

Final Report

# Detailed Vegetation Assessment, and Golden Sun Moth Population and Habitat Monitoring Year 1 (2022/23): Mount Gow, Shelford, Victoria

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**Greater Western Water**

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# 1 INTRODUCTION

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## 1.1 Background

Ecology and Heritage Partners Pty Ltd was engaged by Greater Western Water to undertake vegetation monitoring and Golden Sun Moth *Synemon plana* population and habitat quality monitoring for Year 1 for the offset site located at Mount Gow, Shelford, Victoria (herein referred to as the Mount Gow offset site). The requirement for Golden Sun Moth offset monitoring was associated with the construction of the recycled water pipeline, Parwan to Melton, Victoria (EPBC 2018/8260). The offset requirements were conditions under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the removal of 5.1 hectares of Golden Sun Moth habitat and 4.96 hectares of the NTGVVP at the development site.

A total of 26.5 hectares of Golden Sun Moth habitat has been protected within the offset site, in accordance with the *Victorian Conservation Trust Act 1972* via a Trust for Nature covenant. The management, monitoring and auditing works required to be undertaken at the offset site are detailed in the Offset Management Plan (OMP) (Ecology and Heritage Partners 2021) prepared for the Mount Gow offset site. The OMP was approved by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the EPBC Act (EPBC 2018/8228).

Detailed vegetation monitoring and Golden Sun Moth population and habitat monitoring has been undertaken in accordance with Section 8 of the endorsed OMP (Ecology and Heritage Partner 2021). The following report outlines the results of Year 1 monitoring results, which will provide future targets over subsequent years for the ongoing monitoring and management within the Mount Gow offset site.

## 1.2 Scope and Objectives

The Mount Gow offset site is being managed for the purposes of biodiversity conservation. Management of this site involves the physical protection of the offset site, control of pest animals and high threat environmental weeds, biomass reduction and general maintenance of the character and quality of the native vegetation, consistent with its historic context. The OMP and specified management actions form part of a broader strategy for long-term management of extant Golden Sun Moth populations and habitat.

The objectives of the vegetation monitoring and Golden Sun Moth monitoring were to:

- Undertake detailed vegetation monitoring of GSM habitat (i.e. Plains Grassland) to assess the overall quality and quantity of vegetation and composition of species (i.e. Habitat Hectares assessment);
- Assess biomass levels within 14 x 1 m<sup>2</sup> sampling plots equidistant within the Mount Gow offset site;
- The extent, severity, trend and presence of current weed species and any new and emerging weed species;
- Determine the abundance and distribution of Golden Sun Moth throughout the offset site;
- Determine any potential impacts to Golden Sun Moth and their associated habitat in response to current management practices; and,

- Provide advice on recommendations that may be undertaken to avoid and/or mitigate potential adverse impacts on significant ecological values.

### 1.3 Study Area

The Mount Gow offset site is located at a private property in Mount Gow, Shelford, Victoria, and is approximately 42 kilometres west of Geelong, Victoria (Figure 1). The offset site comprises 26.5 hectares of Golden Sun Moth habitat, which supports suitable grassland habitat and the confirmed presence of Golden Sun Moth. The offset site is part of a larger property intersected by Warrambine Creek and additional areas within the property at Mount Gow, Shelford, are currently secured and managed for the conservation of GSM and remnant NTGVVP (under previous EPBC Act approval conditions). The offset site is managed by the Rocklea Pastoral Co. which supports extensive areas of remnant native grassland and Golden Sun Moth habitat.

According to the DEECA NatureKit Map (DEECA 2023a), the study area occurs within the Victorian Volcanic Plain Bioregion. It is located within the jurisdiction of the Corangamite Catchment Management Authority (CMA) and the Golden Plains Shire municipality.

### 1.4 Golden Sun Moth

**EPBC Act Conservation Status:** Vulnerable\*

**FFG Act Conservation Status:** Listed

Golden Sun Moth (Plate 1) typically occurs in native grassland, grassy woodland, dominated by greater than 40% cover of wallaby-grass, in particular *Rytidosperma* spp. (DSE 2004), but may also inhabit areas dominated by Kangaroo Grass *Themeda triandra* (Endersby and Koehler 2006) and introduced grassland dominated by Chilean Needle-grass *Nassella neesiana* and other introduced species (A. Organ pers. obs.). Male flight is typically low, to about a metre above the ground, fast and can be prolonged, but they are generally not recorded flying more than 100 metres from suitable habitat (Clarke and O’Dwyer 2000).



**Plate 1.** Golden Sun Moth (Ecology and Heritage Partners Pty Ltd)

Prior to European settlement, the Golden Sun Moth was widespread and relatively continuous throughout its range, inhabiting grassy open woodlands and grassland, although it now mainly inhabits small, isolated sites (DSE 2004). The species is threatened by habitat loss, disturbance and fragmentation due to agricultural expansion and urbanisation. Many populations are isolated and fragmented, impeding the ability of the relatively immobile females to recolonise areas, thereby reducing the likelihood of genetic exchange (DSE 2004). Such populations are therefore vulnerable as there is little likelihood of recolonisation in the event of a local extinction.

**\*Note:** The EPBC Act Conservation Status for Golden Sun Moth was downgraded from Critically Endangered to Vulnerable, effective 7 December 2021.



## 2 METHODS

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### 2.1 Annual Monitoring and Reporting

Year 1 monitoring has been undertaken by Ecology and Heritage Partners Pty Ltd on behalf of the landowner, and included an assessment of:

- The extent, severity, trend and presence of current weed species and any new and emerging weed species;
- The extent, severity, trend and presence of pest animal activity;
- Biomass levels, visually assessed across the site;
- Evidence of unpermitted human/stock access;
- Any new threats.

Annual monitoring will occur in Years 1-4, 6, 8 and 10 (seven events) over the course of the ten years of the endorsed Offset Management Plan.

### 2.2 Vegetation Assessment

#### 2.2.1 Detailed Vegetation Monitoring

Detailed vegetation monitoring was conducted by a qualified ecologist and documented the following components:

- Overall assessment of the quality and quantity of vegetation and composition of species (i.e. Habitat Hectare assessment);
- Biomass levels, assessed from 14 x 1 m<sup>2</sup> sampling plots, randomly spread throughout the offset site (see Figure 3); and,
- The extent, severity, trend and presence of current weed species and any new and emerging weed species.

#### 2.2.2 Field Assessment

A field assessment was undertaken on 16 November 2023 to obtain information on flora values within the study area. The study area was walked, with all observed vascular flora species recorded, any significant records mapped, the overall condition of vegetation noted and the percentage cover of native plants, weeds, leaf litter, and bare ground estimated. A habitat hectare assessment was undertaken following the methodology described in the Vegetation Quality Assessment Manual (DSE 2004).

## 2.3 Golden Sun Moth Population Monitoring

Golden Sun Moth survey procedures followed the approved monitoring guidelines prepared by DAWE (now DCCEEW). Surveys were undertaken at a time which is considered suitable for detecting the GSM (i.e., when adult males are flying), and when the species was observed flying at a nearby reference site (i.e., Fraser offset site Mount Mercer). The following measures were undertaken as part of population and habitat monitoring for Golden Sun Moth at the offset site:

- Surveys were conducted by suitably trained observers at 50 metre transects, across the entire offset site;
- Surveys were conducted over four separate days during the known flight season. Traditionally this would be November to early January, however the flight season did not commence until mid-December due to unseasonably cool and wet weather. As such, some of the surveys were conducted around mid-January;
- Surveys were undertaken at a time which is considered suitable for detecting the species (i.e. when adult males are flying), and when Golden Sun Moth was observed flying at nearby locations (The male of this species generally flies between 11am and 3pm on calm, warm [over 20°C], sunny days); and,
- Surveys were conducted by qualified zoologists walking 50-metre-wide parallel transects across all areas of suitable habitat.

### 2.3.1 Targeted Golden Sun Moth Surveys

Targeted surveys for Golden Sun Moth were undertaken on 12, 13, 17 and 21 of January 2023 (see section 2.5.2 for justification for the short interval between some surveys). Areas of suitable habitat were walked by qualified ecologists at a time which is considered suitable for detecting the species (i.e. between 10:00am and 3:00pm during suitable weather conditions, when adult males are likely to be flying [DEWHA 2009]). The species was noted to be flying at other sites in the broader locality (i.e. Beaufort and Mount Mercer, Victoria) on the day of the surveys and via the Ecological Consultants Association of Victoria Golden Sun Moth flight diary.

## 2.4 Assessment Qualifications and Limitations

### 2.4.1 Vegetation Assessment

This report has been written based on the quality and extent of the ecological values and habitat considered to be present or absent at the time of the desktop and/or field assessments being undertaken.

