ecology & heritage partners

Draft Report

EPBC 2018/8271: Golden Sun Moth *Synemon plana* Offset Management Plan: Boyers Road, Glenhope, Victoria

Prepared for

Bacchus Marsh Developments Pty Ltd

November 2025

Ecology and Heritage Partners Pty Ltd

MELBOURNE: 292 Mt Alexander Road, Ascot Vale VIC 3032 **GEELONG:** 230 Latrobe Terrace, Geelong West Vic 3218

BRISBANE: Level 22, 127 Creek Street, Brisbane QLD 4000 **ADELAIDE**: 22 Greenhill Road, Wayville SA 5034

CANBERRA: PO Box 6467, O'Connor ACT 2642 **SYDNEY:** Level 5, 62.86 Harris Street, Ultimo, NSW, 2007

DOCUMENT CONTROL

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Address	Boyers Road, Glenhope, Victoria
Project number	10937
Project manager	Shannon LeBel (Associate Ecologist)
Other Staff	Cat Stephenson (Associate Botanist)
Mapping	Monique Elsley – GIS Coordinator
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Draft v2	Updates to respond to comments provided by Cth and Landowner/TFN	SLB/CS	02/12/2024
Draft v3	Update to offset area location	SLB	13/11/2025

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- The landowner for access onto the proposed offset site and site information.
- Vegetation Link for assistance with sourcing the offset site and reviewing the OMP.
- Victorian Department of Energy, Environment and Climate Action (DEECA) for access to online ecological databases.

DECLARATION OF ACCURACY

I declare that:

1. To the best of my knowledge, all the information contained in, or accompanying this Management Plan (EPBC 2018/8271: Golden Sun Moth *Synemon plana* Offset Management Plan, Boyers Road, Glenhope, Victoria) is complete, current and correct.
2. I am the designated proponent or the approval holder for this action.
3. I am aware that:
    a. Section 490 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence for an approval holder to provide information in response to an approval condition where the person is reckless as to whether the information is false or misleading.
    b. Section 491 of the EPBC Act makes it an offence for a person to provide information or documents to specified persons who are known by the person to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) where the person knows the information or document is false or misleading.
    c. The above offences are punishable on conviction by imprisonment, a fine or both.

_____
Signed

_____
Full name (please print)

_____
Organisation (please print)

_____
Date

EXECUTIVE SUMMARY

Introduction

Ecology and Heritage Partners Pty Ltd was engaged by Bacchus Marsh Developments Pty Ltd (herein referred to as BMD) to prepare an Offset Management Plan (OMP) to compensate for the proposed impacts to 22.657 hectares of confirmed habitat for Golden Sun Moth *Synemon plana* (GSM) associated with the development of land several parcels of land located in Merrimu, Victoria (the impact site)

On 5 October 2019, it was determined by a delegate for the Commonwealth Minister for the Environment that under Part 3 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the proposed action (to construct a residential development) is a controlled action, and that the development will likely have a significant impact on 'listed threatened species and communities (sections 18 and 18A)'. It has also been determined that the proposed action will be assessed by preliminary documentation.

Offset site

The proposed offset site is in central Victoria near the locality of Glenhope, approximately 87 kilometres north-west of the Melbourne central business district. The proposed offset site is 38.6 hectares in size. Targeted surveys for GSM within the offset site were undertaken in 2020 by Hamilton Environmental Services (2021) which confirmed the presence of a large population of GSM utilising the property.

The proposed offset site supports moderate to high quality GSM habitat and supports a ground layer comprising a moderate to high cover of Wallaby-grass including Slender Wallaby-grass *Rytidosperma racemosum* var. *racemosum* and Common Wallaby-grass *Rytidosperma caespitosum*.

Based on the EPBC Act offset calculator, the retention and management of 25.3 hectares of GSM habitat within the proposed offsite offset site as an offset mitigates 91.53% of the impact of the removal of 12.502 hectares of GSM habitat quality 4, while the retention and management of an additional 13.3 hectares of GSM habitat mitigates 78.98% of the removal of 10.155 hectares of GSM quality 3 habitat.

The site will be protected through a Trust for Nature (TfN) Covenant under the *Victorian Conservation Trust Act 1972*. TfN undertakes a rigorous quality assurance process for all covenanted sites to ensure the landowner completes the management actions as stipulated in this OMP and any additional or adaptive management techniques as required.

Objectives of the Offset Management Plan

This GSM OMP provides detailed management actions for the identified GSM population at the offset site that will lead to a net benefit for the species. The proposed removal of suitable habitat at the development site will be offset through the protection of 38.6 hectares of confirmed GSM habitat. The objectives of the OMP are to:

- Maintain and improve the habitat quality of 38.6 hectares of GSM habitat at the offset site in a manner consistent with the EPBC Act Environmental Offsets Policy;
- Support establishment of legal security arrangements for the in perpetuity protection and management of the offset site;

- Undertake management actions to protect and improve the quality of GSM habitat within the offset site;
- Provide a timetable of management and monitoring actions, outcomes and progress reviews; and,
- Detail appropriate monitoring and evaluation of management actions and completion criteria.

This OMP will allow for a net benefit to the GSM through long-term protection and management of the existing population at the proposed offset site.

CONTENTS

1 INTRODUCTION

1.1 Background

Ecology and Heritage Partners Pty Ltd was engaged by Bacchus Marsh Developments Pty Ltd (herein referred to as BMD) to prepare an Offset Management Plan (OMP) to compensate for the proposed impacts to 22.657 hectares of confirmed habitat for Golden Sun Moth *Synemon plana* (GSM) associated with the development of land several parcels of land located in Merrimu, Victoria (the impact site) (Figure 1; Figure 2).

On 5 October 2019, it was determined by a delegate for the Commonwealth Minister for the Environment that under Part 3 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the proposed action (to construct a residential development) is a controlled action, and that the development will likely have a significant impact on 'listed threatened species and communities (sections 18 and 18A)'. It has also been determined that the proposed action will be assessed by preliminary documentation.

The intention of this OMP is to support the Preliminary Documentation response, and to detail the ongoing management actions required to protect and improve GSM habitat at an offsite offset located at Boyers Road, Glenhope, Victoria. The OMP has been written in consultation with the landowner of the offset site (Implexa Property Pty Ltd) and is intended to be implemented by the landowner on behalf of BMD.

To partially compensate for the proposed removal of 22.657 hectares of confirmed GSM habitat, the OMP details the proposed management and monitoring actions associated with the proposed protection and maintenance of 38.6 hectares of confirmed GSM habitat within a site located at Boyers Road, Glenhope (the offset site). A GSM survey was undertaken in December 2020 at the offset site by Hamilton Environmental Services (2021). This report provides the basic information to support this OMP, and identified a large, contiguous area of confirmed habitat that supports a significant population of GSM.

The Boyers Road offset site is located approximately 64 kilometres north of the proposed impact site. The impact site is predominantly located within the Victorian Volcanic Plain, with a relatively small areas along the western boundary located within the Central Victorian Upland bioregion (DEECA 2025).

The Boyers Road offs site is located within the Goldfields bioregion. However, the offset site contains, and is surrounded by outliers of newer volcanic olivine basalt flows (consistent with the underlying geological formation within the impact site and other areas within the Victorian Volcanic Plain bioregion (DJPR 2022).

The proposed offset site is privately owned, supports extensive areas of remnant native grassland and open woodland, and is proposed to be managed for the purposes of conservation.

1.2 Objectives

The objective of the OMP is to detail how impacts to GSM will be compensated through offsetting impacts by securing, protecting and improving existing GSM habitat within the proposed offset site. The objectives of this plan are to:

- Maintain and improve the condition of 38.6 hectares of GSM habitat at the offset site in a manner consistent with the EPBC Act Environmental Offsets Policy;

- Support establishment of legal security arrangements for the in perpetuity protection and management of the offset site;
- Undertake management actions to protect and improve the quality of GSM habitat within the offset site from a score of 5 to a 6;
- Provide a timetable of management and monitoring actions, outcomes and progress reviews; and,
- Detail appropriate monitoring and evaluation of management actions and completion criteria.

This OMP is consistent with regional priority recovery and threat abatement actions in the Commonwealth Conservation Advice for *Synemon plana* (Golden Sun Moth) (Department of Agriculture, Water and the Environment [DAWE] 2021), including:

- Establishing formal conservation arrangements, management agreements and covenants on private land;
- Preventing ongoing loss and degradation of habitat and retaining and protecting natural vegetation remnants within the known distribution of the species;
- Monitoring known populations to determine the species' status;
- Monitoring the effectiveness of management actions and the need to adapt them if necessary;
- Control of invasive weeds that threaten habitat; and,
- Implementation of appropriate grazing and burning to maintain and enhance habitat values for the species.

1.3 Method for Calculating GSM Habitat Quality

The habitat quality of the impact and offset site was assessed using the EPBC Act Offsets Assessments Guide to ensure it meets the requirements of the Department's EPBC Act Environmental Offsets Policy (October 2012). Assessments of species habitat quality are based on separate assessments of three parameters: site context, site condition and species stocking rate in line with the key considerations outlined within the Offset Assessment Guide and Offset Policy (DSEWPaC 2012a; 2012b), including an assessment of site condition and site context within the broader property/landscape, and determined as follows:

- **Site context** – assessed as a score out of three where the habitat patch[1] is:
    - 0/3 = < 0.25 hectares;
    - 1/3 = > 0.25 hectares < 10 hectares;
    - 2/3 = > 10 hectares, shaped to reduce edge effects (i.e. not narrow and/or linear);
    - 3/3 = > 10 hectares, shaped to reduce edge effects, and connects previously unconnected suitable/known habitat.
- **Site condition** – assessed as a score out of three as follows:

[1] A habitat patch is defined as an area of suitable habitat separated by other areas of suitable habitat by at least 200 metres of unsuitable habitat, or barrier to dispersal.

- 0/3 = dominated by non-native vegetation that isn't a preferred food source for GSM;
- 1/3 = comprised of a cover of up to 20% of a known food source;
- 2/3 = comprised of a cover of 20% - 40% of a known food source of which is predominantly native; OR, up to 40% cover of a known food source, which is predominantly non-native (i.e. Chilean Needle-grass). Limited inter-tussock space, (i.e. below 10%);
- 3/3 = comprised of a cover of at least 40% of a known food source which is predominantly native. Suitable biomass levels and inter-tussock space (i.e. 10% - 40% cover of bare ground) present.

- **Species stocking rate** - assessed out of four as follows:
  - 0/4 = species not confirmed to be present;
  - 1/4 = species modelled to occur, or confirmed at 0-5 moths per hectare[2];
  - 2/4 = > 5-20 moths per hectare;
  - 3/4 = > 20–50 moths per hectare;
  - 4/4 = > 50 moths per hectare.

1.4 Report Structure

This OMP structured as follows:

Introduction (Section 1)

This section summarises the background information relevant to the Project, including the purpose and scope of the work and the assessment methodology.

Part A: Offset Suitability (Section 2)

This section assesses the suitability of the proposed offset site, and includes details regarding the proposed clearing, gain and site improvement calculations. Part A should be read in conjunction with Part B, but due to its technical nature, the information it contains is not intended to be placed on title (e.g. Covenant under the *Victorian Conservation Trust Act 1972* [VCT Act]).

Part B: Offset Implementation (Section 3)

This section describes how the offset is to be implemented. Part B includes details regarding landowner and EPBC Act approval holder commitments, management activities, monitoring and reporting. This section is intended for those responsible for implementing the OMP, including the landowner (and any future landowners),and the approval holder. Information in this section is intended to be placed on title.

The plan also addresses the requirements of guidelines for the preparation of an OMP under the EPBC Act Environmental Offsets Policy (DSEWPaC 2012a).

[2] Stocking rate calculated as the average # of moths per hectare across the patch as determined by the results of the targeted surveys.

2 PART A: OFFSET SITE SUITABILITY

This section provides details of the clearing site, assesses the suitability of the proposed offset site, and includes details regarding proposed clearing, gain and site improvement calculations.

The location of the impact site and the proposed offset site are provided in Figures 1 and 2 (impact site), and Figures 3 and 4 (offset site) respectively.

2.1 Impact Site Details

A total of 58.298 hectares of GSM habitat was identified within the proposed development site. Of this, a total of 22.657 hectares of GSM habitat is proposed to be removed as part of the proposed action (Table 1; Figure 2).

The proposed development site also supports remnants of the *Natural Temperate Grassland of the Victorian Volcanic Plain* (NTGVVP) ecological community, as well a population of Spiny Rice-flower *Pimelea spinescens* subsp. *spinescens* (SRF). were recorded within the study area. However, no SRF specimens are proposed to be impacted as part of the proposed action.

No other matters of National Environmental Significance (NES) were recorded within the study area, or are considered likely to occur (Ecology and Heritage Partners 2025).

The proposed action will have a direct impact on two matters of NES: GSM and the NTGVVP ecological community. Impacts associated with the proposed development are summarised in Table 1.

Table 1. Matters of ecological significance to be impacted within the development site.

Ecological Value	Impacted	Retained	Total
NTGVVP	1.783 hectares	15.882 hectares	17.665 hectares
GSM	22.657 hectares of GSM habitat	35.750 hectares of GSM habitat	58.407 hectares of GSM habitat

To compensate for the loss of 22.657 hectares of impact to GSM habitat, a total of 45 hectares of confirmed GSM habitat is proposed to be protected and managed. A breakdown of the impacts and proposed offset areas are provided in Table 2.

Table 2. Size and location of the GSM offset sites

GSM Patch #	Proposed Impact GSM Habitat Quality	Impact Area (ha)	Offset Site	Offset Size (ha)	% of impact offset
1/2	Habitat Quality 3	10.155	Glenhope (offsite) (Habitat Quality 5)	13.3	78.98%
3	Habitat Quality 3	10.155	Bences Rd (Property 16) (Habitat Quality 6)	3.8	21.13%
	Total (ha)	**10.155**		**17.1**	**100.11%**
3	Habitat Quality 4	12.502	Bences Rd (Property 16) (Habitat Quality 6)	2.6	8.81%
Offsite	Habitat Quality 4	12.502	Glenhope (offsite) (Habitat Quality 5)	25.3	91.53%
	Total (ha)	**12.502**		**27.9**	**100.34%**
	Overall Total (ha)	**22.657**		**45.00**	

Note: # Patch numbers as per Figure 2.

An OMP relating to the NTGVVP community, as well as on-site offset sites at Bences and Buckleys Road for GSM has been prepared separately to this report (Ecology and Heritage Partners 2024).

Henceforth, this OMP addresses Section 6a – 6i of the Request for Additional Information as it relates to the offsite offset for GSM only, located in Glenhope, Victoria.

2.1.1 GSM Habitat at the Impact Sites

The impact site supports large expanses of the species preferred habitat (i.e. native and introduced grasslands) throughout. The species' preferred host plants (i.e. Wallaby-grasses *Rytidosperma* spp., Spear-grasses *Austrostipa* spp., and Kangaroo Grass *Themeda triandra*) are scattered throughout much of the site, and occur in highest densities within patches of Plains Grassland. In addition to this, there are scattered infestations throughout the site of the Weed of National Significance, Chilean Needle-grass *Nassella neesiana,* which is known to also provide suitable habitat for the threatened GSM.

The highest quality GSM habitat (i.e. open tussock grassland dominated by Wallaby-grass) that supported the highest numbers of GSM will be retained as part of the proposed action.

Habitat proposed to be removed supports a relatively low cover of native and non-native grasses that comprise the species preferred food plants (generally at least 10% cover of Wallaby-grass and/or Chilean Needle-grass). These areas also supported low numbers of GSM relative to higher quality areas elsewhere within the site (Figure 2).

2.1.2 Significance of Impact

Given that habitat known to support GSM is proposed to be impacted, the development has resulted in a 'significant impact' under the definition outlined in the Commonwealth Significant Impact Guidelines for *vulnerable* species (DoE 2013). As such, an onsite offset, and offsite offset site at Glenhope, Victoria will be secured and managed to ensure that residual impacts to the population and associated habitats are appropriately compensated over a 10 year period. The proposed offset site has recent records of GSM

contains high quality GSM habitat, and active management of the site will result in the long-term conservation of the species (see below).

2.2 The Offset Site

2.2.1 Golden Sun Moth Offset Site Location

The proposed offset site is 38.6 hectares in size and is located at the northern end of parcels 3C~D\PP2675 and 3E~D\PP2675, part of the broader property located at Boyers Road, Glenhope, Victoria (Figure 3; Figure 4).

The proposed offset site is in central Victoria near the locality of Glenhope, approximately 87 kilometres north-west of the Melbourne central business district (Figure 1). The property is within the Goldfields Bioregion (DEECA 2025). It is dominated by undulating hills with a sedimentary geology. However, outliers of quaternary basalt geology occurs within and surrounding the broader property, consistent with that of the impact site and other areas throughout the Victorian Volcanic Plain bioregion (DJPR 2022).

2.2.2 GSM Habitat Description

The proposed offset will comprise 38.6 hectares of GSM habitat, which is part of a larger contiguous area of approximately 182 hectares of habitat.

A broad assessment of the proposed offset property was undertaken by Shannon LeBel (Associate Ecologist) on 1 December 2020 to determine the quality and general extent of GSM habitat. Targeted surveys for GSM within the offset site were undertaken in 2020 by Hamilton Environmental Services (2021) which confirmed the presence of a large population of GSM utilising the property. It is understood that incidental observations of GSM have been confirmed at the site several times since in 2021, 2022 and 2023.

The proposed offset site supports a ground layer comprising a moderate cover of Wallaby-grass including Slender Wallaby-grass *Rytidosperma racemosum* var. *racemosum* and Common Wallaby-grass *Rytidosperma caespitosum* (Plate 1; Plate 2). Other native ground layer species present included Common Wheat-grass *Anthosachne scabra*, Wattle Mat-rush *Lomandra filiformis* and Kangaroo Grass *Themeda triandra*.

Non-native grasses were also common throughout the offset site and included Wild Oat *Avena fatua*, Sweet Vernal-grass *Anthoxanthum oderatum*, Fescue *Vulpia* spp., Soft Brome *Bromus hordeaceus*, Great Brome *Bromus diandrus* and Quaking grass *Briza* spp. In low lying areas off the drier, rockier ridges, Cocksfoot *Dactylis glomerata*, Toowoomba Canary-grass *Phalaris aquatica* and Yorkshire Fog *Holcus lanatus* were also present.

Overall, the offsite offset site supports an open, grassland habitat consistent with that described in the Golden Sun Moth Significant Impact Guidelines (DEWHA 2009a) and conservation advice (DAWE 2021), with the proposed offset sites consisting of grassland comprising bare or sparsely covered ground between grass tussocks (inter-tussock space).

Plate 1. Wallaby-grass dominated grassland habitat at the offset site (Ecology and Heritage Partners Pty Ltd 01/12/2020).

Plate 1. Wallaby-grass dominated grassland habitat at the offset site (Ecology and Heritage Partners Pty Ltd 01/12/2020).

