

Ecological Management Plan for National Capital Authority Conservation Areas



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Abbreviations

ACT	Australian Capital Territory
ANU	Australian National University
Box-Gum Woodland	White Box - Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Grassland, a critically endangered ecological community
BOP	Bushfire Operational Plan
EM (unit)	Ecological Management Unit
EMP	Ecological Management Plan
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (C'wth)</i>
FM (unit)	Fire Management Unit
FOG	Friends of Grasslands Inc
LBG	Lake Burley Griffin
NCA	National Capital Authority
NC Act	<i>Nature Conservation Act 2014 (ACT)</i>
NCOSS	National Capital Open Space System
Natural Temperate Grassland	Natural Temperate Grassland of the South Eastern Highlands

Definitions

Conservation Area: those areas within the National Capital Authority Estate that contain matters of national and territory ecological significance.

A best practice is a method or technique that has consistently shown results superior to those achieved with other means, and that is used as a benchmark. In addition, a "best" practice can evolve to become better as improvements are discovered. (https://en.wikipedia.org/wiki/Best_practice)

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1. Introduction

This Ecological Management Plan (EMP) provides a review and update to a Conservation Management Plan prepared in 2009 for sites managed by the National Capital Authority (Sharp 2009). The sites included in the 2009 plan were Yarramundi Grassland, Stirling Park Woodland (including Attunga Point), State Circle Woodland (identified as Scrivener’s Hut Woodland), Guilfoyle St Grassland and Lady Denman Drive Grassland (Yarralumla). The latter has been excluded from this EMP, as it is degraded and small and the existing management is maintaining adequately the few native species that occur there. In this plan a woodland at O’Malley has been included.

Since the development of the 2009 plan implementation of recommended management actions has resulted in significant improvements in the condition of Yarramundi Grassland and Stirling Park and State Circle Woodland. A detailed report of what management has been undertaken and changes to the sites as a result is presented in Attachment A.

1.1 National Capital Authority Estate Conservation Areas

This EMP provides management guidelines to be applied to those areas within the National Capital Authority Estate that contain matters of national and territory ecological significance. There are four areas included in the EMP (Figure 1.1). These are:

1. Stirling Park, Yarralumla (including Attunga Point) and State Circle Woodland [the latter identified as Scrivener’s Hut woodland in Sharp, 2009]) (Figure 1.2)
2. Yarramundi Grassland, Acton (Figure 1.3) [the latter identified as Yarramundi Reach Grasslands in Sharp, 2009])
3. Guilfoyle St Grasslands, Yarralumla (Figure 1.4)
4. O’Malley Woodland within the O’Malley Diplomatic Estate (Figure 1.5)

Matters of ecological significance within these areas include:

Yellow Box—Red Gum Grassy Woodland occurs at Stirling Park and O’Malley: listed as a critically endangered ecological community under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and endangered under the *ACT Nature Conservation Act 2014* (NC Act)

Button Wrinklewort, *Rutidosis leptorrhynchoides* is found at Stirling Park (estimated as containing 70,000 plants): listed as an endangered species under the EPBC Act and the NC Act

Natural Temperate Grassland: occurs at Yarramundi and Guilfoyle St, listed as a critically endangered ecological community under the EPBC Act (Natural Temperate Grasslands of the South-eastern Highlands, listed April 2016) and endangered under the NC Act.

Golden Sun Moth, *Synemon plana* is found at Yarramundi Grassland: listed as a critically endangered species under the EPBC Act and endangered under the NC Act

Striped Legless Lizard, *Delma impar* is found at Yarramundi Grassland: listed as vulnerable under the EPBC Act and the NC Act

Perunga Grasshopper, *Perunga ochracea* is found at Yarramundi Grassland: listed as vulnerable under the NC Act

Other matters of significance

In addition to ecological values these sites have other significance: Indigenous and historical heritage values, community attachment, landscape aesthetics and values for passive recreation. While recognising and acknowledging these other values, they are not directly incorporated into this plan, except where the values overlap and to ensure management actions complement and recognise all values. If any management actions identified in this report may compromise those broader values, consultation with relevant stakeholders will be required to make sure all matters of significance are fully considered.

Figure 1.1 - National Capital Authority Estate conservation areas

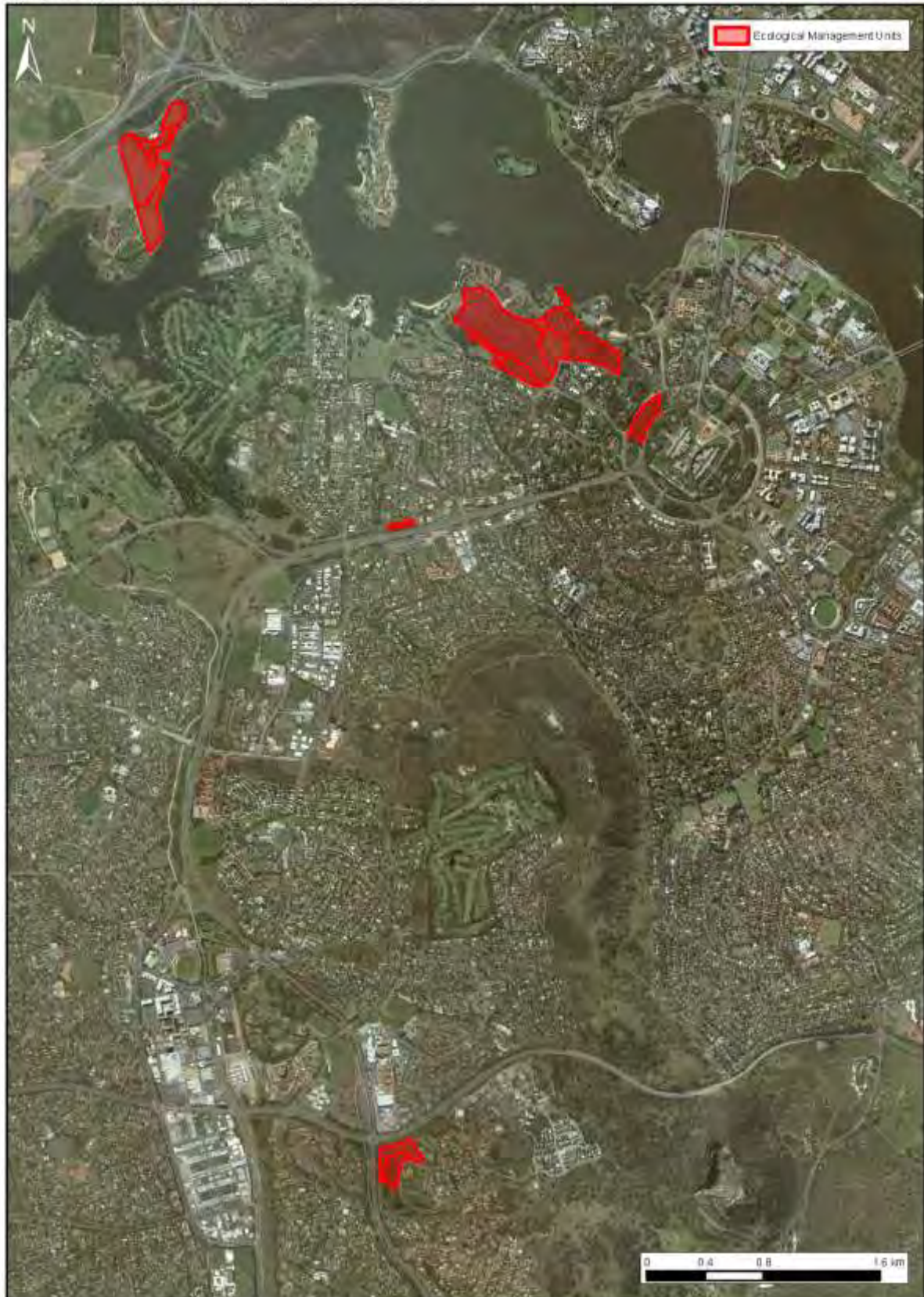


Figure 1.1. National Capital Authority Estate Conservation Areas, from the north: Yarramundi Grassland, Stirling Park, State Circle Woodland, Guilfoyle St Grassland and O'Malley Woodland.



Figure 1.2. Stirling Park Woodland and State Circle Woodland Conservation Areas



Figure 1.3. Yarramundi Grassland Conservation Area

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Figure 1.4. Guilfoyle St Grassland Conservation Area



Figure 1.5. O'Malley Woodland Conservation Area

1.2 Context (planning, legislation and policy)

National Capital Plan

The National Capital Authority (NCA) operates under the *Australian Capital Territory (Planning and Land Management) Act 1988*, and is responsible for the planning and management of all land within the NCA Estate. Actions are required to be undertaken in accordance with the National Capital Plan (National Capital Authority 2008).

The general goal for management of native vegetation on National Land is:

To manage the landscape for in situ conservation of indigenous plant and animal species and communities, while accommodating passive recreational activities and recognising the significance of remnant woodland as a component of the Central National Area's visual setting.

The National Capital Plan, p. 67 states:

11.3 (d) As wide a range as possible of the naturally occurring plant and animal communities and species of the ACT should be protected in situations where their long-term survival can be expected and the propagation of rare or vulnerable species in suitable protected habitats will be encouraged.

Stirling Park is noted in the National Capital Plan as a site of significance, requiring special consideration in regard to protecting its conservation significance.

This is also reflected in policy for the National Capital Open Space System (NCOSS), p. 52:

1.2.3 b) LBG and Foreshores are intended to provide a range of recreational, educational and symbolic experiences of the National Capital in both formal and informal parkland settings with particular landscape characters or themes.

8.3 (a) NCOSS will be planned as an integrated system so as to protect its environmental qualities.

8.3 (b) The natural and cultural resources of NCOSS shall be protected in order to provide educational, cultural and recreational opportunities

The visual importance of the remnant woodland as a component of the Central National Area is recognised, where the remnant woodland is fulfilling a role as the city's key visual and landscape element, and visual backdrop and landscape setting for the National Capital.

Heritage Management Plan for Lake Burley Griffin Study Area

Godden Mackay Logan Heritage Consultants prepared a Heritage Management Plan for the identified Commonwealth and National Heritage values of the Lake Burley Griffin and adjacent areas of National Land (the Study Area) in order to fulfil the obligations of the National Capital Authority under the *Environment Protection and Biodiversity Conservation Act 1999* (C'wth) (EPBC Act). The Study Area includes Stirling Park, Attunga Point and Yarramundi Reach [Yarramundi]. The Heritage Management Plan takes into account requirements under legislation, in particular the EPBC Act, the *Australian Capital Territory (Planning and Land Management) Act 1988* and the *Nature Conservation Act 1980* (ACT) (Godden Mackay Logan 2009).

The key objective of the policy framework in the Heritage Management Plan is to “ensure the conservation of the heritage values of the Lake Burley Griffin Study Area in the context of its future use and enhancement as an essential component of the designed, symbolic landscape of the National Capital. This conservation policy recognises the diversity of character of the Lake Burley Griffin Study Area and the many individually significant places to be found within it, but also promotes a holistic approach to the future management of the Study Area as a cultural landscape” (Godden Mackay Logan 2009 Lake Burley Griffin and Adjacent Lands—Heritage Management Plan, Volume 2, Stirling Park and Attunga Point—Final Report, October 2009, P.17).

An overall goal identified in the Heritage Management Plan is to implement a collaborative approach to management and use of these areas. In addition all recommendations require the development of documents for Service Contracts to mitigate against inadvertent damage to the matters of environmental significance. Relevant actions identified in the Heritage Management Plan are included where relevant in this Environmental Management Plan, and are detailed in Attachment B.

Key ecological recommendations in the Heritage Management Plan are:

Button Wrinklewort habitat and Yellow Box – Red Gum Grassy Woodland in Stirling Park (Vol 2, Section 4, pp 35-40):

- Consolidate disjunct populations of Button Wrinklewort and Box-Gum Woodland in Stirling Park (Actions C4-1.1, C5-1.2)
- Develop, implement and monitor a program of management for maintenance of Button Wrinklewort populations and Box-Gum Woodland, including mowing regimes, removal of over-shadowing eucalypt saplings, removal of

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woody weeds and control of Chilean Needlegrass (Actions C4-1.4, C5-1.1)

- Develop and implement a fire hazard management and wildfire suppression plan to incorporate requirements for maintenance of Button Wrinklewort and Box-Gum Woodland; monitor impacts of management on Button Wrinklewort and reassess management if required (Actions C4-3.2, C5-1.4).
- Document management activities (Actions C4-3.1, C5-3.1)
- Monitor sustainability of the grassy woodland and apply the results back into management (Actions C4-3.2, C5-3.2)

Remnant Grassland at Attunga Point (Vol 2, Section 4, pp 41-42):

- Develop, implement and monitor management practices including mowing, control of weed species, access control and interception drains (Action C6-1.1)

Natural Temperate Grassland and grassland habitat at Yarramundi (Vol 3, Section 4, pp. 38-41):

- Identify and prioritise activities for restoration of the community (Action C4-1.1)
- Undertake threat abatement activities in relation to a mowing regime, removal of Themeda biomass, removal of weeds and a monitoring program (Action C4-1.2)
- Undertake surveys of the Striped Legless Lizard to determine population statistics for the species and implement management to retain the habitat (Actions C4-2.1, 2.2)
- Undertake fire hazard and weed management activities in consultation with ACT Government (Action C4-2.4)
- Document management activities (Action C4-5.1)
- Monitor the grassland community and threatened species and apply the results back into management (Actions C4-5.2, 5.3)

Threatened species and communities

Natural Temperate Grassland of the South Eastern Highlands (Natural Temperate Grassland) and White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Woodland) are listed as critically endangered in the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) and endangered under ACT legislation in the *Nature Conservation Act 2014* (the NC Act).

Box-Gum Woodland

Under the EPBC Act White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland is listed as a critically endangered ecological community (CEEC), supporting significant flora and fauna species. It is estimated that nationally less than 5% of this community remains in good condition.

For an area to be listed as containing the critically endangered ecological community White Box - Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Grassland, the following criteria must be met (Australian Government Department of the Environment and Heritage 2006). A patch must:

- have White Box, Yellow Box and/or Blakely’s Red Gum as the most common species currently or in the past;
- have a predominantly native understorey where at least 50% of the perennial vegetation cover in the groundlayer is made up of native species (i.e. not counting native or exotic annual plant species); and either:
 - be greater than 0.1 ha in size; and contain within the area at least 12 native, non-grass understorey species (including forbs, shrubs and ferns), including at least one important species (as defined in the declaration); or
 - be greater than 2 ha in size with natural regeneration of the overstorey species of 20 or more mature trees (greater than 125 cm circumference at 130 cm height) per hectare.

Natural Temperate Grassland

The previously listed Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT was replaced by a new listing and definition in April 2016. The revised listing has extended its distribution and range, altitude, habitat and threatened status. It is now defined as Temperate Grassland of the South-Eastern Highlands, a critically endangered community, under Commonwealth legislation (EPBC Act). Distribution ranges from Orange and beyond in the north to East Gippsland in Victoria, west to beyond Tumut and east to the Dividing Range. It is found from 350 m to 1200 m in altitude, but does not include high altitude treeless plains. The community occurs on a wide variety of topographic positions and soils, and is found in areas subject to cold air drainage, in frost

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hollows and drainage depressions, on exposed west or north facing hills, on basalt plateaux; a sub-type develops on ephemeral wetlands such as Lake George.

The vegetation community is defined by its dominance by dense to open tussock grasses up to one metre tall, with a range of smaller grasses, forbs and graminoids (grass-like species such as sedges). The dominant grasses include Kangaroo Grass (*Themeda triandra*), wallaby grasses (*Rytidosperma* spp., formerly *Austrodanthonia* spp.), spear or corkscrew grasses *Austrostipa* spp., Red Grass (*Bothriochloa macra*) and tussock grasses (*Poa* spp.). The community may be treeless or contain up to 10% canopy cover of trees, shrubs or sedges.

An area over 0.1 ha in size that is within the defined region, altitude and is apparently naturally treeless meets the criteria as the critically endangered community if it meets criteria A or B:

- A. It contains a foliage cover of more than 50% *Themeda triandra* (Kangaroo Grass), *Poa labillardierei* (River Tussock) or *Carex bichenoviana* (Plains Sedge)
OR
- B. The percentage cover of native vascular plants (including annual and perennial species) in the patch is greater than the percentage cover of perennial exotic species
AND
In favourable sampling times it contains:
- at least 8 non-grass native species **or**
 - at least 2 indicator species **or**
 - a floristic value score of at least 5
- OR
- In other sampling times it contains:
- at least 4 non-grass native species **or**
 - at least 1 indicator species **or**
 - a floristic value score of at least 3

(Indicator species are identified and the floristic value score is described in the Approved Conservation Advice (<http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=152&status=Critically+Endangered>, accessed April 2016).

Threatened species and communities in NCA Conservation Areas

Surveys of sites containing natural grassland were undertaken in the late 1980s (Chan 1989) and again in the 1990s (Sharp 1997, ACT Government 2005). In both studies areas of Natural Temperate Grassland were identified as occurring at Yarramundi. The ACT Lowland Grassland Conservation Strategy (ACT Government 2005) identified that the Natural Temperate Grassland in Yarramundi is a Conservation Category 2 site. The grassland at Guilfoyle St (mis-identified in the strategy as Kintore St Grassland) was also classified as a Conservation Category 2 site. These

sites have a moderate botanical significance rating, contain threatened species habitat and/or are medium sized areas with a lower botanical significance rating (ACT Government 2005). The strategy recommends that activities in these Conservation Category 2 sites should be “compatible with conservation of the native grassland values, provided that appropriate conservation management is in place.” (p.58, ACT Government 2005). These grassland sites also meet the EPBC Act criteria as endangered.

While not surveyed in detail, the woodland at Stirling Park was identified as containing the critically endangered Yellow Box – Blakely’s Red Gum Grassy Woodland in the ACT Lowland Woodland Conservation Strategy (ACT Government 2004). The woodland is classified in the Action Plan as being moderately modified. The woodland at State Circle and O’Malley were not surveyed or identified at that time. In 2013 the State Circle Woodland was classified as containing the endangered Box-Gum Woodland and surveys by Blue Gum Ecological Consulting (O’Sullivan 2013). These areas also meet the EPBC Act criteria as critically endangered. Work undertaken subsequently on these sites has improved the condition of the woodlands.

Button Wrinklewort surveys have indicated that over 70, 000 plants occur at Stirling Park and Attunga Point. This is the largest known population of this endangered species. A population of the species also occurs at State Circle Woodland. These populations are recognised and management actions recommended for the species in the ACT Lowland Woodland Conservation Strategy (2004) and ACT Lowland Native Grasslands Conservation Strategy (ACT Government 2005).

Surveys in Yarramundi were undertaken in the 1990s and the vulnerable Striped Legless Lizard was located. In 2000 one animal was seen and then in 2014 three Striped Legless Lizards were located again at the site. The Golden Sun Moth was discovered at one location within Yarramundi, but its habitat there is considered marginal. Perunga Grasshopper, listed under ACT legislation is present at Yarramundi.

Surveys have documented the ecological condition and values, social significance and past history of Stirling Park and Yarramundi. Of particular importance to the development of the 2009 plan (Sharp 2009) and this EMP is the detailed survey of the vegetation at Yarramundi and Stirling Park in 2005 that resulted in a report on the condition of these sites (Muyt 2005a, b). The results of this study, undertaken in relocatable 0.25 ha grids, provides the basis for future monitoring, and in 2014 a selection of these grids was resurveyed at Stirling Park (see Attachment A2, which compares the results between 2005 and 2014). A study using the same methods was undertaken in 1996 at Yarramundi and Stirling Park (Rowell 1996) but is apparently lost, so unfortunately it cannot be used for otherwise a

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very useful comparison of the condition since that time. If a copy is located it is recommended that an analysis of the changes be undertaken.

Bushfire Operational Plans

In 2012 a Bushfire Operations Plan (BOP) was developed for the National Capital Authority Estate, specifically those prone to bushfire (Beutel and Nash 2012). Management maps for the use of fire and slashing, and including other specified conservation actions have been developed and are updated every two years (Beutel and Smith 2014). The BOPs include prescribed burning, slashing and chemical herbicide application, with outcomes designed to achieve ecological and/or fire mitigation objectives. Public consultation is undertaken prior to the burns, through letter box drops, emails, newsletters and in some cases, telephone, to particularly affected organisations (Beutel and Smith 2014).

All the conservation areas in this EMP are included in the BOP. Each site is divided into fire management units (FMs), which have boundaries that provide breaks, including trails, roads and the lake (note that these boundaries differ from the management units identified in the EMP). The BOP complies with ecological requirements for threatened and rare species and communities (ACT Government 2012); these requirements are detailed in Attachment C.

Burns and slashing have been undertaken since 2012 according to those plans. Maps of the plans indicating past hazard reduction/ecological burns for each of the conservation areas is presented in text.

The Ecological Management Plan

This Ecological Management Plan for National Capital Authority Conservation Areas is consistent with the policies and related actions identified in the Heritage Management Plan and the Grassland and Woodland Conservation Strategies. Where the Heritage Management Plan deals with requirements under legislation, the policies are taken to be relevant to the other three areas that are outside the Study Area (State Circle Woodland, O'Malley Woodland and Guilfoyle St Grassland). This Ecological Management Plan incorporates actions identified within the Conservation Management Plan (Sharp 2009) and the Bushfire Operational Plans. Specific recommendations for Stirling Park, Attunga Point and Yarramundi that relate to protection of Indigenous heritage and the former Westlake Settlement are respected and included where relevant within the Ecological Management Plan.

1.3 Aims and outcomes for the Ecological Management Plan

Aim:

To retain and enhance ecological values of the sites, in terms of:

- a) no loss of native plant species diversity, abundance or distribution;
- b) enhancement of habitat for native plants and animals; and
- c) a reduction in the abundance and distribution of weeds.

Desired outcomes of management:

1. The threatened woodland and grassland communities and populations of threatened species and other fauna and flora improve in ecological condition and extent;
2. Threats of wildfire are managed;
3. Indigenous and post-settlement cultural values are respected and maintained; and
4. Awareness of the ecological values of the sites are reflected through recreational use, other land uses and sympathetic planning and management.

Implementation of the management plan

The plan provides the basis for development of annual work programs for NCA staff, contractors and volunteer groups undertaking management, and principles from which to develop contract specifications and guidance for annual budgets required to implement the actions.

Monitoring of actions and outcomes is to be used to assess the level of compliance (contractors, volunteers and users), identify any new threats and measure quantitatively whether actions are achieving the defined aim and management outcomes. Monitoring also may be used to assess more socially-oriented outcomes including:

- Involvement and understanding by the local community;
- Working with land managers or owners to achieve better management; and
- Collaboration with other non-government organisations, local community, government, communicating results.

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The role of volunteers

The advantages of involving volunteers in the conservation of sites are numerous:

1. Volunteers can undertake activities more regularly and that are more specialised or require finer levels of detail than those generally undertaken by land managers or contractors.
2. Volunteers achieve a sense of ownership with sites and can assist with lobbying for further resources (for example, through grants), and can maintain vigilance to report on and minimise illegal or inappropriate activities;
3. Volunteers can increase their knowledge and understanding of the ecology of the vegetation communities and the natural responses to management, and can help promote knowledge and understanding to others, including the general public and land managers (Sharp 2009).

Since 2009, under a formal agreement with NCA, Friends of Grasslands volunteers, ANU Fenner School volunteers and Yarralumla residents have undertaken over 5000 hours of volunteer work at 77 events at Stirling Park and at Yarramundi, supported by annual grants of \$5000 to \$6000 by NCA. The work has included removal of woody weeds, including Blackberry, Firethorn, Cotoneaster and Broom, and control of St John's Wort, Chilean Needlegrass, Serrated Tussock and African Lovegrass. Over 2000 herbaceous plants and 341 eucalypts, Kurrajongs and Bursaria have been planted, with grant funds and through Greening Australia. In addition to annual grants provided by NCA to support the on-ground work, FOG has facilitated in the order of \$44,000 in grants to employ contractors for more broad-scale treatment of specific weeds, including St John's Wort and CNG and to undertake additional plantings. FOG has also facilitated and assisted research on site, including on-going Button Wrinklewort monitoring to measure changes in regeneration of Button Wrinklewort after fire, teaching students on site about effective weed control and facilitated other learning sessions, and provided information and support to other research institutions, including the Conservation Research group in the Environmental Planning Directorate, ACT Government. FOG has provided advice to NCA and support to NCA to undertake other on-site works particularly in regard to communication with Yarralumla residents in the role of fire within the site and the reasons behind removal of the plantings of Blue Gum in Stirling Park. The management actions and research and monitoring undertaken at Stirling Park, State Circle Woodland and Yarramundi Grassland by volunteers are presented in Attachment A.

The on-going volunteer effort is encouraged and supported by NCA; the volunteers in turn recognise that they work in partnership with government (NCA, Commonwealth Government and ACT Government) to ensure long-term protection and the maintenance of the ecological and cultural values of the sites, as identified and defined under legislative and planning mechanisms.

1.5 General recommendations

It is recommended that:

1. Management is undertaken regularly and according to the priorities and time frames identified in this plan.
2. The National Capital Authority continue to implement fire hazard management and wildfire suppression plans that include ecological burns.
3. NCA and coordinators of the FOG volunteer group meet annually to discuss the plan implementation at Yarramundi Grassland, Stirling Park and State Circle Woodland to develop annual work plans.
4. Activities are documented on an annual basis using a standard report format (including maps), and are regularly analysed, communicated and acted on in a timely manner.
5. Clear and detailed specifications are provided to contractors undertaking management and maintenance activities.
6. Contractors are given on-site induction of the values and issues of the sites.
7. Contract management work is regularly monitored for compliance.
8. Monitoring of weed control and biodiversity is undertaken regularly and analysed every five to seven years to ensure management actions are achieving the desired outcomes.
9. The environmental management plan is reviewed every five years.
10. NCA and stakeholders work together to guide and assist with coordinating actions on the ground and to ensure the application of best practice management¹ and to encourage participation in management by volunteers.
11. Visitor access is enhanced with appropriate signage and track maintenance.

¹ A best practice is a method or technique that has consistently shown results superior to those achieved with other means, and

that is used as a benchmark. In addition, a "best" practice can evolve to become better as improvements are discovered. (https://en.wikipedia.org/wiki/Best_practice)

1.6 Resources

Without adequate resources it is expected that the sites will degrade, even following the high level of work achieved between 2009 and 2015. The highest priority for retention and enhancement of conservation values in Yarramundi Grassland, Stirling Park and State Circle Woodland remains treatment of herbaceous and woody weeds. Yarramundi Grassland in particular is likely to become even more dominated by Chilean Needlegrass, to the extent that the area that meets criteria for the endangered Natural Temperate Grassland ecosystem may be severely reduced. Stirling Park and State Circle Woodland, without continuous follow-up of woody weed control already achieved, will again become dominated by woody weeds, resulting in degraded habitat, competition to native species (especially the nationally endangered Button Wrinklewort) and degraded landscape values. Past treatment of woody weeds without follow-up control has resulted in the need to undertake an extensive treatment since 2009; follow-up treatment requires far fewer resources.

Continuation of a good relationship between NCA and volunteers is important to ensure that cooperation and enthusiasm of volunteers is maintained. It is recommended that following the intensive work undertaken by volunteers and contractors between 2009 and 2015, NCA manage the remaining large-scale spraying of herbaceous weeds, remove thickets of woody weeds and non-indigenous large trees and continue wildfire mitigation measures including burning. It is recommended that volunteers continue to hold regular work parties to mop up the regrowth and to undertake and maintain native plantings.

Herbaceous weeds are harder to control and replace with indigenous species. To achieve a reduced level of herbaceous weed infestation and a corresponding higher level of native diversity within Yarramundi Grassland requires a higher level of resources put in than has been applied since 2009. Contracted work will be required, as the activities that volunteers can undertake at this site are much more limited.

There needs to be consistent investment in control of weeds on all sites if the natural heritage values of the national capital lands are to be conserved.

1. Stirling Park and State Circle Woodland Ecological Management Plan

2.1 Description of the sites

2.1.1 Location

Stirling Park (Yarralumla Block 4 Section 22; Blocks 3, 4 Section 128) is located in Yarralumla, between Alexandrina Drive, Fitzgerald St and Empire Circuit (Figure 1.2). The EMP includes only the native woodland and derived grassland, including those areas of the heritage settlement of Westlake that overlap.

Attunga Point Woodland (Yarralumla Block 13 Section 17) is located on Alexandrina Drive adjacent to the lake and east of Canberra Yacht Club on Lake Burley Griffin. It is fenced, and contains a small population of Button Wrinklewort on the eastern side.

State Circle Woodland (part Parkes Block 1 Section 2) is part of west Capital Hill, accessed from State Circle. In Sharp (2009) it was referred to as Scrivener's Hut Woodland.

2.1.2 Conservation significance

The three areas of woodland in Stirling Park and State Circle Woodland are all on a hillslope that runs between Capital Hill and the Molonglo River. This site would have previously contained woodland across its lower slopes, and still retains connectivity for bird movements across the landscape (ACT Government 2004). There is a small area of woodland managed by the ACT Government (Yarralumla Block 2 Section 128) contiguous with the eastern end of Stirling Park, which enhances the connectivity between Stirling Park and State Circle woodland. The three areas managed by NCA contain woodland, in various degrees of modification. Stirling Park and the State Circle Woodland primarily contain endangered Box Gum Grassy Woodland, co-dominated by Yellow Box (*Eucalyptus melliodora*) and Blakely's Red Gum (*E. blakelyi*), with Apple Box (*E. bridgesiana*). Attunga Point is mainly modified, but a small area of Box Gum Grassy Woodland remains, although no trees are present and it is dominated by Kangaroo Grass (*Themeda triandra*) in the groundlayer has been fenced off. The ridge top in Stirling Park contains dry forest dominated by Scribbly Gum (*Eucalyptus rossii*) with Manna Gum (*E. mannifera*), which intergrades with the woodland on the lower slopes. The ecological management units (EM1 to 8) shown in Figure 1.2 delineate areas of different vegetation associations and condition.

Although there is evidence of past clearing of trees there are very old mature trees remaining, with many of these probably in the order of 200 or more years old, some of which are scar trees.

The woodland in Stirling Park, State Circle and Attunga Point contain populations of the endangered Button

Wrinklewort (*Rutidosia leptorrhynchoides*). Results from surveys undertaken over the past 20 years indicate that the very large population within the Park has remained stable (pers. comm. John Briggs, October 2015). Figure 2.1 indicates the abundance and distribution of the Button Wrinklewort in 2005 (Muyt 2005a), however, further small populations have been identified since then. Populations of five rare plant species identified as Protected Species under the ACT *Nature Conservation Act 2014* (ACT Government, undated) are present throughout Stirling Park. These species are Yellow Burr Daisy (*Calotis lappulacea*), Smooth Flax Lily (*Dianella longifolia*), Wire Lily (*Laxmannia gracilis*) and Australian Trefoil (*Lotus australis*).



Figure 2.1. Distribution and abundance of Button Wrinklewort in Stirling Park, in 2005 (Muyt 2005a)

Canberra Ornithologist Group has provided information on the birds that have been observed casually on the reserve (Attachment A1). Amongst these are several species that are threatened under the EPBC Act and/or NC Act or rare, including Scarlet Robin, Flame Robin, Varied Sittella and White-winged Triller.

Non-indigenous trees including Blue Gum (*E. bicostata*), Ribbon Gum (*E. viminalis*) and Argyle Apple (*E. cinerea*), and exotic species including Monterey Pine (*Pinus radiata*), Maritime Pine (*Pinus pinaster*) and Canary Island Pine (*Pinus canariensis*) were planted, particularly to the west of Stirling Park. Major woody weeds include Cootamundra Wattle (*Acacia baileyana*), Firethorns (*Pyracantha* spp.), Cotoneasters (*Cotoneaster* spp.), Blackberry (*Rubus fruticosus* species aggregate) and Monterey Pine. To reduce the threats to wildfire and to increase the integrity of EM7, 202 trees, including Blue Gum, Cedar Wattle and pines, were cut down and burnt in 2013,.

The foreshore is planted to Willows, White Poplar, and planted native shrubs. Remnant native trees include Blakely's Red Gum, Yellow Box and Apple Box.