Ecological values identified on site were recorded using a hand-held GPS or tablet with an accuracy of +/-3 metres. This level of accuracy is considered adequate to provide an accurate assessment of the ecological values present within the study area although this data should not be used for detailed surveying purposes.

The terrestrial flora and fauna data collected during the field assessment and information obtained from relevant desktop sources is considered to inform an accurate assessment of the ecological values present within the study area.



Whilst the study area wasn't pulse grazed during the time of the assessment (i.e. Spring), pulse grazing was undertaken periodically throughout the year as per the requirement of the OMP. As the site was pulse grazed throughout autumn and winter, the height of tussock grasses was limited, which may have impacted the results of the vegetation monitoring.

#### 2.4.2 *Golden Sun Moth*

Targeted GSM surveys were undertaken by experienced personnel during the known flight period of the species and during appropriate conditions by following suitable survey guidelines. Fauna surveys were conducted under the Ecology and Heritage Partners Pty Ltd Research Permit (#10009538) issued by DEECA under the *Wildlife Act 1975*.

The 2022/23 GSM season presented some unforeseen challenges, and Ecology and Heritage Partners closely monitored the emergence, distribution, and abundance of the species at reference sites across Victoria. Likely due to unseasonably wet and cool conditions through November and December, the species were not observed to be actively flying until mid-late December 2022, and numbers did not become consistent or reach typical abundances until the first to second week of January 2023. Typically, GSM emergence declines towards late January, whereby surveying for this species in February is unprecedented as historically the species' flight season is completed by this stage.

Furthermore, Ecology and Heritage Partners conducted a site assessment on 21 December 2022 and found the ground was too damp to begin the survey effort under suitable environmental conditions. In temperate regions, insect larvae often face a decision between development into their adult stage, or ongoing growth for emergence in the subsequent season (DEWHA 2009). We therefore expected a truncated emergence period for the species once conditions became suitable. However, in order to complete all four survey efforts while the species was known to be flying, surveys were undertaken slightly outside of the guideline's timing constraints, (i.e. surveys being conducted a week apart). As such, two surveys were conducted on consecutive days (12 and 13 January), to take advantage of a favourable weather window.

The species was also known to be flying at other sites in the broader locality (i.e. reference sites north and north east of the study areas) on the days of the survey. Given the species presence on site and the experience of surveyors, the results of this assessment are considered suitable for the purposes of assessing the works against the objectives of the project.

## 3 RESULTS

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The purpose of this Year 1 monitoring was to assess vegetation condition and habitat for 26.5-hectares of Golden Sun Moth offset area within the Mount Gow offset site. Based on the OMP, Golden Sun Moth habitat was categorized as high-quality habitat and moderate quality habitat, comprising 20.5-hectares and 6-hectares, respectively. Previously, the 26.5-hectare Golden Sun Moth habitat offset area comprised of multiple patches of Plains Grassland, including; several high-condition patches (PG1; 0.60/1), which met the condition threshold to be considered Natural Temperate Grassland of the Victoria Volcanic Plain (NTGVVP) (NTGVVP not included as part of this offset) and corresponded with some of the high-quality GSM offset areas (Ecology and Heritage Partners 2021); and several moderate-condition patches (PG3; 0.39/1), which corresponded with some of the high and moderate quality GSM offset areas (Ecology and Heritage Partners 2020; Ecology and Heritage Partners 2021).

The results of the Year 1 detailed vegetation monitoring are outlined below.

### 3.1 Vegetation Assessment

During the site assessment, the Mount Gow offset site was observed to be highly modified, due to environmental weed incursions. Previously, native vegetation within the study area comprised of one EVC: *Heavier Soils Plains Grassland* (EVC 132\_61) (Plate 2; Plate 3). Since the OMP was prepared, the Mount Gow offset site has degraded considerably in condition, and large portions of the site no longer meet the condition threshold to be considered a patch of native vegetation (i.e. >25% relative native cover). As such, due to considerable weed invasion, large portions of the Mount Gow offset site no longer support suitable Golden Sun Moth habitat, due to the lack of native grasses.

The current extent of native vegetation within the Mount Gow offset site is 0.60-hectares of *Heavier Soils Plains Grassland*, which was in low condition (i.e. 0.27/1) (Figure 2). In comparison, the previous extent of native vegetation within the Mount Gow offset site was 26.5-hectares.

In total, 16 flora species were observed within the study area, including six (6) indigenous species and 10 non-indigenous species. A list of all flora species recorded during the field assessment is provided in Appendix 1.1.

#### 3.1.1 Native Vegetation

The entirety of the 26.5-hectare Golden Sun Moth offset area was assessed, of which native grasses comprised approximately 10-15% total cover. Some small patches of native vegetation were identified within the study area; however, the majority of the Golden Sun Moth offset area did not have the 25% relative native cover to be considered a patch of native vegetation. Of the existing patches of Plains Grassland (i.e. PG1), flora species recorded during the site assessment, include *Wallaby Grass Rhytidosperma spp.*, Kangaroo Grass *Themeda Triandra*, Rush *Juncus spp.*, Tussock Grass *Poa spp.* and Sheep's Burr *Acaena echinata*.

Based on the results of the OMP (Ecology and Heritage Partners 2021), the offset site consisted of several patches of native vegetation, including high quality areas (PG1; 0.60/1) and moderate quality areas (PG3; 0.39/1) (Table 1). Prior to Year 1 vegetation monitoring occurring, Jacobs conducted an audit which indicated the majority of the site was no longer considered a patch of native vegetation, with only a small discrete area within the northern extent of PG1-C meeting the definition to be considered a patch of native vegetation in

accordance with the Guidelines (DELWP 2017). The Jacobs assessment indicated the identified patch was of very low quality (0.13/1) (Table 1); however, the assessment was conducted in winter, which is a suboptimal time for observing flora species and the cover of exotic grasses may have been higher at this time. Year 1 monitoring identified several small discrete patches located throughout the study area, which were of low condition (PG1; 0.27/1) (Table 1) (Figure 2).

Since the OMP was implemented, the cover of native grasses and herbaceous plants has reduced considerably, largely due to the presence of Toowoomba Canary Grass *Phalaris aquatica*, which has spread across much of the offset site (Plate 2; Plate 3). This discrepancy is also represented in the audit that was conducted by Jacobs in August 2023 (Jacobs 2023). Based on the results of this assessment, the overall quality of native vegetation and habitat that it provides for Golden Sun Moth has reduced considerably since the OMP was enacted. In order to improve Golden Sun Moth habitat within the offset area, a variety of methods will be required to increase native vegetation cover within the offset site, such as planned burns, spot-spraying and direct seeding.



**Plate 2.** Mount Gow Offset site covered by Toowoomba Canary-grass the offset site (Ecology and Heritage Partners Pty Ltd 16/11/2023).



**Plate 3.** Toowoomba Canary-grass present within the offset site (Ecology and Heritage Partners Pty Ltd 16/11/2023).

**Table 1.** Quantification of the current Site Condition Score based on the management of the offset site during the 2022/23 monitoring period.

Vegetation Zone	Baseline Assessment (EHP 2021; PG1)*	Baseline Assessment (EHP 2021; PG3)*	Jacobs Assessment (2023)	Year 1 Monitoring (PG1)
Bioregion	VVP	VVP	VVP	VVP
EVC	PG	PG	PG	PG
EVC Number	132_61	132_61	132_61	132_61
EVC Conservation Status	Endangered	Endangered	Endangered	Endangered
Large Old Trees /10	N/A	N/A	N/A	N/A
Canopy Cover /5	N/A	N/A	N/A	N/A
Under storey /25	15	10	5	10

<b>Patch</b>	Lack of Weeds /15	6	0	0	2
	Recruitment /10	6	3	0	3
<b>Condition</b>	Organic Matter /5	5	4	4	4
	Logs /5	N/A	N/A	N/A	N/A
	Treeless EVC Multiplier	1.36	1.36	1.36	1.36
	Subtotal =	43.52	32.64	12.24	25.84
<b>Landscape Scores</b>	Patch Size /10	N/P	N/P	1	1
	Neighbourhood / 10			0	0
	Distance to Core Area /5			0	0
	Landscape Value /25	16	16	1	1
	Habitat Points /100	60	49	13.24	27
<b>Habitat Score</b>		<b>0.60</b>	<b>0.49</b>	<b>0.13</b>	<b>0.27</b>

**Notes:** PG = *Heavier Soils Plains Grasslands*; VVP = *Victorian Volcanic Plain*; N/A = not applicable; \* As specified in the Offset Management Plan (Ecology and Heritage Partners Pty Ltd 2021); N/P = not provided in the original baseline assessment.