A small number of canopy trees are present along the eastern boundary and central part of the proposed offset site. However, the remainder of the offset site supports an open, grassland habitat consistent with the Golden Sun Moth Significant Impact Guidelines (DEWHA 2009), with the proposed offset site consisting of grassland comprising bare or sparsely covered ground between grass tussocks (inter-tussock space).

2.2.3 GSM Habitat Quality Calculations

The offset site has been proposed as it supports a large population of GSM, and has been attributed a habitat quality score of 5/10 in accordance with the EPBC Offset Assessment Guide (DSEWPaC 2012b) (Table 3) and provides a clear conservation benefit and increase in conservation values when compared to the size and condition of GSM habitat at the proposed clearing site.

Although the 38.6 hectares of GSM habitat are located in two separate parcels, given they are both part of a larger contiguous 182 hectare area of confirmed GSM habitat, they have been scored as a single area of GSM habitat.

Table 3. Habitat Quality Calculations at the Glenhope offsite offset site.

Property/Patch	Area (ha)	Site Context	Site Condition	Species Stocking Rate	Habitat Quality Score	# GSM^	Stocking Rate ^
Glenhope	38.6 *	2	2	1	5	785	4.3

Note: ^ as per targeted survey results in Hamilton Environmental Services (2021); * Part of a larger 182 hectares of confirmed GSM habitat.

A habitat quality score of 5/10 has been applied to the offset site. This rating has been determined based on the presence of a relatively large extent of moderate to high quality GSM habitat that supports a known population of the species. Scores against the offset site suitability criteria are as follows:

- Site context score: 2/3. Site is larger than 10 hectares, but does not connect previously unconnected suitable/known habitat;

- Site condition: 2/3. Site supports approximately 20-30% cover of Spear-grass and Wallaby-grass, but otherwise dominated by non-native, non-preferred food sources;
- Species stocking rate: 1/4 (density of 4.3 moths per hectare). This is based on a total of 785 moths recorded over the broader 182-hectare site supporting contiguous GSM habitat.

2.2.4 Previous Records of Golden Sun Moth

GSM baseline abundance surveys conducted as per the survey requirements detailed in the *Significant Impact Guidelines for the Critically Endangered Golden Sun Moth* (DEWHA 2009a) were undertaken by Hamilton Environmental Services (2021).

These surveys identified a total of 785 male GSM across five surveys, with 41, 121, 166, 185 and 272 individuals being observed respectively within the broader 182 hectare property (Hamilton Environmental Services 2021). This equates to a density of 4.3 individual moths per hectare.

A large population of GSM is also known to occur in a property located immediately to the west of the proposed offset site, with over 1000 moths recorded by Biosis during targeted surveys conducted as part of the approval requirements for EPBC 2017/8008 (Biosis 2020).

2.3 Offset Suitability

The proposed offset site has been subject to past current agricultural use, with the grazing of domestic stock (sheep) ongoing. It is likely that some level of historical pasture improvement has been undertaken as evidenced by the presence of Rye Grass *Lolium* spp., Wild Oat, Toowoomba Canary-grass and Cocksfoot.

While some areas of the broader property do not support a cover of native vegetation that exceeds 25% in order to be defined as a patch of native vegetation under Victoria's native vegetation policy (DELWP 2017), the ridgelines and rocky sedimentary slopes generally support a moderate to high cover of Wallaby-grass, Spear Grass and/or Kangaroo Grass, as well as grassland herbs which achieve this threshold. As detailed in Hamilton Environmental Services (2021), these are the areas which correspond to higher abundances of GSM within the property. The area selected as the proposed offset site correlates with these areas (Figure 4; Figure 4-1 of Appendix 3).

Weed cover is typically dominated by annual introduced grasses. However, scattered occurrences of noxious weeds are present, including Spear Thistle *Cirsium vulgare and* Paterson's Curse *Echium plantagineum*. While these species are present at relatively low abundance, they retain the potential to degrade the GSM habitat present if not managed appropriately.

2.3.1 Offset Assessment Guide Calculator

The EPBC Act offsets policy (DSEWPaC 2012a) provides the details of the offsetting approach for matters of National Environmental Significance; this includes an Offset Assessment Guide and offset calculator.

The Offset Assessment Guide offset calculator (DSEWPaC 2021b) has been completed to determine the area of offset required to adequately compensate for the removal of the GSM habitat at the proposed impact site.

The Offset Assessment Guide offset calculator is provided in Appendix 1, with a justification for the scores given provided below (Table 4).

2.3.2 *Offset Calculator Justification*

Based on the EPBC Act offset calculator (DSEWPaC 2012b), the retention and management of 25.3 hectares of GSM habitat within the proposed offsite offset site as an offset mitigates 91.53% of the impact of the removal of 12.502 hectares of GSM habitat quality 4, while 13.3 hectares of GSM habitat mitigates 78.98% of the removal of 10.155 hectares of GSM quality 3 habitat (Table 2; Table 4).

Table 4. EPBC Act Offset Calculator for the Glenhope GSM Offset site

Offset Criteria	Response
Impact Site	
Impact Location	Bences Road, Merrimu.
Habitat to be removed	10.155 hectares of GSM habitat quality score of 3; 12.502 hectares of GSM habitat quality score of 4.
Habitat quality	3/10. Habitat proposed to be removed supports a relatively low cover of native and non-native grasses that comprise the species preferred food plants (generally 20-25% cover of Wallaby-grass and/or Chilean Needle-grass). Impacted habitat has been subjected to high levels of disturbance in the form of historical grazing and soil disturbance These areas also supported low numbers of GSM relative to higher quality areas elsewhere within the site. Impacted habitat is dominated by species such as Serrated Tussock, Brome Grass and Toowoomba Canary-grass 4/10. Habitat proposed to be removed supports a relatively low to moderate cover of native and non-native grasses that comprise the species p referred food plants (generally 20-30% cover of Wallaby-grass and Chilean Needle-grass). Impacted habitat has been subjected to high levels of disturbance in the form of historical grazing and soil disturbance These areas also supported low numbers of GSM relative to higher quality areas elsewhere within the site. Impacted habitat is dominated by species such as Serrated Tussock, Brome Grass and Toowoomba Canary-grass
Offset Site	
Offset location	Parcels 3C~D\PP2675 and 3E~D\PP2675, part of the broader property located at Boyers Road, Glenhope, Victoria
Risk-related time horizon	20 years. The land will be managed in perpetuity for conservation purposes for GSM.
Time until ecological benefit	10 years. The existing habitat condition is expected to be protected and maintained over the 10-year active management schedule detailed in the OMP.
Start area and quality of offset site	38.6 hectares; 5/10 (Table 3). The habitat within the offset site is considered to be of high quality, and contiguous with other areas of confirmed GSM habitat (i.e. over 100 hectares of GSM habitat). This is due to the moderate cover of key food resources (approx. 20-30% cover of Wallaby-grass, Spear-grass) present within the offset area, and the current low cover of high threat weeds or weed species that would otherwise reduce the quality of the GSM habitat. Further, the structure of the vegetation is an open native tussock grassland, with areas of bare ground and embedded and surface rock present. This combination of factors is favourable to GSM, resulting in a large population being present within the site. The definition of suitable GSM habitat has been based on information provide in the species conservation advice (DoEE 2013). The combination of habitat factors presented has resulted in the starting quality of GSM habitat being assessed as 5/10.
Risk of loss without offset	7.91%. There are currently no formal protection mechanisms that protect the ecological values present within the offset site. Without protection and ongoing management as an offset site, there is uncertainty regarding the future condition of the land. There are currently no restrictions to agricultural practices within the FZ associated with the application of fertiliser, high stocking rates, seeding areas with exotic pasture or changing the type of animal traditionally raised within a property (i.e. changing from sheep to cattle or horses). All such practices are considered as of right uses associated with land within the FZ, whether or

Offset Criteria	Response
	not such areas support native vegetation. This has the potential to result in a decline in the condition and extent of GSM habitat within the offset site and surrounding areas due to an increase in the abundance and cover of introduced pasture species such as Toowoomba Canary-grass, Wild Oat and Cocksfoot, which are not known GSM food species. Further, this is likely to result in an increase in biomass resulting in a decrease in the overall density (i.e. stocking rate) of GSM present. Based on the current absence of a formal protection mechanism on the site, there is a risk that weed invasion and pest animal disturbance will contribute to the degradation of the offset site without management actions enacted. A protective covenant provides legal protection, which would prevent any further development, thereby averting this risk of losing GSM populations within the site. Within a 10-year period, it is considered to be a 7.91% chance of that the habitat within the offset site will be subject to a reduction in quality due to the continued degradation of habitat as a result of agricultural influences. This is likely to result in a reduction in the current population of GSM as habitat within the site becomes more unsuitable for GSM. The 7.91% value is derived from Table 3, Figure 4 (Pathway C) and Appendix 1 of the Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offsets when evaluating biodiversity offset proposals under the EPBC Act document (The University of Queensland 2017), which provides a background rate of loss for Mitchell Shire Council of 7.91%.
Future quality without offset	4/10. Without protection as an offset site there is uncertainty regarding the future condition of the land. As detailed above, there are currently no restrictions to agricultural practices within the FZ, and all potential practices are considered as of right uses associated with land within the FZ. This has the potential to result in a decline in the condition and extent of GSM habitat within the offset site and surrounding areas. Without strategically designed grazing strategies, stock can overgraze/undergraze GSM host plants, leading to a shift in introduced species dominance and/or, preventing host plants from recruiting. This has the potential to result in the site condition score reducing from 2/3 to 1/3 (See Table 3) Rabbits were recorded within and nearby the offset site. Without increased management, rabbits are likely to prevent the recruitment of host plants, leading to a decline in GSM habitat. Without the establishment of an offset site, a decline in condition from a score of 5/10 to 4/10 is considered conservative for a 10-year period.
Risk of loss with offset	0%. When a site is secured and managed for offset purposes, the risk of loss is considered to decline significantly. This value is as per the guidance deriving 'Risk of Loss' estimates when evaluating biodiversity offsets proposals under the EPBC Act document (The University of Queensland 2017).
Future quality with offset	6/10. The offset site is to be secured and managed for conservation purposes in perpetuity, with implementation of a management plan incorporating weed control, biomass control and regular monitoring, aiming to enhance habitat quality for GSM. The quality of GSM habitat will be improved by actions outlined in the OMP (Appendix 3), and include: • Eliminating woody weeds which outcompete host plants for GSM and provide harbour for rabbits; • Managing all high threat weeds, reducing competition for host plants for GSM; • Reducing rabbit populations, and thereby reducing the threat posed to on-going survival and establishment of host plants by overgrazing from exotic herbivores; and, • Ensuring that grazing regimes by stock is undertaken in a manner sensitive to the habitat requirements for GSM. An elevated level of weed control and permanent application of targeted management to improve the habitat for GSM is expected to provide an improvement by elevating site condition score from 2/3 to 3/3 comprising a moderate to high cover of preferred native food plants to a cover of at least 40%. This also has the potential to facilitate an increase in the density of GSM

Offset Criteria	Response
	per hectare resulting in a species stocking rate score increase from 1/4 to 2/4 (greater than 5 moths per hectare). Proposed management actions are above and beyond both current and past management of the site. While the site is currently grazed, and has been historically grazed, the grazing periods are not managed in consideration of biodiversity values and GSM. Further, while some weed and rabbit control has occurred on the property, the level of control committed under this management plan is well beyond current management. Based on the increased management of the site, as outlined within the OMP (Appendix 3), the habitat quality and/or stocking rate of the offset site is likely to be improved beyond what the site would be without implementation of the offset.
Confidence in result	80%. Confidence in applied scores is relatively high due to careful consideration of the offset site, existing condition and evidence of the landholder's capability to manage threats through recent conservation works. The landholder is experienced in land management, having actively managed several offset sites over a number of years. The site will be protected through a TfN covenant under the VCT Act. TfN undertakes a rigorous quality assurance process for all offset sites to ensure the landowner agreements address the management commitments in the plan. 80%. Confidence in the result associated to averted loss is relatively high due to the likely effectiveness of the management and monitoring measures proposed to achieve the designated outcomes. The management measures proposed have been successfully utilised by the landowner in several other GSM offset sites and resulted in improvements to habitat quality. Further, the landowner is experienced with a demonstrated capability to manage and monitor threats through recent conservation works to ensure the objectives are achieved.
% of impact offset off-site	91.53% (of the impact of the removal of 12.502 hectares of GSM habitat quality 4 (Table 2) 78.98% (of the impact of the removal of 10.155 hectares of GSM habitat quality 3 (Table 2)

2.4 Benefit of the Impact / Offset Approach against a 'Do Nothing' Scenario

The management actions detailed in this OMP for the offset area have been designed to provide a net benefit when compared with a 'do nothing' scenario for the GSM within the impact area.

Under a 'do nothing' approach, existing land management practices would continue, without regard to the GSM population present. While the recent practices have maintained a habitat suitable for the species, there is no guarantee that this would continue in the future, as the land is not being specifically managed for the conservation of the species. Alteration of grazing pressure, or not managing the spread of weeds may have a negative impact on the GSM population.

Protection of the area as an offset site provides a degree of certainty as to the future conservation of GSM habitat and facilitates habitat improvement actions, and this removes the current uncertainty around future management actions and their impact on the species. The proposed offset will provide a net conservation benefit for the species compared with a 'do nothing' scenario.

2.4.1 Existing Offset Arrangements

The proposed offset site has not been allocated for the provision of any other offsets, either under the EPBC Act Environmental Offsets Policy or for provision of offsets under any current or past Victorian policy. Other sections of the property contain habitat and records of GSM. These sections may be subject to separate, future offset arrangements for other projects.

3 PART B: OFFSET IMPLEMENTATION

This section presents the actions required to implement the OMP. The OMP details methods for the management, conservation and improvement of native vegetation at the offset site for the benefit of the protected matter (GSM) over a 10-year period commencing from the date of registration of the covenant. These actions are required over the initial ten year period and, while the OMP may be updated after that period with approval from DCCEEW, ecological management to maintain and improve GSM habitat condition is required for a minimum 10 year period, and from thereon in perpetuity.

All works will be conducted by a suitably qualified and experienced contractor and/or the landholder. The OMP aims to achieve habitat improvement gains through on-ground actions and therefore is required to be achievable, straightforward and practical. All the management actions specified are measurable and support the offset completion criteria.

3.1 Offset Site Details

Details summarising the attributes of the offset site, including the parcel numbers and landowner details are summarised in Table 5.

Table 5. Security and Management Responsibility.

Landowner of Offset Site	Implexa Property Pty Ltd
Type of security mechanism	Covenant as to part Section 3A of the *Victorian Conservation Trust Act 1972*
Location and address of Offset Site	Boyers Road, Glenhope, Victoria
Parish	Glenhope
Standard Parcel Identifier	3C~D\PP2675 and 3E~D\PP2675
Allotment	3C Sec. D and 3E Sec. D
Local Government Area	Mitchell Shire
Council Property Number	113989 (part)
Bioregion	Goldfields

3.1.1 Security and Management of the offset site

The proposed offset site will be secured via a TfN covenant and this type of security mechanism meets the requirements under the offset policy (DSEWPaC 2012a).

For the offset site to qualify as an appropriate offset to compensate for the approved removal of suitable habitat associated with the proposed action, management actions will be undertaken to protect and improve the quality of habitat of the offset site. Management actions described below are to be implemented for a mandatory period of 10 years, and the primary objective of management, which is consistent with the Golden Sun Moth Significant Impact Guidelines (Page 7 in DEWHA 2009a), is to ensure actions that may lead to the loss, degradation or fragmentation of GSM habitat are avoided. These actions (to be avoided) include:

- Clearing of grassland or grassy woodland, including soil cultivation;

- Modification of habitat (e.g. changes to shading, wind patterns, species composition) except in accordance with the approved management actions detailed in Section 3.4;
- Management practices (e.g. changes in fire regime, slashing, mowing, increases or decreases in the intensity of a grazing regime) except in accordance with the approved management actions detailed in Section 3.4;
- Chemical application of pesticides and fertilisers. Herbicide can be used only where in accordance with this plan.

The offsets will be achieved through the active implementation of this OMP and ensuring weed levels are reduced, biomass is controlled, and cover of preferred food plants for GSM is enhanced. This will deliver improved conservation outcomes for the species, which is aligned with the objectives outlined in Golden Sun Moth Significant Impact Guidelines (DEWHA 2009).

Security, management and monitoring responsibilities are summarised in Table 6.

Table 6. Security and Management Responsibility.

Offset Security and Management Responsibility	
Who is liable/responsible for meeting offset requirements?	Bacchus Marsh Developments Pty Ltd
Type of security mechanism	Covenant as to part Section 3A of the *Victorian Conservation Trust Act 1972*
Date of Covenant Registration	TBC
Date 10-year offset management to commence	From date when TfN deed of covenant is registered on title
Offset Monitoring Responsibility	Bacchus Marsh Developments Pty Ltd
Offset Site management responsibility	Implexa Property Pty Ltd
Auditing	Bacchus Marsh Developments Pty Ltd
Reporting Responsibility (to TfN)	Implexa Property Pty Ltd
Reporting Responsibility (to DCCEEW)	Bacchus Marsh Developments Pty Ltd
Plan Review	Bacchus Marsh Developments Pty Ltd

Implementation of this management plan is the overall responsibility of BMD, which has engaged the landowner (Implexa Property Pty Ltd) to deliver the offset outcomes on BMD's behalf. However, direct management responsibility may be delegated to a designated site manager and/or managing ecologist. The approval holder (BMD) is responsible for engaging a qualified, independent ecologist to conduct monitoring (Section 3.5) with reports submitted to BMD, DCCEEW and the landowner. The landowner will provide monitoring reports to TfN.

Management actions by the landowner will be overseen by TfN as part of the legal protection over the site.

Implementation of the OMP will commence upon TfN deed of covenant being registered on title.

Funding for implementation of this OMP has been agreed between BMD, the landowner and TfN. Where appropriate, or otherwise agreed, funding will be held by the TfN and paid to the landowner over the 10-year management period as per a land owner agreement. This will include agreed funding for anticipated ongoing

management required to maintain completion criteria at the offset site in perpetuity, beyond the initial 10 year period during which the completion criteria are achieved.

3.1.2 Objectives of the Golden Sun Moth Offset Site

This plan details methods for the management and conservation of GSM habitat at the offset site over the requisite 10-year management period and into perpetuity. The key environmental objectives to be achieved through the protection and management of the offset site are:

1) Permanent legal protection of 38.6 hectares of GSM habitat;
2) Physical protection of the offset area from manageable threats including uncontrolled stock grazing, weed infestations and degradation by pest animals; and,
3) Attainment of GSM habitat condition completion criteria, as determined and measured via ongoing monitoring, auditing and reporting.

3.1.3 Performance Targets and Completion Criteria

Monitoring results will be used to determine if the following performance criteria are met, as interim outcomes and targets, prior to completion criteria being achieved. These criteria provide an indication of the success of the management measures being implemented for GSM, and serve as trigger values where failure to achieve will result in the implementation of corrective actions.