2.1.3 Cultural Heritage Significance

Stirling Park is recognised as Ngunawal Land and as a meeting place for a number of Aboriginal groups including the Walgalu, Monero, Yuin & Narigu. The area is part of a traditional Aboriginal pathway connecting Black Mountain to the former Capital Hill. The area was utilised as a ceremonial and camping ground and continuity endures to this day. Evidence includes scarred trees, stone artefacts and stone arrangements, which are listed in the ACT Heritage Register. Capital Hill (where Parliament House stands) was used as a major meeting place as the pathways from Tuggeranong, Pialligo and Gungahlin diverged here. There were numerous minor pathways along waterways (Ginninderra Creek, Sullivans Creek) and ridgelines (Mt Majura, Mt Ainslie) that led to Stirling Park (Molonglo Catchment Group, draft management plan, 2015). Grants received by Molonglo Catchment Group from ACT Government are being used to remove woody weeds and reduce the abundance of herbaceous weeds within Block 2 Section 128 Yarralumla, in addition to better managing the indigenous cultural values. The work done within this block adjacent to EM3 (Figure 1.2) adds to the extent of the area being managed for conservation values and enhances connectivity between Stirling Park and the State Circle Woodland.

The Westlake settlement was established in the central portion of Stirling Park in the 1920s and has local historical significance. Houses were removed and the site cleaned up in the 1960s. There are surface materials remaining on site that relate to early use of the site, including building footings and garden vegetation that need to be protected. There is an on-going association by former residents with the site (Godden, McKay and Logan Pty Ltd 2009). A sewer vent, on the ACT Heritage Register, is located in the south-eastern part of Unit EM5. Many of the woody weeds within Stirling Park are likely to have escaped from garden plantings.

2.1.4 Condition of the woodland

Within the woodland in Stirling Park there are areas that contained residences (e.g. Howie's Hut in Unit EM3), and horses, and possibly other domestic stock were kept in fenced areas in the woodland. Wholesale clearing and thinning of trees occurred during this and earlier periods. Soil was dumped and excavated in a number of locations. Surveys in 2005 in Stirling Park (Muyt 2005a) identified a very high cover of woody weeds present, particularly *Cotoneaster* (*Cotoneaster* spp.), Firethorn (*Pyracantha* spp.), Hawthorn (*Crataegus monogyna*), Periwinkle (*Vinca major*) and Blackberry (*Rubus fruticosus* spp. aggregate). A variety of other garden escapees were identified (see Attachment A1). Similarly, State Circle Woodland has been subjected to high invasion by woody and

herbaceous weeds, soil disturbance and tree thinning and clearing.

Despite considerable past disturbance, Stirling Park and State Circle Woodland contain a high diversity of native plants and birds including threatened, rare and declining species (see Attachment A1), and retains considerable importance as a corridor of native vegetation that runs east to west to the south of Lake Burley Griffin.

2.1.5 Ecological management units

Stirling Park has been divided into seven management units and State Circle Woodland contains another unit (Figure 1.2) that reflect their ecological condition. These have been modified slightly from those identified in Sharp (2009) and areas that do not contain matters of national environmental significance are not included in the EMP.

EM1 (Attunga Point): located in the fenced area of Yellow Box – Red Gum grassy woodland dominated by Kangaroo Grass and containing a Button Wrinklewort population adjacent to Lake Burley Griffin. This area is in very good condition (Figure 2.2) after clearing of woody and many herbaceous weeds between 2009 and 2015, and could be used as a 'demonstration site' of a largely weed-free Yellow Box – Blakely's Red Gum Grassy Woodland with a diversity of species including the threatened Button Wrinklewort. A planned burn was undertaken in 2011 and again in autumn 2016.



Figure 2.2. EM1 habitat, Attunga Point (Dec. 2015)

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EM2 (Stirling Park): located in the flat area adjacent to Alexandrina Drive that has been planted with trees, shrubs and forbs between 2012 and 2015 to increase the connectivity of woodland between EM3 and EM5, as recommended in Sharp (2009) (Figure 2.3). There has been some work of moderate success in containing Chilean Needlegrass (*Nassella neesiana*) since 2009.



Figure 2.3. EM2 habitat, Stirling Park (Dec. 2015)

EM3 (Stirling Park): located on the eastern-most hillslope of Yellow Box – Red Gum grassy woodland containing Button Wrinklewort and a high native biodiversity (Figure 2.4). Much of EM3 has been cleared of woody weeds, St John's Wort and Chilean Needlegrass, but the eastern portion still retains a high woody weed cover (Figure 2.5). A planned burn was undertaken in FM2 (the western portion of EM3) in 2012.



Figure 2.4. EM3 (west) habitat, Stirling Park (Dec. 2015)



Figure 2.5. EM3 (east) habitat, Stirling Park, with very high woody weed cover (Dec. 2015)

EM4 (Stirling Park): located in the flat area that contained the Westlake Settlement and the adjacent weed-infested creek-line. Weeds are indicative of urban plantings and invasive species, including Periwinkle, stone and other fruit trees (*Prunus* species, Pomes), Desert Ash (*Fraxinus angustifolia*), and Hawthorn (Figure 2.6), and in the creekline, Willows (Figure 2.7). The groundlayer is dominated by native spear grasses, but has a high component of introduced species, especially Chilean Needlegrass (*Nassella neesiana*). Few significant native species remain, however, it provides connectivity between EM3 and EM5. Cultural heritage values are high and the area should be managed for those values, but control of weeds needs to be carried out where they are invading units EM2, EM3 and EM5.



Figure 2.6. EM4 habitat, Stirling Park adjacent to EM5 (Jan. 2014)



Figure 2.7. EM4 Haines Creek habitat, Stirling Park (Dec. 2015)

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EM5 (Stirling Park): located on the hillslope and ridgeline, containing Yellow Box – Red Gum grassy woodland and the majority of the population of Button Wrinklewort, a high native biodiversity (Figure 2.8) and some very old trees (Figure 2.9) and including scarred trees. Woody weeds present in 2009 have been largely removed, except for a small patch in the western portion. A planned burn was undertaken in FM3 (the south-eastern portion of EM5) in 2013 and a further burn is proposed for autumn 2020. The southern ridge (FM4.3) was burnt in autumn 2015 and is planned to be burnt again in autumn 2021. The area west of FM3 was burnt in autumn 2016 and is planned to be burnt again in autumn 2022. There are no records that the western portion of EM5 (FM7) has previously been burnt.

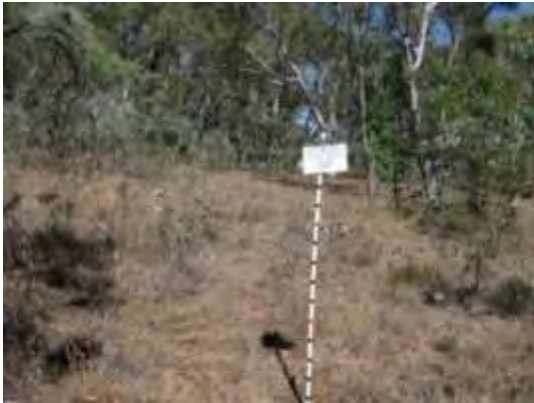


Figure 2.8. Unit EM5, Stirling Park (Jan. 2014)



Figure 2.9. EM5 habitat, Stirling Park, examples of very old mature trees that require conservation (Dec. 2015).

EM6 (Stirling Park): Located below the ridgeline and above the grassland adjacent to Fitzgerald St. Cleared woodland dominated by Speargrasses (*Austrostipa* spp.), with scattered regenerating trees and Button Wrinklewort, in which shrub and tree plantings have been undertaken in 2014 (Figure 2.10).



Figure 2.10. EM6 habitat, Stirling Park (Dec. 2015)

EM7 (Stirling Park): located on the southern side of Stirling Ridge. This area was dominated by Blue Gums prior to their removal in 2013, and still contains planted Argyle Apple and Ribbon Gum (Figure 2.11), with a moderate diversity native shrub and groundflora. The unit was burnt in 2014 (FM4.2) and the area is being revegetated by volunteers with endemic species typical of this habitat (Figure 2.12).



Figure 2.11. EM7 habitat, Stirling Park, Blue Gums cut, before burning (Jan. 2014)



Figure 2.12. EM7 habitat, Stirling Park, indicating recovery of native and introduced vegetation after burning (Dec. 2015).

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EM8 (State Circle Woodland, Capital Hill): Located between State Circle and Capital Circle, west of Flynn Drive. Contains Yellow Box – Red Gum grassy woodland with approximately 200 Button Wrinklewort plants (Figure 2.13). Woody weeds and debris have been largely removed since 2009. Button Wrinklewort plants are confined to the upper slope near the track. The lower slope above the creek contains many weeds, especially Chilean Needlegrass and St John's Wort. There are no records that this area has previously been burnt.



Figure 2.13. EM8 habitat, State Circle Grassland (Nov. 2012)

2.1.6 Use of the area

Levels of passive recreation within Stirling Park is variable. The park is frequently used by walkers with and without dogs, and more rarely, cyclists. There are many walking tracks crossing throughout the ridge. There are several vehicle tracks within Stirling Park, used for general access and more specifically for access to powerlines.

As the woodland in Attunga Point is fenced off, visitation within the site is extremely low, but there is a frequently used narrow walking track below it, probably mostly used by fishermen. There is a well-used walking track through State Circle Woodland, but few people appear to go off-track.

Stirling Park is zoned to allow for development (National Capital Plan 2002). Stirling Park was identified in the 1980s as a potential site for a new official residence for the Prime Minister. A further investigation in 2012 (National Capital Authority 2012) reiterated this option, affecting Units EM1 and EM3. The importance of Stirling Park as a natural backdrop for the Central National Area and the matters of environmental significance within Stirling Park, with associated legal requirements for their protection are in conflict with this zoning.

There is a designated road easement through EM4 and EM5 in Stirling Park. Development of this road would significantly impact the conservation values of the site through fragmentation, loss of habitat and reduction

of Button Wrinklewort populations, an increase in potential weed invasion and other edge effects.

2.1.7 Stakeholders

1. National Capital Authority: legislative, management, planning and financial responsibility
2. ACT Government:
 - Environment Planning Directorate, Conservation Research: threatened biota
 - Territory and Municipal Services, Fire Management Unit: liaison regarding fire mitigation requirements and
 - Territory and Municipal Services, City Services: neighbour and complementary management arrangements
3. Friends of Grasslands volunteers involved in on-ground management of the area and advocacy
4. Buru Ngunawal Aboriginal Corporation and Thunderstone Aboriginal Cultural & Land Management Services: local traditional custodians/carers, Ngunawal cultural heritage management with current involvement in natural resource management of Yarralumla B2S128 adjacent to, and contiguous with, Stirling Park
5. Yarralumla Residents Association: Stirling Park neighbour, advocates and on-ground volunteers
6. Molonglo Catchment Group: involvement in natural resource management of Yarralumla B2S128
7. Greening Australia: trials of diverse herbaceous plantings (Stirling Park and Yarramundi)
8. Fenner School ANU: research and source of volunteers
9. Canberra CIT: on-going survey and research, educational opportunities
10. Other stakeholders include neighbouring businesses, embassies, property owners and residents and Orienteering ACT.

2.2 Management history

2.2.1 Prior to 2009

In the period between the removal of the houses in Westlake Settlement in the 1960s and 2009 management of Stirling Park and State Circle woodlands consisted primarily of maintaining the areas for landscape and infrastructure protection (e.g. maintenance of tracks for access to infrastructure, containing regrowth under power lines). Several times between 1995 and 2005 and contractors undertook large-scale clearance of woody weeds, however, with no-follow up treatment, the woody weeds regrew and regenerating, resulting in plants with multiple stems and creating dense thickets.

2.2.2 2009 – 2015

Management since 2009 has been undertaken in accordance with the Management Plan (Sharp 2009), by NCA, Friends of Grasslands and weed contractors, recognising and protecting the significant natural and cultural heritage values of the site.

NCA has let contracts to control specific weeds and in weeds in specific locations, including the removal of Blue Gums in EM7, and herbicide treatment of a single Madeira Vine (*Anredera cornifolia*), woody weeds on the eastern edge of EM5, blackberries in units EM3, EM4 and EM5, Chilean Needlegrass in EM3, EM4 and EM5 and St John's Wort in EM2, EM3, EM4, EM5, EM6 and EM7 (unpublished mapping provided by NCA).

In 2012 NCA prepared and implemented a Bushfire Operational Plan (BOP) (Beutel and Nash 2012), updated in 2014 (Beutel and Smith 2014). Activities include hazard reduction burns and slashing. The hazard reduction burns are timed to ensure they meet ecological outcomes defined in ACT Government, 2012 (summarised in Beutel and Smith 2014) and included consultation with FOG. There are nine fire management units (FM units) across the site (Figure 2.14). These units do not coincide with the Ecological Management units, as practical boundaries such as tracks are required for fire control.

By December 2015 there were five FM units burnt: in FM1 in 2011 (EM1), FM2 in 2012 (north-eastern EM5), FM3 (south-eastern EM5), FM4.2 in 2014 (EM7 where the Blue Gums were cut) and FM4.3 in 2015 (the ridgeline of EM5) (Figure 2.14). Other BOP actions include slashing grassland around the perimeter of the woodland and the track through EM4, and removal of woody weed and Blue Gum regrowth in EM7. State Circle Woodland is not included in the burn program due to the potential for smoke to enter Parliament House.

A volunteer group led by Friends of Grasslands and including Yarralumla residents has been cutting and daubing woody weeds since 2009 (with modest annual grants to support the work from NCA) in Stirling Park and State Circle Woodland. Additionally broadscale control of St John's Wort and Chilean Needlegrass has been undertaken by contractors in units EM2, EM8 and on the edge of EM4 adjacent to EM5. This was funded through two grants provided to FOG by the ACT Government. FOG volunteers have also undertaken finer scale spot spraying of herbaceous weeds in units EM1, EM2, EM3, EM5 and EM6, where broadscale weed control could lead to damage to the native vegetation. Until the end of 2015, over 4 000

m³ of woody weeds have been cut and removed at a total of 66 work parties, by nearly 1 000 volunteers, on average each working for 4.5 hours (see Attachment A1 for more details). Approximately 95% of Stirling Park and all of State Circle woodland and Attunga Point was cleared of woody weeds by the end of 2015, although regeneration is occurring where earlier work has been undertaken. Endemic species have been planted in units EM2, EM4 and EM6 to increase the natural plant diversity, undertaken with the assistance, support and guidance of Greening Australia (ACT).

Outcomes of actions undertaken between 2009 and 2015 are compared against the proposed outcomes of the management of the site identified in the previous management plan (Sharp 2009) in Table 2.1. A more detailed description of management undertaken prior to 2009 and between 2009 and 2015 is in Attachment A1.

2.2.3 Monitoring and research

Surveys by FOG volunteers in 2014 were undertaken in a sub-set of the locations as those used by Muyt (2005a) using the same methods, to enable comparison of changes that have occurred. The results indicate no apparent change in the numbers of Button Wrinklewort plants, but a significant reduction in the cover, diversity and abundance of woody weeds and herbaceous weeds. More details are in Attachment A1.

Canberra Ornithologist Group members in 2010 surveyed birds at Stirling Park. The species observed then and in former years is presented in Attachment A1. Four rare or threatened species (Scarlet Robin, Flame Robin, Varied Sittella and White-winged Triller) were observed.

Students have been undertaking regular monitoring of Button Wrinklewort in plots within EM5 that were burnt in 2012 (in unit FM2; Figure 2.14) and in EM3 that hasn't been burnt, with surveys prior to and following the burn, to determine if there is a detrimental effect on adult plants and regeneration as a result of burns. A recent report identified that the data were not convincing in determining the impacts of fire (Matthews 2014), and a small group of FOG volunteers, CIT students and consultants are currently discussing implementation of a modified monitoring program. Other CIT students undertake mapping of weed distribution, which is used to assist in prioritising weed control. Students have also participated in weed control under instruction by FOG volunteers, to meet requirements of their courses.



Figure 2.14. Hazard reduction/ecological burns undertaken at Stirling Park between 2009 and 2015

Table 2.1. Progress towards meeting 2009 outcomes, Stirling Park and State Circle Woodlands

Proposed outcomes of management (Sharp 2009)	Progress towards meeting outcomes, December 2015
The remnant woodland is fulfilling a role as the city's key visual and landscape element, and visual backdrop and landscape setting for the National Capital (NCOSS).	Progress in removal of woody weeds is improving the ecological condition and aesthetics of the areas; removal of Blue Gums has temporarily reduced aesthetics in that area, but condition is improving through natural regeneration and planting of replacement endemic shrubs and trees.
The site has a high natural biodiversity.	Progress in removal of woody weeds is improving the ecological condition; comparison of data from surveys undertaken in Stirling Park in 2005 and in 2014 indicated a similar abundance and distribution of Button Wrinklewort and rare plant species and a significant reduction in woody weeds. The creek-line remains weedy.
There is contiguous woodland along the length of Stirling Park from east to west.	Progressing well, with control of woody weeds, herbaceous weeds. Planted trees in EM2 between the areas of woodland in EM3 and EM5 in 2015 are 2 m tall.
Declared pest plants are controlled overall and are eradicated in the areas of highest value	The first cut-over of woody weeds is complete in State Circle Woodland and Attunga Point and almost complete in Stirling Park. Follow up work for missed plants, regrowth or regeneration is ongoing. Herbaceous weeds density is reducing in select locations due to intensive herbaceous weed control, but is still present particularly around the edge of the woodlands.
Habitat complexity is maximised to increase the probability of fauna persisting on site.	Replanting is replacing some habitat lost as a result of removal of woody weeds.
Specific habitat features for threatened species are retained and populations of threatened species remain on site.	Button Wrinklewort population appears to be stable; populations of rare plants are common. Rare and threatened birds were observed in Stirling Park in 2010.
Recreational pursuits that are compatible with retaining the existing conservation values are undertaken.	No major issues were identified as a result of recreational pursuits, although erosion of the tracks is exacerbated by constant pedestrian traffic. Local residents are much better informed of values since 2009.
There is no reduction in the size of the area that contains habitat for the threatened species and Yellow Box – Red Gum grassy woodland.	The area of Box-Gum Woodland that meets the definition of the endangered community has increased (including EM6) as a result of planting and weed control.
A fire plan is in place.	The Bushfire Operational Plan was developed in 2012 and 2014 and is being implemented and impacts on Button Wrinklewort are being monitored.

2.3 Management Plan, Stirling Park

This plan identifies the management actions required to retain ecological integrity. Other management actions will also occur at Stirling Park, but this plan should be considered initially, to ensure other actions will not compromise the intents of this plan. Such actions include management of the boundary plantings, management of tracks, access requirements for emergency or fire management, recreation and education.

2.3.1 Conservation management aims and requirements

1. To conserve, restore, further link and expand the extent of Yellow Box – Red Gum grassy woodland endangered ecological community.
2. To increase the biodiversity and structural diversity of the native vegetation communities.
3. To retain and enhance threatened species habitat (Button Wrinklewort) and that of other native flora and fauna.
4. To enhance diversity and habitat movement by undertaking revegetation of the open areas along the northern section of the Park.
5. To control weed spread and avert the introduction of other weeds.
6. To manage fire fuel hazard (for protection of surrounding areas and for ecological outcomes).
7. To prevent damage to the soil through disturbance, compaction or erosion.
8. To protect and manage cultural heritage values (Indigenous and European) in accordance with the Lake Burley Griffin Heritage Management Plan (Godden McKay Logan, 2009).
9. To educate the general public about the natural values of the area and to encourage respect for the site as part of our natural and cultural heritage.

2.3.2 Management issues

1. **Biomass management**
 - Slashing may be spreading weed seed; review the boundaries of the areas that need to be slashed regularly and ensure contractors comply with vehicle hygiene practices.
 - Woody weeds in EM3, regrowth of planted trees in and around EM4 and pines in the south-west of EM5 are a fire hazard.
 - Monitoring indicates that the impacts of burning on Button Wrinklewort survival and regeneration remain unclear.

2. Weeds

Woody weeds

- Woody weeds on the borders of the conservation area provide on-going sources of seed for re-invasion.
- Woody weed density is high in parts of units EM3, EM5, EM7 and the edge of EM4, where broadscale clearance has not yet been completed.
- Haines Creek is weedy and in poor condition.
- Regrowth and minor untreated woody weeds is occurring in areas cleared between 2009 and 2015 (units EM1, EM3, EM5, EM7, EM8).
- Blackberry thickets and woody weeds are dense in the still untreated area in unit EM3.
- Removal of woody weeds reduces habitat used by birds.
- Madeira Vine has been treated but will need constant inspection to treat it as it is likely to resprout.
- There are native plantings within Stirling Park which are not endemic to the area, including Argyle Apple (*Eucalyptus cinerea*), Oven's River Wattle (*Acacia pravissima*) and Knife-leaved Wattle (*A. cultriformis*).

Herbaceous weeds

- Herbaceous weeds, especially African Lovegrass, on the borders of the conservation area provide on-going sources of seed for re-invasion.
- Slashers in EM4, EM6 and EM8 spread weeds seed from other sites and elsewhere within Stirling Park.
- Great Mullein (*Verbascum thapsus*) is spreading from unit EM4 into EM3.
- Periwinkle remains dominant in and near Haines Creek (EM3, EM8).
- St John's Wort, Chilean Needlegrass occurs in the mown areas and northern end of woodland in EM8.
- Bare ground remains in some locations where weed control has occurred (edge of EM4, EM6).

3. Erosion and other physical damage

- Dumping, mainly of household furniture and waste, is an ongoing problem.
- Active erosion is occurring mainly on smaller walking tracks, causing loss of plants holding the soil on the track, and resulting in users walking onto and damaging adjacent native vegetation to avoid those uneven areas (EM5 and EM8).

4. Lack of information

- No information is readily available for the general public and neighbours to understand the values of the area.

5. Landscape and aesthetics

- Non-native vegetation to the north-west and south-west of EM5 and in EM4 is overgrown, reducing aesthetics, increasing fire risk and in the south-west of EM5, resulting in a safety risk from falling branches and trees.

2.3.3 Management guidelines

The key management for native grasslands and more specifically Box-Gum Woodland and associated threatened species (ACT Government 2012; Sharp et al, 2015) are presented below. Other more general guidelines are provided in Attachment C.

Yellow Box- Red Gum Grassy Woodland

- Maintain habitat diversity, including fallen timber, hollows, rocks and vegetative structural diversity.
- Control biomass ideally through burning, and slashing in more open areas only.
- An optimal fire frequency for Box Gum woodland in ACT has not been defined.
- Avoid slashing with tractor-mounted or ride-on implements under the canopy of trees.
- Slashing should be undertaken with a whipper-snipper to avoid root/trunk damage and compaction.
- Chemical application should be minimised as far as possible in YBRG.
- Vehicles, plant and fuel should not be stored or parked off road or trail surfaces.
- Avoid damage to Cherry Ballart trees that provide habitat for a range of fauna and are readily killed by fire; use rake hoe lines around these plants and determine risk mitigation strategies as required.

Button Wrinklewort and other rare plants

- Burns should be restricted to between April and November to avoid summer flowering and fruiting season.
- Burns must be patchy and low-intensity.
- No ground disturbance should occur within 50 m of known colonies.
- Undertake spot spraying and cut and daub methods of weed control within 10 m of Button Wrinklewort habitat.
- Avoid physical damage to plants.

Woodland birds

- Generally areas with shrubby vegetation should not be burnt in spring to avoid the primary nesting season.
- Where spring burning is undertaken in bird habitat, patches of shrubby vegetation should be left unburnt.
- As far as possible native vegetation removal operations should be minimised during spring to avoid disturbance to bird breeding.

2.3.4 Management actions

Priorities have been identified to ensure that the most critical issues have been identified to improve ecological integrity. Priorities are based on ecological criteria, although where relevant other criteria are included. It will not always be relevant or possible, however, to undertake these actions in order of priority. At other times opportunities may arise to action items lower on the priority list, or else they may be prioritised for other reasons. Annual plans need to be developed to ensure actions are undertaken strategically.

1. General

High priority:

- Prepare an annual operational plan and Bushfire Operational Plan to implement the actions identified in this plan.

2. Biomass management

High priority

- Implement and regularly review and update the BOP.
- Slash for amenity and fire mitigation according to the BOP; provide updated maps to contractors to protect plantings. Ensure only those defined areas are slashed and that vehicle hygiene practices are implemented.

3. Weeds

High priority

- Cut and daub remaining woody weeds in north-west of EM5 and in EM3 east and Desert Ash east of EM5 and remove cut material off site.
- Continue to treat St John's Wort, Chilean Needlegrass (and African Lovegrass as required) in the woodland areas (EM3, EM5, EM6, EM8), spot spraying unless a broad area is to be treated (e.g. on the edge of EM4).
- Remove Periwinkle from areas containing Button Wrinklewort populations (EM3, EM5).
- Undertake regular follow-up control of woody and herbaceous weed regrowth or missed plants in all management units, especially highly invasive species (Broom, Madeira Vine) (EM1, EM3, EM5, EM7, EM8).
- Remove Blue Gum regrowth and other weeds.
- Follow up blackberry treatment: treat regrowth and missed plants in EM3, EM4, EM5.
- Remove woody weeds and control invasive herbaceous weeds on the boundaries of the conservation areas to minimise constant re-invasion.

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Moderate priority:

- Remove woody weeds between EM1 and the lake at Attunga Point.
- Remove willows in Haines Creek on the eastern edge of EM4.
- Thin Argyle Apples (*Eucalyptus cinerea*) in EM7.
- Contain the Periwinkle population starting from within woodland areas (EM3).

Lower priority:

- Thin Knife-leaved Wattle and Oven's River Wattle
- Remove invading pines in the south-western end of EM5 (low priority ecologically, high priority for safety).

4. Planting

High priority

- Undertake additional planting in key locations to increase diversity of structure and composition, particularly in light of the significant reduction of habitat provided by the woody weeds that have been removed (EM4, EM5, EM6).
- Plant in replacement native plantings in old Blue Gum patches in EM7.

Moderate priority:

- Plant in understorey species (shrubs and herbaceous species) in EM2 and EM4 east of EM5 to enhance the connectivity between the areas of woodland.

5. Erosion and other physical damage

High priority

- Ensure vehicles within the site are entering legally and keeping to tracks to reduce damage to native vegetation.
- Ensure operators of hot air balloon companies using EM4 for landings adhere to guidelines (NCA 2014).

Moderate priority:

- Undertake walking track maintenance for erosion control.

6. Communication and signage

High priority

- On each entrance erect signs to advertise volunteer work parties to inform users and encourage additional participation.

Moderate priority:

- Put up permanent signs to inform users of the cultural (Westlake, Indigenous) and ecological values of Stirling Park and State Circle woodlands.

As opportunities arise:

- Increase involvement by neighbouring businesses, residents and other users.
- Explore potential for sponsors: e.g. Canberra Yacht Club, mosque.

7. Landscape and aesthetics

Lower priority:

- Trim the exotic trees and consider replacement of these species adjacent to EM3, EM5 and EM8.
- Remove regrowth in EM4 and EM6 and trim mature exotic trees to enhance their aesthetics.

8. Adaptive management

High priority:

- Review the burn program in light of research on impacts of burning on Button Wrinklewort and other fauna and flora and Box-Gum Woodland as it becomes available.

Moderate priority:

- Continue to monitor Button Wrinklewort in select locations to guide the frequency of burning; consider alternative ways to monitor the changes more effectively.

As opportunities arise:

- Continue to support and encourage student projects and other research programs to enhance knowledge about the impacts of management of woodlands and threatened species, particularly burning
- Involve the Indigenous community in management, including options to undertake trials of traditional land management practices

2.3.5 Other actions

High priority:

- Prepare a detailed planning framework for Stirling Park, Attunga Point and State Circle Woodland to identify and ensure long-term protection to the conservation areas
- Remove the easement for the extension of Empire Circuit which will dissect the woodland and compromise its ecological integrity.

3. Yarramundi Grassland Ecological Management Plan

3.1 Description of the site

3.1.1 Location

Yarramundi Grassland is on the western side of Lake Burley Griffin, incorporating Canberra Central Rural Section 1344 (part) and Section 1339 (part). It is bordered by Lady Denman Drive between Acacia Inlet and Barrenjoey Drive to the north-west, Lindsay Prior National Arboretum to the west and Lake Burley Griffin to the east (Figure 1.3). The Australian and Torres Strait Cultural Centre is located adjacent to the carpark. Bollards demarcate the building grounds from Yarramundi Grassland. The site is designated National Land. In June 2013 the land use was changed from National Capital Use to Open Space.

3.1.2 Conservation significance

The site is open grassland, predominantly a native grassland, particularly dominated by Kangaroo Grass (*Themeda triandra*). The grassland has been identified as containing areas of the threatened Natural Temperate Grassland endangered ecosystem (ACT Government 2005), which would have extended up from the Molonglo River and into Glenloch Interchange prior to European settlement. Creation of Lake Burley Griffin has modified the local climate. Due to a range of disturbance factors the native cover is now extremely patchy. In 2005 a detailed survey in 0.25 ha grids was undertaken (Muyt 2005b). Based on those data the approximate extent of Natural Temperate Grassland and other areas containing native species can be identified, where the cover of native vegetation is over 50% (Classes 4 and 5) (Figure 3.1). This distribution needs to be interpreted with some care, as the data are 10 years old, and further survey is required to ascertain how accurate this is, particularly against likely imminent changes to the criteria within the declaration of Natural Temperate Grassland as a threatened community under the EPBC Act (see Section 1).

With the exception of a group of about six Black Cypress Pine (*Callitris endlicheri*) in the north-west portion of the site, all trees within Yarramundi Grassland have been planted; many are not locally occurring species. The area adjacent to the lake has been planted with non-indigenous eucalypts and other species but is infested with Blackberry (*Rubus fruticosus* species aggregate) and other woody weeds including willows (*Salix* spp.). Parts of the site have become heavily infested with herbaceous weeds, especially the perennial species Chilean Needlegrass (*Nassella neesiana*), Paspalum (*Paspalum dilatatum*), St John's Wort (*Hypericum perforatum*) and the annual grass Wild Oats (*Avena* spp.).



Figure 3.1. Native vegetation cover, 2005 (from Muyt 2005). Approximate extent of Natural Temperate Grassland is indicated where cover is over 50% (classes 4 and 5).

Yarramundi Grassland supports a population of the threatened Striped Legless Lizard (*Delma impar*), detected in 1991, 1993, 2000 and 2014 (Snape pers. comm., October 2015). The habitat for this species shown in Figure 3.2 includes the majority of Yarramundi, including areas identified as having a low cover of native species (Figure 3.1). Surveys have also detected Olive Legless Lizards (*D. inornata*) and 2014 surveys also detected the Three-toed Skink (*Hemiergis decresiensis*) and Delicate Skink (*Lampropholis delicata*). There is one historical record of the Golden Sun Moth at Yarramundi Grassland (within unit EM10) but the habitat is considered to be marginal (Snape pers. comm., October 2015). The Perunga Grasshopper (*Perunga ochracea*), a species declared vulnerable under the ACT *Nature Conservation Act 2014*, has been observed on the site. A list of the species surveyed in Yarramundi Grassland is presented in Attachment A2.

Indigenous heritage values are associated with the foreshore at Yarramundi, although there was no evidence of the presence of previously recorded sites in 2006 (Godden, McKay and Logan Pty Ltd 2008). As part of the landscape surrounding the Cultural Centre there may be specific features of the site that are valued by the Aboriginal community, and as such, their interests and involvement need to be incorporated within the management and use of Yarramundi Grassland.



Figure 3.2. Striped Legless Lizard habitat in Yarramundi Grassland (data provided by ACT Government, 2015).

3.1.3 Condition of the grassland

In the 1980s Yarramundi Grassland was recognised as one of the most diverse and ‘important’ grasslands in the Territory (Chan 1989), but has become increasingly invaded by herbaceous weeds, particularly Chilean Needlegrass, and some woody weeds including Blackberry significantly reducing the condition of the Natural Temperate Grassland remaining. The survey by Muyt (2005b) identified the location and abundance of rare plants, weeds and native vegetation cover, and these data assist to identify the location and extent of the issue of weed control in the site. Muyt’s survey indicated that Chilean Needlegrass had invaded much of the site, with significant sized patches with more than 75% cover of the species. Paspalum was widespread, often reaching over 50% cover. St John’s Wort was scattered throughout the entire area, with heavier patches in some locations. The annual grass, Wild Oats occurred throughout the site. More details and maps of the distribution of these species are provided in Attachment A2.

In 2009 the Commissioner for Sustainability and the Environment presented an investigation into the condition of Natural Temperate Grassland remnants in the ACT (Cooper 2009). Yarramundi Grassland was included in the survey undertaken for this study (Hodgkinson 2009), and subsequently identified as being in critical condition, requiring weed control and an ecological burn program.

An inspection undertaken in 2015 to guide this report indicated that the condition of the grassland remained very patchy, with extensive areas of moderately

diverse native grassland interspersed with patches of predominantly introduced species, especially Chilean Needlegrass, Paspalum, St John’s Wort, Wild Oats and other weeds. It appeared that weeds such as Chilean Needlegrass had spread further since 2005 when the detailed survey by Muyt was undertaken. The ecological management units in this plan reflect the relative predominance and size of native patches compared to introduced patches (Figure 1.3). The southern end of the Reach below the cyclepath was more disturbed, dominated by exotic perennial species (mostly Chilean Needlegrass and Paspalum), with occasional native grass dominated patches (unit EM11 in Figure 1.3), as was also the situation in 2005 (Figure 3.1). Nevertheless this area does retain habitat suitable for the Striped Legless Lizard (Figure 3.2).