### 3.1.2 Weeds

The overall cover of exotic vegetation has increased considerably since the Offset Management Plan was implemented in 2022, with observed specimens including Toowoomba Canary-grass *Phalaris aquatica* (Plate 2; Plate 3), Wild Oat *Avena fatua*, Fescue *Vulpia* spp., Onion Grass *Romulea rosea*, Brome *Bromus* spp., Rye Grass *Lolium* spp., Rough Dog's-tail *Cynosurus echinatus*, Cat's Ear *Hypochaeris* spp., Hair Grass *Aira* spp., Serrated Tussock *Nassella trichotoma* and Variegated Thistle *Silybum marianum*. A list of all observed weeds, percentage cover and the Year 10 target cover is outlined in Table 2.

The overall cover of weeds within the offset area was estimated between 71-95%. The cover of weeds is largely due to the expansion of Toowoomba Canary Grass, which had a varied cover of 45-60% across the offset area. Other annual and perennial weeds had a combined cover of approximately 26-35% (Table 2). Since the OMP was enacted, woody weeds, primarily African Box-thorn *Lycium ferrocicimum*, has reduced to <1% cover. The OMP noted the herbaceous weed cover within the offset area to be estimated at 30-75% throughout the offset area, with weed cover higher in areas not recorded as NTGVVP. As per the OMP, management of herbaceous weeds was proposed to be undertaken through pulse grazing and spot-spraying; however, current methods to manage herbaceous weed cover within the offset area appear inadequate, given the increase in total weed cover.

Two declared noxious weeds, Variegated Thistle and Serrated Tussock, as defined under the *Catchment and Land Protection Act 1994* (CaLP Act), were observed during the site assessment; however, these species both comprised <1% cover. Serrated Tussock is also listed as a Weed of National Significance (WoNS).

Ongoing, intensive active management is required to ensure the percentage cover of weeds and biomass meets the objectives of the OMP, and options such as conducting a planned burn at the site to reduce biomass and weed cover, followed by targeted weed control, should be investigated.

**Table 2.** Weeds and percentage cover identified within the OMP Assessment (EHP 2022), Year 1 Monitoring and Year 10 Target Cover.

Scientific Name	Common Name	High Threat	OMP % Cover (EHP 2022)	Year 1 Monitoring % Cover	Year 10 Target % Cover
<b>Annual Weeds</b>					
<i>Hordeum spp.</i>	Barley Grass	-	3%	3%	<1%
<i>Hypochaeris radicata</i>	Flatweed	Y	3%	3%	<1%
<i>Aira spp.</i>	Hair Grass	-	0%	1%	<1%
<i>Acetosella vulgaris</i>	Sheep Sorrell	-	1%	1%	<1%
<i>Romulea rosea</i>	Onion Grass	-	0%	1%	<1%
<i>Bromus spp.</i>	Bromes	Y	0%	3-5%	<1%
<i>Vulpia spp.</i>	Rat-tail Fescue	Y	2%	3-8%	<1%
<i>Avena fatua</i>	Wild Oat	-	3%	3%	<1%
<b>Perennial Weeds</b>					
<i>Silybum marianum</i>	Variegated Thistle	Y	0%	<1%	<1%
<i>Lolium spp.</i>	Rye Grass	Y	0%	3-5%	<1%
<i>Cynosurus echinatus</i>	<i>Rough Dog's-tail</i>	Y	0%	3%	<1%
<i>Phalaris aquatica</i>	Toowoomba Canary-grass	Y	25-40%	45-60%	<1%
<i>Lycium ferrocicimum</i>	African Boxthorn	-	<1%	0%	<1%
<i>Cirsium vulgare</i>	Spear Thistle	Y	<1%	0%	<1%
<i>Nassella trichotoma</i>	Serrated Tussock	Y	<1%	<1%	<1%
		<b>Total % Cover</b>	40-55%	71-95%	N/A

**Notes;** \*Annual weeds which have been averaged due to grouping in the original baseline assessment and Jacobs Audit report; N/A = not applicable, not observed during the assessment; Y = High threat weed.

### 3.1.3 Biomass Bonitoring

As outlined in the Offset Management Plan for the Mount Gow offset site (Ecology and Heritage Partners 2021), the objective of biomass control is to promote and maintain floristic diversity, and inter-tussock space

for germination of native flora associated with NTGVVP community. Biomass monitoring was undertaken across 14x1m<sup>2</sup> plots within the study area, which were deployed in a grid-like formation. The purpose of biomass monitoring was to determine the percentage native vegetation cover, percentage weed cover, percentage of bare ground and percentage cover of rocks. The aim of biomass monitoring is to maintain approximately 20% cover of bare ground or inter-tussock space to allow for sufficient space for recruitment of native herbs and grasses. Based on the results of this assessment, native vegetation cover was approximately 12%, weed cover was approximately 74.1%, bare-ground cover was approximately 10.0%, and percentage rock cover was approximately 3.7% (Table 3).

In comparison with the objectives outlined in the OMP, the Year 1 biomass monitoring indicates that the cover of bare ground is lower than the objective cover of 20%. This is likely due to the increase in weed cover across the site, primarily due to the spread of Toowoomba Canary-grass. On-going management is required in order to increase the percentage cover of bare-ground, which will enable the recruitment of native grasses and herbs. Due to the high percentage cover of weeds and lack of suitable recruitment space for native species, a variety of methods such as planned burns, spot-spraying, pulse grazing and direct seeding will be required to improve biomass conditions within the offset site.

**Table 3.** Biomass Monitoring conducted at 14 one-metre<sup>2</sup> established points across the study area.

Plot Number	Percentage (%) Native Cover	Percentage (%) Weed Cover	Percentage (%) Bare Ground	Percentage (%) Rock Cover
<b>Year 1</b>				
1	30	60	8	2
2	20	70	10	0
3	25	45	30	0
4	25	70	5	0
5	15	65	5	15
6	15	65	5	15
7	0	70	30	0
8	0	100	0	0
9	0	99	1	0
10	20	70	10	0
11	5	60	15	20
12	0	95	5	0
13	0	99	1	0
14	15	70	15	0
<b>Total Average</b>	12.14286	74.14286	10	3.714286

### 3.2 Golden Sun Moth Monitoring

The following sections summarise the previous and current Golden Sun Moth monitoring results for the offset site located at Mount Gow, Shelford, Victoria.



### 3.2.1 Previous Survey Results

Golden Sun Moth was initially recorded during targeted surveys across the north of the Mount Gow offset site. The result of the population monitoring is provided below (Table 4).

More than 991 Golden Sun Moth were recorded during habitat monitoring on 14 and 24 November 2017, 15 and 22 December 2017, and 11 January 2018 across the offset site (Ecology and Heritage Partners 2021).

In addition, several individuals were detected during targeted surveys across Mount Gow offset site, during the 2014/15 flight period (AECOM 2015).

The species has been recorded predominantly within areas of Natural Temperate Grassland of the Victorian Volcanic Plain (NTGVVP), containing more open ground and preferred host plants, including Wallaby Grasses. Targeted surveys were undertaken in accordance with the Significant Impact Guidelines for the Golden Sun Moth (DEWHA 2009).

**Table 4.** Previous Golden Sun Moth Population Monitoring within the Mount Gow offset site.

Survey Year	GSM Abundance	Management Recommendations
2014/15	low	While the number of GSM was lower this is likely due to the timing of the surveys as opposed to the quality of habitat on site given conditions have not decreased in quality over the past year.
2017/18	991	The species was detected in high numbers demonstrating that the species still resides in high population numbers within the offset site.
2019/20	60+	The species was detected in the northern portion of the offset site in substantial population numbers.

### 3.2.2 Year 1 Survey results

Prior to undertaking Golden Sun Moth surveys within the study area, reference sites were checked to determine if the species was actively flying on the day (Table 5).

**Table 5.** Reference sites for the 2022/23 flight season.

Date	Survey times	Reference site*	Temperature (°C)	Wind (km/hr)	Cloud cover (%)	No. of days since rain	No. GSM recorded within reference area
12/01/2023	10:00-3:00pm	Mount Mercer	24.0	5.5 SSW	5	10	32
13/01/2023	10:00-3:00pm	Beaufort	25	33 SE	35	11	47
17/01/2023	10:00-3:00pm	Mount Mercer	25.7	3.7 ESE	20	14	21
21/01/2023	10:00-3:00pm	Mount Mercer	20.5	7.4 SE	60	2	4

\*reference site refers to known locations of GSM populations where individuals were recorded flying on the day of the relevant survey to allow confidence that the survey conditions were suitable.

Targeted surveys identified a total of three (3) Golden Sun Moth at the Mount Gow offset site (Table 3; Figure 2b).

One of these individuals was detected on 17 January within higher quality Golden Sun Moth habitat near the centre of the offset site, within the area which was previously mapped as NTGVVP. The other two individuals were both detected on 21 January, with one detected within moderate quality habitat at the northern end and one in higher quality habitat at the southern end (Figure 3).

