

**2023 GOLDEN SUN MOTH  
MONITORING REPORT**

Yarralumla Equestrian Park

**FINAL**

June 2024

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Yarralumla Equestrian Park

## FINAL

Prepared by  
Umwelt (Australia) Pty Limited  
on behalf of  
ACT Government Suburban Land Agency

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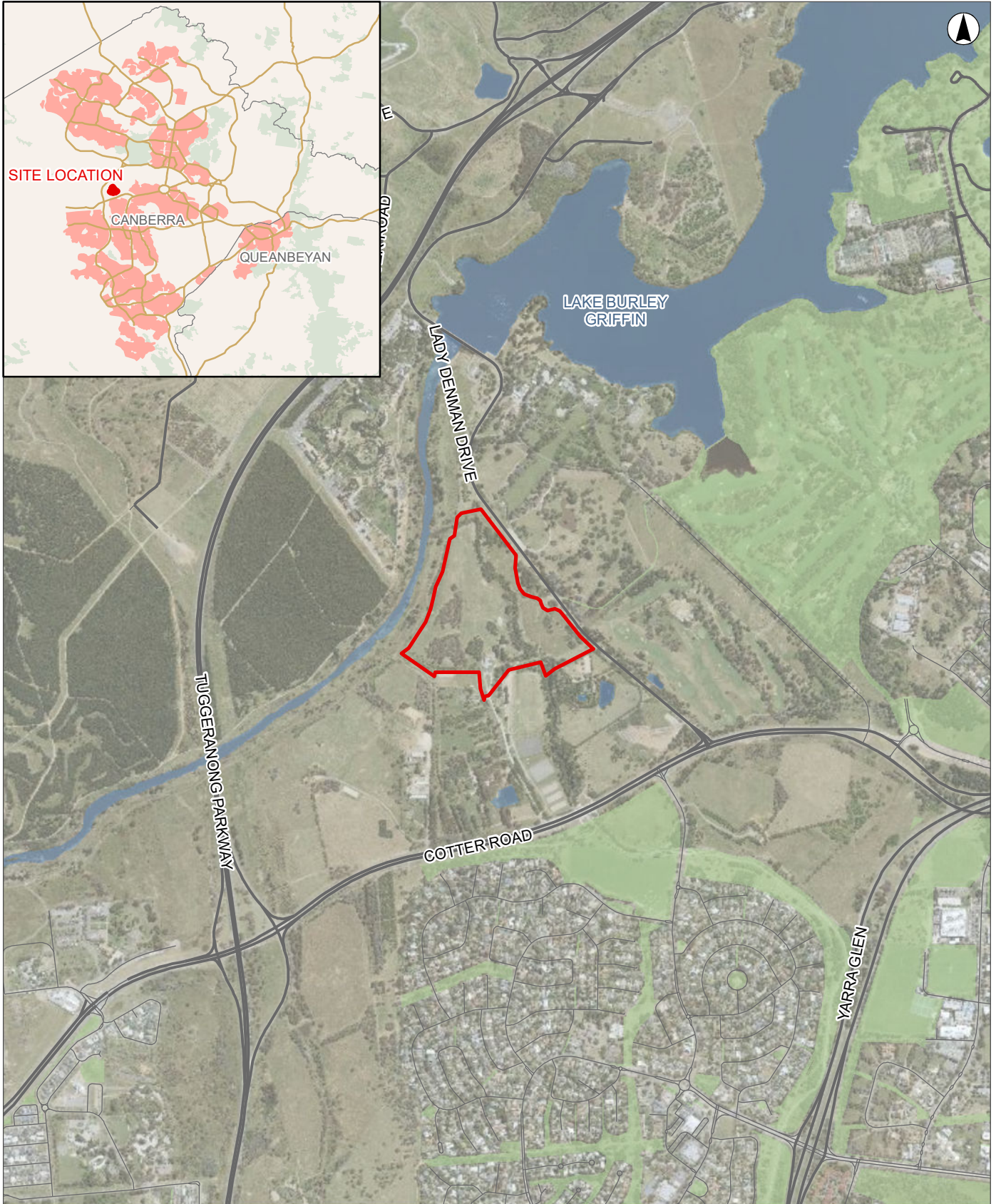
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# 1.0 Introduction

Umwelt monitored the extent and condition of the critically endangered *Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory* ecological community (natural temperate grassland) and the extent and condition of habitat for the vulnerable golden sun moth (*Synemon plana*) and its population within the Yarralumla Equestrian Park (YEP) offset area (YEP offset area) (**Figure 1.1**). The monitoring was undertaken on behalf of the ACT Government Suburban Land Agency and forms part of the annual reporting requirements for the YEP offset area, pursuant to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval decision (EPBC 2012/6292).

This report presents the results of monitoring surveys undertaken in November 2023 and February 2024 in the YEP offset area. The results are briefly examined in relation to existing site information, results from the baseline year (i.e. year 0) and monitoring data collected from year 1 through to year 8 (RJPL 2014; RJPL 2015; SMEC 2016; SMEC 2017; SMEC 2018; Umwelt 2019; Umwelt 2020; Umwelt 2021; Umwelt 2022; Umwelt 2023). The implications of results are considered in relation to the performance targets identified in the updated OMP (Umwelt 2021).



**Legend**

- Yarralumla Equestrian Park Boundary
- Waterbody
- Open Space

0 250 500 750 1,000 m

**FIGURE 1.1**  
Locality Plan

## 2.0 Methods

The survey area comprised the YEP offset area, as defined in the original OMP (RJPL 2014a) (**Figure 2.1**)

### 2.1 Grassland Condition

#### 2.1.1 Grassland Floristics and Determination of the Extent of Natural Temperate Grassland

Grassland monitoring was conducted over two days on 22 and 30 November 2023. Twelve fixed 20 m x 20 m plots were completed, recording floristic diversity and cover within the plot (**Figure 2.1**). The location of the plots was consistent with previous monitoring assessments, and located via georeferenced points. Floristic value scores were then calculated in accordance with Rehwinkel (2015) to enable consideration against condition thresholds (benchmarks) for the natural temperate grassland community (TCCS 2016) and comparison with monitoring data collected since 2018 using the ACT Government Offsets Monitoring – Floristic Surveys Survey 123 App (ACT Government 2020).

Previous monitoring reports collected data using 4 x 4 m plots consistent with the methods described in Rehwinkel (2007). This was no longer deemed necessary to track the trajectory of grassland condition, noting that impact thresholds and contingency measures are based on the results of the past three years (**Section 5.4**). Four years of data is now available following Rehwinkel (2015) from which the trajectory of grassland condition can be measured.

To meet criteria for classification as natural temperate grassland, the patch must be >0.1 ha (e.g., 20 m x 50 m), within the defined region and altitude, and naturally treeless or sparsely treed, and it must meet criterion A or B:

- Criterion A: contains a foliage cover of more than 50% *Themeda triandra* (Kangaroo Grass) or *Poa labillardierei* (River Tussock) – or *Carex bichenoviana* (Plains Sedge) if the patch is an ephemeral wetland.
- Criterion B: contains a greater percentage cover of native plants (including annual and perennial species but not cryptogams) than of perennial exotic species (including weeds), AND in favourable sampling times (generally spring and early summer, and in non-drought affected seasons) it has:
  - at least 8 non-grass native species, or
  - at least 2 indicator species, or
  - a floristic value score of at least 5
- or at other sampling times, it has:
  - at least 4 non-grass native species, or
  - at least 1 indicator species, or
  - a floristic value score of at least 3.

Thresholds for favourable sampling times were applied.

Due to the absence of a minimum size criteria for the former EPBC Act listed *Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory* endangered ecological community used to assess the YEP offset area during the original assessment, the minimum size restriction was not considered as part of the thresholds when monitoring the extent of natural temperate grassland at this site. The application of this threshold would result in artificial changes in the extent of natural temperate grassland present.

### 2.1.2 Grassland Structure

Twelve 25 m transects were completed to assess grassland structure, biomass, weed cover, and abundance of golden sun moth feed species, collected using the *ACT Government Understorey Structure – Step Point App* (ACT Government 2020). Each transect commenced within or adjacent to a 20 m x 20 m plot (**Figure 2.1**). Data on the presence of the following 14 attributes were collected at 50 points along each transect:

- cryptogams
- bare ground
- rock
- litter
- thatch cover
- Chilean needlegrass (*Nassella neesiana*)
- serrated tussock (*Nassella trichotoma*)
- annual exotic grass
- perennial exotic grass
- exotic broadleaf
- native wallaby grass (*Rytidosperma* spp.)
- native spear grass (*Austrostipa* spp.)
- perennial native grass
- other.

### 2.1.3 Weeds

An assessment of the extent and density of significant weed species within the YEP offset area. Areas dominated by significant weed species (i.e. >50% cover) were mapped. Previous mapping of areas of significant weed species were assessed and updated to reflect changes in area size.

Significant weed species are:

- serrated tussock
- African lovegrass (*Eragrostis curvula*)
- Chilean needlegrass
- Paterson's curse (*Echium plantagineum*)
- St John's wort (*Hypericum perforatum*).

Additional weeds with potential management implications were recorded where applicable. Data collected will assist in determining the effectiveness of weed management actions undertaken by the land managers. Weed surveys are undertaken in conjunction with the floristic surveys as described in **Section 2.1.1**.

## 2.2 Revised Grassland Mapping

Mapping of the extent and distribution of vegetation types was conducted in February 2024. Mapping was conducted via a meandering traverse throughout the YEP offset area, with close inspection of native pasture and natural temperate grassland areas. The distribution of natural temperate grassland, native pasture, mixed native and exotic pasture, and exotic pasture was mapped. Maps of exotic perennial tussock grasses were also updated.

Native pasture is defined as areas of grassland that are dominated by native plant species but do not meet the floristic value score to be deemed natural temperate grassland. Native pasture areas continuous with areas of natural temperate grassland are considered as components of the natural temperate grassland. Mixed native and exotic pasture is defined as grassland areas in which coverage is split evenly between native (perennial and annual) and exotic (perennial) cover. Exotic pasture is defined as an area that is dominated (>50%) by exotic perennial cover.