Completion Criteria

The offset calculations used to define the extent of the offset area specify an improvement in habitat condition throughout the offset site over the period of the OMP from 5/10 to 6/10 (Section 2.3.2). Habitat condition will be assessed using the habitat features known to support GSM, including the presence of an open tussock grassland structure (preferably 10-40% open ground or inter-tussock spaces) and the abundance of known food plants such as Spear-grass *Austrostipa* spp., and Wallaby-grass *Rytidosperma* spp.

By the end of the 10 year period of the OMP, the offset site must achieve the following GSM habitat condition:

- Comprise a cover of at least 40% of the species preferred food plants (Spear-grass and Wallaby-grass), with suitable biomass levels and inter-tussock space present (between 10-40%) (resulting in an increase in Site Condition score from 2/3 to 3/3); or,
- An increase in the stocking rate of GSM to greater than 5 moths per hectare (resulting in an increase in Species Stocking Rate score from 1/4 to 2/4).

The achievement of either of these criteria will result in the GSM Habitat Quality score increasing from 5/10 to 6/10.

Key Performance Targets

The key performance criteria for this OMP are:

- Preventing unauthorised stock and vehicle access into the offset site;
- Preparation of a detailed baseline report on the habitat quality and composition of the offset site against which the effectiveness of management activities can be compared;

- Establishment of eight photo points and eight monitoring quadrats to form the basis of vegetation monitoring to document changes in GSM habitat quality over time, performance in continuous improvement, and assessment against habitat quality completion criteria;
- Improving GSM habitat quality through the removal of all existing woody weeds and maintaining woody weed levels at <1% cover by the end of year 1 of commencement of the plan;
- Annual monitoring and control of woody and high threat herbaceous weeds with weed control carried out in accordance with the Management Standards for Native Vegetation Offset Sites (DELWP 2019).
- Implementation of a biomass management (pulse grazing) regime to develop and maintain an open grassland structure and to reduce the abundance of perennial weeds while increasing the abundance of grasses which are known food plants for GSM;
- An increase in the cover of native perennial grass species (i.e. Spear-grass and Wallaby-grass) to at least 40% at the end of 10 years of management;
- No increase in the baseline cover of exotic perennial grasses within the offset site at the end of 10 years of management.
- New and emerging woody weeds identified and eradicated;
- Implementation of a GSM survey monitoring and evaluation program;
- No measurable decline in the abundance and area of occupancy of GSM within the offset area after 10 years;
- Identification and removal of surface harbour for pest animals.
- Control of rabbits and foxes in accordance with the Management Standards for Native Vegetation Offset Sites (DELWP 2019) including achieving a target of no active fox dens or rabbit warrens within the offset area.
- New and emerging pest animals identified and prevented from establishing in the offset area;
- Monitoring and management of indigenous tree and shrub regeneration to ensure regeneration does not degrade the quality of GSM habitat in the offset area; and,
- Prepare annual reports detailing the monitoring and management actions and outcomes outlined in this OMP

Key performance criteria, completion criteria and corrective actions for each of the listed management actions are provided in Section 3.4.

3.2 Ongoing Management Commitments

The offset site will be managed for the conservation of GSM. From the commencement of the approved OMP and conservation agreement, the landowner agrees to undertake the following management commitments in perpetuity:

- Eliminating all woody weeds through continuous detection, treatment and infestation prevention;
- Weed cover is managed in perpetuity to ensure it does not increase beyond the level attained at year 10 of management;

- Prevent the spread of, and as far as possible, eradicate pest animals (i.e. rabbits, hares and foxes) from the offset site;
- Retaining all existing standing trees, dead or alive;
- Retaining fallen logs and fallen branches;
- Exclude stock except as otherwise specified under this approved plan;
- Exclude the use of stock feed such as hay or other material which could support weed seeds that is sourced from outside the offset area. Sterile feed such as pellets may be sourced externally; and,
- Exclude pasture improvement (but not ground cover rehabilitation to increase the cover of native grasses and herbs), and cultivation for commercial cropping.

3.3 Adaptive Management Approach and Risk Assessment

This OMP will use an Adaptive Management Approach to allow the flexibility to respond appropriately and effectively to the uncertainties involved in ecological processes. This will ensure that management objectives are being met while allowing for altered circumstances to be included in the OMP.

Of particular note, weed invasion and inappropriate grazing regimes (overgrazing, or loss of inter-tussock space due to undergrazing/lack of fire) are two of the main demonstrated threats to GSM (DEWHA 2009a; 2009b; DAWE 2021).

This OMP addresses these demonstrated threats by including management actions aimed at reducing the likelihood of weed invasion. The plan includes a basic strategy (pulse grazing) for ground-cover biomass control which is considered a major ecological management requirement for the site. Where this fails to deliver the prescribed outcome in any one year, ecological burning provides an option to achieve the required biomass management target (i.e. maintaining an open grassland environment dominated by native species). The application of one or both management actions will provide the biomass control outcome required.

It is acknowledged that the response of natural environments to management can be unpredictable and management activities need to be flexible to respond to changing conditions and unpredictable events.

Seasonal conditions can also vary greatly from year to year and influence offset site management actions in any one year. This seasonality is recognised in this offset plan by allowing for flexibility around timing of actions at the discretion of the land manager in consultation with TfN to attain and maintain performance and completion criteria.

There is some risk that biomass control is not properly managed in any one year. This has the potential to occur in response to above average rainfall years when ground cover growth is persistently high and wet conditions restrict stock access or limits opportunities for the application of ecological burning to reduce biomass. If such events occur, the land manager will ensure additional efforts are made by in subsequent years to maintain the rate of improvement required.

Examples of potential risks are outlined in Table 14. Key risks identified in Table 14 include:

- Unauthorised entry of domestic stock or vehicles into the offset area;
- Woody weed infestations;

- Failure to detect and control new infestations, as well as failure to reduce existing infestations;
- Failure to increase the species composition and density of perennial native grasses;
- Rabbit infestations;
- An unexplainable decline in the abundance of GSM.

Failure of the adaptive management approach to adequately respond to risks, as identified in monitoring reports (Section 3.6) or audits (Section 3.7), will result in a review of this plan, as discussed in Section 3.8 and Table 13.

3.4 Management Actions and Land Use Commitments

The following section discusses the actions required to implement the OMP, and achieve the performance objectives by Year 10 management actions described below are to be implemented for a mandatory period of 10 years, however, a five-year review will be undertaken to ensure that the management actions will result in the performance targets being achieved.

There are several standard actions that must be followed if the offset site is to be considered suitable as an offset site. These include:

- No cropping, no drainage/hydrology alteration;
- No rock removal or cropping;
- Weed cover is managed in perpetuity to ensure it does not increase beyond the level attained at year 10 of management; and,
- GSM habitat extent is maintained.

Any proposed uses or development of the site which conflict with the landowner's commitments are not permitted under this plan. The sensitivities of the site must be considered with all management actions and all contractors entering the site need to be made aware of the values.

The following management and monitoring actions detailed in this OMP have regard to the following legislations and/or policies:

- *Environment Protection and Biodiversity Conservation) Act 1999;*
- *Flora and Fauna Guarantee Act 1988* (FFG Act)*;*
- *Catchment and Land Protection Act 1994* (CaLP Act)*;*
- Commonwealth's Threat abatement plan for competition and land degradation by rabbits (DoEE 2016);
- Significant impact guidelines for the critically endangered golden sun moth (Synemon plana) (DEWHA 2009)
- Approved Conservation Advice for *Synemon plana* (Golden Sun Moth) (DAWE 2021)

Further, the actions contained in this OMP address several Priority Actions included in the conservation advice (DAWE 2021) that will be undertaken to support to recovery of GSM, including:

- Habitat Loss, Disturbance and Modification:

- Investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate and/or secure inclusion in reserve tenure if possible;
- Minimise disturbance in areas where the GSM occurs, excluding necessary actions to manage the conservation of the species. Retain and protect natural grassland remnants within the known distribution of the species;
- Do not destroy habitat and surrounding areas by ploughing;
- Ensure remnant populations remain connected or linked to each other; in case where remnants have become isolated, consider revegetation to re-establish links and aid dispersal;
- Monitor known populations to determine the species' status;
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary; and,
- Identify populations of high conservation priority. Search for the species in suitable habitat in areas that are proposed for development.

- Invasive Weeds
  - Control invasions of environmental weeds and pasture species, and consider the impact of herbicide use in habitat. Where possible, use methods that directly target weeds such as spot spraying, and hand removal to minimise the adverse impact on GSM.
- Trampling, Browsing or Grazing
  - Manage the extent and intensity of grazing to minimise any direct adverse effects on the GSM or its habitat. Indeed, the proposed grazing regime will be suitable for GSM persistence and spread across the site.

Prior to works being undertaken each year an annual works program will be developed by an experienced bushland regenerator or the landowner. The person undertaking the works will prepare a detailed works program which will also address issues that may not have been anticipated in formulating this original management plan. The OMP will be updated as required (as detailed in Section 3.8) with any revised versions of the OMP to be submitted to the DCCEEW for approval.

3.4.1 Access Control

Without active management and appropriate fencing, unrestricted access into the offset site may result in loss of native vegetation cover, soil disturbance and compaction, and weed facilitation.

The property boundary is currently fenced. There is no requirement to provide additional fencing for the offset area, as it is located within a fully fenced property. Monitoring of fence condition will be undertaken on a quarterly basis, with fencing repaired or upgraded as required to control threats.

The boundary of the offset site will be set up at the beginning of the offset period to clearly identify the area for monitoring and management purposes.

If existing land-use rights are to be fully exercised in the remainder of the broader parcel, fencing to control stock access to the offset site will be required. Fencing will meet the minimum standard set by DEECA's fencing

standards in DEECA's Management standards for native vegetation offset (DELWP 2019), to establish a sturdy stock proof fence. If rabbit populations impacting the site cannot be controlled to an adequate level (based on advice from TfN) then fencing protecting the offset site will be upgraded to a rabbit proof standard.

A 20 metre buffer will be established around the existing two farm dams located within the offset site to enable the enable construction of a perimeter fence to enhance ecosystem services and biodiversity (Figure 4).

Performance Criteria and Corrective Actions

Table 7 provides a summary of the performance criteria and corrections actions associated with access control. Implementation of access control measures within the offset site is the responsibility of the landowner. Monitoring is the responsibility of BMD.

Table 7. Performance criteria and corrections actions associated with access control.

Performance Criteria	Corrective Action	Completion Criteria
Preventing unauthorised stock and vehicle access into the offset site	Any damage to fencing that allows unpermitted stock, personnel or vehicle access must be repaired within seven days from identification	No unpermitted access within the offset site, by personnel, vehicles, or stock
Quarterly monitoring of fence condition is to be undertaken	If rabbit populations impacting the site cannot be controlled to an adequate level (based on advice from TfN) then fencing protecting the offset site will be upgraded to a rabbit proof standard. If unauthorised stock are observed within the offset site, monitoring and repair of stock-proof fencing must be undertaken around the offset site (or broader parcel) within 2 weeks to address identified risks	Exclusion of rabbits and unauthorised stock from the offset site.

3.4.2 Weed Control

The objective of weed control within the offset site is to enhance the existing GSM habitat by reducing the current cover of high threat weeds, and manage any future invasion of the offset site by exotic flora. This will be achieved through a combination of controlled pulse grazing (to limit opportunities for weed establishment and seed set in exotic flora), and through on-ground management activities.

The control of weed species is a key management action across the offset area and is critical to the maintenance of indigenous vegetation cover and species diversity. Effective weed control will promote the regeneration of existing populations of indigenous species and encourage recruitment from soil seed banks. Weed control work will be undertaken by a suitably qualified contractor or someone with proven plant identification skills.

The following general guidelines should be considered as basic management principles regarding weed control:

- Any weed control should be done in a manner that minimises soil disturbance and damage to off-target species;
- Where herbicide application is necessary, waterway sensitive products such as Roundup Biactive®, Weedmaster Duo® or Weedmaster 360® should be employed, without the addition of surfactant;

- Where herbicides are used, selective application is preferable to broad area application but clearly the loss of non-target species needs to be balanced with the threat of incomplete control of the existing weed population;
- Selective herbicides and those that kill plants quickly and are rapidly inactivated, leaving no residues ('knockdown' herbicides) are generally preferable to residual herbicides;
- Pest plants that reproduce sexually (by seed) are best controlled before seed ripens;
- To reduce the amounts of herbicide used, the target biomass should be reduced (e.g. grazed) before application so the herbicide can also be absorbed by the actively regrowing plants. Herbicides are only effective when plants are actively growing;
- Weed control works should be monitored regularly to assess their effectiveness, perform follow up works and evaluate the feasibility of management objectives; and,
- Weed control works following grazing periods are considered essential.

Woody Weeds

Few woody weeds are present on the offset site. Monitoring for new and emerging woody weeds will be conducted throughout the year for the term of the agreement, and all woody weeds will be controlled and removed by the end of Year 1 of the OMP. Any new and emerging woody weeds will be removed on an ongoing basis.

Herbaceous Weeds

Whilst the ultimate objective is to ensure no increase in the existing cover of weed species, emphasis will be placed on priority weeds within the offset site. Priority weeds include woody weeds, all noxious weeds listed under the *Catchment and Land Protection Act 1994* (CaLP), and all other high threat weed species identified on site (Table 8).

The control of high threat and listed noxious weed species is a key management action within the offset site and must be adequately addressed if the completion criteria are to be achieved. Monitoring will occur every year to ensure that high threat weed cover is reduced. Weeds will be treated before the plant has flowered and set seed using the methods outlined in Table 8 or as otherwise approved by TfN.

Annual weeds within the offset site are not considered a significant threat in this environment and will be managed using grazing to reduce their prominence.

The cover of species within the offset site is likely to change over time in response to seasonal conditions, or because of pulse grazing. Weed cover and species will therefore be monitored and management adapted in response to achieve desired outcomes outlined in this management plan.

Weed control will consist of manual removal and/or spot spraying with an appropriate herbicide which may involve localised slashing if spot-spraying proves ineffective. A dye will be used in the spray to mark where the spraying has occurred.

Care must be taken when spraying herbicide to ensure that the poison does not affect native vegetation in the local application area.

New and emerging herbaceous weeds

Monitoring for new and emerging herbaceous weeds will be conducted throughout the year for the term of the agreement, and any new and emerging high threat weeds controlled.

Any other significant environmental weeds identified within the broader property during monitoring will also be controlled. Other high threat weeds, such as Chilean Needle-grass *Nassella neesiana*, which is known to occur in the region, but was not identified within the proposed offset site, will be controlled should the species be detected on the site.

Table 8. Herbaceous weeds to be controlled – method and timing.

Common name	Scientific name	Method	Timing
Spear Thistle *	*Cirsium vulgare*	Manual Removal, Annual Spraying (before seeding)	All Year (removal); late winter to early summer (spray)
Cocksfoot *	*Dactylis glomerata*	Spot Spray before seeding; Controlled pulse crash grazing by sheep.	Late winter to early summer
Serrated Tussock *	*Nassella trichotoma*	Spot Spray before seeding	Late winter to early summer
Long Stork's-bill	*Erodium botrys*	Spot Spray before seeding; Controlled pulse crash grazing by sheep.	Late winter to early summer
Perennial Rye- grass *	*Lolium perenne.*	Spot Spray before seeding; Controlled pulse crash grazing by sheep.	Late winter to early summer
Yorkshire Fog *	*Holcus lanatus*	Spot Spray before seeding; Controlled pulse crash grazing by sheep.	Late winter to early summer
Toowoomba Canary-grass *	*Phalaris aquatica*	Controlled pulse crash grazing by sheep to prevent seed set; spot spraying of herbicide;	Summer, Autumn (grazing) Spot Spray (Late winter to early summer)
Brown-top Bent *	*Agrostis capillaris*	Controlled pulse crash grazing by sheep to prevent seed set; spot spraying of herbicide;	Summer, Autumn (grazing) Spot Spray (Late winter to early summer)
Ribwort	*Plantago lanceolata*	Manual Removal, Annual Spraying (before seeding), Chip.	Summer, Autumn (grazing) Spot Spray (Late winter to early summer)
Bromus *spp.**, *Aira* spp., *Briza* spp., *Avena* spp., Sweet Vernal-grass, *Vulpia* spp.	Annual Grasses	Controlled pulse crash grazing by sheep to limit opportunities for weed establishment; spot spraying of herbicide.	Summer, Autumn (grazing) Spot Spray (Late winter to early summer)

Note: this is not an exhaustive list of all weeds either present or that have the potential to occur on the site in the future; * High threat weeds.

Performance Criteria and Corrective Actions

Table 9 provides a summary of the performance criteria and corrections actions associated with weed control. Implementation of weed control measures within the offset site is the responsibility of the landowner. Monitoring is the responsibility of BMD.

Table 9. Performance criteria and corrections actions associated with weed control.

Performance Criteria	Corrective Action	Completion Criteria
Preparation of a detailed baseline report on the habitat quality and vegetation composition of the offset site against which the effectiveness of management activities can be compared		Baseline assessment and report prepared by the end of Year 1.
No increase in the cover of high threat weeds at the end of each year of management compared to baseline cover.	Immediate and intensive weed control program with an increased monitoring frequency for the next year of management, or until the performance criteria achieved	No increase in the cover of high threat weeds at the end of Year 10 compared to baseline cover
Woody weeds eliminated (i.e. <1% cover) by the end of Year 1	Immediate and intensive weed control program with an increased monitoring frequency until performance criteria achieved	Ecological monitoring data shows no woody weeds within the offset site beyond Year 1
No establishment of any new or emerging high threat weeds;	Any populations of new and emerging high threat weeds will be treated promptly (within 1 month) and eliminated.	Ecological monitoring data shows all new high threat weeds are controlled and eliminated prior to establishing.

These performance indicators have been selected as they are measurable and reflect the priority actions as outlined within the Conservation Advice (DAWE 2021) and Significant Impact Guidelines (DEWHA 2009, p4). These performance indicators must be recorded during the baseline assessment and ongoing annual site monitoring and included within annual reports (Section 3.6).

3.4.3 Biomass Control

The objective of biomass control within the offset area is to promote the floristic diversity through the provision of inter-tussock space for germination and recruitment of native flora associated. In addition, these actions will improve habitat quality for GSM and assist with minimising the weed growth.

Biomass control will aim to maintain 10% to 40% cover of bare ground or inter-tussock space to maintain optimal vegetation structure for GSM, and allow sufficient space for recruitment of herbs and grasses. If GSM habitat is less than 10% bare ground then biomass reduction will be implemented at the earliest opportunity (with consideration of seasonality to minimise risk to ecological values, life and assets).

The independent ecological monitoring undertaken by a suitably qualified ecologist will assess the effectiveness of the biomass control techniques applied and the need for any adjustments to the management regime to achieve or maintain the completion criteria.

Controlled sheep grazing will be applied to reduce biomass and maintain an open tussock-grass structure for this grassy ground cover.

If appropriate, ecological burning can also be utilised as a biomass control method.

Controlled Grazing

The offset property has historically been subject to unrestricted grazing. Unrestricted grazing regimes have the potential to result in substantial alterations in the vegetation structure, levels of biomass present, as well as facilitate unwanted shifts in flora species diversity, dominance and/or distribution within a site. At Boyers

Road, substantial changes in the vegetation structure and/or cover of Wallaby-grass are likely to be unfavourable to GSM.

