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Provisional Management Recommendations for York Park Moth Site

E.D. Edwards



Report to the NATIONAL CAPITAL PLANNING AUTHORITY

June 1995



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PROVISIONAL MANAGEMENT RECOMMENDATIONS FOR YORK PARK MOTH SITE.

Introduction

These management recommendations apply to the native grassland site situated in Section 22 of York Park, Barton. They have been drafted solely with a view to maintaining the population of the golden sun moth, *Synemon plana*, at this site. The conservation requirements of other invertebrates and plants which may occur at this site have not been considered in these recommendations. Background information on the moth may be obtained in Edwards (1994) and the references mentioned therein.

Recommendations

1. Invasion by weeds

This is perhaps the most imminent threat to the long term survival of the moth at the site. Introduced weeds frequently choke out native species because they can be more vigorous and taller growing. Introduced grasses which are or could be a problem on the site are: Avena spp. (Wild Oats), Bromus spp. (Brome grasses), Dactylis glomerata (Cocksfoot), Festuca nigrescens (Chewings Fesque), Holcus lanatus (Yorkshire Fog), Hordeum leporinum (Barley Grass), Lolium spp. (Ryegrasses), Phalaris aquatica (Phalaris) and Stipa neesiana (Needle Grass). There are also some herbaceous weeds which are a problem: Arctotheca calendula (Capeweed), Hypochoeris radicata (Catsear), Plantago lanceolata (Ribwort) and Trifolium spp. (Clovers). A list of the plants present on the site may be found in Davis and Hogg (1992). It is also possible for inappropriately introduced native plants to become weeds but none are currently known at the site.

Mowing

The most general management tool used in controlling introduced weeds is mowing but fire and grazing can be appropriate in some circumstances. In the case of York Park both fire and grazing are not appropriate. As the weeds grow taller and more vigorously so they are selectively disadvantaged by mowing. It is a normal recommendation for the management of natve grasslands in the ACT that they should be mowed high. Woodruff and Florence (1991) recommend a height of 75-100 mm for the sites where the Golden Sun Moth is found. Much further work is needed to determine an optimum mowing height for a *Danthonia carphoides* dominated grassland but *D. carphoides* is a particularly low growing grass (and so particularly vulnerable to weed competition) and so a lower height of mowing may well be optimal. The consistency and frequency of mowing will also be important in determining the optimum height as areas mown regularly at the same low height will tolerate low mowing better than areas mown irregularly or at different heights. It may well benefit the grassland if the height of mowing were gradually lowered to 50 mm.

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The timing of mowing is also important. The main aim is to prevent the weeds from becoming rank and shading native plants and to prevent the weeds from seeding. Timing will depend on the weeds present as some are spring growing, for example ryegrasses, cocksfoot, and some are summer growing, for example paspalum. The seasonal distribution of rainfall is also important. Paspalum is particularly susceptible to summer drought but rapidly becomes a major problem in a wet summer. In dry periods other weeds may need less frequent mowing. In the normal Canberra season most weed growth occurs in spring and mowing will be needed several times in the spring period and the area should always be mown in early November just prior to the moth's emergence. This is principally to avoid unnecessary mowing while the moths are flying, the time when they are most vulnerable to mowing. During the flight period the females are the most vulnerable to mowing because of their immobility. However if the area has not been mowed prior to emergence, perhaps because of wet weather, then mowing should proceed during the flight period rather than let the weeds become rank and seed down. The small loss of moths will be more than compensated for by the benefit to the natve plants. In a wet summer mowing will need to continue while ever the weeds are growing. In general the seeding of weeds should be prevented and mowing should be as frequent as necessary to prevent them seeding. The optimum number of times to mow each year will depend on the season but twice in spring is a minimum and it may need to continue throughout the summer. Mowing should be avoided when the ground is soft and spongy due to recent rain. If there is doubt about the frequency of mowing then it is better to mow more frequently rather than less frequently. Danthonia carphoides should seed successfully even with very frequent mowing provided the height is consistent but this may need to be watched. If mowing is infrequent then at each mowing windrows of cut grass may remain. If these windrows are thick enough to shade the Danthonia underneath then they should be removed at the time of mowing. These will also contain weed seeds so removal rather than redistribution is preferable. Stipa bigeniculata is a natural codominant at the site and it seeds on tall stems so its frequency at the site will need to be monitored to see if it declines over a long period.

*Mow at height 50mm to prevent weeds seeding and at least 3 times a year (twice in spring).

*If necessary mow even when the moths are flying.

*Do not mow when ground soft and spongy due to recent rain.

Spot spraying

This is an effective method of weed control in a small area like York Park but expensive to apply over large areas. The chemical used should not leave residues which remain in the soil. Spot spraying has been successfully carried out at the site on paspalum, phalaris and some other tussocky weeds although many of these weeds remain. Spot spraying should be continued so as to eliminate the well established tussock forming weeds. As these weeds disappear then the need for spot spraying 11

should lessen until a yearly examination should be enough. The main disadvantages of the method are the cost and the necessity that the operator be able to distinguish reliably the tussocky weeds from the native grasses.

* Spot spraying should be used against invasive tussocky weeds.

Removal by hand

This is another labour intensive method of removing selected weeds. It is more labour intensive than spot spraying but has no potential residue problems. The soil disturbance it causes should not be significant. It may be particularly useful for the removal of *Stipa neesiana*. The operator(s) must be able to reliably distinguish weeds from native species. As it is more labour intensive than spot spraying sympathetic organisations such as Friends of Grasslands may prove a useful aid.

* Hand removal should be used where this proves practicable.

Quarantine

There is little hope of preventing the appearance of some weeds not currently present at the site but some may be avoided by preventing their introduction. Obviously trees and shrubs should not be planted on the site. Native species not already present should not be introduced without a careful assessment of their impact. Plantings in areas adjacent to the site should be of drought resistant non-invasive natives and these could help to reduce invasions of weeds originating on the perimeter of the site.

* Woody species should not be planted on the site and surrounding areas should be planted with drought resistant, non-invasive natives.

Grazing

This is an alternative to mowing on large sites but is not an option on a small site like York Park within a city.

2. Changes in water regimes.

The grassland and the moths are very sensitive to changes in the moisture status of the soil. There is circumstantial evidence that moth populations are strong after a winter drought. Increased soil moisture on the site will not only encourage weed growth but may also lower the survival rate of the underground larval stage of the moth. Moisture entering the soil should come only from rain falling in the site. Any run on of water must be avoided. Peripheral plantings must be of drought resistant natives which do not need to be watered. Surrounding areas must also be well drained so that

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ponding does not occur with heavy rain. The water table should not be raised by a high input of water on surrounding areas.

- * The watertable should not be raised.
- * Drainage should be maintained or improved.
- * No run on of water should be permitted.

3. Shading

Shading may effect the soil moistue content maintaining it at a higher level longer into spring. Moister soil may adversely effect the early stages of the moth but no experimental evidence is available for this view. Moth populations do tend to be higher after a dry winter. Shading will also effect the composition of the grassland significantly favouring weed growth but the extent of the effect of several hours of additional shade per day in early spring is not known. The effect will be compounded by different grasses and weeds being affected to different degrees and so the competitive balance of the grassland may be altered. The site should not be shaded unnecessarily by planting trees or tall shrubs on the northern or western perimeter. A tolerable level of shading is not known.

- * Shading of the grassland should be avoided as far as possible.
- 4. Trampling and passage of vehicles

The passage of vehicles over the site should be prevented except where mowing is needed. The occasional passage for mowing is not a problem and there should be no hesitation to mow on account of the vehicle except when the soil is soft and soggy after rain. The occasional random passage of people walking over the site is also not a problem and the current arrangement where access is fully available to people but not vehicles on two sides has been satisfactory. However regular heavy use either for passage or sporting activities would be detrimental to the survival of the moth. Facilities and fences should be arranged so that the movement patterns of people to and from work or the bus are not channelled onto the site. Adequate clear space for sporting facilities should be provided elswhere close by so that the moth site is not in demand for that purpose. The ready availability, to the public working nearby, of information on the purpose of the site would help in this regard.

* Vehicles should be excluded from the site except for mowing.

* No vehicles should enter while the soil is soft and sodden.

* People should not be excluded from the site but measures should be taken to discourage regular use of the site for passage, sport etc.

5. Edge effects

The loss of some adult moths at the edges of the site is to be expected. Some will wander from the site and be lost and others will be killed by passing vehicles. As the female is so inactive in this species this effect is small and in any case little can be done about it. Edges are also a source of weed entry. Shading or any other effects which tend to narrow the effective size of the block are dangerous in this respect.

* Effects which tend to narrow the effective site should be particularly guarded against.

6. Fire

Fire should not be used a a management tool. The site has been unburnt for many years. The moth may well survive fire successfully but other invertebrates necessary for the health of the grassland may not. Even though the moths may survive the fire the long term effect may be detrimental as the larvae essentially feed on the underground reserves of the plants which will be mobilised in the plants' recovery after fire.

* Fire should be avoided.

7. Soil disturbance

There should be no soil disturbance at the site except where grassland sward is relocated to the site and hand weeding is carried out.

* Soil disturbance should be avoided.

8. No spoil from surrounding activities and building sites should be dumped on the site.

* No spoil should be dumped

9. No fertilizer should be applied to the site.

* No fertilizer should be applied.

10. No sowings of exotic species should occur on the site or its periphery.

* No exotic species should be sown.

11. Mulch should not be applied to the site except when used in the establishment of native species. In this case it should be free of weed seeds.

* Mulch should not be applied.

12. Public access

Within the limitations discussed in 4 above there should be public access to the site. People are more likely to be interested and respond positively to the reserved area if they can see for themselves what it contains and do not feel excluded.

* Some public access should be permitted.

13. Signposting and information

Explanations about the purpose of the site and information on its inhabitants and maintenance should be available in the surrounding buildings. An explanatory notice should be erected beside the site so as to satisfy people's natural curiosity and need for information.

* Explanations and information should be available to the public on the site and in surrounding buildings.

14.Restoration

Areas which have been heavily invaded by weeds may need to be restored following the weeds' removal or poisoning. Restoration should involve the establishment and transplanting of seedlings of species already present. The seedlings, where ever possible, should originate from seed collected on the site.

* Restoration of disturbed areas may be necessary.

15. Role of community organisations

There are several community organisations with an interest in the moth site. Notable amongst these are the Field Naturalists Club of the ACT, the National Parks Association of the ACT, Friends of Grasslands and the Society for Growing Australian Plants ACT. These groups may be interested in reseeding, seed collection, weeding and in excursions to the site to see the moth. These activities should be encouraged. In particular Friends of Grasslands may prove a valuable resource for weed removal, grassland maintenance and the establishment of seedlings of native species.

* Involvement of community organisations should be encouraged.

16 Monitoring and assessment of management

A scheme for funding and organising the monitoring of the grassland and the moth population and the periodic assessment of the success or otherwise of the management of the site should be instituted. Following the detailed population monitoring of the moth population by CSIRO Division of Entomology funded by NCPA (Cook and Edwards 1993, 1994) a less rigorous annual assessment of the moth population is probably adequate with a detailed assessment every five years. The condition of the grassland should be monitored from a botanical point of view concurrently.

* Funding and a proceedure for periodic monitoring should be established.

Comments

The recommendations presented here are based on a general knowledge of the biology, behavior and requirements of the Golden Sun Moth. Experimental work to support and substantiate this knowledge has not been attempted. While such experimental support is highly desirable it is time consuming and expensive to obtain. The most pressing limitation in knowledge is the length of the larval stage and without this information the population size on the area cannot be accurately assessed and nor can the genetic resources available. The results of experimental work commissioned by the Lowland Grassland Recovery Plan for the ACT may add to and complement these recommendation when they are available. In very general terms if a healthy *Danthonia carphoides* grassland can be maintained on the site then the moth population should remain healthy and viable. Replacement of the *Danthonia* by weeds will lead to a decline in the moth population.

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Department of Finance

Block 3, Section 22, Barton ACT

Heritage Assessment

Final

0325464 April 2016



Block 3, Section 22

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Environmental Resources Management Australia Pty Ltd Quality System

Heritage Assessment

Department of Finance

April 2016

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ACRONYMS AND ABBREVIATIONS

AHC	Australian Heritage Council
AHD	Australian Heritage Database
AHPI	Australian Heritage Places Inventory
CHL	Commonwealth Heritage List
DoE	Department of the Environment (Commonwealth)
EPBC Act	Environment Protection & Biodiversity Conservation Act 1999
ERM	Environmental Resources Management Australia Pty Ltd
Finance	Department of Finance
НА	Heritage Assessment
NES	National Environmental Significance
NHC	Natural Heritage Charter
NHL	National Heritage List
PAD	Potential Archaeological Deposit
RAO	Registered Aboriginal Organisation
The Burra Charter	The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance (Adopted 31 October 2013)

EXECUTIVE SUMMARY

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by the Department of Finance (Finance) in November 2015 to prepare an updated Heritage Assessment (HA) for Block 3 Section 22 property site located within Barton, ACT (henceforth referred to as 'the Site').

This assessment has been undertaken to meet Finance's obligations with respect to the requirements of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). This HA examines the potential Indigenous, natural and historic heritage values of the Site.

The desktop review indicated that one previous Indigenous heritage item was recorded at the Site, Barton Potential Archaeological Deposit (PAD) 1. Sub-surface testing was undertaken at this PAD site with no archaeological deposits found. A field survey undertaken by an ERM Archaeologist and ACT Representative Aboriginal Organisations (RAO) on 26 November 2015 identified that no Indigenous heritage values exist within, or in close proximity to, the Site. Comments from the ACT RAOs during this field survey indicated that the Site and surrounding area had been subjected to extensive ground disturbance and was unlikely to contain Indigenous heritage items. This assessment concluded that this site does not have Indigenous heritage values.

The potential natural heritage values of the Site do not meet Commonwealth or ACT heritage listing criteria. However, the Site contains natural features that are protected under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and the ACT Nature Conservation Act 2014. These include a Territory-listed endangered ecological community and a Commonwealth and Territory-listed endangered species. The presence of these features has some value however is not sufficient to meet the eligibility criteria for inclusion on the ACT Heritage Register or Commonwealth Heritage List.

Desktop review indicated that no previously recorded historic heritage sites had been recorded at the Site and previous heritage assessments for the Site found no historic heritage items to occur. A field survey undertaken by an ERM Archaeologist on 26 November 2015 identified no potential historic heritage items within the Site, and determined that there was a low potential for historic heritage values to occur.

The following recommendations are provided to facilitate the ongoing protection of heritage values at the Site. These recommendations are provided in relation to Finance's current ownership of the Site and its potential future divestment.

<u>Recommendation 1:</u> The Unexpected Finds Procedures for Indigenous and Historic heritage objects should be implemented for the Site (see Section 6).

<u>Recommendation 2</u>: A copy of this report should be disclosed to a future purchaser and ACT Heritage if divested from Commonwealth ownership.

<u>Recommendation 3:</u> In the event that the property is divested from Commonwealth ownership, requirements for the implementation of the Unexpected Finds Procedures (refer Section 6) should be provided to any new owners as sales clauses.

1 INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by the Department of Finance (Finance) in November 2015 to update a Heritage Assessment (HA) of the property at Block 3 Section 22 located with the suburb of Barton, Australian Capital Territory (ACT) (henceforth referred to as 'the Site').

This assessment has been undertaken in order to meet Finance's obligations with respect to the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

1.1 SITE OWNERSHIP

The Site is owned by the Commonwealth government and is part of Finance's property portfolio.

1.2 HERITAGE STATUS

The Site is not currently cited within any Commonwealth or ACT heritage lists for its Indigenous, natural or built heritage values. A 2009 Cultural Heritage Assessment (CHA) prepared for the site which included a desktop review, field survey and consultation with Representative Aboriginal Organisations (RAOs) identified one area of Potential Archaeological Deposit (PAD) within the Site (herein referred to as Barton PAD 1).

The Site includes approximately 0.4 hectares (ha) of conservation area containing a population of the Golden Sun Moth and its associated habitat of Natural Temperate Grassland, both of which are protected under the EPBC Act.

1.3 SITE LOCATION

The Site comprises approximately 1.2 ha of land at the corner of National Circuit and Sydney Avenue in Barton, ACT (refer to *Figure 1.1*). The Site is surrounded by roads and several recently constructed hotels and large high rise buildings.

1.4 OBJECTIVES

The objectives of this HA are to assess the potential Indigenous, natural and built heritage values of the Site to identify any areas that require further investigation and advise/inform any policies for managing potential heritage values in accordance with the EPBC Act.

1.5 METHODOLOGY

This HA has been prepared in accordance with the following guidelines and requirements:

- EPBC Act and Regulations requirements for the assessment of places against the Commonwealth Heritage criteria and Commonwealth Heritage Management Principles;
- The Finance HA Format;
- The Commonwealth Heritage Criteria;
- Australia ICOMOS Burra Charter 2013 The Australia ICOMOS Charter for Places of Cultural Significance;
- Ask First: A Guide to Respecting Indigenous Heritage Places and Values;
- The Australian Natural Heritage Charter for the Conservation of Places of Natural Heritage Significance;
- The former Department of Sustainability, Environment, Water, Population and Communities (now Department of the Environment - DoE) Guide: *Australia's Commonwealth Heritage – Working Together – Managing Commonwealth Heritage Places;*
- Australian Heritage Council, 2010 Identifying Commonwealth Heritage values and Establishing a Heritage Register: A Guide for Commonwealth Agencies;
- ACT Heritage Act 2004; and
- ACT Cultural Heritage Reporting Policy 2015.

To assess the potential heritage values of the Site, the following tasks were undertaken:

• *Background research:* review of historical and other relevant information pertaining to the Site was sourced from the National Archives, previous reports, and NSW Department of Lands Historic Parish Maps (which covers the ACT), vegetation, soil and geology mapping products. This information was used to formulate a historical overview of the Site and to understand its associated historic themes;

- *Database searches:* Searches of relevant heritage databases were undertaken including:
 - ACT Heritage Register for Indigenous and historic heritage sites;
 - Commonwealth Department of Environment (DoE) Protected Matters Search Tool (PMST) for ecological Matters of National Environmental Significance (MNES) e.g. threatened ecological communities (TECs) and species and migratory species listed under the EPBC Act;
- *Site inspection:* during this inspection the general site layout and physical condition of the Site features were observed;
- Assessment against heritage criteria: an individual assessment of Indigenous, natural and built heritage values was undertaken against the Commonwealth heritage criteria and the ACT heritage criteria. This included a comparative analysis of the Site's potential values in the context of the wider environment to identify the relative importance and eligibility for listing under the criteria;
- *Significance Ranking:* heritage values were ranked using the Finance Significance Ranking Guide provided in *Annex A;* and
- *Summary, Conclusion and Recommendations*: a summary statement of significance was prepared for the Site. Recommendations to assist with the ongoing protection and management of known and potential unknown heritage values of the Site are provided.

1.6 CONSULTATION

Consultation between ERM and Finance was initiated with an inception meeting 5 November 2015 and continued through the project via email and telephone correspondence.

ERM also consulted with the ACT RAOs including Buru Ngunawal Aboriginal Corporation, King Brown Tribal Group, Little Gudgenby River Tribal Council and Ngarigu Currawong Clan as part of this HA. James Mundy of Ngarigu Currawong Clan and Kristal House of Little Gudgenby River Tribal Council attended the site visit and provided input into the Indigenous heritage values assessment. Members of the King Brown Tribal Group and Buru Ngunawal Aboriginal Corporation were not available to participate in the site visit.

All groups were provided with the draft report for comment on 1 March 2016. No comments on the draft report were received.

1.7 AUTHORSHIP

The primary author of this HA was ERM Heritage Consultant Janene May. ERM Senior Ecologist Matthew Flower prepared the natural heritage assessment sections. ERM Principal Environmental Consultant, Claire Arthur, undertook a technical review of the report, and ERM Partner Alan Simonic provided the Quality Assurance review.

1.8 ACKNOWLEDGEMENTS

ERM wishes to acknowledge and thank the ACT RAOs Kristal House and James Mundy for their time and assistance in undertaking the field survey of the Site.

ERM also gratefully acknowledges the assistance provided by Finance staff members.



2 LEGISLATION

The Site is Commonwealth owned and therefore is subject to Commonwealth legislation. The primary environment and heritage legislation to be addressed in the management of the Site is therefore the EPBC Act. Finance also employs a practice of complying with State and Territory environmental policies, initiatives and legislation where these do not conflict with Commonwealth Legislation. In addition, under s.26 and s.28 of the EPBC Act, Finance is required to avoid, minimise or manage potentially significant impacts on the environment. This provision takes in the broader suite of issues listed under the EPBC Act and can include State and Territory listed species and heritage values.

