra East Reserve (JE05) 72 ha
  BSR 4(3)

(Where a site contains small patches of vegetation with a higher or lower BSR than the majority of the site, these ratings are indicated in brackets.)

Remnant size is a critically important factor in conservation planning. Among those attributes positively correlated with size of habitat area are diversity of vegetation types, the likelihood of occurrence of rare or specialised habitats, the richness of plant and animal species, the size of populations and the sustainability of natural disturbance regimes. In particular, the maintenance of natural patch-dynamic processes in fragmented landscapes is critically dependent on the presence of areas of sufficient size to sustain a mosaic of habitats that correspond to different states (Bennett 1999, p. 15).

The integration of smaller remnants into larger conservation systems increases their conservation value (Williams *et al.* 1995, p. 15, Principle 15). Five grassland areas take the form of contiguous patches (Majura Valley East and West, Jerrabomberra East and West, and Lawson). These account for 1484 hectares or 68% of the 2172 hectares of native grassland in the ACT. Five sites connect with extensive areas of other native vegetation (Majura Valley East and West, Jerrabomberra Valley East and West, and Caswell Drive).

FRAGMENTATION OF GRASSLAND REMNANTS

Remaining areas of lowland native grassland in the ACT have survived largely by chance, following the earlier period of pastoral use of ACT lands and the later development of Canberra. Urban Canberra was built over much of the entirely treeless grassland identified by Pryor (1938). The distribution of the remnants is highly fragmented and further fragmentation, especially of the larger areas, still constitutes a major threat to the ecological community.

Some areas exist in an extensive matrix of developed land uses with no possibility of restoring connectivity (e.g. urban sites such Australian Centre for Christianity and Culture, Barton and York Park, Barton). Thirteen of the 47 sites are isolated within a highly modified urbanised landscape. With planned urban development in Gungahlin and Belconnen, another seven sites will become similarly isolated, resulting in almost half of all sites being in this situation.

The setting aside of areas for public institutions and government offices resulted in small grassland areas remaining in the Central National Area of Canberra (Frawley 1995). Examples include the Australian Centre for Christianity and Culture, Barton (1.9 ha) containing very high quality *Themeda* grassland, and York Park, Barton (0.4 ha), an *Austrodanthonia* grassland containing a population of the endangered Golden Sun Moth *Synemon plana*.

Other sites, though isolated to varying degrees from other grassland, are located close to other native vegetation e.g. lowland woodland. Important woodland/grassland interfaces occur at the Caswell Drive and Glenloch Interchange grasslands, Majura East and West and Jerrabomberra West. In some instances, there is potential to connect to other habitat. An example is the actual and potential connectivity from Black Mountain/Aranda Bushland (open forest)—

Aranda Bushland/Glenloch (lowland woodland, native grassland)—Yarramundi Peninsula (native grassland)—Lake Burley Griffin (riparian and aquatic communities).

The locations with large areas of grassland (Lawson, Majura Valley East and West, Jerrabomberra Valley East and West) have some internal fragmentation but still represent critical habitat for both grassland and some threatened plant and animal species. The conservation value of these areas may be enhanced by complementary management of linking areas even if these areas are not high quality natural temperate grassland, or by undertaking restoration activities (see 'Ecological Restoration' in s. 3.4.5). It is important to maintain the natural integrity of these areas by avoiding further fragmentation.

WEED INVASION

The proneness of grassland to weed invasion and ongoing threats are discussed in s. 2.1.7. Weed control is a key element in conservation planning and management of remaining native grasslands (see s. 3.7.5).

The weed species that are of particular threat to the integrity of native grasslands are Serrated Tussock (*Nassella trichoma*), Chilean Needle Grass (*N. neesiana*), both of which are Weeds of National Significance, African Love Grass (*Eragrostis curvula*) and St Johns Wort (*Hypericum perforatum*). While there are many more species that are far more common in the grasslands, these species are highly invasive and can become extremely dense, sometimes forming monocultures, in even the least disturbed sites. Woody weeds, particularly Briar Rose (*Rosa rubiginosa*), are common in grasslands but these are relatively easy to control.

3.5

Assessing the Conservation Value of Native Grasslands

In order to be able to determine the conservation significance of each grassland site and, where appropriate, to compare sites with different characteristics, it is necessary to develop criteria that enable the available data to be evaluated. Criteria used to assess the conservation significance of sites have been developed from principles defined in Williams *et al.* (1995) (see s. 3.4.1).

The primary criteria used in this *Strategy* for native grassland sites are:

- botanical significance rating (s. 3.2, Appendix 1);
- size and shape (which affects viability, ability to withstand disturbance and species diversity); and
- significance as threatened species habitat (see below).

Secondary criteria that assist in assessing conservation value are:

- the presence of more than one grassland association or threatened species;
- integration of smaller areas into larger units;
- distribution throughout the ACT;
- connectivity with other native vegetation (e.g. lowland woodland).

Data and other relevant information for each grassland site against these criteria is summarised for each district in Tables 3.4–3.8. For the purposes of this *Strategy*, the size of an area is considered to be:

- large if it is greater than 100 ha;
- medium if between 100 ha and 10 ha;
- small if between 10 ha and 1 ha; and
- very small if less than 1 ha.

Grassland sites in the ACT (Table 3.2) have been grouped into three categories based on the above criteria. These are discussed in s. 3.5.1 to s. 3.5.3 (below).

ASSESSMENT OF THREATENED SPECIES HABITAT

Native grasslands provide important habitat for threatened species. Threatened species habitat is identified from known occurrences of species, relative population sizes/distributions and from knowledge of the biology and habitat requirements of species. In addition to native grassland habitat, other areas (including exotic pasture or degraded native pasture) may be important in providing connections between habitats or acting as buffers to adjacent incompatible land uses.

In this *Strategy*, habitat supporting a threatened species population that is considered viable in the medium to long-term (at least 50 years) is considered key habitat. As discussed by Williams et al. (1995), to assess the viability of populations requires extensive and detailed knowledge of population structure (e.g. sex ratio, age structure, age at first breeding, mortality rates) and the response of populations to disturbance. Response to disturbance or fragmentation is affected by genetic variation within and between populations, reproductive rates and dispersal patterns in relation to patches. Population viability also depends on the frequency of stochastic catastrophic events, such as bushfire, drought or disease outbreak.

Much of this information is not available for threatened species in the ACT, and consequently it is not possible to rigorously and quantitatively assess the long-term viability of their populations. Instead, a qualitative approach has been taken to assess key habitat, based on the following ecological principles relating to the viability of small populations:

- Larger populations are more likely to be viable in the long-term (more robust to demographic and environmental stochasticity and loss of genetic diversity).
- Larger areas of habitat with high 'area to perimeter' ratio (less 'edge' effect) are more likely to maintain their ecological condition in the long term (particularly if buffered from incompatible landuse) and are more likely to support a higher number of species.
- Higher quality habitat is more likely to support reproducing populations, and to buffer populations against poor seasonal conditions. For the threatened ACT grassland species, higher quality habitat is more likely to be grassland that is relatively less modified (i.e. higher BSR).

There is a clear connection between the principles relating to habitat (last two above) and principles relating to the conservation of vegetation communities. In addition to supporting viable populations, an area is considered to be key habitat if it supports a population that is important in terms of genetic diversity for a species.

3.5.1 Category 1: Core Conservation Sites

Sites in this category meet the following criteria:

- high botanical significance rating (BSR of 1 or 2, but may contain or adjoin areas of lower rating); or
- key threatened species habitat; or
- large sites (more than 100 ha) with a BSR of 3.

Nineteen sites in the ACT have been assessed as meeting these criteria. The total area of these sites is 1663 ha (comprising 808 ha of natural temperate grassland, 714 ha of native pasture, 141 ha of exotic pasture. The sites represent the core group of areas needed to ensure conservation of the best quality natural temperate grassland and the major habitats for grassland threatened species. They warrant the highest level of protection. The sites are (see also Figures 2.3–2.7):

- Majura Valley East (Training Area (MA01), Airport Services Beacon (MA02) and Canberra International Airport (MA03));
- Majura Valley West (Campbell Park (MA05) and Majura West (MA06))
- Jerrabomberra Valley East ('Woden Station' East (JE05), Harman Bonshaw South (JE06), Harman Bonshaw North (JE07));
- Jerrabomberra Valley West ('Callum Brae' (JE02) and 'Woden Station' (JE03);
- Lawson (Commonwealth) (BE08));
- Dunlop Nature Reserve (BE02); and
- Gungahlin grassland reserves (Mulanggari (GU01), Gungaderra (GU02), Crace (GU03)).

Four sites (totalling 11 ha) with a high BSR are each relatively small in size:

- Caswell Drive (BE10) and Glenloch Interchange (BE11):
  —These sites have a BSR of 2 and are contiguous with woodland, including Snow Gum Lowland Grassy Woodland.
- Australian Centre for Christianity and Culture, Barton (CC04):
  —This is the only site with a BSR of 1. Because of its low degree of disturbance and rarity, the site is considered to be of high conservation value even though it is a small site.
- Isabella Pond, Monash (TU01):
  —This small site has a BSR of 2.

For areas that are Territory Land, the appropriate level of protection is reservation under the *Land (Planning and Environment) Act 1991* (four sites totalling 474 ha are already protected in reserves). The ACT Government has identified a further two sites (totalling 177 ha) in the Jerrabomberra Valley as nature reserves. Sites managed by Canberra Urban Parks and Places are protected as Urban Open Space and are managed to maintain their conservation values. Where grasslands are located on National Land, Memoranda of Understanding with Commonwealth Government agencies have been established, though statutory reservation is desirable to ensure protection in the long term. MOUs cover 479 ha in five sites. For privately leased land (Australian Centre for Christianity and Culture, Barton; Canberra International Airport) protection provisions may be incorporated in lease conditions or other arrangements such as a Memorandum of Understanding.

3.5.2 Category 2: Complementary Conservation Sites

Sites in this category meet the following criteria:

—moderate botanical significance rating (BSR of 3, but may contain or adjoin areas of higher or lower rating); or

- threatened species habitat; or
- medium area sites (10–100 ha) and BSR of 4.

Grassland sites meeting these criteria are those with a history of greater modification than Category 1 sites (e.g. they exhibit reduced plant species diversity, loss of disturbance sensitive species and increase in disturbance tolerant species, and greater weediness) or those that do not contain key threatened species habitat. They are assessed as having a BSR of not higher than 3 as their long-term viability as conservation areas may be limited by virtue of their size, low area to perimeter ratio and/or impacts from surrounding land uses. Category 2 sites may contain threatened species habitat that is not key habitat, however, they may complement core conservation grassland, providing habitat and/or a buffer. Although populations of some threatened species occurring in these areas are small they are considered to be viable in the medium term.