Sheep grazing to reduce biomass is reliable to improve the ecological values within the offset area. Grazing will be undertaken in a controlled manner to ensure that biomass accumulation control within the offset site is consistent with the standards for management of ecological grazing provided by DELWP (DSE 2009). Specifically, the following standards as detailed in DSE (2009) will be applied:

- Existing woodland/treed areas will be designated stock exclusion zones, with an area twice the canopy diameter of trees protected from stock to allow natural recruitment to occur (See Figure 5);
- To reduce the risk of introducing and spreading weeds, livestock will be held in a stock pen for a minimum period of 24 hours prior to entering the offset site.

Grazing of domestic stock will be restricted to the use of sheep. Grazing by other domestic stock, including, but not restricted to, cattle, goats and horses are excluded from the offset site by this plan.

It is proposed that sheep grazing continue under a modified regime designed to provide improved conservation of the ecological values of the Offset area. This modified regime is referred to as 'pulse grazing' in this OMP. The term 'pulse grazing' (also referred to as 'crash grazing') is used to describe grazing that occurs at high intensity for a short period of time, followed by a period of rest. The pulses can be repeated multiple times within a season to manipulate the growth patterns of particular types of grasses or herbs and therefore favour desirable species in preference to undesirable species (e.g. weeds).

The timing of grazing will be controlled to allow native species to grow and set seed over the spring to midsummer period (DSE 2009). Stock will be excluded or only occur at very low levels (i.e. less than 20% of recommended stocking rates) from the beginning of October to the end of December annually, for the life of the OMP. However, this period will be flexible to reflect the prevailing climatic conditions and allow the period of grazing exclusion to be varied on ecological advice.

The timing of grazing must be strictly controlled to preventing pugging and other soil disturbance within the offset site, and to enhance opportunities for native grasses to grow and set seed during Spring and early Summer.

The landowner will keep records of the number of stock, timing and duration of grazing within the offset area. This data will be provided to the TfN on an annual basis as part of the Landholder monitoring and reporting process. This data and the resultant impact on biomass will provide the basis for an on-going grazing strategy to be approved by the TfN or an independent ecologist approved by the TfN.

A summary of grazing management is provided below (Table 10).

Table 10. Grazing Management Plan within the offset site.

Grazing Requirement	Targets
Period where grazing by domestic stock is not permitted	Stock will be excluded or only occur at very low levels (i.e. less than 20% of recommended stocking rates) from the beginning of October to the end of December annually, for the life of the OMP, in addition to times outside this period when standing water is present, or soil is waterlogged.

Grazing Requirement	Targets
	However, this period will be flexible to reflect the prevailing climatic conditions and allow the period of grazing exclusion to be varied on ecological advice.
Biomass management thresholds	Minimum height of 5 cm; total vegetation cover of no less than 60% or greater than 90%
Target inter-tussock space	Between 10-40% of total offset site cover.

Grazing may only be undertaken when there is not standing water or waterlogged soils in the GSM offset area (Table 10).

Stock must be removed should total vegetation cover fall to or below 60%. Stock pens and heavy vehicle traffic must be confined to the areas outside that covered within this OMP. Following any high rainfall events that result in standing water being present within the offset site, stock will be removed from the affected area of the offset site immediately.

Ecological Burning

Burning within the offset area will be undertaken only with due consideration to relevant health and safety issues and in line with a fire management plan completed by a suitably qualified consultant and registered with Fire Permits Victoria. The following provides guidelines for use of burning only in an ecological sense.

While grazing by domestic stock will be the typical manner in which ground cover biomass will be regulated, the controlled application of fire is an efficient and cost-effective alternative technique for reducing biomass in grassy ecosystems such as those that occur within the offset site. Importantly, burning (compared to grazing or slashing) allows greater access and efficiency for weed control and increased natural regeneration of indigenous plant species. While burning may enhance germination of indigenous species, it can also be expected to promote certain exotic species and as such post-burning weed control will be vital to effective weed control. However, stimulating the soil-stored weed seed bank is seen as positive as this allows this seed bank to be exhausted through active management.

Burning is acknowledged as an important component of the natural disturbance regime in grassy ecosystems but because of the habitat requirements for GSM, burning will be restricted to outside the GSM flight season (generally mid-October to January in Victoria). This allows management to be consistent with the relevant conservation advice.

The controlled application of fire can be used for biomass reduction in all or parts of the offset site. Selected areas of grassland may be burnt to tackle particular weed issues or to assist in the lowering of soil nitrogen and phosphorous which would also assist in weed control works. However no area is to be burnt more frequently than once every three years (unless approved by TfN in consultation with a qualified ecologist).

Burning will be conducted in a mosaic pattern and any individual burn will not burn more than one third of the entire offset site. The landowner will prepare maps identifying the fire history of the offset area to ensure biomass control efforts are at appropriate frequencies and recorded. Details of fire and grazing within the offset will also be documented in the annual reporting as outlined in Section 3.6.

Any burning strategy will minimise impacts to GSM and the potential for fire to spread in an uncontrolled manner. Ecological burning will:

- Be in accordance with a controlled burn plan registered with Fire Permits Victoria;
- Be applied when grazing is deemed insufficient to manage biomass;
- Only occur outside the prescribed declared fire danger period for this region;
- Only occur outside the flight season of the species (October to January) in autumn or early winter;
- Implemented in a mosaic fashion with no more than one third of the site in any one year; and,
- Be monitored, measuring the extent of burns and influence on GSM habitat quality.

Except on the advice from an ecologist, burnt areas will be protected from stock grazing for at least 4 months immediately following the burn to allow species regeneration and recruitment to occur. Unless advised by an ecologist, a cover of ground-storey vegetation above 70% is required before grazing can be re-introduced.

Access control and pest animal control measures (as detailed in Section 3.4.1 and Section 3.4.4 respectively) must be undertaken every 4 weeks post burning event for 4 months to ensure other herbivores (i.e. rabbits) are excluded from the area subject to the burning event to facilitate regeneration and recruitment post-fire.

Performance Criteria and Corrective Actions

Table 11 provides a summary of the performance criteria and corrections actions associated with biomass control. Implementation of biomass control measures within the offset site is the responsibility of the landowner. Monitoring is the responsibility of BMD.

Table 11. Performance criteria and corrections actions associated with biomass control.

Performance Criteria	Corrective Actions	Completion Criteria
Inter-tussock space (bare-ground) to be no less than 5% throughout offset site (on average)	If inter-tussock space falls below 5%, immediate implementation of biomass control will be implemented at the earliest opportunity (with consideration of seasonality to minimise risk to ecological values, life and assets)	Average of between 10%-40% inter-tussock space (bare-ground) after 10 years.
	Ecological burning can be applied when grazing is deemed insufficient to manage biomass;	
Vegetation cover not to fall below 60%, or minimum height of 5 centimetres due to grazing.	Stock must be removed immediately should total vegetation cover fall to or below 60%, or grazed lower than 5 centimetres (in the area being grazed).	Vegetation cover maintained at between 60%-80% cover at the end of each 12 month monitoring period.
No evidence of soil pugging in offset area	Following any high rainfall events that result in standing water being present, stock will be removed from the affected area within the offset site immediately. Grazing must not resume where there is standing water or waterlogged soils.	Vegetation and soil structure in offset site maintained.
Burnt areas protected from grazing for at least 4 months.	Unless advised by an ecologist, a minimum 70% vegetation cover is required before grazing can be re-introduced. Exclude other herbivores from burnt areas.	Allow species regeneration and recruitment to occur post burning event

These performance criteria have been provided to meet the conservation outcomes for GSM, as outlined within the Conservation Advice (DAWE 2021) and the Significant Impact Guidelines (DEWHA 2009, p4). These performance criteria must be recorded during site monitoring and included within annual reports (Section 3.6).

3.4.4 Pest Animal Control

Rabbits and hares remain a threat for the regeneration/recruitment of native species throughout western Victoria. All vermin harbour (i.e. burrows) will be treated, without disturbance to native vegetation or significant soil disturbance.

Foxes are a threat to native fauna and will be controlled if found on the property. Fox dens where present will be destroyed through fumigation and hand collapse.

Any observations of pest animals within the offset site during other activities will be recorded. The landowner/contractor will monitor pest animal use of the offset site whilst undertaking vegetation management works. The presence and abundance of each pest species will be included in the annual report. Control works will ensure that the abundance of any pest species is maintained at low to negligible levels.

Active control works targeting pest animals are not expected to have any negative impact on GSM located at the offset site. The landowner will monitor and control rabbits, hares and foxes all year round as well as any new and emerging pest animals.

Any changes in the influences of pest animals may require a change in the management actions.

Performance Criteria and Corrective Actions

Table 12 provides a summary of the performance criteria and corrections actions associated with pest animal control. Implementation of pest animal control measures within the offset site is the responsibility of the landowner. Monitoring is the responsibility of BMD.

Table 12. Performance criteria and corrections actions associated with biomass control.

Performance Criteria	Corrective Actions	Completion Criteria
Monitoring for rabbit activity to be undertaken concurrently with vegetation management activities.	Any rabbit warrens are controlled immediately following detection. Review effectiveness of rabbit control.	Rabbit activity appropriately controlled (i.e. no active rabbit warrens) within offset site by Year 5.
Monitoring for fox activity to be undertaken concurrently with vegetation management activities.	Any fox dens recorded within offset site are destroyed immediately (hand collapse and fumigation) following detection. All fox harbour removed from offset site on detection.	Foxes appropriately controlled (i.e. no active fox dens or fox harbour) within offset site by Year 5.

Any evidence of pest animal activity must be recorded during the baseline assessment and any pest animal monitoring and management activities must be effectively documented, and included within annual reports (Section 3.6).

3.5 Monitoring

3.5.1 Baseline Monitoring

Vegetation Monitoring

While the condition of the broader area of grassland was noted during the initial site visit conducted by Ecology and Heritage Partners in 2020, details of the specific matters relating to the selected offset area will be established by the collection of baseline condition data. These data will provide the baseline information for future comparisons and assessments to define the efficacy and progress of the management of the offset site to achieve the performance targets and completion criteria.

Within the first Spring/Summer following the EPBC approval and prior to the commencement of any management activities a suitably experienced ecologist will systematically survey the site and collect information on the flora species (native and introduced) present and maintain a complete list of all vascular species observed. Notes will be taken on the distribution and location of weed species with GPS waypoints recorded to provide detailed information on the location, extent and severity of target pest plant infestations. This information will be mapped to provide a guide to both management activities and allow a visual assessment of management progress over the life of the plan.

GPS locations will be recorded and mapped to identify the location of any threatened species observed and the location of any other survey and monitoring infrastructure (i.e. photo points).

Improving the abundance and cover of Spear-grasses and Wallaby-grasses identified in the baseline vegetation condition assessment will be taken as improving the relevant food resources for GSM. The abundance of these plant genera will be measured annually. Improving these levels will be taken as the improvement of food resources for GSM, and contribute towards meeting the performance and completion criteria.

The Baseline report will be provided to the Commonwealth, the Landowner and TFN.

Golden Sun Moth

Baseline monitoring of the GSM population within the offset site will occur in the first flight season after the registration of the TfN deed of covenant on title. Monitoring will record the location and number of individuals observed along monitoring transects as described below (Section 3.5.2).

The baseline data will establish the species density (i.e. species stocking rate) within the offset site, and will allow comparison against the results of subsequent years' survey to understand the effectiveness of site management to facilitate the persistence of the population of the species within the offset site.

3.5.2 Golden Sun Moth Monitoring

GSM populations are known to vary on spatial and temporal scales depending upon habitat conditions at a site. Monitoring is required to determine if GSM has persisted on the offset site and to ensure that management actions and habitats are suitable for a viable GSM population in the future.

The monitoring and reporting of GSM populations within the offset site is the responsibility of the approval holder (BMD). Monitoring of GSM populations will be undertaken every second year (i.e. Year 2, 4, 6, 8 and 10) for the duration of the OMP to evaluate the persistence and relative abundance of GSM within the offset site against the baseline data.

Specific GSM survey procedures will follow those approved monitoring guidelines for GSM prepared by the Commonwealth (DEWHA 2009a). The following measures will be undertaken as part of population and habitat monitoring for GSM:

- Collection of baseline data to be used as a reference point to assess the impacts of management actions. This action will comprise targeted GSM surveys undertaken throughout the offset site in Year 1 (Section 3.5.1);
- Surveys are to be conducted by suitably trained observers;
- Surveys must take place during the species' flight season. In western Victoria this is generally mid October to early January;
- A minimum of four surveys must be undertaken during conditions suitable for detecting the species. Male moths generally fly between 9am and 4pm on warm (over 20˚C by 10am) days with minimal cloud cover and still conditions. However, if males are observed flying after 3pm or during moderately windy conditions surveys can continue until males are no longer observed flying; and,
- Surveys will be conducted using 50-metre wide, parallel transects with observers walking or driving in a car at < 10 km / hour (flying male moths can be readily seen from a vehicle).

Tracks will be recorded using a GPS and a waypoint taken for each location where GSM are observed. Any obvious changes to the habitat characteristics of the offset area will be recorded during the GSM survey. This will be supported by relevant photos of the habitat or management issues identified.

As the species is known to occur at the offset site no reference site is required for monitoring the population of GSM. However, prior to surveys being conducted, reports of GSM flying in or around Melbourne or within the broader locality of the offset site are likely to provide a useful indicator to identify the start of the flight season around Glenhope.

Habitat Quality Calculations

Ongoing monitoring of the GSM population will quantify the stocking rate of the species within the offset site.

An increase in species stocking rate to > 5 moths per hectare will result in the habitat quality score increasing from 1/4 to 2/4 for species stocking rate, achieving one of the two completion criteria of the OMP (See Section 2.2.3 and 3.1.3).

3.5.3 Vegetation Monitoring

The vegetation monitoring against the targets of this OMP within the offset site is the responsibility of the approval holder (BMD). Detailed vegetation monitoring will be conducted by a qualified ecologist for an initial four-year period, and then in years 6, 8 and 10 of this management plan.

Weed monitoring will be conducted between spring – early summer (September – December). There will be three components to the monitoring:

- Inspection of the entire offset area by a suitably qualified ecologist for woody weeds, by walking and/or driving throughout the area such that a visual inspection (including with binoculars) would detect the presence of any woody weeds. All patches of infestations or individual plants will be mapped with a GPS, and the locations will be supplied to the weed management

contractor/landholder for treatment. Subsequent monitoring will then revisit previously mapped/identified infestations to evaluate the success of weed control, as well as inspecting the entire offset site for new infestations.

- While conducting the woody weed surveys, notes will be taken regarding the presence of any herbaceous weed infestations, and cover will be estimated to the nearest five percent. Species and areas suitable for targeted treatment (such as spot spraying), will be mapped and supplied to the weed management contractor/landholder for treatment.
- A minimum of eight five by five metre quadrats will be established in selected locations across the offset site. Each monitoring quadrat will be representative overall vegetation composition in that area of the offset site. These quadrats will be used to assess and record the:
    - percentage % total vegetation cover;
    - percentage % cover of inter-tussock spaces and % cover bare ground;
    - floristic composition (with a focus on GSM food species and weed species);
    - total % cover GSM food species, % native and exotic grasses, % Wallaby-grass and Spear-grass cover;
    - % cover of Chilean Needle-grass;
    - grassland structure and biomass using the 'golf-ball' method (Morgan 2015);
    - average height of vegetation (and grasses/GSM food species); and
    - the cover of native and exotic life-forms.
- The permanent vegetation monitoring quadrats established by the botanist will also serve as permanent photo points. Photo points will be located to adequately characterise the current vegetation condition, and include a range of weed species. Using a selected marker point for the vegetation monitoring quadrat, a photo will be taken facing the four points of the compass (N, S, E and W). These baseline photos will be used to provide a visual document and for monitoring the vegetation response to management.
- Signs of pest animals (rabbits, hares and foxes) will be recorded during weed monitoring surveys, and at all other times when visiting the offset site. In particular, the locations of any active rabbit warrens will be mapped using GPS, and the locations supplied to the pest animal management contractor/landholder for treatment. Subsequent monitoring will then revisit previously mapped warrens to check for on-going use, as well as searching for new warrens throughout the offset area.

Habitat Quality Calculations

Ongoing monitoring of the vegetation will quantify the site condition score within the offset site.

An increase in the cover of native species comprising the preferred food source for GSM (i.e. Spear Grass and Wallaby-grass) to at least 40% will result in an increase in the site condition score from 2/3 to 3/3, achieving the completion criteria for the OMP (See Section 2.2.3 and 3.1.3).

Improvement in the cover of Spear Grass and Wallaby-grass improve the quality of food resources for GSM. It is anticipated that the weed control and biomass management works undertaken as per the OMP will facilitate the increased recruitment and establishment of Spear Grass and Wallaby-grass.

3.6 Reporting

3.6.1 Reporting to the Commonwealth

This OMP requires the BMD to submit a report to Commonwealth after years 1 - 4, 6, 8 and 10 of monitoring and management. The reports will include the results of the monitoring detailed in Sections 3.5.1 – 3.5.3 and a review of past management works against the objectives contained within this OMP at Section 3.1.2, and performance targets detailed in Sections 3.1.3, 3.4.1, 3.4.2, 3.4.3 and 3.4.4. Future management priorities will also be detailed in these reports.

Reports should provide enough detail in the form of written comments and supporting evidence that an assessor can easily determine the completion of/progress against the commitments for the offset site.

Information to be provided in the report includes:

- Results of GSM population monitoring;
- A description of the specific monitoring results from ecological surveys undertaken;
- Results of weed and pest animal monitoring;
- Assessment against the performance targets;
- Any problems or issues experienced (i.e. new infestation of weed species, etc.);
- Any corrective actions and contingency measures where monitoring indicates that there has been a deterioration in the native vegetation or GSM population;
- Photo points; and,
- Assessment on how the site is on track to meet, or meets the conditions under the EPBC referral (EPBC 2018/8271).

If any agreed management actions or commitments are incomplete or have not been undertaken in the times specified, the landowner is to document the justification and the substituted actions that will be undertaken in order to compensate and ensure the required outcomes are achieved.

Reports are to be submitted by BMD to the Commonwealth by the anniversary date of the registration of the TfN deed of covenant on-title. Reports will also be published online by BMD within 3 months of every 12 month anniversary where reporting is required.

3.6.2 Reporting to Trust for Nature

An Annual Report relating to fencing, weed control and pest animal control, and revegetation will be provided by the landowner, and submitted on an annual basis to TfN two months prior to the anniversary of the TfN deed registration on title. Annual Reports will provide sufficient detail in the form of written comments and supporting evidence that an assessor can easily determine the completion of/progress against the management commitments. Information to be provided in the reporting form includes:

- A copy of the Management Action Table from the OMP with information on which actions have been completed for year/s of this reporting period;
- Extent (area) of weed and pest animal control, indication of the success or failure;
- Any corrective actions and contingency measures where monitoring indicates that there has been a deterioration in the native vegetation or GSM population;
- Provide photographs showing evidence of works; and
- Identification and management of current, new and emerging threats to GSM habitat.