Changes in the extent of vegetation types and golden sun moth habitat was assessed against that mapped in previous years.

## 2.3 Golden Sun Moth Habitat Condition Mapping

As specified in the OMP (RJPL 2014a), an assessment of golden sun moth habitat was undertaken using a meandering traverse throughout the YEP offset area, covering both exotic and native grass dominated areas. The distribution of golden sun moth habitat was mapped to the following condition classes:

- **High Quality habitat:** natural temperate grassland or native pasture dominated by native larval food plants with low weed cover and some bare ground. Minimum values:
  - 10% cover *Rytidosperma* sp
  - > 15% cover *Rytidosperma* sp. and *Austrostipa* sp combined
  - > 5 % bare ground
  - < 5% broadleaf

- Low to moderate biomass
- Moderate to high native plant diversity.
- **Moderate quality habitat.** Primary or secondary grassland, with a moderate component of *Rytidosperma* sp. and/or *Austrostipa* sp., and/or moderate weed cover. Minimum values:
  - > 5% cover *Rytidosperma* sp.
  - > 10% cover *Rytidosperma* sp. and/or *Austrostipa* sp. combined
  - > 3 % bare ground,
  - < 10% broadleaf,
  - Low to moderate biomass
  - Moderate native plant diversity.
- **Low quality habitat.** Larval food plants (*Rytidosperma* sp., *Austrostipa* sp. and/or Chilean needle grass) are a minor component of the ground layer, growing sparsely or in patches among unsuitable vegetation such as:
  - Exotic species (excluding Chilean needle grass)
  - Native C4 grasses (such as *Themeda triandra*)
  - Other unsuitable native ground cover (e.g. *Poa labillardieri*, rushes/sedges)
  - And the minimum values are met:
    - > 10% cover *Rytidosperma* sp. and/or *Austrostipa* sp. combined
    - < 20% broadleaf
- **Chilean needle grass dominated habitat.** Grassland dominated by Chilean needlegrass, or as a major component.

## 2.4 Golden Sun Moth Surveys

The start of the golden sun moth flying season within the ACT was confirmed based on the emergence of moths within known reference sites as communicated by a contact group that includes local consultants and ACT Government ecologists.

Golden sun moth surveys were undertaken within the flight season on the 23 and 28 November 2023.

Golden sun moth surveys were conducted according to the protocol outlined in the draft updated OMP (Umwelt, unpublished), with additions to improve consistency with the ACT Government protocols for monitoring golden sun moth in offset areas (ACT Government 2010). This included reducing the number of survey days from three to two.

Two sampling methods were undertaken to survey golden sun moth in accordance with Umwelt (unpublished), being:

- Rotational point counts at 12 established locations for comparison with surveys conducted from 2013-2021 (RJPL 2014b).
  - Each rotational point count is completed by turning 360 degrees over 30 seconds, repeated a total of 10 times (for a total of 300 seconds survey time). The average number of golden sun moths seen per rotation in each plot was calculated (total number of golden sun moths counted at each point divided by 10). This calculation was undertaken in order to compare results within previous reports.
- Timed transects across 15 established 100 m transect locations for consistency with ACT Government Offset golden sun moth survey protocol (ACT Government 2010).

On-site weather data was recorded during all flying golden sun moth field surveys. Incidental golden sun moth observations were also recorded during other site visits and between surveys.

Female golden sun moths and pupa cases were recorded separately from the timed surveys. The records were identified as incidental observations.

The surveys were undertaken on days with suitable conditions for the golden sun moth (**Table 2.1**), specifically:

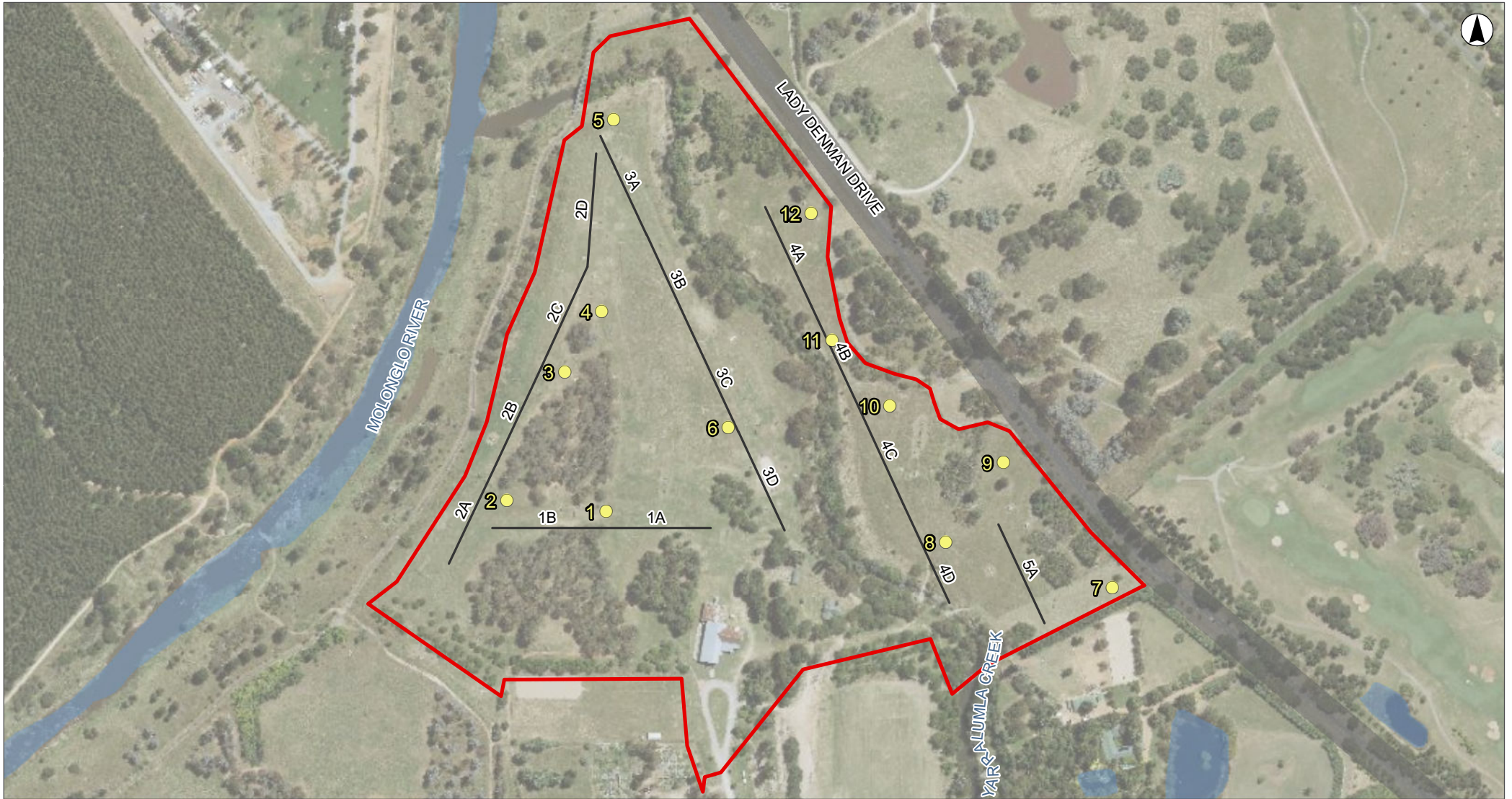
- warm to hot days (above 20°C by 10am)
- warmest part of the day (between 10am – 2pm)
- clear mostly cloudless sky
- still or relatively still wind conditions
- no less than two days since rain (>1 mm) or an unusually cold night.

**Table 2.1 Weather conditions during 2023 Golden Sun Moth Surveys**

Component	Date	Temp (°C) (average)	Last rainfall (mm)	Wind speed (Low, Medium, High)	Cloud cover (%)
<b>Transect Survey 1 / Rotational Survey 1</b>	23/11/23	24.2	0.2 (22 <sup>nd</sup> November)	<19 km/h	<70
<b>Transect Survey 2 / Rotational Survey 2</b>	28/11/23	22.1	2.0 (26 <sup>th</sup> November)	<13 km/h	100

## 2.5 Meteorological Data

Meteorological data for Canberra Airport (BoM station: #70351) dating from 1 January 2013 to 31 December 2023 was obtained from the Bureau of Meteorology website to allow examination of the relationship between observed golden sun moth abundance and meteorological variables such as rainfall. References to climate data within this report predating 2009 pertain to data recorded at the closed Canberra Airport Comparison site (BoM station no. 70014).



**Legend**

- Vegetation Plots and Rotational Points
- Indicative GSM Transects
- Yarralumla Equestrian Park Boundary
- Waterbody



**FIGURE 2.1**  
Yarralumla Equestrian Park Offset Area  
Survey Details

## 3.0 Results

### 3.1 Grassland Condition (following Rehwinkel 2015) and Structure

A summary of the results of the 2023 floristic surveys, following Rehwinkel (2015) and the results for the comparison of each plot against the benchmark condition for each metric are displayed in **Table 3.1**. Benchmarks include those for grassland structure. While no data on thatch density nor grass height was collected in 2023, it was observed that grass height was very long across the YEP offset area (at least 1 m high) and very hard to walk through in sections. The lack of bare ground across the YEP offset area also indicates that the thatch density was higher than benchmark level.

Overall, the number of values that were within benchmark range was very low. Only four plots met the benchmark FVS. Seven plots met the criteria for thatch cover. One plot met the benchmark for bare ground cover. No plots met the criteria for proportion of native cover or native species richness.

The YEP offset area is dominated by exotic species within all plots.