2.1 STATUTORY CONSIDERATIONS

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the Act as matters of national environmental significance (NES).

The EPBC Act enables the Australian Government to join with the States and Territories in providing a national scheme of environment and heritage protection and biodiversity conservation. The EPBC Act focuses Australian Government interests on the protection of matters of NES, with the Territories having responsibility for matters of Territory and local significance.

The key parts of the EPBC Act that are of direct relevance to this HA are:

- Part 3, Division 1: Requirements Relating to Matters of National Environmental Significance;
- Section 26: Requirement for approval of activities involving Commonwealth land;
- Section 28: Requirement for approval of activities undertaken by a Commonwealth agency with the potential to have a significant impact on the environment;
- Section 183/188: Requirement to manage the environment in accordance with any management actions listed in a threat abatement plan developed to control a listed key threatening process with the potential to have a significant impact on the environment;

- Section 341S: Requirement that a Commonwealth agency must make a written plan to protect and manage the Commonwealth Heritage values of a Commonwealth Heritage place it owns or controls;
- Section 341ZC: Requirement to minimise adverse impacts on the heritage values of a place included on the National and/or Commonwealth Heritage List; and
- Section 341ZE: Requirement to provide ongoing protection of heritage values of a place included on the Commonwealth Heritage List in the event of sale or transfer.

Matters of National Environmental Significance (NES)

Part 3, Division 1 of the EPBC Act requires that actions that have, will have or are likely to have a significant impact on NES matters require approval. The NES matters are:

- World Heritage Areas;
- National Heritage Places;
- Wetlands of international importance (Ramsar wetlands);
- Listed threatened species and endangered communities;
- the Great Barrier Reef Marine Park;
- Listed migratory species;
- Nuclear actions;
- Commonwealth marine environments; and
- A water resource in relation to coal seam gas development or large coal mining development.

Under this Section of the Act, any action that will or is likely to have a significant impact on an NES matter is to be referred to the Department of Environment (DoE) for consideration by the Minister for that portfolio.

DoE administers a web-based search tool that allows a geographic search of all the species and ecological communities listed under the EPBC Act, and National and Commonwealth Heritage List places that are expected/likely to be present within a given area. This tool does not preclude Site verification.

Sections 26 and 28

Section 26 relates to actions undertaken on Commonwealth land which will, or are likely to significantly impact the environment and Section 28 relates to actions undertaken by a Commonwealth agency (such as Finance) which will, or are likely to significantly impact the environment. The term 'environment' has a broader coverage than NES matters and relates to environmental matters that are not necessarily formally listed.

The Act defines the environment as:

- a) ecosystems and their constituent parts, including people and communities; and
- b) natural and physical resources; and
- c) the qualities and characteristics of locations, places and areas; and
- d) heritage values of places; and
- *e) the social, economic and cultural aspects of a thing mentioned in paragraph (a), (b), (c) or (d).*

Any actions which will, or are likely to significantly impact the environment need to be assessed. If potentially significant impacts are identified, opportunities for their avoidance, reduction or management must be sought. A referral under the EPBC Act may also need to be considered.

Sections 183 and 188

These sections detail the listing of key threatening processes and amendment of these key threatening processes relating to listed threatened species and ecological communities.

Section 341ZC

This section of the EPBC Act requires the minimisation of adverse impacts to the heritage values of a National or Commonwealth Heritage place. This might be direct impacts from physical disturbance or could also include secondary impacts in the event of activities that would impact on the visual aspect, cultural importance, landscaping and curtilage of an adjacent listed property.

Section 341ZE

This section of the EPBC Act applies if Finance (as a Commonwealth Agency) sells or leases all or part of a Commonwealth area that is or includes part of a Commonwealth Heritage place, for example the Commonwealth Heritage List (CHL) or National Heritage List (NHL). Finance must notify the Minister for DoE of such an intent at least 40 business days prior to the transfer or sale, and include in the sale or lease contract a covenant to protect the Commonwealth Heritage values of the place during the sale process and after the property has left Commonwealth control.

Commonwealth Heritage List Criteria

A place can be included on the CHL if it is found to be significant at a National, Territory or local level for one or more of the following criteria:

- a) the place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history.
- b) the place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history.
- c) the place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history.
- d) the place has significant heritage value because of the place's importance in demonstrating the principal characteristics of:
 - i) a class of Australia's natural or cultural places; or
 - ii) a class of Australia's natural or cultural environments.
- e) the place has significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.
- f) the place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.
- g) the place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.
- h) the place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.

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i) the place has significant heritage value because of the place's importance as part of Indigenous tradition.

CHL/NHL Thresholds

DoE online heritage information provides some guidance on determining the level of heritage significance a place may have. DoE states that as well as assessing a place against criteria for its heritage value, the Australian Heritage Council applies a 'significance threshold' test. This test helps the Council to determine the level of significance of a place's heritage value by asking 'just how important are these values?'

To reach the threshold for the NHL, a place must have 'outstanding' heritage value to the nation against one or more criteria. To be entered on the CHL, a place must have 'significant' heritage value against one or more criteria. It is noted that the Australian Heritage Council's (AHC) publication *Identifying Commonwealth Heritage Values and Establishing a Heritage Register A Guideline for Commonwealth agencies* states that the threshold for inclusion on the Commonwealth Heritage List is local heritage significance (AHC 2010).

2.1.2 Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The Aboriginal and Torres Strait Islander Heritage Protection Act 1984 protects areas and/or objects which are of significance to Indigenous people and which are under threat of destruction. The Act can, in certain circumstances override State and Territory provisions, or it can be implemented in circumstances where State or Territory provisions are lacking or are not enforced. A significant area or object is defined as one that is of particular importance to Indigenous people according to Indigenous tradition. The Act must be invoked by or on behalf of an Aboriginal or Torres Strait Islander or organisation.

2.2 ACT HERITAGE ACT 2004

Although the primary heritage legislation that applies to the study area, as Commonwealth land, is the EPCB Act, it is important to consider the ACT *Heritage Act 2004*. Should responsibility for this land be divested to the ACT government, this will be the primary legislation applying to the study area.

The *Heritage Act* 2004 has been updated with new amendments in place since 30 March 2012. The Heritage Act provides for the recognition, registration and conservation of places and object of natural and cultural significance. Further, the Act details offences relating to damaging heritage, heritage directions and enforcement, obligations of public authorities, and incentives for heritage conservation.

Under Section 10 of the Heritage Act, a range of criteria for the assessment of heritage values and significance (including archaeological) have been defined. Under Section 10 of the Heritage Act *a place or object has heritage significance if the place or object meets 1 or more of the following criteria (the heritage significance criteria):*

- a) importance to the course or pattern of the ACT's cultural or natural history;
- b) has uncommon, rare or endangered aspects of the ACT's cultural or natural history;
- c) potential to yield information that will contribute to an understanding of the ACT's cultural or natural history;
- *d) importance in demonstrating the principal characteristics of a class of cultural or natural places or objects;*
- *e) importance in exhibiting particular aesthetic characteristics valued by the ACT community or a cultural group in the ACT;*
- *f) importance in demonstrating a high degree of creative or technical achievement for a particular period;*
- g) has a strong or special association with the ACT community, or a cultural group in the ACT for social, cultural or spiritual reasons;

Section 74 and 75 of the *Heritage Act 2004* makes it an offence to disturb, damage or destroy or cause or permit to be disturbed, damaged or destroyed an unregistered Aboriginal place without reasonable excuse unless that place had first been registered to the Heritage Places Register and the registration then been cancelled.

Under Section 9 of the *Heritage Act* 2004, an 'Aboriginal place' is a place of significance in Aboriginal tradition. 'Aboriginal tradition' means "traditions, observances, customs or beliefs of the people who inhabited Australia before European colonisation and include traditions, observances, customs or beliefs that have evolved or developed from that tradition since European colonisation".

Section 76 of the *Heritage Act 2004* includes administrative provisions which permit the disturbances of an Aboriginal site or place when that site or place has been registered to the Heritage Places Register with a specific conservation requirements allowing disturbance.

Section 51 of the Heritage Act 2004 requires that a person who discovers an unregistered Aboriginal place report the discovery to the council within five days. A report to the Minister can then be made through ACT Heritage.

2.2.1 ACT Heritage (Representative Aboriginal Organisations) Declaration 2006 (No 1)

Under the *Heritage Act* 2004 (Section 14), this instrument provides for the scope of consultation with declared Representative Aboriginal Organisations (RAOs).

2.2.2 Nature Conservation Act

The *Nature Conservation Act 1992* commenced on 19 December 1994. The Act is based on principles to conserve biological diversity, foster ecologically sustainable use of wildlife, ecologically sustainable development and the application of international criteria developed by the World Conservation Union (International Union for the Conservation of Nature and Natural Resources) for establishing and managing protected areas.

Natural heritage values identified at the Site were assessed under the *Nature Conservation Act*. The *Nature Conservation Act* protects native plants and animals within the ACT and provides for the management of the conservation reserve network. Native species within the ACT can be identified as threatened and protected under this Act. Two species present at the Site have been identified as critically endangered and endangered under this Act.

2.2.3 Heritage and Development in the ACT

The ordinary definition of 'development' under the *Planning and Land Management Act 1988* is broadened where the land to be developed is in an urban lease area and is registered or nominated for registration under the ACT Heritage Register. In this circumstance, any works that would affect the landscape of the land are considered to be 'development' and therefore must be considered for approval by the ACT Environment and Planning Directorate and the ACT Heritage Council, as appropriate.

For development which requires an Environmental Impact Assessment (EIA), consideration must be given to the heritage significance of the land including the surrounding land. Development applications that have potential to damage heritage items listed on the Heritage Register are sent from ACT Planning and Land Authority to the Heritage Council for advice.

While the Site remains in Commonwealth ownership, the requirements of the ACT Heritage Act provide relevant information in the event that divestment of the Site is considered in the future.

2.2.4 National Capital Plan

The National Capital Plan (NCP) is administered by the NCA and outlines planning principles and policies, standards for the maintenance and enhancement of the national capital and general aesthetic principles. The Commonwealth and ACT governments must not undertake an activity that is inconsistent with the NCP. The NCP was updated with amendments in December 2012.

2.3 NON-STATUTORY CONSIDERATIONS

2.3.1 Ask First

The Commonwealth Policy Ask First: A guide to respecting Indigenous heritage places and values provides a practical guide for land developers, land users and managers, cultural heritage professionals and many others who may have an impact on Indigenous heritage. The Ask First guidelines are considered the national best practice guidelines for cultural heritage management.

This guideline sets out principles and processes to encourage the consultation with and active involvement of Indigenous people in the identification, conservation and management of Indigenous Cultural Heritage. In particular, the document emphasises that Indigenous people should be the determinants of the significance of places in accordance with their culture. A copy of *Ask First* can be accessed at:

www.environment.gov.au/heritage/ahc/publications/commission/books/a sk-first.html.

2.3.2 National Heritage Charter

The Natural Heritage Charter (NHC) provides best practice guidance for the conservation and management of natural heritage values in Australia. It provides a framework for making appropriate decisions for managing and restoring natural heritage values based on ecological processes which occur in natural systems and provides a process that can be used to support and implement local, State and Territory, national and international policies, agreements, strategies and plans. A copy of the charter can be accessed at: www.environment.gov.au/heritage/ahc/publications/commission/books/publs/australian-natural-heritage-charter.pdf.

2.3.3 The Burra Charter

The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance (Adopted 31 October 2013) (The Burra Charter) sets a standard of practice for those who provide advice, make decisions about, or undertake works to places of cultural significance including owners, managers and custodians.

The Charter provides specific guidance for physical and procedural actions that should occur in relation to significant places. A copy of the 2013 charter can also be accessed at: <u>http://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf.</u>

2.3.4 National Trust

The National Trust is a community-based, non-government organisation, and has no statutory power. The National Trust has been gathering information about heritage places in Australia for decades. This list contains individual buildings, precincts, natural environment places or culturally significant artefacts. Inclusion on the National Trust Heritage List does not provide any legal protection for a place, nor does a listing place the owner of a listed property under any legal obligation. The National Trust of ACT Heritage list is recognised as an authoritative statement of the significance of particular places and is held in high esteem by the public. The National Trust also has an advisory role, regularly lobbying all levels of government regarding sensitive heritage issues for communities across the Territory.

2.3.5 The Register of the National Estate

The Register of the National Estate (RNE) is an archive of important natural, Aboriginal and historic places throughout Australia. The RNE is maintained on a non-statutory basis as a publicly available archive and educational resource.

3 SITE BACKGROUND

The following Chapter provides an environmental and heritage background to the Site.

3.1 SITE DESCRIPTION

3.1.1 Setting

The Site consists of a cleared block situated on Sydney Avenue in Barton, Canberra. The Site is surrounded be large high rise buildings, including the recently constructed hotel at the north-west corner of the Site. Four trees are located within the south-west border of the Site and a line of trees are present along the Sydney Avenue border and north-west border of the Site. A pedestrian access track (Windsor Walk) also runs along the north-west border of the Site. Views to and from the Site are limited due to surrounding development.

3.1.2 Geology and Soils

The Site is situated on the Canberra Formation from the Wenlock period of the Early Silurian. The Smc deposit of the Canberra formation underlying the Site is described by (Abell 1992) as consisting of mudstone, siltstone, minor sandstone, limestone, hornfels, dacitic, ignimbrite and volcaniclastic sediments.

Soils at the Site were examined and described by Navin Officer during subsurface testing of Barton PAD 1 (Navin Officer 2010). Soils were described as:

The soil profiles were generally characterised by a natural stratigraphy with gradual and regular transitions from a brown or grey-brown clay loam to an orange or yellowgrey gravelly clay, indicative of a decomposing bedrock layer. However, the test pits in the north-eastern area (e.g. Pits 3-5) were characterised by a very thin A horizon, which has been interpreted as evidence of previous land surface modification that has resulted in removal of substantial portions of the upper sections of the soil profile (Navin Officer 2010:7).

3.1.3 Topography and Landforms

The western portion of the Site is slightly raised with underlying fill. The Site dips within the eastern portion of the Site.

3.1.4 Hydrology

The Site is situated approximately 800 m south of Lake Burley Griffin which runs into the Molonglo River approximately 2 km to the north-east. Prior to development of the Site a small creek ran east-west through the central portion of the Site.

3.2 INDIGENOUS HERITAGE

Results of an ACT Heritage Register search were received on the 23 November 2015. This search revealed that there are no previously recorded Indigenous heritage objects within the Site. However, 52 Indigenous heritage sites have been previously recorded within the Barton area and surrounding suburbs. Further details pertaining to the regional Indigenous heritage archaeological record are provided in *Section 4.4*.

3.3 HISTORIC HERITAGE

Based on the desktop information reviewed and the field survey, the Site comprises a cleared lot surrounded by large buildings, roads and a pedestrian access track to the north-west. No buildings, structures or areas of historic interest were identified within the site (based on desktop information and the field survey). The Site has been historically used for agricultural purposes. Desktop information and the field survey identified a potential former garden shed within the north-west corner of the Site.

3.4 NATURAL HERITAGE

Substantial survey and maintenance effort has been undertaken to understand and manage the Natural Temperate Grassland (NTG) and Golden Sun Moth (GSM) population at the Site since the early 1990s (Umwelt 2014). Most recently, vegetation condition assessment and GSM monitoring occurred in 2014 (Umwelt 2015).

Umwelt (2014) notes the north-western part of the Site appears to have received fill material (during nearby development) and is dominated by exotic species (Umwelt 2014). The eastern portion of the Site however, known as York Park, contains an area of approximately 0.5 ha of NTG (endangered under the *Nature Conservation Act* (NC Act) and EPBC Act) and a population of GSM (critically endangered under the EPBC Act and endangered under the NC Act).

Surveys of GSM and NTG undertaken in 2013 and 2014 report the vegetation and habitat values of the Site are relatively stable, and that a population of GSM persists at the Site. The conservation value, and relative level of disturbance to the Site, was assessed using the criteria presented in the *ACT Lowland Native Grassland Conservation Strategy* (ACT Government 2005). Based on this assessment, the NTG was assigned:

• a Botanical Significance Rating of 4 (Low), as the species present at the Site include species moderately tolerant of disturbance; and

• a Conservation Rating of 2 (Complementary Conservation Site), as, despite the low Botanical Significance Rating, the Site provides habitat for a threatened species that is considered viable in the medium term (Umwelt 2014)..

In addition to the NTG and GSM, active burrows of the uncommon Canberra Raspy Cricket (*Cooraboorama canberrae*) were recorded at the Site in 2006 and 2007, however the burrows or other signs of the species were not observed during 2013 surveys (Umwelt 2014). The species has a restricted distribution within the ACT and nearby parts of NSW, and occurs only in relatively undisturbed grasslands (Umwelt 2014).

Details of natural heritage features present at the Site are provided below. These features are assessed for their heritage value in *Section 5.2* of this report.
4 HISTORICAL BACKGROUND

This chapter outlines the history of the Site and the surrounding region.

4.1 PREHISTORY

Archaeological evidence suggests that Aboriginal people had occupied all of Australia's environmental zones by 31 000 years before present (BP) (Flood 1995: 286). Ethnographic information relating to the Aboriginal occupation of the study area has been obtained predominantly from historical documentation written by early European settlers and government officials during the mid to late 18th century (Barwick 1984).

Australian Aboriginal people occupied land according to a system of spatial organisation and land occupancy (Clark 1990: 11-14). Individual groups were intimately familiar with their own geographical regions and the seasonal availability of resources within it. Tribal boundaries were often defined through linguistic associations, social relations, and spiritual links to the land. These boundaries were most likely fluid, changing position over time. If this was the case, then tribal boundaries recorded by European people at, or after, the point of contact can only be considered as current to that period and were probably quite different prior to European observation. To make things more ambiguous, the few European accounts of Aboriginal groups in the broad study region are limited in detail, often confused in regard to Aboriginal group names and give varying interpretations of territorial boundaries (Flood 1980: 2).

In general, early settlers recorded very little of their observations, particularly in regard to the Aboriginal people they encountered (Flood 1980: 26). The best recorded observations come from the journals of early explorers, government surveyors and authors of travel books. By the early 1840s, Currie, Bennet, Lhotsky, Backhouse, and George August Robinson had each recorded small amounts of detail regarding the Aboriginal people within a broad region surrounding the study area. These records are not detailed and by the 1880s, when more serious ethnographers came into the region, the consequences of European settlement had already greatly altered the traditional Aboriginal way of life (Flood 1980: 26).

As far as can be ascertained, the Aboriginal groups living permanently in the Canberra region spoke different, but related languages (all most likely associated with the dominant Ngarigo) (Cooke 1988: 33; Flood 1980: 194). Aboriginal people in the broader Canberra district are associated collectively within the Ngunawal boundaries (refer to *Figure 4.1*). These people are thought to have lived in small, highly mobile, kin-based groups.

Individual groups came together regularly to participate in trade, marriage and ceremonial gatherings.

An early ethnographic account from Bennett (1834: 173) records their diet as including flying squirrel, kangaroo, wallaby, wombat, koala, possum, emu, duck, swan, snake, goanna, platypus, ant eggs, insects, fish, mussels, yabbies, plant tubers, berries and seeds.

Currently, four Aboriginal groups are representative of the Australian Capital Territory region. These groups are:

- Buru Ngunawal Aboriginal Corporation;
- King Brown Tribal Group;
- Little Gudgenby River Tribal Council; and
- Ngarigu Currawong Clan.



Figure 4.1 Tribal boundaries of the Canberra and wider region (after Tindale 1974).

4.2 HISTORICAL DEVELOPMENT

The first documented case of Europeans visiting the Canberra/Queanbeyan region is in 1820 when Charles Throsby passed through the area in search of the Murrumbidgee River. In locating the Murrumbidgee River, Throsby and his party followed the river to the Queanbeyan River and further into the eastern part of the Canberra region (Cross 1985).

The Site is located within land that originally formed part of the Campbell's Estate. This section briefly describes the Campbell family and the nature of their Estate.

4.2.1 Duntroon Estate and the Campbell Family

The land on which the Site is situated was first owned in the European sense, by the Campbells (a European family) in 1824. Robert Campbell was a Sydney merchant who, whilst conducting services for the government, lost his ship – the 'Sydney'. As compensation, he was awarded a land grant in the Canberra Queanbeyan region, known as 'Pialligo' (ERM 2005). At its height (as a sheep grazing estate) Campbell's land holdings encompassed 32,000 acres, had 27 workers cottages, including 'The Oaks Estate', Blundell's Cottage, several stables, an apple shed, an apiary, a dairy, and a woolshed.