GSM were not detected in similar numbers relative to previous surveys undertaken in surrounding areas (Tables 1 and 2), demonstrating that unfavourable weather conditions have negatively impacted the flight season for GSM. Additionally, since the OMP was enacted, the total cover of native vegetation has reduced considerably throughout the offset site, resulting in a reduction in total habitat for Golden Sun Moth. The combined increase in cover of weeds, reduction in native vegetation and poor weather conditions throughout the 2022/2023 period may be indicative of the reduced number of Golden Sun Moth recorded within the study area.

**Table 6.** Golden Sun Moth survey results during the 2022/23 flight season.

Date	Survey times	Temperature (°C) (start and end of survey)		Wind (km/hr)	Cloud cover (%)	No. of days since rain	No. GSM recorded within study area
12/01/2023	3:15PM	28.8	28.7	5.5 NNE	20	>7	0
13/01/2023	3:00PM	24.0	25.1	19 SSE	66	>7	0
17/01/2023	12:32PM	35.3	37.6	26.5 NNW	0	3	1
21/01/2023	2:40PM	21.8	21.8	24.1 SE	62	1	2

### 3.2.3 Stocking Rate

Based on the monitoring results for Year 1 surveys, the stocking rate of GSM for the 2022/2023 survey season was 0.0057 GSM/Hectare (Table 7).

**Table 7.** Golden Sun Moth Stocking Rate at the Mount Gow Offset Site

Year	No. of GSM	Stocking Rate*
1	3	0.0057

**Note:** ^ Four Surveys undertaken; \* GSM per hectare

### 3.3 Management Targets

The following section discusses the performance measures outlined within the OMP (Ecology and Heritage Partners Pty Ltd 2021), and the recorded cover of biomass and pest plant cover during the 2022/23 monitoring of the offset site. The following information aims to compare the overall targets of the vegetation quality noted within the OMP and baseline assessment with the current levels measured on site during the spring and summer of the 2022/23 assessments. The management targets outlined in the OMP aim to improve and/or maintain existing Golden Sun Moth habitat within the study area by the end of Year 10 of management.

#### 3.3.1 *Weed Control*

The objective of weed control within the offset site is to improve the existing quality of Golden Sun Moth habitat by reducing/minimising future invasion 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 weed spraying, through on-ground management activities.

##### 3.3.1.1 Performance Indicators

- Eliminate all high threat and woody weeds (<1% cover) within Habitat Zone 1;
- Where herbicide application is employed, waterway sensitive products and non-residual herbicides are to be employed;
- Achieve a VQA weed score of at least 6/15 by the end of the 10 year management period;
- Achieve an understory score of at least 15/25 by the end of the 10 year management period;
- No off-target damage to indigenous plants; and
- No new or high threat weeds establishing within the offset site.

#### 3.3.2 *Biomass Control*

The objective of biomass control within the offset site is to promote and maintain floristic diversity, and inter-tussock spaces for germination and recruitment of native flora associated to provide Golden Sun Moth habitat. In addition, these actions will improve habitat quality for existing flora present within the offset site, and assist with minimising the growth of weeds.

##### 3.3.2.1 Performance Indicators

- Maintain or improve species richness and improve species diversity;
- Improve species recruitment through improvement and maintenance of suitable vegetation structure throughout the site; biomass remains moderate (i.e. no increase on current levels), and suitable inter-tussock spaces for natural recruitment maintained/provided (through transect monitoring and photo-points – see below);

- Achieve a VQA understory score of at least 15/25 by the end of the 10 year management period;
- Achieve a VQA recruitment score of at least 6/10 by the end of the 10 year management period;
- Stock grazing is excluded between October-November, except where necessary for further biomass reduction during dry periods. Grazing does not occur between October-November in more than two consecutive years;
- Establishment of 14 x 1m<sup>2</sup> quadrats throughout the offset site to monitor density of biomass;
- Weed biomass does not increase in areas of remnant vegetation;
- Minimum of 20% of total offset site cover will comprise inter-tussock space; and,
- All grazing events effectively documented.

### 3.3.3 *Pest Animals*

The objective of pest animal management is to control pest animals (e.g. rabbits, foxes) within the offset site, as required, to minimise negative impacts to the Plains Grassland communities, which provides habitat for GSM. The *Catchment and Land Protection Act 1994* lists rabbits and foxes as established pest animals and requires that all landowners take reasonable steps to prevent the spread of, and as far as possible eradicate, established pest animals on their land.

#### 3.3.3.1 **Performance Indicators**

- Any rabbit warrens or fox dens are controlled immediately following detection;
- Reduction in the abundance of pest animals, and no detectable impacts to the native grassland community; and,
- All monitoring and management activities are effectively documented.

### 3.3.4 *Fencing*

An existing permanent stock-proof fence currently exists around the perimeter of the broader offset property. Under this agreement livestock (sheep) may be permitted into the offset site for control of herbaceous/grassy weeds and biomass management, with grazing to be generally excluded between 1<sup>st</sup> October and 31<sup>st</sup> January. The purpose of maintaining fencing along the border of the offset site is to ensure that stock are excluded during the relevant periods.

#### **Performance Indicators**

- Stock excluded from offset site during relevant exclusion period (generally October-November) (see Section 5.5.5 for further information on exclusion period);
- Access to the offset site is appropriately controlled;
- Existing and temporary fencing is maintained in good repair;
- Posts around the perimeter of the offset site are established for monitoring and management purposes; and,

- All fencing activities and repairs are effectively documented.

## 4 DISCUSSION

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### 4.1 Vegetation Condition

Native vegetation condition and extent has reduced considerably within the Mount Gow Offset site over the past several years, since the original baseline assessment was conducted in 2020 (Ecology and Heritage Partners 2020) and the OMP was enacted in 2022 (Ecology and Heritage Partners 2021). The OMP was enacted to secure 26.5 hectares of Golden Sun Moth habitat within the offset site, which corresponded with 26.5 hectares of *Heavier Soils* Plains Grassland (EVC 132\_61). When the original baseline assessment was conducted, two distinct quality conditions for patches of native vegetation were recorded within the offset area, including; several high condition patches (PG1), which also met the condition threshold to be considered NTGVVP (approximately 2.21 hectares); and several low condition patches (PG3), which corresponded with the remainder of the Golden Sun Moth offset area (approximately 24.29 hectares).

In Year 1 of management (2022/2023), the overall extent of *Heavier Soils* Plains Grassland recorded within the offset area was approximately 0.6 hectares. In addition, the vegetation condition for patches of native vegetation was 0.27/1. Across the *understorey*, *lack of weeds*, *recruitment* and *organic matter* scores, there has been a marked reduction in each component.

In the original baseline assessment the *understorey* component achieved a score of 15/25, whereas Year 1 monitoring achieved a score of 10/25, indicating lower floristic diversity in patches of native vegetation. Patches of native vegetation (PG1) contained a very low diversity of native herbs, well below the benchmark number of species, with no large herbs (benchmark # of spp. 2) or medium herbs (benchmark # of spp. 12), and only one (1) small or prostrate herbs (benchmark # of spp. 4) being identified. There was a low to moderate diversity of native grasses recorded within the study area, with one (1) large tufted graminoid (benchmark # of spp. 1) and four (4) medium to small tufted graminoid (benchmark # of spp. 13) being identified. No medium to tiny non-tufted graminoid (benchmark # of spp. 4) were identified. Additionally, bryophytes/lichens and soil crust were also present.

In the original baseline assessment, the *lack of weeds* component achieved a score of 6/15, whereas Year 1 monitoring achieved a score of 2/15, indicating a marked increase in the total cover of weeds within the site. Additionally, the *recruitment* component has reduced from 6/10 since the baseline assessment was conducted to 3/10 in Year 1 of monitoring. The cumulative percentage of bareground, byophytes/lichens and soil crust was the same in the baseline assessment and Year 1 of monitoring (between >5% to 20% cover); however, the reduction in score is due to the lack of native herb diversity, which is evident by the low herb diversity recorded in patches of native vegetation.

Lastly, in the baseline assessment, the *organic litter* component (benchmark of 10% cover) achieved a score of 5/5, whereas Year 1 Monitoring achieved a score of 4/5, suggesting that while both assessments had between >50% or <150% of the benchmark cover for *organic litter*, it was dominated by non-native organic litter in Year 1, rather than native organic litter.

Based on the requirements outlined in the OMP, the vegetation condition and extent has reduced considerably within Plains Grassland patches, which is consistent with the finding of the Jacobs audit (Jacobs 2023). The



study area contained low floristic diversity and a high cover of exotic species, predominantly Toowoomba Canary-grass.