**Table 3.1 Assessment of Plots Against Benchmark Condition of each Metric Measured following Rehwinkel (2015), (benchmark levels for each metric in brackets; green cells are within benchmark)**

Plot	Vegetation Type	Floristic Value Score (FVS) (≥5)	Native plant species richness (≥24)	Proportional native cover (<1m height) (%) (≥50)	Bare ground cover (%) (10-20)	Thatch cover (%) (10-20)	No. of condition metrics within benchmark level
1	Exotic Pasture	0.3	1	5	0	26	0/5
2	Exotic Pasture	3.8	5	42	0	18	1/5
3	Exotic Pasture	8.1	5	29	10	42	1/5
4	Exotic Pasture	10.3	5	42	0	8	1/5
5	Exotic Pasture	3.6	2	11	0	22	0/5
6	Exotic Pasture	8.7	7	7	0	10	2/5
7	Exotic Pasture	3.6	2	9	0	18	1/5
8	Exotic Pasture	4.7	4	17	4	12	1/5
9	Exotic Pasture	0.3	1	10	0	14	1/5
10	Exotic Pasture	1.5	4	0	0	22	0/5
11	Exotic Pasture	4.7	4	5	0	12	1/5
12	Exotic Pasture	12.6	9	7	0	14	2/5

#### 3.1.1 Comparison with Previous Years

The floristic value scores have been in decline, with all plots recording FVS below 2020 values (**Table 3.2**). Native plant species richness has declined in 10 of the 12 plots over the past three years, with all plots recording a decline since 2022. The proportion of native cover has significantly reduced in 11 of the plots since 2020, with only one plot (plot 4) recording an increase. Bare ground cover has also decreased from 2021 in five plots, with 10 plots recording 0% bare ground cover in 2023. Only one plot (plot 3) recorded an increase. Thatch cover met the benchmark condition in 7 plots, with the remaining 4 plots recording an increase and one plot (plot 4) recording a slight decrease.

**Table 3.2 Comparison of Grassland Condition and Structural Metrics (2020-2023)**

Plot	Vegetation type	Floristic Value Score (FVS) (≥5)				Native plant species richness (≥24)				Proportion native cover (<1m height) (%) (≥50)				Bare ground cover (%) (10-20)				Thatch cover (%) (10-20)				Thatch density (thatch cover x thatch depth) (<0.25)				Average grass height (cm) (5-12)				No. of condition metrics within benchmark level			
		2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023	2020*	2021	2022	2023	2020*	2021	2022	2023	2020*	2021	2022	2023*	2020*	2021	2022	2023*	2020*	2021	2022	2023
1	Exotic Pasture	2.6	2.4	1.2	0.3	4	10	6	1	18	3.4	3.4	5		0	4.0	0		13	24	26		0.11	0.13			21	5.9			2/7	1/7	0/5
2	Exotic Pasture	14.1	10.5	14.6	3.8	9	13	12	5	100	48.1	28.6	42		3	1.2	0		5	24	18		0.02	0.18			8.8	5.3			3/7	2/7	1/5
3	Exotic Pasture	15.3	13.8	17.5	8.1	10	16	16	5	86	43.6	29.3	29		6	0.0	10		5	22	42		0.03	0.12			10.6	5.2			3/7	2/7	1/5
4	Exotic Pasture	16.9	10.6	5.9	10.3	10	11	6	5	22	27.3	8.3	42		3	0.0	0		10	38	8		0.07	0.28			14.5	6.1			3/7	2/7	1/5
5	Exotic Pasture	6.4	3.5	4.1	3.6	5	3	4	2	47	0.0	0.0	11		0	0.0	0		2	19	22		0.02	0.3			20.5	7			1/7	1/7	0/5
6	Exotic Pasture	11.9	14.9	9.7	8.7	7	11	12	7	80	37.7	0.0	7		0	3.4	0		7	14	10		0.05	0.11			19.1	8.3			2/7	2/7	2/5
7	Exotic Pasture	9.9	9.9	7.6	3.6	4	11	7	2	73	27.6	0.0	9		0	2.5	0		7	23	18		0.04	0.72			23	7.3			2/7	2/7	1/5
8	Exotic Pasture	18.5	16.3	7.2	4.7	10	18	11	4	92	16.7	9.1	17		2	1.7	4		9	24	12		0.05	0.2			18	13.8			2/7	2/7	1/5
9	Exotic Pasture	3.7	1.6	2.1	0.3	3	8	7	1	12	5.3	0.0	10		0	0.0	0		12	21	14		0.10	0.76			20.5	10.2			2/7	1/7	1/5
10	Exotic Pasture	20.7	8.5	10.6	1.5	10	12	11	4	96	33.9	20.8	0		1	3.5	0		15	17	22		0.11	0.14			22.5	18			3/7	2/7	0/5
11	Exotic Pasture	13.2	15.9	19.7	4.7	9	14	11	4	38	9.6	20.7	5		8	8.0	0		20	14	12		0.12	0.25			19	10.7			3/7	3/7	1/5
12	Exotic Pasture	16.7	21.4	18.1	12.6	8	17	14	9	100	37.5	57.1	7		3	8.6	0		11	22	14		0.07	0.15			15.5	4.4			3/7	2/7	2/5

\*No data recorded

## 3.2 Assessment Against Criteria for the Critically Endangered Natural Temperate Grassland Community

The assessment of the YEP offset area against the updated criteria for the natural temperate grassland (TSSC 2016) is demonstrated in **Table 3.3**. As a minimum criteria, the percentage cover of native perennial and annual flora species must be higher than the percentage cover of exotic perennial flora species. No plots met this criteria, and thus no plots are determined to be natural temperate grassland. While the number of indicator species and the FVS for some plots remain relatively high in 2023 (**Table 3.3**), the overall cover of exotic species within the plots prevents the associated patches being classified as natural temperate grassland

**Table 3.3 Summarised Assessment Against the Criteria Thresholds (in brackets) for the EPBC Act-listed Natural Temperate Grassland Critically Endangered Ecological Community (20 X 20 m plots), YEP Offset Area, 2023**

Plot	Vegetation Type	Native perennial & annual cover (%) > perennial exotic cover (%)			Number of non-grass native species (≥8)	Number of indicator species (≥2)	Floristic value score (≥5)	Meets natural temperate grassland criteria (TSSC 2016)
		Native %	Exotic %	Meets Criteria				
1	Exotic Pasture	4	70	No	0	0	0.3	No
2	Exotic Pasture	32	44	No	3	2	3.8	No
3	Exotic Pasture	14	34	No	4	4	8.1	No
4	Exotic Pasture	22	30	No	4	4	10.3	No
5	Exotic Pasture	4	32	No	2	1	3.6	No
6	Exotic Pasture	6	72	No	6	5	8.7	No
7	Exotic Pasture	10	46	No	1	1	3.6	No
8	Exotic Pasture	2	20	No	3	3	4.7	No
9	Exotic Pasture	0	82	No	1	0	0.3	No
10	Exotic Pasture	4	72	No	4	2	1.5	No
11	Exotic Pasture	6	74	No	4	3	4.7	No
12	Exotic Pasture	8	68	No	6	6	12.6	No

### 3.2.1 Comparison with Previous Years

The number of plots that met the revised criteria for the natural temperate grassland community increased from six in 2020 (Umwelt 2021) to nine in 2021 (Umwelt 2022). This subsequently fell to one in 2022 and no plots in 2023. All plots have declined in quality.

## 3.3 Grassland Mapping

**Table 3.4** and **Figure 3.1**. shows the extent and distribution of vegetation types mapped within the YEP offset area. The YEP offset area was determined to only support exotic grassland. A large component of the perennial exotic coverage included the weeds detailed in **Section 3.4**, as well as paspalum (*Paspalum dilatatum*), festuca (*Festuca arundinacea*), *Hypochaeris* sp., and skeleton weed (*Chondrilla juncea*). Exotic annual species were also widespread including oats (*Avena* sp.), fescues (*Vulpia* sp.), plantain (*Plantago lanceolata*), and fleabane (*Conyza bonariensis*).

**Table 3.4 Extent of Vegetation Types within the YEP Offset Area, November 2023**

Vegetation Type	Extent (ha)
Natural Temperate Grassland	0.00
Native pasture	0.00
Mixed native and exotic pasture	0.00
Exotic pasture	13.70
<b>Total extent of surveyed vegetation types in the Project Area</b>	<b>13.70</b>



**Legend**

- Yarralumla Equestrian Park Boundary
- Waterbody
- Vegetation Communities**
- Exotic Pasture

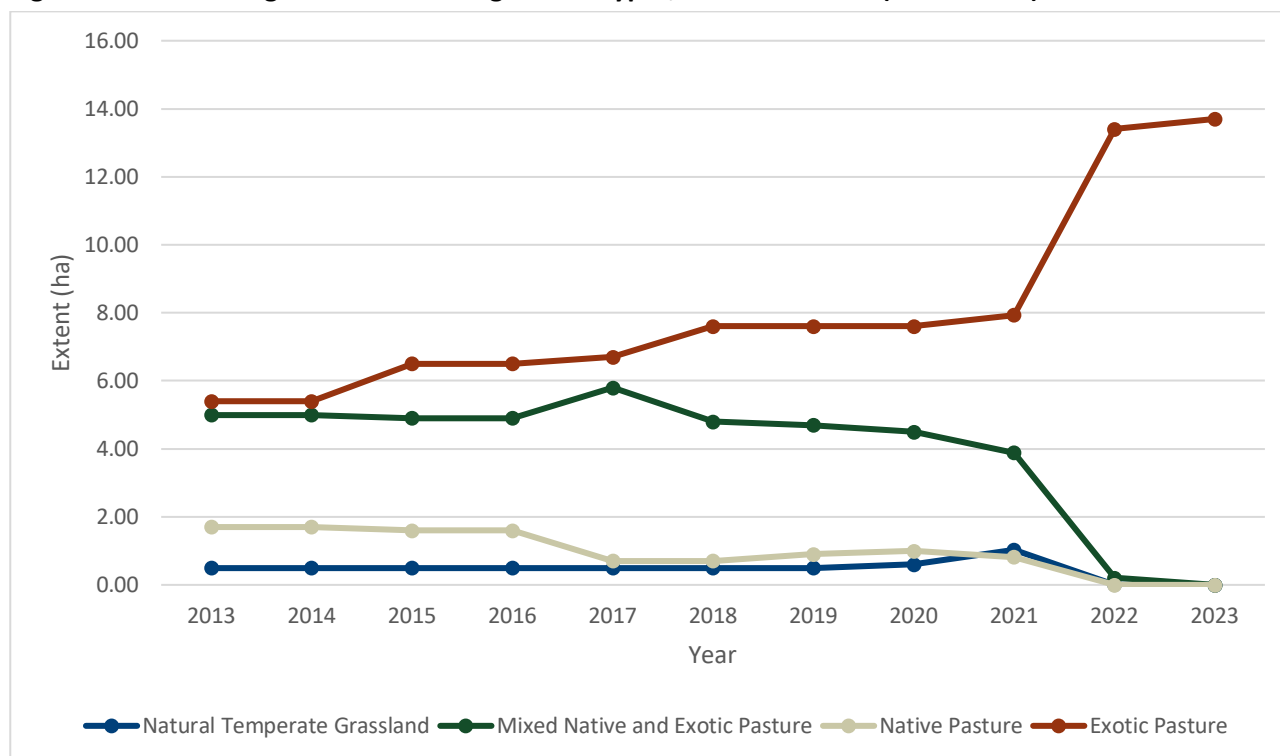
0 50 100 150 200 m

**FIGURE 3.1**  
Yarralumla Equestrian Park Offset Area Vegetation Types

### 3.3.1 Comparison with Previous Years

Trends in the extent of natural temperate grassland and other grassland types within the YEP offset area are shown in **Figure 3.2**, with continued decline in site quality and now the loss of natural temperate grassland from within the YEP offset area.