Twenty-two sites in the ACT are assessed as being complementary conservation sites. The total area of these sites is 421 ha (comprising 175 ha of natural temperate grassland, 239 ha of native pasture, 7 ha of exotic pasture). The sites are (see also Figures 2.3–2.7):

- Rural sites:
  —Ginninderra Experimental Station (BE01) and 'Jarramlee' (BE03).
- Near-urban sites:
  —'Mugga Mugga' (Special Purpose Reserve) (JE01) and North Mitchell (GU04).
- Sites with threatened species, but not containing key habitat for those species:
  —York Park (CC05), St Johns Church, Reid (CC03), Lake Ginninderra (BE06), Constitution Ave, Reid (CC02), Woods Lane (JE04), Cookanalla (JE08), Amtech (JE09), Tennant St, Fyshwick (JE10), Malcolm Vale (MA04), and Yarramundi Reach (CC06).
- Isolated urban sites with BSR 3:
  —Umbagong (BE04), Evatt Powerlines (BE05), CSIRO Headquarters (CC01), Lady Denman Drive (CC07), Dudley St, Yarralumla (CC08), Kintore St, Yarralumla (CC09), Black St, Yarralumla (CC11) and Mitchell (GU05).

In addition to the above sites, important habitat for the Grassland Earless Dragon is located in degraded native pasture or exotic pasture surrounding Category 1 sites in the Jerrabomberra Valley (JE05, JE06, and JE07) (Figure 2.4). These areas do not contain natural temperate grassland, but are likely to provide a buffer for key habitat where the species is known to breed. In the case of Amtech where the Grassland Earless Dragon has been recorded, further work is required to determine whether the area should be retained or allowed to be developed.

Recognition and protection of these areas on Territory Land may be achieved through Public Land categories of the *Territory Plan* including Nature Reserve, Urban Open Space and Special Purpose Reserve. Thirteen, mainly small, grassland sites are located in Urban Open Space and one ('Mugga Mugga') in Special Purpose Reserve.

Activities permitted in these land use categories may be compatible with conservation of native grassland values, provided that appropriate conservation management is in place. In these cases maintenance of the conservation values of the site is the responsibility of the relevant ACT Government agency. Other similar land uses include road reserves and power-line easements.

For National Land, Memoranda of Understanding with Commonwealth Government agencies are appropriate. MOUs can embrace all native grasslands managed by these agencies, not only those that are core conservation sites. Land Management Agreements provide the primary means to achieve conservation management of these grasslands on rural leases.

3.5.3 Category 3: Landscape and Urban Sites

Category 3 sites have a lower conservation value than those in categories 1 or 2, but may still contribute to conservation of grassland biodiversity. They meet the following criteria:

- low to very low botanical significance rating (BSR of 4 or 5); and small to very small area (less than 10 ha); and
- may contain small populations of threatened species in marginal or fragmented habitat that is considered to be not viable in the medium to long term.

These sites tend to be very fragmented and have reduced viability as a grassland community. However, some have value as buffers or connections between higher conservation value sites, as landscape features within the urban fabric, or in providing opportunities for education or rehabilitation research.

Six sites in the ACT are categorised as landscape and urban sites. The total area of these sites is 88 ha (comprising 8 ha of natural temperate grassland, 71 ha of native pasture, 9 ha of exotic pasture). The sites are (see also Figures 2.4–2.7):

- Urban sites with BSR 4 or 5:
  —Lawson (Territory) (BE07), Novar St, Yarralumla (CC10).
- Isolated near-urban sites:
  —Kaleen East paddocks (BE09), Belconnen Pony Club (GU06), Wells Station Road (GU07), Nicholls (GU08).

OTHER AREAS INCLUDED IN CATEGORY 3

In addition to the above sites, there are areas of degraded native pasture or exotic pasture of insufficient quality to be included in the grassland inventory (Table 3.2), that contain records of threatened species. These areas are generally associated with higher quality native pasture or natural temperate grassland. Figures 2.3, 2.4, 2.5 and 2.7 show the distributions of threatened species habitat and their relationship to the various grassland types.

Where possible, sites with these characteristics should be retained and appropriately managed until their long-term future is determined. Each one needs to be assessed as part of the outline planning, environmental assessment and development approval process. Planning and management arrangements to protect and manage their natural values may include agreements with non-government landholders, property management agreements with rural lessees and protection of sites within the urban fabric.

These areas are:

- East Jerrabomberra (Block 2060 Jerrabomberra and adjoining Block 6 Section 53 Hume):
  —This area is situated between the Monaro Highway and JE06 (Figure 2.4). The area has records of the Striped Legless Lizard and forms a logical connection between habitat in east and west Jerrabomberra;
- East Jerrabomberra (Part of Block 49 Jerrabomberra):
  —This area is situated between JE06 and the ACT/NSW border (Figure 2.4) and is habitat for the Grassland Earless Dragon and to a lesser extent Striped Legless Lizard. It provides an opportunity to maintain a habitat connection across the ACT/ NSW border.
- West Majura (parts of Block 3 Section 9 and adjoining Block 2 Section 12 Pialligo):
  —Both sites are adjacent to Majura Road west of the airport (Figure 2.3). This area is also most likely to be habitat for the Striped Legless Lizard and provides an opportunity for a connection between grassland in east and west Majura.
- Gungahlin (Kenny):
  —An area of Striped Legless Lizard habitat in degraded native pasture east of Mitchell.
- Baptist Church (Parkes):
  —This area contains a small population of Button Wrinklewort.

3.5.4 Summary of Grassland Sites and Categories

The following table summarises the data on grassland type and area according to the three categories above (s. 3.5.1 to s. 3.5.3). Eighty-one per cent (808 ha) of the remaining natural temperate grassland meets the criteria for Category 1 sites (Core Conservation Sites) where there is a high level of protection in reserves and through Memoranda of Understanding.

Table 3.3: Grassland Types and Areas in Each Category of Grassland Sites in the ACT

	Hectares				
	No. of Sites	TOTAL	NTG	NP	EX
Category 1 (Core)	19	1663	808	714	141
Category 2 (Complementary)	22	421	175	239	7
Category 3 (Landscape and Urban)	6	88	8	71	9
Total	**47**	**2172**	**991**	**1024**	**157**

NTG: Natural Temperate Grassland; **NP**: Native Pasture; **Ex**: Exotic

3.6

Planning and Conservation Issues for Lowland Native Grasslands and Threatened Species Habitats in the ACT

The areas of land in the ACT that contain remnants of the original natural temperate grassland and grassland habitat for species of conservation interest are located in five geographic areas: Gungahlin, Majura Valley, Jerrabomberra Valley, Belconnen, and Central Canberra. The only remaining site in Tuggeranong is included in the Central Canberra group. These areas are the remnants of the original valley floor distribution in the ACT of natural temperate grassland. Each geographic area, sub-units and the key species found in them are described in detail in sections 3.6.1 to 3.6.5.

Planning and conservation issues relevant to the remaining grassland are common across all or most locations and need to be considered regardless of the exact location. The issues are:

- ensuring the core conservation sites (Category 1) (see s. 3.5.1 and Table 3.2) are protected in perpetuity and other sites are afforded appropriate protection and conservation management consistent with their size, condition, location and tenure;
- avoiding, where possible, any further fragmentation of remaining sites through clearing for urban, industrial and infrastructure development and for agricultural purposes;
- providing for ecological connectivity where possible between separated sites, across common boundaries, and with other adjacent natural ecological communities (usually lowland woodland);
- ensuring that selection of protected areas takes into account any information about the genetic variability of remaining species populations;
- restoring (through revegetation or regeneration) patches of vegetation with a low botanical significance rating in natural temperate grassland sites;
- exploring opportunities for restoring substantially modified grasslands and habitats for threatened species;
- increasing the area of occupancy of threatened flora and fauna, particularly where these have small populations or restricted distributions; and
- taking into account the regional context of any grassland and habitat for threatened plants and animals.

3.6.1 Majura Valley

DESCRIPTION

The Majura Valley contains some of the most diverse and valuable areas of natural temperate grassland and habitat for threatened species left in the ACT (Figure 2.3, Table 3.4). The dominant floristic association is *Austrodanthonia* (191 ha), with a small area (17.5 ha) of Wet *Themeda*. Approximately 430 hectares of grassland habitat has been confirmed as supporting threatened species. The biodiversity significance of the area is recognised in the *Canberra Spatial Plan* (ACT Government 2004b). The existing Majura Road that will be upgraded in the future to parkway standard divides the valley into eastern and western sections. There has also been a proposal for a future railway connection from Sydney to the Canberra International Airport. This may be revived given the significant benefits for businesses in the ACT and surrounding NSW. Protection of remaining grasslands and their threatened species will be an important issue as these transport links are planned and constructed, and when subsequent development and employment opportunities are realised.

On both the eastern and western sides of the valley, natural grassland merges with Yellow Box–Red Gum grassy woodland. Woodland–grassland ecotones such as these were identified in the *ACT Lowland Woodland Conservation Strategy* (ACT Government 2004a) as being a priority for protection. The western example is more disturbed than the eastern one due to the intrusion of the Campbell Park offices, Northcott Drive and previous land management practices that have significantly reduced the area of natural temperate grassland. However, habitat for the Grassland Earless Dragon and other threatened species still exists along the woodland–grassland edge of Mt Ainslie Nature Reserve. Only about 12 ha of this area are assessed as being natural temperate grassland, but the extended area of native pasture contains habitat for the Grassland Earless Dragon and the Striped Legless Lizard.

Grassland habitat east of the Majura Road, including that at the Majura Training Area, the Canberra International Airport and Blocks 102 and 146 Majura (approximately 500 ha in total) is one of only a few large contiguous areas containing extensive samples of natural temperate grassland. The area contains *Austrodanthonia* and Wet *Themeda* floristic associations. These grasslands are highly diverse floristically and are habitat for five threatened species typical of natural grasslands (Button Wrinklewort, Striped Legless Lizard, Grassland Earless Dragon, Perunga Grasshopper and Golden Sun Moth).

Table 3.4: Majura Valley: Grassland Types and Conservation Significance

Majura Valley		Area (ha) and Grassland Type NTG, NP, E	Botanical Significance Rating	Wet *Themeda*	Dry *Themeda*	*Austrodanthonia*	*Austrostipa*	*Poa*	Grassland Earless Dragon	Striped Legless Lizard	Golden Sun Moth	Perunga Grasshopper	Button Wrinklewort	Comments	Conservation Category*
Majura Valley East (Majura Training Area)	MA01	113.7 NTG 5.8 NP 7.1 E	2(1)	6.8		106.9			K	K	K	✔	K	Links with extensive woodland	1
Majura Valley East (Air Services Beacon)	MA02	10.7 NTG	2(4)	10.7					K	K	K	✔		Surrounded on three sides by MA01	1
Majura Valley East (Airport)	MA03	73.6 NTG 62.9 NP 67.1 E	3 (1,2,5)			73.6			K		✔	✔		Contiguous with MA01	1
'Malcolm Vale'	MA04	155.4 NP							✔		✔			Contiguous with MA01	2
Campbell Park	MA05	10.9 NTG 0.8 E	3(2)			10.9			K	✔	✔	✔	✔	Links with woodland on Mt Ainslie and contiguous with MA06	1
Majura West	MA06	133.3 NP							K	✔	✔	✔		Links with woodland on Mt Ainslie and contiguous with MA05	1
Total Natural Temperate Grassland		**208.9**		**17.5**		**191.4**									
Total other threatened species habitat		**432.4**													

NTG: Natural Temperate Grassland; **NP**: Native Pasture; **E**: Exotic; **K**: Key habitat; ✔: Species present. * Refer ss. 3.5.1–3.5.3.