In order to improve the condition and extent of native vegetation within the study area, and concurrently the Golden Sun Moth habitat, intensive management actions will be required to decrease the cover of exotic plants and increase the cover of native vegetation within the study area. Direct seeding of native grasses and herbaceous plants will be required to improve the *understorey* component, and active weed management (i.e. spot-spraying) will be required to improve the *lack of weed* score. Other methods, such as planned burns and pulse grazing should be undertaken to reduce the cover of weeds, improve the *organic litter* components and increase the *recruitment* scores.

Weed cover and management measures are outlined below (Section 4.1.1)

#### 4.1.1 Weed Cover

The OMP noted the total percentage cover of weeds to be between 40-55% within the Golden Sun Moth Offset area. Year 1 monitoring indicated the overall cover of weeds was between approximately 71-95% across the study area, with patches of native vegetation (i.e. PG1) having the lowest cover of weeds. Outside patches of native vegetation, the cover of weeds was considerably higher. As outlined in the OMP, the objectives of weed management is to achieve and maintain a VQA *lack of weed* score of at least 6/15 (i.e. 25-50% cover and less than 50% high threat weeds). Based on Year 1 of monitoring, the lack of weed score was 2/15. A target of the OMP was to eliminate all high threat and woody weeds (<1% cover), and any new and emerging herbaceous weeds need to be eliminated (<1% cover). In Year 1 monitoring, all woody weeds, primarily African Box-thorn, were approximately managed and the cover of woody weeds across the study area was <1%. During the field assessment, the total cover of environmental weeds has increased considerably (Table 2), including:

- Toowoomba Canary-grass which was in high abundance through the offset area, with a total cover of 40-60%, increased from 25-45% since the OMP was enacted. Due to the large degree of encroachment which has occurred, on-going and active management will be required (i.e. spot-spraying) to manage Toowoomba Canary-grass, and potentially an ecological burn;
- The cover of Barley Grass has remained consistent since the OMP was enacted, with a total cover of 3%;
- The cover of Flatweed has remained consistent, with a total cover of 3%;
- While not recorded in the baseline assessment, Bromes *Bromus* spp. have been recorded within the study area, with an estimated cover of 3-5%;
- The cover of Rat-tail Fescue has increase to 3-8%, from 2% since the OMP was enacted;
- The cover of Wild Oat has remained consistent, with an estimated 3% cover; and,
- While not previously identified in the OMP, Rye-grass and Rough Dog's-tail were recorded within the offset area, with a total cover of 3-5% and 3%, respectively.

Since the OMP was completed in 2021 (Ecology and Heritage Partners 2021), there has been a considerable increase in the total cover of environmental weeds, despite the decrease in cover of noxious weeds. Due to the high cover of environmental weeds in the throughout the offset area, ongoing and intensive weed

management will be required to meet the performance indicators outlined in the OMP. Given the increase in cover of a variety of environmental weeds, high-threat weeds have been recategorized based on the threat they pose to Golden Sun Moth habitat within the offset area. The list of current high threat weeds is outlined in Table 2. Ongoing intensive and integrated weed management is required to ensure these high threat weeds do not continue to increase in cover within the offset site, and over the next couple years, these weeds should be the focus of weed management activities. This should include a combination of herbicide application and pulse grazing as per the OMP. The idea of an autumn burn should also be investigated, which may assist in reducing the overall cover of weeds within the study area and support recruitment for native grasses and herbs. Weed management measures should aim to reduce the overall cover of weeds to <25% over the coming years, which would increase the *lack of weeds* score, improving the vegetation condition. Given the marked increase in environmental weeds, it's highly recommended a land management contractor is engaged to manage environmental weeds within the offset area.

Specific weed management actions undertaken (i.e. physical removal, spraying, pulse grazing) will be provided by the landowner as part of their annual report.

#### 4.1.2 Biomass Control

Biomass management is essential to enhance the ecological values throughout the offset site, including the maintenance and improvement of GSM habitat. Biomass management is also required to maintain inter-tussock spaces and prevent excessive competition to grassland forbs. Biomass control will aim to maintain approximately 20% of bare ground or inter-tussock space to allow sufficient space for recruitment of herbs and grasses. Based on the results of Year 1 of Monitoring, the cumulative percentage of bare-ground was approximately 10%, which is lower than the goal cover of 20% outlined in the OMP (Table 3). This may be due to the unseasonably wet conditions over the past two years (2021/2022), which maintained consecutive La Niña years.

In order to improve biomass levels to the amount specified within the OMP, the landowner should explore a variety of options, including:

- Pulse Grazing – which should occur throughout winter to prevent increases in weeds and biomass to uncontrollable levels. However, grazing should not occur between October 1 and January 31. Aim for total vegetation cover of no greater than 80% after grazing. Additionally, pulse grazing should not occur too frequently during periods of high rain, which might result in pugging, disturbing the soil. Currently the intensity of pulse grazing may not be sufficient, as evident by the increase in Toowoomba Canary-grass and other environmental weeds. Based on observations from the field assessment, the pulse grazing appears to be reducing the total cover of native grasses and the intensity may not be sufficient to reduce the cover of Toowoomba Canary-grass. Sheep may be preferring to graze native grasses, rather than environmental weeds. Thus, an increase in the intensity of pulse grazing during winter may assist in reducing the cover of Toowoomba Canary-grass and other environmental weeds, creating space of native recruitment in spring;
- Ecological Burn – this is not a compulsory component of the OMP, however, it is considered that an appropriate ecological burning regime will appropriately control biomass and enhance and promote the maintenance of species diversity within the offset site. Given the ineffectiveness of pulse grazing to date, it is highly recommended that an ecological burn is explored, which would create space for

native recruitment. If this option is explored, an ecological burn should occur in later summer, early autumn, and should occur every 2-5 years. The intensity and extent of the ecological burns may need to be adjusted based on the effectiveness of the action of the coming years; and,

- Weed spraying – this method should occur in conjunction with pulse grazing and ecological burns, and effort should be made to minimise environmental weeds within the offset area. This method would reduce the cover of weeds, enabling recruitment of native grasses and herbs in these areas. It is highly recommended that spot-spraying occurs, targeting high threat weeds outlined in Table 2. Boom spraying should not occur within the offset area, as this may inadvertently impact native grasses and Golden Sun Moth populations.

It is anticipated that, if weather conditions permit, an integrated approach with pulse grazing followed by weed spraying at the appropriate time would be beneficial to the site and assist in meeting the biomass control target of 80% by the completion of the OMP. Due to the high cover of environmental weeds, it is highly recommended an ecological burn should occur within the offset area.

#### 4.1.3 *Pest animals*

The objective of pest animal management is to control pest animals (e.g. rabbits, foxes) within the offset site, as required, to minimise negative impacts to the Plains Grassland communities, which provides habitat for GSM. During the site assessment, one rabbit warren was recorded in the south of the offset area, approximately 700-metres to the south of the Golden Sun Moth offset area. As per the requirements of the OMP, the rabbit warren must be controlled immediately.

#### 4.1.4 *Fencing*

During the site assessment, the boundary of the offset area was walked to ensure that permanent stock-proof fencing was maintained in good condition, as per the requirement of the OMP. It was noted that all fencing was maintained around the offset area in good condition, and no fence gaps were recorded. This ensures that stock is adequately excluded from the offset site during the relevant exclusion period (October-November). Current fencing meets the requirements outlined in the OMP.

## 4.2 **Golden Sun Moth**

Targeted surveys identified a total of three (3) Golden Sun Moth flying within the Mount Gow offset site over four days (12, 13, 17 and 21 of January 2023). Golden Sun Moth were not detected in similar numbers relative to previous surveys undertaken in surrounding areas, demonstrating that atypical weather conditions during the 2022/23 survey season may have compelled Golden Sun Moth to stay in the larval stage rather than emerge and develop into an adult, and await warmer drier conditions in the subsequent season (DEWHA 2009).

Continued biomass and weed control within the offset site can enhance existing GSM habitat by reducing and/or minimising future invasion by exotic flora. This will assist in supporting the open structured Plains Grassland community suitable for the ecological requirements of Golden Sun Moth. Should the 2023/24 survey period provide more favourable warm and dry survey conditions, we expect a more accurate representation of Golden Sun Moth abundance in the Year 2 monitoring season, particularly as these conditions relate to

ground and soil dryness. Given the increase in environmental weeds and decrease in cover of native vegetation, which golden Sun Moth rely on, active weed management will be required to improve the habitat conditions for Golden Sun Moth. Direct seeding of native grasses should occur in conjunction with weed management activities and pulse grazing, to ensure that adequate recruitment of native grasses occurs.

Nevertheless, given the extent of suitable habitat for Golden Sun Moth within and adjacent to the offset site, as well as the high numbers of individuals previously recorded, it is anticipated that provided environmental conditions are optimal in future years and management actions are appropriately undertaken, the stocking rate will increase.

### 4.3 Management Actions Summary – 2022/23

A summary of the required management actions and completion dates for 2022/23 as outlined in the OMP are provided below in Table 6.