Dense thatching of Kangaroo Grass is a recurring issue raised by past surveyors (Muyt 2005b; Cooper 2009; Hodgkinson 2009), requiring removal or thinning by burning, mowing or grazing. Unless this biomass is removed the process ‘inevitably contributes to the decline in the cover and abundance of native groundflora Eventually these plants are eliminated from an area ... and undermines the growth of Kangaroo Grass itself.... This then opens up areas to weed invasion.’ (p.4, Muyt, 2005b). It is surmised that lack of biomass management in the past 30 or more years since grazing of domestic stock ceased is a major cause of the highly patchy vegetation within this site.

In 2005 sightings and droppings of rabbits and hares indicated that they were very numerous, although there was no evidence of burrows (Muyt 2005b). The current situation is likely to be similar, with many droppings evident all over the site, although there has been no further incidences of burrows recorded, possibly as a result of the removal of clumps of Blackberry and woody weeds in the 1990s.

Given the amount of time since quantitative surveys have been undertaken, and the changes in management applied on the site since 2009 it is recommended that surveys be undertaken across Yarramundi, to provide more detailed information about the condition of each area and to better define which areas meet the criteria to be classified as part of the Natural Temperate Grassland endangered ecological community. Studies consistent with the methodology applied by Muyt (2005b) would enable a comparison of changes over that time.

3.1.4 Ecological management units

The site has been divided into seven units (Figure 1.3) which reflect their ecological condition. These have been modified slightly from those identified in Sharp (2009), and several areas identified in Sharp (2009) have not been included as they contain predominantly introduced vegetation and are not considered to be of ecological significance.

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EM9 (Management Units 2 and 5 in Sharp 2009): located in the central portion of site including the creek line to the west, bounded by the building, the official vehicle track to the cyclepath, the planted trees adjacent to the cyclepath and the western side of the old creek line. This unit contains Natural Temperate Grassland dominated by Kangaroo Grass and River Tussock (*Poa labillardierei*). There are several small to large patches of weeds, especially of Chilean Needlegrass. Wild Oats are scattered throughout the unit and there are remnant patches of St John's Wort and Blackberry resprouting after control (Figures 3.3, 3.4). This is the unit in the site that is in the best condition, in which the most amount of management effort has been applied since 2009. A planned burn was undertaken in FM11 (EM9) in autumn 2012.



Figure 3.3. EM9, Yarramundi Grassland along the creek line (Dec. 2015)



Figure 3.4. EM9 habitat, Yarramundi Grassland (Dec. 2015)

EM10 (Management Units 1 and 3 (north) in Sharp 2009): located in the north- western portion of site, bounded by Lady Denman Drive, the Lindsay Prior National Arboretum and the drainage line. This unit is mostly Natural Temperate Grassland dominated by Kangaroo Grass and with a moderate diversity of native species (Figures 3.5, 3.6). It also contains more degraded patches that are co-dominated by Speargrass (*Austrostipa bigeniculata*) and Chilean Needlegrass and also containing Paspalum, St John's Wort and Wild Oats with scattered Kangaroo Grass. Several Black Cypress Pine trees (*Callitris endlicheri*) have established (apparently naturally) in the north-western end of the unit. The Striped Legless Lizard (*Delma impar*) was trapped in the eastern portion of unit EM10 in 1991, 1993 and again in 2014 (Figure 3.2). A planned burn was undertaken in FM10 (north of the cyclepath) in autumn 2012 and in FM13 (south of the cyclepath) in spring 2015.



Figure 3.5. EM10 habitat, Yarramundi, south of the cyclepath, post burn (Dec. 2015)



Figure 3.6. EM10 habitat, Yarramundi, north of the cyclepath (Dec. 2015)

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EM11 (Management Unit 3 in Sharp 2009): located in the south-western area, bounded by a dirt walking track to the north, the Lindsay Prior Arboretum and the lake. EM11 contains very patchy native vegetation, with very low species diversity, with much larger patches are dominated almost exclusively by herbaceous weeds, including Chilean Needlegrass, Phalaris (*Phalaris aquatica*), Paspalum, with tree and shrub plantings and woody weeds including Blackberry (Figure 3.7). There are several rocky outcrops, but these contain few native species. Even though containing only degraded native vegetation the unit contains habitat deemed suitable for the Striped Legless Lizard (Figure 3.2). A planned burn was undertaken in FM9 (the southern portion of EM11) in spring 2011.



Figure 3.7. EM11 habitat, Yarramundi Grassland (Dec. 2015)

EM12 (Management Unit 4 in Sharp 2009): located in the northern portion bounded by Lady Denman Drive, the building, the cyclepath and Acacia Inlet. The unit is a mosaic of patches of moderately diverse native grassland dominated by Kangaroo Grass (Figures 3.8) and patches dominated by Chilean Needlegrass, Paspalum, St John's Wort and other introduced species (Figure 3.9). Striped Legless Lizards were trapped in this area in one trap site in 1991 and 1993. A planned burn was undertaken (FM12.1) in autumn 2013.



Figure 3.8. EM12 habitat, Yarramundi, a predominantly native area (Dec. 2015)



Figure 3.9. EM12 habitat, Yarramundi, a predominantly exotic area (Dec. 2015)

EM13 (Management Units 6 in Sharp 2009): two areas of tree plantings located between EM9 and the cycle path (Figure 3.10), containing Yellow Box (*Eucalyptus melliodora*), Snow Gum (*E. pauciflora*) and various non-local eucalypts. The understorey of these two plantings contains a high diversity of naturally occurring herbaceous species (Figure 3.11).



Figure 3.10. EM13 habitat, Yarramundi Grassland (Dec. 2015)



Figure 3.11. EM13 habitat, Yarramundi, with diverse native understorey (Dec. 2015)

3.1.5 Use of the site

A major cycleway goes through the site. Cycle traffic is frequent, fast and regular, and includes commuter and recreational cyclists. In addition walkers with and without dogs regularly use the cycle path and the tracks. The dense grass on most of the site discourages casual pedestrian traffic through the site.

Many people use the carpark adjacent to the Cultural Centre as an entry point to the cyclepath and lake, for walking with or without dogs and cycling. People access the lake from the carpark and from Lindsay Prior Arboretum to go fishing. Since fencing was erected along the southern boundary illegal access by vehicles from Barrenjoey Drive, an issue identified in Sharp (2009) has ceased.

3.1.6 Stakeholders

1. National Capital Authority: legislative, management, planning and financial responsibility
2. ACT Government:
 - Environment Planning Directorate, Conservation Research: threatened biota
 - Territory and Municipal Services, Fire Management Unit: liaison regarding fire mitigation requirements and
 - Territory and Municipal Services, City Services: neighbour and complementary management arrangements
3. Friends of Grasslands volunteers involved in on-ground management of the area and advocacy
4. Aboriginal and Torres Straits Islander (ATSI) Cultural Centre managers and users
5. Greening Australia: trials of diverse herbaceous plantings
6. Fenner School ANU: research and source of volunteers
7. Canberra CIT: on-going survey and research, educational opportunities
8. Walkers, cyclists

3.2 Management history

3.2.1 Prior to 2009

Details of management prior to 2009 are included in the review of management at Yarramundi Grassland presented in Attachment A2.

3.2.2 2009-2015

Management since 2009 has been undertaken in accordance with the Conservation Management Plan (Sharp 2009), by NCA, Friends of Grasslands and weed contractors. Bushfire Operational Plans (BOP) have been developed by NCA (Beutel and Nash 2012; Beutel and Smith 2014). Burns are undertaken in five fire management units across the site and to date, the entire area of Yarramundi Grassland has been burnt once, between 2011 and 2015 (Figure 3.12). Other fire mitigation actions identified include the planned

removal of Blue Gums east of EM10 when funds allow and slashing around the perimeter of the site and along internal tracks.

The majority of actions recommended in Sharp (2009) have been achieved or are being addressed, with mixed success in meeting the identified aims and objectives. The actions include weed control, biomass management for ecological outcomes and fire mitigation and landscape protection and fencing. Table 3.1 presents a summary of outcomes of actions undertaken between 2009 and 2015, compared against the proposed outcomes of the management of the site identified in Sharp (2009).

FOG has undertaken finer scale spot spraying of herbaceous weeds in the areas of highest conservation value, in EM9 and EM13 and the north-eastern end of EM10. Contractors to NCA and also paid through grants awarded to Friends of Grasslands have undertaken more extensive treatment of African Lovegrass (which is mainly occurring along the cyclepath), Blackberry, Chilean Needlegrass and St John's Wort. Nevertheless on-going treatment of these weeds, and Paspalum, is required to contain them, and reduce their abundance within the areas of Natural Temperate Grassland and Striped Legless Lizard habitat.

Some planting of indigenous species has occurred to increase the diversity, undertaken with the assistance and support of Greening Australia (ACT) in units EM9 and 10.

Further details are presented in Attachment A2.

3.2.3 Monitoring and research

Monitoring to determine changes in dominance where Chilean Needlegrass is predominant is being undertaken by Friends of Grasslands volunteers annually in select locations in EM9 and 10 (see Attachment A2). Results indicate, however, that little change in the relative dominance of Chilean Needlegrass and native species has occurred, except in one location that was disturbed and treated with broadscale herbicide.

Information supplied by ACT Government about research and monitoring of threatened fauna is quoted as follows (Snape pers. comm., October 2015): "For over two decades, Conservation Research (Environment Planning Directorate, ACT Government) has undertaken intermittent monitoring at Yarramundi Grassland to detect the presence of lizards using concrete tiles or pit fall traps placed on site. During this time, Yarramundi Grassland has consistently supported a low density population of the threatened Striped Legless Lizard, *Delma impar*. Surveys in 1991 and 1993 made two and three detections respectively, one individual was detected in 2000 and one skin in 2001, and more recently three individuals were detected within a one hectare research plot (indicated

in Figure 3.2) in 2014. The Conservation Research survey plot at Yarramundi Grassland (surveyed in 2014 and due for repeat survey in 2015) is part of a broad-scale project assessing kangaroo grazing impacts on biodiversity, including assessments of grazing pressure, vegetation structure and the diversity and abundance of reptiles and both native and exotic vegetation. Management guidelines for the Striped Legless Lizard are currently under review.”

3.2.4 Conclusions

Friends of Grasslands and other volunteers undertake work in only about 7% of the site, due to the time taken and constant requirement to undertake initial and follow-up work to contain the herbaceous weeds. However, most woody weeds have been eradicated in and adjacent to the eucalypt plantation to the south of Unit EM9. Blackberry has been treated, but follow-up is required to treat the regenerating plants, ideally while they are still small in size.

FOG’s aims are to continue to work within the area EM9, the area of highest conservation value, particularly to remove Blackberry that is regenerating, contain St John’s Wort, Paspalum and Wild Oats and to try to reduce the cover of Chilean Needlegrass. The plantings by Greening Australia in their Groundcover project have been successful, and it is hoped that these will regenerate and spread.

The confirmation that Striped Legless Lizard is still at the site indicates a need to consider requirements for maintaining optimal habitat for this species over the entire area. The recommendations in the guidelines being developed by ACT Government should be incorporated into management at Yarramundi Grassland when they become available.

Broadly across the site the concern and difficulty is the patchiness of the native grassland, so that it is difficult to delineate the areas of importance and to determine of what management should be achieving. African Lovegrass is regularly sprayed along the cycle path, but re-invasion from the cyclepath and road is continuous. Serrated Tussock occurs in low abundance in units EM10 and EM11. Treatment of Chilean Needlegrass throughout the site remains the biggest and most difficult issue. If it remains untreated throughout the rest of the site it is expected to spread further and ultimately replace the native species and thus destroy the endangered ecological community and habitat for grassland species. Movement of vehicles (slashers, trucks or cars) between areas of the site will inevitably spread the grass back into areas that have been treated by volunteers. Currently the major infestations are around the buildings and along tracks. Paspalum is also widespread in the site, especially along the cyclepath. Wild Oats remains at high levels, although at certain times it is not as apparent, as it is an annual species. A considerably increased investment of time and resources is required to reduce the dominance by the herbaceous weeds, and it is beyond the resources of volunteers to do so.

It is considered that the best option for maintaining and hopefully increasing the diversity and abundance of native species across the site is the continued implementation of burning. ACT Government is planning to implement further trials to guide the frequency of burns in native grassland. If guidelines provided by ACT Government change as a result, these need to be implemented at Yarramundi. The impacts of slashing multiple times a year should also be investigated.



Figure 3.12. Hazard reduction/ecological burns undertaken at Yarramundi Grassland between 2009 and 2015

Table 3.1. Progress towards meeting 2009 outcomes, Yarramundi Grassland (see also Attachment A2)

Proposed outcomes of management (Sharp 2009)	Progress towards meeting outcomes, 2015
The site has a high natural biodiversity.	EM9 and parts of EM10 have been planted with grassland species, including some forbs; burns undertaken have opened the canopy and facilitated flowering and seeding of native plants.
Major weeds are controlled overall and are eradicated in the areas containing the endangered Natural Temperate Grassland community.	St John's Wort is significantly reduced in EM9, EM10 and EM13; Blackberry and other woody weeds have been removed or reduced, although regrowth needs on-going treatment. However, herbaceous weed infestation remains very high and abundance and distribution of Chilean Needlegrass remains unchanged.
Habitat complexity is maximised to increase the probability of fauna persisting on site.	The burns have increased structural complexity. Populations of Striped Legless Lizard has survived over time, having been observed during surveys.
Specific habitat features for threatened species are retained so that populations of threatened species remain on site.	The site has retained a population of Striped Legless Lizard.
There is no reduction in the size of the area that contains habitat for the threatened species and Natural Temperate Grassland.	The area of NTG remains similar to 2005. An unofficial service vehicle track within EM9 has caused considerable degradation to the grassland in this area.
A fire plan is in place.	Prepared initially in 2012, and being implemented since then (see Figure 3.9)
Recreational and educational pursuits that are compatible with retaining the existing conservation values are undertaken.	Erection of the fence along the north-south boundary adjacent to the Lindsay Prior National Arboretum has reduced illegal vehicular entry across the site. Soft surface formal and unofficial tracks are in poor condition. Previous entry by the site by ballooning companies has ceased and the NCA policy (T217754) is being enforced.
There is a strong sense of knowledge about the site, and pride and ownership of the site by the occupants of the Cultural Centre, the National Capital Authority and the general public.	The general public are still mostly unaware of the values of the site, and the users of the Cultural Centre are not involved in management. National Capital Authority implementation of management since 2009 has significantly increased, and indicates greater commitment to facilitate the retention of conservation values. Yarramundi Grassland land use designation has been changed from National Use to Open Space.

3.3 Management Plan, Yarramundi Grassland

This plan identifies the management actions required to retain ecological integrity. Other management actions will also occur at Yarramundi, but this plan should be considered initially, to ensure those actions will not compromise the intents of this plan. Such actions include management of the boundary plantings, management of the cyclepath, access requirements for emergency or fire management, recreation and education.

3.3.1 Conservation management aims and requirements

1. To retain and increase the biodiversity in Units EM9, EM10, EM12 and EM13.
2. To maintain native plant diversity within Units EM10 and EM11.
3. To retain and enhance known and potential habitat for threatened species (Striped Legless Lizard, Golden Sun Moth, Perunga Grasshopper) in units EM9, EM10, EM11 and EM12.
4. To retain and enhance habitat for other native grassland flora and fauna generally across the site.
5. To control weed spread and prevent the introduction of other weeds, especially declared pest plant species.
6. To minimise the sizes of patches of predominantly introduced species in units EM9, EM10 and EM12.
7. To manage fire fuel hazard for conservation outcomes and for protection of surrounding areas.
8. To prevent damage to the soil through disturbance, compaction or erosion.
9. To involve the Aboriginal Culture Centre users in the conservation of the ecological values and heritage of the site.
10. To educate the general public about the natural values of the area and to encourage respect for the site as natural heritage.
11. Undertake management of pest plants on national land outside the conservation areas to ensure re-invasion is minimised.

3.3.2 Management issues

1. Biomass management

- Frequency of the burns requires review as research results become available to ensure conservation outcomes are achieved.
- Frequency and timing of burns within Striped Legless Lizard habitat need to be reviewed in relation to guidelines being prepared by ACT Government relating to survival and habitat retention for the species.
- The bollards in Unit EM9 were put in place to separate the mown area around the building from the NTG below and identify the different management regimes – for landscaping around

the building above, and to achieve ecological outcomes below. The regularly mown strip below the bollards in the grassland is generally far wider than required for access or fire mitigation (Figure 3.13), and is frequent enough to preventing regeneration of the native species. This may result in a loss of the taller native species and an increase in weeds through mowers spreading weed seed, but this requires further investigation.



Figure 3.13. Wide slashed area below bollards, EM9, Yarramundi, may be impacting regeneration of taller native species.

2. Weeds

Woody weeds

- The National Land outside the Conservation Area that borders Lake Burley Griffin, the Lyndsay Prior National Arboretum and Acacia Inlet are an on-going source of weeds, including Blackberry, St John's Wort and Cootamundra Wattle.
- Large blackberry clumps remain in units EM10, 11 and 12.
- Blackberry is resprouting following treatment in EM9, EM10 and EM13.
- Exotic pine wildings are invading Unit EM10.
- Regenerating planted eucalypts (non-indigenous species) and Cootamundra Wattle regrowth in Unit EM13 are competing with significant grassland flora including Bulbine Lilies and Blue Devils.

Herbaceous weeds

- Grass cuttings are being dumped in EM9, increasing weed invasion.
- Herbaceous weeds on the borders of the conservation area provide on-going sources of seed for re-invasion.
- Chilean Needlegrass is widespread and abundant throughout Yarramundi Grassland, competing with native forbs and grasses in units EM9 (Figure 3.14), EM10, EM11 and EM12.
- African Lovegrass is continuously re-invading the edges of the bike paths and tracks and being spread by vehicles and mowers from populations around the cultural centre.

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- Paspalum is present in all units and being spread by slashers.
- Run-off entering the creek in EM9 is contributing to continuous weed invasion in the creekline and surrounding grassland.



Figure 3.14. Areas in orange in EM9 have a high density of Chilean Needlegrass.

3. Tracks

- An unnecessary vehicle track bisecting Unit EM9 is being used as a short cut to the southern end of the site (Figure 3.15) and is resulting in compaction, the loss of native species and spread of weed species.
- The formal walking track through Unit EM9 is weedy, and eroded and the area outside the track mown unnecessarily wide.



Figure 3.15. Informal track bisecting EM9, Yarramundi. The green grass in the foreground is predominantly Chilean Needlegrass and annual exotic grasses.

4. Management of degraded native grassland

- Continuing lack of management of weeds and biomass in EM11 and EM12 will inevitably result in further degradation.

5. Signage

- Existing signage is worn, illegible and outdated.

6. Adaptive management

- It is more than 10 years since the condition of the grassland has been quantitatively assessed.

7. Management around the Cultural Centre

- In the rock garden around the Cultural Centre several weed species have been planted (e.g. Bluebell Creeper (*Billardiera heterophylla*) or have become established.
- Rubbish and grass clippings are being dumped at the north-western end of unit EM9.
- The Chilean Needlegrass around the Cultural Centre is continuously infesting the grassland.

3.3.3 Management guidelines

The key management for native grasslands and more specifically Natural Temperate Grassland and associated threatened species (ACT Government 2012; Sharp et al., 2015) are presented below. Other more general guidelines are summarised in Attachment C.

Natural Temperate Grassland:

- An optimal fire frequency for Natural Temperate Grassland in ACT has not been defined, in recommended frequency in NTG in Victoria is 2 – 3 years.
- As a general principle, biomass should be maintained on average at between 2 and 4 t/ha.
- Burns should be patchy
- After slashing there may be a requirement to remove slash to prevent changes to light, moisture and nutrients that are likely to deleteriously affect native species.
- Appropriate timing of biomass reduction enables natural regeneration and maintenance of habitat.

Striped Legless Lizard and other reptiles:

- Burns should be restricted to early spring (Sept – Oct) before summer breeding, or early autumn (March – April) to ensure sufficient regrowth of vegetation before winter.
- Burns must be patchy and low intensity.
- Burns or slashing should be conducted during the middle of the day or evening, rather than early morning when the lizards may be cold and slow moving.
- Slashing in habitat should not be undertaken below 20 cm to retain tussock structure.

3.3.4 Management actions

Priorities have been identified to ensure that the most critical issues have been identified to improve ecological integrity. Priorities are based on ecological criteria, although where relevant other criteria are included. Section 6 contains operational plans that provide a guide to the timing of implementation of actions for 2016 to 2018. At times opportunities may arise to action items lower on the priority list, or else they may be prioritised for other reasons.

1. General

High priority:

- Prepare an annual operational plan and Bushfire Operational Plan to implement the actions identified in this plan.

2. Biomass management

High priority:

- Review burning plan to undertake burns at a frequency that maintains biomass between about 2 and 4 t/ha and at intervals of approximately 3 years.
- Identify the required width of the asset protection zone around the buildings and ensure mowing undertaken beyond that zone is for ecological outcomes.
- Reduce the mowing width of the walking track in Unit EM9.

3. Weeds

High priority:

- Undertake follow-up weed control after burns and following weed control by contractors to reduce re-infestation.
- Undertake spot spraying in smaller patches of weeds within EM9 and EM13.
- Undertake broadscale weed control to reduce the larger infestations of herbaceous weeds in units EM9, EM10 and EM12.
- Annually spray African Lovegrass along cyclepath and check for then treat new infestations.
- Remove Blackberry and Cootamundra Wattle on the roadside, along lakeside and clumps within the grassland: cut back treated plants (or burn them) and retreat them as required.
- In the Lindsay Prior Arboretum ensure no weed species are planted, control herbaceous weeds and remove Cootamundra Wattle to minimise sources of seed.

Moderate priority:

- Discuss replacing weed species with endemic species in the Cultural Centre gardens with the managers.
- Install a retention pond on the creekline below Lady Denman Drive to retain pollutants and nutrients and improve the quality of the water flowing into Lake Burley Griffin.

4. Planting

High priority:

- Continue planting in units EM9 and EM10 to increase competitive native cover.

5. Tracks

High priority:

- Close off access to the informal vehicle track and repair the walking track, treat weeds and prevent vehicle usage within EM9.

6. Management around Cultural Centre

High priority:

- Identify a place for mowing contractors to dump grass clippings well away from the grassland.

7. Signage

Moderate priority:

- Remove old signs and erect new signs in entrances: on the bike path and adjacent to the cultural centre; include Indigenous information with advice on wording sought from users of the Cultural Centre.
- Remove superfluous star pickets.

8. Adaptive management

High priority:

- Undertake a quantitative survey to assess the condition of each of the management units against identified benchmarks and to map the extent of Natural Temperate Grassland.
- Use research on impacts of burns within native grassland to guide the frequency of control burns.
- Incorporate information from ACT Government on management requirements for the Striped Legless Lizard when available, considering areas outside NTG, especially EM10, EM11 and EM12.

As opportunities arise:

- Support research on effects of current management on Striped Legless Lizard populations and habitat and more optimal management of biomass for species diversity generally.
- Involve the Indigenous community through the users of the Cultural Centre in management, including options for interpretation of the landscape.

3.3.5 Other actions

- Prepare a detailed planning framework to identify and ensure long-term protection to the conservation areas
- Consider the long-term use and appropriate management of the areas of grassland at Yarramundi that do not meet the criteria as the endangered Natural Temperate Grassland ecological community.

4. Guilfoyle St Grassland Management Plan

4.1 Description of the site

4.1.1 Location

Block 20 Section 66 Yarralumla (Guilfoyle Street) is a small grassland (0.8 ha) between Guilfoyle St and established tree and shrub plantings (and woody weeds) west of Adelaide Avenue and between Cambage and Gunn Streets (Figure 1.4).

4.1.2 Conservation significance

EM14 (Unit 1 in Sharp (2009) (Figure 4.1) contains native grassland identified as Natural Temperate Grassland in ACT Government (2005), although it is possible it is secondary grassland, derived from Yellow Box – Blakely's Red Gum Grassy woodland. In either case, it meets the criteria as being endangered under EPBC Act and NC Act. The site was identified as a Category 2 Conservation site in ACT Government (2005).

There is a medium density population of the critically endangered Golden Sun Moth present that has the potential to continue to be viable and one historical record of one Button Wrinklewort (Rowell 2006), although it has not been sighted for some years during regular inspections of the site (Environment and Planning Directorate 2015).



Figure 4.1. EM14 habitat, Guilfoyle St Grassland (Aug. 2015)

Unit 2 identified in Sharp (2009) has been removed from this EMP due to its very low ecological values, being in a low-lying run-on area and dominated by weeds, particularly Chilean Needlegrass).

4.1.3 Condition of the grassland

The grassland is dominated by Kangaroo Grass (*Themeda triandra*), with speargrasses (*Austrostipa* spp.) and wallaby grasses (*Rytidosperma* spp.) more prevalent along the boundaries of the grassland. Some more uncommon plants occur within the plantings above Adelaide Avenue (Yam Daisy *Microseris lanceolata*, a plumegrass *Dichelachne* sp. and Curved Riceflower *Pimelea curviflora* (Rowell 2006).

The grassland has a low diversity of other native species. Whether there is a diversity of species still present cannot be ascertained in the absence of regular biomass management followed by more detailed surveys. A species list from 2006 (Rowell 2006) is in Attachment A3.

There is a high cover of Chilean Needlegrass along the edge of the grassland, together with Paspalum and Wild Oats. A clump of woody weeds, including Hawthorn and Cootamundra Wattle, occur at the northern edge of the grassland (Figure 4.1).

In 2009 the Commissioner for Sustainability and the Environment published an investigation into the condition of Natural Temperate Grassland remnants in the ACT (Cooper 2009), including the Guilfoyle St Grassland. The grassland was identified as being in critical condition, requiring weed control and an altered mowing regime, fencing and consideration of the introduction of a burn program (Hodgkinson 2009).

4.1.4 Use of the site

The land is within the Central Diplomatic Area (National Capital Plan 2002), designated for use to accommodate future diplomatic facilities.

There are no signs that it is used recreationally or otherwise.

4.1.5 Stakeholders

1. National Capital Authority: legislative, management, planning and financial responsibility
2. ACT Government:
 - Environment Planning Directorate, Conservation Research: threatened biota
 - Territory and Municipal Services, Fire Management Unit: liaison regarding fire mitigation requirements and
 - Territory and Municipal Services, City Services: neighbour and complementary management arrangements
3. Friends of Grasslands volunteers involved in on-ground management of the area and advocacy
4. Other stakeholders include neighbouring property owners and residents

4.2 Management history

Following the establishment of the suburb of Yarralumla in the 1960s it is likely the area was mown occasionally. The boundary along the roadside has been more regularly mown, likely introducing, then spreading, Chilean Needlegrass and Paspalum. Plantings were established at the eastern edge probably when Adelaide Avenue was built.

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In 2012 NCA prepared and implemented a Bushfire Operational Plan (BOP) (Beutel and Nash 2012), updated in 2014 (Beutel and Smith 2014). A burn was undertaken in 2010 and the site has been slashed, the last time in 2014, in lieu of the planned 2014 burn. Other actions identified in 2009 have not been

implemented, including removal of woody weeds in the grassland and along the edge of the plantings alongside Adelaide Avenue and control of Chilean Needlegrass in the grassland. Progress towards meeting the outcomes defined in 2009 are presented in Table 4.1.

Table 4.1. Progress towards meeting 2009 outcomes, Guilfoyle St Grassland, Yarralumla

Proposed outcomes of management (Sharp 2009)	Progress towards meeting outcomes, 2015
The site has a high natural biodiversity.	Biodiversity values appear to have remained constant, although there has been no monitoring to quantify this.
Weeds are controlled and are eradicated in the areas of highest value.	No reduction in weed abundance or distribution.
Habitat complexity is maximised to increase the probability of fauna persisting on site.	Habitat complexity compromised by the consistent dense biomass of Kangaroo Grass and weeds.
Specific habitat features for threatened species are retained and populations of threatened species remain on site.	No surveys have occurred since 2006 to determine if Golden Sun Moth or Button Wrinklewort have survived.
There is no reduction in the size of the area that contains habitat for the threatened species and Natural Temperate Grassland.	It is likely that there is a reduction of the area of NTG due to gradual weed invasion, although no monitoring has occurred to confirm this.
A fire plan is in place.	The BOP was prepared in 2012. The planned burn for 2014 did not occur; to reduce biomass the site was slashed in 2014.

4.3 Management Plan, Guilfoyle St Grassland

This plan identifies the management actions required to retain ecological integrity. Other management actions may also occur, but this plan should be considered initially, to ensure those actions will not compromise the intents of this plan

4.3.1 Conservation management aims and requirements

1. To maintain and enhance the conservation values of the grassland
2. To maintain a viable population of Golden Sun Moth
3. To provide opportunities for all native species to regenerate

4.3.2 Management issues

1. Biomass management

- Kangaroo Grass is very dense, requires biomass reduction to enhance growth and regeneration of Kangaroo Grass and other species
- Trash from mowing events very dense in places, inhibiting growth of natives and creating mulch that encourages establishment of exotics.

2. Weeds:

- Encroachment of Cootamundra Wattle from plantings above Adelaide Ave.
- The clump of woody weeds adjacent to Guilfoyle St is encroaching into the grassland.
- Chilean Needlegrass is encroaching from the road verge.
- African Lovegrass and St John's Wort established in the grassland
- Other weeds include Rosemary Grevillea cultivar, Paspalum, and abundant Wild Oats

4.3.3 Management guidelines

The key management for native grasslands and more specifically Natural Temperate Grassland are presented below. Other more general guidelines are summarised in Attachment C.

- An optimal fire frequency for Natural Temperate Grassland in ACT has not been defined, recommended frequency in NTG in Victoria is 2 – 3 years.
- As a general principle, biomass should be maintained at between 2 and 4 t/ha on average.
- Burns should be patchy
- After slashing there may be a requirement to remove slash to prevent changes to light, moisture and nutrients that are likely to deleteriously affect native species
- Appropriate timing of biomass reduction enables natural regeneration and maintenance of habitat

4.3.4 Management actions

High priority:

- Prepare an annual operational plan and Bushfire Operational Plan to implement the actions identified in this plan.
- Burn the grassland, and repeat when biomass exceeds 4t/ha.
- Avoid slashing when the biomass is very dense.
- Remove woody weeds and plantation species.
- Spray out herbaceous weeds.
- Erect markers to indicate the boundary of the area to prevent grassland being mown.
- Erect a sign to communicate the values on site.

4.3.5 Other actions

- Prepare a detailed planning framework for the conservation areas.

5. O'Malley Woodland management plan

5.1 Description of the site

5.1.1 Location

The site is on the lower north-western facing slopes of Mt Mugga Mugga, which is part of the hills and elevated valleys running north-south from Red Hill south to beyond the ACT border. The area included in this management plan is woodland in O'Malley Section 4, Blocks 10 to 14 (part), 18 (part) to 21 (Figure 1.5), between Dunoon St and Jindalee Crescent. The area of woodland is within a larger area with land use defined as Diplomatic Estate.

5.1.2 Conservation significance

A preliminary environmental assessment of Section 4 and 5, O'Malley was undertaken by Blue Gum Ecological Consulting (O'Sullivan 2013). This study delineated the areas that have retained natural ecological values, the most significant being the area addressed in this management plan. The area of Box-Gum Woodland in Section 5 above Jindalee Crescent was identified by O'Sullivan (2013) as being small, containing a low diversity of species but it did not meet the criteria as an endangered community under the EPBC Act. The vegetation at the southern end of Section 4 are not included in this EMP, as they include planted woodland with low native groundflora diversity and three patches of non-native woodland, shrubland and grassland and a small, isolated patch of Broad-leaved Peppermint Shrubby Woodland with a low diversity of native understorey species (Patch 5 in Section 4 in O'Sullivan 2013)).

A site visit was conducted for this study in September 2015 to identify management issues and determine management requirements, but the detailed study by O'Sullivan (2013) was the primary source of information about the condition of the woodland, and used to derive the areas of high conservation value. The area addressed in this EMP contains Yellow Box – Blakely's Red Gum Grassy Woodland (with or without Apple Box) and Apple Box – Broad-leaved Peppermint Grassy Woodland on the steeper rockier slopes. Areas of the site also contain rocky habitat that supports native fauna, and potentially a population of Pink-tailed Worm-lizard, although no animals were found during surveys (O'Sullivan 2013). There is a high structural diversity, consisting of diverse strata of vegetation, hollows in trees which are likely to support native birds, macrofauna and invertebrates and fallen timber (O'Sullivan 2013). A more detailed description of these areas is in O'Sullivan (2013) and the species list from this study is presented in Attachment A4.