Grasslands in the mid-valley floor, west Majura Road, and north of the Majura Training Area are now highly disturbed as a result of soil cultivation and cropping. One record of the Striped Legless Lizard near Majura Road might indicate that in former times the populations of this species (and probably others) were once joined. Maintaining or re-establishing such a link should be a long-term goal for conservation in the Majura Valley.

No natural temperate grassland areas of the Majura Valley have been destroyed or significantly degraded since publication of Action Plan 1 (ACT Government 1997a) although development at the Canberra International Airport has reduced the area of grassland. Surveys undertaken since then have revealed a population of the Striped Legless Lizard at Campbell Park, an extension of the known population of Button Wrinklewort at Campbell Park, and the presence of the Grassland Earless Dragon on Blocks 102 and 146 Majura, between the Training Area and Canberra International Airport. Development of runway infrastructure at the airport in 2001 reduced the area of grassland habitat and required the salvage of five specimens of Grassland Earless Dragon. Future planned works at the airport will have similar impacts.

PLANNING AND CONSERVATION ISSUES

In addition to the issues summarised above (s. 3.6), the following are specific to the Majura Valley:

- Resolving planning proposals, transport and other infrastructure development for the airport and its surrounds, including identifying boundaries of areas to be protected for nature conservation or managed with nature conservation as a primary objective.

  The ACT Planning and Land Authority is undertaking a detailed planning study of the north-south employment corridor along Majura Road (Majura Valley) and the Monaro Highway to the Hume industrial area (Jerrabomberra Valley). The study will identify areas that are significant for biodiversity conservation as well as identifying other environmental issues.
- Maintaining the integrity of the remaining areas and improving the condition of grassland habitats by selective revegetation and weed control, avoiding fragmentation, degradation and impacts from adjacent developments.
- Maintaining ecological connectivity between grasslands and adjacent woodlands at both the eastern and western valley fringes, and if feasible across the Majura Valley.
- Restoring habitat for threatened species on land adjacent to areas with high conservation value. This is particularly relevant to Blocks 53, 102 and 146 Majura adjacent to the Majura Training Area (MA01), to Blocks 687 and 655 near Campbell Park offices and to the Canberra International Airport (MA03).
- Implementing Environment Management Plans for those areas owned or occupied by private organisations or Commonwealth government agencies (Canberra International Airport (Capital Airport Group), Majura Training Area (Department of Defence)).

3.6.2 Jerrabomberra Valley

DESCRIPTION

The Jerrabomberra Valley is similar in many ways to the Majura Valley, with large and significantly diverse areas of natural temperate grassland, a range of threatened flora and fauna, and examples of the grassland–woodland interface. The dominant floristic association is *Austrodanthonia* (172 ha) with *Austrostipa* (84 ha) and Wet *Themeda* (11 ha). Another 430 ha are grassland habitat containing threatened species. The valley is also divided north-south by a major transport corridor, the Monaro Highway. When considering planning and conservation issues in this valley, it is important to recognise similar natural areas in adjacent land in NSW, namely the Letchworth Nature Reserve and rural land known as 'The Poplars', separated from the ACT by the railway and railway easement.

West of the Monaro Highway is a large area (280 ha) of natural temperate grassland and other grassland habitat, with one of the largest remaining populations of Grassland Earless Dragon. Other threatened species found here are the Perunga Grasshopper, Golden Sun Moth and the Pink-tailed Worm Lizard (*Aprasia parapulchella*) (listed as Vulnerable under the EPBC Act (Cwlth)). This grassland was identified in Action Plan 1 (ACT Government 1997a) as being a core area for natural temperate grassland protection. In the south-western and north-western parts of the area, grassland merges with lowland woodland.

East of the Monaro highway, remnant patches of natural temperate grassland (119 ha) are surrounded by native pasture (the two categories totalling 374 ha). This area provides habitat for the Striped Legless Lizard and Grassland Earless Dragon and there are several populations of the Button Wrinklewort (in Woods Lane and Harman Bonshaw North, as well as in Letchworth and 'The Poplars'). Previous land use associated with the Defence communication facility is likely to have resulted in a management regime conducive to the survival of these species, particularly in those areas where there are communication aerials.

Table 3.5: Jerrabomberra Valley: Grassland Types and Conservation Significance

Jerrabomberra Valley		Area (ha) and Grassland Type NTG, NP, E	Botanical Significance Rating	Wet Themeda	Dry Themeda	Austrodanthonia	Austrostipa	Poa	Grassland Earless Dragon	Striped Legless Lizard	Golden Sun Moth	Perunga Grasshopper	Button Wrinklewort	Comments	Conservation Category*
'Mugga Mugga'	JE01	15.0 NTG	4(3)			1.4	13.7								2
'Callum Brae'	JE02	162.7 NTG	5						K					Contiguous with JE03 Links to woodland	1
'Woden Station'	JE03	115.2 NTG 1.7 NP	3			62.8	52.4		K		K	K		Links to woodland	1
Woods Lane	JE04	10.3 NTG	3		10.3								✔	Contiguous with JE05 and Links to Letchworth NR (NSW)	2
'Woden Station' east	JE05	62.2 NTG 7.8 NP 2.0 E	4(3)			44.2			K	K	K	✔		Links to Letchworth NR (NSW)	1
Harman-Bonshaw South	JE06	105.7 NP	5						K	K	✔	✔		Contiguous with JE05	1
Harman-Bonshaw North	JE07	46.3 NTG 68.3 NP	5(4)			46.3			K	K		✔	✔	Contiguous with JE06	1
'Cookanalla'	JE08	81.5 NP	5						✔						2
AMTECH, Fyshwick	JE09	18.0 NTG	4			18.0			✔	✔		✔		Isolated by major roads	2
Tennant St, Fyshwick	JE10	0.3 NTG	3		0.3								✔	Isolated	2
Total Natural Temperate Grassland		**267.4**			**10.6**	**172.7**	**84.1**								
Total other threatened species habitat		**429.7**													

NTG: Natural Temperate Grassland; **NP**: Native Pasture; **E**: Exotic; **K**: Key habitat; ✔: Species present. * Refer ss. 3.5.1–3.5.3.

Providing for ecological connectivity between the high value areas east and west of the highway, across the ACT–NSW border and between grasslands and woodlands is a particular issue for the Jerrabomberra valley. The *ACT Lowland Woodland Conservation Strategy* (ACT Government 2004a) has also identified the importance of these areas for animal movements and maintaining ecological connectivity between and beyond the Majura and Jerrabomberra valleys. The ACT Government has identified Blocks 6 and 12 of Section 18 Jerrabomberra in the southern part of the valley as the location for the ACT prison, subject to environmental and other assessments. This is expected to provide an opportunity to maintain some habitat suitable for east-west connectivity between 'Woden Station' east and the prison. Protection of land known as Mikes Hill adjacent to the Letchworth Nature Reserve and 'The Poplars' provides another opportunity to maintain connectivity and achieve an enlarged area of occupancy for the Grassland Earless Dragon. There are several locations elsewhere in the valley where connectivity between grassland areas should be a consideration as planning and development proposals are progressed into specific developments.

In 2000 the ACT Government ruled out intensive development of the Jerrabomberra Valley to ensure the protection of its environmental values. The ACT Planning and Land Authority has undertaken a planning study of the valley that will inform government decisions about detailed development and conservation opportunities. The study identifies key areas where protection of nature conservation values will be the major objective. In order to ensure that habitat for threatened species is maintained on land leased for rural purposes, the Conservator of Flora and Fauna has issued Conservator's Directions, pursuant to s. 47 of the Nature Conservation Act 1980. These directions require landholders to obtain the prior agreement of the Conservator before carrying out activities (e.g. cultivating, fertilising, cropping) that may damage the conservation values of the land. During 2005, new grassland reserves will be established east and west of the Monaro Highway. They will be the first to ensure protection of Grassland Earless Dragon habitat in the ACT.

PLANNING AND CONSERVATION ISSUES

- Establishing the new nature reserves announced in July 2004 within the context of overall planning for the Jerrabomberra Valley.
- Maintaining the integrity of remaining areas and improving the condition of grassland habitats by selective revegetation and weed control, avoiding fragmentation, degradation and impacts from adjacent developments.
- Maintaining ecological connectivity between grasslands east and west of the Monaro Highway, between grasslands and adjacent woodlands west of the Monaro Highway and between adjacent grasslands on the ACT–NSW border near Queanbeyan.
- Enlarging the area of occupancy of threatened species by restoring suitable habitat on land adjacent to existing or future nature reserves.
- Preparing and implementing Environment Management Plans for those areas owned or occupied by private organisations or government agencies (Harman-Bonshaw (Department of Defence), Southcare Helicopter base, ACT Prison).

3.6.3 Gungahlin

DESCRIPTION

The natural vegetation of the Gungahlin valley was originally a mosaic of natural temperate grassland and lowland grassy woodland, primarily Yellow Box–Red Gum grassy woodland. The *ACT Lowland Woodland Conservation Strategy* (ACT Government 2004a) sets out the priorities for woodland conservation in the area, focussing mostly on the extensive band of woodland from the Federal Highway, through Gooroo and Mulligans Flat and westward to Kinlyside and Hall. Existing and future proposed reserves would protect a significant part (1500 ha) of this area.

In the valley floors natural grassland predominated prior to more recent rural use and urban development, which left three relatively large areas of native grassland and several very small and isolated fragments, to the south and south-east of the Gungahlin town centre. The dominant floristic association is *Austrodanthonia* (93 ha) with Wet *Themeda* (46 ha), *Austrostipa* (36 ha) and Dry *Themeda* (5 ha) (Table 3.6). As a result of a major planning study in 1995, three nature reserves were established (Crace, Gungaderra, Mulanggari) known collectively as the Gungahlin Grassland Reserves.

The location of the three nature reserves was determined on the basis of both the remaining fragments of natural temperate grassland and the known distribution of the Striped Legless Lizard. The reserves include about 160 ha of natural temperate grassland and another 230 ha of habitat occupied by the Striped Legless Lizard. Parts of each reserve are adjacent to one of the others, but are separated by Gungahlin Drive. In the Gungaderra Nature Reserve nearly 16 ha of Wet *Themeda* grassland is contained

Table 3.6: Gungahlin Valley: Grassland Types and Conservation Significance

Gungahlin		Area (ha) and Grassland Type NTG, NP, E	Botanical Significance Rating	Wet Themeda	Dry Themeda	Austrodanthonia	Austrostipa	Poa	Grassland Earless Dragon	Striped Legless Lizard	Golden Sun Moth	Perunga Grasshopper	Button Wrinklewort	Comments	Conservation Category*
Mulanggari Nature Reserve	GU01	58.6 NTG 9.4 NP 0.5 E	2(3)	7.5		51.1				K	K	✔		Linked to GU02; separated by major road	1
Gungaderra Nature Reserve	GU02	41.9 NTG 115.2 NP 30.2 E	5(2,4)	15.7		4.3	21.9	#		K	✔	✔		Linked to GU01, GU03; separated by major road Linked to woodland to the west; small patch of remnant Snow Gum woodland on one slope	1
Grace Hill Nature Reserve	GU03	61.6 NTG 41.1 NP 33.3 E	3(5)	22.5	3.1	35.9				K	K	✔	K	Linked to GU02; separated by major road	1
North Mitchell	GU04	14.8 NTG 1.2 E	3(4)			1.4	13.4				✔				2
Mitchell	GU05	1.6 NTG	3		1.6					✔					2
Belconnen Pony Club	GU06	0.3 NTG	4			0.3									3
Wells Station Road	GU07	0.2 NTG	4				0.2			✔					3
Nicholls	GU08	0.3 NP	4				0.3			✔					3
Total Natural Temperate Grassland		**179.2**		**45.7**	**4.7**	**93.0**	**35.8**								
Total other threatened species habitat		**230.9**													

NTG: Natural Temperate Grassland; **NP**: Native Pasture; **E**: Exotic; **K**: Key habitat; ✔: Species present. * Refer ss. 3.5.1–3.5.3.