**Table 6.** Management Action Table for the offset site for the Year 1 (2022/23) monitoring period.

Year from Commencement	Area	Management Action Description	Resource	Timing of action	Key performance target/s for end of 10-year management plan	Year 1 Action Completed? (Yes/No)	Date	Additional Comments
<b>Fencing</b>								
<b>Year 1 - 10</b>	26.5 hectare GSM habitat	Establish fence around the boundary of the offset site in accordance with advice from a qualified ecologist and land surveyor Refer Section 5.5.2 of the OMP	Landowner	Ongoing	Exclude stock from the offset site during exclusion period to protect Golden Sun Moth habitat.	Yes	Details provided by Charles Cameron (Landholder)	See Appendix 2 for details
	26.5 hectare GSM habitat	Maintain fencing in good condition to appropriately exclude unintended grazing by livestock over the 10 year management period. Refer Section 5.5.2 of the OMP		ongoing	Maintain fencing to DELWP fencing standards in BushBroker Information Sheet 12 - Standards for Management – Fencing (excluding the southern boundary along the stone wall where a simple stock-proof fence will be used)	Yes	Details provided by Charles Cameron (Landholder)	See Appendix 2 for details
<b>Woody Weed Control</b>								

Year from Commencement	Area	Management Action Description	Resource	Timing of action	Key performance target/s for end of 10-year management plan	Year 1 Action Completed? (Yes/No)	Date	Additional Comments
Year 1 - 10	26.5 hectare GSM habitat	Control new and emerging woody weeds Refer Section 5.5.3 of the OMP	Landowner	Ongoing	Maintain woody weeds (<1% cover)	Yes	Details provided by Charles Cameron (Landholder)	See Appendix 2 for details
<b>Herbaceous Weed Control</b>								
Year 1 - 10	26.5 hectare GSM habitat	Control herbaceous weeds. Refer to Table 7 for list of herbaceous weeds, their control method and timing of actions Refer Section 5.5.3 of the OMP	Landowner	Refer to Table 8 of the OMP.	Maintain high threat weeds to levels outlined with section 5.5.4. Minimise off-target damage (avoid all native plants)	Yes	Details provided by Charles Cameron (Landholder)	Herbaceous weeds were controlled in accordance with the requirements of the OMP. However, new emerging weeds, such as Toowoomba Canary-grass, Brome and Rat-tailed fescue will need to be controlled during following years. See Appendix 2 for details
	26.5 hectare GSM habitat	Control all new & emerging herbaceous weeds Refer Section 5.5.3 of the OMP		Ongoing.	<2% cover of all new and emerging herbaceous weeds at the end of Year 10	Yes	Details provided by Charles Cameron (Landholder)	See Appendix 2 for details
<b>Pest Animals</b>								
Year 1 - 10	26.5 hectare GSM habitat	Control rabbits and foxes. Refer to Section 5.5.4 for a list of control	Landowner / Pest Animal Contractor	Refer to Table 9 of the OMP.	No surface disturbance within the offset site; No active rabbit warrens to be present;	Yes	Details provided by Charles Cameron (Landholder)	See Appendix 2 for details



Year from Commencement	Area	Management Action Description	Resource	Timing of action	Key performance target/s for end of 10-year management plan	Year 1 Action Completed? (Yes/No)	Date	Additional Comments
		methods and timing of actions Refer Section 5.6 of the OMP			No active fox dens to be present; No rubbish/artificial harbour present; Minimal artificial piles of logs and rocks			
	26.5 hectare GSM habitat	Monitor and control rabbits and foxes Refer Section 5.5.4 of the OMP		Ongoing	Reduction in the abundance of pest animals, and no detectable impacts to the native grassland	Yes	Details provided by Charles Cameron (Landholder)	See Appendix 2 for details
	26.5 hectare GSM habitat	Monitor and control all new and emerging pest animals Refer Section 5.5.4 of the OMP		Ongoing	Control numbers of any new & emerging pest animals	Yes	Details provided by Charles Cameron (Landholder)	See Appendix 2 for details
<b>Biomass Management</b>								

Year from Commencement	Area	Management Action Description	Resource	Timing of action	Key performance target/s for end of 10-year management plan	Year 1 Action Completed? (Yes/No)	Date	Additional Comments
<b>Year 1 -10</b>	26.5 hectare GSM habitat	Pulse grazing in dry years and light grazing in wet years. Refer Section 5.5.5 of the OMP	Landowner	The maximum length of continuous grazing is four weeks with at least two weeks rest between cycles. Stock generally excluded during October - January Stock removed immediately following any high rainfall events.	Stock must be removed should total vegetation cover fall to or below 70% Sufficient bare ground (approximately 20%) maintained in order to maintain space for recruitment of herbs and grasses. Maintain or improve species richness and improve species diversity. No loss of native plant diversity as a result of grazing regimes. Reduction in weed cover. All grazing events to be documented.	Yes	Details provided by Charles Cameron (Landholder)	Year 1 pulse grazing was conducted, however the intensity of the action was no sufficient. The intensity of pulse grazing should be increased throughout Years 2 and 3 and an ecological burn should be considered.
<b>Detailed Golden Sun Moth Population and Vegetation Monitoring</b>								
<b>Years 1-4, 6, 8 and 10</b>	26.5 hectare GSM habitat	Monitoring Refer Section 8.2, 8.3 and 8. of the OMP Landowner responsible for arranging third party monitoring, while the Approval Holder is	Suitably qualified ecologist (Ecology and Heritage Partners)	Spring/Summer	Assessment of the effectiveness of the management actions. Monitoring reports will include a review of past management works against the performance targets and objectives contained within this OMP, and	Yes	See Sections 3 and 4 above.	N/A

Year from Commencement	Area	Management Action Description	Resource	Timing of action	Key performance target/s for end of 10-year management plan	Year 1 Action Completed? (Yes/No)	Date	Additional Comments
		responsible for funding monitoring and reporting			recommended changes to management actions where required. Landowner to submit Annual Reports including surveys to TFN and the Approval Holder. The Approval Holder is responsible for submitting all reporting to DCCEEW			

## 4.4 Recommendations

Recommended measures to improve the condition and extent of native vegetation and associated Golden Sun Moth habitat within the offset site, include:

- Continue to implement pulse grazing during late summer, early autumn and winter (if dry) to reduce (and then maintain) the overall biomass cover to 80% across entire offset site;
- Pursue the possibility of conducting an autumn burn to help reduce the grassy weed cover on site and reduce the amount of weed seed present (that set and dropped due to conditions being unsuitable to spray prior to seed set). Care should be taken to ensure the native grasses have dropped their seed, as this may take place later than usual due to the wetter conditions this year. Burns should not occur more than once every 5 years. The frequency at which burns occur may need to be altered based on the effectiveness of the management action. Should the use of an burn be explored, this must be conducted outside the active period for Golden Sun Moth (i.e. October to February);
- Additional active weed control by the landowner or a suitable contractor will be required to maintain and/or reduce the cover of high threat weed species below the threshold of <1%. Spot spraying of Flatweed, Rat-tailed Fescue, Toowoomba Canary-grass, Wild Oat, Rye Grass, Bromes, and Rough Dog's Tail should occur throughout the study area, and controlling newly emerging high threat weeds must be actively continued to meet the required target weed cover across the offset site. Weed control actions, over multiple days, will be conducted outside of the normal active period for Golden Sun Moth (between October to February) to avoid any unexpected impacts to Golden Sun Moth populations as the effects of herbicide application on Golden Sun Moth remain unknown; and,
- Active seeding of native grasses, such as Wallaby Grass and Spear Grass, should be undertaken within the offset area to assist with native recruitment. Direct seeding will focus on establishment of wallaby-grasses, as these species are known to be the primary food source of Golden Sun Moth; however, a variety of species should also be used to improve the overall vegetation condition, such as Spear Grass, Tussock Grass and Kangaroo Grass. Direct seeding should occur in October/November, with a frequency of no more than once a year; and,
- One rabbit warren was detected in the south of the offset site, approximately 700-metres to the south of the Golden Sun Moth offset area, on the eastern side of the river. If this has not already been actioned, the rabbit warren must be immediately fumigated, according to best practice management techniques. Fumigation works must be conducted by the landowner or a suitably qualified operator where rabbit activity is identified.

Whilst it is understood that the OMP allows for the landholder to use an Adaptive Management Approach to allow the flexibility to respond appropriately and effectively to the uncertainties involved in ecological processes, it should be noted that *any proposed changes to the management (i.e. alterations to strategic grazing regime) contrary to that specified within the OMP must be approved by DCCEEW, prior to implementation*. For instance, the OMP indicates that pulse grazing should not occur between 1<sup>st</sup> October and 31<sup>st</sup> January. Should pulse grazing be proposed to occur during this period, this action must be approved by

DCCEEW prior to implementation. Additionally, should an ecological burn be proposed to occur within the offset site, this action must be approved by DCCEEW prior to implementation.