**Figure 3.2 Changes in Extent of Vegetation Types, YEP Offset Area (2013 - 2023)**



### 3.4 Weeds

Four species declared under the ACT Government *Pest Plants and Animals Act 2015*, were identified within the YEP offset area, including two Weeds of National Significance (WoNS) (**Table 3.5**). While Chilean needlegrass is identified as a WoNS, it remains an important habitat component for the golden sun moth. A discussion on the approach to control this species and maintain habitat for the golden sun moth is included in **Section 4.3**.

**Table 3.5 Pest Plants and Class, YEP Offset Area, 2023**

Pest Plant	WoNS	Class
Chilean needlegrass ( <i>Nassella neesiana</i> )	Yes	Class 3 - must be contained Class 4 - prohibited
Serrated tussock ( <i>Nassella trichotoma</i> )	Yes	Class 3 - must be contained Class 4 - prohibited
African lovegrass ( <i>Eragrostis curvula</i> )	No	Class 3 - must be contained
St John's wort ( <i>Hypericum perforatum</i> )	No	Class 3 - must be contained

### 3.4.1 Weed Extent

The distribution of significant weeds within the YEP offset area is shown in **Figure 3.3**, and the calculated extent of weed infestations across 2023 is summarised in **Table 3.6**. The extent of weeds is greater than the total area, noting the overlap in the extent of different species. Information on the extent of each species is provided to support weed control planning and implementation.

African lovegrass saw the largest increase of any recorded weed species, and is now across 29% of the entire YEP offsite area (3.91 ha). The species is spreading into areas where it was not previously recorded and is the leading cause for degradation of native grassland across the YEP offset area.

The extent of Chilean needlegrass (1.64 ha) has also risen since 2022 with an increase of 0.23 ha across the YEP offset area. Chilean needlegrass has the second greatest extent of all weed species within the YEP offset area.

St John's wort is found scattered across the entirety of the YEP offset area, with densities insufficient to map in discrete patches. Only isolated plants of serrated tussock were observed.

Caltrop (*Tribulus terrestris*) was found occasionally scattered throughout the Project Area. This was observed to be establishing in 2020 in the YEP offset area after being introduced via the importation of sand that is used to support the management of the equestrian tracks. The current survey found the extent of this species has increased slightly relative to the 2022 survey season.

### 3.4.2 Comparison with Previous Years

Trends in the extent of African lovegrass and Chilean needlegrass since 2013 are shown in **Figure 3.3**.

Extensive areas of African lovegrass continue to dominate much of the central and eastern parts of the YEP offset area. In 2013, the YEP offset area had no recorded presence of African lovegrass. However, over the next six years, it gradually expanded to cover 3.2 ha by 2019. Weed management activities during this period helped reduce its extent to 1.39 ha in 2020. Since then, African lovegrass has largely been left unmanaged, leading to its largest recorded extent at the YEP offset area, reaching 3.91 ha in 2023.

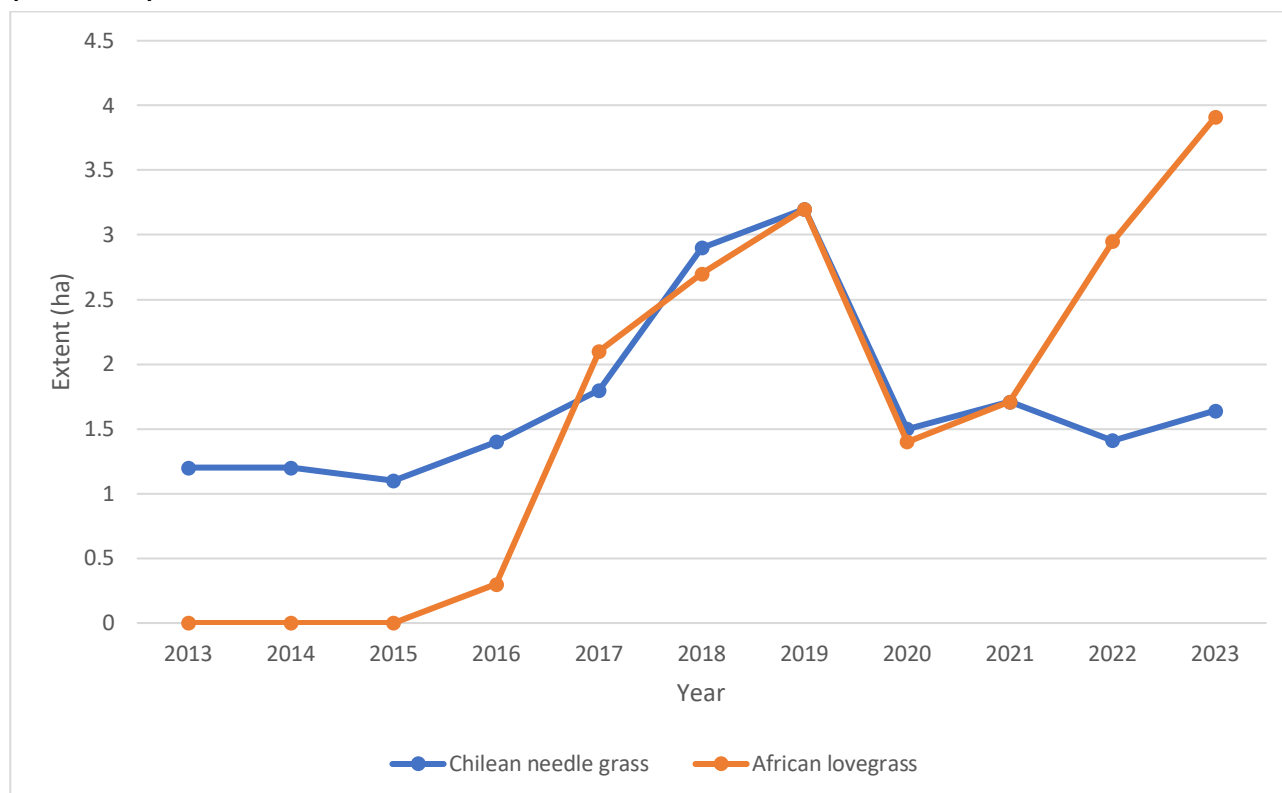
In 2013, 1.2 ha of Chilean needlegrass was recorded. The extent of this species gradually increased, peaking at 3.2 ha in 2019. Weed management activities during this period helped reduce the extent to 1.50 ha in 2020. However, its extent since has increased slightly to 1.64 ha recorded in 2023.

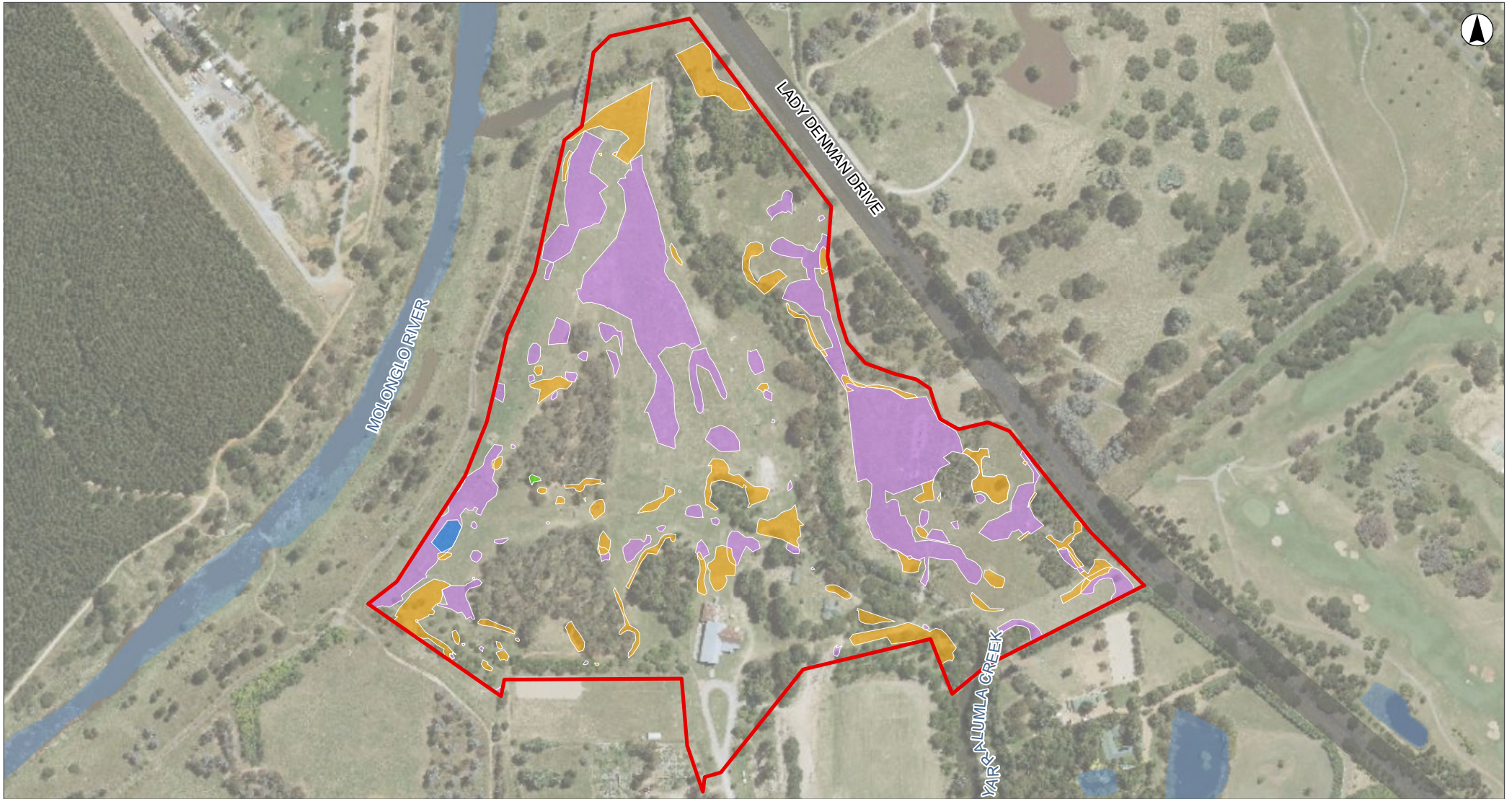
Caltrops and St John's wort were not identified in patches large enough to be mapped.