Figure 4.2 Extract from 1832 Parish Map Showing Campbell's Land Holdings. Approximate location of the Site is circled in red. (Source ACT Land Titles Office).

Campbell advertised for tenant farmers to work his estate. The tenant farmers were given a house and an area of land to farm, with a portion of each crop going to Campbell (Saunders 2004: 11). Campbell's main overseer, James Ainslie, found the land on the banks of the Molonglo River to be excellent for livestock grazing. This was most probably the first European use of land associated with the Site.

In 1833, Campbell contracted stonemasons from Sydney to construct a homestead from local stone on his Estate, approximately 2.5 kilometres southeast of Site. This homestead was named Duntroon House (*Figure 4.3*). During this early period of European settlement, the area was considered remote and did not attract development. In 1834, the Polish naturalist, John Lhotsky, described Robert Campbell's house as being at the end of the world and declared that he was heading into a 'land with no government'. The house was used as a residence for the Campbell family until 1903, when Robert Campbell's wife Marianne died, and the remaining family moved away. The house remained vacant from 1903 to 1910. In 1910 a lease was taken by the Commonwealth Government for two years which covered the homestead and 374 acres of surrounding land. On this land the Royal Military College of Australia was established in 1911, and continues to operate as an active officer training facility (ERM 2005).



Figure 4.3 The Campbell family at Duntroon House 1870 (Image Courtesy of the ACT Heritage Library Image Number: 006888).

By 1913, the Commonwealth for the Federal Capital Territory resumed Portion 36 as part of their plan for the development of Canberra. By this time a few substantial houses had been built within the Canberra area such as Duntroon, Acton and Yarralumla. However, most of the regions early houses were basic arrangements built with rough wooden frames and earthen walls. As far as could be ascertained, no housing or other structures associated with the Campbell's ownership were built on the Site.

4.2.2 The Nation's Capital

The search for a location to house the nation's capital took place between 1902 and 1908. Forty already settled districts were proposed, 23 of these were inspected by an official party who then narrowed the choice to seven. Albury, Bombala, Lake George, Lyndhurst, Tumut, Dalgety and Queanbeyan-Canberra were all examined closely, particularly with regard to water supplies, climate and landforms suitable for the building of a 'garden city'. In 1908, the Queanbeyan-Canberra area was selected as capable of fulfilling all requirements, and 2,368 km² were set aside as the Australian Capital Territory (ACT), with a separate coastal area selected at Jervis Bay for access to the sea.

Charles Scrivener, Surveyor-General selected the most suitable area of the ACT for the construction of a city. He chose the broad flood-plain of the Molonglo River, 550 metres above sea-level with additional land to the north and south, including two lines of hills on the north side rising 300 metres above the plain.

An international competition for a city plan was launched in 1911 and attracted 137 entries. First prize was awarded to American landscape architect Walter Burley Griffin (*Figure 4.4*). Griffin's plan laid out a city for a population of 25,000 people, with flexibility to expand to 75,000 people. The plan for the Nation's capital was heavily influenced by the natural topography and setting of the area (Vernon 2002). Griffin's plan for the Nation's capital was largely centred on one key design concept, the 'Parliamentary Triangle', comprising three 'nodes' or zones connected by major roadways (refer *Figures 4.5, 4.6,* and *4.7*). The three nodes included the military node at the eastern apex, the civic node at the western apex and the parliamentary node at the south.

After the First World War, under the guidance of the Federal Capital Advisory Committee, the construction of Canberra progressed. Road and sewerage developments continued, tree plantings were carried out, and the construction of a temporary Parliament House was completed in 1926. Shops were built at Civic, Manuka and Kingston, and offices, hostels and houses were completed for 1,100 public servants (Hutchison 2000).



Figure 4.4 One of Walter Burley Griffin's 1913 Plans for Canberra (Source: NAA Series A1, 1917/7242)



Figure 4.5 Close-up of Griffin's plan, showing Parliamentary Triangle (defined in black) and site of East Lake and East Lake Park (Source: NAA Item 7013065)

Shortages during the Depression, Second World War and post-war slowed the development of Canberra, with only a small number of national projects, such as the Australian War Memorial (1941) and the Australian-American Memorial (1954), being completed.



Figure 4.6 1950 Aerial Photograph of the Parliamentary Zone. The planning for the Parliamentary Zone is clearly apparent (Source: ACT Land Titles Office).

4.2.3 National Capital Development Commission

In April 1957, Australian Parliament established the National Capital Development Commission (NCDC) to plan and continue the development of Canberra. John Overall, a distinguished Army Officer and architectural designer, was appointed the first Commissioner of the newly established NCDC. In this role, Overall made a significant contribution to the development of Canberra. With Overall as Commissioner of the NCDC, the general administration of the ACT lay with the Department of the Interior.

Upon completion of the new Parliament House in 1988 (which was built by the Parliament House Construction Authority, not the NCDC) and the introduction of self-government to the ACT, the Government concluded that the Commission's role was no longer needed. The NCDC was abolished in 1989 and most of its functions and staff transferred to the new ACT Government. A new National Capital Planning Authority (NCA) was established to represent the Commonwealth's interest in the future planning and development of the national capital. (History section of the NCA website: nationalcapital.gov.au accessed 10 January 2013).

4.2.4 Block 3 Section 22 Barton

Aerial photography and parish maps show the Site has not been developed. The Site originally formed part of Robert Campbell's estate as described above, and was used for agricultural purposes during this time, refer to Figure 4.7.



Figure 4.7

1882 Parish Map showing the location of the Site (NSW Department of Lands).

The development of Canberra commenced following World War I, with the construction of Parliament House completed in 1926. Development of shops, offices, hostels and houses followed in surrounding areas. The Site appears to have remained cleared during this time and throughout the 20th century as surrounding development occurred.



Figure 4.8 1964 aerial photograph showing the approximate location of the Site (National Library of Australia Picture nla.pic-an14324452-54).

4.3 USES AND PROCESSES

A timeline for the historical events associated with the Site is provided in *Table 4.1*.

Table 4.1Historical timeline for the Site and local region

Date	Activity or Event
Pre-	Ngunawal people travelling through the region, utilising resources on the annual
European	gatherings for moth hunting and initiation ceremonies.
settlement	
1830s	Pastoral settlement of the region, large areas of land granted to and purchased by
	Robert Campbell. Introduction of sheep farming.
1910s	Walter Burley Griffin wins design competition for the new Federal Capital.
	Construction of Canberra begins.
1926	Parliament House established and development commences in areas surrounding the Site.
1960s	Site still comprises a cleared lot, development of surrounding area increase.
2015	Site has been established as 'York Park' and is surrounded by large buildings and roads.

ARCHAEOLOGICAL BACKGROUND

4.4

The Site was surveyed by Navin Officer Heritage in 1992 as part of a wider archaeological assessment of the York Park development area. No cultural heritage sites were identified during the 1992 assessment. A former compound and shed were identified to be potentially located within the northwestern corner of the Site but currently located underneath a layer of fill.

Navin Officer also prepared a Cultural Heritage Assessment (CHA) of the Site in 2009. The CHA was undertaken to determine the potential impacts to heritage values of a proposed new office building at the Site, and the associated divestment of the property. The CHA included a desktop assessment, a field survey and consultation with the ACT RAOs. Desktop assessment for the Site indicated that no Indigenous or historic heritage sites had been previously recorded within the study area. A field survey of the Site identified no Aboriginal or historic heritage objects or places within the Site, however one area of PAD was identified (Barton PAD1) (refer to *Figure 4.9*).

This site was described as:

One of the last remaining relatively undisturbed areas within Barton and the Parliamentary Triangle.

Old aerial photographs and a 1992 survey indicate that the area has never been developed and that the drainage line present on the site is an original feature. The PAD includes that grassland reserve.

It is considered that the area has moderate potential to contain relatively undisturbed subsurface archaeological deposits and for these deposits to be of moderate archaeological significance. The site is therefore assessed as having moderate archaeological potential (Navin Officer 2009).

A program of archaeological test excavation was recommended to be undertaken at Barton PAD1 prior to any land disturbance.



Figure 4.9 Barton PAD 1 (yellow) (Adapted from Figure 7.2 of Navin Officer 2009).

The 2009 CHA provided the following recommendations:

- A program of archaeological test excavations should be conducted within Barton PAD 1 prior to any land surface disturbance relating to development of the site. The PAD is located in a Designated Area, and as a consequence, approval to conduct the archaeological test excavations should be sought and gained from the NCA.
- A copy of this draft report should be provided to each of the RAOs for input and comment (Navin Officer 2009).

Navin Officer (2010) subsequently undertook archaeological sub-surface testing of the Barton PAD 1 site. A total of nine test pits were dug across the Barton PAD 1 site (refer to *Figure 4.10*). Results of the sub-surface excavation indicated that the location was relatively undisturbed. However, no Indigenous heritage objects were found during the excavation. Navin Officer (2010) determined that this area was unlikely intensely utilised by Indigenous people in the past, however, the area may have been used for movement through country, hunting and gathering or similar activities that can result in extremely low or negligible densities of artefactual material.



Figure 4.10 Location of test pits dug at Barton PAD 1 (Figure 5.1 in Navin Officer 2010).

Navin Officer (2010) concluded that while the landform and aspect of the Barton PAD 1 site conforms to predicted areas suitable for human occupation, the distance to water sources and other features in the landscape has resulted in very little or no archaeological evidence is now present. Based on results of the sub-surface testing, Navin Officer (2010) recommended that:

- No further archaeological assessment is required in relation to the area of Aboriginal archaeological potential at Barton PAD 1.
- Any development within the PAD1 area should adhere to the stop work procedures as defined in the Unanticipated Discovery Plan provide in Appendix 5 (of Navin Officer 2010).

4.4.1 ACT Heritage Database Searches

A search of the ACT Heritage Register indicates that there are currently no Indigenous heritage sites recorded within the Site. Barton PAD 1 was recorded by Navin Officer in 2009 during a field survey. However, subsequent sub-surface testing of the PAD in 2010 found no archaeological deposits at this location (Navin Officer 2010).

The ACT Heritage Register search revealed 52 Indigenous heritage sites previously recorded within the Barton area and surrounding suburbs. These sites predominantly consist of stone artefact sites including stone artefact scatters and isolated finds. The spatial distribution of these sites shows a concentration of stone artefact sites within proximity to water sources including Lake Burley Griffin and the Molonglo River and on footslopes of Black Mountain and Mount Ainslie. Numerous scarred trees have also been identified approximately 4.5 km south of the Site within gently sloping open valley depression.

The nearest recorded site on the ACT Heritage Register is OPH1, a hatchet and boomerang found 100 m west of Old Parliament House. OPH1 is located approximately 1 km north-west of the Site.

4.5 PREDICTIVE MODEL

Information obtained relating to the environmental context of the Site, regional archaeological patterning and ethnographic information has enabled a set of parameters to be established which can be used to predict the potential location of Indigenous heritage sites across the wider region. These parameters are:.

- Indigenous sites are most likely to be stone artefact sites.
- Stone artefact sites are most likely to occur within 400 m of a permanent water course, although smaller creeks may have associated artefact scatters, particularly if near to larger water courses.
- Surface expressions of artefacts are most likely to be found on raised level or gently sloping ground associated with the crest or shoulder of a ridge line, and on flats associated with river valleys.
- Scarred trees (with an Aboriginal cultural origin) could occur on mature trees.
- Obvious local landscape features, such as spur lines or flat elevated terrain, could provide a suitable camping position and view point across the generally flat region.
- Flood (1980) has suggested that there appears to be a preference in the Canberra region for locations away from cold air drainage, sheltered from prevailing winds, with an easterly or north-east outlook.
- Human burials are rare, but if present would most likely be in the alluvial 'slope wash' soils that make up the study area's flood plain, creek and river terraces or found in recesses within rock outcrops.

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The knowledge gained from examining landforms, geology, the regional archaeological pattern, and prior archaeological reports have enabled a set of parameters to be established to predict the potential location of Indigenous sites within the Site. Predictions for Indigenous heritage sites to occur within the Site are:

- Indigenous sites are most likely to be stone artefact sites.
- As no mature trees are present at the Site, no scarred trees are expected to occur.

Based on historical use of the Site, previous survey results and sub-surface test excavation it is considered that there is an overall low potential for Indigenous heritage sites to occur.

4.6 SITE INSPECTION RESULTS

The Site was inspected by ERM Archaeologist Janene May, ERM Ecologist Matthew Flower, James Mundy of Ngarigu Currawong Clan and Kristal House of Little Gudgenby River Tribal Council on 26 November 2015. No Indigenous or historic heritage items were identified during this site inspection. The Site was covered in grass and ground surface visibility was poor. Due to results of previous archaeological investigations (Navin Officer 2009; 2010), disturbance at the site and conversations with RAOs, it is considered that the Site has a low potential to contain unknown heritage items.



Photograph 4.1 View of the Site looking north (ERM 2015).

ASSESSMENT OF HERITAGE SIGNIFICANCE

The Site has been assessed for its Indigenous, natural and historic heritage values against the CHL and ACT Heritage criteria. The CHL heritage criteria are provided in *Table 5.1*. The CHL values have been ranked using Finance Significance Ranking Guide provided in *Annex A*. The ACT Heritage Assessment Policy was used to provide further guidance on assessments against the ACT heritage criteria.

Table 5.1CHL Significance Criteria

5

Criterion	Description
a	the place's importance in the course, or pattern, of Australia's natural or cultural history;
b	the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;
с	the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history;
d	the place's importance in demonstrating the principal characteristics of:
	i) a class of Australia's natural or cultural places; or
	ii) a class of Australia's natural or cultural environments;
е	the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
f	the place's importance in demonstrating a high degree of creative or technical achievement at a particular period;
g	the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
h	the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history; and
i	The place's importance as part of Indigenous tradition.

The ACT heritage significance criteria are outlined in the *Heritage Act* 2004. These criteria are provided in *Table 5.2*. In order to be entered into the ACT Heritage Register a place must meet at least one of these criteria.

Table 5.2ACT Heritage Significance Criteria

Criterion	Description
a	importance to the course or pattern of the ACT's cultural or natural history;
b	has uncommon, rare or endangered aspects of the ACT's cultural or natural history;
с	potential to yield information that will contribute to an understanding of the ACT's cultural or natural history;
d	<i>importance in demonstrating the principal characteristics of a class of cultural or natural places or objects;</i>
e	<i>importance in exhibiting particular aesthetic characteristics valued by the ACT community or a cultural group in the ACT;</i>
f	importance in demonstrating a high degree of creative or technical achievement for a particular period;

Criterion	Description
g	has a strong or special association with the ACT community, or a cultural group in the ACT for social, cultural or spiritual reasons;
h	has a special association with the life or work of a person, or people, important to the history of the ACT.

5.1 INDIGENOUS HERITAGE ASSESSMENT

The assessment of the Indigenous heritage significance of the Site has been undertaken in accordance with the Commonwealth *Ask First: A guide to respecting Indigenous heritage places and values* and with Finance's HA template.

5.1.1 Description

Background research has indicated that one PAD has been previously recorded within the Site (Barton PAD 1). However, sub-surface testing of this PAD yielded no archaeological deposits (Navin Officer 2010). No Indigenous heritage sites were recorded during the ERM 2015 field survey. The Site was observed to be highly disturbed and unlikely to contain any unknown Indigenous heritage objects or places.

5.1.2 Archaeological Potential

The results of the field survey, coupled with an understanding of local and regional Aboriginal site patterning, permits the designation of zones that potentially hold archaeological deposits (PADs). PAD areas can be defined as locations where the possibility of discovering new Aboriginal sites exists (on the surface or in subsurface contexts). The archaeological potential is based upon three measures:

- the statistical likelihood of finding a site (based upon a background understanding such as predictive modelling);
- the condition of the area (the condition of the natural materials within the study area); and
- the integrity of sites (how much the study area has been disturbed since it was created).

A basic ranking system can be applied - high, moderate, low or no potential. No areas of archaeological potential were identified during the field survey.

5.1.3 *Comparative Analysis*

No Indigenous heritage sites are known to occur within the Site and a comparative analysis is therefore not required.

5.1.4 Assessment of Indigenous Heritage Significance

Although considered to have a low potential, unknown Indigenous heritage values could still be present within the Site. Discussions with James Mundy of Ngarigu Currawong Clan and Kristal House of Little Gudgenby River Tribal Council during the field survey and previous archaeological research indicate that Indigenous heritage sites found across the general region demonstrate the use of the wider landscape by Indigenous people in the past.

An assessment of the Indigenous heritage values of the Site against the CHL criteria is provided in *Table 5.3*.

Table 5.3Indigenous heritage assessment against the CHL criteria

Criteria	ERM Assessment	Finance Ranking
а	There are no known Indigenous heritage sites within the Site. Due to the extensive level of disturbance to the Site, it is considered that there is a low potential for unknown Indigenous heritage objects to occur. Criterion not met.	None
Ь	There are no known Indigenous heritage sites within the Site. Due to the extensive level of disturbance to the Site, it is considered that there is a low potential for unknown Indigenous heritage objects to occur. Criterion not met.	None
С	Due to the extensive level of disturbance to the Site, the potential for the Site to yield Indigenous heritage objects that may contribute to an understanding of Australia's cultural history is low. Further, subsurface testing undertaken of the identified PAD site yielded no archaeological deposits. Criterion not met.	None
d	The Site does not contain any known Indigenous heritage objects or places that demonstrate principal characteristics of a class of cultural places or environments. Criterion not met.	None
е	The Site does not contain any known Indigenous heritage objects or places that exhibit aesthetic qualities valued by a community or cultural group. Criterion not met.	None
f	The Site does not contain any known Indigenous heritage objects or places that demonstrate a high degree of creative or technical achievement. Criterion not met.	None
8	The Site does not contain any known Indigenous heritage objects or places that have a special or strong association with the Indigenous community. Criterion not met.	None
h	The Site does not contain any known Indigenous heritage objects or places that have a special association with the life or works of a person or group of persons of important in Australia's cultural history. Criterion not met.	None

Criteria	ERM Assessment	Finance Ranking
i	There are no known Indigenous heritage objects or places within the Site that are of importance as part of Indigenous tradition. Due to the high level of disturbance at the Site, the potential for unknown Indigenous heritage objects to occur is considered to be low. Criterion not met.	None

Table 5.4 presents an assessment of the Indigenous heritage values of the Site against the ACT heritage significance criteria.

Table 5.4Indigenous heritage assessment against the ACT criteria

Criteria	ERM Assessment
a	There are no known Indigenous heritage sites within the Site. Due to the extensive level of disturbance to the Site, it is considered that there is a low potential for unknown Indigenous heritage objects to occur. Criterion not met.
b	There are no known Indigenous heritage sites within the Site. Due to the extensive level of disturbance to the Site, it is considered that there is a low potential for unknown Indigenous heritage objects to occur. Criterion not met.
с	Due to the extensive level of disturbance to the Site, the potential for the Site to yield Indigenous heritage objects that may contribute to an understanding of Australia's cultural history is low. Criterion not met.
d	The Site does not contain Indigenous heritage objects or places that demonstrate principal characteristics of a class of cultural places or environments. Criterion not met.
е	The Site does not contain Indigenous heritage objects or places that exhibit aesthetic qualities valued by a community or cultural group. Criterion not met.
f	The Site does not contain Indigenous heritage objects or places that demonstrate a high degree of creative or technical achievement. Criterion not met.
g	The Site does not contain Indigenous heritage objects or places that have a special or strong association with the Indigenous community. Criterion not met.
h	The Site does not contain Indigenous heritage objects or places that have a special or strong association with the Indigenous community. Criterion not met.

NATURAL HERITAGE ASSESSMENT

Background research indicated the eastern portion of the Site contains a Territory and Commonwealth-listed endangered ecological community, and a population of the endangered GSM (Umwelt 2014).

5.2.1 Natural Features of the Site

5.2

This section describes the natural features of the Site in these broad categories:

- Ecosystems;
- Vegetation (including TECs/EECs);
- Flora (including threatened species); and
- Fauna (including threatened species).

Ecosystems

The Site is a grassland in an urbanised area.

Vegetation

Two general vegetation assemblages are present at the Site, described in *Table 5.5* and shown in *Figure 5.1*.

Table 5.5Vegetation assemblages recorded during the ERM field survey

Vegetation Assemblage	Description	Listing Status
Exotic grassland with scattered non-native trees	This vegetation occurs on the north western half of the Site. It is dominated by non-native perennial grasses and has abundant non-native legumes (clovers) and other non-native herbs. Scattered non-native trees present include Rowan (<i>Sorbus domestica</i>), Black Alder (<i>Alnus</i> glutinosa) and Ash (<i>Fraxinus angustifolia</i>).	-
Native Grassland	The eastern half of the Site is a mostly native grassland that provides habitat for the threatened invertebrate species: GSM (<i>Synemon plana</i>).	This vegetation on the Site meets the criteria of Natural Temperate Grassland as listed under the NC Act and EPBC Act.