A proposed timeline for Year 2 for recommended management actions to improve the condition and extent of Golden Sun Moth habitat within the offset area is outlined in Table 8.

**Table 8.** Proposed timelines for recommended management actions, the responsible authority and end of year 2 targets.

Year	Management Action	Recommended Timing of Action	Responsible Authority	End of Year 2 Target	Comments
Year 2	Pulse Grazing	Recommended pulse grazing cycle required is a minimum of four events; four weeks on, two weeks off, excluding October to November period. T	Landowner	<80% total biomass	Pulse grazing should continue to occur throughout year 2; however, if planned burns occur, stock should be excluded from the offset site for a month so the soil is not disturbed and to enable native recruitment. The landowner report (Appendix 2) indicates that ongoing pulse grazing has been occurring as per the requirement of the OMP. Consideration should be given to increasing the number of times pulse grazing occurs throughout Year 2.
	Ecological Burn	An ecological burn should occur in late summer, early autumn. Ecological burns should not occur more than once every 5 years.	Land Management Contractor/CFA	Decrease in exotic vegetation within the study area at the end of Year 2, measured by an increase in the quality and extent of Plains Grassland patches.	A late summer to early autumn burn is recommended because it avoids the reproductive cycle for most plants and animals. This would assist in managing rampart Toowoomba Canary-grass growth within the offset site. Livestock should be excluded from the offset site for approximately four weeks following the ecological burn, to ensure the soil is not significantly disturbed. As an ecological burn is not outlined as an approved management action within the OMP, this action must be approved by DCCEEW prior to commencement.
	Weed Management	Once every two weeks, conducted outside of October to February, when Golden Sun Moth are active.	Land Management Contractor	<20% cover of weeds	Weed management should be undertaken by a qualified land management contractor that is experienced in grassland management, in order to effectively manage environmental weeds within the offset site.
	Direct Seeding	Once in October and/or November, across the entire offset area	Land Management Contractor	Increase in native recruitment at the end of Year 2, measured by an increase in the quality and extent of Plains Grassland patches.	Direct seeding should occur in October or November, using an indigenous species mix supplied by a reliable contractor. As direct seeding is not outlined as an approved management action within the OMP, this action must be approved by DCCEEW prior to commencement.

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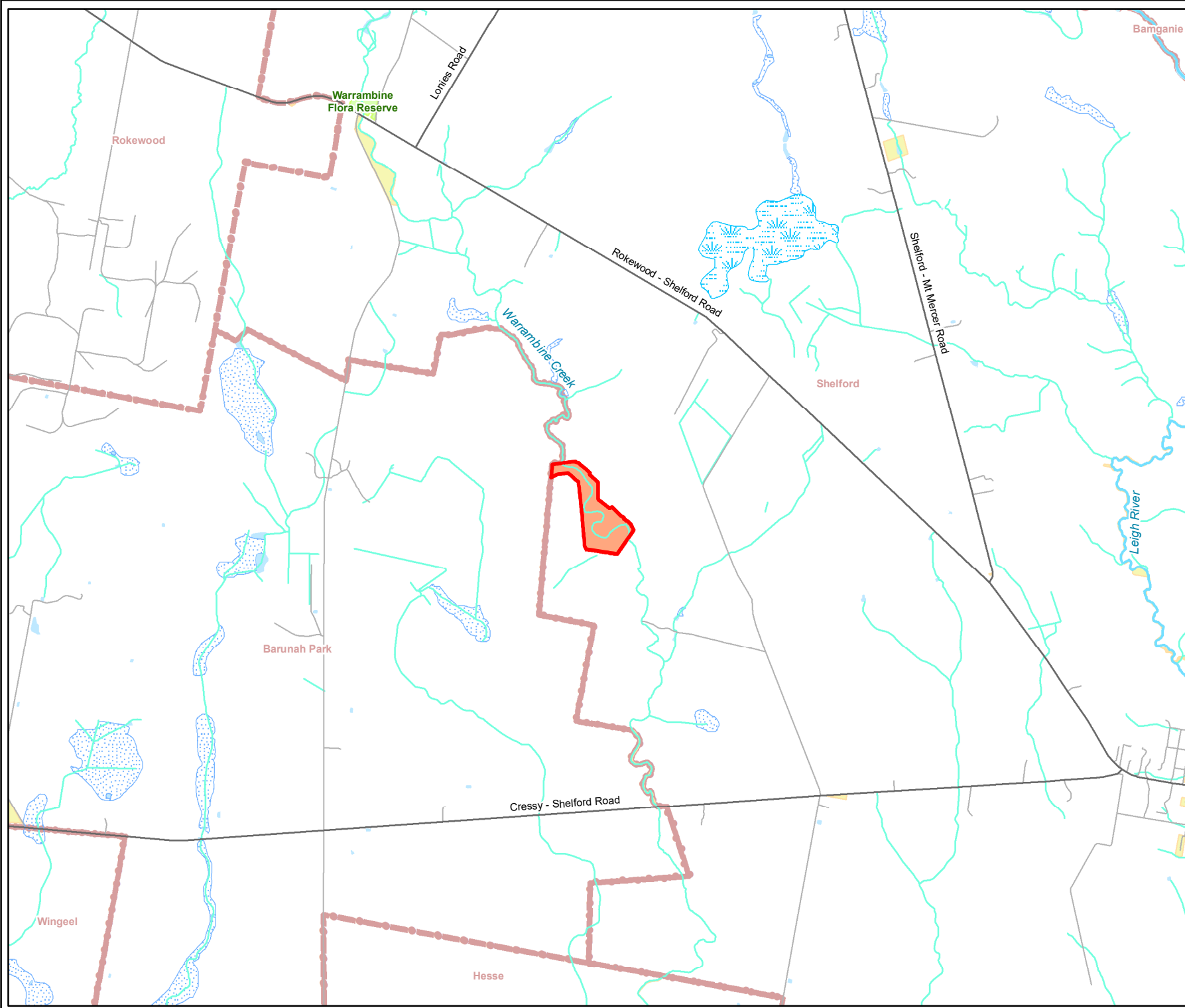
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## FIGURES

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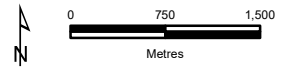


**Legend**

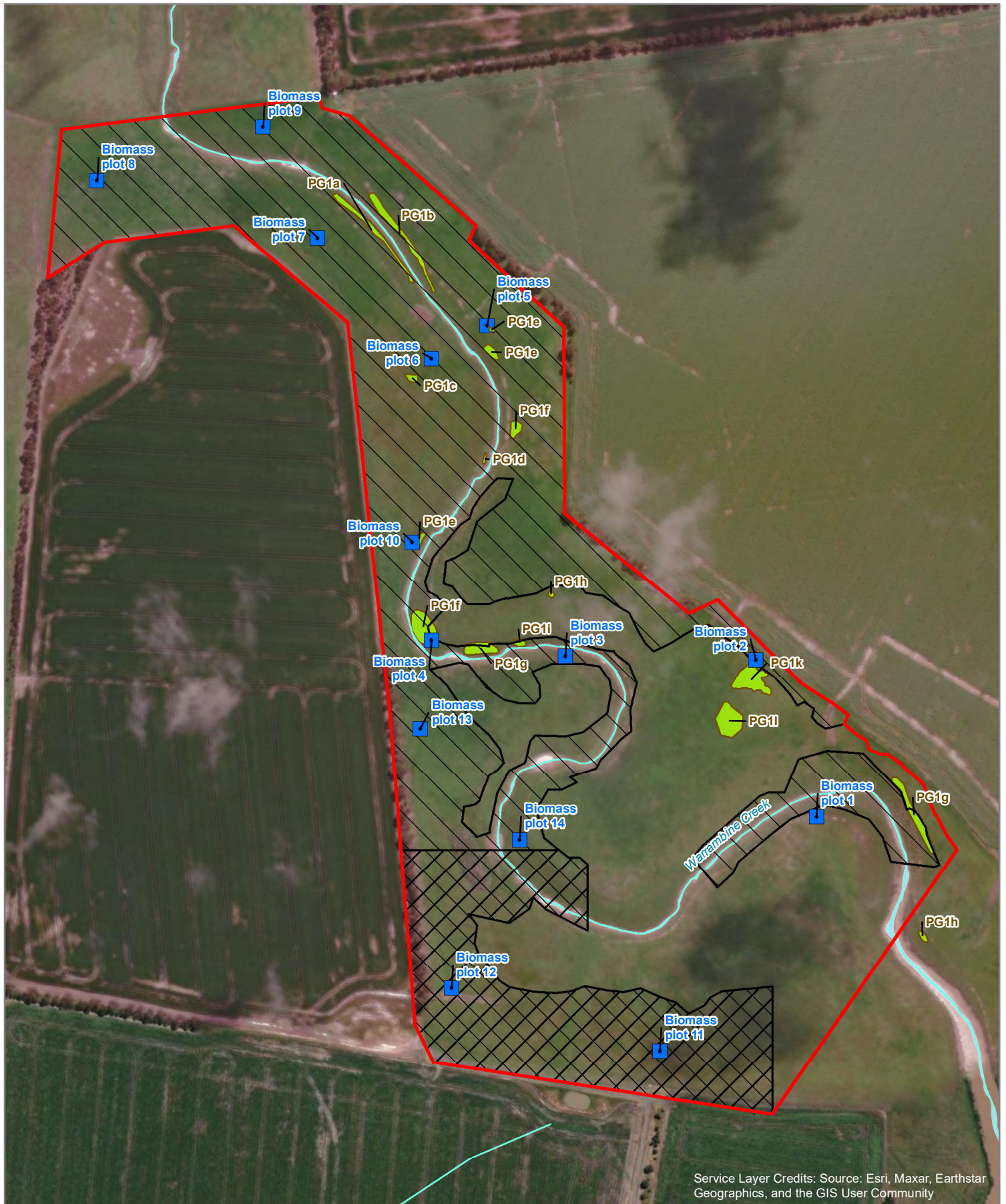
- Mount Gow Offset Site
- Collector Road
- Minor Road
- Minor Watercourse
- Major Watercourse
- Permanent Waterbody
- Land Subject to Inundation
- Wetland/Swamp
- Parks and Reserves
- Crown Land
- Localities