**Table 3.6 Changes in the Extent of Significant Weeds, YEP Offset Area, 2020 vs 2023**

Vegetation type	2020 Extent (ha)	2021 Extent (ha)	2022 Extent (ha)	2023 Extent (ha)	Change in Extent 2020 – 2021 (ha)	Change in Extent 2021 – 2022 (ha)	Change in Extent 2022 – 2023 (ha)
Chilean needlegrass dominant	1.50	1.71	1.41	1.64	-0.09	-0.3	+0.23
Serrated tussock	Isolated plants	Isolated plants	Isolated plants	Isolated plants	Isolated plants	Isolated plants	Isolated plants
African lovegrass dominant	1.39	1.71	2.95	3.91	+ 1.56	+ 1.24	+ 0.96
St John’s wort	0.18	Scattered throughout	Scattered throughout	Scattered throughout	Scattered throughout	Scattered throughout	Scattered throughout
Caltrop	0.94	0.05	0	0.05	-0.94	-0.05	+0.05

**Figure 3.3 Change in the Extent of Chilean Needlegrass and African Lovegrass, YEP Offset Area (2013-2023)**





**Legend**

- Yarralumla Equestrian Park Boundary
- Waterbody
- Weed Distribution**
- African Love Grass
- Caltrop
- Chilean Needle Grass
- Serrated Tussock



**FIGURE 3.4**  
Yarralumla Equestrian Park Offset Area  
Significant Weeds

### 3.4.3 Weed Density

The weed value score and percentage cover of significant weed species at each plot are shown in **Table 3.7**. Key observations for each of the invasive tussock grasses comprises:

- African lovegrass had the greatest cover (16.6%) of all significant weed species across all plots. African lovegrass control continues to be a very high priority within the YEP offset area.
- Chilean needlegrass had an average cover of 2.2%.
- St John’s wort had an average cover of 4.2%.
- The weed value score is high and broadly consistent across all plots.

No serrated tussock was observed within the plots; however, this species is present in the wider area of the YEP offset area and could potentially re-occupy areas should weed control be discontinued.

**Table 3.7 Weed Value Score and Percentage Cover of Significant Tussock Weeds per Plot for the YEP Offset Area, 2023**

Plot	Vegetation Type	Weed Value Score	% Cover - Chilean needlegrass	% Cover – African lovegrass	% Cover – St John’s wort
1	Exotic Pasture	15.7	2	2	0
2	Exotic Pasture	17.6	0	4	0
3	Exotic Pasture	14.5	10	10	0
4	Exotic Pasture	13.0	0	20	0
5	Exotic Pasture	15.4	4	0	0
6	Exotic Pasture	18.4	0	26	16
7	Exotic Pasture	13.1	0	6	4
8	Exotic Pasture	12.6	0	14	2
9	Exotic Pasture	14.9	0	24	8
10	Exotic Pasture	17.4	2	30	6
11	Exotic Pasture	19.8	8	32	2
12	Exotic Pasture	12.5	0	34	4
<b>Average</b>	<b>N/A</b>	<b>15.4</b>	<b>2.2</b>	<b>16.6</b>	<b>4.2</b>

#### 3.4.3.1 Comparison with Previous Years

Both African lovegrass and St John’s wort recorded their highest average percentage covers (within plots) in 2023 compared to other years (**Table 3.8**). African lovegrass has seen a significant increase on the previous year, exceeding the previous high of 14.2% cover in 2021. Chilean needlegrass coverage had decreased in the previous two years of monitoring, but has also increased this year by a small amount (**Table 3.8**).

**Table 3.8 Average Percent Cover of Significant Weed Species (Across All Plots) Between 2020-2023, YEP Offset Area, 2023**

Year	2020	2021	2022	2023
African lovegrass	8	14.2	2.5	16.3
Chilean needlegrass	3.75	2.5	1.82	2.2
St John's wort	Not recorded	0.16	3	4.2

## 3.5 Golden Sun Moth Habitat Mapping

The extent of golden sun moth habitat is summarised in **Table 3.9** and **Figure 3.5**. GSM habitat exists in the form of low quality habitat and low quality habitat dominated by Chilean needlegrass. No areas of high or moderate quality habitat were recorded during the field surveys.

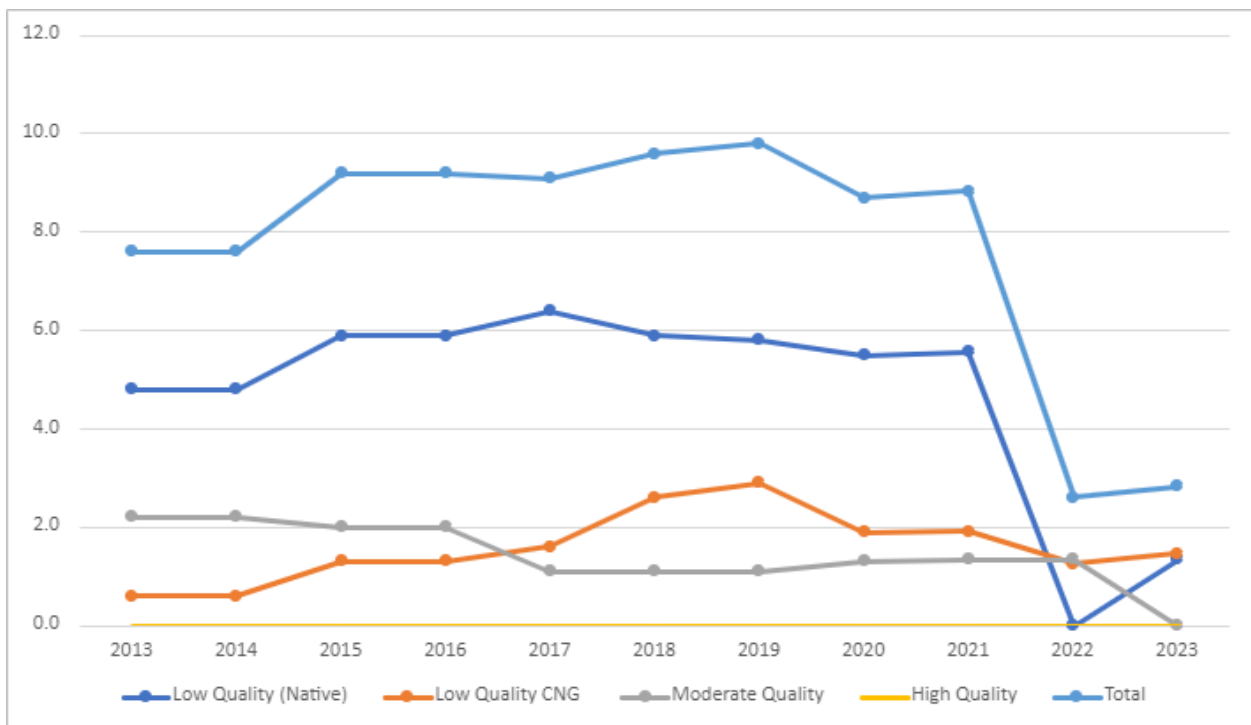
**Table 3.9 Extent of Golden Sun Moth Habitat Condition Classes within the YEP Offset Area, 2023**