Flora Species

The western half of the Site is dominated by introduced grasses, legumes and herbs and the eastern half is dominated by native grasses. No threatened flora species were observed during the ERM Site assessment and no records of threatened flora were identified through database searches.

Fauna Species

The Site contains a known population of GSM, described further in Annex B.

Natural Features Summary

The natural features of the Site include:

- An area of native grassland that constitutes NC Act-listed endangered ecological community, Natural Temperate Grassland; and EPBC Act-listed threatened ecological community, Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT;
- a population of Golden Sun Moth (critically endangered under the EPBC Act; endangered under the NC Act); and
- previous records of burrows of the uncommon Canberra Raspy Cricket (*Cooraboorama canberrae*), however these have not been recorded since 2007 (Umwelt 2014).

5.2.2 Assessment of Natural Heritage Significance

The assessment of natural heritage significance against the CHL criteria and ACT heritage assessment criteria are presented in *Table 5.6* and *Table 5.7*.

5.2.3 *Comparative Analysis*

A comparative analysis for natural heritage values of the Site is provided in *Annex B*. The Golden Sun Moth (critically endangered under the EPBC Act and endangered under the NC Act) and Natural Temperate Grassland (endangered under the *Nature Conservation Act* (NC Act) and EPBC Act) have been identified at the Site.

The comparative analysis presented in *Annex B* has found that extensive populations of the GSM are present at Majura Training Area, Canberra International Airport and the Belconnen Naval Station. Large, intact and protected areas of known GSM populations or key habitat in the ACT include Crace Nature Reserve (136 ha in area), Dunlop Nature Reserve (82ha in area) and Mulangarri Nature Reserve (69 ha in area) (Act Government 2005; Environment ACT 2006a). Other populations, although less extensive, are present at 'Woden' in the Jerrabomberra Valley, Mulanggari Grassland Reserve (Gungahlin) and Crace Grassland Reserve (Gungahlin).

The Site is identified as a 'smaller site' of GSM. Comparative analysis has found that the Site is not a significant example of GSM and that there are better examples of larger populations in other parts of the ACT.

Large, intact and protected areas of known NTG in the ACT include >400 ha of NTG in the Gungahlin Grassland Reserves (Crace Nature Reserve, Mulangarri Nature Reserve and Gungaderra Nature Reserve) and Dunlop Nature Reserve (ACT Government 2005; Environment ACT 2006b). The *ACT Lowland Native Grassland Strategy* (ACT Government 2005: 55) states that in the ACT there are 47 native grassland sites, of which there are 11 sites greater than 100 ha in size. Eight of those 11 sites contain NTG in moderate to good condition and are greater than 50 ha in size (ACT Government 2005: 55). Comparative analysis has found that better examples of larger NTG remnants exist in other parts of ACT

A detailed comparative analysis supporting these conclusions is provided in *Annex B*.

CHL Criteria	ERM Assessment	Finance Ranking
(a) The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history.	The eastern portion of the Site provides for the continued breeding of a critically endangered invertebrate, the GSM, in an otherwise urban environment. However, as other GSM populations persist in other parts of the ACT, New South Wales and Victoria (refer <i>Annex B</i>), the Site is not considered to have significant natural heritage value. Criterion not met	None
(b) The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history.	The Site contains an area of grassland, identified as endangered at a Territory and Commonwealth level, and a population of the nationally critically endangered (EPBC Act) GSM. This combination of a critically endangered species and native grassland is rare in the context of the urban Canberra environment, however occurs in numerous other locations within and outside the ACT (refer <i>Annex B</i>). Due to the existence of numerous other GSM populations in Australia, and in consideration of the small extent of GSM habitat at the Site (0.5ha), the presence of the critically endangered GSM at this location is not considered to have significant natural heritage value. Criterion not met	None
(c) The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or	The GSM population at the Site has been the subject of past studies and is the subject of ongoing monitoring. These studies have the potential to reveal important information relating to the species' life cycles and habitat requirements. However, this is not considered to be a significant natural heritage value, as other places can yield the same kind of information. Refer to <i>Annex B</i> for a more detailed comparative analysis against this criterion.	None

Table 5.6 Natural heritage assessment against the CHL criteria

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CHL Criteria	ERM Assessment	Finance Ranking
cultural history.	Criterion not met	
 (d) The place has significant heritage value because of the place's importance in demonstrating the principal characteristics of: (i) a class of Australia's natural or cultural places; or (ii) a class of Australia's natural or cultural 	While the native vegetation at the Site demonstrates the characteristics of NTG, the Site has been modified from its natural state due to fragmentation from other patches caused by neighbouring urban development leading to reduced grass and herb diversity. It is expected that more representative examples of this community are available in the surrounding region. Criterion not met	None
environments.		
(e) The place has significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.	The Site is typical of the surrounding agricultural landscape and is not considered to provide significant aesthetic value. Criterion not met	None
(f) The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.	Not relevant to natural heritage values. Criterion not met	None
(g) The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural, or spiritual reasons.	No evidence was identified to suggest an association between the natural features of the Site and any community group. Criterion not met	None
(h) The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, or importance in Australia's natural or cultural history.	No such association has been identified. Criterion not met	None

CHL Criteria	ERM Assessment	Finance Ranking
 (i) The place has significant heritage value because of the place's importance as part of indigenous tradition. 	No such association has been identified. Criterion not met	None

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Natural heritage assessment against the ACT Heritage Assessment Criteria

Criteria	ERM Assessment
(a) importance to the course or pattern of the ACT's cultural or natural history	The eastern portion of the Site demonstrates continuity of the breeding of a critically endangered invertebrate, the GSM, in an otherwise urban environment. However, the GSM is known to occur and breed at a number of locations throughout ACT, and, due to the isolated context of GSM habitat at the Site, the Site is not considered to provide an important example of the continuity of this process. In addition, the Heritage Assessment policy indicates that places already protected under the NC Act do not warrant protection under the <i>Heritage Act 2004</i> , and therefore, the Site does not meet this criterion. Criterion not met
(b) has uncommon, rare or endangered aspects of the ACT's cultural or natural history	The Site contains an area of NTG (endangered under the NC Act and EPBC Act) and a population of GSM (endangered under the NC Act and critically endangered under the EPBC Act). This combination of a critically endangered species and ecological community is rare in the context of the urban Canberra environment, however is not uncommon in the broader ACT and a detailed comparative analysis demonstrates that the Site does not meet the eligibility for this criterion. Criterion not met
(c) potential to yield information that will contribute to an understanding of the ACT's cultural or natural history	The GSM population at the Site has been the subject of past studies and is the subject of ongoing monitoring. These studies have the potential to reveal important information relating to the species' life cycles and habitat requirements. However, this is not considered to be a significant natural heritage value, as the information is readily available from other sites of GSM populations within NTG. Criterion not met
(d) importance in demonstrating the principal characteristics of a class of cultural or natural places or objects	While the native vegetation at the Site demonstrates the characteristics of NTG, the Site has been modified from its natural state due to fragmentation from other patches caused by neighbouring urban development leading to reduced grass and herb diversity. It is expected that more representative examples of this community are available in the surrounding region. Criterion not met
(e) importance in exhibiting particular aesthetic characteristics valued by the ACT community or a cultural group in the ACT	The Site is typical of the surrounding agricultural landscape and is not considered to provide significant aesthetic value. Criterion not met

Criteria	ERM Assessment
(f) importance in demonstrating a high degree of creative or technical achievement for a particular period	Not relevant to natural heritage values. Criterion not met
(g) has a strong or special association with the ACT community or a cultural group within the ACT for social, cultural or spiritual reasons	No evidence was identified to suggest an association between the natural features of the Site and any group of people. Criterion not met
(h) has a special association with the life or work of a person, or people, important to the history of the ACT.	No such association has been identified. Criterion not met

5.3 HISTORIC HERITAGE ASSESSMENT

5.3.1 Description

The Site was historically part of a land grant to Robert Campbell. The area surrounding the Site was developed throughout the 20^{th} century commencing with the construction of Parliament House in 1926. The Site is situated on one of Burley Griffins' major axes, which later became Sydney Avenue (refer to *Figure 4.4*). It appears that there were no specific plans to establish the Site as an open space as part of Burley Griffins' plan of the Canberra area (refer to *Figure 4.4*).

The area remained a cleared lot and is now established as York Park. The Site is now surrounded on all sides by development including large hotels and multi-storey buildings. It remains one of the few open spaces within the heavily developed Barton area.

Based on the desktop information reviewed and the field survey, there is no known evidence of this history present within the Site. Based on the history of the Site, there would be potential for sheds or domestic structures and artefacts to be located within the area, however no evidence of former structures was identified by the field survey.

5.3.2 Comparative Analysis

No historic heritage values are known to occur within the Site. The Site has been identified has having potential scientific and research values for its natural heritage values. Comparative analysis of natural heritage values is provided in *Annex B*. This analysis demonstrates that the Site has been extensively utilised for scientific research and has been the subject of ongoing monitoring. These studies have potential to yield information relating to life cycles and habitat requirements of the GSM and information pertaining to NTG. The Site is located within an urban environment and is therefore easily accessible for scientific research. However, several other locations within Canberra and the wider ACT afford opportunity for scientific research and provide more intact, larger examples of the GSM and NTG which are also accessible (refer to *Section B.2* of *Annex B*).

5.3.3 Assessment of Historic Heritage Values against the CHL Criteria

An assessment of the historic heritage values of the Site against the CHL criteria is provided in *Table 5.8*.

Table 5.8Historic heritage assessment against the CHL Heritage criteria

Criteria	ERM Assessment	Finance
		Ranking
а	There is no known evidence of the 19th century land-holders	None
	remaining on site. Historic parish maps do not indicate the presence	
	of any structures located within the site, and it is considered that it	
	was likely utilised for grazing. The Site is situated on one of Burley	
	Griffins' major axes, which later became Sydney Avenue however it	
	appears that there were no specific plans to establish the Site as an	
	open space as part of Burley Griffins' plan of the Canberra area. The	
	site does not provide a significant insight into the course of	
	Australia's cultural history.	
	Criterion not met	
Ь	The desktop review did not identify any aspects of the site with	None
	importance to Australia's natural history.	
	Criterion not met	
С	The site is unlikely to yield information relevant to an understanding	None
	of Australia's natural history.	
	Criterion not met	
d	The Site is highly modified from its natural state and does not	None
	demonstrate the principal characteristics of a class of Australia's	
_	cultural places.	
	Criterion not met	
е	The Site is one of the few remaining open spaces within the heavily	None
	developed Barton area. However, it does not exhibit particular	
	aesthetic characteristics valued by a community group.	
	The Site does not contain any assets with significant architectural	
	qualities.	
	The Site is situated on one of Burley Griffins' major axes, which later	
	became Sydney Avenue, however there were no specific plans to	
	establish the Site as an open space as part of Burley Griffins' plan of	
	the Canberra area	
	Criterion not met	

Criteria	ERM Assessment	Finance Ranking
f	The Site does not exhibit any features of technical or creative	None
	achievement.	
	Criterion not met	
8	There is no evidence to suggest the place has a strong association with	None
	a particular group of people.	
	Criterion not met	
h	There is no evidence to suggest the place has a special association	None
	with a particular person or group of people.	
	Criterion not met	
i	This criterion is not applicable to historic heritage.	None
	Criterion not met	

5.3.4 Assessment of Historic Heritage Values against the ACT Significance Criteria

An assessment of the built heritage values of the Site against the ACT Heritage criteria is provided below in *Table 5.9*.

Table 5.9

Built heritage assessment against the ACT Heritage criteria

Criteria	ERM Assessment
a	There are no known historic heritage sites within the Site. Due to the extensive level of disturbance to the Site, it is considered that there is a low potential for unknown historic heritage objects to occur. Criterion not met.
b	There are no known historic heritage sites within the Site. Due to the extensive level of disturbance to the Site, it is considered that there is a low potential for unknown historic heritage objects to occur. Criterion not met.
с	Due to the extensive level of disturbance to the Site, the potential for the Site to yield historic heritage objects that may contribute to an understanding of Australia's cultural history is low. Criterion not met.
d	The Site does not contain historic heritage objects or places that demonstrate principal characteristics of a class of cultural places or environments. Criterion not met.
e	The Site does not contain historic heritage objects or places that exhibit aesthetic qualities valued by a community or cultural group. Criterion not met.
f	The Site does not contain historic heritage objects or places that demonstrate a high degree of creative or technical achievement. Criterion not met.
g	The Site does not contain historic heritage objects or places that have a special or strong association with local community. Criterion not met.
h	This criterion is not applicable to built heritage.
	Criterion not met.

5.4 ASSESSMENT OF SIGNIFICANCE

A significance assessment of the Indigenous, natural and historic heritage values of the Site has been undertaken against the CHL and ACT significance criteria, as provided in the sections above. The Site is not known to contain historic heritage values at a Commonwealth, Territory or local level.

The natural heritage values of the Site do not meet Commonwealth or ACT heritage listing criteria, however the presence of a Territory-listed endangered ecological community and a Commonwealth and Territory-listed endangered species, present some ecological values.

The Site has not been found to have heritage values that meet thresholds of the CHL or ACT heritage significance criteria and a Statement of Significance is therefore not required.

6 RECOMMENDATIONS

The following recommendations are provided for the future management of the Site.

6.1 INDIGENOUS HERITAGE

This HA has found that there are no known Indigenous heritage objects or places within the Site, and the Site has a low potential to contain unknown Indigenous heritage sites. Consultation with the ACT RAOs has further confirmed that the Site has a low potential to contain Indigenous heritage objects or places. However, there is still potential Indigenous heritage values may occur within the Site. It is recommended that in the event that Indigenous heritage objects are found within the Site, an Unexpected Finds Procedure should be implemented. An Unexpected Finds Procedure is provided in *Section 6.1.1* of this report. This procedure has included steps for the Site while it is Commonwealth owned, and in the event that it is divested.

6.1.1 Indigenous Heritage Unexpected Finds Procedure

If any heritage sites, as protected under ACT legislation, are uncovered at the Site, then the following steps should be followed:

- all activity in the immediate area should cease;
- an appropriately qualified heritage professional should be consulted;
- the DoE should be notified; and in the event that the Site is divested, ACT Heritage should be immediately contacted;
- local ACT RAOs should be notified; and
- an appropriately qualified heritage professional should record the location and attributes of the Site and determine the significance of the find.

In the event of the discovery of human skeletal material (or suspected human skeletal material) in the Site the following steps should be followed:

- all activities and/or works in the immediate area must cease;
- the DoE should be contacted while the Site is under Commonwealth ownership, and in the event that the Site is divested, ACT Heritage and ACT RAOs should be contacted; and
- any sand/soils removed from the near vicinity of the find must be identified and set aside for assessment by the investigating authorities.

6.2 HISTORIC HERITAGE

This HA has found that there are no known historic heritage objects or places within the Site, and the Site has a low potential to contain unknown historic heritage sites. However, there is still a chance historic heritage values may occur within the Site. It is recommended that in the event that historic heritage objects are found within the Site, an Unexpected Finds Procedure should be implemented. An Unexpected Finds Procedure is provided in *Section 6.3.1* of this report.

6.2.1 Historic Heritage Unexpected Finds Procedure

In the unlikely event that evidence of former structures, or other artefacts are found during the proposed works the steps outlined below should be followed.

Historic heritage items could include or archaeological features. It is not considered likely that archaeological deposits will be found however the following steps are provided below in the event that deposits are found.

- where a potential historic heritage item is found during works, all works within the vicinity of the item, or with the potential to impact the item should cease and a temporary exclusion zone established;
- an appropriately qualified heritage consultant should examine the item to assess its significance and further archaeological potential; and
- where a suspected historic heritage item is found, the DoE should be notified while the Site is under Commonwealth ownership, and in the event that the Site is divested, ACT Heritage should be notified. Approval will likely be required prior to the continuation of works. Other archaeological deposits should be recorded and assessed for significance and potential salvage by an appropriately qualified heritage consultant.

6.3 DIVESTMENT RECOMMENDATIONS

In the event that the Site is divested it is further recommended that:

- This report is disclosed to any future landowners; and
- Clauses should be included in sales contracts for the protection of any unknown heritage values present at the Site (including the Unexpected Finds Protocol).

REFERENCES

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Finance Significance Ranking Guide





Significance Ranking For Commonwealth Heritage Listed Properties

Ranking significance assists with identifying management priorities in the first instance. Ranking also assists with determining if a property meets the threshold for inclusion on the Commonwealth Heritage List (CHL). The criteria state that a place needs to have "significant" value in order to meet one or more criterion.

Ranking of significance is also a tool to be used in the development of management recommendations, maintenance priorities and long term planning decisions. Secondarily, they can be used in support of funding and resource allocations.

Therefore, ranking is a critical component underpinning specific management planning development.

The significance rankings described here are divided into three categories – Item, Precinct/Group and Intangible. These categories are based on our experience with large and complex sites and with managing European, Indigenous and Natural values. This allows a more meaningful use of ranking when:

- a) Comparing of individual items and precincts within the site itself (ie multiple items which may have varying degrees of significance based on their context, integrity and condition);
- b) Comparing a property with other similar sites (eg two buildings of comparable significance at 2 different sites may have settings of differing significance, thereby allowing a clearer comparison and more informed and secure basis for the overall ranking);
- c) Identifying CH values across the site and making management recommendations specific to those defining qualities;
- d) Providing a context to the ranking where an element may be contributory rather than significant as an individual item. This underpins management of the item as a part of a larger context and assists in prioritising maintenance resources.

The values identified can then either be managed under the CH provisions or broader environmental requirements of the *Environment Protection and Biodiversity Conservation Act* (EPBC Act) depending on whether the CH threshold has been met. We find that this system allows us to be more



specific about why a place has value, which in turn helps us to develop more targeted management methods.

The ranking system has been developed in reference to the ICOMOS, Burra Charter, World Heritage Guidelines, Ask First Guideline for Indigenous places and the Natural Heritage Charter. We have included "universal" level ranking for identifying potential national or World Heritage values.

The tables below outline the categories and ranking levels for built and Indigenous values (Table 1) and natural values (Table 2).