5.1.3 Ecological management units

Two management units have been identified, based on the surveys of O'Sullivan 2013 (Figure 1.5).

EM15 (2.7 ha, primarily in Blocks 10, 11, 19, 20, 21) is an open woodland dominated by Yellow Box and Blakely's Red Gum with Apple Box more predominant to the west (Patch 2 in O'Sullivan 2013). The woodland is on the lower slopes, and contains a diversity of native species, primarily grasses and forbs and some regenerating or resprouting woody weeds (Figure 5.1). There are scattered surface rocks. This was identified as being of moderate diversity by O'Sullivan (2013).



Figure 5.1. EM15 habitat, O'Malley Woodland (Aug. 2015)

EM16 (1.5 ha, primarily in Blocks 12, 13, 14, 18, 19) contains Apple Box – Broad-leaved Peppermint Shrubby Woodland with a more shrubby understorey than EM15, on the higher slopes above the Yellow Box dominated woodland (Figure 5.2). The site is rocky, containing both surface and buried rock (Figure 5.3). The southern portion of this unit has a lower native species diversity and higher component of woody weeds.



Figure 5.2. EM16 habitat, O'Malley Woodland (August 2015)



Figure 5.3. EM16 habitat, O'Malley Woodland, rocky outcrop (Aug. 2015)

5.1.5 Use of the site

The site is designated for use to accommodate future diplomatic facilities. There may be a small amount of passive recreation (e.g. walking dogs), but no human tracks are evident.

5.1.6 Stakeholders

1. National Capital Authority: legislative, management, planning and financial responsibility
2. ACT Government:
 - Environment Planning Directorate, Conservation Research: threatened biota
 - Territory and Municipal Services, Fire Management Unit: liaison regarding fire mitigation requirements and
3. Friends of Grasslands volunteers, advocacy
4. Other stakeholders include neighbouring property owners and residents

5.2 Management history

Broadscale removal of woody weeds in summer 2012/2013 has been undertaken. There is evidence of kangaroo grazing. The groundlayer biomass is not high.

5.3 Management Plan, O'Malley Woodland

This plan identifies the management actions required to retain ecological integrity. Other management actions may also occur, but this plan should be considered initially, to ensure those actions will not compromise the intents of this plan.

5.3.1 Conservation management aims and requirements

1. To maintain and enhance the conservation values of the woodland
2. To maintain diversity of habitat for fauna
3. To provide opportunities for all native species to regenerate

5.3.2 Management issues

1. Biomass management

- Although biomass is controlled by kangaroo grazing, additional biomass management through ecological burns may be required periodically.

2. Weeds

Woody weeds

- Cootamundra Wattle (*Acacia baileyana*), occasional, in patches.
- Cotoneaster (*Cotoneaster* spp.), occasional, in patches.
- Pine wildings (*Pinus radiata*) (in EM16), occasional.
- Privet (*Ligustrum* spp.), rare.
- Firethorn (*Pyracantha* spp.), occasional, in patches.
- Rosemary Grevillea cultivar (*Grevillea rosmarinifolia x juniperina*), common.
- Sweet Briar (*Rubus rubiginosa*), occasional.
- Tree of Heaven (*Ailanthus altissima*) (O'Sullivan 2013; not observed in August 2015).

Herbaceous weeds

- African Lovegrass (*Eragrostis curvula*), occasional, in patches.
- Serrated Tussock (*Nassella trichotoma*), occasional, in patches.
- St John's Wort (*Hypericum perforatum*), occasional.
- Paterson's Curse (*Echium plantagineum*) (O'Sullivan 2013; not observed in August 2015).
- Viper's Bugloss (*Echium vulgare*) (O'Sullivan 2013; not observed in August 2015).

5.3.3 Management recommendations

The key management required to achieve biodiversity outcomes for native woodland and more specifically the endangered Yellow Box – Blakely's Red Gum Grassy Woodland and threatened species (ACT Government 2012; Sharp et al., 2015) are presented below. Other more general guidelines are summarised in Attachment C.

Yellow Box – Blakely's Red Gum Grassy Woodland

- Maintain habitat diversity, including fallen timber, hollows, rocks and vegetative structural diversity
- Control biomass ideally through burning, and slashing in more open areas only
- An optimal fire frequency for Box Gum woodland in ACT has not been defined.
- Avoid slashing with tractor-mounted or ride-on implements under the canopy of trees
- Slashing should be undertaken with a whipper-snipper to avoid root/trunk damage and compaction.
- Chemical application should be minimised as far as possible in YBRG
- Vehicles, plant and fuel should not be stored or parked off road or trail surfaces.
- Avoid damage to Cherry Ballart trees that provide habitat for a range of fauna and are readily killed by fire; use rake hoe lines around these plants and determine risk mitigation strategies as required.

5.3.4 Management actions

The following recommendations are consistent with these guidelines.

1. Prepare an annual operational plan and Bushfire Operational Plan to implement the actions identified in this plan.
2. Prepare a biomass management plan, to include prescribed burns and control of woody weeds, recognising that removal of woody weeds will reduce fire hazard for the adjacent residences.
3. Spray and cut and daub woody weeds; remove cuttings to prevent seed drop.
4. Remove pine wildings.
5. Contain Chilean Needlegrass and African Lovegrass, Paterson's Curse, St John's Wort, eradicate Serrated Tussock.
6. Remove dumped material.
7. Erect signage to identify significance of the area.
8. Undertake a quantitative survey within the two management units to assess their condition against the benchmarks for the vegetation communities.
9. Consider placing out tiles for further survey to determine if the Pink-tailed Worm-lizard does occur on the site.

5.3.5 Other actions

- Prepare a detailed planning framework for the conservation areas.
10. Retain mature hollow-bearing trees that occur on other parts of the site.
 11. Reduce the woody weeds in other parts of Section 4 to minimise re-invasion into units EM15 and EM16.

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Personal comments

- Melanie Snape, Conservation Research, Environment and Planning Directorate, ACT Government, October 2015
- John Briggs, NSW Office of Environment and Heritage, Queanbeyan, August 2015

7. Attachments

Attachment A. Management history and background information about the conservation areas

Background

This report provides a summary of the management that has been undertaken between March 2009 and December 2015 at Yarramundi, Stirling Ridge (Stirling Park, Attunga Point and State Circle), Guilfoyle Street Grassland at Yarralumla and O'Malley Woodland. The achievements are compared against the recommended management actions identified in the Management Plan (Sharp 2009). Results of surveys undertaken in 2005 and 2014 are provided to describe changes in condition over that time.

The NCA undertake mowing for fire mitigation, weed control, and since 2011, burns that are undertaken for ecological purposes as well as for fire mitigation. More details of what NCA have done in each site is presented below.

FOG/NCA on-ground project, 2009-2015

All effort by the volunteers has been put into undertaking work at the sites at Yarramundi and Stirling Ridge. Friends of Grasslands has received annual grants in the order of \$6000 a year from NCA since 2009, to support work parties with buying tools, training in chemical handling, chainsaw use and first aid, and expendable items, including herbicides and food and drink for volunteers. All the work undertaken is in accordance with Sharp (2009) and discussed with NCA officers. In addition the NCA provided support for three working parties held by Conservation Volunteers Australia (CVA): two at Stirling Park and one at Scrivener's Hut. Under the partnership agreement with NCA, FOG has undertaken work in 82 events between April 2009 and December 2015, with a total of 1 186 volunteers, 5 176 volunteer hours and cut over 4 000 m³ of introduced vegetative material (Table A.1). The work parties have been organised primarily by Jamie Pittock (ANU Fenner School and member of FOG) with Peter McGhie and John Fitz Gerald.

Table A.1. Data on FOG volunteer work on NCA lands (collated by J. Pittock, FOG)

	No. events	No volunteers	No volunteer hours	Estimated volume of cut material (m ³)	Participants at annual walk
Yarramundi Grassland					
2009	3	56	216	42	
2010	2	19	126	3	
2011	2	46	178	4	
2012	3	39	53	0	
2013	2	20	85	1	
2014	2	14	57	0	
2015	2	7	25	0	
Total	16	201	740	50	
Stirling Ridge and State Circle Woodland					
2009	3	40	289	110	6
2010	5	62	411	272	30
2011	6	103	491	298	27
2012	9	196	1 083	1 014	na
2013	14	235	919	1 199	19
2014	14	164	592	397	30
2015	15	185	651	1 053	82
Total	66	985	4 436	4 343	194
Total	82	1 186	5 176	4 393	194

FOG also received three grants from ACT Government:

- \$26,965 from the ACT NRM Council's Weeds of National Significance program in 2012 to advance conservation at key sites (Yarramundi and Stirling Park). The funding was used to employ contractors to Blackberry and Chilean Needlegrass and small infestations of other weeds like African Lovegrass. Weed spraying was planned using maps of Blackberry and African Lovegrass infestations prepared by FOG volunteers John Bruggeman and Naomi Cassilles-Southgate. FOG volunteer John Fitz Gerald worked with the contractors on site to help them target their efforts.
- \$17,282 from the ACT Environment Grants program in 2014 to advance conservation of the sites, and FOG and partners then contributed work valued at more than \$64,000 in labour and weed spraying.

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- \$6000 from the ACT Environment Grants program in 2015 to contract weed control of St John's Wort and Chilean Needlegrass and to undertake plantings.

CIT students have undertaken monitoring of Button Wrinklewort at Stirling Park, surveyed and mapped weed infestations, undertaken practical classes in weed control and a number have returned to assist at work parties.

Annual reports on the work parties at Stirling Ridge and Yarramundi prepared for FOG AGMs

FOG NCA project report for 2009

This year we will have had five working bees – two at Yarramundi and three at Stirling Ridge [Stirling Park and State Circle Woodland]. These are having impact on vegetation.

Budget to NCA for 2010 has submitted by Jamie Pittock.

FOG NCA project report for 2010 (Jamie Pittock)

Conservation of the grasslands at Yarramundi and grassy woodlands at Stirling Park was the focus of the second year of a FOG project undertaken in conjunction with the Fenner School of Environment and Society at ANU. Six work parties were undertaken with an average of 14 volunteers contributing 90 hours work on each day, and an average of 46m³ of weed material being removed. Our thanks go to the many volunteers who contributed over 500 hours to the restoration of these key habitats.

This work was supported with welcome funding from the National Capital Authority (NCA) for supplies and equipment.

At Stirling Park vast areas of woody weeds are gradually being removed from amongst the nation's second largest population of the endangered Button Wrinklewort. Regeneration of understorey vegetation with the rains in spring 2010 has been remarkable and inspiring. Common woody weeds are being removed in vast numbers. Small infestations of particularly nasty weeds are being controlled, namely broom, serrated tussock, African Lovegrass and St John's Wort. Sadly, the ACT's first infestation of Madeira Vine was located in the park. Also notable are a new tranche of woody weeds emerging from garden plantings, including desert ash and Chinese Pistachio. In winter 2010 sixty woodland trees and shrubs were planted into disturbed areas of the park, strategically, to reconnect habitat. A FOG nature walk at Stirling Park was fully subscribed and involved a lot of local residents.

At Yarramundi our work to find methods to replace invading Chilean needle grass, among other horrors, with native grasses continues. While we have had a lot of success killing the exotic grasses we have not yet succeeded in facilitating growth of indigenous species from seed and thatch. In spring 2010 some 300 cells of four local species were planted in trial plots. However the massive growth of grass and weeds following good rains in late 2010 has made work on the site more difficult. FOG continues to monitor both sites to identify more optimal conservation techniques.

In late 2010 FOG collaborated with Conservation Volunteers Australia, which led three more woody weed removal parties, two at Stirling Park and one at a new site at Scrivener's Hut, between State and Capital Circles (west).

In 2011 FOG has a third year of planned activities, including one nature walk and seven work parties at Scrivener's Hut, Stirling Park and Yarramundi. We have again received welcome financial support from the NCA for this work.

FOG remains concerned at the limited resources available to the NCA to manage these key grassy ecosystem remnants and at the lack of security of conservation tenure of these lands. In 2010 FOG made a number of representation to the federal government seeking removal of potential development zonings over these lands, greater investment in conservation management, targeted removal of exotic trees, and co-management of Yarramundi with the Lindsay Pryor Arboretum. We expect to step up our advocacy for conservation of the grassy ecosystems on national lands in 2011.

FOG NCA project report for 2011 (Jamie Pittock)

FOG in association with the ANU Fenner School continued its work to restore key grassy ecosystem remnants on national capital lands in central Canberra in 2011. Since establishing our partnership with the National Capital Authority 21 work parties have been held since 2009 involving 341 volunteers and 1770 volunteer hours work. In 2011 there were 8 work parties involving 149 volunteers and 670 volunteer hours work. As in previous years FOG's efforts have been supported by a grant from the National Capital Authority that covers safety training, tools and expendable materials for our work parties.

At Stirling Park and Attunga Point (52 ha) in Yarralumla our volunteers continued extensive woody weed control and nearly a third of the site is now clear. An estimated 740 m³ of wet woody weed material has been cut. Work is shifting from the central portion of the Park to the southern part of Stirling Ridge and FOG is engaging more local residents in

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this work in 2012. FOG assisted two Fenner School students in their individual research projects examining the impact of controlled burning on the endangered Button Wrinklewort population at the site. Amy Macris found that the species' population was not impacted by the cool burn in July 2011 whereas Catherine Ross found that the weed population was diminished by the fire in the Button Wrinklewort habitat. FOG has also held two work parties on an associated site, Scrivener's Hut, between State and Capital circles on Capitol Hill and has cleared woody weeds from half this land.

At Yarramundi (21 ha) in Acton efforts continued to replace Chilean Needle Grass infestations with indigenous grasses. While we have successfully killed exotic grass infestations there has been only moderate success in establishing indigenous grasses and a depressing influx of other weeds. New approaches will be tried in 2012. FOG has applied for funding in 2012 for contract sprayers to tackle weeds of national significance on both sites.

FOG continues to express concern at the inadequate resources available to the National Capital Authority to conserve matters of national environmental significance on these lands. We welcome positive developments in 2011 included the Authority's efforts to reinstate controlled burns with part of each site being treated in 2011, and also investment in weed spraying on part of Yarramundi. Following our representations, FOG is hopeful that the Authority will take further steps in 2012 to revoke mooted developments on the sites, including a road, museum facilities and a new Lodge. FOG has opposed an option to develop part of Stirling Park for new embassies and supported local resident's identification of an alternative site in Yarralumla for this development. Further advocacy is underway in 2012.

We thank the traditional custodians of these lands, our many volunteers, the ANU Fenner School and the National Capital Authority for their support in conserving these sites in 2011.

FOG NCA project report for 2012 (from FOG newsletter 3Dec12)

Grasslands on national lands

This spring saw a magnificent display of wildflowers at Stirling Park and Yarramundi in areas that FOG has been restoring and where the National Capital Authority (NCA) has reinstated control burns. At Stirling Park new populations of the endangered Button Wrinklewort have been located for conservation. FOG made a huge effort in 2012 to improve the conservation status of grassy ecosystems on national lands on the ground, with money and through advocacy.

On the ground, with money

FOG gratefully received grants of \$26,965 from the ACT NRM Council's Weeds of National Significance program to advance conservation at key sites. The habitat of the endangered Button Wrinklewort was greatly improved. Extensive Blackberry and Chilean Needle Grass infestation were significantly reduced to the point where our volunteers can now maintain control over key areas of habitat. Small infestations of other weeds like African Lovegrass have also been controlled.

FOG weed control work was at Stirling Park (52 ha; Yarralumla), including subsidiary sites at Scrivener's Hut and Attunga Point, as well as at Yarramundi (23 ha; Acton). These sites managed by the National Capital Authority (NCA) in central Canberra are large remnants of grassy woodland and temperate native grasslands listed under ACT and federal environmental laws as endangered ecological communities. Stirling Park has the second largest remaining population of the endangered Button Wrinklewort. Both sites are being overrun by infestations of Blackberry, Chilean Needle Grass and St John's Wort, and secondarily by Serrated Tussock and African Lovegrass.

Work at the Stirling Park grassy woodland complex focussed on restoring and linking prime Button Wrinklewort habitat. Work at the Yarramundi grassland focussed on following up a control burn in the central portion of the site in winter 2012 by spraying out exposed Chilean Needle Grass. Work undertaken at these sites is detailed below and is in accordance with the NCA's management plan by Sharp (2009 "Conservation Management Plans For Sites Managed by the National Capital Authority: Yarramundi Grassland, Stirling Park Woodland, Yarralumla, Guilfoyle St Grassland, Yarralumla and Lady Denman Drive Grassland, Yarralumla." Our volunteers also cut out an estimated 1,014 m³ of green woody weeds in 2012.

Weed spraying was planned using maps of Blackberry and African Lovegrass infestations prepared by FOG volunteers John Bruggeman and Naomi Cassilles-Southgate. Chilean Needle Grass infestations were visible on Google Earth images in grasslands and too extensive to map. Monitoring by FOG at the sites includes photo points at both sites, GPS records of Blackberry and African Lovegrass infestations and transects at Yarramundi and Stirling Park. Lessons from the weed control work in 2012 include the value in following behind control burns when weeds are easier to see and spray, using good quality contractors and having FOG volunteers work with the contractors on site to help them target their efforts (in particular, John FitzGerald assisted work on site by the contractors).

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Receipt of the WONS grants has leveraged considerable additional resources for conservation of the sites, as detailed in the table below. FOG increased the number of its planned work parties from the 8 originally scheduled to 12 which generated matching voluntary labour. The increased tempo of work parties at Stirling Park has contributed to a larger number of residents of Yarralumla volunteering for our weed control work. FOG volunteer hours doubled in 2012 over those in 2011 to 1,083. The NCA has supported FOG with additional weed control work scheduled in FY13 of \$20,000 and a grant to FOG of \$4,210 in 2012 to support work parties with herbicides and equipment. Further, FOG now has the opportunity in collaboration with Greening Australia Capital Region to enrich diversity of herb species by further planting into depauperate locations chosen at both Yarramundi and Stirling Park through an ACT Government supported program.

Under our partnership agreement with the National Capital Authority, FOG has now held over 30 work parties at these sites since 2009, contributing over 2,000 volunteer hours to conservation of these lands. In 2013 FOG expects to be supported again by the NCA to undertake 10 work parties on the sites.

Through advocacy

Linked to our on-ground work FOG has been advocating for Yarramundi and Stirling Park to be designated for nature conservation and for enhanced management by the Federal Government through meetings with the NCA and federal politicians, as well as publications in the Canberra Times. In October 2012 the NCA proposed two draft amendments to the National Capital Plan. At Yarramundi, FOG welcomed Draft Amendment 80 proposes to change the land use from "National Capital Use" – a potential development zone - to "Open Space", which will assist the conservation of the nationally endangered native temperate grassland ecosystem. Removal of the notation on the Plan stating that the needs of the National Museum of Australia must be taken into account prior to a decision being made about the use of the site is timely and welcome. FOG is asking that this notation be replaced with a new notation that the area rezoned as open space is to be: managed primarily for natural and Indigenous heritage conservation purposes, that only planted only with locally indigenous flora species are to be planted on the site in future, and that management continue to require control burning.

Draft Amendment 78 covering Stirling Ridge (section 22) and Attunga Point (section 128) is a more mixed picture. Securing much of Stirling Ridge by changing the land use policy from "National Capital Use" to "Open Space" is a most welcome proposal. FOG does not support the proposed development of 5 to 6 embassies at Stirling Park. While a large part of the land to be developed does not have significant ecological values, it is considered very likely that long term impacts from this development (such as construction sprawl, weeds, fire control and recreational use) will spill over and degrade the high conservation value land immediately adjacent to the proposed embassies. We urge the NCA to consider alternative ways of housing the greater numbers of diplomatic missions, as 25 were originally was said to be required in the next 30 years. These options could include: use of existing, undeveloped blocks; incentives for missions to sub-divide their current blocks; and a strata title development to house smaller missions along Constitution Avenue and in the Russell area.

FOG opposes allocation of Attunga Point as a possible future location for the Prime Minister's Residence. The fenced area at Attunga Point and the knoll immediately south of Alexandrina Drive has high numbers of the nationally endangered Button Wrinklewort and comprises the critically endangered White Box – Yellow Box – Blakely's Red Gum Grassy Woodland that is in very good condition. The Residence and mooted partial realignment of Alexandrina Drive could not proceed without destroying a portion of this population and Yellow Box – Blakely's Red Gum grassy woodland, and further segmenting the remaining Button Wrinklewort population. FOG believes that because a new Prime Minister's Residence should could be built within Lodge Park there is no requirement to retain the Attunga Point and Stirling Park area as an alternative option. We also consider that there may be an opportunity to develop such a residence within the current grounds of Government House.

However the NCA does plan to remove (at FOG's request) the National Capital Use designation of an area intended as an extension to Empire Circuit, passing through part of Stirling Ridge and the former Westlake community to connect with Alexandrina Drive. Road development would destroy a portion and further segment the remaining Button Wrinklewort population and Box-Gum Grassy Woodland ecological community. The eastern end of Stirling Park, Section 128, is still zoned as National Capital Use. The biodiversity conservation values of this land are similar to those of Stirling Ridge in terms of containing part of the same Button Wrinklewort population and White Box – Yellow Box – Blakely's Red Gum Grassy Woodland. Consequently FOG is asking that this land is also rezoned as open space. Similarly, the land in Section zoned "Parliamentary purposes" between State and Capital Circles contains a Button Wrinklewort population and White Box – Yellow Box – Blakely's Red Gum Grassy Woodland should also be rezoned as open space. FOG is asking that the newly zoned open space be annotated to acknowledge that these lands are to be: managed primarily for natural and Indigenous heritage conservation purposes, and that management may continue to require burning for ecological and fire fuel management. We are calling for these lands to be given a suitable formal title on the Plan, for example, "Nature Park".

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In late November 2012 a Parliamentary National Capital and External Territories Committee hearing saw Gai Brodtmann MHR initiate an inquiry into the management of the diplomatic estates in Canberra to respond to the changing needs of our city and our diplomatic community. This should test exactly how many new embassy sites are required. As a result the NCA has said it will not take a final decision on DA78 until the inquiry has concluded.

FOG NCA project report for 2013 (Jamie Pittock)

In 2013 FOG expanded its work to conserve grassy ecosystems on national lands managed by the National Capital Authority (NCA) in central Canberra. Our 2009 partnership agreement with the NCA was renewed, reiterating our organisations' commitments to conserving the Scrivener's Hut, Stirling Park and Yarramundi grasslands. FOG's work for these sites has involved both on-ground work and advocacy.

On-ground work

The number of work parties increased from 12 in 2012 to 16 in 2013 following the commencement of mid-monthly events in Stirling Park and increased support from residents of Yarralumla. FOG supporters contributed over 1,000 hours in volunteer work in 2013, for a total of 3,860 since 2009. Around 1,200 m³ of woody weeds were cut, for a total of over 2,900 m³ since 2009. The NCA provides FOG with \$6,000 per year for work party tools and other supplies. FOG's work was boosted by significant additional funding and support for weed control and reintroduction of wildflower species at Yarramundi through the support of the ACT and federal governments' environmental programs, as well as from Greening Australia. In particular an ACT Environment Grant of \$17,282 in 2013-14 is supporting contract weed spraying and revegetation.

Large areas of Stirling Park were weeded in 2013, including the southern half of Stirling Ridge as well as the first repeat weeding of parts of the eastern part of the Park that were first treated from 2009. Significant regeneration of groundcover species is evident where dense woody weeds have been removed. FOG's work has dovetailed with the NCA's program of patch burning, weed spraying, as well as the felling of over 200 Blue Gums, Cedar Wattle and pines. Contract spraying has focussed on African Lovegrass, Blackberry, Chilean Needle Grass and St John's Wort.

At Yarramundi two work parties focussed on extensive weed spraying and replanting of grasses and forbs. Significant progress has been made in weeding at Scrivener's Hut. The 23 February 2014 work party will be FOG's 50th since 2009, and should complete the first cut over of woody weeds at Scrivener's Hut. Restoration of the three sites is now considerably advanced thanks to the support of so many FOG volunteers.

Advocacy

As outlined in the advocacy, FOG continues efforts to protect the three sites against proposed developments and for their dedication for nature conservation. In July 2013 Yarramundi was rezoned as open space, adding additional protection. Further protection is required for Stirling Park in 2014, where there are a number of development proposals.

FOG NCA project report for 2014 (Jamie Pittock)

FOG made a huge effort during the year to improve the conservation status of grassy ecosystems on national lands managed by the National Capital Authority (NCA) in central Canberra, namely Stirling Park (52 ha; Yarralumla), including subsidiary sites at Scrivener's Hut and Attunga Point, as well as at Yarramundi (23 ha; Acton).

The NCA has supported FOG with a grant \$6,000 in 2014 to support work parties with training, plants, herbicides and equipment. FOG gratefully received \$17,282 from the ACT Environment Grants program to advance conservation of the sites, and FOG and partners then contributed work valued at more than \$64,000 in labour and weed spraying. Extensive Blackberry infestations were significantly reduced to the point where our volunteers can now maintain control over key areas of habitat. Chilean Needlegrass and St John's Wort has been pegged back in key places.

Further, over 200 trees and shrubs were planted to re-establish key woodland links at Stirling Park and a water tank was installed to maintain them. In collaboration with Greening Australia over 2,000 forbs were planted at Stirling Park and Yarramundi to re-establish species that had been eliminated or significantly diminished. In some of these places wild populations have been re-established. Small infestations of other weeds, like African Lovegrass, have also been controlled. A further grant of \$6,000 from the ACT Government in 2014-15 is enabling follow up weed spraying and replanting.

The habitat of the endangered Button Wrinklewort was greatly improved. Spring and summer 2014 saw fantastic indigenous understory regrowth and magnificent displays of wildflowers at Scrivener's Hut, Stirling Park and Yarramundi in areas that FOG has been restoring. Monitoring by FOG at the sites was expanded with a major vegetation survey in the summer of 2013-14, replicating that of Muyt in 2005. The results show that the numbers of

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threatened plant species are at similar levels as 2005 but woody weed species are significantly reduced in areas that FOG has restored.

FOG volunteer hours decreased from 1,013 volunteer hours in 2013 to 649 in 2014, partly due to a reduction in the number of work parties for 17 to 14 to avoid extreme weather. Under our partnership agreement with the National Capital Authority, FOG has held 63 work parties at these sites since 2009, contributing over 4,500 volunteer hours to conservation of these lands. New work with the Molonglo Catchment Group and Ngunawal nation has been planned for 2015 to restore a 2.3 hectare block of ACT land at Stirling Park that contains significant cultural sites as well as endangered grassy woodland.

Little progress was made in 2014 to reserve Stirling Park from options to develop new embassies and a Prime Ministerial Lodge on parts of this land.

A1. Stirling Park and State Circle Woodland

A1.1 Management history

Management prior to 2009

Prior to establishment as open space, clearing and thinning of trees occurred, together with grazing by domestic stock. Plantings along the southern and western edges probably coincided with the establishment of Yarralumla, while the plantings within the Westlake settlement would have been earlier, after the 1920s.

Management plans and operational plans were prepared between 1995 and 2009, with varying levels of compliance (National Capital Planning Authority (1994); NCA Maintenance Contract L08-08, (1997); Muyt 2005b; Godden, McKay and Logan Pty Ltd (2009). These plans recommended removal of woody weeds, burning of woodland in autumn, mowing grassland above 100 mm height, thinning of eucalypt regeneration, removal of planted eucalypts and pines, rationalising the track system, erection of interpretive signage, protection of Button Wrinklewort plants from herbicide run-off, control of herbaceous weeds and evaluating outcomes of management.

Woody weed control was undertaken in 2003, but with no follow up regrowth recurred. In 2009 woody weed density was likely to have been worse than in 2005 when it was surveyed by Muyt (2005b).

Unit EM1 at Attunga Point was burnt for ecological purposes in 2005.

Management 2009 to 2015

Management has included the clearance of woody weeds in about 90% of Stirling Park (Figure A1.1) and 100% of State Circle Woodland, extensive spraying of herbaceous weeds and planting of trees, shrubs and herbaceous species at Stirling Park.

NCA (through contractors):

- Mowed all verges and Units EM4 and EM6 for general maintenance.
- Spot sprayed Madeira Vine and a clumps of other weeds in Unit EM4.
- Removed several dead exotic trees.
- Removed cut woody and herbaceous material following Friends of Grasslands working parties.
- Undertaken four prescribed burns in Stirling Park and Attunga Point, totalling approximately 25% of the woodland
- Slashed along the boundary, in grassland areas and through the centre vehicle track
- Sprayed African Lovegrass along the areas infested (primarily the boundary of the site)
- Sprayed Blackberry infestations
- Sprayed Chilean Needlegrass in EM4 and part EM5
- Sprayed St John's Wort infestations around the perimeter of the site
- Cut, daubed and removed heavy infestations of woody weeds in a portion of EM3

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Friends of Grasslands

66 working parties have been held at Stirling Park and State Circle Woodland between 2009 and December 2015. During this time, a total of 985 volunteers participated for a total of 4436 hours and 4343 m³ vegetative material was removed (Table A.1).

In summary, the volunteers have:

- Removed all woody weeds and majority of herbaceous weeds from unit EM1 (0.5 ha);
- By the end of 2015, removed all woody weeds from approximately 95% of Stirling Park and 100% of State Circle Woodland and Attunga Point (Figure A1.1)
- Undertaken follow-up woody weed control in approximately 20% of Stirling Park.
- Sprayed Chilean Needlegrass and other herbaceous weeds in Units EM3, EM2 (the Gap), EM5 and EM8;
- Planted trees and shrubs² in the Gap (Unit EM2) and adjacent open areas in Units EM3, EM5, EM6 and EM7 and staked existing regenerating saplings to reduce the chance of them being slashed;
- Facilitated communication of NCA plans to Yarralumla residents about the removal and burning of Blue Gums and helped identify which trees to remove
- Established photo points and two monitoring sites to assess change in the diversity of species; and
- Held six annual spring walks for community members, particularly targeting local residents every year from 2009 to 2015 (total attendance, 194 people).

Contractors to FOG

FOG has managed contractors to spray Blackberry, Chilean Needlegrass, African Lovegrass and St John's Wort, through grants received through ACT Government in 2012, 2014 and 2015.

CVA working parties

Three Conservation Volunteers Australia working parties removed woody weeds in Unit EM5 and at State Circle Woodland (EM8) and undertook limited spot spraying of herbaceous weeds.

CIT students

Students enrolled in the Environment Diploma at CIT, under the tutelage of Hannah Selmes, have participated in a number of activities as part of their training. This has included woody weed control to learn best practice techniques, GIS of weed infestations (Figure A1.2) and one student has taken on a special project to monitor Button Wrinklewort and pull previous data together (Matthews 2014).

The management achieved at Stirling Park related to the management recommended in Sharp 2009 is presented in Table A1.1.

² Local species planted in Stirling Park Unit 4 on 26/6/10: Blakely's Red Gum (*Eucalyptus blakelyi*), Yellow Box (*E. melliodora*), Apple Box (*E. bridgesiana*), Australian Blackthorn (*Bursaria spinosa*), Kurrajong (*Brachychiton populneus*) and Silver Wattle (*Acacia dealbata*).



Figure A1.1 Area in which woody weeds have been treated by FOG, NCA and CVA, to end 2015



Figure A1.2. Weed distribution in Stirling Park (P. Calaby, CIT student, 2015).

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Table A1.1. Summary of actions undertaken in ecological management units between 2009 and 2015 against the recommendations from Sharp (2009). In brackets are the management units identified in Sharp (2009).