If any agreed management actions or commitments are incomplete or have not been undertaken in the times specified, the landowner is to document the justification and the actions that will be action/s will be undertaken to implement the requirement. All records/evidence of management actions will be maintained and provided to TfN upon request.

Copies of all annual monitoring reports (see Section 3.6.1) will also be provided to the landowner and TFN.

The landowner will also provide annual reports to BMD for review as part of the preparation of reports to the Commonwealth.

3.7 Audit

The approval holder (BMD) is responsible for auditing the implementation and effectiveness of the OMP. Audits will be conducted by an independent ecologist at the following stages:

- At the end of the first year of site management - this is to ensure that initial management and monitoring actions are conducted to the satisfaction of the approval holder and DCCEEW, including implementing the legal security mechanism, ensuring the property is securely fenced, and that other initial management and baseline monitoring actions have commenced.
- At the end of the fourth year of site management – this will involve a review of four annual monitoring and management reports, as well as an independent assessment of the condition of GSM habitat within the site.
- At the end of the eighth year of site management – as per the four year audit.
- Following the completion of the 10th year – to be an audit of the implementation and effectiveness of this OMP.

The timing of scheduled audits is detailed in Table 13. Additional audits may be triggered as a result of a plan review (Section 3.12) or following an environmental incident resulting in significant change to site conditions, as identified in the risk assessment (Table 14).

3.8 Review

This plan includes an adaptive management approach, where corrective actions may be triggered by events occurring within the offset site, or the results of monitoring activities. A review of the OMP will only be necessary in the event of a major incident that makes a significant change to the character or condition of the offset area. The most likely such event is a major wildfire or drought, as described in Table 14.

If a plan review is triggered, this will be conducted by BMD in consultation with the offset site owner and DCCEEW. Any future adaptive management changes will be incorporated into the OMP and an updated version of the OMP will be supplied to DCCEEW for approval.

The OMP review will involve changes to any part of the OMP, in order to adequately respond to the trigger and re-direct management actions towards achieving the offset completion criteria under potentially altered site conditions. This could involve changes to:

- Specific details of offset site management methods.
- Monitoring methodology.
- Schedules of monitoring, reporting and auditing.

4 SCHEDULE OF MANAGEMENT AND MONITORING ACTIONS

Management and monitoring actions are summarised below (Table 13). The actions constitute the minimum management requirements for the offset site over the mandatory 10-year management period.

Table 13. Summary of Management and Monitoring Actions for the Boyers Road Offset Site.

	Year from Commencement	Area	Management Action Objective	Timing	Environmental outcome to be achieved
	Fencing				
1	**1-10**	Offset Site	Maintain fencing in good condition around entire boundary of offset site where fencing exists or is required. Exclude unauthorised access. Refer Section 3.4.1	External fencing checked every 3 months.	Maintain fencing to DELWP fencing standards in DELWP's Management standards for native vegetation offset (DELWP 2019). Fencing repaired or upgraded as required to control threats.
2	**1-10**	Offset Site	Erect temporary fencing around offset site during grazing exclusion period (if stock present during this period within the property cannot be confined to certain areas) Refer Section 3.4.1; 3.4.3.1	October - December	Exclude stock from the offset site during exclusion period to protect GSM habitat.
3	**1-10**	Offset Site	If a threat arises erect an additional fence immediately around the entire boundary of the offset site Refer Section 3.4.1	Immediately on identification of threat	Erect fencing to DELWP fencing standards in DELWP's Management standards for native vegetation offset (DELWP 2019)
4	**1**	Offset Site	Mark the boundary of the offset site in accordance with advice from a qualified ecologist and land surveyor Refer Section 3.4.1.	Immediately on approval of Year 1 of management works	Facilitate management and monitoring of the offset site. Delineate location of temporary exclusion fence.
	Woody Weeds				

	Year from Commencement	Area	Management Action Objective	Timing	Environmental outcome to be achieved
5	1	Offset Site	Control and removal all existing woody weeds Refer Section 3.4.	Year 1	Eliminate woody weeds (<1% cover) by end of Year 1
6	1-10	Offset Site	Eliminate all new and emerging woody weeds Refer 3.4.	Annually, as per Section 3.4.	Eliminate woody weeds (<1% cover)
	Herbaceous Weeds				
7	1-10	Offset Site	Control all herbaceous weeds. Refer to Table 5 for list of herbaceous weeds, their control method and timing of actions. Refer Section 3.4.	Refer to Table 8	Control all high threat weeds; No increase in the cover of weeds at the end of Year 10 compared to baseline cover. Minimise off-target damage (avoid all native plants)
8	1-10	Offset Site	Eliminate all new & emerging herbaceous weeds Refer Section 3.4.	Any populations of new and emerging high threat weeds will be treated promptly (within 1 month) of detection.	<1% cover of all new and emerging herbaceous weeds at the end of Year 10
	Pest Animals				
9	1-4	Offset Site	Monitor and control rabbits and foxes. Refer Section 3.4.4	Concurrently with weed control and biomass control activities.	Any rabbit warrens are controlled immediately following detection. Any fox dens recorded within offset site are destroyed immediately (hand collapse and fumigation) following detection. All fox harbour removed from offset site on detection.
10	5-10	Offset Site	Monitor and control rabbits and foxes. Refer Section 3.4.4	Concurrently with weed control and biomass control activities.	No surface disturbance within the offset site; No active rabbit warrens to be present; No active fox dens to be present; No rubbish/artificial harbour present; Minimal artificial piles of logs and rocks;

	Year from Commencement	Area	Management Action Objective	Timing	Environmental outcome to be achieved
11	**1-10**	Offset Site	Monitor and control all new and emerging pest animals Refer Section 3.4.4	Concurrently with weed control and biomass control activities.	Control numbers of any new & emerging pest animals
	Biomass Management				
12	**1-10**	Offset Site	Pulse grazing Refer Section 3.4.3.1	Stock will be excluded or only occur at very low levels during October -December Stock removed immediately following any high rainfall events.	Stock must be removed should total vegetation cover fall to or below 60% Sufficient bare ground (approximately 10% to 40% cover) maintained in order to maintain space for recruitment of native herbs and grasses. No loss of native plant diversity as a result of grazing regimes. Reduction in weed cover.
13	**1-10**	Offset Site	Ecological burning, if undertaken, should occur between April and early winter. Refer Section 3.4.3.2	Between April and early winter. Outside known GSM flight season. Outside prescribed declared fire danger period	Burnt areas will not be grazed for at least four months after the burn. Maintain open grassy tussock structure No more than one third of the offset site burnt at any one time No area to be burnt more than once every three years
	Detailed GSM population monitoring				
14	**1**	Offset Site	Baseline GSM monitoring. Refer Section 3.5.1.2.	GSM flight season (generally October – early January)	Collection of baseline GSM data on the population density and distribution throughout the offset site.
15	**Years 2, 4, 6, 8 and 10**	Offset Site	GSM targeted surveys Refer Section 3.5.2	GSM flight season (generally October – early January)	Assessment of any trends in GSM population size or extent. Quantification of stocking rate. No measurable decline in the GSM population within the offset site.

	Year from Commencement	Area	Management Action Objective	Timing	Environmental outcome to be achieved
	Vegetation Monitoring				
16	**1-10**	Offset Site	Eight quadrats to be monitored in Years 1-4, 6, 8, 10. Refer Section 3.5.3	Monitoring between September - December	Within each quadrat, record: • percentage % total vegetation cover; • percentage % cover of inter-tussock spaces and % cover bare ground; • floristic composition (with a focus on GSM food species and weed species); • total % cover GSM food species, % native and exotic grasses, % *Rytidosperma* spp. cover, and • % cover of Chilean Needle-grass; • grassland structure and biomass using the 'golf-ball' method (Morgan 2015); • average height of vegetation (and grasses/GSM food species); and • the cover of native and exotic life-forms. Photo points to be established at each quadrat.
17	**1-10**	Offset Site	Inspect site for all high threat weeds and woody weeds. Refer Table 5.	Monitoring between September - December	Annual monitoring of woody weeds within offset site, including areas previously treated for woody weeds to determine effectiveness Annual monitoring of herbaceous weeds within offset site, including areas previously treated to determine effectiveness. New outbreaks of weeds identified and mapped each year. Mapped location of weeds supplied to landowner within 1 month of monitoring.
	Reporting				

	Year from Commencement	Area	Management Action Objective	Timing	Environmental outcome to be achieved
18	**1-10**	Offset Site	Landowner to prepare and submit an annual management report and photo monitoring to TfN. Refer Section 3.6.2	Submit at least 2 months prior to on-title agreement anniversary date	Annual report is signed, dated and submitted by the Landowner at least 2 months prior to the anniversary date of on-title agreement registration Report provides enough detail in the form of written comments and supporting evidence that an assessor can easily determine the completion of progress against the commitments for the offset site as detailed in the OMP and TfN Covenant.
19	**1-4, 6, 8, and 10**	Offset Site	BMD to submit a monitoring report to Commonwealth after years 1 - 4, 6, 8 and 10 of monitoring and management. Refer Section 3.6.1.	Submit by on-title agreement anniversary date	Annual report is signed, dated and submitted by BMD by the anniversary date of on-title agreement registration. Report provides enough detail in the form of written comments and supporting evidence that an assessor can easily determine the completion of progress against the commitments for the offset site.
20	**1, 4, 8 and 10**	Offset Site	Audit effectiveness of OMP. Refer Section 3.7.	End of Year 1, 4, 8 and 10.	Ensure OMP is facilitating the performance target outcomes and completion criteria.

5 RISK ASSESSMENT

An assessment of potential risks associate with the objectives of this plan are outlined within Table 14. The likelihood and consequence classification is provided in Appendix 2. All risks are considered manageable and actions within subsequent sections of this OMP address relevant risks.

Table 14. Risk assessment and management table for specific offset site.

Management objective (See Table 10)	Event or circumstance	Trigger for action	Residual risk			Trigger detection and monitoring activity(ies)	Feasible/effective corrective actions	Notes
			L	C	RR			
	Failure to legally secure approved offset site	The landowner commits to enter into an agreement with TfN. In addition, DCCEEW will require this for the site to be registered as an offset site for GSM. This is a process that is undertaken regularly and accepted.	Unlikely	Moderate	Low	n/a	Engage a consultant	Low risk: the site will be secured with an on-title agreement through a Trust for Nature Covenant.
	Legislative reform prejudices proposed tenure arrangements for offset properties.	Monitor DCCEEW, DELWP, LGAs and other legislative bodies on developments regarding offsets. This is a low risk as the process is undertaken regularly.	Rare	High	Low	Newsletters, expert liaison, press releases and direct contact.	Adjust offset calculations accordingly.	
1, 2, 3	Exclusion of unauthorised persons, vehicles or stock from the offset site.	Grazing/trampling/damage to vegetation within the offset site. Damage to the groundlayer/compaction of soils	Unlikely	High	Medium	Stock in offset site outside of grazing period. Unauthorised vehicle observed in offset site. Evidence of recent tyre tracks.	Assess integrity of fencing and access points. Repair/upgrade fencing/access points as required.	The site will be protected through a TfN Covenant. This agreement has a rigorous quality assurance process for all offset sites to ensure the landowner agreements address the management commitments in the plan, and that the management actions are adequately implemented during the life of the OMP.
	Adjacent/regional landowner's land	If deemed necessary, liaise with adjacent landholders. Ensure	Unlikely	High	Medium	Adjacent land practices begin	Take steps to halt negative impacts.	There are no dwellings within 50m of the site. Based on the current land

Management objective (See Table 10)	Event or circumstance	Trigger for action	Residual risk			Trigger detection and monitoring activity(ies)	Feasible/effective corrective actions	Notes
			L	C	RR			
To achieve performance targets and completion criteria for GSM	management practices fail to support attainment of offset outcomes.	understanding of offset objectives. However, the site is bound by a road to the south and west, a railway line to the north, and an adjoining property to the east, therefore the risk of adjacent landowner management actions impacting the offset site is very low (currently fenced and private property).				to negatively impact offset site.	Follow up with stakeholder discussions.	management practices in the region it is unlikely that any foreseeable land management practices within the vicinity of the proposed offset site will impact the offset site.
	Insufficient funds provided by approval holder to implement the plan.	The proponent will be responsible for adequate funding of the 10-year management actions outlined in this OMP. This will be a requirement of the approval. Regular reporting against the management actions at the offset site will be an approval requirement under the EPBC Act for the proposed development.	Unlikely	High	Medium	Monitoring and/or annual reporting	Review plan for cost efficiencies.	The landholder is committed in ensuring that the offset is managed principally for conservation, and the offset funds provided by the proponent will be paid to the landowner to ensure management actions can be adequately implemented. An annual report will be prepared by the landholder for a period of 10 years.
	Stochastic events (wildfire/drought/flood) prejudice attainment of interim performance targets and/or completion criteria for GSM.	Ensure appropriate biomass management. Plan for scheduling delays.	Possible	High	Medium	Monitoring and/or annual reporting	Apply adaptive management to ensure the objectives of the OMP are not compromised.	-

Management objective (See Table 10)	Event or circumstance	Trigger for action	Residual risk			Trigger detection and monitoring activity(ies)	Feasible/effective corrective actions	Notes
			L	C	RR			
	Approved development on/near project/offset prejudicing plan outcomes.	Ensure proper stakeholder engagement to prevent poor outcomes.	Unlikely	High	Medium	Advertisement of planning scheme amendments/planning permit applications.	Objection to proposed development/laisse with proponent to ensure the proposed development does not compromise the objectives of the OMP.	The offset site is within a rural agricultural landscape, as such, there is a low likelihood of development within adjacent properties. However, should there be any proposed development or intensification of land (e.g. cropping) adjacent to the proposed offset site it is highly unlikely that this will impact the long-term suitability of the site, as the ecological values within the offset site do not rely on habitat values within adjacent land.
GSM habitat improved	Drought	Apply adaptive management to ensure the site is not over-grazed	Likely	Moderate	Medium	Drought Event	Apply adaptive management to ensure the site is not over-grazed.	GSM habitat is located within a mosaic of native and introduced grassland, historically subject to drought and occasional wildfire. As such, the GSM habitat and known population on the site is likely to survive / persist after such an event.
	Wildfire		Likely	Moderate	Medium	Wildfire Event		
	Uncontrolled grazing	Maintain fences and install temporary fencing, if required (Section 3.4.1) Exclude stock during October-December [generally]) (see Section 3.4.3 and Table 10 for further information on exclusion period)	Highly Likely	Moderate	Unlikely	Continual monitoring	Repair permanent fences, and/or install temporary exclusion fences.	The strategic grazing regimes specified within this plan aim to shift species dominance to favour native species abundance and diversity, improving the ecological condition and habitat. Further, strategic grazing strategies will improve and maintain recruitment

Management objective (See Table 10)	Event or circumstance	Trigger for action	Residual risk			Trigger detection and monitoring activity(ies)	Feasible/effective corrective actions	Notes
			L	C	RR			
	High biomass levels preventing establishment of native herbs (see	Undertake pulse grazing or ecological burning (Section 3.4.3) Exclude stock during October-December [generally]) (see Section 3.4.3 and Table 10 for further information on exclusion period)	Highly Likely	Moderate	Possible	Annual monitoring	Apply pulse grazing or seasonal burning in appropriate season to reduce biomass levels (Section 3.4.3)	space required for native plants to establish, further improving species diversity over time.
	Loss of biodiversity due to competition with weeds (see Section 3.4.2 for performance indicators)	Spot spraying of weeds Undertake pulse grazing Annual monitoring to adapt future control works and targets (Section 3.5)	Likely	Moderate	Possible	Annual monitoring	Undertake weed control activities	The OMP includes actions to control weed cover, improving the ecological condition of the site over the ten-year period.
	Loss of biodiversity due to pest animal activity (see Section 3.4.4 for performance indicators)	Rabbit warrens or fox dens are controlled (Section 3.4.4)	Likely	Moderate	Possible	Annual monitoring	Undertake pest control activities (Section 3.4.4)	The OMP includes actions to reduce pest animal activity, thereby reducing grazing/soil disturbance by Rabbits. As a result, the GSM habitat is likely to improve.

Notes. L = Likelihood; C = Consequence; RR = Residual Risk

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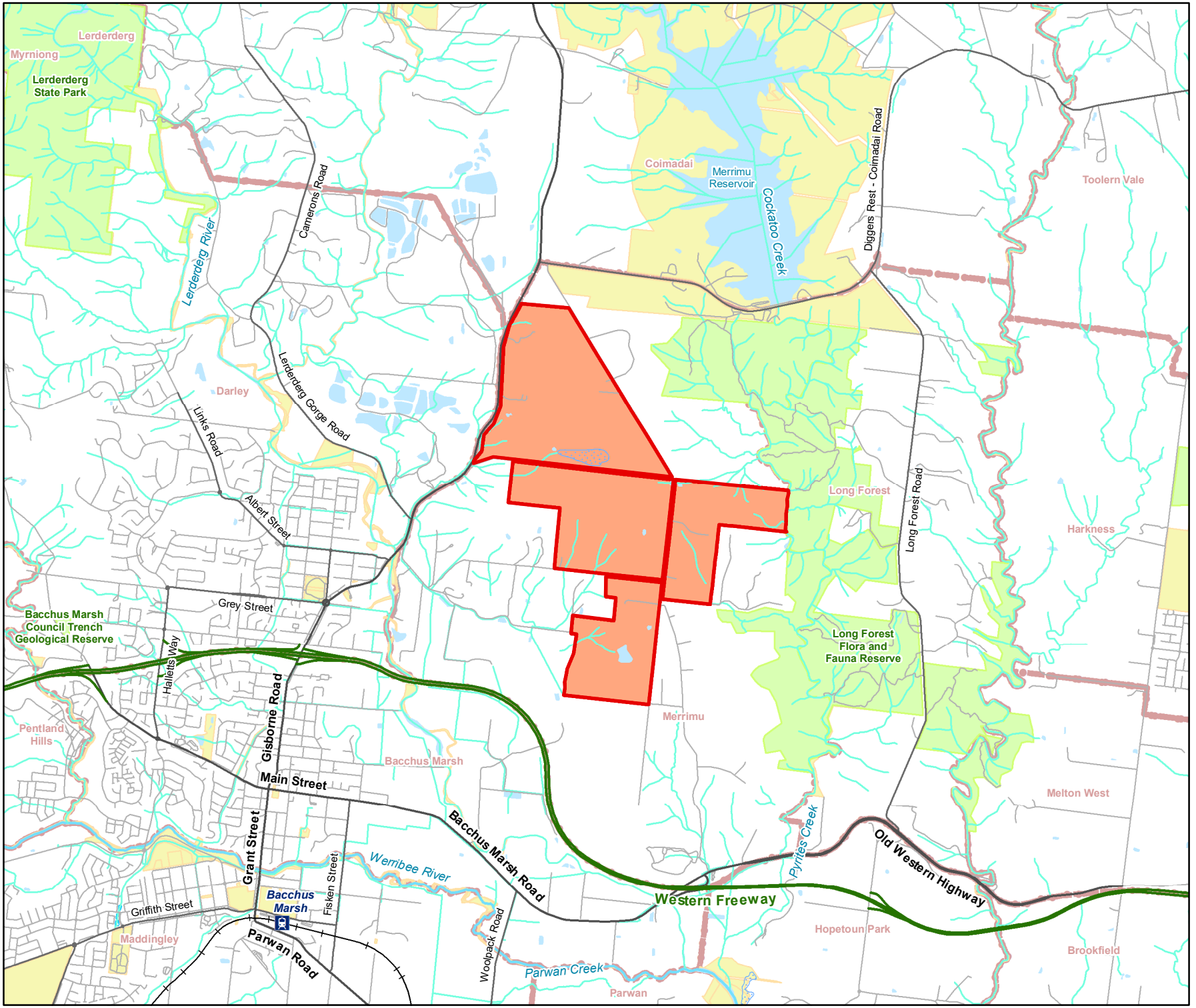