Table 1 Summary of Significance Rankings for Built and Indigenous Heritage

Ranking	Justification – Item	Justification – Precinct/Group	Justification – Intangible
Universal (only to be used for World Heritage Sites)	Monuments: architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of outstanding universal value from the point of view of history, art or science;	Groups of buildings: groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of outstanding universal value from the point of view of history, art or science;	Sites: works of man or the combined works of nature and man, and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological point of view.
Exceptional	The item is a demonstrably rare, outstanding and / or an irreplaceable example of its type. It has a high degree of intact and original fabric that is readily interpreted. Loss or alteration would substantively undermine the Commonwealth heritage values of the place overall.	The precinct/group demonstrates collective characteristics that are rare or unique in Australia Precinct/group is intact and readily interpreted Loss, alteration or removal of component elements would substantially undermine the CH values of the place overall	The site represents significant social, cultural, natural and/or mythological values that may not be embodied in any physical item but which demonstrate unique, iconic markers in Australia's past or ongoing dynamic histories and / or processes.
High	The item demonstrates a rare example of its type Is largely intact and interpretable Loss or unsympathetic alteration may diminish the Commonwealth Heritage values of the item and of the place overall	The precinct/group demonstrates a rare example of collective characteristics or features physically linking or defining the space Precinct/group is largely intact and interpretable Loss, unsympathetic alteration or removal of component elements or defining qualities may detract from the CH values of the precinct/group and of the site overall	The site represents important social, cultural, natural and/or mythological values that may not be embodied in any physical item but which demonstrate rare points in Australia's past or ongoing dynamic histories and / or processes.
Moderate	The item may have altered or modified elements Item is intact enough to be partially interpretable as a single item or as part of the site in its entirety Loss or unsympathetic alteration is likely to diminish the	Precinct/group demonstrates valuable (although modified) collective characteristics and linking/defining spatial qualities Precinct/group intact enough to be interpreted as a discrete space or as part of the site overall Loss, unsympathetic alteration or	The site represents social, cultural, natural and/or mythological values that may not be embodied in any physical item but which demonstrate points in Australia's past or ongoing dynamic histories and / or

	Commonwealth Heritage values of the item and potentially the place if inappropriately managed	removal of component elements or defining qualities may detract from the CH values of the precinct/group and potentially of the site overall if inappropriately managed	processes.
Low	The item may be largely altered Does not demonstrate the key defining qualities of the CH values, but may be contributory Alteration and / or modification may make it difficult to interpret the item depending on the existing integrity of the item Loss may not diminish the Commonwealth Heritage values of the place overall.	Precinct/group demonstrates some (but possibly largely altered) collective characteristics and/or linking/defining spatial qualities Precinct/group not easily interpreted and represents unclear spatial definition in relation to the rest of the site Loss, alteration or removal of component elements may not detract from the CH values of the place overall	The site represents some social, cultural, natural and/or mythological values that may not be embodied in any physical item but which demonstrate points in the site's history, associative values and/or historical themes.
None (Does not meet CHL criteria)	Item does not reflect or demonstrate any Commonwealth heritage values	Precinct/group does not reflect or demonstrate any CH values	The site represents no social, cultural, natural or methodological themes or values
Intrusive	Potentially detracts from the overall Commonwealth heritage values of the place as an intrusive element. Loss may actually contribute to the Commonwealth Heritage values of the place.	Precinct/group potentially detracts from the interpretation and understanding of the site overall Loss, alteration or removal of component elements actually contribute to the CH values of the place overall	N/A
	The item is an intrusive element in the heritage values of the place in its entirety		

Table 2 Summary of Significance Ranking for Natural Heritage Values

Significance Ranking	Justification – Natural
Universal (only to be used for	Natural features consisting of physical and biological formations or groups of such formations, which are of outstanding universal value from the aesthetic or scientific point of view;
World Heritage Sites)	Geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals and plants of outstanding universal value from the point of view of science or conservation;
	Natural sites or precisely delineated natural areas of outstanding universal value from the point of view of science, conservation or natural beauty.
Exceptional	The species, area or ecosystem demonstrates individual or collective characteristics that are rare or unique in Australia
	Species, area or ecosystem is in high level of health, condition and integrity
	Loss, alteration or removal of component elements would substantially undermine the CH values of the place overall
High	The species, area or ecosystem demonstrates a rare example of individual or collective characteristics or features physically linking or defining space
	Species, area or ecosystem is largely intact and in good state of health
	Loss, damage or removal of components or defining qualities may detract from the CH values of the area or ecosystem and of the site overall
Moderate	Area or ecosystem demonstrates valuable (although modified) qualities
	Intact enough to be interpreted as a discrete space or as part of the site overall with ability to be regenerated
	Loss, damage or removal of component elements or defining qualities may detract from the CH values of the area or ecosystem and potentially of the site overall if inappropriately managed
Low	Species, area or ecosystem demonstrates some (but possibly largely altered) defining qualities
	Area or ecosystem not in a good state of health and regeneration in doubt
	Loss, alteration or removal of component elements may not detract from the CH values of the place overall
None (Does not meet CHL criteria)	Species, area or ecosystem does not reflect or demonstrate any CH values
Intrusive	Loss, alteration or removal of component elements actually contribute to the CH values of the place overall

Annex B

Natural Heritage Comparative Analysis

B.1 INTRODUCTION

This annex presents a comparative analysis of natural heritage values of the Site, focussing on three criteria of particular importance (note that wording here is from the ACT criteria):

- (b) The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history.
- (c) The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history.
- (g) The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural, or spiritual reasons.

Assessment of natural heritage values is conducted at both the scales of the Commonwealth and the ACT, however the detailed analysis provided here relies heavily on the guidance of the ACT Heritage Assessment Policy (ACT Government 2015). The ACT Heritage Assessment Policy provides highly detailed explanations of the eligibility criteria, and is explicit in its guidance of what should meet the eligibility criteria for each criterion. The ACT and Commonwealth heritage listing criteria are both derived from the HERCON (Heritage Convention) criteria, a standard set of heritage significance criteria agreed to by all Australian jurisdictions, and therefore analysis between the two contexts is very similar.

B.2 CRITERION (B) - HAS UNCOMMON, RARE OR ENDANGERED ASPECTS OF THE ACT'S CULTURAL OR NATURAL HISTORY (ACT GOVERNMENT 2015; P15)

B.2.1 Explanatory Note

The relevant part of the ACT Heritage Policy 'explanatory notes' (ACT Government 2015; p15) regarding this criterion states that it applies to, "places which provide a significant habitat for qualifying native species (i.e. rare, threatened, uncommon, at limits of range etc.) or places which are important in the life cycle of a qualifying native species not normally resident in the ACT" (ACT Government 2015; p15).

B.2.2 Relative Importance Against Explanatory Note

The discussions below focus on the potential for the Site to 'provide a significant habitat' for GSM and NTG. The second part of the explanatory note above does not apply, as both the GSM and NTG are resident within the Site.

The analysis was undertaken relying on the following sources of information:

- The Act Lowland Native Grassland Strategy (Act Government 2005);
- GSM Information Sheet (Environment ACT 2006a); and
- NTG Information Sheet (Environment ACT 2006b).

Golden Sun Moth

Environment ACT (2006a) states that the extensive populations of this species are present at Majura Training Area, Canberra International Airport and the Belconnen Naval Station. Other populations, although less extensive, are present at 'Woden' in the Jerrabomberra Valley, Mulanggari Grassland Reserve (Gungahlin) and Crace Grassland Reserve (Gungahlin). York Park is listed amongst a number of other 'smaller sites'. The stated threats to the species include that relevant to York Park which is the loss of habitat due to urban development. A number of conservation actions are identified, the most relevant of which being to "seek protection of key habitat known to support viable populations of the species" (Environment ACT 2006a; p2).

Large, intact and protected areas of known GSM populations or key habitat in the ACT include Crace Nature Reserve (136ha in area), Dunlop Nature Reserve (82ha in area) and Mulangarri Nature Reserve (69ha in area) (Act Government 2005; Environment ACT 2006a).

Section 3.5 of the *ACT Lowland Native Grassland Strategy* (the 'Grassland Strategy') (ACT Government 2005) assesses the conservation value of ACT's native grasslands and provides a categorisation of sites based on their ecological value. The three categories into which native grasslands are categorised in descending ecological value are:

- Category 1: Core Conservation Sites
- Category 2: Complementary Conservation Sites
- Category 3: Landscape and Urban Sites

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York Park is categorised into Category 2. Category 2 generally includes those sites exhibiting a greater level of disturbance than the Category 1 'core' sites or those that do not contain key threatened species habitat. Category 2 sites may contain threatened species habitat that is <u>not key habitat</u> (defined as being of medium-long term viability (>50 years)) (ACT Government 2005; p56), however may complement core conservation grassland by providing habitat and/or a buffer (ACT Government 2005; p58). Category 2 sites are further categorised into four sub-categories:

- rural sites;
- near-urban sites;
- sites with threatened species, but not containing key habitat for those species;
- isolated urban sites [of reasonable botanical significance].

York Park is listed in the third sub-category: 'sites with threatened species, but <u>not containing key habitat</u> for those species'.

Section 3.4.6 of the Grassland Strategy discusses the key characteristics of the ACT grassland sites. Of importance to understanding the relative ecological value of York Park is fragmentation of the grassland remnants. The Grassland Strategy states that grasslands remaining in central Canberra (such as York Park) have occurred by chance due to the setting aside of area for "*public institutions and government offices… in the Central National Area of Canberra*" (ACT Government 2005; p55). Those remaining have a highly fragmented distribution (ACT Government 2005; p55). Some, such as York Park, "*exist in an extensive matrix of developed land uses with no possibility of restoring connectivity*" (ACT Government 2005; p55). York Park is an isolated remnant within a highly modified urbanised landscape.

Due to its isolation, York Park is likely in Category 2 because of the GSM presence, rather than providing a buffer that complements areas of higher conservation significance. The categorisation of York Park in the Grassland Strategy can therefore be understood to be based solely on the presence of the GSM. The Grassland Strategy identifies that the GSM presence at York Park is not key habitat and is therefore, by definition, not likely to be viable over a timeframe of >50 years. Due to surrounding land uses and urban development, the opportunity to increase the presence of favourable habitat to the species (identified as of major conservation significance to this species) is not possible beyond modest increases (in the order of 0.1-0.2ha).

York Park is grouped geographically in the Grassland Strategy in the 'Central Canberra and Tuggeranong' sites, and is one area measuring 0.4ha of the 12 remnants totalling 37ha in area. The Grassland Strategy concedes that, "*Restoring ecological connectivity between [grassland] remnants is impossible*" (ACT Government 2005; p68). Of these 12 remnants, seven contain the GSM (including York Park) and York Park is the smallest.

The analysis concludes that York Park is not <u>significant habitat for qualifying</u> <u>native species</u> (the GSM) because it:

- does not contain key habitat i.e. does not contain a viable GSM population in the medium-long term; and
- is isolated with no possibility of restoring connectivity (therefore can't provide complementary conservation purposes).

Natural Temperate Grassland

Large, intact and protected areas of known NTG in the ACT include >400ha of NTG in the Gungahlin Grassland Reserves (Crace Nature Reserve, Mulangarri Nature Reserve and Gungaderra Nature Reserve) and Dunlop Nature Reserve (ACT Government 2005; Environment ACT 2006b). The Grassland Strategy states that in the ACT there are 47 native grassland sites, of which there are 11 sites greater than 100ha in size (ACT Government 2005; p55). Eight of those 11 sites contain NTG in moderate to good condition and are greater than 50ha in size (ACT Government 2005; p55). There are 808ha of NTG in the ACT (equalling 81% of that remaining) that are categorised in the Grassland Strategy as 'Core Conservation Sites' (Category 1) (ACT Government 2005; p59).

Most of the discussion included above in the GSM section regarding the Grassland Strategy categorisation of the York Park grassland as Category 2: 'Complementary Conservation Sites' is relevant not only to the GSM but also to the NTG as they are treated in the Grassland Strategy complementarily. The Grassland Strategy identifies that York Park is of low long-term viability and is isolated with no chance of restoring connectivity (ACT Government 2005; p55-6). As an urban grassland site in the 'Central Canberra and Tuggeranong' group, it is one area measuring 0.4ha of the 12 grassland remnants totalling 37ha in area (of which, all twelve grassland remnants contain NTG which measure 35.8ha in total). Previous grassland monitoring using a relative metric measure of botanical diversity have ranked the Botanical Significance of York Park as 'low' (i.e. a score of 4 on a scale of 1-5 where 1 is highly significant and 5 is of low significance) (Umwelt 2014).

The analysis concludes that York Park is not <u>significant habitat for qualifying</u> <u>native species</u> (NTG) because it:

- does not contain key habitat;
- the botanical significance is relatively low (Umwelt 2014); and
- is isolated with no possibility of restoring connectivity (therefore can't provide complementary conservation purposes).

B.2.3 Relative Importance against Inclusion Guidelines

Table B.1 presents the relevant inclusion guidelines under this criterion (ACT Government 2015; p15) and a statement against each.

B.2.4 Conclusion for Criterion (B)

The discussion presented above, and in *Table B.1* identifies that neither the GSM population nor NTG area at the York Park Site are of sufficient importance to qualify for inclusion under criterion (b).

Inclusion Guideline ^{1,2}	Clarifying Information ¹	Statement for GSM	Statement for NTG
It is the only and/or the only extant example within the ACT with integrity or authenticity	1	No; discussion above identifies other populations of the GSM in the ACT.	No; discussion above identifies other large areas of NTG in the ACT.
Few examples <u>of its kind</u> exist because the original population of examples has decreased due to destruction	T	No; discussion identifies that the York Park population is not viable in the medium-long term and is isolated. Other, more substantial populations (in size) and with greater long term viability exist in the ACT.	No; discussion identifies that the York Park does not contain key habitat, its botanical significance is relatively low and it is isolated. Other, more substantial NTG (in size) and with greater quality exist in the ACT.
It has a mix or composition of features which is rare or uncommon in ACT	Rarity and uncommonness is judged in context of similar places in ACT. Rarity and uncommonness in one location compared with abundance in another location may not be automatically eligible. A rare, uncommon or endangered place must have sufficient integrity to be able to demonstrate those qualities. 'Endangered' is not as the ecological sense, but defined as that the place/object has become so rare over time that there is a risk in the short to medium term that no such item will remain.	No; GSM is uncommon/rare, however discussion above identifies that York Park is not a significant example and that better examples of larger populations exist in other parts of ACT. Also, that it is one of seven urban populations in the ACT is not enough to meet this criteria because the relative abundance elsewhere must be considered and despite being an endangered species, some large, extensive and well-protected populations occur in other parts of ACT outside the Central Canberra region. The integrity is not high (the discussion above identifies that the GSM population has low viability). Considering larger, well-protected populations in reserves, the loss of York Park population will not likely lead to a loss of the GSM.	No; NTG is uncommon/rare, however discussion above identifies that York Park is not a significant example and that better examples of larger NTG remnants exist in other parts of ACT. Also, that it is an urban occurrence of NTG in the ACT is not enough to meet this criteria because the relative abundance elsewhere must be considered and despite being an endangered ecological community, some large, extensive and well- protected areas occur in other parts of ACT outside the Central Canberra region. The integrity is not high. Considering larger, well- protected NTG communities in reserves, the loss of the York Park NTG would not likely lead to a loss of the NTG.
 Taken from ACT Government (2015; Only relevant inclusion guidelines h 	p15). ave been discussed here.		

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B.3 CRITERION (C) – POTENTIAL TO YIELD INFORMATION THAT WILL CONTRIBUTE TO AN UNDERSTANDING OF THE ACT'S CULTURAL OR NATURAL HISTORY (ACT GOVERNMENT 2015; P18)

B.3.1 Explanatory Note

The relevant part of the ACT Heritage Policy 'explanatory notes' (ACT Government 2015; p18) regarding this criterion states that it applies to, "places and objects that have the potential to provide substantial information that will contribute to our knowledge and understanding of significant aspects of the natural... history of the ACT". The explanatory notes state further that the criterion applies not to sites where a significant body of information has already been gathered, but that the site must contain the potential to yield further information and that any site is relatively more important if it is the only known source of information (ACT Government 2015; p18). The 'inclusion guidelines' state that,

"The place or object must itself be important to the understanding and not simply replicate or confirm evidence provided by other similar places... Every Aboriginal and historic site and every natural area has the possibility of contributing some evidence, but not all have the potential to yield important or substantial information." (ACT Government 2015; p18)

B.3.2 Relative Importance against Explanatory Note

The eligibility of York Park's GSM and NTG features are analysed for this criterion considering the identified relative importance of the features in the context of the ACT. Umwelt (2014) identify that the Site has been subject to a large amount of ecological studies, particularly for the GSM population including studies focussed on population dynamics and genetic studies for more than 20 years (Umwelt 2014; p6). There is no doubt that the GSM and NTG of York Park have yielded significant scientific information in the past as is described in Umwelt (2014) the Site has been subject to studies for more than 20 years. It is not likely that these various studies have occurred in York Park because it is the only or best available occurrence of these features, but perhaps due to convenience being located in the National Capital District of Canberra. It is not asserted that the Site has no further potential to yield information regarding GSM or NTG, however, according to the explanatory notes for this criterion, a site must essentially provide information that can't be gained from other areas or examples of its type to be eligible for listing under this criterion.

Table B.2 and *Table B.3* demonstrate that there are GSM and NTG sites present in conservation reserves and areas managed for conservation purposes, as well as a number present in areas of other land use.

There are 474ha of Core Conservation Sites (Category 1 sites) on Territory Land that are protected in four publicly accessible reserves in the ACT (ACT Government 2005; p57). There are a further five Category 1 sites, totalling 479ha, that are on National Land that are managed under Memoranda of Understanding (ACT Government 2005; p57). These Category 1 sites are significantly larger than York Park and contain GSM populations and NTG communities that are likely to better represent areas and populations less impacted by development, and are therefore likely to contain more potential to yield important or substantial information regarding these natural heritage values.

Site ¹	Conservation Category ^{1,2}	Land Use ^{1,2}
Majura Valley		
Majura Valley East (Airport)	1	Airport
'Malcolm Vale'	2	Rural Lease
Campbell Park	1	Defence
Majura West	1	Rural Lease
Jerrabomberra Valley		
Harman-Bonshaw South	1	Defence, Rural Lease
Gungahlin Valley		
Gungaderra Nature Reserve	1	Reserve
North Mitchell	2	Vacant
Belconnen		
Dunlop Nature Reserve	1	Reserve
Lake Ginninderra	2	UOS
Central Canberra and Tuggeranong		
CSIRO Headquarters	2	CSIRO
Constitution Avenue, Reid	2	UOS
St John's Church, Reid	2	Urban Lease
ACCC, Barton	1	Urban Lease
York Park, Barton	2	UOS
Dudley Street, Yarralumla	2	UOS
Black Street, Yarralumla	2	UOS

Table B.2Known Populations of GSM and Land Use

1. Based on Tables 3.2, 3.4-3.8: Native Grassland in the ACT: List of Sites Grouped by Geographic Location (pp48-49).

2.

UOS = Urban Open Space which means, "generally Public Land under The Territory Plan" (ACT Government 2005; p52).

Category 1 sites that are on Territory Land and are designated as 'Reserve' are protected by reservation under the Land (Planning and Environment) Act 1991 (ACT Government 2005; p57).

Category 2 sites that are 'Urban Open Space' on Territory Land are managed by the relevant ACT Government Agency. For those sites that are on National Land, the ACT Grassland Strategy recommends management and protection via Memoranda of Understanding with Commonwealth Government agencies are appropriate (ACT Government 2005; p58). In the case of York Park, it is currently maintained by the National Capital Authority which carries out weed control and other management activities under an MOU with Environment ACT (ACT Government 2005; p70).

Table B.3Known Areas of NTG and Land Use

Site ¹	Conservation Category ^{1,2}	Land Use ^{1,2}	Area (ha)
Majura Valley			
Majura Valley East (Majura Training Area)	1	Defence	113.7
Majura Valley East (Air Services Beacon)	1	Airport Services	10.7
Maiura Valley East (Airport)	1	Airport	73.6
Campbell Park	1	Defence	10.9
Jerrabomberra Valley	GRANE CONTRACTOR		10.9
'Mugga Mugga'	2	Reserve	15.0
'Callum Brae'	1	Rural lease/ Reserve	162.7
'Woden Station'	1	Reserve	115.2
Woods Lane	2	Roadside	10.3
'Woden Station' east	1	Reserve	62.2
Harman-Bonshaw North	1	Defence, Rural Lease	46.3
AMTECH, Fyshwick	2	Vacant	18.0
Tennant St, Fyshwick	2	Agisted	0.3
Gungahlin Valley			
Mulangarri Nature Reserve	1	Reserve	58.6
Gungaderra Nature Reserve	1	Reserve	41.9
Grace Hill [Crace] Nature Reserve	1	Reserve	61.6
North Mitchell	2	Vacant	14.8
Mitchell	2	Rural (agisted)	1.6
Belconnen Pony Club	2	Rural	0.3
Wells Station Road	3	Roadside	0.2
Belconnen			
Ginninderra Experimental Station	2	Research	18.9
Dunlop Nature Reserve	1	Reserve	81.9
'Jarramlee'	2	Rural (agisted)	52.0
Umbagong Park	2	UOS	9.0
Evatt powerlines	2	UOS	1.1
Lake Ginninderra	2	UOS	1.9
Lawson (Territory)	3	Rural (agisted)	3.3
Kaleen east paddocks	3	Rural (agisted)	4.0
Caswell Drive	1	UOS	5.8
Glenloch Interchange	1	UOS	2.2
Central Canberra and Tuggeranong			
CSIRO Headquarters	2	CSIRO	3.0
Constitution Avenue, Reid	2	UOS	0.7
St John's Church, Reid	2	Urban Lease	0.9
ACCC, Barton	1	Urban Lease	1.9
York Park, Barton	2	UOS	0.4
Yarramundi Reach	2	UOS	21.2
Lady Denman Drive, Yarralumla	2	Roadside	0.4
Dudley Street, Yarralumla	2	UOS	1.5
Kintore Street, Yarralumla	2	Vacant	0.8
Novar Street, Yarralumla	3	UOS	0.2
Black Street, Yarralumla	2	UOS	3.6
Isabella Pond, Monash	1	UOS	1.2

1. Based on Tables 3.2, 3.4-3.8: Native Grassland in the ACT: List of Sites Grouped by Geographic Location (pp48-49).

2.

UOS = Urban Open Space which means, "generally Public Land under The Territory Plan" (p52).

Site ¹	Conservation	Land Use ^{1,2}	Area
	Category ^{1,2}		(ha)

Category 1 sites that are on Territory Land and are designated as 'Reserve' are protected by reservation under the Land (Planning and Environment) Act 1991 (ACT Government 2005; p57).

Category 1 sites that are on National Land are managed through Memoranda of Understanding between the ACT and Commonwealth Government agencies.