An area (6 ha) of degraded native pasture dominated by Poa remains in Gungaderra Nature Reserve.

within a fenced area occupied by the NTL Transmitting Station. A trunk sewer laid across the Gungaderra Nature Reserve in 2004 avoided any natural temperate grassland and minimised impact on the Striped Legless Lizard. The Commonwealth Government assessed the project for its environmental impact under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth).

Since these reserves have been established and the grazing management altered to promote conservation values, populations of Button Wrinklewort, Perunga Grasshopper, and Golden Sun Moth have been recorded during monitoring by Environment ACT ecologists. Vegetation surveys undertaken in 2003–4 indicate that in Crace Nature Reserve, the area dominated by native species has increased since 1995. The Gungaderra Nature Reserve protects a small example of the interface between grassland and woodland on the southern slopes of Gungahlin Hill, near the Barton Highway. The Grassland Earless Dragon has never been recorded in the Gungahlin Valley.

Small areas of natural temperate grassland are also located in Mitchell and north of Mitchell (west of the junction between Flemington Road and the future Wells Station Drive), at the foot of Percival Hill and on Wells Station Road. The Striped Legless Lizard is found in several locations across Kenny in habitat that no longer represents natural temperate grassland. Small populations have been recorded at Percival Hill, CSIRO (Sustainable Ecosystems), the Gungahlin Cemetery and at Palmerston, but never above 620 m asl.

PLANNING AND CONSERVATION ISSUES

The distribution of natural temperate grassland and related habitat for threatened species (particularly the Striped Legless Lizard) was the subject of a significant planning study by Williams *et al.* (1995) that resulted in a major change to the *Territory Plan* (ACTPLA 2003). As a result of this, the location for the Gungahlin Town Centre and other planned developments were moved to permit establishment of the Gungahlin Grassland Reserves. Consequently, the planning and conservation issues in Gungahlin are not as great as in other areas, although some remain. These are:

- Resolving the future status of natural temperate grassland at Flemington Road.
- Improving the condition of grassland habitats protected in reserves, particularly addressing impacts from adjacent residential developments as these are built.
- Providing ecological connectivity between the Gungahlin Grassland Reserves.
- Investigating the potential for small areas of habitat in Kenny occupied by Striped Legless Lizard to be retained as part of the urban fabric (road reserves, public parks, large area developments).
- Preparing and implementing Environment Management Plans for those areas owned or occupied by private organisations or government agencies (Gungahlin Cemetery, CSIRO (Sustainable Ecosystems)).

3.6.4 Belconnen

DESCRIPTION

The pattern of urban development in the area now occupied by Belconnen is similar to that seen elsewhere in Canberra, with large areas of former natural temperate grassland changed initially through rural land uses and subsequently cleared for residential development. Nevertheless, 175 ha of *Austrodanthonia*, 57 ha of *Austrostipa*, 53 ha of Dry *Themeda* and 15 ha of Wet *Themeda* remain in the area (Table 3.7). A much higher proportion of the remaining native grassland in Belconnen is assessed as natural temperate grassland compared with Gungahlin, and the Majura and Jerrabomberra valleys.

As a result of security fencing of land at Lawson for the Belconnen Naval Station (Department of Defence communications facility) and minimal disturbance, about 120 ha of natural temperate grassland (*Austrodanthonia*) remains in very good condition, supporting the largest population of the Golden Sun Moth in the region. In 1994, a previously undescribed species of herb was found on the site, and is the only known population of the species. It was named the Ginninderra Peppercress (*Lepidium ginninderrense*) and is now listed as an endangered species in the ACT and nationally. The Perunga Grasshopper has also been found there, but repeated searches for the Grassland Earless Dragon have failed to record any. In 2001 a small area of *Themeda* grassland containing the Striped Legless Lizard was found near Baldwin Drive during ecological studies associated with planning for the future suburb of Lawson.

It is anticipated that as a result of the planning studies for Lawson carried out by ACT and Commonwealth Government agencies, Category 1 grassland will be identified for declaration as a new nature reserve that protects a core ACT grassland site and the significant population of the Golden Sun Moth.

If a grassland nature reserve is established at Lawson, it is likely to retain an existing population of Eastern Grey Kangaroos. Whether this will remain a viable option in the long-term will depend upon development

Table 3.7: Belconnen: Grassland Types and Conservation Significance

Belconnen		Area (ha) and Grassland Type NTG, NP, E	Botanical Significance Rating	Wet *Themeda*	Dry *Themeda*	*Austrodanthonia*	*Austrostipa*	*Poa*	Grassland Earless Dragon	Striped Legless Lizard	Golden Sun Moth	Perunga Grasshopper	Button Wrinklewort	Comments	Conservation Category*
Ginninderra Experimental Station	BE01	18.9 NTG 0.5 E	4		18.9										2
Dunlop Nature Reserve	BE02	81.9 NTG	3(2)	4.9		77.0					✔			Important habitat for uncommon plant species in Wet *Themeda* area	1
'Jarramlee'	BE03	52.0 NTG	4(3)	4.7			47.3								2
Umbagong Park	BE04	9.0 NTG 1.8 NP 4.7 E	4(3,5)		8.0	0.8	0.2								2
Evatt powerlines	BE05	1.1 NTG	3		1.1										2
Lake Ginninderra	BE06	1.9 NTG	3		1.7	0.1					✔				2
Lawson (Territory)	BE07	3.3 NTG 46.9 NP 9.1 E	5(3)		1.1	2.2									3
Lawson (Commonwealth)	BE08	120.3 NP	2(3,4)	2.9	16.5	91.2	9.8			✔	K	✔	K		1
Kaleen east paddocks	BE09	4.0 NTG 24.2 NP	5(3)			4.0				✔					3
Caswell Drive	BE10	5.8 NTG	2	2.3	3.5									Links to Snow Gum Woodland and other woodland	1
Glenloch Interchange	BE11	2.2 NTG	2	2.2										Links to Snow Gum Woodland and other woodland	1
Total Natural Temperate Grassland		**300.4**		**14.8**	**53.0**	**175.3**	**57.3**								
Total other threatened species habitat		**87.2**													

NTG: Natural Temperate Grassland; **NP**: Native Pasture; **E**: Exotic; **K**: Key habitat; ✔: Species present. * Refer ss. 3.5.1–3.5.3.

of a humane method for fertility control of the kangaroo population, an ability to protect kangaroos from domestic dogs, and successful management of visitors to the reserve. The existing buildings that are used to manage the communications facility may lend themselves to subsequent uses that complement the nature conservation objectives of the area.

At Glenloch interchange, small fragments of the former grassland now remain within the existing road network. Designs for development of this road system as part of the Gungahlin Drive extension project retain all of the grassland. Across Caswell Drive there is another area of natural temperate grassland that adjoins the Aranda Bushland, including areas of Yellow Box–Red Gum grassy woodland and Snow Gum woodland. This ecological interface was identified in the *ACT Lowland Woodland Conservation Strategy* (ACT Government 2004a) as being of significance and warranting protection. A small area of the natural temperate grassland on the roadside of Caswell Drive is to be removed as a part of the Gungahlin Drive Extension.

Elsewhere in Belconnen, land containing natural temperate grassland is found along the ACT–NSW border at 'Jarramlee', the Ginninderra Experimental Station and at Dunlop. An area of natural temperate grassland (containing Wet *Themeda* and *Austrodanthonia* floristic associations) and Yellow Box–Red Gum grassy woodland was excised from land proposed for residential development at Dunlop and included in the Dunlop Nature Reserve. Other small areas of natural temperate grassland are found in open space at Evatt and Florey e.g. Umbagong Park contains nine hectares of natural temperate grassland.

The Striped Legless Lizard has been recorded at several locations at Kaleen, in land between the existing suburb, the Barton Highway and the future Gungahlin Drive Extension. These animals are likely to have been connected to populations at Crace, and their ability to maintain a viable population is unknown.

PLANNING AND CONSERVATION ISSUES

- Resolving planning issues for the new suburb of Lawson, and protecting those areas that have natural values as future nature reserve or other open space.
- Preventing any future development or inappropriate activities on Umbagong Park (south) (requiring variation to the *Territory Plan*).
- Ensuring protection and conservation management of grassland remnants in close proximity to developments such as the Gungahlin Drive Extension.
- Improving the condition of grassland and threatened species habitats by appropriate management, including weed control.
- Establishing an appropriate management regime for any areas of grassland protected at Lawson, including management of the kangaroo population.
- Preparation of Environment Management Plans for those areas owned or occupied by private organisations or government agencies.
- Maintaining habitat for Striped Legless Lizard within the small fragmented areas in Kaleen.

3.6.5 Central Canberra and Tuggeranong

DESCRIPTION

Grasslands in the Central Canberra area now comprise only twelve, small remnants (totalling 37 ha), each well separated from the others. Restoring ecological connectivity between these remnants is impossible. However, some of the remaining areas are of high quality and retain sufficient suitable habitat to support small populations of some threatened species. These remnants are reminders, in the central part of the city, of the previous natural landscape.

The largest remaining native grassland remnant in Central Canberra is at Yarramundi Reach. A population of the Striped Legless Lizard (*Delma impar*) has been recorded and monitored for a number of years. It appears that there may be some inter-specific interaction with a related species *Delma inornata* that is displacing *Delma impar* from this habitat. It will be of interest to monitor this over time.

Both the Yarramundi and Glenloch interchange grasslands (Table 3.8) are included in a National Capital Authority study of land uses and land use policies in the western foreshores area of Lake Burley Griffin following the bushfires of December 2001 and January 2003 (Capital Planners Pty Ltd 2004).

Other small fragments of grassland are located in Yarralumla (Dudley St, Kintore St, Novar St, Black St and Lady Denman Drive adjacent to the Royal Canberra Golf Course), in Campbell (CSIRO corporate headquarters on Limestone Avenue) and in Reid (Constitution Avenue).