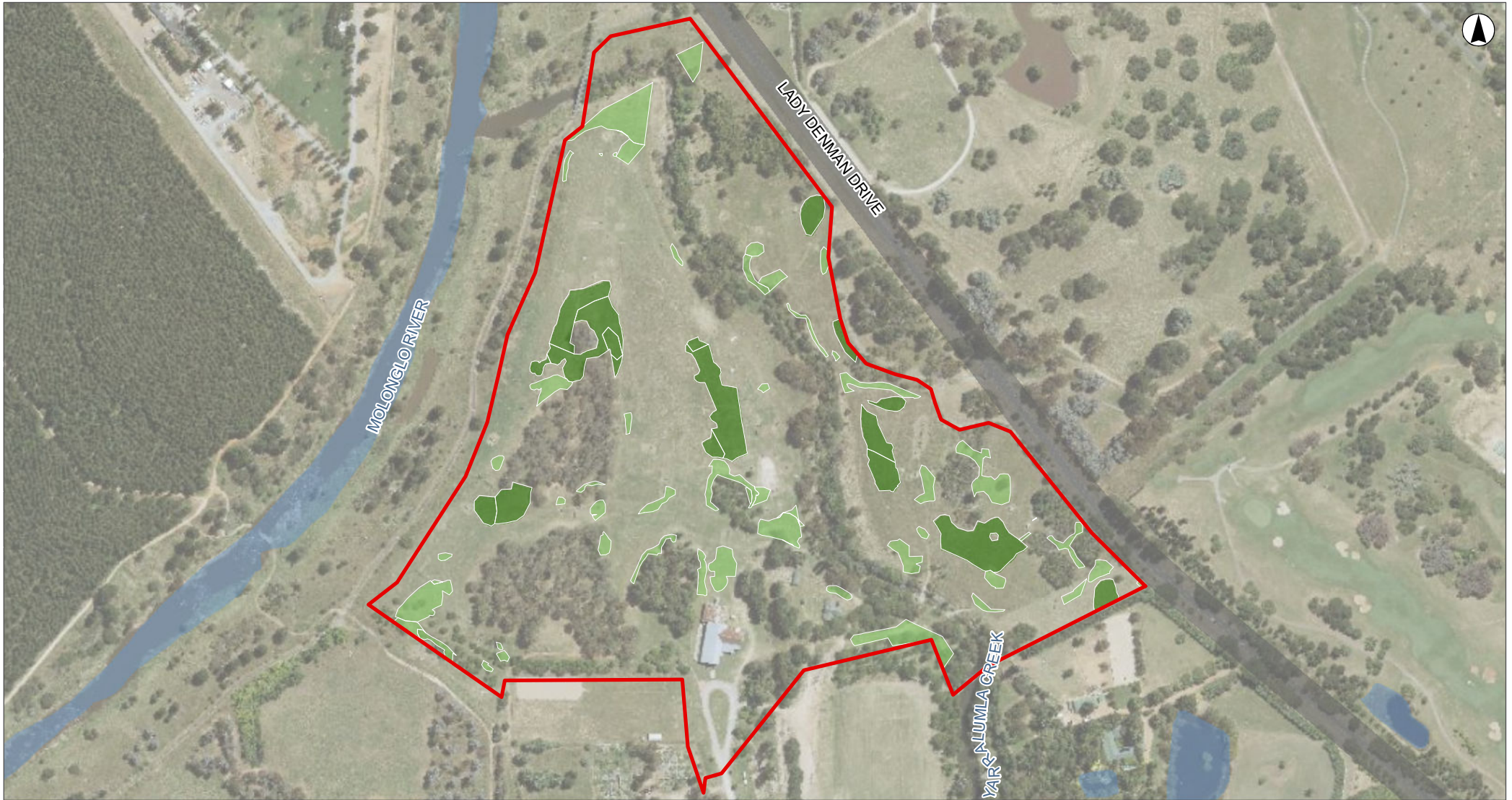
Golden Sun Moth Habitat Condition Classes	Extent (ha)
Low quality habitat	1.35
Moderate quality habitat	0.00
High quality habitat	0.00
Low quality habitat dominated by Chilean needlegrass	1.47
<b>Total</b>	<b>2.82</b>

### 3.5.1 Comparison with Previous Years

The total extent of golden sun moth habitat (ha) remained relatively consistent from 2013 to 2021 but decreased substantially between the 2021 to 2022 (**Figure 3.5**). This reduction was due primarily to the decrease in the extent of low quality native habitat. The 2023/24 monitoring recorded no moderate quality habitat, with all previous moderate quality habitat now mapped as low quality habitat, thus a 'rebound' in low quality habitat. The slight increase in low quality Chilean needlegrass dominated habitat resulted in an increase of the total area of golden sun moth habitat compared to 2022. No high quality habitat was recorded.

**Figure 3.5** Change in the Extent (ha) of Golden Sun Moth Habitat, YEP Offset Area (2013-2023)





**Legend**

- ▭ Yarralumla Equestrian Park Boundary
- ▭ Golden Sun Moth Habitat
- ▭ Waterbody
- ▭ Low Quality (Chilean needlegrass)
- ▭ Low Quality (Native)



**FIGURE 3.6**  
Yarralumla Equestrian Park Offset Area  
Golden Sun Moth Habitat

## 3.6 Golden Sun Moth Surveys

### 3.6.1 Rotational Point Counts

Six golden sun moths were observed during the rotational point counts with an average of 0.6 per rotation. Two golden sun moths were recorded at point three (average of 0.2 per rotation), and four golden sun moths (average of 0.4 per rotation) were recorded at point six. Zero golden sun moths were observed at the remaining points (**Table 3.10, Figure 3.7**).

**Table 3.10 Summary of Results for the Golden Sun Moth Rotational Point Counts, YEP Offset Area, 2023**

Point	1	2	3	4	5	6	7	8	9	10	11	12	Total
Average of 1 <sup>st</sup> Rotational Count	0	0	0.2	0	0	0.4	0	0	0	0	0	0	0.6
Average of 2 <sup>nd</sup> Rotational Count	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0.2	0	0	0.4	0	0	0	0	0	0	0.6
Average	0	0	0.1	0	0	0.2	0	0	0	0	0	0	0.3

### 3.6.2 Transect Counts

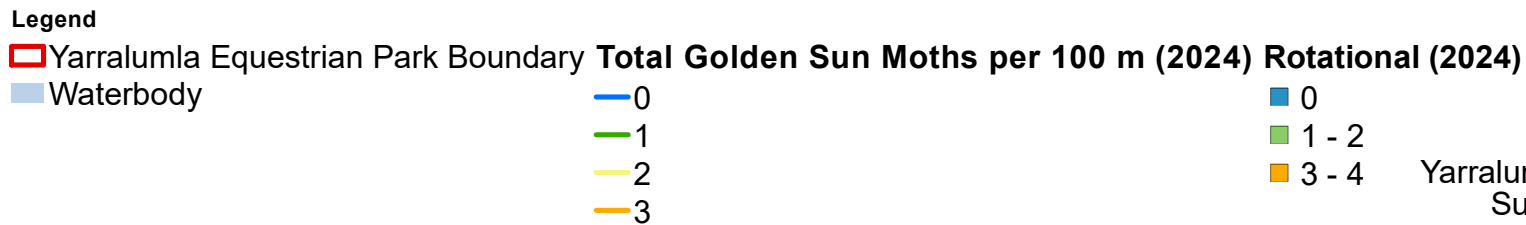
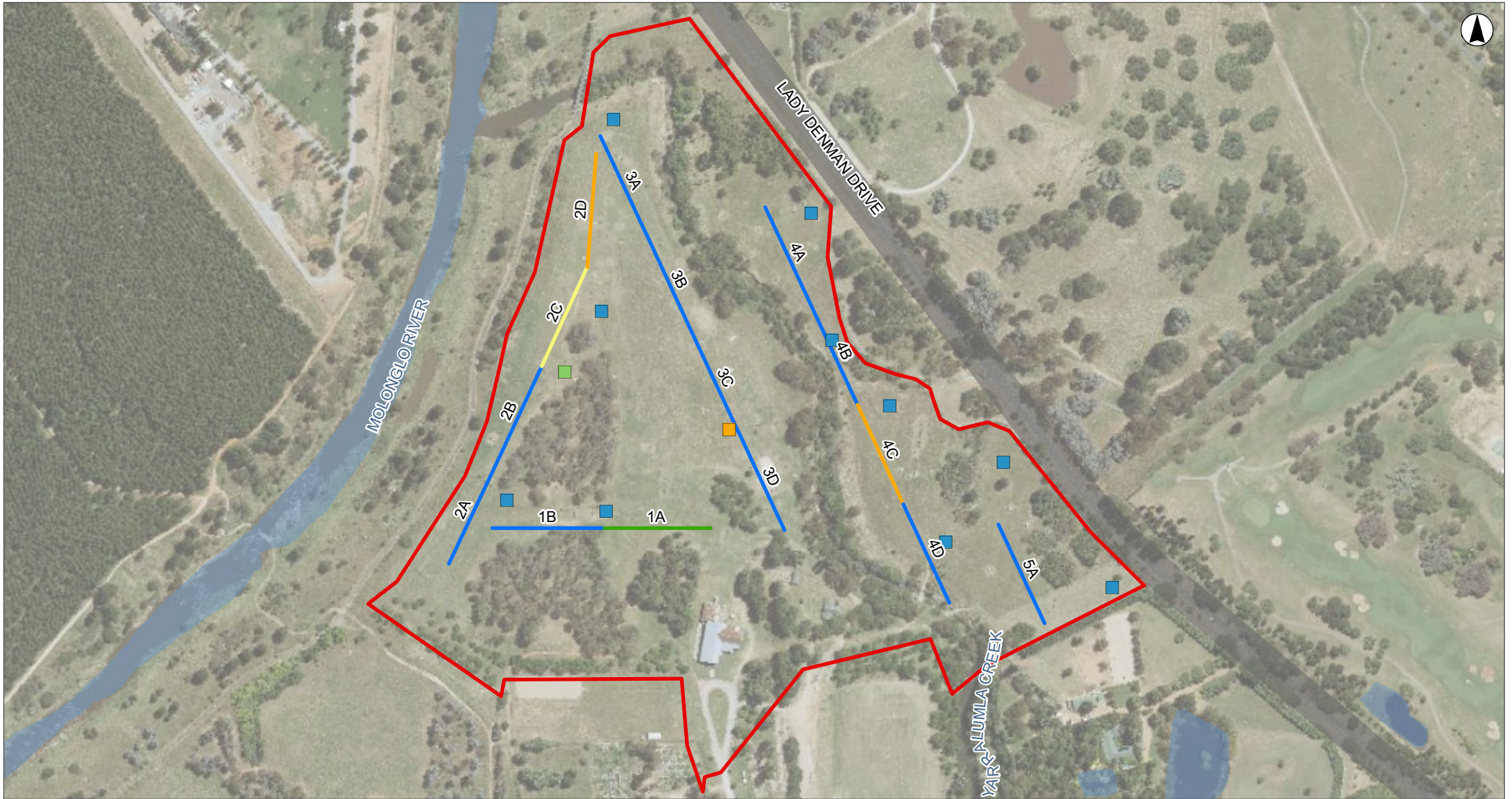
Nine golden sun moths were detected across the 15 transects for both survey days (**Table 3.11; Figure 3.7**).