Category 2 sites that are on Territory Land and designated as 'Reserve' allow activities "compatible with conservation of native grassland values, providing appropriate conservation management is in place" (ACT Government 2005; p58). The responsibility for managing the conservation values of these lands lies with the relevant ACT Government agency (ACT Government 2005; p58).

Category 2 sites that are 'Urban Open Space' on Territory Land are managed by the relevant ACT Government Agency. For those sites that are on National Land, the ACT Grassland Strategy recommends management and protection via Memoranda of Understanding with Commonwealth Government agencies are appropriate (ACT Government 2005; p58). In the case of York Park, it is currently maintained by the National Capital Authority which carries out weed control and other management activities under an MOU with Environment ACT (ACT Government 2005; p70).

The GSM flies ephemerally at seasonally opportune times during the summer and the time at which this occurs is important to researchers conducting studies and seasonal surveys of the GSM. The researchers will observe the flight of a known population (a 'reference site') at which time they will then know that they can conduct surveys at any other site subject to GSM study to determine their presence. The value of any known population as a 'reference site' is high, significantly higher if it is the only known reference site. In the case of York Park, *Error! Reference source not found*. demonstrates that there are a large number of known populations in publicly accessible reserves in the ACT. Furthermore, as identified in the Grassland Strategy (ACT Government 2005), the York Park population is not viable in the medium-long term and therefore its value as a reliable reference site will diminish over time as the GSM population declines. The value as a reference site is therefore not greater than any other area in which the GSM occurs.

As discussed under the explanation for Criterion (b), the York Park GSM and NTG do not demonstrate a higher ecological value than other examples or occurrences of these features. The potential to yield further scientific information (as required for this criterion) will likely diminish over time as the Grassland Strategy (ACT Government 2005) states that the ecological features are not viable in the medium-long term and that the Site is ecologically isolated with no potential to restore connectivity. The Grassland Strategy also categorises York Park as a Category 2 grassland, one that could complement conservation efforts for species or communities but does not represent core habitat itself. More important or significant information that could be gained about these features in the future would be more likely available from studying larger, long-term viable populations of core habitat in reserved areas.

B.3.3 Conclusion For Criterion (C)

The above discussion identifies that the GSM population and NTG area at the York Park Site do not contain the potential to yield sufficiently important or significant information to qualify for inclusion under criterion (c).

B.4 CRITERION (G) – HAS A STRONG OR SPECIAL ASSOCIATION WITH THE ACT COMMUNITY, OR A CULTURAL GROUP IN THE ACT FOR SOCIAL, CULTURAL OR SPIRITUAL REASONS (ACT GOVERNMENT 2015; P27)

B.4.1 Explanatory Note

The explanatory notes for this criterion (ACT Government 2015; pp27-8) states that "An ordinary person should be able to easily recognise the association between the community or cultural group and the place or object" and that "Professional groups and special interest groups do not constitute the community or a cultural group".

B.4.2 Relative Importance Against Explanatory Note

Umwelt (2014) states that York Park has been subject to a large amount of ecological studies, particularly for the GSM population including studies focussed on population dynamics and genetic studies for more than 20 years (Umwelt 2014; p6). There is a high likelihood that the Site holds social values to both the ecologists who have conducted surveys at the Site in the past, as well as those ACT ecologists currently involved with seasonal GSM surveys throughout the ACT.

B.4.3 Conclusion for Criterion (G)

This criterion is not met because an ordinary person would not be able to recognise the link between ecologists and the ecological values at the Site. Furthermore, ecologists would be considered professional or special interest groups which the explanatory note discounts from eligibility under this criterion.

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Will Osborne

(AB





Will Osborne

Synemon's last stand

or the moths that ate Belconnen Naval Base

by Rodney Falconer

If any living thing could be said to typify the plight of native species in the ACT, then Synemon plana might well be it.

Synemon plana is a medium sized, ark brown, endangered species of moth with a silvery underside and attractive pale green eyes. It is one of a dwindling number of species representative of old Canberra. Very old Canberra. For Synemon plana belongs to the Family Castiniidae, a group of moths which evolved in Gondwanaland, the giant supercontinent of which Australia was a part, and which began to break up about 90 million years ago.

The moth evolved with its food plant, silver-top wallaby-grass (Danthonia carphoides). For most of the year the larvae live underground, feeding on the roots of this grass, but for a short period of two weeks or so in November, the adults are active during the day. And they are very selective about when they will come out, and only then if it is sunny.

At about midday, the males appear, flying about a metre above the ground. They concentrate in areas dominated by Danthonia carphoides. If other grasses dominate, even though their food plant is still present, they will quickly back into the wallabyveer grassland proper. About an hour later, the females appear. They can barely fly, only doing so if hard pressed, and then for only about 1 or 2 metres. This seems to indicate habitat was once their that extensive and fairly continuous. grass and They sit in the seductively spread their wings,



Top to bottom: Parliament House/weedy grassland dominated by wild oats and exotic trees/ unmown native grassland/mown Danthonia grassland, December 1990 Photo: Rodney Falconer

attracting the flying males with large orange spots on their hind wings. Another hour later and nearly all the males, whether they have successfully mated or not have disappeared. The females by now are likely to be searching the grass tussocks, looking for appropriate cracks in which to poke their long ovipositors so as to ensure that each egg will be near enough to caterpillar food. An hour later and they will all be gone.

These moths, with such ancient lineage, are correspondingly very primitive. The adults only live a short time, perhaps a day or two at the most. This is because they have no mouth — no biting jaws or sucking tubes — nothing. At this stage of their year-long life cycle, they literally live to reproduce.

Their host plant is just as quaint. It forms a small pale green tussock, with silvery flower heads. Australia, especially some parts of the ACT, was once the home of extensive native grasslands. The northern drift of the continent saw the invasion of several other groups of grasses, many of which had time enough to adapt to our conditions and form species which have long been regarded as native to this land. Each grass prefers particular environmental factors, can be SO grasslands and dominated by one species, or be a mixture of many.

Some of the most common native grasses in the ACT include: •red-leg grass (Bothriochloa macra)

- •tall spear-grass (Stipa bigeniculata)
- •kangaroo grass (Themeda triandra)
- •wallaby grasses (Danthonia species)
- •windmill grass (Chloris truncata)

Red-leg grass prevails when the



land has become degraded. It is that long gangly grass with reddish stalks that often occurs on unmown suburban parks, roadside verges and median strips. Windmill grass also survives many of our changes and also regularly pops up in lawns, parks and verges. It is a small tussock plant with short but broad flower-heads forming the spokes of an imaginary wheel. Kangaroo grass reflects less disturbed grassland, as it disappears under grazing and heavier mowing, but can quickly predominate in favourable circumstances. It forms magnificent pink and tan swathes of long grass. Spear grass often reflects the use of fire. It is a tall species and is often most readily recognised by its long-awned seeds inflicting sublime torture upon the ankles of trespassers as the seeds screw

their way through clothes and into soft flesh.

Danthonia carphoides doesn't cope well with fertilisers or generous watering. It is easily overtaken by more aggressive grasses such as kangaroo grass or spear grass. But it likes to be lightly grazed and this is a clue to the present predicament of the moth.

No-one can be certain of the pre-European distribution of the moth. It probably favoured areas that were more heavily grazed by kangaroos and wallabies. With the clearing of sheep pastures there were early and established records from Bathurst to the Grampians and from the Yass Plains to Bordertown in South Australia.

But no longer. Since the 'improvement' of pasture – the introduction of exotic grasses and

this moth seems about to be stepped upon by the jackboots of humanity

Left: *Danthonia carphoides*, silver top wallaby grass at Yarralumia, December 1990

Below: Dr Ted Edwards of CSIRO Divison of Entomology, foremost authority of Synemon plana walking throughKangaroo grassland at Yarralumia

Photos: Rodney Falconer



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Assassin fly devouring Synemon plana, perched on Kanagaroo grass

the heavy use of super phosphate fertiliser - the native moth has greatly declined. Up until early this year, when two more sites were identified near new Parliament House, there were only nine records of its continued existence. One site in Victoria is thought to be too small and isolated to sustain the species. The remaining eight sites are inside the ACT, mostly around urban Canberra. Of these, all but one are no larger than about 100 by 35 metres – making the

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survival of the moth problematical.

The remaining site, several hectares in extent, is thought to easily be the best prospect for the long-term survival of the species. But unfortunately it has been eyed as a dead certainty for urban development. It is Belconnen Naval Base

The Naval Base is an island in a sea of improved pasture. Its cyclone wire fence is accompanied by a bulldozed section of bare earth across which few exotic grasses seem to have passed. The small flock of sheep used to reduce fire hazards has, by chance, provided optimal conditions for the flourishing of the wallaby-grass ecosystem. It is surrounded by suburbs. eved eagerly by developers: the featureless brown lawn largely ignored by the locals.

When Joseph Wild came here, in about 1820, he found the and Murrumbidgee Molonglo Rivers, limestone plains and lots of fires. There were emus, bustards and brolgas, trout cod and rock. wallabies. There was the Ngunawal nation who used sophisticated fire management/ techniques to retain the openwoods and grasslands. The bustards, brolgas, rock wallabies and Ngunawal have gone. Emus and trout cod have been reintroduced to a couple of reserves and man-made dams.

The farmers of the nineteenth century looked across the land they called the Limestone Plains over open woodlands interspersed with seas of grass. Those seas have almost vanished.

The yellow grasslands of, say, Mount Painter reflect the dried colours of exotic grasses brought in to 'improve' the native pasture. Wild oats, prairie grass, rats-tail fescue and scores of other species from other countries have spread over the hills and plains, usually replacing the native grasses of the 'unimproved' soils.

Our summers were tan, pink and silver with wallaby grass, red-leg grass, kangaroo grass and spear grass. Their spring greenness was interspersed with swathes of yellow paper-daisies and goodenias, purple pea-flowers, blue devils and bluebells, pink bindweeds, patterned white early nancies and small orchids. For the grasslands are much more complex than they at first appear, and have been regularly underestimated. Western Australia and Sydney were not alone in possessing fields of wildflowers with bright colours and sweet scents.

 New suburbs threaten to sprawl into the domain of the forty or so larger patches of remaining native grassland. Smaller pockets still hang on in the open spaces of older suburbs, like Yarralumla and Barton. Once common species are now rare or vulnerable. They may reflect the crippling of ecosystems - a wingless grasshopper (Keyacris scurra), two species of legless lizard (Delma impar and Aprasia parapulchella) and this moth that can barely fly a hundred metres. The rare plants have few common names, like the little yellow daisy called charmingly button wrinklewort (Rutidosis leptorhynchoides).

CSIRO researchers are finding ways of cultivating our native grasses and government authorities are becoming aware of those lawns that don't need water and fertiliser, and only the occasional lawn-mower. Perhaps some portions of the Limestone Plains landscape might be rescued in the nick of time.

I think Synemon plana will be a litmus test of our ability to coexist with the natural environment in the ACT. For if it is exterminated, it is likely to be the direct result of a conscious decision to do so. The planners and the government know it is there. It is neither cute nor cuddly. It is invisible for eleven months of the year. It is arguably more Australian than the gum tree. It is an integral part in what little is left of the Limestones Plains ecosystems. It could be saved or exterminated this year.

archival record REFERENCE NO. 24

Friends of Grasslands

What does the Golden Sun Moth look like? Poster presented to Friends of Grasslands volunteers, Institute for Applied Ecology, University of Canberra, Canberra

What does the Golden Sun Moth look like?



Where can the moth be found?



Native grassland

- Treeless native grassland
- Dominance of native grasses (Wallaby & Kangaroo Grass)
- Variety of flowers (bluebells)

Road verges

- Mixtures of native & exotic plant species
- Regularly managed



Secondary native grassland

- Few scattered trees
- Native grasses and flowers in understory

Exo - Do (Cl

- Exotic pasture
- Dominance of exotic grasses (Chilean Needle Grass)
- Lack of native flowers

When can the moth be found?



- Flight period (red) is from mid October to mid January
- Egg deposition during the flight period
- Larvae live in soil for 2 to 3 years, feeding on grass roots
- Males are more encountered than females

The best **weather conditions** to spot the moths are during the hottest part of a sunny day within the flight period.



Contact information





Urban grassy patches

- Surounded by urban structures (e.g. houses & roads)
- Mixture of native & exotic plant species

Backyard

- Plant native species
- You never know- always keep your eyes open for the moth!

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archival record REFERENCE No. 25

Gibbon, P & Reid, T 2013 Managing pasture for the critically endangered Golden Sun Moth (*Synemon plana*) Prepared for the Lachlan Catchment Management Authority, ANU Edge Canberra



FINAL REPORT

Managing pasture for the critically endangered Golden Sun Moth (Synemon plana)

Submitted July 2013

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Managing pasture for the critically endangered Golden Sun Moth (*Synemon plana*)

Consultant report to the Lachlan Catchment Management Authority as part of the Native Grasslands Recovery for Greater Landscape Resilience Project

July 2013

Philip Gibbons and Thomas Reid

Fenner School of Environment and Society, The Australian National University

Executive summary

This is the final report for the consultancy *Survey for Golden Sun Moth* which is part of the Lachlan Catchment Management Authority's Native Grasslands Recovery for Greater Landscape Resilience Project.

The Golden Sun Moth (*Synemon plana*) is listed as critically endangered in the *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999*. At the commencement of this project, the New South Wales Wildlife Atlas contained records of the Golden Sun Moth from 14 locations in the upper Lachlan Catchment, with no officially listed locations on private land (Reardon pers comm 2013).

The objectives of this project were:

- 1. Increase the area of private land surveyed for the Golden Sun Moth in the upper Lachlan Catchment.
- 2. Develop a field survey protocol that can be used to determine if the Golden Sun Moth is present on private land, predict sites favoured by the species and identify management regimes that favour the species.
- 3. Provide recommendations regarding sites and management regimes to guide investment decisions for the conservation of the Golden Sun Moth on private land in the upper Lachlan Catchment.

Survey methods

In consultation with experts, we developed a survey protocol for the Golden Sun Moth to meet our objectives. Two surveyors recorded the presence or absence of the Golden Sun Moth in 10m x 50m belt transects randomly located at each site (paddock). Each transect was surveyed for a fixed period (3 min). Surveys were conducted only when temperatures exceeded 20°C and there was little to no wind.

The following habitat data were collected at each transect: % cover by plant species, % cover of bare ground, % cover of cryptogams, % cover of tussock bases and biomass (tonnes per ha). We also recorded the following management data at each site in a semi-structured interview with landholders: dry sheep equivalents per hectare (DSE per ha), how often the paddock was rested from grazing in the previous 12 months, fertiliser history and cultivation history.

Results

A total 83 transects on 23 properties were surveyed in the upper Lachlan Catchment from late November to December 2012. The Golden Sun Moth was recorded in 26 transects on 11 properties. A separate spreadsheet containing details for all locations has been provided to the Lachlan CMA.

A statistical model we fitted to the survey data indicated that the Golden Sun Moth is most likely to be found in paddocks within the upper Lachlan CMA that are dominated by wallaby grasses (*Austrodanthonia* spp.), where a tussock structure is maintained, where there is a high cover of bare ground between tussocks and the site is managed with a low average DSE per ha. These results are consistent with the known habitat requirements for this species.

The amount of rest from grazing that a paddock received (per year) and biomass (tonnes per ha) were not statistically significant predictors for the presence of Golden Sun Moth in the upper Lachlan Catchment.

Which sites are likely to support the Golden Sun Moth

Investments to conserve Golden Sun Moth habitat on private land in the upper Lachlan Catchment should prioritise sites that have, or have potential to support, a high cover of wallaby grasses (*Austrodanthonia* spp.), a moderate basal area of tussock grasses and bare ground between tussocks.

These variables can be readily measured using the step-point method and therefore, in conjunction with the model provided in an Excel spreadsheet provided with this report, can be used by CMA staff to predict the suitability of a site for the Golden Sun Moth, or by landholders to monitor the suitability of a paddock for this species.

Given the limited dispersal abilities of the Golden Sun Moth, actions that increase the continuity of habitat for this species across the upper Lachlan Catchment are recommended. Building connectivity around, and between, known strongholds for this species should be a priority.

Management at sites supporting the Golden Sun Moth

Our results indicated that livestock grazing at sites managed for the Golden Sun Moth should be maintained at, or below, an average of three DSE per ha, which is consistent with the level of grazing recommended by the New South Wales Department of Primary Industries for high quality native pastures (NSW DPI 2013). At average habitat conditions observed in this study, reducing the level of grazing from the average observed in the study area (12 DSE per ha) to the level recommended by the New South Wales Department of Primary Industries for high quality native pastures (3 DSE per ha), increased the predicted probability of occurrence of the Golden Sun Moth in the study area by an average of 22%.

We found no evidence that rotational grazing afforded any advantage for the Golden Sun Moth. Conversely, crash grazing that resulted in a high average DSE per ha had a negative effect on the species. However, as a precautionary measure, grazing could be excluded during the period when the Golden Sun Moth emerges and reproduces (November to January). We found no evidence that grazing by sheep, cattle or horses had a differential impact on the species.

Management actions that maintain or increase the cover of wallaby grasses (*Austrodanthonia* spp.) and bare ground between tussocks are an important management action for the Golden Sun Moth on private land. While we did not find evidence for any effect of fertiliser application on the presence of the Golden Sun Moth, data we collected on fertiliser history were not reliable. As a precautionary measure we therefore recommend that additional applications of fertiliser should not occur on sites managed for the Golden Sun Moth to reduce the likelihood for spread of exotic grasses or increased grass cover.

Introduction

The Golden Sun Moth, *Synemon plana* Walker (Lepidoptera: Castniidae) is a diurnal species of moth that inhabits natural temperate grasslands in south-eastern Australia (Zborowski and Edwards 2007). The species is nationally listed as critically endangered throughout its natural range (DEWHA 2009). This is primarily because the Golden Sun Moth is typically found in small, isolated patches of remnant natural grassland (O'Dwyer and Attiwill 2000) or within native pastures (Brown, *et al.* 2012), and is unable to disperse through large areas of unsuitable habitat to colonise previously occupied habitat (O'Dwyer and Attiwill 1999). Genetic studies by Clarke and O'Dwyer (2000) and Clarke and Whyte (2003) indicate that the species once had a more continuous distribution in south-eastern Australia, but this former range has been extensively fragmented with the loss of habitat associated with intensive agriculture and urban expansion (Kirkpatrick et al 1995).

Current knowledge of the habitat requirements of the Golden Sun Moth suggest that the soil dwelling larvae feed on the roots of native C₃ grasses within the genera *Austrodanthonia* (wallaby grasses) and *Austrostipa* (speargrasses) (Brown, *et al.* 2012;Clarke 1999;O'Dwyer and Attiwill 1999;SMEC 2012). A more recent finding has been observations that larvae have apparently adapted their diet to the exotic weed *Nassella neesiana* (Chilean Needle Grass) (Gilmore et al 2008 in SMEC 2012). However, this is not considered to be an important food species as numerous previous studies have most strongly associated the presence of the Golden Sun Moth with high cover of native C₃ grasses, *Austrodanthonia spp.* in particular (DSEWPaC 2012;O'Dwyer and Attiwill 1999) and a switch in larvae diet does not necessarily mean that all populations across the species range have the ability to also switch (Braby and Dunford 2006). Many aspects of its biology, especially its feeding habits, are not yet well understood although it is thought that the larvae feed on these grasses for up to two years before emerging as adults for between one or two days (Clarke and Whyte 2003).

Much of the survey effort for the Golden Sun Moth has focused on determining its presence or absence in areas proposed for development rather than quantifying habitat preferences or management requirements (e.g. Hogg 2010;SMEC 2012). More detailed research into the habitat of this species has concentrated most strongly on large grasslands on public reserves where Golden Sun Moth populations are known to be persisting, or are considered likely to be persisting. Very little published work has addressed how land management practices on private land may influence site occupancy by the Golden Sun Moth, despite this being potentially a key threat to the species. Current understanding of the Golden Sun Moth habitat requirements suggests there may be large, undiscovered populations of the species on agricultural land that has had minimal pasture improvement and support grasslands dominated by *Austrodanthonia* spp. (Clarke 1999).

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Austrodanthonia spp. is a dominant component of native pastures as they are relatively palatable and have been shown to thrive under reasonably heavy stocking rates (Garden, *et al.* 2000). What is not known, however, is how different grazing regimes may alter Golden Sun Moth habitat. Here we aim to quantify relationships between pasture composition, structure and management and the presence of the Golden Sun Moth.