A small but significant area (BSR 1) of natural temperate grassland (Dry *Themeda*) in very good condition remains in Barton on land occupied by the Australian Centre for Christianity and Culture and the Anglican Church (St Marks Theological College). The site is unusual in that it is little disturbed by exotic weeds or human activities, and populations of Button

Table 3.8: Central Canberra and Tuggeranong: Grassland Types and Conservation Significance

Central Canberra/Tuggeranong		Area (ha) and Grassland Type NTG, NP, E	Botanical Significance Rating	Wet *Themeda*	Dry *Themeda*	*Austrodanthonia*	*Austrostipa*	*Poa*	Grassland Earless Dragon	Striped Legless Lizard	Golden Sun Moth	Perunga Grasshopper	Button Wrinklewort	Comments	Conservation Category*
CSIRO Headquarters, Campbell	CC01	3.0 NTG 0.5 E	3		3.0						✔				2
Constitution Avenue, Reid	CC02	0.7 NTG	3		0.7						✔				2
St John's Church Reid	CC03	0.9 NTG	4			0.9					✔				2
ACCC, Barton	CC04	1.9 NTG	1		1.9						✔		✔		1
York Park, Barton	CC05	0.4 NTG	4			0.4					✔				2
Yarramundi Reach	CC06	21.2 NTG	3(5)		4.8		16.4	#		✔ ?		✔			2
Lady Denman Drive, Yarralumla	CC07	0.4 NTG	3			0.4									2
Dudley Street, Yarralumla	CC08	1.5 NTG	3	0.9		0.6					✔				2
Kintore Street, Yarralumla	CC09	0.8 NTG	3		0.8								✔	Only one Button Wrinklewort present	2
Novar Street, Yarralumla	CC10	0.2 NTG	4				0.2								3
Black Street, Yarralumla	CC11	3.6 NTG	3		3.6						✔				2
Isabella Pond, Monash	TU01	1.2 NTG	2		1.2										1
Total Natural Temperate Grassland		**35.8**		**0.9**	**16.0**	**2.4**	**16.6**								
Total other threatened species habitat		**0.7**													

NTG: Natural Temperate Grassland; **NP**: Native Pasture; **E**: Exotic; **K**: Key habitat; ✔: Species present. * Refer ss. 3.5.1–3.5.3.

A very small remnant (less than 0.2 ha) of degraded native pasture dominated by *Poa* remains in the Yarramundi Reach site.
? Striped Legless Lizard was last recorded on the site in 1991. Surveys to determine presence are continuing.

Wrinklewort (approximately 100 plants) and Golden Sun Moth are located there. Considerable cooperative effort over several years by a range of government agencies and other organisations has endeavoured to retain the conservation values of the grassland while at the same time allowing for a major development in the immediate area. The lease for the area identifies the grassland as requiring conservation management according to an Environment Management Plan agreed to by the Conservator of Flora and Fauna. The Button Wrinklewort is also found in substantially modified native grassland in the grounds of the Baptist Church in Barton.

At York Park, Barton another very small fragment of natural temperate grassland (*Austrodanthonia*) that is highly modified is being maintained by the National Capital Authority. The half-hectare site contains a small population of Golden Sun Moth. The Authority carries out weed control and other management activities under an MOU with Environment ACT.

The original vegetation of what is now the Tuggeranong Valley was largely natural temperate grassland. Now, only one small area (about 1 hectare) of natural grassland remains next to Isabella Pond.

PLANNING AND CONSERVATION ISSUES

- Improving the condition of small grassland remnants and threatened species habitats by appropriate management, including weed control.
- Establishing an appropriate management regime for areas of grassland that are retained around Lake Burley Griffin, particularly at Yarramundi Reach.
- Preventing any future development or inappropriate activities on Isabella Pond, Monash (requiring a variation to the *Territory Plan*).
- Preparing and implementing Environment Management Plans for those areas owned or occupied by private organisations or government agencies (Yarramundi Reach (National Capital Authority), Australian Centre for Christianity and Culture, Barton (Anglican Church)).

3.7

Management of Native Grassland for Conservation

3.7.1 Best Practice Management and Adaptive Management

A central management objective for the remaining areas of native grassland in the ACT is to maintain or improve their ecological condition and habitat quality (see s. 4.2). Management that is regarded by experts in a particular field to be of the highest standards at the time is termed ‘best practice management’. In the context of biodiversity conservation, best practice management is that which promotes biodiversity and healthy ecosystem function. Details of a best practice approach to conservation of native grasslands are outlined in Ross (1999, pp. 25–42) who suggests five main elements for a systematic and comprehensive conservation program:

- knowledge gathering and processing;
- priority setting;
- strategic planning;
- developing the means to achieve conservation objectives; and
- stewardship and management.

The approach outlined by Ross is based on experience from grassland extension programs in Victoria and includes advice based on the ‘lessons’ learned from that program.

Guidance on protecting natural heritage through conservation planning, based on the principles, processes and practices outlined in the *Australian Natural Heritage Charter* (AHC 2002) is provided by the Australian Heritage Commission (AHC 2003). The following is based on this approach, adapted for native grassland:

- Obtaining and studying evidence about native grassland.
  (This includes evidence for: (i) the characteristics of the ecological community that existed prior to European settlement and the effects of Aboriginal people on the grassland environment; (ii) how the ecological community has changed since European settlement and what disturbance factors have been involved.)
- Identifying/involving ‘stakeholders’
  (Those people or groups with an interest in native grassland and those who have native grassland on lands they own or manage.)

- Assessing the physical condition of a native grassland area and identification of management issues.
  (This involves an assessment of the condition and natural integrity of the place and the threats to that natural integrity. A clear understanding of management issues is necessary to determine an appropriate conservation policy and required management actions in a management plan.)
- Determining the natural significance of a native grassland area.
  (This is derived primarily from an assessment of botanical significance and the presence of threatened/uncommon flora and fauna. Grassland areas may also have other values e.g. aesthetic, cultural heritage.)
- Developing conservation policy or objectives.
- Developing and implementing the conservation (or management) plan.
- Monitoring the results and reviewing the plan.

ADAPTIVE MANAGEMENT

Though there have been significant advances in knowledge of native grassland in south-eastern Australia over the last two decades, many aspects remain uncertain. Within an overall objective of maintaining and improving grassland biodiversity, an appropriate response to this uncertainty is to apply 'adaptive management' to remaining grassland areas. Adaptive management allows for the testing of management practices *in situ* to determine if they are achieving the desired outcomes, and adapting them as required. Adaptive management requires that clearly defined objectives be developed, based on current knowledge of the vegetation community, associated species and their responses to management. It is critical that both the management goals and on-ground management be subject to ongoing review (Bruce and Lunt 2003). The results of the management regime that is established must be monitored, so that its effectiveness can be assessed and management practices modified as required. Monitoring assists in distinguishing between seasonal fluctuations in the abundance of particular species and long-term changes to species and site characteristics (Sharp 1998).

An important part of this adaptive management approach is the recognition that flexibility is required in the management techniques applied to particular grasslands. Grassland structure and composition differ dramatically between sites in different regions, and between sites with different soils and management histories in the same region. Consequently, no single management regime will be suitable for all species and all sites in all regions (Lunt 1995). Where sites contain threatened species, management must take account of the requirements for their survival (Rowell 1994; Sharp 1995). There is now widespread acceptance by grassland ecologists of the need to adopt site-specific management approaches within the more general theoretical and empirical framework of native grassland management.

Environment ACT has adopted a step-by-step guide to the preparation and implementation of site-based management plans outlined in Sharp *et al.* (2005).

3.7.2 Key Aspects of Best Practice Management of Native Grassland

Increased attention given to the conservation of native grassland over the last two decades has resulted in a better knowledge of management requirements for long-term conservation though much still remains to be understood. A number of management guidelines have been published (Barlow 1998 (Victoria); Department of Conservation and Environment 1992 (Melbourne area); Diez and Foreman 1996 (Riverine Plains); Dorrough 1996 (Monaro); Eddy 2002 (based on NSW Southern Tablelands but written in general terms). A grassy ecosystem management kit (Sharp *et al.* 2005) provides a guide to developing management plans for native grassland based on current best practice and adaptive management. The kit highlights the importance of managing grass biomass in a way that is most suitable to individual remnants, rather than adopting the more prescriptive approaches that were sometimes advocated in the 1990s.

MANAGEMENT OBJECTIVES

It is essential to define specific management objectives for grassland remnants (Robertson *et al.* 2000; Sharp 2000). These objectives may vary from one remnant to another, within the broad goals and objectives for native grassland conservation. Specific management objectives may include: maintaining the structure and integrity of the community; managing biodiversity and/or particular flora and/or fauna species; removing or controlling threats; and maintaining a certain amount of biomass. Sharp (1995) and Sharp and Rehwinkel (1998) recommended a site-specific management approach. Where sites contain threatened species, management must take account of their requirements for survival (Sharp 1995; Rowell 1994).

The broad management goal for natural temperate grassland in the ACT is to maintain it in perpetuity as a viable and well-represented ecological community (Table 4.1). Achieving this goal and supporting objectives requires maintaining ecosystem processes

(Williams *et al.* 1991; Williams *et al.* 1995), maintaining dominant species, and maximising or enhancing species diversity and structural complexity (ACT Government 1997a; Rowell 1994; Sharp 1995; Sharp and Rehwinkel 1998). It also requires maintaining soil and existing drainage conditions, controlling plant introductions and weediness, removing biomass through appropriate defoliation regimes to enable native plants to flower, set seed and allow their seedlings to establish, and if possible maintaining connectivity between natural temperate grassland remnants and between them and other native grassland, woodland or naturally vegetated areas (ACT Government 1997a; Environment ACT 2005). Where native tree species are a natural component of the grassland, these should be managed as an integral part of the community (Eddy 2002; Sharp and Rehwinkel 1998).

Ideally, management actions should be tailored to the specific habit, habitat and life cycle requirements of individual species in the grassland (Wildlife Research Unit 1994; Williams *et al.* 1995). Such information is generally available for threatened plants and animals in various action plans and recovery plans (see ACT Government 1997a-c, 1998 a-b, 1999, 2004a; NSW NPWS 2000; Osborne and Jones 1995; Robertson and Cooper 2000; Smith and Robertson 1999; Zich *et al.* 1995). However it is rarely available for all the component species in a grassland remnant. In these situations categorising species into broad ecological types (for example dominant tussock grasses, inter-tussock perennial forbs, and inter-tussock annuals) may assist in the development of particular management regimes (Lunt 1995).

Where growth-form data allow the effect of different forms of management to be predicted; Lunt (1995), McIntyre (1995) and Tremont and McIntyre (1994) noted that such knowledge might also be useful in developing specific management regimes. For example, Lunt (1995) noted that mowing or grazing generally select for small rather than tall species, while low rosette plants or creeping species will survive best where there is little competition for light from dominant grasses. Small annuals will generally increase in abundance in open grazed areas, while tall upright species have a greater ability to survive thick grass. Barrer (1993) noted that mowing can discriminate against taller and slower-maturing species, and considered that herbs such as the endangered Button Wrinklewort (*Rutidosis leptorrhynchoides*) were unlikely to survive annual mowing.