**Table 3.11 Summary of Results for the Golden Sun Moth Transect Counts, YEP Offset Area, 2023**

Transect	1A	1B	2A	2B	2C	2D	3A	3B	3C	3D	4A	4B	4C	4D	5A	Total
Survey 1	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	4
Survey 2	1	0	0	0	1	0	0	0	0	0	0	0	3	0	0	5
Total	1	0	0	0	2	3	0	0	0	0	0	0	3	0	0	9
Average	0.5	0	0	0	1	1.5	0	0	0	0	0	0	1.5	0	0	4.5

### 3.6.3 Incidental Observations

No male or female golden sun moths or pupal cases were recorded incidentally.



**FIGURE 3.7**  
Yarralumla Equestrian Park Offset Area Golden Sun Moth Records (Transect + Rotational)

### 3.6.4 Comparison with Previous Years

#### 3.6.4.1 Rotational Point Counts

The total of the average number of golden sun moths recorded per rotation across the YEP offset area (**Table 3.12**) demonstrates a decrease in the number of moths in the last two years. Despite a marginal increase in 2023 compared to 2022, the last two years point towards a continued decline overall. The 2023 average is significantly below the baseline average (2013-2015).

**Table 3.12 Total of the Average Number of Moths Observed per Year per Rotation at the YEP Offset Area, 2023**

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Baseline (Average 2013-2015)
Total Average number of moths	13.1	26.1	19.8	83.5	9.6	95.6	15	30	1.05	0.2	0.3	19.7

#### 3.6.4.2 Transect Counts

As noted in the OMP (Umwelt, unpublished), the average of the transect counts collected between 2018-2020 is considered the baseline against which future changes in the population of golden sun moths will be assessed. Monitoring in 2023 saw an increase in average golden sun moth per transect from the previous three years, noting that 2022 saw low numbers of golden sun moth across the ACT region (Umwelt 2022). However, compared to the baseline numbers, golden sun moth sightings are still significantly down (**Table 3.13**).

**Table 3.13 Total and Average Golden Sun Moth Transect Count Per Year and Compared to Baseline (2018-2020), YEP Offset Area, 2023**

Year	2018	2019	2020	2021	2022	2023	Baseline (2018-2020)
Total number recorded across the YEP offset area	1312	248	41	8	1	9	533.67
Average number per transect	29.1	5.5	1.3	0.27	0.03	4.5	11.96

## 3.7 Meteorological Data

Canberra experienced a drier and warmer than average winter (**Table 3.14** and **Table 3.15**). The total winter rainfall (as measured at Weather Station #070351) of 71.0 mm was 55% of the long-term average of 128.8 mm. The average winter maximum (14.4°C) and minimum (1.2°C) temperatures were above the long-term averages, 13.4°C and 0.7°C, respectively (BoM 2023a).

Canberra also experienced drier, warmer days in September and October (**Table 3.14** and **Table 3.15**), with total rainfall for September (14.2 mm) being 28 % of the long-term monthly average and October rainfall (32.6 mm) being 58 % of the long-term monthly average.

The average daily maximum temperature for September (20.9°C) and October (21.9°C) was above the long-term averages of 17.9°C and 21.2°C, respectively (BoM 2023b; BoM 2023c).

The YEP offset area experienced a wetter November and December and a cooler December (**Table 3.14** and **Table 3.15**), with rainfall events occurring in both months resulting in 134.2 mm and 104.4 mm, respectively, over their long-term averages. November's average daily maximum (25.5°C) and minimum (10.5°C) temperatures and December's minimum (12.7°C) temperature were above long-term averages of 24.9°C, 9.8°C and 11.9°C, respectively. The December maximum average daily temperature of 27.1°C was only 0.1°C below the long-term average (BoM 2023d; BoM 2023e).

**Table 3.14 2023 Rainfall (taken from Bureau of Meteorology (BoM) Canberra Airport Weather Station #070351)**

Month	Rainfall (mm)	Long-term Average Rainfall (mm)	2023 Rainfall Compared to Long-term Average
June	39.6	48.3	82% of the long-term average
July	10.0	31.0	32% of the long-term average
August	21.4	49.5	43% of the long-term average
September	14.2	51.0	28% of the long-term average
October	32.6	55.9	58% of the long-term average
November	134.2	77.8	172% of the long-term average
December	104.4	75.8	138% of the long-term average

**Table 3.15 2023 Temperature (taken from BoM Canberra Airport Weather Station #070351)**

Month	Maximum Temperature (°C)			Minimum Temperature (°C)		
	2023	Long-term Averages	2023 Compared to Long-term Average	2023	Long-term Averages	2023 Compared to Long-term Averages
June	13.1	13.3	0.2 below	2.5	1.1	1.4 above
July	14.5	12.7	1.8 above	-0.2	0.1	0.3 below
August	15.7	14.1	1.6 above	1.3	1.0	0.3 above
September	20.9	17.9	3.0 above	2.3	3.2	0.9 above
October	21.9	21.2	0.7 above	5.1	6.3	1.2 below
November	25.5	24.7	0.8 above	10.5	9.7	0.8 above
December	27.1	27.2	0.1 below	12.7	11.9	0.8 above

## 4.0 Discussion

### 4.1 Grassland Mapping and Condition

The extent of natural temperate grassland has been verified based on the updated criteria for the *Natural Temperate Grassland of the South- Eastern Highlands* critically endangered ecological community (**Figure 3.2** and **Table 3.3**).

The extent of natural temperate grassland has decreased significantly during 2023 to the point where it is not present within the YEP offset area. This was following a negative trend in the extent recorded over the past three years from 1.03 ha in 2021, 0.01 ha in 2022 and 0 ha in 2023.

Native pasture and mixed native and exotic pasture are also no longer present at the YEP offset area. The change in the floristic composition of areas that previously supported natural temperate grassland and native pasture reflects the trend of an overall increase in cover of exotic species, and as a result, the YEP offset area is now comprised completely of exotic pasture.

The extent of African lovegrass increased by 33% from 2.95 ha in 2022 to 3.91 ha in 2023. This represents the highest recorded extent of this invasive species since monitoring began in 2013 (**Figure 3.3**). The extent of Chilean needlegrass increased by 16% from 1.41 ha in 2022 to 1.64 ha in 2023. These increases partially explain the increase in the extent of exotic grassland and decrease in other native dominated vegetation types.

The exotic pasture has expanded at a rate similar to the decline in the extent of mixed pasture (**Figure 3.2**). This indicates that the extent of exotic species in areas that comprised of mixed pasture increased at the expense of native species cover and diversity (**Section 3.3**). An increase in the cover of exotic grasses can also explain the loss of native pasture. **Section 4.2** provides further discussion on the management of weeds in the YEP offset area.

While native plant species diversity is low and below benchmark level across the YEP offset area, some important species and high floristic values scores that are above benchmark level were recorded in some plots (**Table 3.3**). This indicates that with urgent and intensive weed control (of exotic grasses and broadleaf weeds), some patches within the YEP offset area may still be able to be restored so they are consistent with the native pasture vegetation type. It is unlikely that patches of natural temperate grassland can be established without restoration efforts that include revegetation with native grasses and forbs.

#### 4.1.1 Grassland Structure

Consistent with the finding of the previous monitoring event in 2022, bare ground was below benchmark across the YEP offset area. Thatch cover was also greater than benchmark values for five of the twelve plots. While this can be explained partly by continued mild weather in 2023, the height of grass in some areas (over 1 m as observed by ecologists in the field) is also likely due to insufficient biomass management.

The YEP offset area is mown at least twice a year in April/May and in October/November to coincide with planned equestrian events. While this is sufficient in most years, regular monitoring of thatch cover, density and bare ground is required throughout the year to determine if short term management responses are required. This is especially important in times of increased growth due to higher than average rainfall and changes in volunteer capacity to manage the YEP offset area.

## 4.2 Weed Distribution and Management

The rapid increase in the extent of significant weed species, including African lovegrass and Chilean needlegrass are the likely cause of the increase in exotic pasture and disappearance of natural temperate grasslands within the YEP offset area.

Certain areas were dominated by the tussock forming perennial exotic grasses *festuca* and *paspalum*. Widespread exotic annual species including the grasses belonging to the oats and fescue genus, as well as forbs including plantain, fleabane, and catsear were also of note, with these species recorded consistently at high coverage amounts across the YEP offset area.

Weed management actions in 2022/23 were insufficient, leading to an increase in the extent and density of African lovegrass and Chilean needlegrass across the site.

The higher soil moisture during 2022 and 2023 may also have stimulated the emergence of weed seeds (including grasses and broadleaf species), resulting in additional recruitment and increased robustness of already mature individuals. Under a regular weed control program this would provide for more effective control of the actively growing young plants and further reductions of weed species in the soil seed bank.

Urgent increased weed control efforts are required that are consistent with the weed control plan (Umwelt 2018).

As reported in Umwelt (2021) early measures to control the outbreak of caltrop across the YEP offset area were successful. However, due to insufficient maintained weed control effort the species has re-established at the YEP offset area. This species was introduced via the importation of sand used to reduce the hardness of the ground along equestrian trails. While it is recognised that such activities are necessary to minimise risks for horses and riders in the event of falls, it highlights the importance of bringing in clean material as well as regularly monitoring for and controlling outbreaks as soon as they arise.

## 4.3 Golden Sun Moth Habitat Extent

The extent of golden sun moth habitat increased slightly during 2023. However, the total extent of habitat has decreased significantly from 7.6 ha in 2013 to 2.82 ha in 2023 (noting the majority of this decline (6.2 ha) occurred during 2021 to 2022; **Figure 3.6**).

An increase of 1.35 ha of low-quality habitat and 0.21 ha of Chilean needlegrass dominated low quality habitat occurred during 2023, due to the loss of moderate quality habitat from the YEP offset area.

The loss of moderate quality golden sun moth habitat is likely a result of the increase in the prevalence of exotic species, particularly African lovegrass. The ongoing control of African lovegrass is vital to reduce further degradation of golden sun moth habitat at the YEP offset area.

The control of Chilean needlegrass also remains a priority. While golden sun moth populations persist in Chilean needlegrass dominated habitat, the increase in the extent of Chilean needlegrass is a likely factor in the loss of natural temperate grassland.