Methods

Study site

This study was undertaken in the upper Lachlan Catchment, within the South West Slopes Bioregion (DSEWPAC 2013) in the State of New South Wales, south-eastern Australia (see Appendix 1). The upper Lachlan River catchment is characterised by a matrix of agricultural land with remnants of box gum grassy woodlands, temperate native grasslands and more contiguous dry forest on exposed ridges. Livestock grazing (sheep, beef cattle) and cultivation are the dominant land uses in the region (Sherren, *et al.* 2012). Annual precipitation is between 600 and 850mm.

Golden Sun Moth survey

A total of 83 belt transects were measured across 27 paddocks (23 properties) identified through expressions of interest by landholders or by approaching landholders directly. Each belt transect was 50m long and 10m wide. A total of 3-6 transects were placed randomly within individual paddocks with the number of transects roughly proportional to the area of each paddock. During the summer of 2012, two observers familiar with the Golden Sun Moth recorded the presence or absence of the Golden Sun Moth by walking each transect for no longer than three minutes on a single relatively calm day when the temperature was \geq 20 degrees Celcius, which are the conditions in which emergence and flight are most likely to occur (Brown, *et al.* 2012).

Habitat variables

Habitat data were recorded at each transect using the point intercept method for individual species cover estimates and native species richness estimates (White, *et al.* 2012) (Table 1) and rising plate meter readings to estimate biomass along at each transect (Stockdale 1984) (Table 1).

Table 1: Habitat Variable Collection Methods

Variable	Definition
Cover by Species (% Cover)	The presence or absence of each ground cover
	species at a single point every 1m along a 50m
	transect was recorded. The total number of
	presences for each species was summed and
	reported as a percentage out of 50 points.
Ground Stratum (% Cover)	The presence or absence of each ground cover
	type including bare ground, leaf litter, cryptogam
	and rock at a single point every 1m along a 50m
	transect was recorded. The total number of
	presences was summed and reported as a
	percentage out of 50 points.
Tussock basal area (% Cover)	The presence or absence of tussock bases was
	recorded at a single point every 1m along a 50m
	transect. The total number of presences was
	summed and reported as a percentage out of 50
	points.
Number of Native Species (Richness)	Each ground cover species intercepted over 50
	points was recorded and summed.
Biomass (tonnes ha ⁻¹)	A rising plate meter reading was taken every 5
	meters along a 50m transect, the readings were
	summed and divided by the number points (10)
	(See Stockdale 1984). This value was then
	converted to tonnes of dry matter ha ⁻¹ using
	calibration data (unpublished data: Kay, 2012).

Management variables

Semi-structured interviews were conducted with landholders in order to determine the management history of each site. Landholders were asked what type of livestock were being grazed on the site surveyed, how many head of livestock had been grazed on the site in the last 12 months, the size of the paddock and the number of days the paddock was rested from grazing in the last 12 months. From this information we derived a measure of grazing intensity as DSE ha⁻¹ using conversion tables (Attwood 1997; Goodburn 2009). It is important to note that DSE ha⁻¹ in our study reflects a single grazing event at the paddock scale, not the farm scale. It was assumed that our measure of grazing intensity at the time of survey was representative of the management of that particular paddock from year to year. Fertiliser histories were difficult to obtain accurately across sites due to a lack of records. Therefore, fertiliser history was represented using a simple categorical variable with two levels (<15 years and >15 year).

Exploratory analyses

Exploratory analyses were undertaken to gain an understanding of the distribution and variation within each potential explanatory variable (Table 1). We found that only one of our continuous variables (DSE ha⁻¹) had a highly skewed distribution. Twelve outlying observations corresponded where graziers were implementing crash grazing (where high numbers of livestock were grazed in small areas for short periods of time). We therefore log₁₀ transformed this variable in order to give it a more homogenous distribution for modelling. Given the large spread of data within this variable, however, we decided it was appropriate to present two regression models. The first, a model with all observations of DSE ha⁻¹ included and a second, alternative model, with all observations above 100 DSE ha⁻¹ excluded.

Statistical analyses

A matrix of correlations using Pearsons correlation coefficient (r) was constructed in order to identify all pairs of explanatory variables that we highly correlated. No high level of correlation (r > 0.6) was identified, meaning all of the above variables (table 1) were suitable for regression analyses.

In order to account for the nested sampling design in our study (i.e., multiple transects in single paddocks) we conducted regression analyses using Generalised Linear Mixed-effects Models (GLMM's). GLMM's allow exploration of conventional fixed effects and how they relate to site occupancy, as while accounting for inherent correlation caused by random (paddock level) effects. We used the function glmer in the R statistical package implemented through the Ime4 library in R with a logit link (R Core Development Team 2010). Conventional information criterion selection for a model of best fit (i.e. AIC) is an unreliable form of model selection for GLMM's (Bolker, *et al.* 2009). Therefore, model selection was based on a conventional backward exclusion of non-significant (p>0.05) explanatory variables in the model. All predictions were made from the full model, except for a prediction of DSE ha⁻¹, which was made to compare DSE ha⁻¹ results between a model with all observations (full model) and a model with outlying DSE ha⁻¹ values excluded (alternative model).

Results

We sampled 83 transects from 27 paddocks. The Golden Sun Moth was present on 31.3% of the 83 transects and 47% of the 27 paddocks that were surveyed.

Summary statistics for continuous explanatory variables are described in table 2.

Table 2: Summary statistics for all potential explanatory variables

Variable	Mean	Range (lower – upper)
% Exotic annual plant cover	40.4	0-100
%Exotic Perennial Plant Cover	6.7	0-52
% Austrodanthonia spp. Cover	34	0-82
%Austrostipa spp. Cover	3.5	0-20
%Bare Ground Cover	10.6	0-42
%Tussock base cover	7.8	1-20
Biomass (tonnes ha ⁻¹)	3.4	1.5-7.1
Native Plant Species Richness (Count)	5	0-13
DSE ha ⁻¹	36.1	0-277
Days rested from grazing in the last 12 months	237	0-365

For fertiliser history, the first level (less than 15 years since fertiliser) had 44 observations (16 with Golden Sun Moth and 28 without Golden Sun Moth). The second level (greater than 15 years since fertiliser) had 38 observations (10 with Golden Sun Moth and 28 without Golden Sun Moth).

Factors affecting site occupancy by the Golden Sun Moth

Our full logistic regression model (GLMM) included four significant explanatory variables (Table 3). Our selected model indicated that there was a higher probability of finding the Golden Sun Moth where: (1) grazing intensity was low (Figure 1); (2) there were higher amounts of bare ground (Figure 2); (3) where there was a more pronounced tussock structure (Figure 2); and (4) where the cover of *Austrodanthonia* spp. was higher (Figure 2).

	Estimate	Standard Error	Р
Intercept	-4.686	1.72	0.0064
Average DSE/ha (log10)	-2.265	0.88	0.01
% Bare Ground	0.125	0.04	0.005
% Large Tussocks Bases	0.191	0.10	0.06
% Austrodanthonia spp. Cover	0.068	0.03	0.03

Table 3: Selected GLMM with all significant explanatory variables, their standard error and p values.

Our alternative regression model where outliers of grazing intensity (DSE ha⁻¹ >100) were removed confirmed that the negative relationship between Golden Sun Moth occupancy and grazing intensity is a negative effect regardless of outliers in the data (est= -7.580 \pm 2.56(SE) p=0.004) (Figure 1).



<u>Figure 1</u> – The effect of grazing (±s.e.m) on the probability of Golden Sun Moth occurrence across the upper Lachlan Catchment. These predictions were made with other explanatory variables held at their mean values. The lighter (grey) line represents predicted probabilities where 12 large observations of DSE ha⁻¹ in the last grazing event were removed. The black line is the full model where all observations of DSE ha⁻¹ were included.



<u>Figure 2</u> – The effects of habitat variables (\pm s.e.m.) on the probability of Golden Sun Moth occurrence across the upper Lachlan Catchment. All predictions were made with other significant explanatory variables held at their mean values.

The predicted effects of habitat and grazing on the occurrence of the Golden Sun Moth

With all other model terms held at their mean values, the likelihood of occurrence of the Golden Sun Moth was predicted to increase, on average, by 7.1% with every 10% increase in *Austrodanthonia* cover, by 3.4% with every 10% increase in the basal cover of tussock grasses, by 3.7% with every 10% increase in bare ground and by 4.8% with every unit reduction in average DSE ha⁻¹.

Discussion

Our primary objective in this study was to determine what factors may influence the occupancy of the Golden Sun Moth on private land managed for livestock grazing. We predicted that the cover of wallaby grasses (*Austrodanthonia* spp.) and structural attributes such as the amount of large tussocks and inter-tussock bare ground are important habitat features for the Golden Sun Moth. Our results indicate that there was a negative relationship between grazing intensity at the paddock scale and the presence of the Golden Sun Moth. Here we discuss each of these variables.

Grassland composition

Austrodanthonia spp. are the primary host plant of Golden Sun Moth larvae (Douglas 2004). Although a 40% threshold of *Austrodanthonia* cover for Golden Sun Moth habitat suggested by O'Dwyer and Attiwill (1999) has been disputed (see Bradbury and Dunford 2006), our results support this prediction and show that higher levels of *Austrodanthonia* are important provided a tussock structure and inter-tussock bare ground is maintained (Figure 2). Our results showed no significant effect of the cover of exotic perennial (pasture) grasses, which is not surprising as they were a minor component of the grasslands that we targeted for survey. Therefore, it is difficult for us to make inference on the interaction between exotic pasture grasses and *Austrodanthonia* cover. However, in a published attempt at restoring the habitat of the Golden Sun Moth, O'Dwyer and Attiwill (2000) found that, in order to increase the cover of wallaby grass, management of weeds (mainly competitive exotic perennial grasses) is required alongside plantings. This is also consistent with management aimed at maintaining inter-tussock bare ground (DEWHA 2009).

Grassland structure

While our model predicted an increase in the probability of Golden Sun Moth occurrence with higher covers of wallaby grasses (*Austrodanthonia* spp.), increasing cover of wallaby grasses alone on grazing land is unlikely to increase habitat quality for the Golden Sun Moth. Our results suggest that tussock structures are important to the Golden Sun Moth. McIntyre and Tongway (2005) found that native grasslands will lose their tussock structure under heavy grazing due to the selective grazing of more palatable regrowth. While wallaby grasses are highly grazing tolerant, they still have the ability to change tiller direction under heavy grazing which may reduce their tussock structure (Waters, *et al.* 2009). This may explain why the Golden Sun Moth was less likely to be found in largely *Austrodanthonia* dominant pastures with higher grazing pressures. It is likely that the Golden Sun Moth prefers a tussock structured habitat with bare ground between tussocks for a variety of reasons: (1) tussocks may provide cover from predators (McIntyre 2005), (2) because species from the *Synemon* (sun moth) genus have very long retractable ovipositors in which they use to deposit their eggs underground, or at the base of tussocks (Douglas 1999) and (3) because females need to be visible to patrolling males (Brown, *et al.* 2012;Clarke 1999).

Inter-tussock bare ground

In addition to the composition of grassland and tussock structure, we found a significant (p>0.05) positive relationship between cover and the presence of the Golden Sun Moth. Bare ground between tussocks is an important feature for the Golden Sun Moth because pupation occurs below the ground. Surface litter and other obstructions therefore may cause damage to the moth as it emerges (Douglas 2004). The specific effects of grazing on soil invertebrate fauna remains relatively understudied, suffice to say that there are notable changes in assemblages between areas grazed by domestic hoofed animals and areas that are not (Bromham, *et al.* 1999). It is postulated that higher grazing pressures, especially associated with crash grazing, may cause soil disturbances that are detrimental to Golden Sun Moth larvae (for example pugging and crust breakage) (Drewry 2006). This may be why we found crash grazed sites were unlikely to support the Golden Sun Moth.
Maintaining Golden Sun Moth habitat

Of the three management variables that we collected for this study (time since fertiliser, days rest from grazing and DSE ha⁻¹), only grazing intensity (DSE ha⁻¹) was significantly (negatively) associated with the presence of the Golden Sun Moth. Of most interest was that there was no significant relationship between the amount of rest a paddock receives each year, and the presence or absence of the Golden Sun Moth. Our model predictions also showed that, with all other variables fixed at their mean, a reduction in grazing from 12 DSEha⁻¹ (the average DSE ha⁻¹ observed on sites we sampled) to the New South Wales Department of Primary Industries (DPI) recommended carrying capacity for high quality native pastures (3 DSE ha⁻¹) (NSW DPI 2013) increased the predicted probability of Golden Sun Moth occurrence by 22%. These results suggest that continuous grazing at low intensities may be an acceptable management tool. However, such grazing management should also be considered in light of broader grasslands conservation objectives and the lifecycle of the Golden Sun Moth. Set stocking may encourage livestock to preferentially graze more palatable intertussock species leading to a reduction in plant species richness (Clarke 2003; Garden, et al. 2000;McIntyre, et al. 2003). It is also unknown how grazing during the Golden Sun Moth emergence season affects newly hatched larvae or mortality of ground-dwelling females (Douglas 2004). Given these uncertainties, we recommend ongoing monitoring of wallaby grass cover, bare ground cover and the cover of tussock basal area alongside any changes to grazing.

Sampling considerations for future surveys

In order to balance the dual goals of maximising the likelihood of detecting the Golden Sun Moth and gaining sufficient replication of management treatments we made three tradeoffs in our sampling design. First, we concentrated survey efforts on sites that current literature indicated to be most likely to suitable habitat for the Golden Sun Moth. For example, it is understood that the Golden Sun Moth occupies habitat with high covers of native C₃ grasses (Braby and Dunford 2006;Clarke 1999;Clarke and Whyte 2003;Gibson and New 2007;O'Dwyer and Attiwill 1999;O'Dwyer and Attiwill 2000;SMEC 2012). Therefore, landholders that were contacted to participate in this study were engaged by the Lachlan Catchment Management Authority (LCMA) through a native grasslands conservation project. These landholders had all expressed an interest in native grasslands or pastures on their properties. We therefore established sites on as many of these properties as time and practicalities would allow during the Golden Sun Moth emergence season in 2012/2013.

Our second trade off was determining whether a site was truly not occupied by the Golden Sun Moth. It is recommended (DSEWPaC 2012) that each site is visited at least four times in at least biweekly intervals on appropriate survey days (days with temperatures above 20°C with no to very light winds and between the hours of 10:00 and 15:00). Sites can only be considered unoccupied if these survey rules are followed (Gibson and New 2007). Such guidelines prohibit gaining sufficient replication of sites across the landscape as the season of Golden Sun Moth emergence is often very short (November to Early January in the region) and the number of suitable days for survey within a given season can be few (Brown, *et al.* 2012). Therefore we restricted our surveys to a single site visit on the most suitable days for the Golden Sun Moth to emerge (>20°C by 10am with average wind speeds ≤15km/hr). Despite these limitations, we were able to identify significant associations between the occurrence of the Golden Sun Moth and habitat and management features that may aid in the conservation of this species on private land.

Conclusion

Our objective was to identify how habitat and land management affect the occurrence of Golden Sun Moth on land managed for livestock grazing. We predicted that the cover of *Austrodanthonia* spp., the basal cover of grass tussocks, the cover of bare ground and grazing intensity are the most important variables influencing the presence of the Golden Sun Moth on land managed for livestock grazing. Monitoring of populations should also occur alongside information on year-to-year grazing, the cover of wallaby grasses, the cover of grass tussocks and the cover of bare ground in order to refine these findings and for more informed adaptive management of Golden Sun Moth populations on private land. Grazing timing should also consider other native grassland conservation objectives with pasture values.

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Appendix 1

Map of the study region:

From:

http://www.environment.nsw.gov.au/resources/nature/NSWSouthWesternSlopesMapsLocation.pdf



NSW South Western Slopes Biogeographic Region (IBRA) - Location

Appendix 2

Attached as electronic files are the following:

- 1. An excel spread sheet with geocodes for each transect surveyed for the Golden Sun Moth (sheet name "geocode")
 - 2. An excel spread sheet with all field measurements of vegetation

(sheet name "field_data")

3. An excel spread sheet tool setup for the use of CMA staff (sheet name "prediction tool")

Note that item 3 allows staff to estimate the probability of Golden Sun Moth Presence using our statistical model at any site provided that they can supply information on:

- % Austrodanthonia spp. cover (using point intercept method)
 - % Bare Ground Cover (using the point intercept method)
- % cover of large tussock bases (using the step intercept method)
 - DSE/ha⁻¹ over the last 12 months in the paddock of interest

Note that predicted values are modelled estimates only

archival record REFERENCE No. 26

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Problems in studying populations of the golden sun-moth, Synemon plana (Lepidoptera: Castniidae), in south eastern Australia

L. Gibson · T. R. New

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Abstract Surveys of the threatened golden sun-moth, *Synemon plana* (Walker), on an extensive grassland habitat in Victoria demonstrate some of the challenges for evaluating its population sizes and distributions, and developing its flagship values for ranking grassland sites for priority conservation significance. A more effective sampling protocol is suggested, which takes into account the unusual biological features of this species.

Keywords Grassland · Flagship species · Transects · Surveys · Phenology

Introduction

The diurnally active golden sun-moth, *Synemon plana* (Walker), was once distributed widely across native grasslands in temperate south eastern Australia. Much of those grasslands has been lost to agricultural conversion, and they now occupy less than 1% of their former extent of some two million hectares (Kirkpatrick et al.1995). The sun-moth has become locally extinct over most of its former range, and now has a highly fragmented distribution. Most of the known colonies are confined to small grassland remnants of no more than a few hectares in Victoria, New South Wales and the Australian Capital Territory (ACT).

Synemon plana is the most widely distributed castniid in the region and has become an important flagship invertebrate for the conservation of native

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grasslands. Considerable efforts have thus been made to elucidate its biology and population status (Clarke 2000) and habitat requirements (O'Dwyer and Attiwill 1999, 2000), and to reserve key habitat patches for the moth (Douglas 2004). Studies on population size and distribution have been important for such evaluations, and the sun-moth has recently gained additional notoriety through its presence on grasslands scheduled for urban development near Melbourne. *S. plana* is scheduled as 'critically endangered' under the federal Environment Protection and Biodiversity Conservation Act 1999, and is listed separately as threatened under all three state or territory acts covering its range.

In this note, we draw attention to the difficulties of evaluating populations of *S. plana*. These difficulties reflect its unusual biology. We note, in particular, that a number of the more usual approaches to estimating population size may give very inaccurate, perhaps misleading, information. In response, we suggest protocols to help overcome these challenges.

Biology of S. plana

Synemon plana exhibits a number of features that render it intrinsically difficult to study, and particularly to estimate population size as a key need in conservation evaluation.

On any site, the adult flight season extends over about 6-8 weeks. The exact timing reflects latitude and weather, with some variation between years. In southern Victoria (the area of our study) the flight season occupies parts of November-January. In warmer inland areas, moths may emerge as early as late October, and have disappeared completely by late

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November (Douglas 2004). However, within that flight season there is fairly continuous adult emergence and rapid turnover of individuals. The non-feeding adults live for only 1-4 days. Cook and Edwards (1994) noted that most males in an ACT population they surveyed lived for only 1 or 2 days, with a maximum of 5 days in cool weather. During that time, males fly actively, and patrol in search of mates, and are the only sex that can be surveyed even reasonably adequately. Females fly little, if at all. Males fly fast and (usually) in short bursts, about 1 m above the ground. Females respond to the sight of males by exposing their brightly coloured hind wings, to which the males respond in turn and land as a prelude to mating. Males fly only in warm conditions (above about 20°C), in bright sunlight and in the absence of rain and of wind above a gentle breeze. Furthermore, they are active for only about 3-4 h in the middle of the day, with flight starting around 11:00 h (Eastern Davlight Saving Time) in warm weather and lessening conspicuously after about 14:00 h.

Thus, unlike many longer-lived insects with a lifestyle affording greater apparency, attempts to assess *S. plana* populations must take account of the following constraints:

- 1. Only males are ever sufficiently conspicuous and active to include in counts for estimates of population size. Despite presumption of a sex ratio of unity, searching for females is laborious and unreliable. They are found most easily by tracking males seen to 'dive' into grassland. Caterpillars live underground and cannot be sampled easily.
- 2. Males (although capable of longer flight) tend to fly for only short distances (a few tens of m) and in short bursts, rather than be exposed continually for observation.
- 3. Mark-release-recapture exercises have very limited value because of rapid individual turnover.
- 4. Direct counts on any single occasion, however accurate they may be, can reflect only one 'emergence cohort', as most individuals in the population will not be available on any single date. Prediction of the flight season is difficult, and planning a survey necessitates visits to the site over a period spanning the periods before and after the anticipated dates of appearance in any year.
- 5. All such counts must be made within the short daily activity period, so that comparative counts on different sites may not be possible on the same day, or under the same weather conditions. Likewise, site inspections outside this diurnal interval may not reveal *S. plana* populations present.