In the absence of detailed knowledge about the requirements of individual species in grasslands and the effects of management activities on them, a 'default' management approach has been widely espoused (e.g. ACT Government 1997a). This involves continuing the previous management at particular sites, if it has resulted in the maintenance of high quality grassland and/or the continued presence of threatened species. However, given the threatened status of the natural temperate grassland ecological community and species within it, the continuing spread of weeds, and the possibility that the past disturbance regime has been causing a slow loss of biological diversity, this approach needs to be kept under review for each site. As noted in s. 3.2.1, a literature review on the use of grazing for management of biomass in native grasslands has been prepared (Lunt 2005).

DISTURBANCE

Natural temperate grassland remnants require active management and monitoring, in part because their small size leads to greater external impacts and likelihood of species becoming locally extinct (Williams *et al.* 1991;Williams *et al.* 1995). It is widely accepted that natural temperate grasslands need appropriate disturbance as part of a specific management regime, both on- and off-reserve to maintain their conservation values (ACT Government 1997a; Eddy 2002; Environment ACT 2005; Lunt and Morgan 2002; McIntyre 1995).

The main type of disturbance needed for management is highlighted in a 'model' of *Themeda triandra* dominated natural temperate grassland, developed by Lunt and Morgan (2002). These authors note that grasslands are characterised by the following features:

- A dominant, vigorous perennial grass that rapidly out-competes associated species (mostly forbs) through the accumulation of biomass which reduces the amount of light available for inter-tussock species.
- Inter-tussock spaces that provide the habitat for many smaller forb species. These are predominantly perennials; growing, flowering and setting seed in spring and early summer and dying back to buds or tubers at or below ground level over summer. This vegetative 'bud and tuber bank' is critical for the persistence of the species.
- Many perennial native inter-tussock species that possess small, transient soil seed banks, and whose seedling recruitment appears to occur infrequently;
- With appropriate climatic conditions, plants that flower and set seed abundantly when biomass levels are low.
- Many plants that will die beneath the dense grass sward if the biomass is not removed. In the absence of a persistent soil seed bank, the species

may become locally extinct, especially in small isolated remnants.

Under this model, the key disturbance required is managing the biomass of the dominant grass (e.g. by burning, mowing/slashing and/or grazing) to maintain its health and retain a high diversity of forb species (Lunt and Morgan 2002). These authors comment that perennial grasses such as *Austrodanthonia* and *Austrostipa* typically have less biomass and shorter life spans than *Themeda triandra* or *Poa* species, and thus removal of their biomass through management actions is not necessarily required in order to retain the floristic diversity of the communities they dominate.

Although the above model was based predominantly on detailed studies of natural temperate grassland in southern Victoria, it appears to be generally applicable to the natural temperate grassland in the Southern Tablelands (R. Purdie pers. comm.). For example, grasslands on the Monaro also contain a high proportion of forbs that are perennials with protected reproductive buds (Costin 1954), and biomass control is a critical aspect of the proposed management of natural temperate grassland remnants (e.g. Environment ACT 2005; see also Benson 1997; Rowell 1994). Sharp (pers. comm.) considers that biomass management should be based on removing biomass 'as often as is necessary' (i.e. without causing adverse effects) to maintain inter-tussock species, noting that the frequency of biomass removal will vary with different dominant grasses and seasonal variation.

Activities that should generally be avoided in conservation based disturbance of grassland include ploughing, earthworks that alter drainage patterns, clearing, rock removal, cultivation, pasture improvement, adding fertiliser, excessive livestock grazing, topsoil removal, and stockpiling, dumping or spreading of soil (Eddy 2002; Wildlife Research Unit 1994; Sharp and Rehwinkel 1998). Prolonged intensive uses that may reduce plant cover and cause soil compaction, disturbance or erosion should also be avoided (ACT Government 1997a). Exotic or non-local tree or shrub species should not be planted, and self-sown exotic or non-local trees and shrubs removed (Eddy 2002). Introduced pest animals such as rabbits, cats, pigs and foxes should also be controlled (Eddy 2002). It is important to avoid grassland areas becoming shaded from tree planting or the construction of buildings (Dorrough 1996; Environment ACT 2005).

MOSAIC MANAGEMENT

When using destructive management practices to remove biomass, a mosaic management approach should be adopted. This is preferable to applying such practices uniformly across entire remnant areas (Dorrough 1996; Sharp and Dunford 1994; Sharp and Rehwinkel 1998). Williams *et al.* (1991) and Williams *et al.* (1995) also stressed the importance of maintaining a diversity of patch types (e.g. burnt and unburnt) between remnants as well as within high conservation value areas. Such mosaics or patchiness are needed to ensure that features reported to be important for grassland conservation, such as structural diversity and optimum habitat for animal and plant species are always present (Rowell 1994; Sharp 2000; Williams *et al.* 1991).

In natural temperate grassland in southern Victoria, Lunt (1995) noted that the regular use of any particular management regime (e.g. frequent mowing or grazing) would strongly select for some species and lead to a reduction in species diversity and structural complexity. He advocated the use of a combination of management techniques, such as integrated burning or mowing with seasonal grazing or selective applications of herbicides.

Sites adjacent to high quality grassland remnants need to be managed sympathetically to avoid adverse effects such as run-on of water containing fertilisers, herbicides or pollutants, weed invasion, unplanned fires and trampling (Sharp and Dunford 1994; Sharp and Rehwinkel 1998; Williams *et al.* 1995). Williams *et al.* (1995, p. 66) noted that each adjacent land use had a characteristic set of possible impacts on conservation areas. They provided a table showing the level of compatibility of a range of adjacent uses with conserving the threatened Striped Legless Lizard (*Delma impar*). This approach can be applied more widely to other threatened species.

MONITORING

The importance of monitoring in a best practice management regime for grassland areas has been discussed in s. 3.4.2.

3.7.3 Rehabilitation, Regeneration and Restoration of Native Grassland

As noted in s. 2.1.7, some form of degrading disturbance threatens all grassland remnants even those in permanent reserves, and it is difficult to find sites not invaded by weeds. In this context, the rehabilitation of grassland remnants will take an increasingly important role in grassland management. The small size, fragmentation and proneness to weed invasion of remaining grassland areas pose particular difficulties for management (see s. 3.4.6).

Native grasslands are highly dynamic by comparison with other vegetation communities in which a higher proportion of the biomass is relatively 'fixed' in woody

tissue that can stand for many years. Perennial grasses form the structural backbone to the ecological community, yet this structure can fluctuate dramatically with the seasons and in response to soil moisture, temperate, frost, grazing, fire and human activities. Though most of the plants in the grassland community are perennials, many of them can reach productive maturity in their first growing season, and produce seed and recruit new plants under favourable conditions. Because native grasslands can show such a high rate of turnover, of both biomass and individual plants, disturbance to either the biomass or plant population can change substantially the structure or composition of the grassland in a short period (Eddy 2002). The dynamics of grassland, including the rapid response to changed management or climatic conditions, and the difficulty in distinguishing between short-term fluctuations and long-term detrimental change, highlight the need for regular monitoring (Sharp 1999).

Rehabilitation of native grasslands may involve regeneration, restoration or reinstatement that represent progressively greater degrees of human intervention. Definitions adopted for this *Strategy* are from the *Australian Natural Heritage Charter*, 2nd Edit. (AHC 2002).

- *Regeneration* means the natural recovery of natural integrity following disturbance or degradation.

Regeneration is essentially dependent on natural processes. It does not include physical intervention, but should be accompanied by monitoring and protection measures that do not create degradation. However, intervention is now required in native grasslands, particularly with regard to defoliation management. Native grasslands have evolved under a defoliation and disturbance regime (burning, defoliation by large and small animals, and ground disturbance by animals and in some grassland areas by Aboriginal people harvesting edible tubers). Defoliation is a requirement for natural regeneration and the appropriate type for individual grassland sites is a major management issue. While current management of native grasslands is directed mainly towards a self-sustaining condition based on natural regeneration, increased intervention to deal with threats such as weed invasion will be necessary for many significant grassland areas.

- *Restoration* means returning existing habitats to a known past state or to an approximation of the natural condition by repairing degradation, by removing introduced species or by reinstatement.

Native grassland restoration is discussed also in s. 3.4.5. A restoration process implies sufficient evidence of an earlier state to guide the conservation process. While historical and other records, and the existence of sites that appear relatively undisturbed provide some guidance, the actual species composition of the pre-European grasslands is unknown. Restoration activities, consistent with the natural significance of the place, should therefore be focussed on maintaining and improving the biological diversity of the site and improving the overall condition of the remnant (Kirkpatrick *et al.* 1995, p. 87). Restoration activities mostly involve grass and litter removal to promote growth and survival of inter-tussock herbs, weed control, and specific actions to provide suitable conditions for the survival of threatened plant and animal species (Kirkpatrick *et al.* 1995; Lunt 1995; Ross 1999).

- *Reinstatement* means to introduce to a place one or more species or elements of habitat or geodiversity that are known to have existed there naturally at a previous time, but that can no longer be found at that place.

For the foreseeable future, reinstatement is unlikely to be part of native grassland management except on a very small scale or for particular purposes. While there is clearly a role for restoration of existing remnants that might include some specific reinstatement, large-scale expansion or 're-creation' of native grasslands is not feasible with current knowledge, technology and funding (Ross 1999). However, establishment of native grass swards, using seed stock of known provenance, is becoming a practical and economic proposition in buffer areas to native grassland. This approach has been used in parts of the ACT e.g. Barton Highway road verges near Crace Grassland Reserve.

PURPOSES OF REHABILITATION

Generalised purposes of rehabilitation of native grasslands include:

- maintaining and restoring native grassland as a unique Australian ecosystem;
- providing for, or increasing connectivity for animal movement (this may include connectivity through areas of lower quality native grassland and to other ecological communities e.g. lowland woodland);
- increasing the size of remnants to improve resilience to external threats, increase animal habitat, increase landscape heterogeneity and minimize the impact of edge effects from adjacent land uses;
- restoring specific habitat elements for reptiles, birds, small mammals and invertebrates especially for threatened species;
- mitigating against erosion and to control salinity;

- rehabilitating weed infested areas in otherwise good sites; and
- replacing inappropriate introduced species.

PRINCIPLES FOR RESTORATION

Principles for undertaking regeneration and plant restoration activities (after Eddy 2002 and McIntyre *et al.* 2002) are:

- ensure that the reasons for undertaking the activities are clear, that the project is viable, and that the activities will achieve the desired outcomes;
- consider managing to increase natural regeneration before undertaking planting to recreate habitat;
- encourage natural regeneration by controlling grazing and weeds, using fire, and preventing erosion or soil compaction;
- where possible, collect seed for restoration activities from local populations to maintain local genetic provenances;
- avoid soil disturbance when undertaking rehabilitation activities;
- avoid tree planting in native grassland areas. Remove self-sown exotic trees and native trees where these have not been previously part of the grassland;
- use restoration to provide buffer areas to core conservation areas, to increase size of remnants and to enhance connectivity; and
- minimise opportunities for re-invasion by introduced species after rehabilitation.

RESTORATION OF HABITAT FOR FAUNA

To restore habitat for fauna, an essential management objective for native grassland is to maintain or improve the diversity of its structure and species composition (see s. 3.4 and Fauna Habitat Management in s. 3.7.5). Williams *et al.* (1995) suggest that rehabilitation of fragmented habitats be considered as a means of increasing overall size, buffering and interconnection. There are few examples of projects in native grassland aimed specifically at restoration of habitat. This reflects limited knowledge of species requirements, uncertainty surrounding outcomes, and the high initial and ongoing cost of such activities. There is a need for ongoing research into, and experimentation with methods of rehabilitating grassland habitats.