Legend

- Location of the BMD Land
- Railway
- Freeway
- Major Road
- Collector Road
- Minor Road
- Minor Watercourse
- Major Watercourse
- Permanent Waterbody
- Land Subject to Inundation
- Wetland/Swamp
- Parks and Reserves
- Crown Land
- Localities

Figure 1

Study area - proposed impact area

Bacchus Marsh Development Project

N

0 600 1,200

Metres

ecology & heritage partners

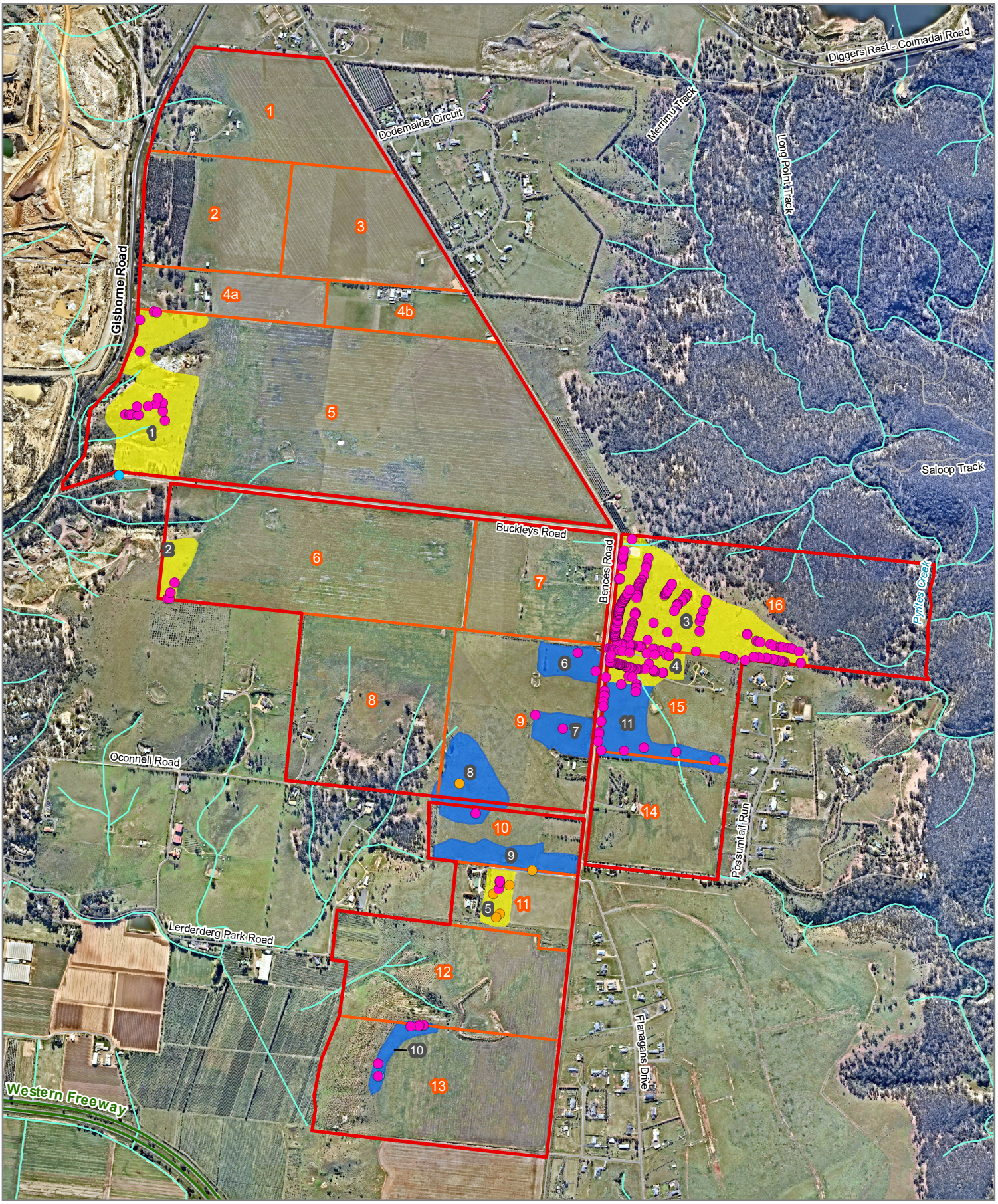


Figure 2
Ecological features at impact site
Bacchus Marsh Development Project

Legend

- Study Area
- Golden Sun Moth habitat proposed to be removed
- Golden Sun Moth habitat proposed to be retained

Golden Sun Moth Records:

- Survey date 30/11/17 (a)
- Survey date 30/11/17 (b)
- Survey date 12/12/17

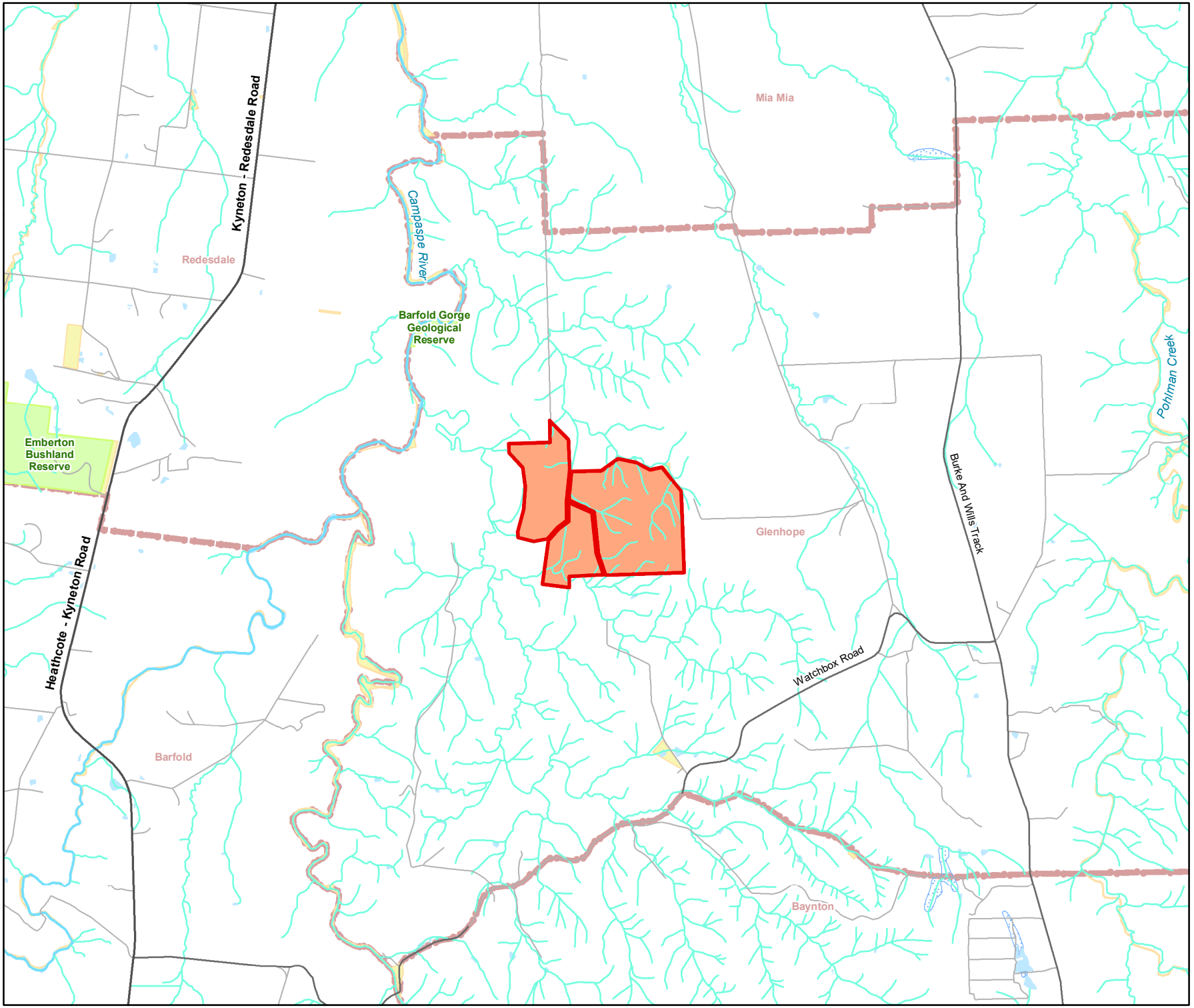
N

0 200 400
Metres

10937_Fig02_EcoFeat_IS_P 12/10/2023 melsley

ecology & heritage partners

Aerial source: Nearmap 2020



Legend

- Proposed offet site
- Major Road
- Collector Road
- Minor Road
- Minor Watercourse
- Major Watercourse
- Permanent Waterbody
- Land Subject to Inundation
- Parks and Reserves
- Crown Land
- Localities

Figure 3

Study area - proposed offset area

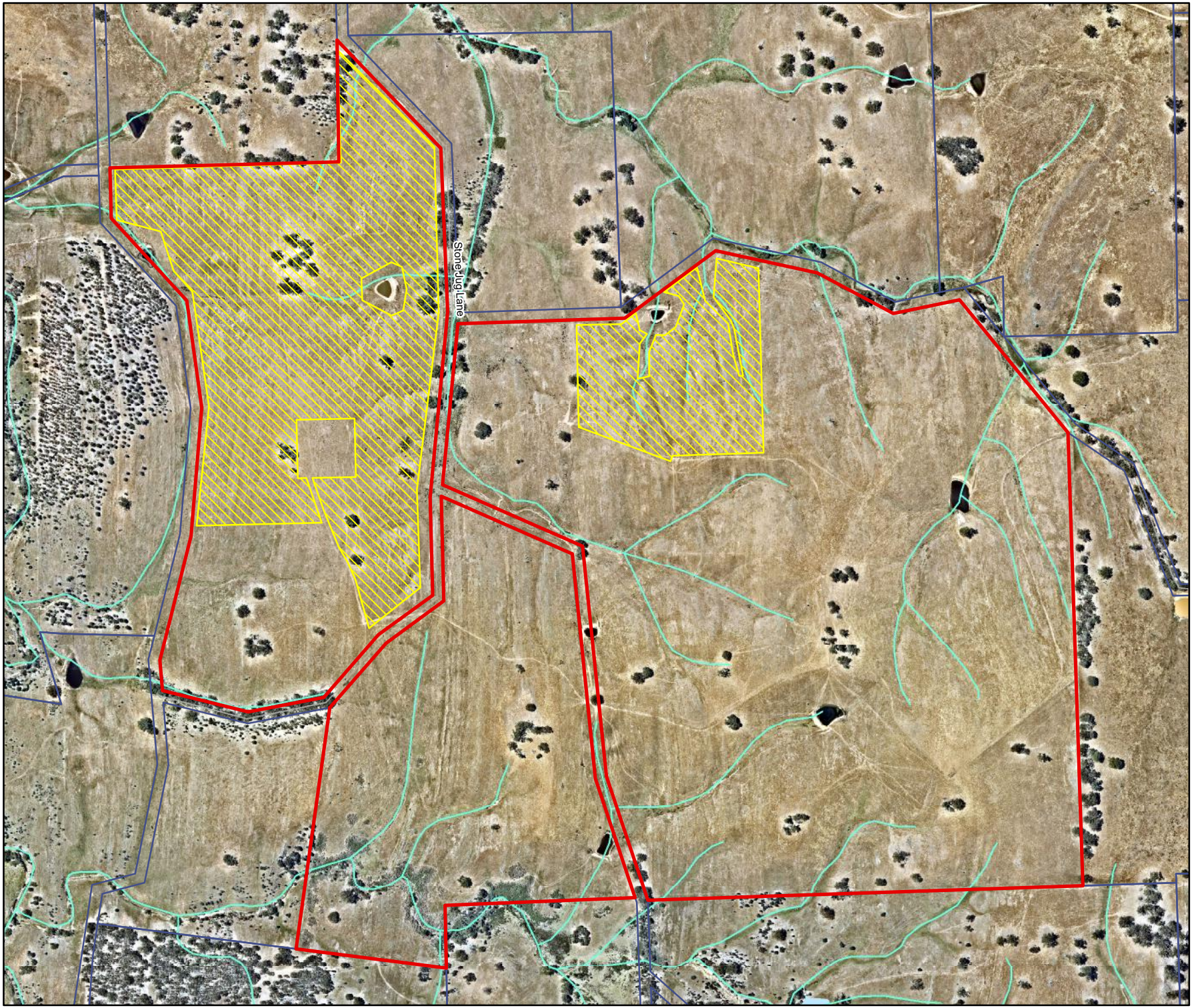
Bacchus Marsh Development Project

N

0 600 1,200

Metres

ecology & heritage partners



Legend

- Proposed offet area
- Proposed Golden Sun Moth offset site (38.6 ha)
- Property Boundaries

Figure 4

Proposed Golden Sun Moth offset site

Bacchus Marsh Development Project

N

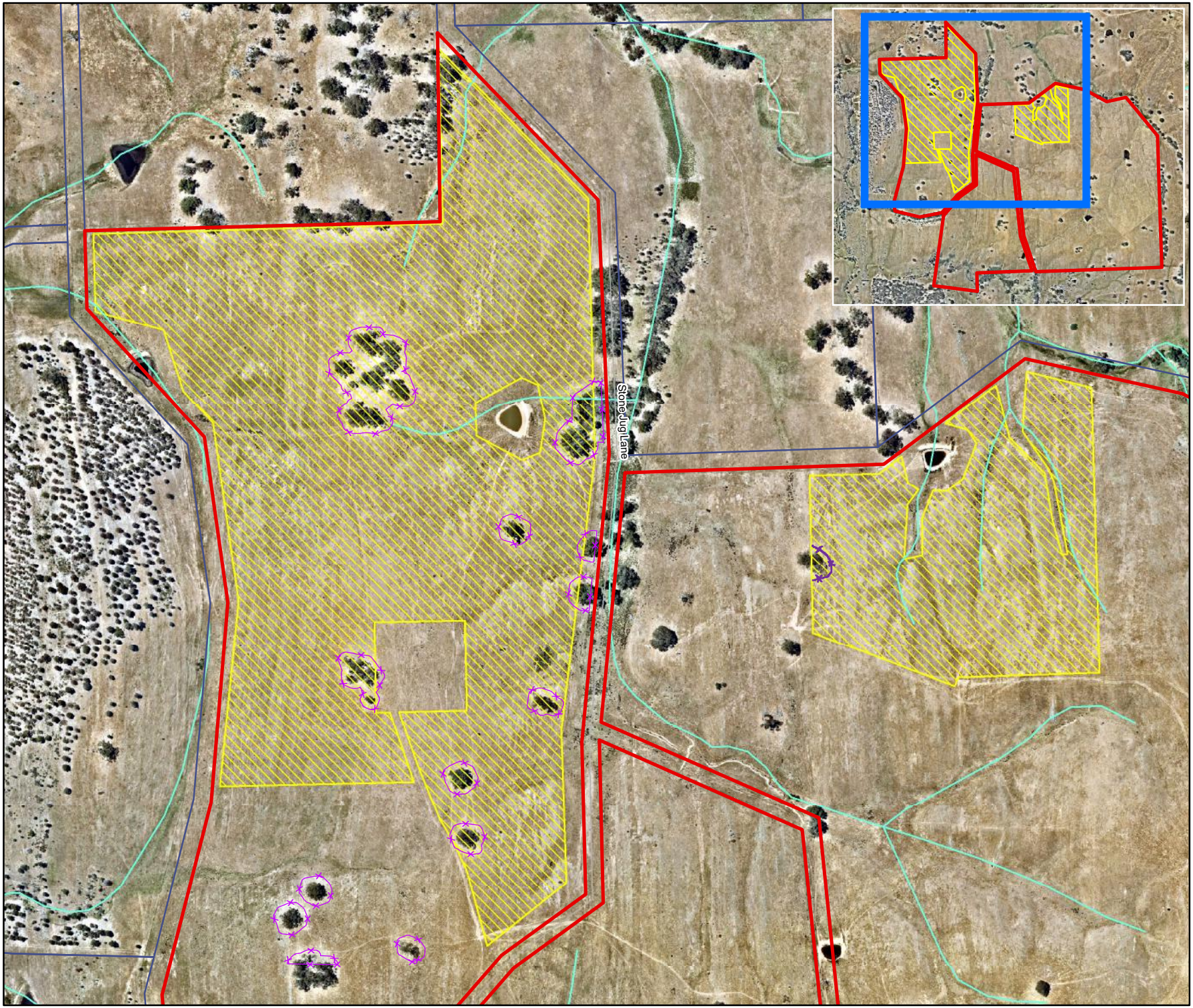
0 100 200

Metres

ecology & heritage partners

10937_Fig04_PropGSM_Site 28/07/2025 psorensen

Aerial date 12/2021 / Source: Nearmap 2022



Legend

- Proposed offet area
- Proposed Golden Sun Moth offset site (38.8 ha)
- Stock exclusion zone
- Property Boundaries

Figure 5

Stock exclusion zones

Bacchus Marsh Development Project

N

0 75 150

Metres

ecology & heritage partners

10937_Fig05_StockExclZones 28/07/2025 psorensen

Aerial date 12/2021 / Source: Nearmap 2022

APPENDIX 1 – EPBC ACT OFFSET CALCULATOR

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Golden Sun Moth
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes		**Area**	10.16	Hectares	Field Surveys
			Quality	**3**	Scale 0-10	
			Total quantum of impact	3.05	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)		% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																					
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**										
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0									
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**										
Threatened species habitat																					
Area of habitat	Yes	3.05	Adjusted hectares	Glenhope - 13.3 hectares	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	13.3	**Risk of loss (%) without offset**	8%	**Risk of loss (%) with offset**	0%	1.05	80%	0.84	0.81	2.41	78.98%	No		
									Future area without offset (adjusted hectares)	12.2	**Future area with offset (adjusted hectares)**	13.3									
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	5	**Future quality without offset (scale of 0-10)**	4	**Future quality with offset (scale of 0-10)**	6	2.00	80%	1.60	1.57					
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**		**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																				
Condition of habitat Change in habitat condition, but no change in extent	No																				
Threatened species																					
Birth rate e.g. Change in nest success	No																				
Mortality rate e.g Change in number of road kills per year	No																				
Number of individuals e.g. Individual plants/animals	No																				

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	3.0465	2.41	78.98%	**No**	$0.00	#DIV/0!	#DIV/0!
Area of community	0				$0.00		$0.00
					$0.00	**#DIV/0!**	**#DIV/0!**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Golden Sun Moth
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes		**Area**	12.5	Hectares	Field Surveys
			Quality	**4**	Scale 0-10	
			Total quantum of impact	5.00	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	5.00	Adjusted hectares	Glenhope - 25.3 hectares	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	25.3	**Risk of loss (%) without offset**	8%	**Risk of loss (%) with offset**	0%	2.00	80%	1.60	1.54	4.58	91.53%	Yes	
									Future area without offset (adjusted hectares)	23.3	**Future area with offset (adjusted hectares)**	25.3								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**5**	**Future quality without offset (scale of 0-10)**	**4**	**Future quality with offset (scale of 0-10)**	**6**	2.00	80%	1.60	1.57				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	5.0008	4.58	91.53%	**Yes**	$0.00	#DIV/0!	#DIV/0!
Area of community	0				$0.00		$0.00
					$0.00	**#DIV/0!**	**#DIV/0!**

APPENDIX 2 – RISK FRAMEWORK

Table A2.1. Risk Framework

		Consequence				
Likelihood		**Minor**	**Moderate**	**High**	**Major**	**Critical**
	Highly Likely	Medium	High	High	Severe	Severe
	Likely	Low	Medium	High	High	Severe
	Possible	Low	Medium	Medium	High	Severe
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Low	Medium	High

Table A2.2. Likelihood and consequence

Qualitative measure of likelihood (how likely is it that this event/circumstances will occur after management actions have been put in place/are being implemented)	
Highly likely	Is expected to occur in most circumstances
Likely	Will probably occur during the life of the project
Possible	Might occur during the life of the project
Unlikely	Could occur but considered unlikely or doubtful
Rare	May occur in exceptional circumstances
Qualitative measure of consequences (what will be the consequence/result if the issue does occur)	
Minor	Minor risk of failure to achieve the plan's objectives. Results in short term delays to achieving plan objectives, implementing low cost, well characterised corrective actions.
Moderate	Moderate risk of failure to achieve the plan's objectives. Results in short term delays to achieving plan objectives, implementing well characterised, high cost/effort corrective actions.
High	High risk of failure to achieve the plan's objectives. Results in medium-long term delays to achieving plan objectives, implementing uncertain, high cost/effort corrective actions.
Major	The plan's objectives are unlikely to be achieved, with significant legislative, technical, ecological and/or administrative barriers to attainment that have no evidenced mitigation strategies.
Critical	The plan's objectives are unable to be achieved, with no evidenced mitigation strategies.