- 6. Vagaries of weather confine valid surveys to particular conditions of temperature, wind and precipitation, even within the short activity period.
- 7. A final uncertainty is that the sun-moth may have a life cycle extending over more than one year. Two years was considered likely by Clarke (2000). Up to three years' generation time has been suggested, but Clarke's genetic data led him to imply the likelihood of a univoltine pattern. It is possible that some variation occurs across the moth's range, but also possible that the total number of moths observed in a flight season may simply be one annual cohort of a larger resident population.

Synemon plana at Craigieburn Grassland Reserve, Melbourne

Our observations on *S. plana* at an unusually large grassland remnant near Melbourne in 2005 are discussed below, in an effort to augment understanding of how populations may be assessed in the future.

Craigieburn Grassland Reserve (CGR) is one of the largest remnants of Victorian Western Basalt Plains Grassland, and is the largest area known to be occupied by *S. plana* in Victoria. CGR (37°37.43 S, 144°57.39 E) is some 20 km north of the Melbourne CBD, and is a largely flat area of some 340 ha, in which native *Austrodanthonia* grasses (the presumed food plants of larval sun-moths) are widely distributed. CGR is managed by Parks Victoria.

Synemon plana was discovered at CGR in 2003, and observations in 2004 implied that it was widely distributed across the reserve (Van Praagh 2004). During the 2005 flight season, attempts were made to clarify its distribution and population structure, using a series of spot counts and an expanded transect survey to detect male moths.

Spot counts

CGR was visited on all suitable days between 1 November 2005 and 15 January 2006. *S. plana* males were seen only from 12 November to 29 December, so that the longer inspection period encompassed the entire flight season. Within the flight season, weather conditions were suitable for moth activity on only 13 days (less than 30% of days in the period), on each of which a series of 'spot surveys' was undertaken by a single observer. On each day,12 sites (together spanning about 1.5 km N–S and about 600 m W–E) were

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surveyed between 11:00 h and 14:00 h. At each site, the observer stood still for 6 min and counted all moths flying within a radius of 30 m (reflecting the greatest distance at which the moths could be detected easily whilst flying over grassland with vegetation up to about 0.8 m tall). These surveys were undertaken to give an impression of (a) local abundance of moths and its variation within the CGR area and (b) variation in numbers at each site over the flight season.

Belt transect

A single occasion belt transect survey was undertaken, with the help of 24 volunteer observers (some of them experienced observers of *S. plana*) on 11 December 2005. Twelve parallel transects were walked simultaneously from S to N, 10 m apart and 1200 m in length. Every 100 m, the numbers of moths seen within 10 m to the right of the transect lines were recorded, to give 144 counts, each representing numbers in a cell 100×10 m.

Experienced observers were distributed across the line, so that any ambiguous sighting could be validated (or not) quickly by consultation. The exercise commenced soon after 11:00 h and occupied about 2 h. This exercise helped to indicate (a) the extent of patchiness of the moth numbers across the larger area and (b) possible variations in information obtained from the more usual approach to surveying *S. plana*, of single line transects across the habitat (following methods devised by Pollard and Yates 1993).

Results

Spot counts

Records of sun-moth numbers varied considerably across sites (0-151) and on different days (0-147), with a combined total of 456 male moths seen over the survey. Table 1 shows moth numbers for each site. The two highest values were both on flat grassy sites, with the highest number on a site with only sparse vegetation due to control burning some months before our study. Numbers of moths on each sampling occasion (Table 1) showed similar inconsistencies across sites, but some limited correspondence between 'number of occasions on which moths present' and 'total moths present'. No site yielded moths on all sampling occasions, and eight sites yielded moths on six or fewer occasions-that is, on half or less of the sampling visits. Most surveys revealed few moths, with the maximum of 46 (site 11, 30 November) a clear outlier.

Belt transect

Altogether, 1248 moths were counted in this exercise. The numbers seen in each cell, and sums for each transect, are shown in Table 2. Moths are distributed very widely across the area surveyed, with only five sample areas yielding no moths. Numerical distribution is summarised in Fig. 1, showing a clear peak density in the 1–5 individuals per sampling area category. Two sampling areas yielded high numbers (33, 38) as apparently localised 'hotspots', each abutted by areas with considerably lower numbers. For individual transects, moth numbers ranged from 63 to 143 (S–N,1200 m, same recorders along a transect) or 38–168 (W–E, 120 m, different recorders for each cell across belt).

Discussion

Our results (collectively representing a sampling effort far greater than usual in attempting to appraise its numbers on smaller grassland sites) demonstrate considerable variation in S. plana incidence in both space and time. The only comparable data of which we are aware is from a survey of a small (0.4 ha) area (York Park, Canberra, ACT, 35°18.40 S, 149°07.59 E) supporting one of the largest S. plana populations known (Cook and Edwards 1994; Edwards 1994). As Edwards (1994) emphasised 'great caution must be exercised' in interpreting counts. At York Park, numbers of male S. plana in daily counts varied considerably over the period of 17 November 1993 to early January 2004, but the 'peak season' encompassed around 25 November-16 December, so that Cook and Edwards recommended sampling during that period. Daily numbers over that period (omitting rainy days) ranged from 7 to 34 moths, and the distribution of moths on that small site changed considerably: S. plana was much more widespread in December than in November.

Variations in numbers of sun-moths observed were also considerable at CGR, with no consistent trend over the flight season. However, the two highest spot survey counts were on consecutive occasions over the last week of November and first week of December, with considerably lower numbers either side of this. This central period also yielded the highest moth numbers found on 10 of the 11 occupied sites.

Any single occasion may thus not reflect accurately the numbers present, and can be little more than a 'snapshot' that does not reflect the rapid turnover of individuals within the population. Thus, in our spot survey counts, it is likely (allowing for a male moth

Site	Sampling date													Total
	12.xi	14.xi	17.xi	23.xi	24.xi	30.xi	5.xii	7.xii	8.xii	9.xii	14.xii	28.xii	29.xii	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	4	0	0	0	4	0	0	0	8(2)
3	4	0	0	4	4	18	5	0	2	7	0	0	0	44(7)
4	1	0	0	1	1	8	13	0	0	7	0	0	0	31(6)
5	2	0	0	1	1	8	7	0	0	0	0	0	1	20(6)
6	0	0	0	0	0	7	7	0	0	0	0	0	0	14(2)
7	7	5	0	0	0	0	0	0	0	0	0	0	0	12(2)
8	4	0	0	2	2	11	8	1	0	1	0	0	1	30(8)
9	5	0	0	0	0	8	12	0	0	7	0	0	3	35(5)
10	9	0	3	5	5	18	9	0	0	10	0	1	7	67(9)
11	24	15	5	31	3	46	13	4	1	8	0	1	0	151(11)
12	0	0	0	0	0	19	11	0	0	10	0	0	4	44(4)
Total	56	20	8	44	16	147	85	5	3	54	0	2	16	456

 Table 1
 Numbers of male S. plana recorded at Craigieburn Grassland Reserve, Melbourne during spot surveys at each of 12 sites on 13 occasions, November–December 2005

Total moths on each site gives number of positive sampling dates in parentheses

Table 2 Results of belt transect survey for S. plana at Craigieburn Grassland Reserve, Melbourne on 11 December 2005 (see text)

	1	2	3	4	5	6	7	8	9	10	11	12	Total
L	33	3	0	6	3	5	2	2	1	3	20	13	91
K	3	2	5	6	4	5	0	8	2	8	20	18	81
J	10	14	10	25	20	25	6	12	2	15	6	23	168
I	16	38	4	14	3	3	4	4	0	3	10	6	105
Н	10	4	8	20	4	19	15	6	6	3	7	6	108
G	4	8	6	8	11	16	14	10	4	4	15	6	106
F	5	5	10	13	15	16	7	22	9	13	12	3	130
E	10	16	25	9	7	20	10	19	5	7	11	11	150
D	12	9	8	5	2	8	1	11	17	19	16	10	118
С	4	3	2	3	5	12	2	1	5	16	7	15	75
В	0	1	2	3	7	12	7	8	9	11	9	9	78
A	3	2	4	1	0	2	3	2	3	5	5	8	38
Total	110	105	84	113	81	143	71	105	63	107	138	128	1248

Numbers of moths for each sampling cell given: A-L, successive 100 m intervals from south to north; 1-12, successive 10 m intervals from west to east, collectively representing 12 S-N adjacent transects and 12 W-E transects

lifespan of 4 days) that males seen on 12, 17, 23, 30 November, followed by 5, 9, 14 and 28 December would not overlap at all, so that a minimum population



Fig. 1 The distribution of moth numbers across 144 sampling areas (cells) of the belt transect survey for *S. plana* at Craigieburn Grassland Reserve, Melbourne, 11 December 2005

D Springer

size estimate (or annual population cohort) would reflect the sum of individuals seen on those occasions. However, considerable shorter term variations also occur, as shown by the differences between two pairs of consecutive day samples in different parts of the flight season (23, 24 November; 28, 29 December).

Similarly, the 12 individual transects of the belt transect exercise span more than two-fold differences in numbers, so that 'quantitative' surveys based on single line transects are not definitive—and, perhaps, not even indicative of the population size on a single occasion. Such shortcomings are difficult to overcome. Earlier records of *S. plana* at CGR (December 2003–January 2004) ranged from '1' to '100s' on different dates (Van Praagh 2004), the latter comprising moths distributed widely over more than 3 km. The belt transect survey confirmed the wide distribution of the moth on CGR, and supported strongly that the

J Insect Conserv (2007) 11:309-313

distribution is continuous rather than forming local population segregates. *S. plana* apparently does not form a classical metapopulation structure within the grassland. Clarke and O'Dwyer (2000) believed that, because the males do not generally fly for more than 100 m (and, usually, much less), populations separated by more than 200 m can be considered effectively isolated, with intermediate areas unlikely to be (re-)colonised. The levels of microdifferentiation across apparently continuous populations inhabiting large sites such as CGR remain unknown.

A monitoring protocol for S. plana must (a) reliably detect the presence or absence of the moth, (b) provide for some appraisal of numbers, with potential for these to be compared realistically across sites and thereby be a tool in ranking grassland patches for value as S. plana habitats, (c) appraise distribution in relation to area and quality of habitat, and (d) provide sufficiently reliable quantitative information for use in plotting numerical changes over generations (years). Single visit surveys in any year are patently inadequate to provide this information in any realistic form. Their unsuitability is enhanced if undertaken in even marginally suitable weather conditions or time of day. We suggest that any such appraisal should be based on a minimum of four visits to a site within the main flight period of the moth. These surveys should be undertaken at (approximately) weekly intervals to reflect incidence of different individuals, with the four values summed to provide a minimum estimate of total population size. Either spot surveys or transects may be used. The latter may be more fruitful in a limited period, in allowing more ground to be covered to assess distributional heterogeneity. However, spot counts are valuable in associating moth numbers with different vegetational or topographic features of a site.

The biology of *S. plana* thus provides both hindrances and opportunities for quantitative population assessments and comparison of moth populations between different sites. Our purpose here is to indicate the problems of doing this, and the need to refine survey methods for this important flagship species, to enable more reliable use of this species in comparative assessments of the values of grassland remnants for conservation.

Acknowledgements This project was undertaken with the aid of volunteers and staff of the Merri Creek Management Committee and the Friends of Merri Creek. We thank, particularly, Brian Bainbridge and Wendy Moore for their enthusiastic support. The study was authorised through Parks Victoria, under Flora and Fauna permit no. 10003414, and we thank the Rangers in charge of Craigieburn Grasslands, Fiona Smith and Katrina Lovett for facilitating this. We greatly appreciate comments on a draft of this paper from Fabian Douglas and Dr Beverley Van Praagh.

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archival record REFERENCE No. 27

Harwood, T, Narain, S & Edwards, E 1995 Population monitoring of endangered moth *Synemon plana* 1994–95, York Park, Barton Prepared for the National Capital Planning Authority, Commonwealth Scientific and Industrial Research Organisation, Canberra

ARCHIVAL RECORD REFERENCE NO. 28

Hnatiuk, S 2008a golden sun moth Newsletter no. 1 Friends of Grasslands 12 November 2008 Canberra

12 November 2008

Welcome to our first newsletter, and thank you for your enthusiasm for the Golden Sun Moth counters project. We hope it will be rewarding and interesting experience for all.

In this newsletter there is information about the GSM sites and counters, maps for your sites, contact details, what to do with completed recording sheets, and practice sessions this coming weekend on counting and recording moths and pupal cases. A flow diagram of the steps for starting up your monitoring is on page 3.

SITES AND COUNTERS

A list of all GSM sites, arranged by the area in Canberra where they are situated, is provided with this email. Please check to make sure that you have been correctly registered you for the site(s) you want to monitor.

AND IF YOU HAVE NOT ALREADY DONE SO, PLEASE SIGN UP FOR A

SITE. Please would you see if you can identify a site(s) you would like to monitor and let me and Anett know. We can then let you have your map. Any questions about the sites should be directed to Anett.

MAPS

Anett has produced maps showing the placement of plots for many of the sites for which people have signed up. If there is a map of your site, it is attached or enclosed. The others will come after Anett's return to Canberra at the weekend.

PRACTICE SESSIONS

Anett will be at the following sites this coming weekend to demonstrate pupal case and moth recognition, counting and recording.

Saturday, 15 November:

- 1. 10am 11am at York Park, Barton (bounded by John McEwen Crescent, Sydney Avenue and National Circuit)
- 2. 11:30am 12:30pm at Dudley Street, Yarralumla
- **3.** 1:30pm 2:30pm at Umbagong Park, Latham or Dunlop Grassland off Binns Street, Fraser check with Anett on Saturday to find out which (0401 233 801).

Sunday, 16 November:

- 12 noon 1pm at York Park (bounded by John McEwen Crescent, Sydney Avenue and National Circuit)
- 1:30pm 2:30pm at the grassland bounded by Anzac Parade Constitution Avenue, Creswell Street, etc. Access from Constitution Avenue.

CONTACT INFORMATION

Name	Phone	Mobile	email
Anett Richter	6201 2937	0401 233 801	a.richter@student.canberra.edu.au
		Unavailable 12-14	
		November incl.	
Sarah Hnatiuk	6251 2228	0424 263 565	hnatiuk1@cyberone.com.au
Geoff Robertson	6241 4065	0403 221 117	geoffrobertson@iprimus.com.au

Contact information for others involved with moth counting is in the list of the sites.

WHAT TO DO WITH COMPLETED RECORDING SHEETS

Anett will pick up your completed recording sheets from you. Alternatively, you can mail them to Anett Richter, Institute of Applied Ecology, University of Canberra, ACT 2601 or drop them off at her lab.



Female Golden Sun Moth – photo by Fabian Douglas

For more information on the sun moth:

- <u>http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=25234</u> has lots of photos (including of Anett!)
- <u>http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.asp</u> x?id=10791



archival record REFERENCE No. 29

Hnatiuk, S 2008b golden sun moth Newsletter no. 2 Friends of Grasslands 21 November 2009 Canberra

GSM NEWSLETTER no. 2

21 November 2008

Where are we at now?: There are 41 people counting moths at around 36 sites. Geoff, Anett and Sarah have been contacting the moth counters to see how they are going and if they need any help. One or two sites have been finished. Many sites have now been set up and the vegetation surveys are underway. This seems to be the biggest task. Some people are still to start, but their sites should be largely set up by the end of next week. Ten people were able to attend the practice session last weekend.

Please tell us how we might improve on how we do things. As the Golden Sun Moth Project is a pilot project, we are looking at how we might improve our procedures and communications, if we are to do this again.

Revised vegetation record sheet. This is a message for those of you who have not yet done your vegetation survey. If you have already done your vegetation survey, you need read no further.

As part of our efforts to improve on our processes, Anett has modified the vegetation record sheet to clarify the recording process and reduce the amount of writing you have to do. **Please use this record sheet at your site if you have not already done the vegetation survey.** It is on pages 2-3 of this newsletter and also attached as a separate document for those of you receiving the newsletter by email.

Photos of pupal cases. Some of you who have yet to see a pupal case have asked for photos of them. These photos, taken by Dana, are of cases protruding from the ground and a case that has been dug out, showing the dirt-covered part of the case from below the ground.







Golden Sun Moth Photo Contest 2008. We're searching for the most impressive photo of the "Sun Moth Count"!!!! Send us your favourite photo which shows us not only the Golden Sun Moth, but also fieldwork, grasslands or anything you decide to capture on photo! Regardless of whether you are a professional or an amateur, we're looking forward to seeing all your interesting photos! Please send your photo to: <u>Anett.Richter@canberra.edu.au</u>.

The award for the best photo will take place at our last evaluation workshop at the beginning of January 2009. The Photo Contest Prize Winner will receive a field guide, "Butterflies of Australia".

Compiled by S. Hnatiuk

VEGETATION RECORD SHEET

Your Name				Date				Monitorii	ng Site			
List All Plant Species and Code Abundance: 1 plant (R), 1-5 plants (+), 6-15 plants (2a), 16-30 plants (2b), 31-40 plants (3a), >40 plants (4a)			Record % Bare Ground : <1%, 1-5%, >5-10%, >10-20%, >20-40%, >40%				Record % Litter+ Lichen : <1%, 1-5%, >5-10%, >10-20%, >20-40%, >40%					
	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12
% Bare ground												
% Litter + Lichen												
All Plant Species												

Plant Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12
Please re	cord Basa	l Cover at o	each plot fo <19	or the follov %, 1-10%,	ving specie >10-25%, >	s that are e •25-40%, >	expected to 40-65%, >0	be found ii 65%	n relation to	o Golden S	un Moths:	
Grass species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12
Bothriochloa macra												
Austrostipa scabra												
Austrostipa bigeniculata												
Austrodanthonia species												
Themeda australis												
Nassella neesiana												
Nassella trichotoma												

archival record REFERENCE No. 30

Hnatiuk, S 2008c golden sun moth Newsletter no. 3 Friends of Grasslands 28 November 2008 Canberra

GSM NEWSLETTER no. 3

28 November 2008



HOW ARE WE GOING? The recent cool, damp weather and prospect of more of it into next week has been frustrating for moth counters, especially those who are keen to press ahead. There is no need to wait for temperatures to reach 25°C before you do your counts; some moths will be flying at lower temperatures although they will be fewer than when it is hotter. Information from cooler days is still useful as Anett can relate the numbers counted to information about weather conditions from the Bureau of Meteorology. However, if there is snow on the Brindabellas and/or the wind blows your hat off, don't count!

It would be good if we could finish our four moth and pupal counts by the end of December, so Anett can get started on analysing the data. However, if that is not possible, please finish your count by mid January. Anett says she has never seen moths flying in January but in the past others have. Late records would therefore be useful in helping to confirm if this is a continuing change in Sun Moth behaviour.

THE DEADLINE FOR GETTING YOUR RECORD SHEETS TO ANETT IS 31 DECEMBER IF AT ALL POSSIBLE.

IF YOU CANNOT COMPLETE ALL YOUR COUNTS BY THEN, CONTINUE INTO JANUARY AND HAVE YOUR RECORDS TO ANETT BY 15 JANUARY.

Please mail or deliver your records to Anett. Alternatively, she will come to you and pick them up. Her contact details are:

Institute for Applied Ecology, University of Canberra, ACT 2601 Phone 6201 2937 or 0401 233 801 Email Anett.Richter@canberra.edu.au

GOLDEN SUN MOTH WEBSITE. Sylvio has very nearly completed the website for the project and has put it up on the internet. You can see it at <u>http://aerg.canberra.edu.au/teams/osborne/moth-count/</u>.

ABORIGINAL LAND CLAIM ON BELCONNEN NAVAL STATION HALTS DESTRUCTION OF GOLDEN SUN MOTH HABITAT. From ABC Radio National comes the news that a local Ngambri man, Shane Mortimer, has lodged a Land Rights Claim over two areas of the Naval Station with the Prime Minister's office. He says that his main concern is about caring for country, rather than claiming ownership.

Go to: <u>http://www.abc.net.au/rural/telegraph/content/2006/s2430142.htm</u>. You can listen to it or download it.

REMINDER ABOUT THE GOLDEN SUN MOTH PHOTO CONTEST. Send us your favourite photo which shows us not only the Golden Sun Moth, but also fieldwork, grasslands or anything you decide to capture on photo! Regardless of whether you are a professional or an amateur, we're looking forward to seeing all your interesting photos! Please send your photo to: <u>Anett.Richter@canberra.edu.au</u>, and the award for the best photo, a copy of *Butterflies of Australia*, will be made at our evaluation workshop in early 2009.



Photos by Anett Richter Newsletter compiled by S. Hnatiuk