An attempt to re-establish *Austrodanthonia* grassland and re-introduce the Golden Sun Moth at the Victorian Open Range Zoo (Werribee, Victoria) indicates some of the challenges involved in such an activity including site preparation, sourcing of seed, and obtaining female moths (O'Dwyer 2003).

3.7.4 Defoliation Management

As noted previously, some form of defoliation is essential to maintaining the structure and botanical composition of most native grasslands (Eddy 2002). Without regular removal of some herbage, excess grass will accumulate and die, and can inhibit the growth of many plant species in the sward. Inter-tussock forbs are particularly affected; however there may be also loss of vigour of dominant grasses e.g. Kangaroo Grass. The amount of defoliation required is related to the productivity of the site and the dominant grass species found there. Productive areas carrying Kangaroo Grass or *Poa* tussock will need more intensive treatment than areas of poorer soils carrying spear and wallaby grasses which have much less biomass and shorter life spans (Eddy 2002; Lunt and Morgan 2002).

The three main forms of grassland defoliation are grazing, mowing and slashing, and burning. Eddy (2002) has outlined recent thinking on best practices for grassland management and much of the following and s. 3.7.5 has been drawn from his management guide. This guide and the references cited in s. 3.7.2 should be consulted for more detail.

GRAZING

Natural temperate grassland evolved under the influence of grazing herbivores. Since European settlement, grazing by domestic livestock has been, and is likely to continue to be, the primary use and main method of defoliation in native grasslands. Grazing by domestic stock has had an incalculable effect on the composition and structure of lowland grasslands and grassy woodlands (Lunt 1991) and to the ecosystems as a whole (Freudenberger 2000). Grazing by domestic stock, kangaroos and rabbits is not indiscriminate in its effects on plants (Sharp and Rehwinkel 1998). Grazing by sheep is considered to be more destructive than by cattle (Moore and Biddiscombe 1964 in Lunt 1991). All native grasslands are affected by grazing but this depends on its timing, selectivity, intensity and duration.

The effects of stock grazing in native grasslands have been:

- soil compaction and erosion;
- selection pressures that eliminate more palatable species and allow the less palatable to survive;
- loss of taller and more succulent species (e.g. lilies and orchids) and palatable forbs (e.g. Yam Daisy *Microseris lanceolata*);
- increases in nutrients, especially stock camps that become dominated by exotic weeds; and

- change in community dominants e.g. tall perennial grasses such as Kangaroo Grass are replaced by spear and wallaby grasses and then by introduced, annual grasses and herbs.

(Eddy 2002; Lunt 1991, 1995; Sharp and Rehwinkel 1998)

Where native grassland sites have been maintained under light grazing, continuation of grazing may be the best form of management (Scarlett *et al.* 1992). In some situations, this may be the best way known to control specific weeds or to retain control over biomass production, where alternatives such as burning and mowing may not be possible. In some instances, it may be appropriate to re-orient the management activity e.g. by changing the purpose of grazing from just animal production to also achieving conservation objectives (Sharp and Rehwinkel 1998). Good management of grazing pressure in grasslands requires sound stock proof fencing (Eddy 2002). The use of grazing as a management tool should be carefully monitored and literature on the effects of grazing kept under review. Total grazing pressure needs to be considered (domestic stock, native and feral animals) to ensure a holistic approach to grazing management.

In designing a suitable grazing management regime, the timing, selectivity, intensity and duration of grazing need consideration (Eddy 2002):

- *Timing:* Native grassland must be allowed to grow freely enough to replenish root reserves, flower and set seed or it will inevitably deteriorate. During flowering and seed production (mainly late spring to early summer), grazing should be light or completely removed.
- *Selectivity:* All grazing animals have preferences for certain species and parts of plants over others. Grazing animals are most selective under continuous light set-stocking. Higher stocking for a shorter period can reduce this effect, however stock management of this type is more intensive and must be undertaken carefully.
- *Intensity and duration:* Maximising the harvest of herbage by livestock in order to maximise production tends to result in loss of the tall and diverse structure of grasslands and a shorter and more even grassland structure. The consequences are loss of species, habitat and ecosystem resilience. When herbage quality or quantity becomes too low to maintain livestock condition, stock should be moved rather than supplementary fed, to protect the grassland from over-grazing and excessive trampling.

MOWING AND SLASHING

Mowing and slashing are used in small grassland remnants such as urban areas and cemeteries and on roadsides where there may be small grassland patches. Biomass removal is often based on landscape aesthetics, pedestrian access, and fire hazard reduction. Mowing has the effect of maintaining open structured grassland conducive to the germination of a wide range of wildflowers associated with native grasslands. Any mowing/slashing regime should allow for periods of good plant growth between each mowing and permit the grassland species to flower and set seed at least every few years. Grassland should not be mowed when significant plant species are flowering or setting seed, or when animals likely to be harmed by mowing are active, and depend on the vegetation for shelter or food (Sharp and Rehwinkel 1998).

Important considerations for a mowing/slashing regime include disposal of clippings, impacts of machinery, season/height prescriptions, and seed collection:

- *Clippings:* The creation of 'windrows' or clumps of grass clippings should be avoided by using flail mowers that spread out mulched litter, by catching the clippings, or raking and removing them.
- *Machinery:* Machinery should not be used when the ground is wet to avoid soil compaction, creation of ruts and damage to 'soil crust' lichens and bryophytes (cryptogams). In particular, machinery should be cleaned prior to use to avoid the spread of weed seeds.
- *Season/height prescriptions:* Various prescriptions on height (with a minimum of 10 cm above the ground) and mowing seasons have been advocated previously (Dorrough 1996; Sharp and Rehwinkel 1998). Current best practice is to manage biomass on a site-specific basis in the appropriate season, however, generally applicable guidelines have been developed for *Austrostipa*, *Austrodanthonia*, *Poa* and *Themeda* dominated grasslands respectively (S. Sharp pers. comm.). Groves and Lodder (1991) noted that the vigour and persistence of native grasses is reduced if mowing is performed more than once or twice in any 12-month period.
- *Seed collection:* Where mowing is used as part of a management strategy for collecting seed for grassland restoration, the removal of seed must be monitored to avoid over-collection (Wildlife Research Unit 1994).

BURNING

Changed and inappropriate fire regimes in natural temperate grassland are discussed in s. 2.1.7.

Fire has been an integral part of the evolution of native grasslands and is used as a management tool to maintain plant diversity in *Themeda triandra* grasslands, especially in southern Victoria (Lunt and Morgan 2002). It is less commonly used elsewhere. For the ACT region, Sharp and Dunford (1994) suggested that fire should be used as a management tool only in grassland remnants that have been burnt regularly in the past or where it is recommended for specific purposes. In general, long unburnt patches should not be burnt (Sharp and Rehwinkel 1998) or burnt in patches to allow the fire impacts to be monitored (Rowell 1994).

Considerable uncertainty exists with regard to use of fire as a management tool and with the extrapolation of the results of burning from one site to another. In their review of fire regimes in temperate lowland grasslands, Lunt and Morgan (2002) note that there is only one study that compares the effects of frequent burning against the exclusion of fire and other disturbances (e.g. grazing). This study, over a 17-year period (1978–1995) was of productive *Themeda* grassland in western Melbourne (Lunt and Morgan 1999). The frequently burnt area retained a much higher native cover and low exotic cover compared with the unburnt area. The exotic daisy *Hypochaeris radicata* (Catsear or Flatweed), which attained 33% mean cover of the unburnt zone, had only minimally invaded the burnt area.

If burning is to be used as a management tool, similar considerations apply as for the other means of defoliation, viz. timing, intensity, frequency, fauna impacts, fire breaks, weeds:

- *Timing:* Fires should be timed to allow grassland species to flower and set seed. Some species (e.g. Small Purple Pea *Swainsona recta*) may require fire for germination and establishment (Sharp and Rehwinkel 1998). Eddy (2002) suggests burning between the end of seed set (mid to late summer) and when the plants begin to produce flowers in spring. This is often the only time the grassland will carry a fire. Groves and Lodder (1991) noted that fires could be used between June and August to rejuvenate the grass sward in communities dominated by *Austrodanthonia*, *Poa* and *Themeda*. The season of burn may need to take account of the requirements of individual plant and animal species in particular grassland remnants (Dorrough 1996; Rowell 1994; Sharp 1994).
- *Intensity:* Hot, dry summer conditions and a large dry grass biomass can result in fires that are too hot. These can destroy seeds and burn down into the soil. Fires should only be lit when the soil is reasonably moist and temperature and wind conditions will enable the fire to be kept under control (Eddy 2002).
- *Frequency:* Burning should be carried out only as often as is needed to reduce excessive biomass. In the ACT and Southern Tablelands, a burn frequency of once every two or three years has been recommended, but on low productivity sites may never or only occasionally be necessary (Eddy 2002; Groves and Lodder 1991; Wildlife Research Unit 1994). Current best practice is not to adhere to a prescriptive fire regime, but be guided by the level of biomass present and factors such as the history of the site and presence of particular flora and fauna that may be either advantaged or adversely affected by a certain fire frequency.
- *Fauna impacts:* Fire can threaten small native fauna within grassland remnants. For this reason, patch burning is recommended to ensure unburnt patches are left as faunal refuges (Eddy 2002; Dorrough 1996, Sharp and Rehwinkel 1998). This should be followed by monitoring of potentially affected species.
- *Fire breaks:* If the accidental spread of fire into or from a native grassland is considered a risk, then a firebreak should be mown or slashed around the perimeter. It should not be ploughed or sprayed, which will create an entry point for weed species.
- *Weeds:* When fire is proposed as a management tool, the risk of promoting weed species needs to be assessed, as the benefits of fire to native plant diversity may be overwhelmed by post-fire weed invasion (Morgan and Lunt 1999; Rowell 1994). The soil seed store in some grasslands may be dominated by exotic species which are likely to become dominant after fire. Particularly in degraded remnants, burning promotes many exotic species (Lunt 1990). Sharp and Rehwinkel (1998) noted that burning may enhance invasion by the perennial grass weed African Lovegrass (*Eragrostis curvula*). Fire also promotes the spread of Chilean Needlegrass (*Nassella neesiana*), which is one of the most threatening invasive plants of grassy ecosystems in south-eastern Australia (Muyt 2001).

3.7.5 Other Management Activities

WEED MANAGEMENT

All remaining natural temperate grassland is invaded to varying degrees by weeds (see s. 2.1.7), the control of which is a critical component of management. It is impractical to remove all exotic species, so the aim of management should be to reduce populations of the most invasive weeds present (Sharp and Rehwinkel

1998). The majority of weeds are annual or biennial grasses or forbs that are not particularly troublesome if their populations are kept low. These types of weeds are nearly impossible to completely remove as they germinate, develop and set seed quickly and there is already a large seed store in the soil. The best way to keep their populations low is to maintain a dense groundcover of native plants, particularly in late autumn and winter when most weed species are germinating and establishing (Eddy 2002). However, apparently bare areas containing a cryptogamic crust should not be planted, or disturbed by machinery or vehicles.