**Figure 1**  
**Location of Mount Gow**  
**Offset Site**  
*Offset Site Monitoring*



VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

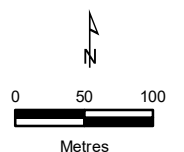


Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

**Figure 2**  
**Survey Results -**  
**Mount Gow Offset**  
**Site**  
*Offset Site Monitoring*

**Legend**

- Mount Gow Offset Site
- Biomass monitoring plot
- Ecological Vegetation Class**
- Plains Grassland (EVC 132)
- Proposed offset sites for EPBC Act referral 2018/8260**
- Proposed moderate quality GSM offset site (6 ha)
- Proposed high quality GSM offset site (20.5 ha)



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Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

**Figure 3**  
**Golden Sun Moth**  
**Habitat Quality -**  
**Mount Gow Offset Site**  
*Offset Site Monitoring*

**Legend**

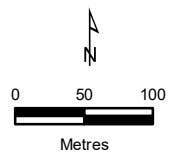
- Mount Gow Offset Site
- Golden Sun Moth (Survey date: 17/01/2023)
- Golden Sun Moth (Survey date: 21/01/2023)

**Weeds**

- + Artichoke Thistle

**Golden Sun Moth Habitat Quality**

- High Quality
- Low Quality



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## APPENDIX 1 FLORA

### Appendix 1.1 Flora Results

**Legend:**

^ Naturally growing (i.e. non-planted) indigenous species to the study area

**Table A1.1.** Flora within the study area.

Scientific Name	Common Name	Notes
<b>INDIGENOUS SPECIES</b>		
<i>Acaena echinata</i>	Sheep's Burr	^
<i>Austrostipa</i> spp.	Spear Grass	^
<i>Juncus</i> spp.	Rush	^
<i>Poa</i> spp.	Tussock Grass	^
<i>Rhytidosperma</i> spp.	Wallaby Grass	^
<i>Themeda triandra</i>	Kangaroo Grass	^
<i>Eryngium pinnatifidum</i>	Blue Devil	^
<i>Oxalis perennans</i>	Grassland Wood-sorrel	^
<i>Glycine clandestina</i>	Twining Glycine	^
<i>Wahlenbergia luteola</i>	Bronze Bluebell	^
<i>Convolvulus</i> sp.	Pink Bindweed	^
<b>NON-INDIGENOUS OR INTRODUCED SPECIES</b>		
<i>Aira</i> spp.	Hair Grass	-
<i>Avena fatua</i>	Wild Oat	-
<i>Bromus</i> spp.	Brome	-
<i>Hypochaeris</i> spp.	Cat's Ear	-
<i>Lolium</i> spp.	Rye Grass	-
<i>Phalaris aquatica</i>	Toowoomba Canary-grass	-
<i>Romulea rosea</i>	Onion Grass	-
Rough Dog's-tail	<i>Cynosurus echinatus</i>	-
<i>Silybum marianum</i>	Variegated Thistle	-
<i>Vulpia</i> spp.	Fescue	-

## **APPENDIX 2 – LANDOWNER REPORT**

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**OMP Report 2023 - May 2023 Report 2**  
**Greater Western Water**

Land Owner of Offset Site	Cameron Agriculture Pty Ltd (previously Rocklea Pastoral Company) managing on behalf of Crichton Properties Pty Ltf ATF Gow Land Trust
Location and Address of the site	185 Mt Gow Rd Shelford VIC 3329  26.5ha GSM area located on a private property in Mt Gow approx 63 aerial kilometers off Mt Gow rd. There are two spots containing GSM & NTGVVP and northern and southern points along the Warrambine creek.
Offset Site Number	EPCB 2018/8260
Responsible Authority	Charles and Emily Cameron
Report #	2
Signature	
Date	Section 173 registered date 22/7/2021  30/5/2023
Details of Work Undertaken	<p><b>Fencing:</b> All fencing is in good condition and erect as of this report date.. There has been some fence maintenance undertaken on the eastern boundary due to machinery access needed for paddock leveling in the paddock to the east of the offset location.</p> <p><b>Evidence of unpermitted stock access</b> During the course of the management time there have been large flows down the Warrambine creek. This increase flows damage the fences into the offset area allowing stock to access from adjacent paddocks and neighbours. We have been constantly checking for damaged fencing and unwanted stock access is required and future strengthening of creek fencing is planned.</p> <p><b>Spot Spraying:</b> There was spot spraying undertaken in</p>

August and November 2022 targeting Box Thorns, Serrated Tussock, Bathurst Burr, Spear Thistles and Toowoomba Canary Grass. We also chipped Burr after it was sprayed to further reduce the chance of reproduction.

**Grazing:** The offset area was not grazed between October and November 2022 as per the OMP. Prior and post this we adopted a 4 week on 2 week off approach with our sheep program in order to keep the phalaris & Toowoomba Canary grasses down. We changed our pulse grazing routine to account for the increased biomass growth due to higher than average rainfall.

**Control Of Pests:** We controlled the rabbit and fox populations within the offset area by going spot lighting and shooting the animals. We engaged in this every month when stock were not in the area. We then picked up any remains and put them in the ground hole. We regularly monitor ongoing animal populations in the area and have seen no new threats.

**Evaluation of Effectiveness:**

Wild sage has been identified on the site and is been managed through spot spraying with selective herbicide and grazed by sheep. The favourable growing season has exacerbated the weed problem.

With persistent selective spot spraying and improved grazing pressure we will work on getting the weed numbers down further.

Phalaris growth in 2022 meant grazing heavily until exclusion period to control

A flood damaged a boundary fence and neighbours sheep entered the offset area for a period before being removed and fence repaired. This occurred when sheep grazing was allowed. Ongoing assessment of this fence and upgrading its robustness is a priority to reduced the risk of grazing during exclusion period


In May 2022 farm machinery damage some offset boundary fence and was quickly repaired.

Pulse grazing has been effective in keeping down biomass, predominantly Phalaris grass and Towoomba Canary grass and 'no grazing period between October and November'.


	There has been ongoing fox & rabbit spotting however damage of burrows and frequency of spotting has been limited due to the frequent extermination efforts.
Photos	<ol style="list-style-type: none"><li>1.</li><li>2.</li><li>3.</li><li>4.</li><li>5.</li><li>6.</li><li>7.</li></ol>





**Photo Point Monitoring - Report 2**


Photo Point Number	Location of Photo Point	Site & Zones	Direction	Date	Notes/ Observations	Photo
PP1	SE Creek small section	South of PG1-A	- 37.9872700, 143.8954359	29/10/22		

PP2	North of small creek section	PG1-C	- 37.984911, 143.891692	29/10/ 22		
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PP3	NE Corner	PG1-C	- 37.983090, 143.892215	29/10/ 22		
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PP4	NW Corner	PG1-C	- 37.981411, 143.886773	29/10/ 22		
PP5	South Section of Creek	PG1-C	- 37.983646, 143.890990	29/10/ 22		



PP6	East	PG1-B	- 37.986833, 143.892581	29/10/ 22		
PP7	South	Mode rate qualit y GSM Offset	- 37.989784, 143.893882	29/10/ 21		