APPENDIX 3 – GOLDEN SUN MOTH SURVEY – BOYERS ROAD

Hamilton Environmental Services
ABN: 89 108 410 911

GOLDEN SUN MOTH SURVEY 2020 –

BOYERS ROAD GLENHOPE

Cassinia environmental

Golden Sun Moth Survey 2020 – Boyers Road Glenhope

Submitted to:

Kim Cornford
Cassinia Environmental Pty. Ltd.
Burke and Wills Track
BARFOLD VIC 3444

Phone: 03 5425 5466
Email: kim@cassinia.com

Submitted by:

Hamilton Environmental Services
2345 Benalla-Tatong Rd.
TATONG VIC 3673

Phone: 03 5767 2358
Mobile: 0409 356 331
Email: steve.hamilton@hamiltonenvironmental.com.au
ABN: 89 108 410 911

Version 2, 2nd August 2021

Cover Photo: A view of the Glenhope property.

TABLE OF CONTENTS

1. INTRODUCTION

Cassinia Environmental were seeking to purchase a property at Boyers Road Glenhope for the primary purpose of Golden Sun Moth offset (Paul Dettmann pers. comm. 2020).

Hamilton Environmental Services (HES) was engaged to supervise the initial survey of this property for Golden Sun Moth on 20th November 2020 to ensure that the standard and appropriate methodology was utilised to undertake the surveys, and then provide reporting on the findings of the surveys.

This Report details the results of the surveys undertaken.

2. BACKGROUND

2.1 Site Locations and Descriptions

The Boyers Road Glenhope property of approximately 182 ha and three land parcels is found within the Mitchell Shire (Council Property Number 113989), and is located approximately 4.7 km SE of Redesdale, at the western end of Boyers Road (Fig. 2-1; VicRoads 60 A3).

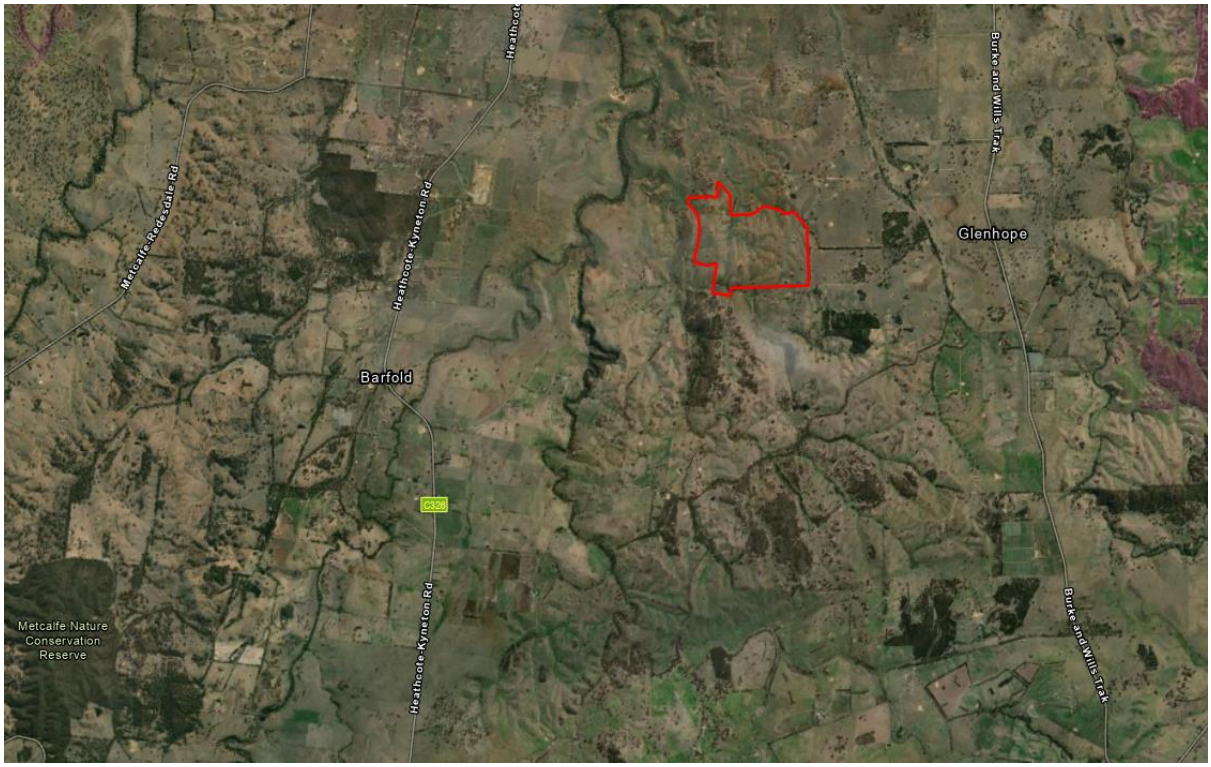


Figure 2-1 Aerial image of the general location of the Glenhope property within the district, shown in red (Image from ESRI Australia 2021).

The property is a combination of plateau, steep slopes and deeply dissected drainage lines; the landscape is dominated by a major north-south valley that transects the western half of the property.

The property has been substantially cleared of indigenous woody vegetation, it does maintain some scattered trees and patches of trees of Grey Box (*Eucalyptus microcarpa*), Long-leaved Box (*E. goniocalyx*), Yellow Box (*E. melliodora*), Red Stringybark *(E. macrorhyncha*), River Red Gum (*E. camaldulensis*) and Red Box (*E. polyanthemos*).

The property has been utilised for stock grazing for a considerable period, and has been divided into a series of paddocks as a consequence. As an artefact of this long-term grazing use, the ground layer vegetation is a mixture of mostly introduced ground layer dominated by opportunistic pasture species such as Squirrel's-tail Fescue (*Vulpia bromoides*), Common Stork's-bill (*Erodium cicutarium*), Wild Oat (*Avena fatua*), Wimmera Rye-grass (*Lolium rigidum*), Barley Grass (*Hordeum leporinum*), Toowoomba Canary Grass (*Phalaris aquatica*), Cat's Ear (*Hypochaeris radicata*) and Great Brome (*Bromus diandrus*), with large patches that have retained a predominantly indigenous ground layer, including species such as Rough Spear-grass (*Austrostipa scabra*), Brown-backed Wallaby-grass (*Rytidosperma duttonianium*), Weeping Grass (*Microlaena stipoides*), Bristly Wallaby-grass (*R. setaceum*), Silvertop Wallaby-grass (*R. pallidum*), Variable Sida (*Sida corrugata*) and Small White Sunray (*Rhodanthe corymbifolia*). The higher points of ridges, most of which were very rocky, and several less accessible slopes, typically did retain these large patches of an indigenous ground layer. Notwithstanding these more typical areas, smaller patches of indigenous ground layer were found scattered across the property.

2.2 Golden Sun Moth

2.2.1 Conservation Status

The Golden Sun Moth (*Synemon plana*) is listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and as a threatened taxon under the Victorian *Flora and Fauna Guarantee Act 1988* (Gilmore *et al.* 2008; Department of the Environment, Water, Heritage and Arts [DEHWA] 2009).

2.2.2 Distribution

Golden Sun Moths were known to occur throughout south-eastern Australia in temperate grasslands (and grassy woodlands) including New South Wales, Australian Capital Territory, Victoria and South Australia (DEHWA 2009). However, the original extent of Golden Sun Moth habitat and continuity of populations has been significantly reduced to only 125 known sites, most of which are < 5 ha in area, resulting in the species becoming fragmented and highly modified by urban and agricultural development.

The Golden Sun Moth is now considered extinct in South Australia (DEWHA 2009).

2.2.3 Habitat

Potential habitat for the species includes all areas which have, or once maintained, native grasslands or grassy woodlands (including derived grasslands) across the historical range of the species. The Golden Sun Moth is also known to inhabit degraded grasslands, including those dominated by the exotic Chilean Needlegrass (*Nassella neesiana*), a weed of national significance (DEHWA 2009).

The 'typical' plant assemblage present is extremely difficult to define, especially in light of the recent discovery of the species at many sites previously considered 'unsuitable'. The species has shown a preference for *Austrodanthonia* species, such as Short Wallaby-grass (*A. carphoides*), Bristly Wallaby-grass (*A. setacea*), Hill Wallaby-grass (*A. eriantha*), Lobed Wallaby-grass (*A. auriculata*) and Clustered Wallaby-grass (*A. racemosa*). However, previous definitions of 40 % *Austrodanthonia* cover (O'Dwyer and Attiwill 1999) are no longer considered accurate (Braby and Dunford 2006, Gilmore *et al.* 2008). The species has been found flying and presumably breeding in grasslands dominated by other indigenous species such as Redleg Grass (*Bothriochloa macra*), Spear-grasses (*Austrostipa* spp.), Weeping Grass (*Microlaena stipoides*), Kangaroo Grass (*Themeda triandra*), and in degraded and weed infested patches dominated by the exotic Chilean Needlegrass (DEHWA 2009).

The site history of a site is likely to be very important in determining habitat suitability for the species; cultivated, fertilised or pasture improved sites are highly unlikely to support Golden Sun

Moth; however, it is likely to occur on sites that have experienced a low intensity grazing history with no or negligible history of site improvement, even if these sites have been grazed for a long period of time. The critical habitat feature seems to be the maintenance of some remnant indigenous grass cover (DEHWA 2009). This view is supported by recent survey efforts that have uncovered many new colonies of the Golden Sun Moth in areas with such a land use history, which most likely indicates that the species has less specific habitat requirements (i.e. in terms of indigenous grass composition and abundance) than previously thought (Gilmore *et al.* 2008).

2.2.4 Biology

Golden Sun Moth larvae spend two to three years under ground feeding on the roots of native perennial grasses including Wallaby-grass (*Rytidosperma* spp.), Spear-grass (*Austrostip*a spp.), and Redleg Grass (Edwards 1994). The belief that the larvae of the species feed on these grasses is based on the presence of cast pupa shells and tunnels leading up to nearby tussocks. It has recently been discovered that larvae may also feed on introduced grass species, with cast pupa shells found protruding from introduced Chilean Needlegrass tussocks. This discovery suggests that in some circumstances the species may feed on exotic grasses (DEHWA 2009).

Adult moths emerge from underground during the breeding season, between mid-October to early January, depending on the climate and location. They are active only during the hottest part of hot, sunny, and relatively still days. Adult emergence occurs continuously across the breeding season, although the distribution and abundance of emerging adults varies with the microclimate and microhabitat features of the site (Department of Environment and Conservation NSW [DEC] 2007). Adult moths lack functional mouthparts and are unable to feed, and live for only one to four days (O'Dwyer and Attiwill 2000).

Adult males spend their time patrolling the grassy patches in search of displaying females, who flash their brightly coloured hindwings to attract the males. Once mated, the females lay their eggs between the tillers of a tussock or between tillers and the soil (Gibson 2006). Females are estimated to lay between 100 and 150 eggs (Edwards 1994). Females are reluctant to fly, and most likely walk between tussocks during display and egg laying. In contrast, adult males are capable of active and prolonged flights, although it is estimated that they will not travel more than 100 m away from suitable habitat patches (Clarke and O'Dwyer 2000).

Figure 2-2 A male (left; taken on-site 20/11/17) and female (right; from DEHWA 2009) Golden Sun Moth.

3. METHOD

Clearly, surveys must be undertaken during the Golden Sun Moth emergence period or 'flying season', which is usually from October to December in Victoria.

DEHWA (2009) outlines the preferred survey methods for Golden Sun Moth. The two methods commonly employed are the Fixed Point method, which is best suited to small sites or sites with a small population, and a Transect method, which is better suited to large sites with extensive populations.

It was decided that application of the 'walked transect' method was the most appropriate for this larger-sized property, given the availability of up to 10 observers.

DEHWA (2009) suggest that the observer should walk/traverse in a vehicle for at least a 100 m distance, recording the number of moths encountered, taking care not to count the same individual twice. Surveys should be conducted over at least 4 suitable days, and once presence has been established, surveys should focus on the determining the relative distribution of the species. The male Golden Sun Moth flying period is probably only over 4-5 days, and within this period, they are likely to be most active on still, clear or mostly cloudless, warm to hot days (> 20°C at 1000 hours), between 1000 and 1400 hours, at least 2 or more days after rain.

Surveys were conducted to conform to the above methodology and optimal conditions, and to ensure that all sections across the property were surveyed.

The 'walked transect' method involved walking in parallel transects approximately 100 m apart using a GPS and compass. The total number of GSM within 25 m either side of the transect line over each transect is recorded continuously during traverse.

The Fulcrum data collection app was utilised to collect data.

The surveys were repeated on five occasions (20/11/20, 26/11/20, 4/12/20, 11/12/20 and 15/12/20).

A series of transects were established to ensure coverage across the whole property: 23 transects were established that traverse the property west-east, with observers generally undertaking a west-bound transect and then immediately returning to the starting point with an east-bound transect. These transects are shown in Fig. 3-1. A complete survey event involved the traverse of 28.54 km.

All transects were conducted with a minimum of 4 observers on each site assessment, with some assessments having 8 observers; all observers were experienced Golden Sun Moth observers who had participated in surveys in previous years.

All transects were geo-located at starting and finishing point.

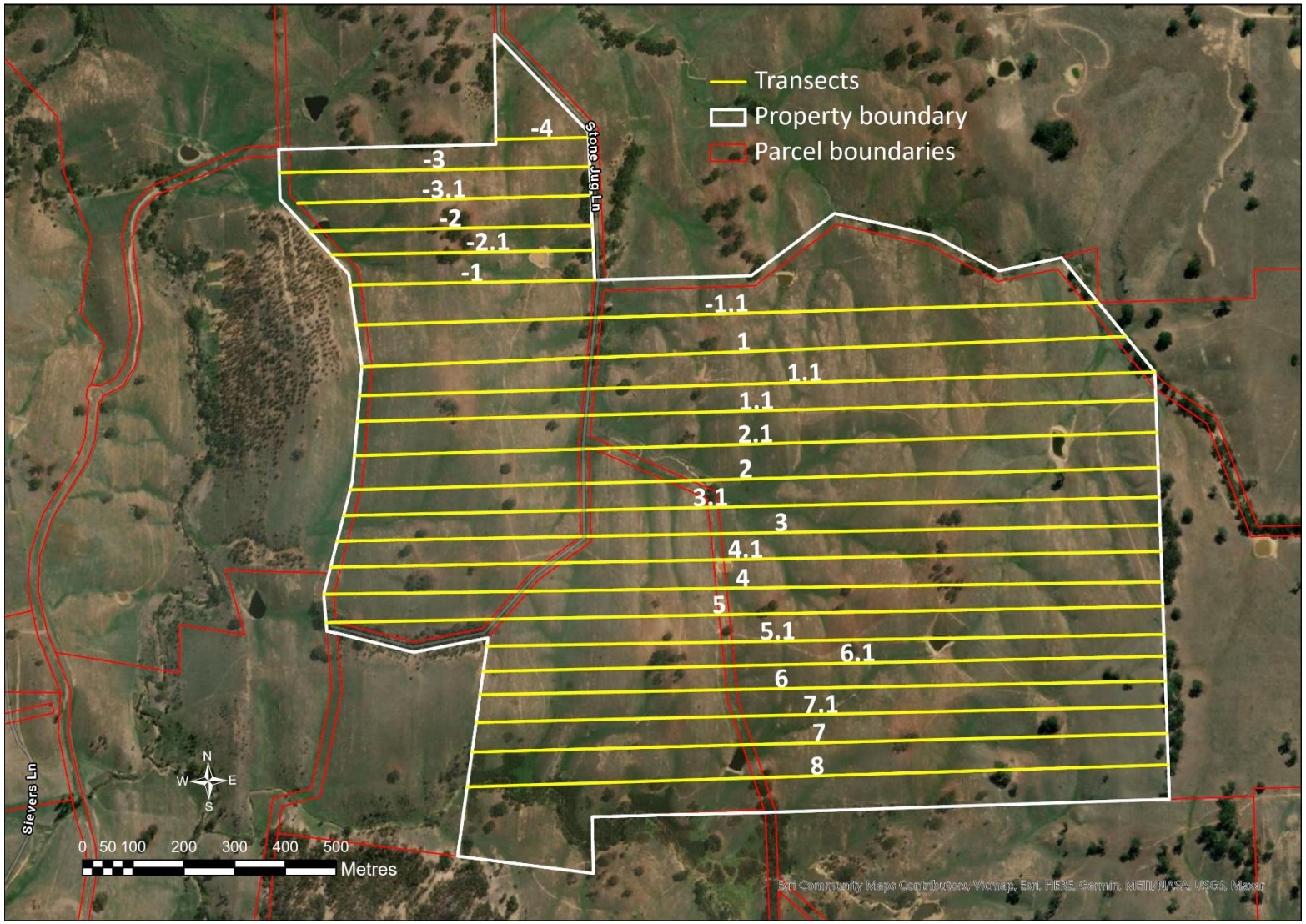


Figure 3-1 **The location of the Golden Sun Moth survey transects conducted on the Glenhope property in 2020, with the transect number placed next to the transect. Image from Department of ESRI Australia (2021).**

4. RESULTS

The details of all transects undertaken on all five surveys, including the prevailing weather conditions, are shown in Table 4-1.