Issues	Actions	Priority	Actions undertaken 2009 to 2015
EM1 (AP1): Erosion and loss of vegetation cover	Increase height of mower and mow less frequently. Cut off illegal vehicle access to site.	1	No change to mowing frequency
Chilean Needlegrass	Undertake control. Revegetate bare areas with native species, preferably Kangaroo Grass.	1	Control in selected areas within woodland
St John's Wort	Undertake control with priorities given to Units EM1 (AP1), EM3 (SP3) and EM5 (SP5).	1	Control undertaken
EM1 (AP1), EM3 (SP3), EM5 (SP5), EM8 (SH1): Woody weed control	Undertake an annual control program. Priorities are control of Cootamundra Wattle and Broom. Work out from areas of BW populations.	1	All of State Circle complete; removal of remainder to be complete by end 2015
EM1 (AP1), EM3 (SP3), EM5 (SP5), EM8 (SH1): Eucalypt seedling and sapling regrowth	Review regrowth and thin in Button Wrinklewort population areas.	1	With removal of woody weeds, priority or requirement to do this decreased
EM4 (SP4), EM5 (SP5): Heritage values	Undertake management in such a way as to retain heritage values, although action is required to remove invasive garden escapees from Westlake Settlement (C2, C3 and C4 plants, see Attachment C).	1	Woody weeds on edges of EM4 undergoing gradual removal
Fire hazard management and wildfire suppression plan	Develop a plan in consultation with ACT Government Emergency Services Bureau and incorporate recommended actions into the annual ACT Bushfire Operational Plans. The plan should not compromise conservation of natural or heritage values.	1	Bushfire Operational Plan established in 2011 and being implemented in mosaics. BOP burns undertaken as follows (Figure 4.2): EM1 (AP1): 2011, EM3 (SP3): 2012 (west), EM5 (SP5): 2013 (east); 2015 (south facing ridge), EM5a (SP5): 2014 (east)
EM3 (SP3), EM5 (SP5), EM8 (SH1): Bird diversity	Undertake an initial bird survey and consider future monitoring to determine whether threatened and/or uncommon bird species inhabit the site	1	2010 survey by COG identified threatened Varied Sittella and White-winged Triller and uncommon species Scarlet Robin and Flame Robin. Earlier records collated (see species list below)
Tracks	Review and remove or improve walking track system to minimise damage to the site whilst providing for recreational and educational opportunities.	2	No actions undertaken
EM1 (AP1): Biomass management	Undertake an ecological burn in autumn 2010, followed by burns at about 5 year intervals, depending on biomass and results of burn trials.	2	Burnt 2011 Monitoring trials established in burnt (EM3, 2012) and unburnt (EM5) areas to measure changes to Button Wrinklewort plants.
EM2 (SP4): Revegetation	Undertake a replanting program of eucalypts and woodland shrubs to provide a contiguous woodland corridor from east to west. A rigorous weed control program should be undertaken first to ensure the revegetation program is successful. Care should be taken to ensure the native groundlayer and soil are not disturbed.	2	Planting of 200 trees and shrubs completed in EM2, and the edge of EM4, EM6 and EM7 following the removal of Blue Gums.
Education and communication	Erect signage informing users of the values of the site.	2	Text drafted for signs at entrances to Stirling Park
EM4 (SP4), EM6 (SP6), EM8 (SH1): Slashing	Continue current program. Ensure vehicle hygiene standards are maintained and mowing height is no lower than 100 mm (see Appendix 1). Undertake woody weed and Chilean Needlegrass control as required.	3	Current program of slashing identified in Bushfire Operational Plans.
EM4 (SP4): Drainage	Improve water quality entering site from Empire Circuit to minimise invasion of weeds and entry of contaminants.	3	No action undertaken

A1.2 Changes in the distribution and abundance of significant species at Stirling Park

Surveys in 2005 (Muyt 2005a) were undertaken in grids of 50 m x 50 m, measuring cover and abundance of Button Wrinklewort, woody weeds, Eucalypt regeneration, Chilean Needlegrass and St John's Wort. A species list was also collated (Table A1.2). The detailed results and report recommendations provided guidance for the control of

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introduced invasive species and protection of threatened and other native species and was the primary reference guiding the recommendations of the Management Plan (Sharp 2009).

In 2014 the same survey methods were repeated in a selection of the grids (Figure A1.3), for comparison in the changes, following 5 years of more intensive management by NCA and by Friends of Grasslands volunteer and contracted work (see above).

A summary of the results of the study are provided below.

Changes between 2005 and 2014

Aims of surveys

In 2005 the aims were to determine the location, extent and approximate abundance of *Rutidosis leptorrhynchoides* (Button Wrinklewort), *Nassella neesiana* (Chilean Needlegrass), *Hypericum perforatum* (St. John's Wort) and woody weed species, in order to aid management decisions such as weed control priorities, rare species management and fire fuel reduction strategies.

In 2014 the aims of the survey were to resurvey the location, extent and approximate abundance of the same species in order to:

- Identify changes in abundance and distribution of any of these species
- Identify effectiveness of the weed control undertaken by Friends of Grasslands on the site since 2009
- Assess distribution and abundance of rare species
- Assess the number of large trees

Survey methods

In 1995 a survey was undertaken by Alison Rowell based on surveying in 0.25 ha grids across the site. The report for this survey has not yet been relocated, but if found, will provide another set of data points to monitor changes over time. Surveys undertaken in January 2005 and for comparison, January 2014 used the same methods.

Within each grid all weeds were identified, the cover of woody weeds, Chilean Needlegrass, St John's Wort, other herbaceous weeds, eucalyptus regeneration (seedlings and saplings) and Button Wrinklewort was estimated in classes, and a count of the number of Button Wrinklewort plants in each grid was taken (or estimated if numbers were higher than 20), the number of other rare species and the number of trees greater than 50 cm in diameter. Each grid was photographed from the NE corner in 2014.

Cover classes used were:

- r: 1-3 individuals, up to 5% cover
- +: from 3 to approximately 15 individuals, up to 5% cover
- 1: many individuals up to 5% cover
- 2: >5-25% cover
- 3: >25% to 50% cover
- 4: >50% to 75% cover
- 5: >75% to 100% cover

In 2005 there were two surveyors, Adam Muyt and Kate Watson, contracted by NCA to undertake the work. In 2014 there were 12 volunteers who undertook the survey.



Figure A1.3. Grids surveyed in 2005 indicated by pink dots. Those resurveyed in 2014 in which woody weed control was undertaken between 2009 and 2014 are indicated by white circles and in which no woody weed control was undertaken between 2009 and 2014 by white triangles.

Results

2005 surveys

In 2005 287 plots, each 0.25 ha in size were surveyed, covering an area of approximately 70 hectares. This followed approximately 10 years since woody weed control was undertaken by contractors, with no follow-up. The condition at Stirling Park is presented in the following figures (Figures A1.4 to A1.8). The circles from smallest to largest represent cover classes.



Figure A1.4. Woody weed cover/abundance, Stirling Park, 2005

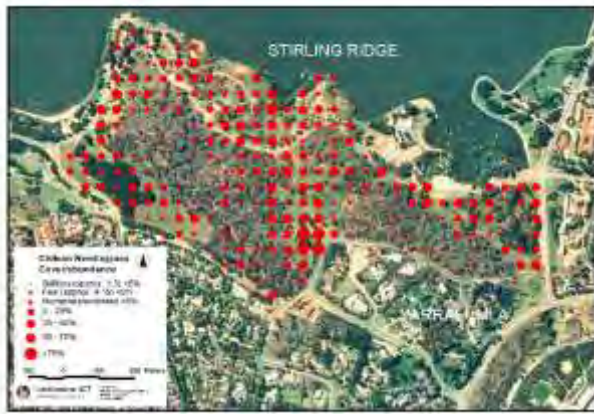


Fig. A1.5. Chilean Needlegrass cover/abundance, 2005



Fig. A1.6. St John's Wort cover/abundance, 2005



Figure A1.7. Button Wrinklewort cover/abundance, 2005



Figure A1.8. Eucalypt regeneration cover/abundance.

2014 surveys

In 2014 58 plots, each 0.25 ha in size were surveyed, covering an area of approximately 14.5 hectares. Of these, 50 plots were in plots where weed control has been undertaken since 2009 and 8 plots were where weed control had not been undertaken.

The data from the plots surveyed in 2014 were compared to that of the same sub-set of plots surveyed in 2005. Several mitigating factors need to be taken into account. In 2005 the ACT was in significant drought conditions, while in 2014 rainfall and temperature was about average. In addition there would have been survey error in estimations of cover, with two experienced surveyors undertaking the entire area in 2005, and 12 volunteers with a range of experience undertaking the work in 2014. In addition cover was measured in classes. Therefore, differences emerging cannot be analysed statistically, but trends can be brought out.

In 2014 five rare native plants were identified and counted:

- *Laxmannia gracilis* Wire Lily: 1 plot, 4 plants
- *Leucochrysum albicans* Hoary Sunray: 4 plots, 4 plants
- *Calotis lappulacea* Yellow Burr Daisy: 24 plots, 260 plants
- *Lotus australis* Austral Trefoil: 4 plots, 48 plants
- *Dianella longifolia* Smooth Flax Lily: 10 plots, 21 plants

52 plots (90%) surveyed in 2014 contained 133 trees with a diameter greater than 50 cm. These trees would be more than 100 years old, some more than 200 years old and hollows are likely to support birds and other fauna reliant on hollows for nesting.

As to be expected, there was a significant decrease in the cover of the woody weeds since 2005 in the same plots (Figures A2.9a and b), given weed control had occurred in 85% of those grids. In 2014 in all the plots in which woody weed control had been undertaken within the past five years had , with one exception, woody weed cover was less than 5%, in 21 of these plots there were no or only a few woody weeds present. There was a significant decrease in cover overall where control was undertaken.

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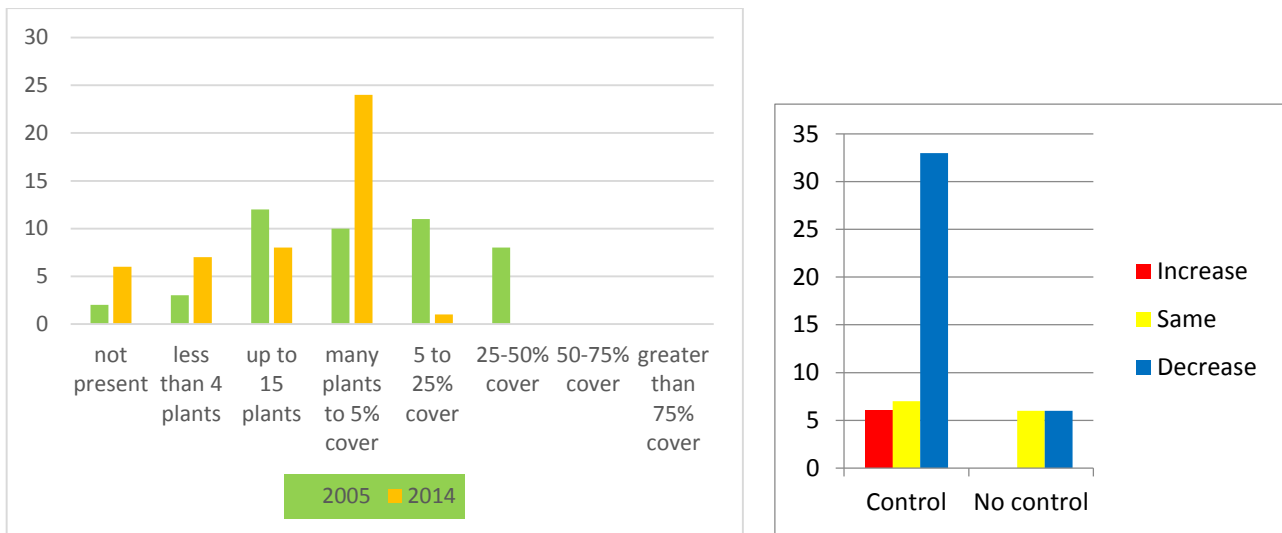


Figure A1.9. Woody weeds, differentiating the plots in which woody weed control had or had not been undertaken: a) The number of plots containing woody weeds within each cover class; b) the number of plots in which there was a change in cover between 2005 and 2014.

In 2005 83 out of 287 plots contained approximately 8000 BWW plants, i.e. on average, 400 plants per hectare. In 2014, 43 out of 58 plots contained over 5500 plants, i.e. 400 plants per hectare, indicating that there was minimal change in overall cover and abundance over time. Within the 38 plots in which woody weed control had been undertaken and there were Button Wrinklewort plants present in 2014, there was an increase in the number of plots that contained Button Wrinklewort (Figure A1.10a, b), but there was no change overall in cover or abundance, with many plots indicating an increase as a decrease in the cover and abundance over the 9 years (Figure A1.11a, b).

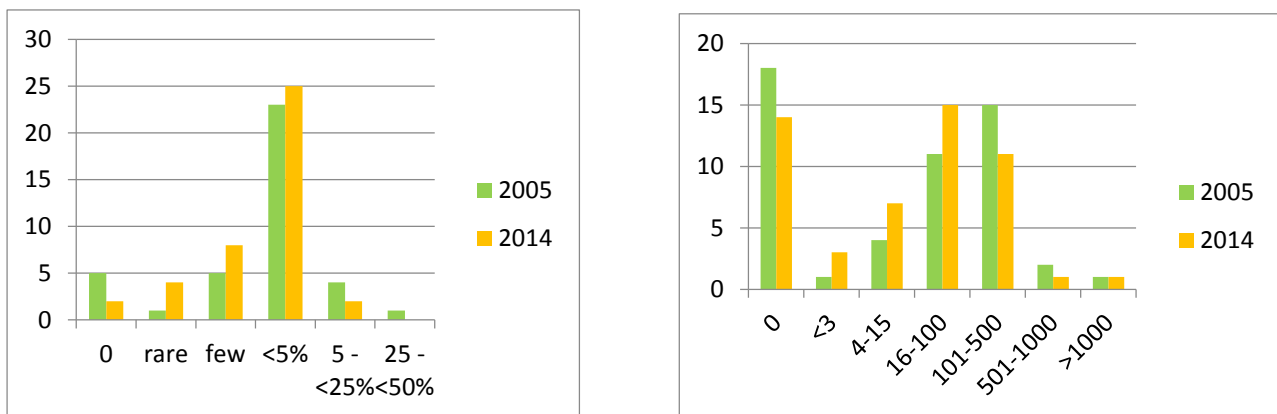


Figure A1.10. Button Wrinklewort in the 48 plots in which woody weed control had occurred: a) Percentage cover in classes; b) Abundance in classes.

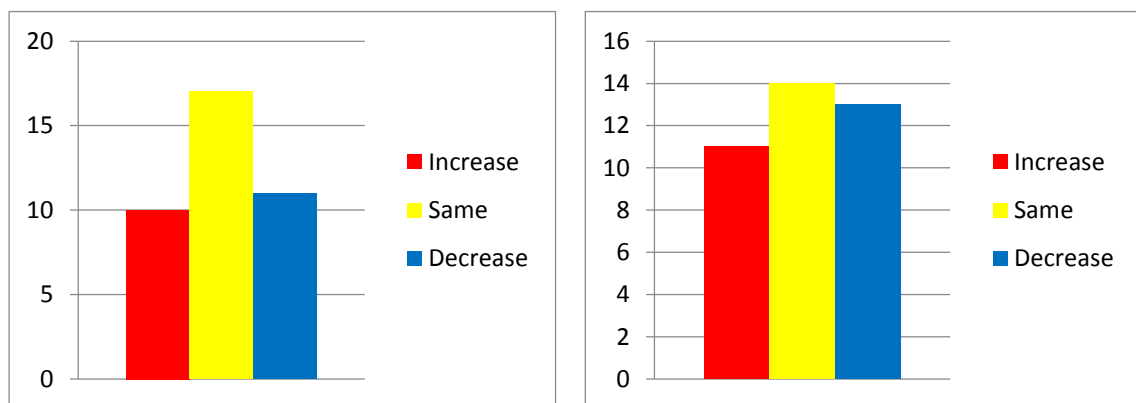


Figure A1.11. Change in Button Wrinklewort in the 38 plots in which woody weed control had occurred and Button Wrinklewort populations were surveyed (in 2014): a) Percentage cover in classes; b) Abundance in classes.

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Where woody weed control had been there was a slightly higher proportion of plots in which there was the same or an increase in *Eucalyptus* species regeneration cover (Figure A2.12), compared to those in which woody weeds had not been treated.

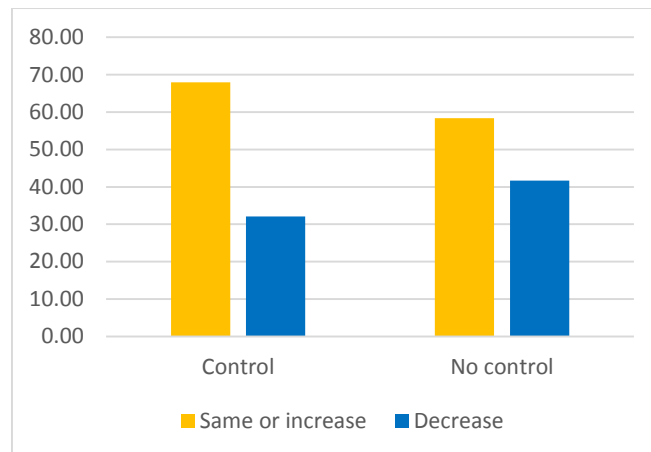


Figure A1.12. Change in the amount of cover *Eucalyptus* species regeneration between 2005 and 2014 differentiated by plots in which control of woody weeds had or had not been undertaken.

The change in Chilean Needlegrass cover between 2005 and 2014 is shown in Figure A2.13. For these comparisons data from all 58 plots were used, as the areas in which Chilean Needlegrass control were not as easily differentiated as woody weed control by the plots. The results indicate that there was overall a decrease in the number of plots with cover greater than 5%, indicating a significant reduction over time. Overall, there were more plots in which the cover of Chilean Needlegrass decreased than those in which Chilean Needlegrass cover increased. This indicates a moderate improvement of control of Chilean Needlegrass.

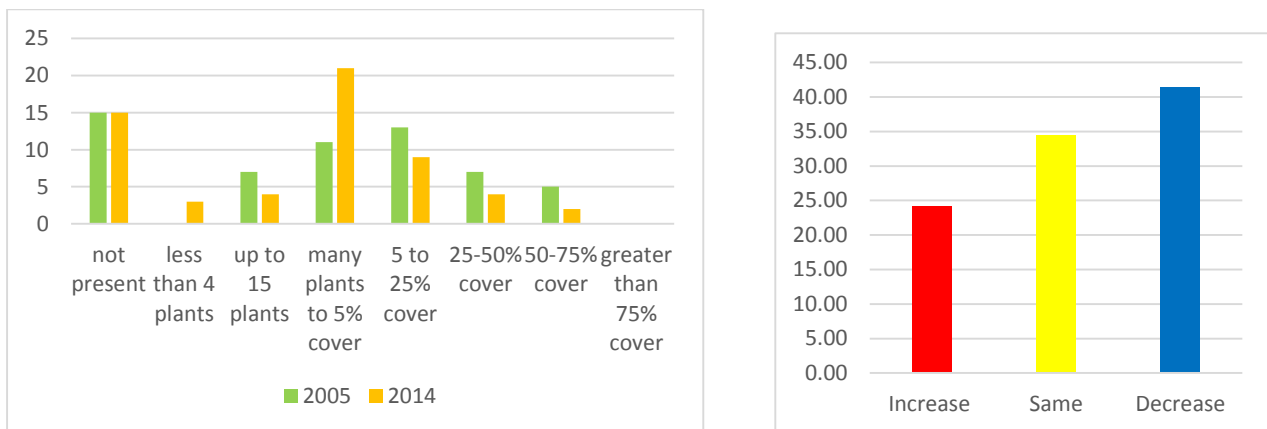


Figure A1.13. Chilean Needlegrass in all 58 plots:

a) number of plots within each cover class in 2005 to 2014; b) the proportion of plots in which there was a change in cover.

Similarly, measured over the entire 58 plots, St John's Wort showed a decrease in cover, with a smaller number of plots with over 5% cover in 2014 than in 2005 (Figure A1.13). There were more plots in which there was a decrease in cover of St John's Wort than the same or an increase in cover (Figure A1.14b).

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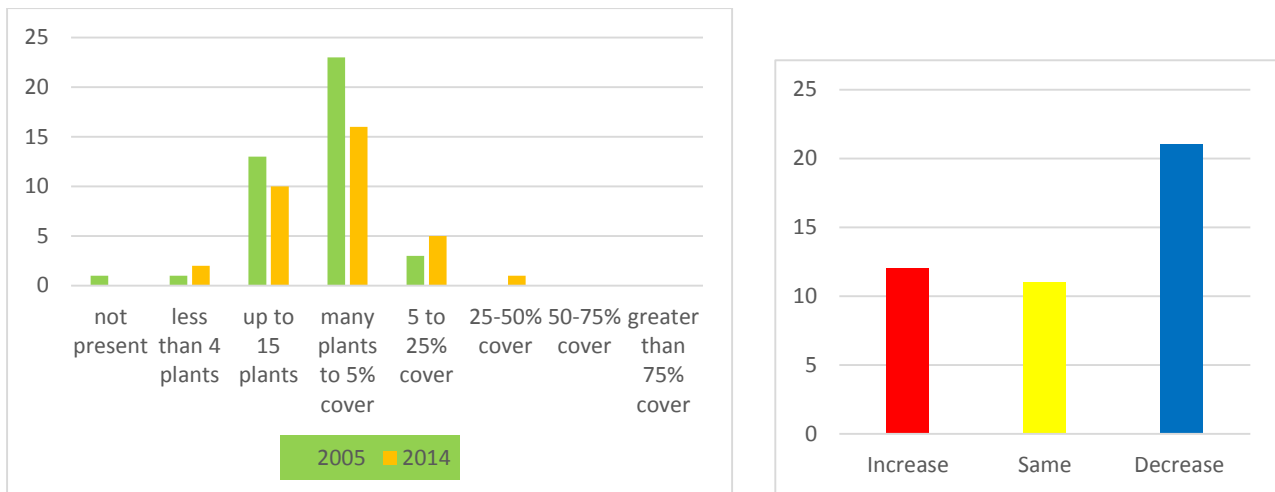


Figure A1.14. St John's Wort in all 58 plots: a) number of plots within each cover class in 2005 to 2014; b) the proportion of plots in which there was a change in cover

Conclusions

Woody weed control has been very effective in reducing the cover of woody weeds. At the same time, in the areas where woody weed control has occurred, the distribution of Button Wrinklewort has increased somewhat, although the cover and abundance overall of the species is not markedly different. Cover of *Eucalyptus* species regeneration has occurred to a greater extent in the areas in which woody weeds have been controlled. Chilean Needlegrass and St John's Wort have also declined in cover and extent in the plots.

A1.3 Button Wrinklewort monitoring at Stirling Park

"The effect of fire on Button Wrinklewort (*Rutidosia leptorrhynchoides*), a perennial forb in the Asteraceae family, was studied in the grassy box/gum woodland of Stirling Park, Canberra. Data from a survey before and after a hazard reduction burn in 2011 was compared to that from a repeat survey in September 2014 [see location of plots in Figure A1.15]. Button Wrinklewort appeared to have declined across control, lightly burnt and heavily burnt sites with the latter showing the largest decline. Seedling numbers were much higher in 2014, but were largely attributable to individual plots in each of the control, lightly burnt and heavily burnt sites with very high seedling counts. However, the data set was too small and skewed for meaningful statistical analysis so there is a degree of uncertainty around the significance of the results." (Abstract p. 1, Matthews, 2014)

Matthews stated in conclusion: "The ACT Government's conservation strategy for Button Wrinkleworts (ACT Government, 2005, p.25) states that "burning should not be used as a broad-scale management tool of *R. leptorrhynchoides* sites in the ACT until it has been established by experimentation that the benefits (seedling establishment) are likely to outweigh the costs (mortality of adult plants)". This study suggests that the benefits do not outweigh the costs, but this cannot be stated with certainty given statistical limitations. It is recommended that FoG consider a larger study in the areas to be burnt in 2015-16 to provide more certain findings" (p. 10, Matthews 2014).

FOG, working with CIT lecturer Hannah Matthews is planning a study to provide more quantitative data and to extend the study to clarify whether Button Wrinklewort survive burning at the frequency proposed for Stirling Park (about every 10 years or so).



Figure A1.15 Stirling Park, showing study sites (Prepared by Lynette Matthews using ACT Government 2008 aerial photos available under license to CIT)

A1.4 Photo monitoring at Stirling Park



Figure A1.16. Howie's Hut, Stirling Park, 2009



Figure A1.17. Howies' Hut, December 2015

A1.5 Species lists, Stirling Park

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Plants

The plant species list collated for 2005 (Muyt 2005b) and Boden (1994) in Stirling Ridge and Attunga Point (Sharp, unpublished data from 2009) are presented in Table A1.2.

Table A1.2. Plant species identified in Stirling Ridge and Attunga Point.

Key: X: Recorded in Surveys;

*: Introduced Species (i.e. non-endemic – native or exotic);

^: Eucalyptus planting (non-endemic);

+: Indigenous Eucalyptus but with supplementary plantings;

Weeds - C2, C3, C4: ACT Weed Categories (Attachment C)

Other weeds – S or P: Serious, or potentially serious, Environmental Weed (based on Brown (2002), Muyt (2001), Blood (2001) and Carr (1992), in Muyt 2005b)

Scientific Name	Common Name	Weed Status	Boden 1994	Muyt 2005	Sharp,2009
<i>Acacia dealbata</i>	Silver Wattle		X	X	
<i>Acacia genistifolia</i>	Spreading Wattle		X	X	
<i>Acacia gunnii</i>	Ploughshare Wattle			X	
<i>Acacia implexa</i>	Lightwood		X	X	
<i>Acacia mearnsii</i>	Black Wattle		X	X	
<i>Acacia rubida</i>	Red-stem Wattle		X	X	
<i>Acaena ovina</i>	Sheep's Burr			X	
<i>Amyema pendula</i>	Mistletoe		X	X	
<i>Aristida ramulosa</i>	Purple Wiregrass			X	
<i>Arthropodium</i> sp.	Chocolate Lily			X	X
<i>Asperula</i> sp.	Woodruff			X	
<i>Atriplex semibarbata</i>	Creeping Saltbush			X	
<i>Rytidosperma</i> sp. 1	Wallaby Grass		X	X	X
<i>Rytidosperma</i> sp. 2	Wallaby Grass			X	
<i>Rytidosperma</i> sp. 3	Wallaby Grass			X	
<i>Austrostipa bigeniculata</i>	Tall Spear Grass		X	X	
<i>Austrostipa densiflora</i>	Dense Spear Grass			X	
<i>Austrostipa falcata</i>	Corksrew Grass			X	X
<i>Bossiaea buxifolia</i>	Box-leaved Bossiaea			X	X
<i>Bothriochloa macra</i>	Redleg Grass			X	
<i>Brachyloma daphnoides</i>	Daphne Heath			X	
<i>Bracteantha viscosa</i>	Sticky Everlasting Daisy		X	X	
<i>Bulbine bulbosa</i>	Bulbine Lily				X
<i>Bursaria spinosa</i>	Sweet Bursaria		X	X	
<i>Calotis lappulacea</i>	Yellow Burr Daisy			X	
<i>Cassinia aculeata</i>	Common Cassinia			X	X
<i>Cassinia longifolia</i>	Shiny Cassinia			X	
<i>Cassinia quinquefaria</i>	Cassinia			X	
<i>Chamaesyce drummondii</i>	Flat Spurge			X	
<i>Cheilanthes</i> sp.	Rock Fern			X	X
<i>Chloris truncata</i>	Windmill Grass			X	
<i>Chrysocephalum apiculatum</i>	Yellow Buttons		X	X	X
<i>Chrysocephalum semipapposum</i>	Clustered Everlasting			X	
<i>Clematis microphylla</i>	Small-leaf Clematis		X	X	
<i>Convolvulus erubescens</i>	Blushing Bindweed			X	
<i>Crassula</i> sp.	Stonecrop			X	X
<i>Cryptandra amara</i>	Bitter Cryptandra		X	X	
<i>Cymbopogon refractus</i>	Barbed Wire Grass			X	
<i>Cynoglossum suaveolens</i>	Sweet Hound's Tongue			X	
<i>Daviesia mimosoides</i>	Narrow-leaf Bitter Pea		X		
<i>Desmodium varians</i>	Slender Tick-trefoil			X	
<i>Dianella amoena</i> sp. aff.	Matted Flax-lily			X	
<i>Dianella longifolia</i>	Smooth Flax Lily			X	
<i>Dianella revoluta</i>	Black-anther Flax-lily		X	X	X
<i>Dicanthium sericeum</i>	Silky Blue Grass			X	
<i>Dichelachne</i> sp.	Plume Grass			X	
<i>Dichondra repens</i>	Kidney Weed			X	
<i>Dipodium</i> sp.	Hyacinth Orchid		X	X	
<i>Einadia nutans</i>	Climbing Saltbush			X	
<i>Elymus scaber</i>	Common Wheat Grass			X	

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Scientific Name	Common Name	Weed Status	Boden 1994	Muyt 2005	Sharp,2009
<i>Epilobium</i> sp.	Willow-herb			X	
<i>Eryngium ovinum</i>	Blue Devil			X	
<i>Eucalyptus blakelyi</i>	Blakely's Red Gum		X	X	X
<i>Eucalyptus bridgesiana</i>	Apple Box		X	X	
<i>Eucalyptus dives</i>	Broad-leaved Peppermint		X		
<i>Eucalyptus mannifera</i>	Brittle Gum		X	X	
<i>Eucalyptus melliodora</i>	Yellow Box		X	X	X
<i>Eucalyptus rossii</i>	Scribbly Gum		X	X	
<i>Euchiton japonicus</i>	Creeping Cudweed				X
<i>Exocarpos cupressiformis</i>	Cherry Ballart		X	X	
<i>Glycine tabacina</i>	Variable Glycine			X	
<i>Gonocarpus tetragynus</i>	Common Raspwort			X	X
<i>Goodenia pinnatifida</i>	Cut-leaf Goodenia			X	
<i>Haloragis heterophylla</i>	Variable Raspwort			X	
<i>Hardenbergia violacea</i>	False Sarsaparilla		X	X	
<i>Hibbertia obtusifolia</i>	Grey Guinea Flower		X		
<i>Hovea linearis</i>	Common Hovea			X	
<i>Hydrocotyle laxiflora</i>	Stinking Pennywort			X	
<i>Indigofera australis</i>	Austral Indigo		X	X	
<i>Joycea pallida</i>	Silver-top Wallaby Grass			X	
<i>Juncus</i> sp.1	Rush		X	X	
<i>Juncus</i> sp.2	Rush			X	
<i>Kunzea ericoides</i>	Burgan		X	X	
<i>Lepidosperma laterale</i>	Variable Sword-sedge			X	
<i>Leucopogon</i> sp.	Beard Heath		X	X	
<i>Linum marginale</i>	Native Flax			X	
<i>Lomandra filiformis</i>	Wattle Mat-rush			X	X
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush		X	X	
<i>Lotus australis</i>	Austral Trefoil			X	
<i>Lythrum salicaria</i>	Purple Loosestrife			X	
<i>Melichrus urceolatus</i>	Urn Heath		X	X	
<i>Microlaena stipoides</i>	Weeping Grass			X	
<i>Oxalis perennans</i>	Wood Sorrel			X	
<i>Panicum effusum</i>	Hairy Panic			X	
<i>Parahebe perfoliata</i>	Digger's Speedwell		X		
<i>Pimelea curviflora</i> var. <i>sericea</i>	Curved Rice Flower			X	
<i>Plantago varia</i>	Variable Plantain			X	
<i>Poa labillardieri</i>	Common Tussock Grass		X	X	
<i>Poa sieberiana</i>	Grey Tussock Grass			X	X
<i>Rumex brownii</i>	Slender Dock			X	
<i>Rutidosis leptorhynchoides</i>	Button Wrinklewort		X	X	
<i>Senecio quadridentatus</i>	Cottony Fireweed			X	
<i>Solanum</i> sp.	Kangaroo Apple			X	
<i>Sporobulus</i> sp.	Rat's-tail Grass			X	
<i>Stellaria pungens</i>	Prickly Starwort			X	
<i>Stypandra glauca</i>	Nodding Blue Lily		X		
<i>Themeda triandra</i>	Kangaroo Grass		X	X	X
<i>Tricoryne elatior</i>	Yellow Rush Lily			X	
<i>Triptilodiscus pygmaeus</i>	Common Sunray				X
<i>Velleia paradoxa</i>	Spurred Velleia				X
<i>Vittidinia cuneata</i>	Woolly New Holland Daisy			X	
<i>Vittidinia muelleri</i>	Narrow-leaf New Holland Daisy			X	
<i>Wahlenbergia communis</i>	Tufted Bluebell			X	x
<i>Wahlenbergia gracilis</i>	Sprawling Bluebell			X	
<i>Wahlenbergia luteola</i>	Yellow-backed Bluebell			X	
* <i>Acacia baileyana</i>	Cootamundra Wattle	S; C4	X	X	
* <i>Acacia cultriformis</i>	Knife-leaf Wattle	S	X	X	
* <i>Acacia decurrens</i>	Early Black Wattle	S	X	X	
* <i>Acacia elata</i>	Cedar Wattle	S	X	X	
* <i>Acacia pravissima</i>	Ovens Wattle	S	X	X	
* <i>Acacia vestita</i>	Hairy Wattle		X		