Perennial weeds are of greater concern and there are a number that have made significant impacts on native grasslands and remain a threat (see s. 2.1.7). Woody weeds can also make an impact over a long period, but can easily be controlled in small areas and by early action before populations increase. Mechanisms for weed control include hand weeding, strategic grazing, mowing or burning and spot spraying (Dorrough 1996; Sharp and Dunford 1994; Sharp and Rehwinkel 1998; Wildlife Research and Monitoring 1994). A particular problem for weed control is that activities targeting a particular species may create disturbance that facilitates further weed invasion (Rowell 1994).

A key aspect of weed control is to avoid management activities that facilitate weed introduction or expansion including too-frequent burning, burning sites with a soil bank of weed seeds, additions of fertilisers or excess water, heavy grazing for too long a period, importing soil or organic material (e.g. straw), cultivation of fire breaks, excessive vehicle use, and using machinery that has not been cleaned (Dorrough 1996; Eddy 2002; Rowell 1994; Sharp and Rehwinkel 1998).

SOIL MANAGEMENT

To maintain native grassland areas, soil disturbance should be minimised as disturbance is followed by significant colonisation by exotic species (Lunt 1991). Disturbance includes physical disturbance (e.g. dam construction and maintenance, laying pipelines), changes in soil structure (e.g. compaction or changed drainage patterns), chemical disturbance (e.g. addition of fertilisers), and stockpiling, dumping and spreading materials such as soil or gravel. If disturbance is necessary in a native grassland remnant, follow up rehabilitation should be undertaken including levelling, weed removal and encouragement of native plant species from the adjacent vegetation (Eddy 2002).

FAUNA HABITAT MANAGEMENT

Natural temperate grassland has a rich diversity of invertebrates, reptiles, amphibians, birds and mammals (see s. 2.3). As a general principle, to maximise the habitat value of native grassland for all faunal groups, the grassland should be managed to maintain or improve the diversity of its structure and species composition. The backbone of the food chain is the plants, and the greater the diversity of plant species, the greater the variety of food types available to support fauna (Eddy 2002). For example, herbivores include folivores such as kangaroos and grasshoppers, granivores such as ants and birds (including Quail, Superb Parrot and Diamond Firetail) and there are numerous insect pollenators. Habitat elements include the grass tussocks and inter-tussock spaces, soil cracks and holes, rocks, wet areas and watercourses, specific micro-habitats (e.g. basking sites for reptiles), plant litter, trees and shrubs. The habitat value of native grassland will be greater where it adjoins or forms a mosaic with other ecosystems such as woodland, forest or wetland (Eddy 2002).

Where grassland contains a diverse flora and threatened fauna, the major management challenge is to maintain an open vegetation structure to maintain plant diversity, while maintaining viable animal populations (Lunt and Morgan 2002). Remaining grassland areas tend to be small in area and highly fragmented. Populations of animals (especially less mobile species) in such areas are at greater risk of extinction through too-frequent burning or a very hot fire, as areas of protective habitat may be reduced and re-colonisation from adjacent areas is not possible.

Management of fauna habitat should be site specific, based on animals (particularly threatened species) known to be present and their habitat and life cycle requirements. Examples of specific management adaptations to maintain habitat include:

- A grassland defoliation regime modified to maintain habitat e.g. for the Striped Legless Lizard (*Delma impar*), not mowing when the lizards are active, mowing on a rotational basis so that in any one season mown and un-mown areas adjoin, and not burning the whole of a site at one time (Rowell 1996).
- For the Grassland Earless Dragon (*Tympanocryptis pinguicolla*) and Golden Sun Moth (*Synemon plana*), maintaining the short, more open grasslands dominated by *Austrodanthonia* spp. (Osborne *at al.* 1995; Sharp 1995). Management actions would include not allowing such sites to become wetter or nutrient enriched so that the *Austrodanthonia* was out-competed by other native species or weeds.

For reptiles generally, maintaining night and day shelter sites, basking sites, foraging areas, food, micro-habitats for reproduction and avoidance of predators,

and over-wintering habitats (Osborne *et al.* 1995). Threats to these habitat requirements include grassland defoliation, use of machinery, vehicle traffic, collection of bushrock and ground disturbance (e.g. ploughing).

Trees and shrubs, where naturally present as part of the community, provide important habitat for many animal, notably birds and mammals. The interface between grassland and woodland is particularly important to a range of species that require both habitat components e.g. Hooded Robin (*Melanodryas cucullata*) and Flame Robin (*Petroica phoenicea*). Particular attention should be given to managing the ecotones where native grassland adjoins forest, woodland or wetland.

TREE MANAGEMENT

Natural temperate grassland is naturally treeless or has a low tree cover (less than one mature tree per hectare) (see s. 2.1.4). Trees can have a strong influence on grassland structure and species composition through competition for light, moisture and nutrition. Trees also provide nutrition to plants under their canopy through litter fall and by attracting birds and other animals that leave droppings under the tree. Natural populations of native trees should be retained and managed as an integral part of the grassland ecological community (Eddy 2002).

Tree planting in grasslands can have an effect on grassland species composition especially due to shading. In general, tree planting should not be undertaken in natural grasslands, but may be part of reinstatement in secondary grasslands (ACT Government 2004a). Self-sown exotic trees (e.g. pine wildings) should be removed while they are still young. Consideration should also be given to removing older exotic trees, possibly replacing them with local native species (Eddy 2002).

FERAL ANIMAL MANAGEMENT

Feral animals can have deleterious impacts on native grasslands. Rabbits have a strong dietary preference for smaller and more succulent plants and plant parts. These are often the more vulnerable native forb, lily and orchid species. Cats and foxes prey on smaller native animals potentially contributing to local extinctions or affecting the composition of local fauna populations. Feral pigs can have a severe impact on grassland areas. Especially favoured are low elevation areas that contain the more sensitive and less well-conserved types of native grassland. Grasslands adjacent to the shelter of tree cover are more prone to damage (Eddy 2002). These animals should be the subject of control programs in conjunction with adjacent land holders. Rehabilitation of grassland will be necessary after some activities e.g. ripping of rabbit burrows.

3.8

Management Agreements and Networks

3.8.1 Land Management Agreements

Land Management Agreements (LMAs) are required under the *Land (Planning and Environment) Act 1991* for all non-urban leases in the ACT. Linked to the granting of long-term leases (20 and 99 years), the purpose of LMAs is to establish a co-operative management regime for non-urban land in the ACT. Over seventy agreements between lessees and Environment ACT were in place in 2003. Except for the Jerrabomberra Valley (Table 3.2), there are few areas of natural temperate grassland on rural leases in the ACT, though patches of native pasture and particular native grassland species occur on many leases.

The principal objective of LMAs is to establish management practices on leases that support the land management aims of both the lessee and the ACT Government. This involves agreement on general management goals and responsibilities; documentation of the current state of the property (including nature conservation, cultural heritage or other significant values); and identification of land management issues and the means for their resolution. Environment ACT provides environmental information to lessees, drawing attention to conservation issues, in particular, presence of, or habitat for, threatened species and ecological communities.

Lessees are required to address the following objectives in the LMA within a framework of sustainable agricultural and pastoral land use practices:

- retain or improve the ecological functioning and integrity of the natural and modified resources of the leased area;
- preserve the extent and character of any threatened ecological community or population of a threatened species;
- pursue all development and management of the land in a way that is consistent with any Action Plan for a threatened species or ecological community;
- manage vegetation identified in the LMA as being of significant conservation value, with the aim of maintaining its structure, floristics and habitat value; and

- ensure that any activities do not adversely impact on riparian or other wetland areas.

The LMA also provides for Land Action Plans to be prepared for a range of issues, including drought risk management, pest plants and animals, sites of significant natural or cultural heritage value, maintenance of water quality, and protection of riparian zones and other native vegetation. Lessees are required to ensure that a flexible grazing strategy is in place designed to achieve conservation objectives.

In 2005, the ACT Government established the Land Keepers program, which will target practical biodiversity conservation outcomes through on-ground works, an education program or demonstration project, or the gathering of information about conservation assets and their management requirements. Funded projects are typically on-ground works e.g. fencing to protect native vegetation remnants or better managing grazing pressure, off-stream watering facilities to protect streamlines, and revegetation to provide habitat links. Where the project involves a continuing commitment by a lessee to a particular management strategy, relevant details of the commitment are entered in the Land Management Agreement for the land in question. The intention is to protect the investment that has been made and to ensure longer-term conservation outcomes.

3.8.2 Voluntary Agreements

Voluntary agreements enable landholders to acknowledge the conservation values of their land through mechanisms designed to provide a level of protection but allow for current land uses to continue. Some involve arrangements that are binding on future landholders, some are binding for current landholders while others can be revoked by landholders at any time. Examples of some of the arrangements that exist in NSW are Voluntary Conservation Agreements, Joint Management Agreements and Wildlife Refuges. Similar arrangements do not exist in the ACT, although Memoranda of Understanding with major Commonwealth landholders in the ACT (Department of Defence, CSIRO and National Capital Authority) are in place, and these provide protection for areas of land that contain natural temperate grassland. Some of these areas are the largest remaining examples of natural temperate grassland in the ACT.

Landholders with such agreements contribute land, their skills, labour, time and materials towards the conservation of native ecosystems, which in turn provide of a range of ecosystem services such as clean water and air and healthy soils (Stephens 2002). For such voluntary agreements to work well, it has been shown that landholders require sufficient support, particularly on-ground labour, advice on non-financial as well as funding sources, technical advice, evaluation of remnant vegetation and habitat values, and links with other landholders (Stephens 2002).

The Conservation Management Network described below can provide such support, and is therefore seen as a way of maintaining management agreements and assisting in their implementation.

3.8.3 Conservation Management Networks

A Conservation Management Network (CMN) is a network of remnants of an ecological community, their owners and managers as well as other people with an interest in that community (Rehwinkel 2002). There is a particular focus on sites, including encouragement of protection measures and the adoption of conservation management. The CMN provides opportunities for information dissemination (including regular newsletters) and participation in knowledge sharing and decision-making. A CMN can assist land managers to access technical and funding assistance, develop site management plans, establish formal protection measures such as voluntary agreements, and link up with people with similar interests. Membership can provide a sense of being part of a larger system, and facilitate access to a range of quality sites (Oliver 2003).

One of the most important goals of CMNs is to help integrate conservation principles and practices into land use management. CMNs are a potential way of developing an integrated conservation estate that is more than the existing nature conservation estate on public land, where the existing landholders continue to manage their own sites, with support and advice from the CMN (Oliver 2003).

In the ACT region, CMNs have been developed for White Box Woodlands in NSW, Monaro Grasslands and Southern Tablelands (NSW) Grasslands. There is potential for Environment ACT to link with this initiative of the NSW Department of Environment and Conservation and become part of an enlarged ACT and Southern Tablelands CMN for grassy ecosystems. Formation of a Conservation Management Network for natural temperate grassland sites in the ACT and New South Wales is an objective of this *Strategy* (see Table 4.1).