The location of all Golden Sun Moth observations along all transects on all five surveys can be seen in Fig. 4-1.

A total of 785 male Golden Sun Moths were observed across the Glenhope property at 394 individual sites, with 41 individuals being recorded on the 20/11/20, 121 individuals on the 26/11/20, 166 individuals on the 4/12/20, 185 individuals on the 11/12/20, and 272 individuals on the 15/12/20 (Table 4-2).

Vegetation data was not formally collected during the 2020 survey given the patchiness of the ground layer of the site and the often sharp change from dominant introduced ground layer to dominant indigenous layer to mixed ground layer.

In general, as previously discussed, the higher points of ridges, most of which were very rocky, and several less accessible slopes, typically did generally retain large patches of indigenous ground layer. Notwithstanding these typical areas, smaller patches of indigenous ground layer were found scattered across the property.

5. DISCUSSION

The surveys conducted have been undertaken with an appropriate methodology with an experienced group of observers, and surveys have clearly demonstrated that Golden Sun Moth is found in abundance across the property: based on all survey results, an average of 157 individuals were observed across the Glenhope site at each survey time, at 0.86 individuals/ha.

The individuals observed were not uniformly distributed, with the more abundant observations of the species tending to be in areas that were dominated by indigenous ground layer species, which were most often found on drier, rockier ridge and spur lines; individuals were found in areas with a mixed ground layer, but it was not common for any individuals to be found in areas dominated by introduced ground layer species.

Table 4-1 **Golden Sun Moth survey data and prevailing weather conditions for the 104 transects completed at the Glenhope property on the 20/11/20, 26/11/20, 4/12/20 and the 11/12/20. Transect locations are shown in Fig. 3-1, and sites of Golden Sun Moth observations can be seen in Fig. 4-1.**

Date	Name of observer	Transect	Transect east end		Start time	End time	Temperature[1] (°C)	Wind speed[2] (km/hr)	Cloud cover[3]	Golden Sun Moth observations/transect
			Latitude	Longitude						
20/11/2020	Anna Radkovic	4	-37.0747413	144.574631	10:06	10:36	0	0	2	0
20/11/2020	Anna Radkovic	4.1	-37.0750237	144.556006	10:38	11:08	0	0	2	3
20/11/2020	Ari Dettmann	5	-37.0757672	144.574614	10:06	11:00	0	0	2	0
20/11/2020	Kim Cornford	6	-37.076618	144.574608	10:07	10:47	0	0	0 Sky completely clear	0
20/11/2020	Kim Cornford	6.1	-37.0767945	144.559631	10:47	11:15	0	0	0 Sky completely clear	7
20/11/2020	Laura Barsdell	3	-37.0734071	144.556731	10:06	10:37	0	0	2	0
20/11/2020	Laura Barsdell	3.1	-37.0740624	144.556611	10:40	11:13	0	0	2	0
20/11/2020	Ray DeMack	1	-37.0712573	144.573634	10:03	10:47	25	2	3	2
20/11/2020	Ray DeMack	-1	-37.0697698	144.556694	10:52	11:01	29	3.5	2	1
20/11/2020	Ray DeMack	-2	-37.0679167	144.562187	11:08	11:20	28	4	3	4
20/11/2020	Ray DeMack	-1.1	-37.0707915	144.556754	11:53	11:58	0	0	3	5
20/11/2020	Steve Hamilton	7	-37.1074582	144.604432	10:09	10:39	0	0	1	2
20/11/2020	Steve Hamilton	7.1	-37.0780858	144.560334	10:39	11:11	0	0	2	7
20/11/2020	Zach Dettmann	2	-37.0724546	144.574591	10:03	10:41	0	0	0 Sky completely clear	2
20/11/2020	Zach Dettmann	-2	-37.0693179	144.5562	10:52	11:04	0	0	0 Sky completely clear	1
20/11/2020	Zach Dettmann	-2.1	-37.0685115	144.561982	11:07	11:20	0	0	0 Sky completely clear	6
20/11/2020	Zach Dettmann	2.1	-37.0729212	144.556703	11:29	11:54	0	0	0 Sky completely clear	1
26/11/2020	Josie	5.1	-37.0757693	144.55599	11:48	12:39	27	8	2	0
26/11/2020	Josie	2	-37.0722121	144.574547	12:48	13:28	25	7	1	1
26/11/2020	Josie	2.1	-37.072816	144.557841	13:30	14:00	25	8	2	0
26/11/2020	Josie	8	-37.0786393	144.57437	10:02	10:16	23.3	2.7	2	1
26/11/2020	Josie	5	-37.0757776	144.574606	10:56	11:43	25	10	2	2
26/11/2020	Josie	8.1	-37.0786393	144.57437	10:20	10:50	24	2.7	2	2
26/11/2020	Ben Thorne	7	-37.0786423	144.574399	10:03	10:30	23.3	2.7	2	2
26/11/2020	Ben Thorne	7.1	-37.0778247	144.559345	10:36	11:01	25	11	2	0
26/11/2020	Ben Thorne	4	-37.0746679	144.574701	11:06	11:40	25	10	2	32
26/11/2020	Ben Thorne	4.1	-37.0745097	144.55621	11:44	12:30	27	8	2	1
26/11/2020	Ben Thorne	-2.5	-37.0679766	144.562159	13:02	13:18	25	7	1	1
26/11/2020	Ben Thorne	-2	-37.0684246	144.555311	13:20	13:38	25	5	2	0
26/11/2020	Ben Thorne	-1	-37.0690785	144.562062	13:40	13:50	25	8	2	0
26/11/2020	Ben Thorne	-2.1	-37.0693069	144.558737	13:55	14:20	25	10	2	0
26/11/2020	Ben Thorne	-1.1	-37.0714622	144.561909	14:22	15:27	25	12	2	2
26/11/2020	Anna Radkovic	6	-37.0785921	144.574363	10:03	10:32	23.3	2.7	2	4
26/11/2020	Anna Radkovic	6.1	-37.0766583	144.55956	10:32	11:00	25	13	2	1
26/11/2020	Anna Radkovic	3	-37.074076	144.574651	11:07	11:48	25	13	3	21
26/11/2020	Anna Radkovic	3.1	-37.0739174	144.556609	11:50	12:28	25	13	3	31
26/11/2020	Anna Radkovic	1	-37.071387	144.573732	12:44	13:21	24.2	11	2	20
26/11/2020	Anna Radkovic	1.1	-37.0718511	144.558074	13:22	13:57	26.1	11	2	0
4/12/2020	Josh	8	-37.0785203	144.574579	10:00	10:59	20	17	0 Sky completely clear	10
4/12/2020	Josh	5	-37.0759073	144.57459	11:02	11:32	20	11	0 Sky completely clear	5
4/12/2020	Josh	5.1	-37.075269	144.55598	11:33	12:01	21	11	0 Sky completely clear	2
4/12/2020	Josh	2	-37.0721611	144.574557	12:10	12:47	20	11	0 Sky completely clear	13
4/12/2020	Josh	2.1	-37.073609	144.556523	12:47	13:21	21	11	0 Sky completely clear	10
4/12/2020	Ray DeMack	6	-37.0768057	144.574559	09:58	10:22	17	11	0 Sky completely clear	10
4/12/2020	Ray DeMack	6.1	-37.0763378	144.559665	10:24	10:52	20	11	0 Sky completely clear	12
4/12/2020	Ray DeMack	3	-37.0744484	144.574616	11:03	11:33	20	11	0 Sky completely clear	14
4/12/2020	Ray DeMack	3.1	-37.0741846	144.556352	11:35	12:02	21	11	0 Sky completely clear	22
4/12/2020	Ray DeMack	-1	-37.070298	144.562566	12:17	12:28	20	11	0 Sky completely clear	9
4/12/2020	Ray DeMack	-1.1	-37.0695728	144.556565	12:29	12:39	20	11	0 Sky completely clear	4
4/12/2020	Ray DeMack	-2	-37.0692141	144.562144	12:40	12:49	20	11	0 Sky completely clear	3
4/12/2020	Ray DeMack	-2.1	-37.0685601	144.555303	12:51	13:02	20	11	0 Sky completely clear	11
4/12/2020	Ray DeMack	-3	-37.0679247	144.562157	13:04	13:18	20	11	0 Sky completely clear	9
4/12/2020	Ray DeMack	-3.1	-37.0675984	144.555283	13:19	13:32	21	11	0 Sky completely clear	7
4/12/2020	Ben McKenzie	7	-37.0775532	144.574535	09:59	10:24	17	17	0 Sky completely clear	1
4/12/2020	Ben McKenzie	7.1	-37.0777603	144.559394	10:26	10:55	20	11	0 Sky completely clear	5
4/12/2020	Ben McKenzie	4	-37.0786761	144.574519	11:02	11:31	20	11	0 Sky completely clear	5
4/12/2020	Ben McKenzie	4.1	-37.0745303	144.55625	11:32	12:00	21	11	0 Sky completely clear	1
4/12/2020	Ben McKenzie	1	-37.0712896	144.573691	12:11	12:43	20	11	0 Sky completely clear	10
4/12/2020	Ben McKenzie	1.1	-37.0717736	144.556877	12:47	13:21	21	11	0 Sky completely clear	3
11/12/2020	Ray DeMack	6	-37.0766813	144.574587	10:07	10:35	19.5	4.6	0 Sky completely clear	8
11/12/2020	Ray DeMack	6.1	-37.0768195	144.559556	10:37	11:10	20	4.2	0 Sky completely clear	16

Date	Name of observer	Transect	Transect east end		Start time	End time	Temperature[1] (°C)	Wind speed[2] (km/hr)	Cloud cover[3]	Golden Sun Moth observations/transect
			Latitude	Longitude						
11/12/2020	Ray DeMack	3	-37.0737987	144.574451	11:25	11:56	23	3.4	2	33
11/12/2020	Ray DeMack	3.1	-37.0740291	144.556364	12:01	12:37	23.5	8.8	2	51
11/12/2020	Ray DeMack	-1	-37.0700729	144.562406	13:19	13:27				5
11/12/2020	Ray DeMack	-1.1	-37.0700573	144.556689	13:28	13:36				4
11/12/2020	Ray DeMack	-2	-37.0690426	144.562181	13:36	13:45				1
11/12/2020	Ray DeMack	-3.1	-37.0686961	144.555482	13:46	13:55				4
11/12/2020	Ray DeMack	-3	-37.0679606	144.562244	13:57	14:09	25	7.6	0 Sky completely clear	2
11/12/2020	Ray DeMack	-4	-37.0677051	144.555279	14:10	14:24	25	6.3	0 Sky completely clear	3
11/12/2020	Katie	7	-37.0786985	144.574625	10:03	11:18			0 Sky completely clear	3
11/12/2020	Katie	4	-37.0748416	144.566005	11:20	12:05			0 Sky completely clear	16
11/12/2020	Katie	4.1	-37.0746796	144.556124	12:07	12:44			0 Sky completely clear	8
11/12/2020	Katie	2	-37.0722333	144.574479	13:13	13:59			0 Sky completely clear	9
11/12/2020	Katie	2.1	-37.0724104	144.556732	14:00	14:38			0 Sky completely clear	2
11/12/2020	Sid Larwill	8	-37.0786874	144.574534	10:03	10:47				3
11/12/2020	Sid Larwill	8.1	-37.0789681	144.561844	10:48	11:11				0
11/12/2020	Sid Larwill	5	-37.0755516	144.574186	11:23	12:00				10
11/12/2020	Sid Larwill	5.1	-37.0758251	144.555836	12:03	12:43				0
11/12/2020	Sid Larwill	1	-37.071319	144.573639	13:14	13:49				7
11/12/2020	Sid Larwill	1.1	-37.071339	144.556934	13:51	14:29				5
15/12/2020	Ben McKenzie	5	-37.0775909	144.574513	10:00	10:35	24.8	4.2	1	7
15/12/2020	Ben McKenzie	5.1	-37.0754798	144.556168	10:36	11:06	0	0	1	2
15/12/2020	Ben McKenzie	2	-37.0724879	144.574153	11:25	11:57	0	0	1	13
15/12/2020	Ben McKenzie	2.1	-37.0723257	144.556867	11:57	12:30	0	0	1	15
15/12/2020	Ben McKenzie	-2.1	-37.0695184	144.556403	12:55	13:12	0	0	1	12
15/12/2020	Ben McKenzie	-2	-37.0695569	144.556472	13:12	13:26	0	0	1	5
15/12/2020	Laura	7	-37.0775788	144.574532	10:00	10:33	24.8	4.2		1
15/12/2020	Laura	7.1	-37.077747	144.559474	10:34	11:07				17
15/12/2020	Laura	1	-37.0714975	144.573854	11:26	12:01				24
15/12/2020	Laura	1.1	-37.0713982	144.556996	12:04	12:36	29	5.1	1	14
15/12/2020	Laura	-1	-37.0702709	144.562536	13:00	13:12				5
15/12/2020	Laura	-1.1	-37.0702703	144.556779	13:14	13:24				3
15/12/2020	Zach Dettmann	6	-37.0776473	144.574516	10:00	10:28	24.9	4.2	1	7
15/12/2020	Zach Dettmann	6.1	-37.0760763	144.559777	10:29	10:55				2
15/12/2020	Zach Dettmann	4	-37.0748602	144.573613	11:18	11:49				26
15/12/2020	Zach Dettmann	4.1	-37.0750502	144.556547	11:50	12:20	0	0	1	22
15/12/2020	Zach Dettmann	-3	-37.0680238	144.562182	13:02	13:12				9
15/12/2020	Zach Dettmann	-4	-37.0677937	144.555359	13:15	13:24	0	0	1	4
15/12/2020	Ray DeMack	8	-37.0775592	144.574518	09:55	10:30	24.8	4.2	1	3
15/12/2020	Ray DeMack	8.1	-37.0795073	144.559664	10:36	11:05			0 Sky completely clear	5
15/12/2020	Ray DeMack	3	-37.0738809	144.574589	11:20	11:52			1	15
15/12/2020	Ray DeMack	3.1	-37.0740227	144.55642	11:53	12:23			0 Sky completely clear	40
15/12/2020	Ray DeMack	-1.1	-37.0706691	144.56261	13:00	13:30			1	16

1. Temperature estimate from Redesdale Weather Station (Bureau of Meteorology 2021);
2. Wind speed estimate using Beaufort Scale class from Redesdale Weather Station (Bureau of Meteorology 2021);
3. Cloud cover estimate using the Okta Scale from Redesdale Weather Station (Bureau of Meteorology 2021).

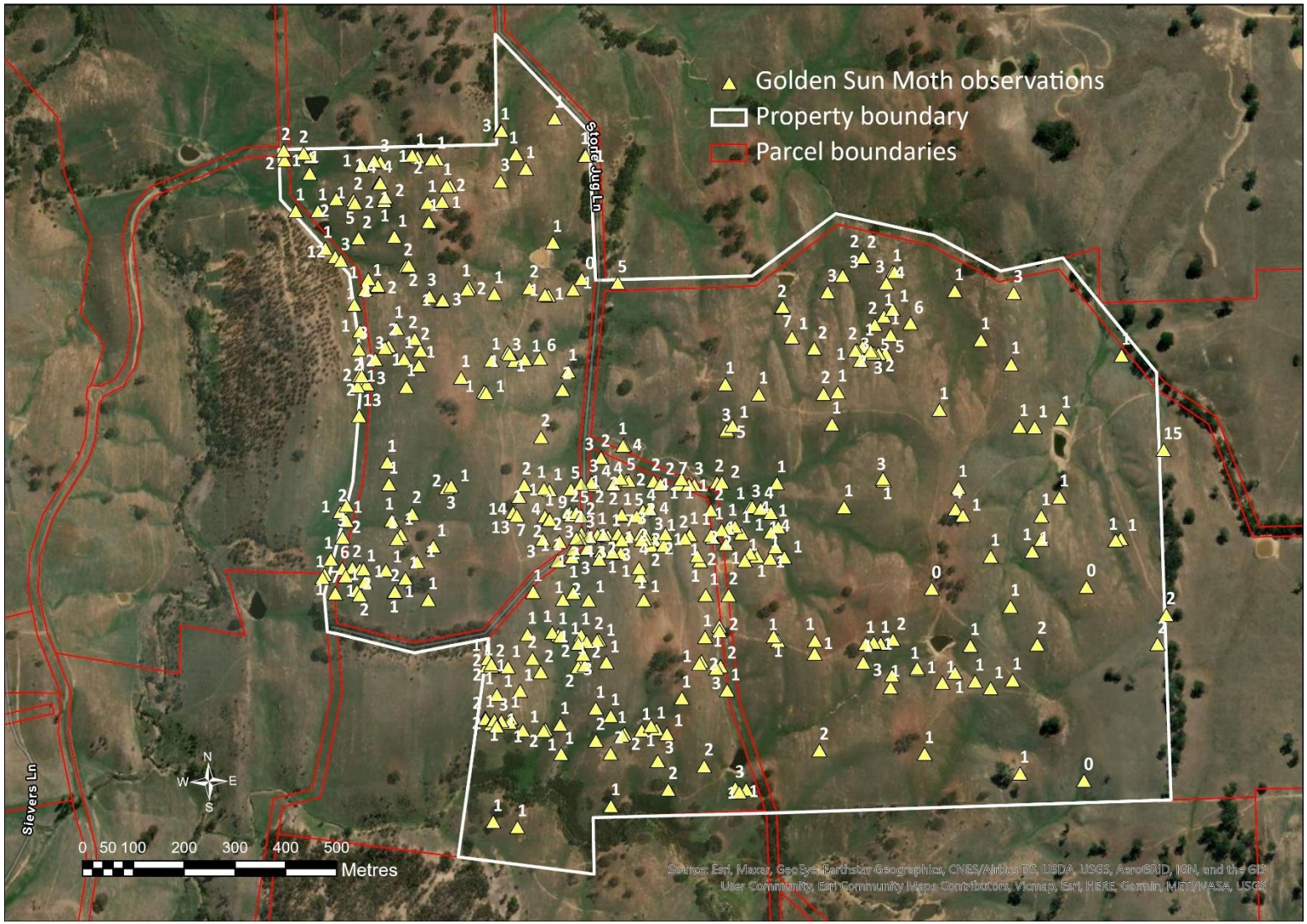


Figure 4-1 **The location of the Golden Sun Moth observations conducted on the Glenhope property in 2020; the number of individuals observed is shown next to the location of the observation. Image from Department of ESRI Australia (2021).**

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