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Scientific Name	Common Name	Weed Status	Boden 1994	Muyt 2005	Sharp,2009
* <i>Acetosella vulgaris</i>	Sheep's Sorrel			X	
* <i>Agave</i> sp.	Century Plant		X		
* <i>Agrostis capillaris</i>	Brown-top Bent	P			
* <i>Ailanthus altissima</i>	Tree of Heaven	S; C4		X	
* <i>Aira</i> sp.	Silvery Grass			X	X
* <i>Arbutus unedo</i>	Irish Strawberry Tree	P		X	
* <i>Asparagus asparagoides</i>	Bridal Creeper	P; C4		X	
* <i>Asparagus officinalis</i>	Asparagus	P		X	
* <i>Avena barbata</i>	Bearded Oat	P		X	
* <i>Brassica</i> sp.	Wild Mustard / Turnip			X	
* <i>Briza maxima</i>	Large Quaking Grass	P	X	X	X
* <i>Briza minor</i>	Small Quaking Grass			X	
* <i>Bromus diandrus</i>	Great Brome			X	X
* <i>Casuarina</i> sp. (planted)	She-oak			X	
* <i>Celtis australis</i>	Nettle tree	S; C4	X	X	
* <i>Centaureum</i> sp.	Centaur			X	
* <i>Chamaecytisus proliferus</i>	Tree Lucerne	S		X	
* <i>Conyza</i> sp.	Conyza			X	X
* <i>Cotoneaster franchetti</i>	Cotoneaster	S; C4	X	X	
* <i>Cotoneaster microphylla</i>	Cotoneaster	S	X	X	
* <i>Cotoneaster</i> sp.	Cotoneaster	S	X	X	
* <i>Crataegus monogyna</i>	Hawthorn	S; C3	X	X	
* <i>Cupressus arizonica</i>	Arizona Cypress		X	X	
* <i>Cupressus lusitanica</i>	Mexican Cypress		X	X	
* <i>Cynodon dactylon</i>	Couch	P		X	
* <i>Cyperus eragrostis</i>	Umbrella Sedge			X	
* <i>Cytisus scoparius</i> subsp. <i>scoparius</i>	English / Scotch Broom	S; C2	X	X	
* <i>Dactylis glomerata</i>	Cocksfoot	S		X	
* <i>Ehrharta erecta</i>	Panic Veldt Grass			X	
* <i>Eragrostis curvula</i>	African Love Grass	S; C3		X	
* <i>Eucalyptus bicostata</i> ^	Eurabbie (Blue Gum)	P	X	X	
* <i>Eucalyptus cinerea</i> ^	Argyle Apple	P	X	X	
* <i>Eucalyptus sideroxylo</i> ^	Red Ironbark		X	X	
* <i>Eucalyptus</i> sp. ^	Eucalyptus (planting)			X	
* <i>Eucalyptus viminalis</i> ^	Manna Gum		X	X	
* <i>Festuca</i> sp.	Fescue	P		X	
* <i>Foeniculum vulgare</i>	Fennel	P		X	
* <i>Fraxinus</i> sp.	Ash	S		X	
* <i>Fraxinus</i> sp.	Ash	P		X	
* <i>Genista monspessulana</i>	Montpellier Broom	S; C2		X	
* <i>Grevillea rosmarinifolia</i>	Rosemary Grevillea	P	X	X	
* <i>Hakea</i> sp.	Hakea	P	X		
* <i>Hedera helix</i>	English Ivy	S; C4		X	
* <i>Holcus lanatus</i>	Yorkshire Fog			X	
* <i>Hypericum perforatum</i>	St. John's Wort	S; C3	X	X	X
* <i>Hypochoeris radicata</i>	Cats Ears	P		X	X
* <i>Iris</i> sp.	Iris	P		X	
* <i>Lactuca serriola</i>	Wild Lettuce			X	X
* <i>Lathyrus</i> sp. (<i>L. latifolius</i> ?)	Everlasting Pea	S	X	X	
* <i>Lepidium africanum</i>	Peppergrass			X	
* <i>Ligustrum lucidum</i>	Large-leaf privet	S	X	X	
* <i>Ligustrum sinense</i>	Small-leaf Privet	S	X	X	
* <i>Linaria peltisserana</i>	Pelisser's Toadflax				X
* <i>Lolium</i> sp.	Rye Grass			X	
* <i>Lonicera japonica</i>	Japanese Honeysuckle	S; C4		X	
* <i>Lycium ferocissimum</i>	African Boxthorn	S; C2	X	X	
* <i>Mahonia aquifolium</i>	Holly Grape	P	X	X	
* <i>Malus domestica</i>	Apple		X	X	
* <i>Marrubium vulgare</i>	Horehound	P	X	X	
* <i>Modiola caroliniana</i>	Red-flowered Mallow			X	
* <i>Nassella neesiana</i>	Chilean Needle Grass	S; C3		X	

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Scientific Name	Common Name	Weed Status	Boden 1994	Muyt 2005	Sharp,2009
* <i>Nassella trichotoma</i>	Serrated Tussock	S; C3		X	
* <i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	S		X	
* <i>Onopordum acanthium</i>	Scotch Thistle	S; C3	X	X	
* <i>Opuntia</i> sp. (<i>O. aurantiaca</i> ?)	Cactus Pear	P		X	
* <i>Oxalis</i> sp.	Sorrel (pink-flowered)	P		X	
* <i>Paspalum dilatatum</i>	Paspalum	S	X	X	
* <i>Petrorhagia nanteuillii</i>	Proliferous Pink	P		X	X
* <i>Phalaris aquatica</i>	Phalaris	S	X	X	
* <i>Photinia robusta</i>	Photinia		X		
* <i>Pinus canariensis</i>	Canary Island Pine		X		
* <i>Pinus pinaster</i>	Maritime Pine	P	X		
* <i>Pinus radiata</i>	Monterey Pine	S; C4	X	X	
* <i>Pistacia chinensis</i>	Chinese Pistachio	S		X	
* <i>Plantago lanceolata</i>	Ribwort		X	X	X
* <i>Polygonum aviculare</i>	Wireweed			X	
* <i>Populus alba</i>	White Poplar	S; C4	X	X	
* <i>Populus nigra</i> 'Italica'	Lombardy Poplar	S; C4		X	
* <i>Prunus</i> sp.	Plum Tree	P	X	X	
* <i>Pyracantha angustifolia</i>	Orange Firethorn	S; C4	X	X	
* <i>Pyracantha</i> sp.	Firethorn	S; C4	X	X	
* <i>Quercus palustris</i>	Pin Oak			X	
* <i>Quercus robur</i>	English Oak	P	X	X	
* <i>Robinia pseudoacacia</i>	Black Locust	S; C4	X	X	
* <i>Rosa rubiginosa</i>	Sweet Briar Rose	S; C3	X	X	
* <i>Rosa</i> sp.	Scrambling Rose			X	
* <i>Rubus fruticosus</i> spp. agg.	Blackberry	S; C3	X	X	
* <i>Rumex crispus</i>	Curled Dock			X	
* <i>Salix</i> sp.	Willow	S; C2		X	
* <i>Sanguisorba</i> sp.	Burnet		X		
* <i>Sequoiadendron giganteum</i>	Giant Redwood		X	X	
* <i>Sollya heterophylla</i>	Bluebell Creeper	S		X	
* <i>Sorbus</i> sp.	Rowan Tree	S; C4	X	X	
* <i>Stachys arvensis</i>	Stagger Weed			X	
* <i>Taraxicum</i> sp.	Dandelion			X	
* <i>Tecomaria capensis</i>	Cape Honeysuckle			X	
* <i>Tragopon porrifolius</i>	Salsify			X	
* <i>Trifolium arvense</i>	Hares-foot Clover	P		X	
* <i>Trifolium</i> sp.	Clover	P		X	
* <i>Ulmus</i> sp.	Elm	P		X	
* <i>Verbascum thapsus</i> subsp. <i>thapsus</i>	Great Mullein	P	X	X	
* <i>Verbascum virgatum</i>	Twiggy Mullein	P	X	X	
* <i>Verbena bonariensis</i>	Purple Top			X	
* <i>Viburnum tinus</i>	Laurustinus	P		X	
* <i>Vicia</i> sp.	Vetch			X	
* <i>Vinca major</i>	Blue Periwinkle	S	X	X	
* <i>Viola odorata</i>	Violet	S		X	
* <i>Vitis</i> sp.	Grape Vine			X	
* <i>Vulpia</i> sp.	Rat's-tailed Fescue	P		X	
* <i>Sonchus</i> sp.	Sow-thistle			X	

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Records of birds observed in Stirling Park

The list of birds in Stirling Park is extracted from the Canberra Ornithological Group (COG) database. The 17/2/2010 sightings were from a COG field trip. The comments below were supplied by Jenny Bounds, member of COG.

Speckled Warbler particularly, but also other small bush birds, which use the shrub layer, are likely to be impacted by woody weed removal. The management plan should allow for this removal to be phased and suitable shrubs planted in patches to replace exotics, e.g. bursaria, wattles, otherwise these birds won't persist. Another idea is to cut down the woody weeds and leave them on the ground as cover until natives can be established, but this might present problems (fire, untidy etc.).

Uncommon species present include Scarlet Robin and Flame Robin. The Varied Sittella and White-winged Triller are on the threatened list under ACT legislation. The list has some birds associated with Lake Burley Griffin and some will be passage migrants which move through (e.g. Rufous Fantail).

Table A1.3. Birds recorded in Stirling Park (records from Canberra Ornithologists Group data)

RAOU Name	No of observations	Total seen	Last seen
Australasian Darter	1	1	17/02/2010
Australian Hobby	1	1	3/04/1997
Australian King-Parrot	5	7	5/06/1994
Australian Magpie	13	36	17/02/2010
Australian Pelican	3	4	23/08/1992
Australian Raven	15	41	17/02/2010
Australian Reed-Warbler	3	3	30/12/1993
Australian Wood Duck	5	6	17/02/2010
Black-faced Cuckoo-shrike	9	20	17/02/2010
Brown Thornbill	3	9	17/02/2010
Buff-rumped Thornbill	11	53	17/02/2010
Common Blackbird	9	12	5/06/1994
Common Myna	5	32	17/02/2010
Common Starling	12	85	17/02/2010
Crested Pigeon	1	3	17/02/2010
Crimson Rosella	12	56	17/02/2010
Dollarbird	2	5	30/12/1993
Double-barred Finch	3	6	16/10/1993
Dusky Woodswallow	5	7	9/11/1997
Eastern Rosella	10	26	17/02/2010
Flame Robin	1	1	10/05/1992
Galah	6	13	17/02/2010
Gang-gang Cockatoo	4	5	16/10/1993
Golden Whistler	9	22	3/04/1997
Grey Butcherbird	1	1	17/09/1997
Grey Currawong	4	5	7/08/1993
Grey Fantail	17	51	17/02/2010
Grey Shrike-thrush	6	6	9/11/1997
Laughing Kookaburra	11	22	5/06/1994
Leaden Flycatcher	3	5	12/10/1997
Little Black Cormorant	3	22	17/02/2010
Little Corella	1	2	17/02/2010
Little Eagle	1	1	12/04/1993
Little Lorikeet	1	1	30/12/1993
Magpie-lark	8	12	17/02/2010

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RAOU Name	No of observations	Total seen	Last seen
Mistletoebird	2	2	9/11/1997
Noisy Friarbird	6	7	9/11/1997
Noisy Miner	2	2	17/02/2010
Olive-backed Oriole	4	5	7/09/1998
Pacific Black Duck	5	6	17/02/2010
Painted Button-quail	4	6	1/11/2001
Pallid Cuckoo	1	1	5/09/1994
Pied Currawong	15	71	17/02/2010
Red Wattlebird	9	11	17/02/2010
Red-browed Finch	1	2	17/02/2010
Red-rumped Parrot	10	41	17/02/2010
Rock Dove	4	6	7/08/1993
Royal Spoonbill	1	2	15/06/1997
Rufous Fantail	2	2	22/03/1996
Rufous Whistler	9	14	17/02/2010
Scarlet Robin	4	4	3/04/1997
Silver Gull	5	406	9/11/2010
Silvereye	13	148	17/02/2010
Speckled Warbler	6	7	17/02/2010
Spotted Pardalote	9	14	5/06/1994
Striated Pardalote	15	50	17/02/2010
Striated Thornbill	8	43	22/08/2009
Sulphur-crested Cockatoo	7	13	17/02/2010
Superb Fairy-wren	14	62	17/02/2010
Varied Sittella	3	5	7/08/1993
Weebill	12	62	17/02/2010
Welcome Swallow	6	9	17/02/2010
White-browed Scrubwren	3	4	17/02/2010
White-eared Honeyeater	2	2	7/08/1993
White-naped Honeyeater	3	8	7/08/1993
White-plumed Honeyeater	4	7	23/08/1992
White-throated Treecreeper	3	10	17/02/2010
White-winged Triller	3	11	9/11/1997
Willie Wagtail	8	11	17/02/2010
Yellow-faced Honeyeater	2	3	12/04/1993
Yellow-rumped Thornbill	10	24	17/02/2010

A2. Yarramundi Grassland

A2.1 Management history

Management prior to 2009

The site was used for grazing, predominantly by sheep, since the 1820s. The remaining dominance by Kangaroo Grass suggests that the grazing pressure was not extreme and that fertiliser use was low and that the area has not been subject to ploughing. There are oral records indicating that the site has not having been grazed since Lady Denman Drive was constructed in about 1963 (Kukolic 1994).

There are no records of significant wildfires prior to December 2001 (Kukolic 1994). In spring 1995 two small blocks within the south-west block (YR1) were burnt as part of an experiment undertaken by Parks, Conservation and Lands. On December 24 2001 a wildfire that began in Stromlo Forest burnt through part of the site (YR1 and YR3) and destroyed the pine plantation to the west of the site.

Between 1963 and 1991 the site was mown irregularly in patches for fire hazard reduction purposes, with more frequent mowing along the cyclepath and around the building. Mowing ceased with the discovery of the presence of Striped Legless Lizard in 1991. No further mowing was undertaken in the site between 1991 and April 1994, intending to reduce impacts on the Striped Legless Lizard (a practice no longer supported).

Groves of trees and shrubs were planted within the site some time prior to the 1990s, in particular along the edge of the cyclepath to the north, adjacent to the lake and surrounding the Cultural Centre. Species include Blue Gum (*Eucalyptus bicostata*), Red Ironbark (*E. sideroxyon*), Manna Gum (*E. viminalis*), Brittle Gum (*E. mannifera*), Yellow Box (*E. melliodora*), Snow Gum (*E. pauciflora*) and several *Acacia* species. It is unknown, but unlikely, that any of these were grown from locally sourced parent material.

Since 1994 several guidelines and plans were produced that provided recommendations for management of the area for its conservation values (Kukolic 1994; Boden and Fraser 1994; Rowell 1995; Frawley 1995; Rowell 1996; NCA Maintenance Contract L08-081997, Muyt 2005a; Godden, McKay and Logan Pty Ltd (2009).

The general advice throughout all was to undertake herbaceous and woody weed control, and to reduce biomass (and remove cut grass if slashed). The initial recommendations were for the site to be rotationally mown over a three year period to retain longer grass habitat for the Striped Legless Lizard and were later revised so that the entire site was to be mown annually between autumn and early spring. From 1994 to 2003 irregular mosaic mowing was undertaken, but the site was not mown between 2003 and 2009 and in 2009 was found to contain a very high biomass, with significant deterioration to the structure and composition of the grassland (Sharp 2009).

The area surrounding the building was mown regularly. In 2002 bollards were placed around the perimeter, to define what would be mown for landscape and amenity, and what would be managed for conservation.

A firebreak was mown regularly around the edge of the site, and along the edges of the cyclepath.

Minimal weed control was undertaken, but some woody weeds and blackberry were removed from YR1.

Management 2009 to 2015

NCA management

- Maintained mown verges around the entire site and around the cultural centre.
- Mowed and bailed entire site in March 2009.
- Mowed and bailed part of site in 2010
- Placed lock on gate at carpark to prevent illegal entry.
- Removed cut woody and herbaceous material following Friends of Grasslands working parties.
- Replaced the fencing along the boundary between the Lindsay Prior Arboretum and Yarramundi
- Undertaken burns in five of six fire management units (Figure 2.9)
- Regularly slashed around the boundary of the site and along internal tracks
- Undertaken African Lovegrass control along the cycle path and other areas of infestation
- Undertaken Blackberry control to the north-east of the site
- Undertaken Chilean Needlegrass spraying in YR1, YR2 and the northern part of YR3
- Undertaken St John's Wort spraying in YR1, YR2, YR3 and along the boundaries and cyclepath

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Friends of Grasslands

15 working parties have been held at Yarramundi Grassland from 2009 to August 2015. During this time, a total of 198 volunteers participated for a total of 735 volunteer hours (Table A1) and 50 m³ vegetative material was removed (Table A1).

In summary, the volunteers have:

- Treated isolated African Lovegrass tussocks along perimeter of cyclepath;
- Removed woody weeds southeast of the cultural centre (especially Cootamundra Wattle, Blackberry and Pines) and undertaken follow up treatment;
- Sprayed (once) herbaceous weeds throughout EM9 and EM13 and partially in EM10 and EM11. The main focus was on Chilean Needlegrass, also incidental spraying of Paspalum and St John's Wort;
- Undertaken follow up spraying in these areas, to reduce re-establishment of the introduced species Chilean Needlegrass spraying in EM9 and partially in EM10, follow-up blackberry removal in EM1;
- Established revegetation trials in four locations in EM9 and EM10 following intense herbicide treatment of weeds: a) Kangaroo Grass hay laid; b) tubestock planted; c) tubestock planted; d) control. Hand weeding of these areas undertaken following establishment of trials (see Attachment A1 for details of the trial);
- Established and maintained monitoring sites in the trial plots; and
- Worked with Greening Australia to plant out a more than 1000 plants, with a mix of grasses and forbs in EM9 and EM10.

Contractors to FOG

- FOG has managed contractors to spray St John's Wort through grants received from ACT Government in 2012 and 2014.

Table A2.1. Summary of actions undertaken at Yarramundi between 2009 and 2015 against the recommendations from Sharp (2009).

Issues (2009)	Recommended Actions (2009)	Priority (2009)	Actions undertaken 2009 to 2015
EM9 to EM12 (YR1, YR2, YR3, YR4, YR5, Sharp 2009): Biomass management: mowing	Mow each area once a year, between February and September. Mow each unit at a separate time, to increase structural heterogeneity over the site. Do not mow the regenerating Black Cypress Pine trees in unit 1.	1	Entire area mown and trash removed, March 2009 Mowing around perimeter of site, above below bollards in Unit 2, along cyclepath and adjacent to other official and unofficial tracks
Fire management	Develop and implement a fire hazard management and wildfire suppression plan that includes ecological burns.	1	Bushfire Operational Plan established in 2012 and being implemented
EM9 to EM12 (YR1, YR2, YR3, YR4, YR5, Sharp 2009): Biomass management: burning	Undertake a burn in each unit approximately every 4 years in accordance with the fire plan. One unit to be burnt annually, either during the spring or autumn burning program. Ensure the burns are included in the ACT's Annual Bushfire Operational Plans.	1	FM9 (EM11) burnt 2011 FM10 (EM10 north) burnt 2012 FM11 (EM9) burnt 2012 FM12 (EM12) burnt 2013 FM13 (EM10 south) burnt spring 2014
EM9 to EM12 (YR1, YR2, YR3, YR4, YR5, Sharp 2009): Woody weeds including blackberry, eucalyptus seedlings, Cootamundra Wattle.	Cut and dab; poison blackberry. Re-treat as required. Retain the regenerating Black Cypress Pine trees in unit 1.	1	Blackberry and woody weeds removed from EM9 and EM13 and along the roadside below Lady Denman Drive above EM12. Some Black cypress pines burnt in the ecological burns.
EM9 to EM12 (YR1, YR2, YR3, YR4, YR5): Perennial herbaceous weeds, especially Chilean Needle Grass, African Love Grass, St John's Wort, Paspalum, Phalaris	Reduce and contain. Retreat as required. Begin in the areas of highest conservation value and move outwards. Undertake extensive St John's Wort control. Undertake a revegetation program (see below) following control of weeds.	1	St John's Wort treatment has reduced abundance Chilean Needlegrass treatment undertaken in EM9 and EM10 (north); no real change in dominance Plantings in EM9: grasses and forbs to replace removed weeds
EM9 to EM11 (YR1, YR2, YR3, YR4, Sharp 2009): Vehicle tracks and fencing	Prevent illegal entry of vehicles except by locked gate at carpark (there is evidence of very high	1	Fence along western boundary complete and no further ingress by unofficial vehicles

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Issues (2009)	Recommended Actions (2009)	Priority (2009)	Actions undertaken 2009 to 2015
	usage from this carpark not consistent with maintenance requirements). Erect fence or 1 m spaced bollards along southern end, keeping a locked emergency gate only and use peripheral tracks only for occasional site inspection. Allow considerable time for natural rehabilitation and then reconsider requirements for restitution.		Track used primarily for legal vehicles and walkers
Cyclepath	Erect appropriate barriers at entrance to site (see attached proposed plan) to prevent illegal vehicle access. Erect barriers for cyclist safety on the edge of the drain.	1	Banana bars installed
Star pickets	Replace the star pickets that are used to mark out existing monitoring points with surveyor pegs, buried to ground level.	1	No actions undertaken
EM9, EM10, EM12 (YR2, YR1, YR4, Sharp 2009): Signs	Remove old signs. Erect new signs at site entry points identifying site's natural and cultural heritage values.	1	No actions undertaken
EM9 (YR1, Sharp 2009): Foot tracks	Make one clear and erosion free track from carpark to cyclepath (through unit 2) and across and around Units 1 and 3 Remove all others.	2	No actions undertaken
EM9 (YR1, Sharp 2009): Bollards	Complete full perimeter of bollards to mark off NTG from the building block and elsewhere as required to ensure access is by bicycle or on foot only	2	Bollards placed round the building to define the boundary and reduce vehicular access
Cyclepath	Erect bollards 2 m (or agreed distance) from edge of cyclepath to delineate the edge of the grassland that is maintained for conservation areas. Replace 2 m wide strip of grass with compressed gravel or other suitable material on each side of the cyclepath for overtaking. Weed as required, no further mowing along cyclepath boundary.	2	No actions undertaken
EM13 (YR6, Sharp 2009): Regrowth and woody weeds Unit 6	Remove regenerating eucalypt seedlings and woody weeds, including <i>Acacia baileyana</i>	2	Removal within and adjacent to the planted clumps
EM5 (YR5, Sharp 2009): Poa grassland	Improve habitat of Poa grassland along creek by removal of weeds. Improve the quality of drainage from the road (e.g. erect a retardation dam).	2	Blackberry and Chilean Needlegrass removed Plantings of River Tussock extensive and successful
YR7: Woody weeds	Remove weeds and revegetate with riparian species, especially River She-oak <i>Casuarina cunninghamiana</i>	3	No actions undertaken
EM12 (YR4, Sharp 2009): Drainage line	Improve drainage line to minimise weed invasion in wet area. Improve drainage across the cycle path or divert the drainage from the road away from the site. Follow up with weed control and possible revegetation.	3	No actions undertaken

A2.2 Distribution and abundance of significant species at Yarramundi Grassland

The following maps have been extracted from Muyt (2005b). They are based on detailed surveys undertaken in grids of 50 m x 50 m, and provide guidance for the control of introduced invasive species and protection of threatened and other native species.

The circles from smallest to largest represent the following cover classes:

1: up to 5% cover; 2: >5-25% cover; 3: >25% to 50% cover; 4: >50% to 75% cover; 5: >75% to 100% cover

Native vegetation cover, effectively herbaceous species is shown in Figure A2.1. Class 4 and 5 represent cover over 50%, indicating areas that are likely to meet criteria as the endangered ecological community.



Figure A2.1 Native vegetation distribution and abundance, Yarramundi Grassland, 2005.

Distribution and abundance of the major weeds at Yarramundi Grasslands in 2005 is shown in Figures A2.2 to A2.4 (from Muyt 2005b).

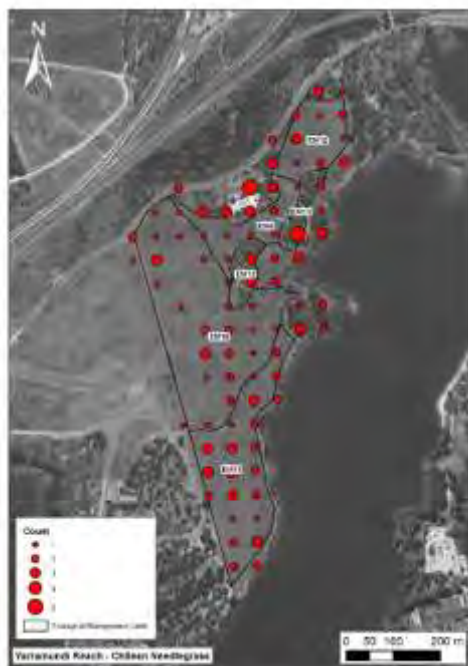


Figure A2.2 Chilean Needlegrass



Figure A2.3 Wild Oats



Figure A2.4. St John's Wort

A2.3 Monitoring at Yarramundi Grassland

Revegetation project: removal of CNG: Regeneration trials on Chilean Needlegrass in Ecological Management Unit 9, Yarramundi Grassland, Sarah Sharp, January 2016.

Acknowledgements: to John Fitzgerald and Barbara Payne who assisted with monitoring data collection.

Aims

To compare changes in species groups as a result of spraying of Chilean Needlegrass and other introduced species, including change in relative dominance of introduced and native herbaceous species.

Methods

Four plots were established (Figure A2.5). Each was originally dominated by Chilean Needlegrass or other exotic perennial species. Plots A, B and D were spot sprayed to treat the perennial weeds in 2009 and Plot C was to be a control where no additional plants were to be added, however, the area was trenched to put in a pipe. Between 2009 and 2013 there were several events of thatching, direct seeding or planting, as follows:

Monitoring Plot A: within a patch of Chilean Needlegrass in otherwise Kangaroo Grass dominated grassland; Themeda thatch was laid out in 2009, sown with virocells in 2010

Monitoring Plot B: planted with virocells of native grasses in 2010

Monitoring Plot C: initially no additional species added; in 2011 planted with native grasses and Carex after extensive soil disturbance and some native forbs were planted in 2013.

Monitoring Plot D: planted with native grasses and Carex in 2010

Monitoring commenced after the initial treatments in 2009, and before the 2010 treatments were applied. Prior to monitoring each year the transects were whipper snipped if required to reduce the biomass to more or less consistent density and height from year to year (except in 2011 in Plots B and D). This occurred before seeding of the plants, so it did not result in spreading of seed, however, the whipper snipping would not have impeded subsequent seed establishment by mature plants.

Cover of plant groups or other attributes was measured along transects within each 10 x 10 m plot. The group with the highest cover within each 10 cm interval along one 10 m transect or two 10 m transects at right angles (crossing at 5 m on the transects) was recorded. The attributes measured were: Chilean Needlegrass alive (CNG A); Chilean Needlegrass dead (CNG D); Native vegetation (NV); Bare ground (BG); Litter (LIT); Exotic annual (EA); Exotic perennial (EP). The values were converted to percentage cover.



Figure A2.5. Location of the four monitoring plots established in 2009 at Yarramundi Grassland.

The plots were all established within EM9, in areas that were initially relatively high in exotic cover. All plots were marked at the north 0 point with a permanent survey peg buried to its top. Each are also identified at their locations by pickets.

Monitoring Plot A: monitoring picket #0397, Below the Cultural Centre (eastern picket). Measured in N-S and E-W direction, each transect 10 m long, intersecting at 5 m. Yellow surveyor peg at North-0

Monitoring Plot B: monitoring picket #0881. Below and south west of the Cultural Centre building, surrounding a yellow capped star picket (~10 m from Plot A). Measured in NS and EW direction, each transect 10 m long, intersecting at 5 m. Yellow surveyor peg at North-0

Monitoring Plot C: Larger patch following pipe trench disturbance west of the Cultural Centre building running down to the creek. Yellow surveyor peg at North-0. Measured NS only, along 10 m transect

Monitoring Plot D: Across creek in low-lying area adjacent to creek, Unit 1. Measured in NS and EW direction, each transect 10 m long, intersecting at 5 m. Yellow surveyor peg at North-0

Results

The data have been presented as photo-monitoring points and summary graphs, in which exotic perennial and exotic annual species and litter and dead Chilean Needlegrass were combined. No statistical analysis was undertaken because the variability between years within the plots is great, so that only trends can be considered.

Monitoring Plot A.

In September 2009 Chilean Needlegrass and Paspalum were spot sprayed. In December 2009 Kangaroo Grass thatch was laid out. In September 2010 directly following the monitoring, herbaceous weeds were removed by hand and Chilean Needlegrass plants were sprayed. The area was planted with cells of Kangaroo Grass and Red-leg Grass and transplanted Common Everlasting. 2010 monitoring photos (Figures A2.6a) and b)) indicate a low cover of grasses overall and the patches of Chilean Needlegrass are clear. Evidence of high biomass of Kangaroo Grass surrounding Plot A is apparent in 2011 (Figure A2.7). The grassland in which Plot A occurs was subject to an ecological burn in July 2012. When monitored in September 2012 it appeared that all the Common Everlasting plants that were planted had died. There was evidence that Chilean Needlegrass which had appeared dead in 2011 was resprouting in 2012 (Figure A2.8). The Chilean Needlegrass was again spot sprayed. No further treatment of Chilean Needlegrass occurred after 2012 (Figures A2 9-10).

There was an increase in cover of Chilean Needlegrass over the first three years, but it declined in cover from 2013 to 2015. Although variable, exotic vegetation cover remained relatively stable, but native vegetation initially declined (2011 and 2012), then returned to 2010 levels (Figure A2.11).



Figure A2.6. Monitoring Plot A, 2010; a) North to south; b) East to west



Figure A2.7. Monitoring Plot A, 2011, North to South



Figure A2.8. Monitoring Plot A, 2012, showing areas of Chilean Needlegrass treated
a) North to south
b) East to west

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Figure A2.9. Monitoring Plot A, 2013, North to south



Figure A2.10. Monitoring Plot A, 2015; a) North to south b) East to west

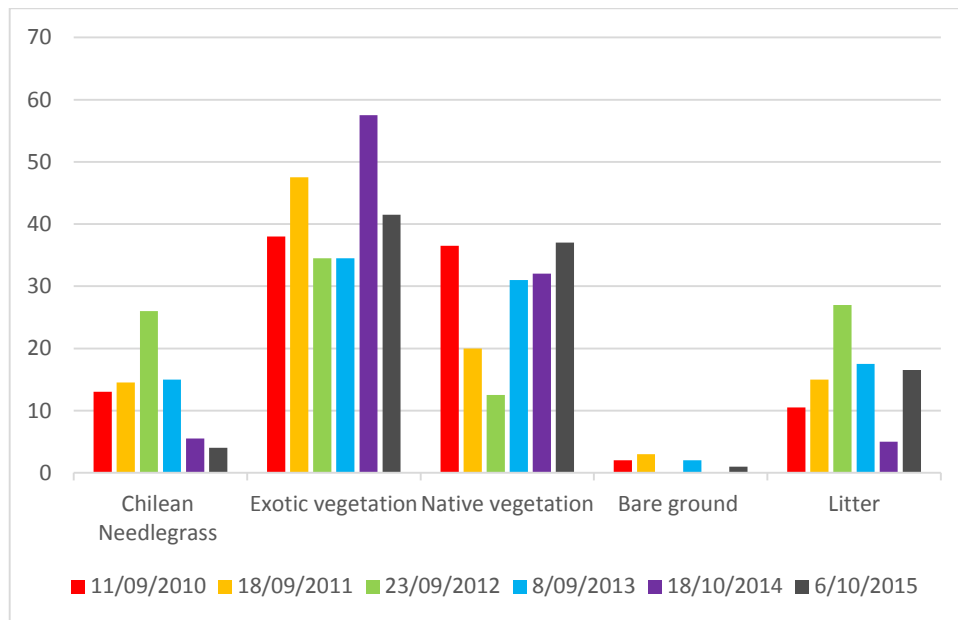


Figure A2.11. Percentage cover of each attribute measured along the two 10 m transects in Monitoring Plot A, 2010 to 2015.

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Monitoring Plot B: Chilean Needlegrass patch in Kangaroo Grass dominated grassland, EM9

In September 2009 Chilean Needlegrass and Paspalum were spot sprayed. In September 2010 directly following the monitoring the area was planted with Kangaroo Grass and Wallaby Grass cells purchased from local suppliers and Common Everlasting transplanted from elsewhere in the site. Chilean Needlegrass was sprayed (Figure A2.12). By September 2011 the area was very overgrown with Kangaroo Grass and weeds (Figure A2.13). Biomass had reduced to low levels after an ecological burn was applied in 2012 (Figure A2.14). By 2012 it appeared that all the Common Everlasting plants that were planted had died. Chilean Needlegrass was more evident from 2013 to 2015 (Figures A2.15-16).

Overall the six years Chilean Needlegrass increased in cover, other exotic vegetation cover was variable, but was relatively stable, and native vegetation decreased then increased again, but not to 2010 or 2011 levels (Figure A2.17).

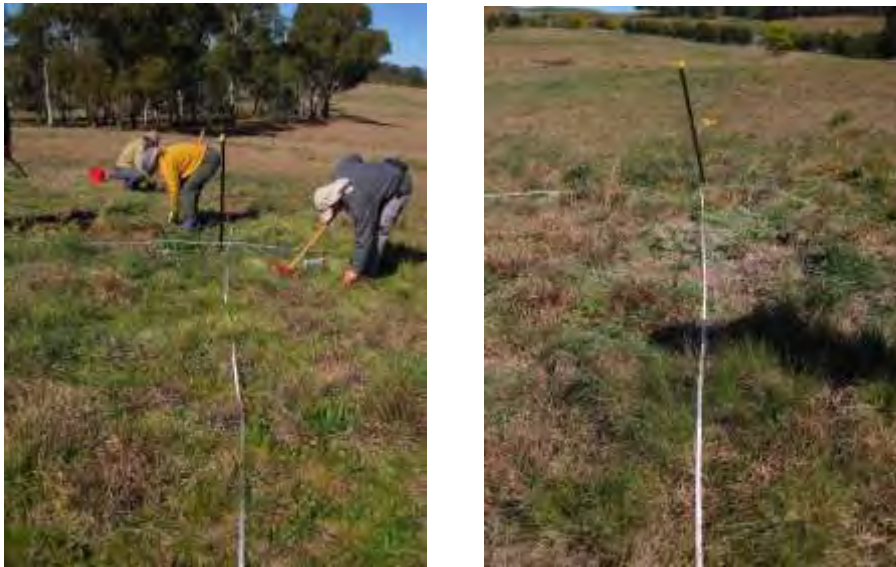


Figure A2.12. Monitoring Plot B, 2010 a) North to south; b) East to west



Figure A2.13. Monitoring plot B, 2011, north to south



Figure A2.14. Monitoring Plot B, 2012; a) North to south; b) East to west



Figure A2.15. Monitoring Plot B, 2013, north to south



Figure A2.16. Monitoring Plot B, 2015; a) north to south; b) East to west

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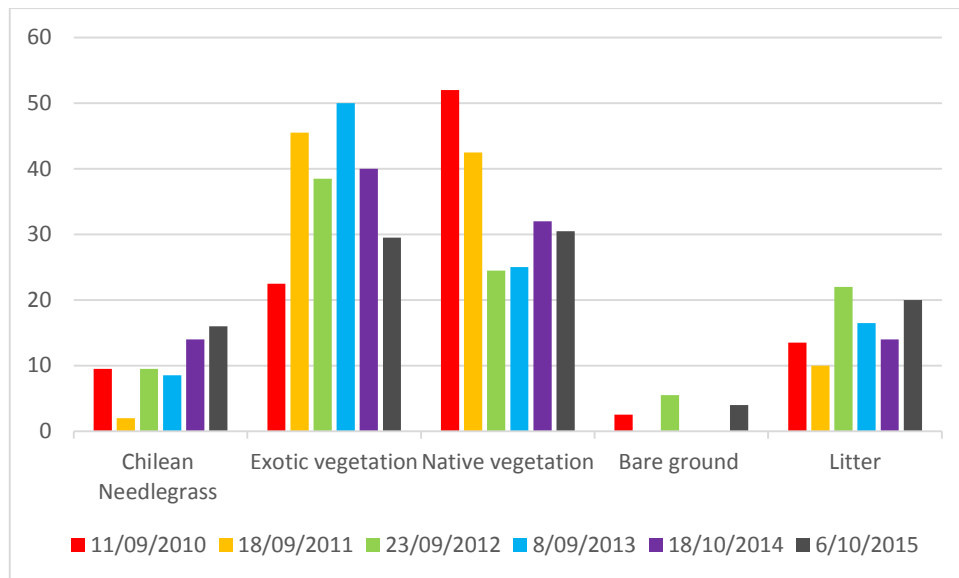


Figure A2.17. Percentage cover of each attribute measured along the two 10 m transects in Monitoring Plot B, 2010 to 2015.

Monitoring Plot C: Disturbed patch, from insertion of a pipe trench, in Kangaroo Grass dominated grassland

In September 2009 Chilean Needlegrass and Paspalum were spot sprayed. The plot was initially to be a control, with no native species to be planted into the area cleared of the major weeds. However, in 2011 a trench was put directly through the area, and it was decided to plant it to River Tussock and Carex, which occurred in 2011 and 2012 (Figures As.18, A2.19). In July 2012 the plot was within the area subjected to an ecological burn. In 2013 adjacent bare patches planted with various native forbs and River Tussock (Figure A2.20). The planted River Tussock in particular established and regenerated extremely successfully by 2015 (Figure A2.21).

Chilean Needlegrass declined over the five years of monitoring (2011 to 2015), as did other exotic vegetation, and there was a significant increase in the cover of native vegetation (Figure A2.22).



Figure A2.18. Monitoring Plot C, 2011



Figure A2.19. Monitoring Plot C, 2012

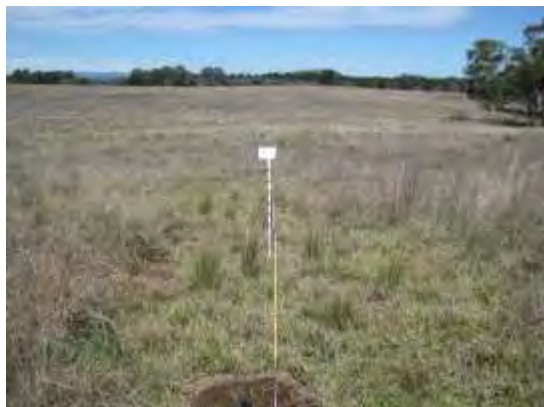


Figure A2.20. Monitoring Plot C, 2013



Figure A2.21. Monitoring Plot C, 2015

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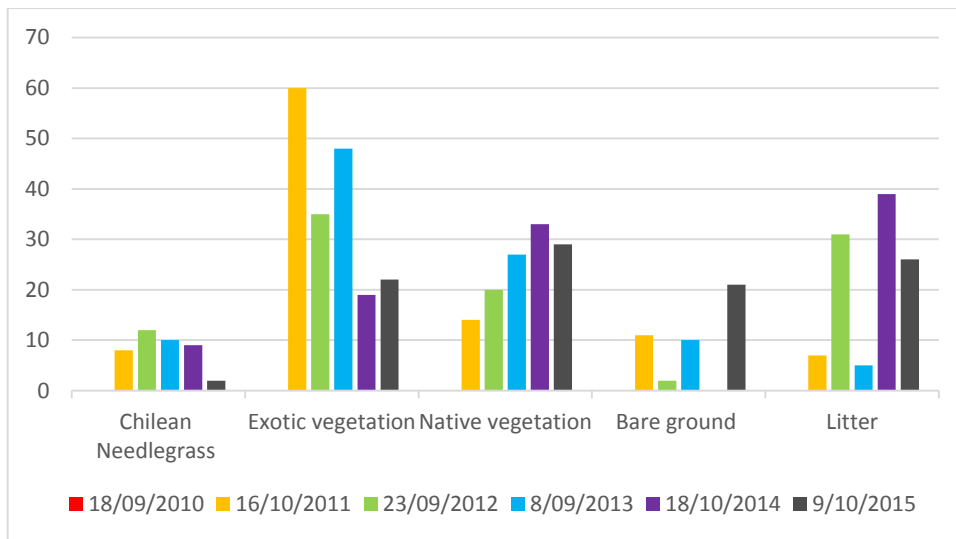


Figure A2.22. Percentage cover of each attribute measured along one 10 m transect in Monitoring Plot C, 2011 to 2015.

Monitoring Plot D: Weedy patch Chilean Needlegrass patch in Kangaroo Grass dominated grassland

In September 2009 Chilean Needlegrass and Paspalum were spot sprayed. Cover of exotic vegetation was higher in this plot than in the other three plots, and remained high throughout the monitoring period (Figure A2.23). In 2010 the plot was weeded by hand and planted with *Carex appressa* and River Tussock. By 2015 the planted tussocks had established well and were regenerating (Figures A2.24-A2.27), even though there was little change in cover of exotic vegetation.

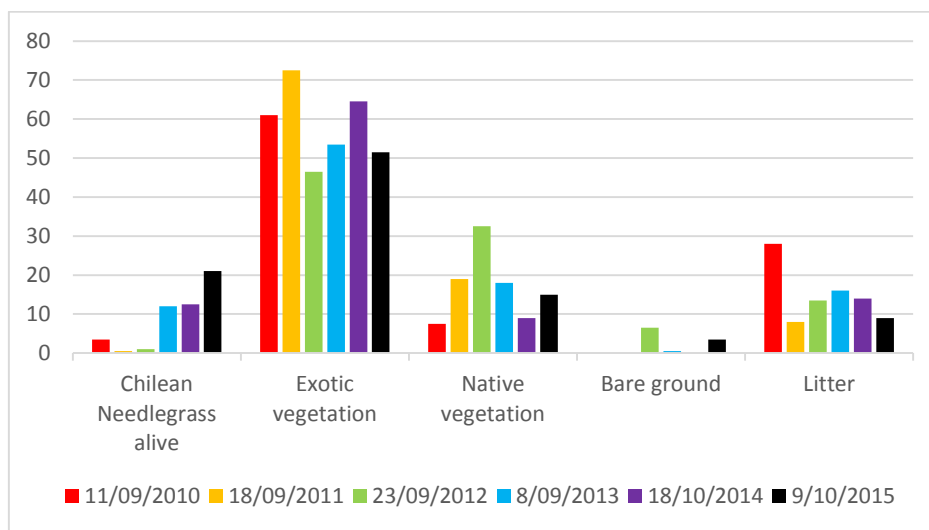


Figure A2.23. Percentage cover of each attribute measured along the two 10 m transects in Monitoring Plot D, 2010 to 2015.



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Figure A2.24. Monitoring Plot D, 2010 Figure A2.25. Monitoring Plot D, 2011

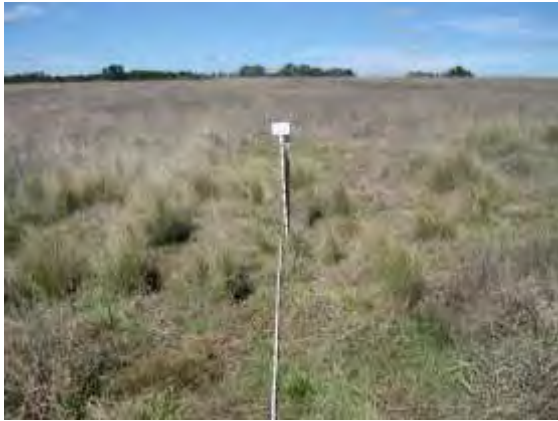


Figure A2.26 Monitoring Plot D, 2013

Figure A2.27. Monitoring Plot D, 2015

Results overall

Chilean Needlegrass showed an initial decline in two of the four plots (Plot A and C), and a similar abundance in the two other plots. However, overall the Chilean Needlegrass changed little in abundance over time, although over the three years of intensive weed control (spot spraying and hand removal) there was a slight decline. Neither exotic vegetation cover nor native vegetation cover changed significantly over the six years (Figure A2.28). Only in Plot C has there been any possible increase in native species cover (Figure A2.22).

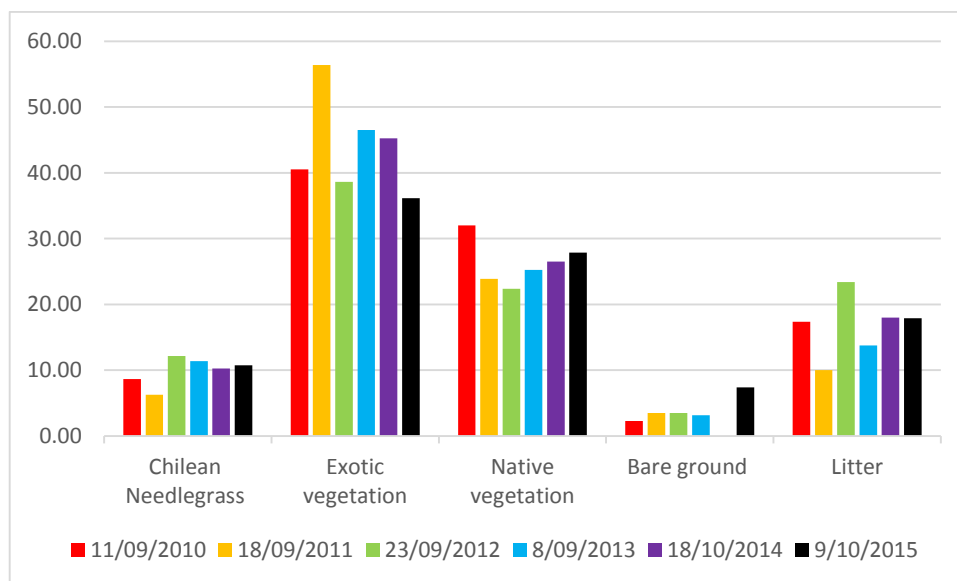


Figure A2.28. Average percentage cover across the plots for each of the species groups, 2010 to 2015.

Discussion and conclusions

There are no clear trends in the change in species dominance, although it is clear that Chilean Needlegrass cover was reduced after the initial spraying and hand weeding (in 2009 to 2012), but increased after spot spraying ceased. It appears overall that it may be increasing (especially notable in Plots B and D).

Disappointingly it appears that with the exception of Plot C, which was initially disturbed through the insertion of the trench for pipes, there has been no increase in cover as a result of revegetation using native species. However, the establishment and regeneration of River Tussock has been significant, as is indicated in Plots C and D (Figures A2.20, A2.21, A2.26, and A2.27). There is no evidence that planted Kangaroo Grass, Redleg Grass or Wallaby Grass have regenerated, and it is unclear if any survived.

The most successful species for revegetation appears to be River Tussock tubestock. Revegetation of a diversity of species was also successful in Plot C following the creation of bare ground after weed control and soil disturbance.

In conclusion it is considered that treatment of Chilean Needlegrass is extremely difficult, and even extensive spot spraying over several years (see Figures A2.11, A2.17, A2.22, A2.23) does not have more than a very short term effect.

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Given that 'dead' Chilean Needlegrass recovered it is also considered very difficult to kill outright. It is unlikely using the current methods that the condition of the patches of native grassland with a moderate to high component of exotic vegetation will increase without changes to current management.

A2.4 Species in Yarramundi Grassland

Table A2.2 presents a list of flora surveyed on three occasions: 1991, from two 10 x 1m² plots (Sharp 1997); 2003 from all the areas in the site that met the criteria as Natural Temperate Grassland (ACT Government 2005); and 2005 from 50 x 50 m grids across the site (Muyt 2005b).

Table A2.2. Plants surveyed at Yarramundi Grassland in 1991, 2003 and 2005

Species	Common Name	Life Form	Weed status	1991	2003	2005
<i>Acacia melanoxylon</i>	Blackwood	Tree				X
<i>Acaena ovina</i>	Sheep's Burr	Herb		X	X	X
<i>Alternanthera</i> sp. A	Hairy Joyweed	Herb		X		
<i>Arthropodium fimbriatum</i>	Nodding Chocolate Lily	Herb		X		
<i>Asperula conferta</i>	Common Woodruff	Herb		X	X	X
<i>Austrodanthonia caespitosa</i>	Ringed Wallaby Grass	Grass		X		
<i>Austrodanthonia carphoides</i>	Short Wallaby Grass	Grass		X		X
<i>Austrodanthonia laevis</i>	Bare-backed Wallaby Grass	Grass		X		
<i>Austrodanthonia</i> spp.	Wallaby Grasses	Grass		X	X	
<i>Austrostipa bigeniculata</i>	Kneed Speargrass	Grass		X	X	X
<i>Austrostipa scabra</i> spp. <i>falcata</i>	Sickle Speargrass	Grass				X
<i>Bothriochloa macra</i>	Redleg Grass	Grass		X	X	X
<i>Bulbine bulbosa</i>	Golden Lily	Herb		X	X	
<i>Carex appressa</i>	Tall Sedge	Sedge				X
<i>Carex inversa</i>	Knob Sedge	Sedge		X	X	
<i>Cheilanthes austrotenuifolia</i>	Rock Fern	Fern			X	X
<i>Chloris truncata</i>	Windmill Grass	Grass		X		X
<i>Chrysocephalum apiculatum</i>	Common Everlasting	Herb		X	X	X
<i>Convolvulus angustissimus</i> subsp. <i>angustissimus</i>	Pink Bindweed	Herb		X	X	X
<i>Cynodon dactylon</i> var. <i>dactylon</i>	Couch grass	Grass				X
<i>Cynoglossum suaveolens</i>	Sweet Houndstongue	Herb			X	
<i>Desmodium varians</i>	Slender Tick-trefoil	Herb			X	
<i>Dianella revoluta</i> var. <i>revoluta</i>	Black-anther Flax Lily	Herb		X		X
<i>Dichondra repens</i>	Kidney Weed	Herb				X
<i>Drosera peltata</i>	Pale Sundew	Herb			X	
<i>Elymus scaber</i> var. <i>scaber</i>	Common Wheat Grass	Grass		X		X
<i>Enneapogon nigricans</i>	Nine-awn Grass	Grass			X	
<i>Epilobium billardioreanum</i> subsp. <i>cinereum</i>	Hairy Willowherb	Herb		X	X	X
<i>Eryngium ovinum</i>	Blue Devil	Herb		X	X	X
<i>Euchiton involucratus</i>	Star Cudweed	Herb			X	X
<i>Glycine tabacina</i>	Variable Glycine	Herb		X		X
<i>Gonocarpus tetragynus</i>	Common Raspwort	Subshrub				X
<i>Goodenia pinnatifida</i>	Scrambled Eggs	Herb		X	X	X
<i>Hydrocotyle laxiflora</i>	Stinking Pennywort	Herb			X	
<i>Juncus filicaulis</i>	Thread Rush	Rush		X		X
<i>Lachnagrostis filiformis</i>	Common Blown Grass	Grass				X
<i>Leptorhynchus squamatus</i> subsp. <i>squamatus</i>	Scaly Buttons	Herb		X	X	X
<i>Lomandra bracteata</i>	Small Matrush	Herb			X	
<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Matrush	Herb		X		
<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle Matrush	Herb				X

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Species	Common Name	Life Form	Weed status	1991	2003	2005
<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Many-flowered Matrush	Herb		X		
<i>Lythrum salicaria</i>	Purple Loosestrife	Herb				X
<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass	Grass			X	X
<i>Oxalis exilis</i>	Slender Oxalis	Herb		X		
<i>Oxalis perennans</i>	Grassland Woodsorrel	Herb		X	X	X
<i>Panicum effusum</i>	Hairy Panic Grass	Grass		X		X
<i>Plantago varia</i>	Variable Plantain	Herb		X	X	X
<i>Poa labillardieri</i> var. <i>labillardieri</i>	River Tussock Grass	Grass		X	X	X
<i>Poa sieberiana</i>	A tussock grass	Grass		X	X	X
<i>Rumex brownii</i>	Swamp Dock	Herb		X	X	X
<i>Schoenus apogon</i>	Common Bog Sedge	Sedge			X	
<i>Senecio quadridentatus</i>	Cotton Fireweed	Herb		X		X
<i>Solenogyne dominii</i>	Smooth Solenogyne	Herb		X	X	X
<i>Stuartina muelleri</i>	Spoon Cudweed	Herb			X	
<i>Themeda triandra</i>	Kangaroo Grass	Grass		X	X	X
<i>Tricoryne elatior</i>	Yellow Rush Lily	Herb			X	X
<i>Triptilodiscus pygmaeus</i>	Common Sunray Narrow-leaved New	Herb			X	
<i>Vittadinia muelleri</i>	Holland Daisy	Herb		X		X
<i>Wahlenbergia communis</i>	Tufted Bluebell	Herb		X	X	X
<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	Tall Bluebell	Herb		X	X	
<i>Wurmbea dioica</i> subsp. <i>dioica</i>	Early Nancy	Herb			X	X
[^] <i>Eucalyptus globulus</i> subsp. <i>bicostata</i>	Southern Blue Gum	Tree				X
[^] <i>Eucalyptus mannifera</i> subsp. <i>mannifera</i>	Brittle Gum	Tree				X
[^] <i>Eucalyptus melliodora</i>	Yellow Box	Tree				X
[^] <i>Eucalyptus pauciflora</i>	Snow Gum					
[^] <i>Eucalyptus viminalis</i> subsp. <i>viminalis</i>	Ribbon Gum	Tree				X
[^] <i>Grevillea</i> sp.	Grevillea	shrub				X
[^] <i>Acacia</i> spp.	Acacias	Shrub				X
* <i>Acacia baileyana</i>	Cootamundra Wattle	Shrub	C4			X
* <i>Acetosella vulgaris</i>	Sheep Sorrel	Herb		X	X	X
* <i>Aira elegantissima</i>	Hairgrass	Grass		X	X	
* <i>Alnus glutinosa</i>	Black Alder	Tree				X
* <i>Arctotheca calendula</i>	Cape Weed	Herb			X	
* <i>Avena barbata</i>	Wild Oats	Grass		X	X	X
* <i>Betula pendula</i>	Silver Birch	Tree				X
* <i>Briza maxima</i>	Quaking Grass	Grass		X	X	X
* <i>Briza minor</i>	Shivery Grass	Grass		X	X	X
* <i>Bromus hordeaceus</i>	Soft Brome	Grass		X		X
* <i>Bromus</i> spp.	Brome	Grass			X	X
* <i>Centaureum erythraea</i>	Common Centaury	Herb		X		X
* <i>Cerastium glomeratum</i>	Sticky Mouse-ear	Herb		X		
* <i>Cirsium vulgare</i>	Spear Thistle	Herb		X	X	X
* <i>Conyza</i> sp.	Fleabane	Herb				X
* <i>Crataegus monogyna</i>	Hawthorn	Shrub	C3	X		X
* <i>Cyperus eragrostis</i>	Umbrella Sedge	Sedge				X
* <i>Dactylis glomerata</i>	Cocksfoot	Grass				X
* <i>Ehrharta erecta</i> var. <i>erecta</i>	Panic Veldt Grass	Grass		X		X
* <i>Eragrostis cilianensis</i>	Stinkgrass	Grass		X		
* <i>Eragrostis curvula</i>	African Love Grass	Grass	C3			X

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Species	Common Name	Life Form	Weed status	1991	2003	2005
<i>*Festuca arundinacea</i>	Tall Fescue	Grass		X		X
<i>*Foeniculum vulgare</i>	Fennel	Herb				X
<i>*Galium divaricatum</i>	Slender Bedstraw	Herb		X		
<i>*Hirschfeldia incana</i>	Hairy Mustard	Herb			X	
<i>*Holcus lanatus</i>	Yorkshire Fog	Grass		X	X	X
<i>*Hypericum perforatum</i> subsp. <i>veronense</i>	St John's Wort	Herb	C3	X	X	X
<i>*Hypochaeris glabra</i>	Smooth Catsear	Herb			X	X
<i>*Hypochaeris radicata</i>	Flatweed	Herb		X	X	X
<i>*Juncus bufonius</i>	Toad Rush	Rush		X		
<i>*Juncus capitatus</i>	Annual Rush	Rush		X		
<i>*Lactuca serriola</i>	Prickly Lettuce	Herb			X	X
<i>*Lolium rigidum</i>	Wimmera Ryegrass	Grass		X		X
<i>*Moenchia erecta</i>	Erect Chickweed	Herb		X		
<i>*Myosotis discolor</i>	Yellow and Blue Forget-me-not	Herb		X		
<i>*Nassella neesiana</i>	Chilean Needle Grass	Grass	C3	X	X	X
<i>*Nassella trichotoma</i>	Serrated Tussock	Grass	C3	X		X
<i>*Oxalis corniculata</i>	Yellow Woodsorrel	Herb		X		
<i>*Parentucellia latifolia</i> subsp. <i>latifolia</i>	Red Bartsia	Herb			X	
<i>*Paspalum dilatatum</i>	Paspalum	Grass		X	X	X
<i>*Petrohragia nantueilii</i>	Proliferous Pink	Herb		X	X	X
<i>*Phalaris aquatica</i>	Toowoomba Canary Grass	Grass			X	X
<i>*Pinus radiata</i>	Monterey Pine	Tree	C4			X
<i>*Plantago lanceolata</i>	Ribwort Plantain	Herb		X	X	X
<i>*Poa annua</i>	Winter Grass	Grass			X	
<i>*Poa bulbosa</i>	Bulbous Bluegrass	Grass			X	
<i>*Polygonum aviculare</i>	Wireweed	Herb				X
<i>*Populus alba</i>	White Poplar	Tree	C4			X
<i>*Pyracantha angustifolia</i>	Yellow Firethorn	Shrub	C4			X
<i>*Quercus robur</i>	English Oak	Tree				X
<i>*Rosa rubiginosa</i>	Sweet Briar	Shrub	C3	X	X	X
<i>*Rubus fruticosus</i> spp. agg.	A blackberry	Shrub	C3			X
<i>*Rumex crispus</i>	Curled Dock	Herb			X	X
<i>*Salix</i> sp.	Willow	Tree	C2			X
<i>*Salvia verbenaca</i> var. <i>verbenaca</i>	Wild Sage	Herb		X	X	X
<i>*Sanguisorba minor</i>	Sheep's Burnet	Herb			X	
<i>*Silene gallica</i> var. <i>gallica</i>	French Catchfly	Herb		X	X	
<i>*Sisymbrium officinale</i>	Mustard Weed	Herb				X
<i>*Sonchus asper</i>	Sowthistle	Herb		X		X
<i>*Tolpis barbata</i>	Yellow Hawkweed	Herb			X	
<i>*Tragopogon porrifolius</i> subsp. <i>porrifolius</i>	Salsify	Herb		X		X
<i>*Trifolium arvense</i> var. <i>arvense</i>	Haresfoot Clover	Herb		X		X
<i>*Trifolium campestre</i> var. <i>campestre</i>	Hop Clover	Herb		X		
<i>*Trifolium dubium</i>	Yellow Suckling Clover	Herb		X	X	
<i>*Trifolium repens</i> var. <i>repens</i>	White Clover	Herb			X	
<i>*Trifolium</i> sp.	Clover	Herb			X	
<i>*Trifolium striatum</i>	Knotted Clover	Herb		X		
<i>*Trifolium subterraneum</i>	Subterranean Clover	Herb		X		
<i>*Verbascum thapsus</i> subsp. <i>thapsus</i>	Great Mullein	Herb				X
<i>*Verbascum virgatum</i>	Twiggy Mullein	Herb				X

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Species	Common Name	Life Form	Weed status	1991	2003	2005
* <i>Vicia sativa</i>	Common Vetch					X
* <i>Vinca major</i>	Blue Periwinkle	Herb				X
* <i>Vulpia bromoides</i>	Squirrel-tailed Fescue	Grass		X		
* <i>Vulpia</i> sp.	Fescue	Grass			X	

X: Recorded in Surveys

*: Introduced Species (i.e. non-indigenous – native or exotic)

^: Native species planting (non-endemic)

Weeds - C2, C3, C4: ACT Weed Categories (Attachment C)

Fauna observed or surveyed

Table A2.3 lists the fauna species observed at Yarramundi.

Table A2.3. Fauna species observed at Yarramundi.

Species	Common name	Legislative status
<i>Synemon plana</i>	Golden Sun Moth	Critically endangered (EPBC Act); endangered (NC Act)
<i>Delma impar</i>	Striped Legless Lizard	Vulnerable (EPBC Act, NC Act)
<i>Delma inornata</i>	Inornate Legless Lizard	
<i>Lamphrobomus delicata</i>	Delicate Sun Skink	
<i>Hemiergis decresiensis</i>	Three-toed Skink	
<i>Menetia greyii</i>	Grey's Skink	
<i>Tiliqua scincoides</i>	Common Blue Tongue	
<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog	
<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog	
<i>Crinia parinsignifera</i>	Plains Froglet	
<i>Crinia signifera</i>	Common Eastern Froglet	
<i>Neobatrachus sudelli</i>	Spotted Burrowing Frog	
<i>Mus domesticus</i>	House Mouse	

A3. Guilfoyle St Grassland Yarralumla

A3.1 Management history

Recorded management at this site consists of a burn in 2013, mowing in 2014, and occasional mowing prior to that. The roadside would have been mown regularly as part of the City Services annual mowing program.

This site has not been subject to any volunteer activity by Friends of Grasslands. Due to the amount of activity already being undertaken by Friends of Grasslands at Yarramundi and Stirling Ridge it is not considered possible for the group to greatly expand its existing activities.

A3.2 Species present

The flora species list from Rowell (2006) is presented in Table A3. 1 below. The species list is from the entire site, including an area that has subsequently been included in the embassy to the east, and in the lower part of the site, where it is more degraded.

Table A3.1. Plants surveyed at Guilfoyle St Grassland (Rowell 2006)

Species	Common Name	Life form
<i>Aristida ramosa</i>	Purple Wire Grass	Grass
<i>Austrostipa bigeniculata</i>	Kneed Speargrass	Grass
<i>Bothriochloa macra</i>	Redleg Grass	Grass
<i>Brachyscome dentata</i>	Lobe-seed Daisy	Herb
<i>Bulbine bulbosa</i>	Golden Lily	Herb
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Rock Fern	Fern
<i>Chloris truncata</i>	Windmill Grass	Grass
<i>Chrysocephalum apiculatum</i>	Common Everlasting	Herb
<i>Convolvulus angustissimus</i> subsp. <i>angustissimus</i>	Pink Bindweed	Herb
<i>Cryptandra amara</i> var. <i>amara</i>	Sweet Cryptandra	Subshrub
<i>Desmodium varians</i>	Slender Tick-trefoil	Herb
<i>Dichelachne</i> sp.	A Plume Grass	Grass
<i>Drosera peltata</i>	Pale Sundew	Herb
<i>Elymus scaber</i> var. <i>scaber</i>	Common Wheat Grass	Grass
<i>Erodium crinitum</i>	Blue Storksbill	Herb
<i>Eryngium ovinum</i>	Blue Devil	Herb
<i>Euchiton</i> sp.	Cudweed	Herb
<i>Glycine tabacina</i>	Variable Glycine	Herb
<i>Goodenia pinnatifida</i>	Scrambled Eggs	Herb
<i>Hydrocotyle laxiflora</i>	Stinking Pennywort	Herb
<i>Hypericum gramineum</i>	Small St John's Wort	Herb
<i>Leptorhynchos squamatus</i> subsp. <i>squamatus</i>	Scaly Buttons	Herb
<i>Lomandra bracteata</i>	Small Matrush	Herb
<i>Melichrus urceolatus</i>	Urn Heath	Subshrub
<i>Microseris</i> sp. Snowfields (D.E.Albrecht 123)	Yam Daisy	Herb
<i>Microtis unifolia</i>	Common Onion Orchid	Herb
<i>Oxalis perennans</i>	Grassland Woodsorrel	Herb
<i>Pimelea curviflora</i>	Curved Riceflower	Subshrub
<i>Plantago varia</i>	Variable Plantain	Herb
<i>Poa labillardieri</i> var. <i>labillardieri</i>	River Tussock Grass	Grass
<i>Rytidosperma</i> spp.	Wallaby Grasses	Grass
<i>Rumex brownii</i>	Swamp Dock	Herb
<i>Solenogyne dominii</i>	Smooth Solenogyne	Herb
<i>Themeda triandra</i>	Kangaroo Grass	Grass
<i>Tricoryne elatior</i>	Yellow Rush Lily	Herb
<i>Triptilodiscus pygmaeus</i>	Common Sunray	Herb
<i>Vittadinia muelleri</i>	Narrow-leaved New Holland Daisy	Herb
<i>Wahlenbergia communis</i>	Tufted Bluebell	Herb
<i>Wahlenbergia gracilis</i>	Sprawling Bluebell	Herb
<i>Wahlenbergia luteola</i>	Yellowish Bluebell	Herb
<i>Wahlenbergia multicaulis</i>	Tadgell's Bluebell	Herb
<i>Wurmbea dioica</i> subsp. <i>dioica</i>	Early Nancy	Herb
* <i>Aira</i> sp.	Hairgrass	Grass
* <i>Anagallis arvensis</i>	Scarlet Pimpernel	Herb
* <i>Arctotheca calendula</i>	Cape Weed	Herb
* <i>Avena</i> sp.	Wild Oats	Grass

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Species	Common Name	Life form
* <i>Briza maxima</i>	Quaking Grass	Grass
* <i>Briza minor</i>	Shivery Grass	Grass
* <i>Bromus</i> sp.	Brome	Grass
* <i>Centaurium erythraea</i>	Common Centaury	Herb
* <i>Cotoneaster</i> sp.	Cotoneaster	Shrub
* <i>Crataegus monogyna</i>	Hawthorn	Shrub
* <i>Echium plantagineum</i>	Paterson's Curse	Herb
* <i>Eragrostis curvula</i>	African Love Grass	Grass
* <i>Erodium cicutarium</i>	Common Crow-foot	Herb
* <i>Hirschfeldia incana</i>	Hairy Mustard	Herb
* <i>Hypochaeris radicata</i>	Flatweed	Herb
* <i>Juncus bufonius</i>	Toad Rush	Rush
* <i>Lactuca serriola</i>	Prickly Lettuce	Herb
* <i>Nassella neesiana</i>	Chilean Needle Grass	Grass
* <i>Paspalum dilatatum</i>	Paspalum	Grass
* <i>Plantago lanceolata</i>	Ribwort Plantain	Herb
* <i>Pyracantha</i> sp.	Firethorn	Shrub
* <i>Rosa rubiginosa</i>	Sweet Briar	Shrub
* <i>Sanguisorba minor</i>	Sheep's Burnet	Herb
* <i>Sonchus oleraceus</i>	Common Sowthistle	Herb
* <i>Trifolium arvense</i> var. <i>arvense</i>	Haresfoot Clover	Herb
* <i>Trifolium campestre</i> var. <i>campestre</i>	Hop Clover	Herb
* <i>Trifolium glomeratum</i>	Cluster Clover	Herb
* <i>Vulpia</i> sp.	Fescue	Grass
^ <i>Acacia baileyana</i>	Cootamundra Wattle	Shrub
^ <i>Eucalyptus globulus</i> subsp. <i>bicostata</i>	Southern Blue Gum	Tree
^ <i>Grevillea rosmarinifolia</i> X	Rosemary Grevillea cultivar	Shrub

Notes:

*: Introduced Species (i.e. non-endemic – native or exotic)

^: Eucalyptus planting (non-endemic)

A4 O'Malley Woodland

A4.1 Management history

While the history has not been documented, it is evident that the site has been disturbed, probably grazed, with some clearing and deliberate planting of Pines (*Pinus radiata*) and non-local eucalyptus species. The area that is included in the EMP is that which has been subject to the least disturbance and retains a higher diversity of species, structure and habitat (O'Sullivan 2013).

A4.2 Species list

The species list in Table A4.1 is from O'Sullivan (2013). As the species list was not defined by the patches identified in O'Sullivan, which have been incorporated into the two management units in the EMP it is not possible to determine whether the species are inside or outside the management units. A quantitative survey within the two management units to assess its condition against the benchmarks for the vegetation communities is recommended.

Table A4.1. Plant species surveyed at O'Malley Woodland (O'Sullivan 2013).

(D: declared pest plant; I: BGW important species, EPBC Act)

Species	Common Name	Habit	Status
* <i>Acacia baileyana</i>	Cootamundra Wattle	Tree	D
* <i>Acer negundo</i>	Box Elder	Tree	
* <i>Acetosella vulgaris</i>	Sheep Sorrel	Herb	
* <i>Avena barbata</i>	Wild Oats	Grass	
* <i>Centaureum erythraea</i>	Common Centaury	Herb	
* <i>Cirsium vulgare</i>	Spear Thistle	Herb	
* <i>Conyza bonariensis</i>	Flaxleaf Fleabane	Herb	
* <i>Cotoneaster</i> sp	a cotoneaster	Shrub	
* <i>Echium plantagineum</i>	Patersons Curse	Herb	D
* <i>Echium vulgare</i>	Viper's Bugloss	Herb	
* <i>Eragrostis curvula</i>	African Love Grass	Grass	D
* <i>Eragrostis ?trachycarpa</i>		Grass	
* <i>Eucalyptus cinerea</i>	Argyle Apple	Tree	
* <i>Hedera helix</i>	English Ivy	Climber	
* <i>Hirschfeldia incana</i>	Hairy Mustard	Herb	
* <i>Hypericum perforatum</i> subsp. <i>veronense</i>	St John's Wort	Herb	D
* <i>Hypochoeris glabra</i>	Smooth Catsear	Herb	
* <i>Ligustrum lucidum</i>	Privet	Shrub	D
* <i>Modiola caroliniana</i>	Red-flowered Mallow	Herb	
* <i>Nassella trichotoma</i>	Serrated Tussock	Grass	D
* <i>Olea</i> sp.	an olive	Tree	
* <i>Paronychia brasiliana</i>	Chilean Whitlow	Herb	
* <i>Petrorhagia nantueilii</i>	Proliferous Pink	Herb	
* <i>Pinus radiata</i>	Radiata Pine	Tree	D
* <i>Plantago lanceolata</i>	Ribwort Plantain	Herb	
* <i>Pyracantha angustifolia</i>	Yellow Firethorn	Shrub	D
* <i>Rosa rubiginosa</i>	Sweet Briar	Shrub	D
* <i>Sanguisorba minor</i>	Sheep's Burnet	Herb	
* <i>Trifolium angustifolium</i> var. <i>angustifolium</i>	Narrow-leaved Clover	Herb	
* <i>Ulmus</i> sp	Elm	Tree	
* <i>Verbascum thapsus</i> subsp. <i>thapsus</i>	Great Mullein	Herb	
* <i>Verbena bonariensis</i>	Purpletop	Herb	
<i>Acacia doratoxylon</i>	Currawang	Tree	
<i>Acacia implexa</i>	Hickory Wattle	Tree	
<i>Acacia mearnsii</i>	Black Wattle	Tree	
<i>Acaena ovina</i>	Sheep's Burr	Herb	
<i>Ajuga australis</i>	Austral Bugloss	Herb	I
<i>Aristida ramosa</i>	Purple Wire Grass	Grass	
<i>Astroloma humifusum</i> var. <i>humifusum</i>	Native Cranberry	Subshrub	I
<i>Austrostipa bigeniculata</i>	Kneed Speargrass	Grass	
<i>Austrostipa scabra</i> subsp. <i>falcata</i>	Sickle Speargrass	Grass	
<i>Bothriochloa macra</i>	Redleg Grass	Grass	

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Species	Common Name	Habit	Status
<i>Brachychiton populneus</i> subsp. <i>populneus</i>	Kurrajong	Tree	
<i>Carex inversa</i>	Knob Sedge	Sedge	
<i>Cassinia ?arcuata</i>	Sifton Bush	Shrub	
<i>Cassinia aculeata</i>	Dollybush	Shrub	
<i>Cheilanthes austrotenuifolia</i>	Rock Fern	Fern	
<i>Chloris truncata</i>	Windmill Grass	Grass	
<i>Chrysocephalum apiculatum</i>	Common Everlasting	Herb	I
<i>Chrysocephalum semipapposum</i>	Clustered Everlasting	Herb	I
<i>Convolvulus angustissimus</i> subsp. <i>angustissimus</i>	Pink Bindweed	Herb	
<i>Cryptandra amara</i> var. <i>amara</i>	Sweet Cryptandra	Subshrub	
<i>Cymbonotus lawsonianus</i>	Bear's Ear	Herb	
<i>Cymbopogon refractus</i>	Barbed-Wire Grass	Grass	
<i>Cynodon dactylon</i> var. <i>dactylon</i>	Couch grass	Grass	
<i>Desmodium varians</i>	Slender Tick-trefoil	Herb	I
<i>Dianella longifolia</i> var. <i>longifolia</i>	Smooth Flax Lily	Herb	IR
<i>Dichondra repens</i>	Kidney Weed	Herb	
<i>Einadia nutans</i> subsp. <i>nutans</i>	Climbing Saltbush	Herb	
<i>Elymus scaber</i> var. <i>scaber</i>	Common Wheat Grass	Grass	
<i>Eucalyptus blakelyi</i>	Blakely's Red Gum	Tree	
<i>Eucalyptus bridgesiana</i>	Apple Box	Tree	
<i>Eucalyptus dives</i>	Broad-leaved Peppermint	Tree	
<i>Eucalyptus mannifera</i> subsp. <i>mannifera</i>	Brittle Gum	Tree	
<i>Eucalyptus melliodora</i>	Yellow Box	Tree	
<i>Euchiton involucreatus</i>	Star Cudweed	Herb	
<i>Exocarpos cupressiformis</i>	Cherry Ballart	Tree	I
<i>Galium gaudichaudii</i>	Rough Bedstraw	Herb	I
<i>Geranium solanderi</i> var. <i>solanderi</i>	Native Geranium	Herb	
<i>Glycine clandestina</i> var. <i>clandestina</i>	Twining Glycine	Herb	I
<i>Gonocarpus tetragynus</i>	Common Raspwort	Subshrub	
<i>Grevillea juniperina</i> subsp. <i>fortis</i>	Prickly Spiderflower	Shrub	
<i>Hardenbergia violacea</i>	False Sarsparilla	Climber	
<i>Hibbertia obtusifolia</i>	Hoary Guinea-flower	Subshrub	I
<i>Hydrocotyle laxiflora</i>	Stinking Pennywort	Herb	
<i>Hypericum gramineum</i>	Small St John's Wort	Herb	I
<i>Kunzea ericoides</i>	Burgan	Shrub	I
<i>Lepidosperma laterale</i>	Variable Sword Sedge	Sedge	
<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle Matrush	Herb	
<i>Lomandra longifolia</i>	Spiny-headed Matrush	Herb	
<i>Oxalis perennans</i>	Grassland Woodsorrel	Herb	
<i>Panicum effusum</i>	Hairy Panic Grass	Grass	
<i>Poa ?sieberiana</i>	A tussock grass	Grass	
<i>Poa</i> sp	a snow grass	Grass	
<i>Rytidosperma pallidum</i>	Redanther Wallaby Grass	Grass	I
<i>Rytidosperma</i> spp.	Wallaby Grasses	Grass	
<i>Themeda triandra</i>	Kangaroo Grass	Grass	I
<i>Tricoryne elatior</i>	Yellow Rush Lily	Herb	I
<i>Vittadinia cuneata</i> var. <i>cuneata</i>	Fuzzy New Holland Daisy	Herb	
<i>Wahlenbergia</i> sp	a bluebell		
<i>Xerochrysum bracteatum</i>	Golden Everlasting	Herb	

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A5 References

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Attachment B. Heritage Management Plan actions relevant to management of NCA conservation areas

Actions relevant to management of NCA conservation areas are included in Attachment 1 (extracted as indicated from Section 3.2, pp 19-28):

1.1.2 The identified heritage values of the Study Area (shown in Table 1.1) will be the principal basis for all future planning, management and impact assessment of activities or actions.

1.1.3 Any proposal or action that will or is likely to have a significant impact on the environment including the identified Commonwealth and National heritage values of the Study Area (Table 1.1) will require a referral to the Minister for Environment, Heritage and the Arts

1.2.1 All the components of the Study Area (identified in Table 1.1) should be added to the NCA's register of places of Commonwealth heritage value, in accordance with s341ZB (1) of the EPBC Act.

1.4.1 Promote a holistic management approach to the Study Area by ensuring that proposals are assessed in terms of their potential to impact on the heritage values of the Study Area as a whole. The aim of this policy is to promote a co-ordinated rather than a piecemeal approach to management.

1.7.5 Rigorously manage new development on Stirling Ridge and Attunga Point in order to conserve the aesthetic and natural values of the landscape, topography and vegetation and its importance in significant views.

1.7.7 Rigorously manage new development on the Yarramundi Peninsula in order to conserve the historical, aesthetic and natural values of the landscape, topography and vegetation and its importance in significant views. In particular manage the Peninsula to maintain the 'natural' river-like qualities of Westlake.

1.8.5 Retain views to the surrounding hillsides as well as their vegetated, natural character.

1.10.1 Recognise Indigenous heritage values which arise from sites, places and the interrelation between sites, places and landscapes.

1.11.1 Conserve the natural heritage values of Stirling Ridge and Attunga Point. The Button Wrinklewort is a listed threatened species under section 18 of the EPBC Act; and Yellow box—Red gum grassy woodland and natural temperate grassland are both listed as threatened ecological communities under section 18A of the Act.

1.11.2 Conserve the natural heritage values of the Yarramundi Peninsula: the natural temperate grassland and grassland habitat for the Striped legless lizard (declared threatened species under the *Nature Conservation Act 1980* (ACT) and threatened species under the EPBC Act) and the Perunga grasshopper (declared threatened species under the *Nature Conservation Act 1980*).

3.4.1 Control access to Stirling Ridge and Attunga Point and the Yarramundi Peninsula, through the use of fencing, signage and control/closure of paths, to consolidate and promote the ecological sustainability of the natural communities in those areas.

4.1.5 Recognise ongoing management needs through the preparation of specific precinct/area conservation management plans and masterplans. These will form the basis for any further assessment of heritage impacts.

In particular, prepare detailed conservation management plans/masterplans for Westlake (rowing course site), Yarralumla Bay, West Basin, Attunga Point/Stirling Ridge and Kingston foreshore as part of the detailed design development for these precincts. These will form the basis for the assessment of any proposed impacts upon the heritage values.

5.3.1 Use the annual collation of monitoring data to identify trends against the condition of values described in this HMP.

5.3.2 Ensure that any review of the HMP responds to and addresses trends revealed in monitoring data by refining management techniques accordingly.

B2 References

Godden Mackay Logan Heritage Consultants, 2009. Lake Burley Griffin and Adjacent Lands Heritage Management Plan Volume 2—Stirling Ridge and Attunga Point. Report prepared for the National Capital Authority, October 2009 (accessed September 2015 at <http://www.nationalcapital.gov.au/index.php/heritage/heritage-management-plans/720-lake-burley-griffin-and-adjacent-lands-heritage-management-plan>)

Attachment C. General Management Guidelines

The major issues in all sites remain the presence of invasive herbaceous and woody weeds and management of biomass for ecological and fire mitigation outcomes. Weed control cannot be undertaken sporadically, as it requires initial control then considerable strategically timed follow-up to prevent reinvasion by the same or different weeds. Similarly, biomass control in grass dominated sites has to be undertaken regularly to prevent overgrowth of thatch and loss of native species. A major component of biomass in these sites is weeds.

C1 Ecological guidelines for biomass management

Biomass management is implemented for a variety of reasons: to enhance ecological diversity and habitat, to reduce bushfire risk, to improve recreational experiences and enhance landscape aesthetics. Biomass management relevant to the conservation areas includes the application of slashing, prescribed fire, chemical application and physical removal (e.g. of woody weeds and/or thinning of shrubs or trees). Other biomass reduction is undertaken by kangaroos, rabbits and other herbivores present in the conservation areas.

Guidelines produced by ACT Government (2012) provide information to guide the use of biomass management so that matters of ecological significance are not damaged or destroyed. Further details related to community or species management are derived from ACT Government (2008), Sharp et al. (2014) and Beutel and Smith (2014). All biomass management, whether for fuel mitigation purposes or habitat enhancement within the conservation areas covered by the EMP should abide with these principles and guidelines.

General Principles for Prescribed Burns:

- Generally burns should be low intensity and patchy, aiming to achieve 30% unburnt, 70% burnt and less than 10% crown scorch
- Vehicles should remain on existing tracks and form crossings wherever possible
- Vehicles should be washed down to remove weeds before and after attending burns
- Every practical measure is to be used to protect habitat and hollow bearing trees from burning or requiring felling
- Avoid burning moist gullies and drainage lines wherever possible
- The use of fire-fighting foam should not be used in any high conservation area
- Fire-fighting foam must not be used, handled or mixed within 100 m of any standing waterbody (i.e., Lake Burley Griffin)

General Principles for Slashing Operations

- Slashing widths should not be extended beyond the previously slashed extent
- Slashing should not be undertaken below 10 cm
- In each area, commence slashing in the areas of fewest weeds before moving into areas of more weeds
- Wash down all machinery, implements and vehicles between slashing areas
- Avoid slashing when weed seeds are viable.

General Principles for Chemical Application

- Chemical application must be undertaken in accordance with ACT Invasive Weed Management Guidelines (ACT Government 2013)
- Restrict chemical application to the target species or minimise application
- Avoid spraying, mixing or use within 30 m of any waterway
- Avoid spraying, mixing or use within 10 m of any mapped threatened plants
- Chemical use on native vegetation should only be used on shrubby or regrowth vegetation after consultation, and not applied to ground cover vegetation
- Boom spraying is recommended to cease if wind conditions cause spray drift onto non-target native vegetation.

General Principles for Access Management

- Plant and vehicles should not impact on adjacent vegetation and habitat for the purpose of parking, refuelling, passing or turn-around requirements

Guidelines for threatened species and communities

Yellow Box – Red Gum Woodland and other woodland and forest

- Maintain habitat diversity, including fallen timber, hollows, rocks and vegetative structural diversity

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- Control biomass ideally through burning, and slashing in more open areas only
- An optimal fire frequency for Box Gum woodland in ACT has not been defined.
- Avoid slashing with tractor-mounted or ride-on implements under the canopy of trees
- Slashing should be undertaken with a whipper-snipper to avoid root/trunk damage and compaction.
- Chemical application should be minimised as far as possible in YBRG
- Vehicles, plant and fuel should not be stored or parked off road or trail surfaces.
- Avoid damage to Cherry Ballart trees that provide habitat for a range of fauna and are readily killed by fire; use rake hoe lines around these plants and determine risk mitigation strategies as required.

Natural Temperate Grassland

- An optimal fire frequency for Natural Temperate Grassland in ACT has not been defined, in recommended frequency in NTG in Victoria is 2 – 3 years.
- As a general principle, biomass should be maintained at between 2 and 4 t/ha on average.
- Burns should be patchy
- After slashing there may be a requirement to remove slash to prevent changes to light, moisture and nutrients that are likely to deleteriously affect native species
- Appropriate timing of biomass reduction enables natural regeneration and maintenance of habitat

Button Wrinklewort and other rare plants

- Burns should be restricted to between April and November to avoid summer flowering and fruiting season
- Burns must be patchy and low-intensity
- No ground disturbance should occur within 50 m of known colonies.
- Undertake spot spraying and cut and daub methods of weed control within 10 m of BWW habitat
- Avoid physical damage to plants

Woodland birds

- Generally areas with shrubby vegetation should not be burnt in spring to avoid the primary nesting season
- Where spring burning is undertaken in bird habitat, patches of shrubby vegetation should be left unburnt
- As far as possible native vegetation removal operations should be minimised during spring to avoid disturbance to bird breeding

Striped Legless Lizard and other grassland lizards

- Burns should be restricted to early spring (Sept – Oct) before summer breeding, or early autumn (March – April) to ensure sufficient regrowth of vegetation before winter
- Burns must be patchy and low intensity
- Burns or slashing should be conducted during the middle of the day or evening, rather than early morning when the lizards may be cold and slow moving
- Slashing in habitat should not be undertaken below 20 cm to retain tussock structure

Golden Sun Moth

- Slashing is preferable to burning in Golden Sun Moth habitat.
- Avoid burning or slashing between November and February to avoid the adult flying season
- Burns must be patchy and low-intensity
- Slashing should not be undertaken below 10 cm

C2 Weed treatment

Weed control strategy

This strategy is based on the ACT Weeds Strategy (ACT Government 2009).

Objectives are to undertake early detection and provide rapid treatment against new problems and reduce the spread of weeds.

The priorities for removal of weeds are to:

- Treat declared pest plants (Table C.1) as a first priority
- Treat weeds on the basis of their impacts on, in order of priority
 - a) biodiversity
 - b) agricultural production and
 - c) recreational amenity.
- Treat weeds based on the degree of infestation and ease of treatment, by, in order of priority:
 - a) Eradication
 - b) Suppression
 - c) Containment

The methods of treatment are determined based on the situation where the weeds occur and methods that exist for their treatment. These include:

- a) Herbicide use
- b) Biological control
- c) Grazing management
- d) Pasture management
- e) Mechanical/physical removal

Monitoring and evaluation is required to determine how effective treatment has been and whether to undertake further treatment.

While many species have already been identified as occurring within the EMP areas, it needs to be recognised that other weeds, whether declared pest plants or that may be of biodiversity concern, may become established, and treatment should occur according to the priorities as identified above. Other woody weeds not declared pest plants that occur within the EMP areas should be treated in the same way because of their impacts on biodiversity.

It is believed that it is feasible to eradicate or suppress woody weeds in each of the areas, through herbicide treatment combined with physical removal of the woody weeds. It is to be expected that weeds will re-invade or recover through regeneration or incomplete kill of some specimens. Follow up and on-going treatment will be required.

Priorities lie in suppressing African Lovegrass, Serrated Tussock and St John's Wort and containing Chilean Needlegrass. In all cases if infestations are found of these weeds they should be eradicated when first observed (undertaking early detection and providing rapid treatment) (ACT Government 2009).

Table C1. Declared pest plants in the ACT. Weeds of National Security (WONS) are indicated.

Common Name	Scientific Name	Declaration
African Boxthorn	<i>Lycium ferocissimum</i>	Must be suppressed/ Prohibited
African Love Grass	<i>Eragrostis curvula</i>	Must be contained
Alligator Weed	<i>Alternanthera philoxeroides</i>	Notifiable/Prohibited
Athel Pine	<i>Tamarix aphylla</i>	Prohibited
Bathurst Burr	<i>Xanthium spinosum</i>	Must be suppressed
Bitou Bush/Boneseed	<i>Chrysanthemoides monilifera</i>	Prohibited
Black Alder	<i>Alnus glutinosa</i>	Prohibited
Blackberry	<i>Rubus fruticosus (aggregate)</i>	Must be contained/ Prohibited WONS*
Box Elder	<i>Acer negundo</i>	Prohibited
Bridal Creeper	<i>Asparagus asparagoides</i>	Prohibited
Broad-kernel Espartillo	<i>Achnatherum caudatum</i>	Notifiable/Prohibited
Broad-leaf privet	<i>Ligustrum lucidum</i>	Prohibited
Broom species	<i>Cytisus (ALL species)</i>	Must be suppressed/ Prohibited
Broom species	<i>Genista (ALL species)</i>	Must be suppressed/ Prohibited

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Common Name	Scientific Name	Declaration
Cabomba	<i>Cabomba caroliniana</i>	Notifiable/Prohibited
Chilean Needle Grass	<i>Nassella neesiana</i>	Must be contained/ Prohibited WONS
Cootamundra Wattle	<i>Acacia baileyana</i>	Prohibited
Cotoneaster	<i>Cotoneaster franchettii</i>	Prohibited
Cotoneaster	<i>Cotoneaster glaucophyllus</i>	Prohibited
Cotoneaster	<i>Cotoneaster pannosus</i>	Prohibited
Cotoneaster	<i>Cotoneaster simonsii</i>	Prohibited
English Ivy	<i>Hedera helix</i>	Prohibited
False Acacia	<i>Robinia pseudoacacia</i>	Prohibited
Firethorn	<i>Pyracantha angustifolia</i>	Prohibited
Firethorn	<i>Pyracantha fortuneana</i>	Prohibited
Fireweed	<i>Senecio madagascariensis</i>	Notifiable/Prohibited
Gorse	<i>Ulex europaeus</i>	Must be suppressed/ Prohibited WONS
Hawthorn	<i>Crataegus monogyna</i>	Must be contained/ Prohibited
Horsetail	<i>Equisetum species</i>	Notifiable/Prohibited
Hymenachne	<i>Hymenachne amplexicaulis</i>	Prohibited
Illyrian Thistle	<i>Onopordum illyricum</i>	Must be contained
Japanese Honeysuckle	<i>Lonicera japonica</i>	Prohibited
Kochia	<i>Kochia scoparia</i>	Notifiable/Prohibited
Lagarosiphon	<i>Lagarosiphon major</i>	Notifiable/Prohibited
Lantana	<i>Lantana camara</i>	Prohibited
Lobed Needlegrass	<i>Nassella charruana</i>	Notifiable/Prohibited
Lombardy Poplar	<i>Populus nigra 'Italica'</i>	Prohibited
Mesquite	<i>Prosopis spp.</i>	Prohibited
Mexican Feather Grass	<i>Nassella tenuissima</i>	Notifiable/Prohibited
Mimosa	<i>Mimosa pigra</i>	Prohibited
Narrow-leaf privet	<i>Ligustrum sinense</i>	Prohibited
Nettle Tree	<i>Celtis australis</i>	Prohibited
Nodding Thistle	<i>Carduus nutans</i>	Must be suppressed
Noogoora Burr	<i>Xanthium occidentale</i>	Must be suppressed
Pampas Grass	<i>Cortaderia jubata</i>	Prohibited
Pampas Grass	<i>Cortaderia selloana</i>	Prohibited
Parkinsonia	<i>Parkinsonia aculeata</i>	Prohibited
Parrot's Feather	<i>Myriophyllum aquaticum</i>	Notifiable/Prohibited
Parthenium Weed	<i>Parthenium hysterophorus</i>	Notifiable/Prohibited
Paterson's Curse	<i>Echium plantagineum</i>	Must be contained
Periwinkle	<i>Vinca major</i>	Prohibited
Pond Apple	<i>Annona glabra</i>	Prohibited
Prickly Acacia	<i>Acacia nilotica ssp. indica</i>	Prohibited
Radiata Pine	<i>Pinus radiata</i>	Must be contained
Rhus Tree	<i>Toxicodendron succedaneum</i>	Notifiable/Prohibited
Rubber Vine Saffron Thistle	<i>Cryptostegia grandiflora Carthamus lanatus</i>	Prohibited; Must be contained
Salvinia	<i>Salvinia molesta</i>	Notifiable/Prohibited
Scarlet Firethorn	<i>Pyracantha coccinea</i>	Prohibited
Scotch Thistle	<i>Onopordum acanthium</i>	Must be contained
Senegal Tea Plant	<i>Gymnocoronis spilanthoides</i>	Notifiable/Prohibited
Serrated Tussock	<i>Nassella trichotoma</i>	Must be contained/ Prohibited WONS
Service Tree, Rowan	<i>Sorbus sp.</i>	Prohibited
Slender Thistle	<i>Carduus pycnocephalus</i>	Must be contained
Slender Thistle	<i>Carduus tenuiflorus</i>	Must be contained
Spanish Broom	<i>Spartium junceum</i>	Prohibited
Spotted Knapweed	<i>Centaurea maculosa</i>	Notifiable/Prohibited
St John's Wort	<i>Hypericum perforatum</i>	Must be contained
Sweet Briar, Briar Rose	<i>Rosa rubiginosa</i>	Must be suppressed/ Prohibited

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Common Name	Scientific Name	Declaration
Tree of Heaven	<i>Ailanthus altissima</i>	Prohibited
Viper's Bugloss	<i>Echium vulgare</i>	Must be contained
Water Hyacinth	<i>Eichornia crassipes</i>	Prohibited
Water Lettuce	<i>Pistia stratiotes</i>	Notifiable/Prohibited
White Poplar	<i>Populus nigra</i> 'Italica'	Prohibited
Willow-leaf Cotoneaster	<i>Cotoneaster salicifolius</i>	Prohibited
All Willows except for the permitted species: Weeping Willow, Pussy Willow, Sterile Pussy Willow	<i>Salix</i> ALL Species of willow except for the permitted species: <i>Salix babylonica</i> , <i>Salix x calodendron</i> , <i>Salix x reichardtii</i>	Must be suppressed/ Prohibited WONS
Yellow Bamboo	<i>Phyllostachys aurea</i>	Prohibited

Guidelines for optimal treatment of selected weeds have been identified and are presented in Table C2. The green cells indicate optimal timing, the orange cells less optimal timing (MCG Weed guidelines).

Table C2. Guidelines for optimal treatment of weeds of particular concern in the EMP areas

Species	Summer	Autumn	Winter	Spring
African Lovegrass	Spray	Dig	Dig	Spray
Chilean Needlegrass	Spray	Spray	Spray	Spray
Serrated Tussock	Spray	Spray	Spray	Spray
St John's Wort	Hand pull	Spray before seed maturation	Hand pull	Spray after flowering
Periwinkle	Cut, daub	Cut, daub		Cut, daub
Cootamundra Wattle	Cut, daub	Cut, daub	Cut, daub	Cut, daub
Pine	Cut, daub	Cut, daub	Cut, daub	Cut, daub
Privet, Cotoneaster, Pyracantha, other evergreen trees and shrubs	Cut, daub	Cut, daub	Cut, daub	Cut, daub
Deciduous shrubs and trees	Cut, daub	Cut, daub		Cut, daub
Blackberry	Spray with broadleaf herbicide	Spray with broadleaf herbicide	Dig	Spray with broadleaf herbicide
Sweet Briar	Cut, daub	Cut, daub		Cut, daub

Key: Green: optimal time; orange: sub-optimal but can be effective

Methods:

Dig, hand pull: small, shallow rooted, isolated plants only.

Cutting: secateurs, hand saw or chainsaw for species that do not require chemicals: Pines and Cootamundra Wattle (except in spring).

Cut and daub: cut the plant close to the ground and immediately (within three seconds) daub (paint) the stump with suitable chemical.

Drill and fill: drill a hole or chip a notch into the cambium layer of the trunk and immediately apply chemicals. Use when the tree will be retained in place for its habitat functions until other species establish.

Spraying: spray weeds with a hand held spray bottle, backpack, suitable for larger infestations. Boom spraying is not appropriate for the four NCA conservation sites. Taskforce is recommended for introduced grasses when possible. Avoid overspraying plants as taskforce will kill native C3 grasses and Glyphosate will kill all native species except when dormant in winter (trials undertaken in the ACT indicate that Chilean Needle Grass and Serrated Tussock will respond to Glyphosate in winter).

C3 Other management guidelines

Soil management

- Do not introduce fertiliser to native grassland and woodland of high conservation value.
- Do not disturb the soil by ploughing, scarifying or dumping material.

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Slashing

- Undertake mowing to retain biomass between approximately 1.5 tonnes dry matter/ha and 3.5 t/ha (height of vegetative material between approximately 5 cm and 15 cm).
- Remove the cut grass immediately after mowing to encourage native plant establishment and growth.
- Keep trucks and machinery off areas of native grassland for loading and unloading of machinery.
- Set the height of the cutting blades to a minimum of 100 mm from ground level.
- Set rake height above ground to prevent soil disturbance.
- Avoid mowing when the ground is wet.
- Clean equipment between site visits to prevent the spread of weed seeds.
- Begin mowing in the least weedy areas and finish with the most weedy.
- Mow generally from mid-summer to late winter after plants set seed.
- Slash no more than twice a year.

Use of fire and protection from wildfire

- Burning should be undertaken at the frequency determined in ACT Government (2012).
- Burn in mosaic patches, to leave areas intact between burns.
- Burn at different times of the year and frequencies to retain heterogeneity.
- Ensure permits and conservation advice is gained before burning.
- Monitor the impacts of burns, whether wildfire or controlled.
- Incorporate knowledge gained from research and monitoring.

Weed control

- Identify the methods proposed for weed control on a site-by-site basis.
- Minimise soil disturbance and limiting fertiliser addition to reduces exotic species growth and establishment.
- Controlled weeds before the plants set seed.
- Use non-residual herbicides in preference to residual herbicides except where the properties of residual herbicides are well understood and ecologically beneficial.
- Seek advice prior to applying herbicides.
- Do not allow herbicides to enter near drainage areas and waterways including creeks, dams and wetlands.
- Spot spray in preference to broad area application, unless the outbreak is widespread and forming a monoculture.
- Hand weeding can be used where infestation levels are low. Even highly invasive weeds may be controlled if persistent hand weeding is undertaken.

Enhancement planting

- Include grasses and ideally also wildflowers indigenous to the site or threatened species already inhabiting the site, preferably collected from or near the site being revegetated.
- Undertake planting for specific purposes and on the basis of a strategic management plan.
- Do not plant native trees and shrubs in naturally treeless grasslands.
- Ensure bushfire risk is not increased by plantings: seek advice prior to selection of plants and sites.
- Following removal of woody weeds replace with native species to provide alternative bird habitat.
- Revegetation plantings must use local species according to provenance guidelines produced by Greening Australia.
- Use restoration to increase diversity of flora and of habitat (rocks, timber, vegetation structure).
- Retain dead trees where possible as these provide habitat in the form of hollows.

Access

- Minimise concentrated pedestrian use of the site, as.
- Avoid vehicle access when soil is wet;
- Avoid vehicle access when weeds are in seed.
- Maintain boundary tracks using mown strips.
- Encourage users of the site to remain mainly in areas that are of lower conservation value.
- Ensure that no materials, including soil, grass clippings, or building materials are dumped on the site.
- Ensure that the grassland is protected during any building construction by fencing in the development area to restrict spread of impacts.
- Do not add fertiliser, as this will encourage the growth of weed species.
- Prevent soil disturbance.

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- Minimise other actions that cause compaction.

Community involvement and education

- Provide opportunities for site users and visitors to participate in educational programs
- Ensure that during any site development, site workers are made aware of the conservation values of the site and how they can mitigate against impact on the grassland.
- Use educational means to encourage the use of alternative places for any activities that may impact the grassland.
- Establish a contact list of community members with interest in educational or grassland management to become involved in the conservation of the site.

C4 References

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