## 4.4 Golden Sun Moth Population Monitoring

A total of 15 golden sun moths were counted across the YEP offset area during the 2023 flying season, with 6 recorded in total for rotational point count surveys, and 9 recorded in total for transect counts. Both survey methods saw a slight increase on the previous two years of monitoring, but are still significantly down on previous years and compared to baseline levels.

The low numbers of golden sun moths recorded in the 2023 could be attributed to the wetter conditions compared to long-term averages within the flight season (**Section 3.7**), similar to 2021 and 2022, which were also considered poor years for golden sun moth emergence in the Canberra region generally (Rowell as per comm. 2023).

Studies have indicated that the timing and onset of warm temperatures and rainfall events can influence migration, breeding, and emergence for invertebrates with short life cycles (Dempster 1983; Gregg et al. 1994). Although there is little evidence of long-term changes in weather patterns on golden sun moth distribution and abundance, studies suggested that local weather conditions, especially extremes, affect golden sun moth distribution and abundance (Kutt et al. 2015; Brown et al. 2012). Kutt et al. (2015) undertook golden sun moth surveys from 2008-2009 to 2011-2012 in a conservation reserve in south-eastern Australia and discovered that distribution and abundance dramatically declined from a drought period in 2008-2009 to above-average rainfall in 2011-2012. Brown et al. (2012) conducted golden sun moth surveys in the Victorian volcanic plains in south-eastern Australia in the summers of 2009 and 2010 and identified that the wetter, cooler season in 2010 affected golden sun moth activity, with numbers sighted to be particularly low.

The overall decline in the extent and quality of golden sun moth habitat at the YEP offset area since 2019 and inadequate biomass management are likely factors contributing to the reduced population counts. Increase completion from weeds has reduced the cover of larval food species (*Rytidosperma* sp. and *Austrostipa* sp.). An increase in the cover of Chilean needlegrass may be partly filling that gap (where African lovegrass is not already dominating), however relying on the cover of Chilean needlegrass to support the golden sun moth within YEP offset area is not consistent with site management objectives.

The low number recorded over the past few years is also likely to have implications on future population counts due to continued declines in breeding opportunities. This snow balling affect is likely to have long term implications on the viability of the species within the YEP offset area.

## 5.0 Compliance with the Offset Management Plan

### 5.1 Survey Requirements

Detailed monitoring has been completed in order to meet monitoring requirements, as described in the OMP (RJPL 2014a). However, several changes to monitoring methods were implemented to improve consistency with monitoring of Commonwealth offsets elsewhere in the ACT and to allow improved quantitative comparison of results against the baseline.

Natural temperate grassland and golden sun moth monitoring surveys were conducted according to the methods specified in the OMP (RJPL 2014a), with the following amendments documented in the updated OMP (Umwelt, in prep):

- '*Meandering traverse*' monitoring was not completed when assessing golden sun moth habitat condition, and replaced with sampling of 100 m transects, as '*meandering traverse*' surveys proved uninformative and difficult to compare between seasons. Data along the 100 m transects has been collected since 2020. The baseline from which golden sun moth habitat condition is measured is now the average of 2020-2022.
- Two targeted surveys for golden sun moth were completed, rather than three, in accordance with standards required for ACT Government monitoring of Commonwealth offsets elsewhere in the ACT.
- Habitat structure assessments are now completed in accordance with standards required for ACT Government monitoring of Commonwealth offsets elsewhere in the ACT.
- Quadrats were located at co-ordinates specified in the 2013 monitoring report (RJPL 2014b), which are consistent with Figure 5 of the OMP (RJPL 2014a), rather than at the incorrect co-ordinates reported in Appendix B of the original OMP ((RJPL 2014a)).
- Grassland condition was assessed using 20 x 20 m plots (following Rehwinkel 2015) only. An assessment based on 4 x 4 m plots (following Rehwinkel 2007) is no longer deemed necessary noting that more than three years of data has been collected following Rehwinkel (2015) from which changes in the trajectory of grassland quality can be determined.

### 5.2 Reporting Requirements

The OMP (RJPL 2014a) requires that annual monitoring reports:

- provide and assess the monitoring data for the previous twelve months against the previous monitoring results
- conclude whether there has been a lack of increase or a decline in the golden sun moth population in the YEP offset area due to equestrian activities, considering regional population trends and local ecological conditions

- conclude whether there has been no improvement or a decline in golden sun moth habitat, and natural temperate grassland quality and extent in the YEP offset area due to equestrian activities, considering local ecological conditions
- the preparation of this report fulfils the reporting requirements for monitoring during the 2023 flying season, as specified in the OMP (RJPL 2014a).

### 5.3 Management Response

The recommended management responses outlined in the *2017 Yarralumla Equestrian Park Offset Report* have been acted upon with weed spraying being carried out all years (except in 2021 due to Covid related restrictions). Current management of the offset area is however not considered appropriate, especially related to the control of weeds and biomass. This is evident by the increase of exotic grassland and potential loss of natural temperate grassland within the YEP offset area.

A consistent effort to monitor and control significant weeds (i.e. African lovegrass and Chilean needlegrass), outbreaks of existing weeds (i.e. serrated tussock and St John's wort), and incursions of new weeds (e.g., caltrop) is required. An improved weed monitoring and control program will likely result in an increase in native species cover and will reduce the impacts of African lovegrass on golden sun moth habitat.

There is, however, potential for grassland diversity to decline because of off-target herbicide application for weed control activities. Application of herbicide must be undertaken in a manner that is sensitive to the grassland values and be undertaken by contractors who are experienced in controlling weeds in areas of high conservation value.

The likelihood is that rehabilitation works (including the possible need to revegetate with native species) will be required if the extent of invasive weeds is not adequately controlled. Potential actions will need to be included in the updated OMP (Umwelt, in prep).

The lack of bare ground, dense thatch and high grasses could also impact the viability of the YEP offset area to support the golden sun moth populations. Low counts combined with habitat that is not suitable for the moths to breed, may result in a continued decline in the population. The overall quality of the golden sun moth habitat is in decline.

The amount of mowing needs to increase, especially in the lead up to the flight season. The mowing regime should be consistent with that in the revised OMP (Umwelt, in prep). The removal of grass clippings during the golden sun moth flying season would be beneficial to the emergence of golden sun moths as it would reduce thatch density and cover.

### 5.4 Impact Thresholds

Assessments were completed against updated thresholds in the current OMP (Umwelt, in prep) (**Table 5.1**) from which responses are required to address potential declines in the condition of the YEP offset area and trigger consultation between the ACT Government and the Commonwealth.

Following SMEC (2018) and Umwelt (2020) the threshold relating to change in qualitative habitat assessments has been removed due to the demonstrated high level of observer bias evident in monitoring.

**Table 5.1 Impact Response Thresholds from Umwelt (in prep)**

No.	Revised Threshold
1	No increase or a decline in spatial extent of natural temperate grassland and/or golden sun moth habitat over at least three consecutive seasons, that cannot be attributed to biological influences and seasonal conditions.
2	A statistically significant lack of increase or decline in native grassland and natural temperate grassland floristic value scores over at least three consecutive seasons that cannot be attributed to biological influences and seasonal conditions.
3	A statistically significant lack of increase or a decline in flying moth numbers over at least three consecutive seasons that cannot be attributed to biological influences and seasonal conditions.
4	No threshold. <i>Qualitative grassland ranking scores and golden sun moth habitat ranking scores removed due to high level of observer variation and lack of consistency with standard ACT Government approaches</i>

### 5.4.1 Threshold 1

The extent of natural temperate grassland has decreased and was not recorded in 2023. The decline in the extent was very rapid, occurring over two years (following an increase in extent in 2021). While this threshold is based on three years of data, due to the apparent loss of the natural temperate grassland community, this threshold has been triggered and a plan to restore the site is now required.

The overall extent of golden sun moth habitat decreased substantially during 2022 following a minor increase in the previous year. While the extent increased marginally in 2023, the overall quality of the habitat has declined. This threshold has not been triggered on the basis that the decline in the extent of golden sun moth habitat, whilst substantial, does not span at least three consecutive seasons.

However, it is likely that without substantial effort to control the spread of weed species within the YEP offset area, it is likely that this threshold will be triggered in response to the 2024 survey results.

### 5.4.2 Threshold 2

The extent of natural temperate grassland and native pasture has decreased, with neither vegetation type recorded in 2023.

The average floristic value score across the site has also decreased to the lowest recorded level to 5.18 across all plots in 2023, compared to 12.49 in 2020. This threshold has been triggered.

### 5.4.3 Threshold 3

A marginal increase in the number of golden sun moths were recorded in 2023. The average number of flying moths recorded during each of the previous three flying seasons is however still lower than the baseline at the rotational points and the transects.

The results are however consistent with results from golden sun moth surveys across the region since 2020.

The low numbers recorded (compared to baseline level) are most likely due to a combination of cooler and extremely wet conditions leading into and during the flying season, and cumulative impacts to the population from consecutive poor flight seasons combined with inadequate biomass management, which would have reduced breeding success. The reduced extent of larval food plants is also a factor.

Urgent action is needed to ensure habitat quality (both in terms of securing the availability of food plants and ensuring that the biomass is management appropriately during the flight season) is improved so that the species has a good chance to persist within the YEP offset area irrespective of seasonal climatic conditions (i.e. even when the seasons are not conducive to high emergence rates that those that do emerge are provided with the best opportunity to breed and that any larvae have sufficient resources to develop and complete their life cycle).

## 6.0 Conclusions and Recommendations

### 6.1 Outcomes

The key results of the 2023 monitoring program are:

- Completion of floristic assessment and vegetation structure assessment at 20 x 20 m plots has identified a total of 0 plots within areas identified as natural temperate grassland meeting criteria for inclusion in the EPBC Act listed *Natural Temperate Grassland of the South Eastern Highlands* critically endangered community.
- The extent of natural temperate grassland decreased from 0.01 ha in 2022 to 0 ha in 2023, continuing a major negative trend in extent recorded since 2021. The extent of native pasture and mixed native exotic pasture has decreased to 0 ha in 2023 as a result of an increase in the extent of perennial exotic species, particularly African lovegrass. Areas previously mapped as native pasture and mixed native exotic pasture are now classified as exotic pasture.
- The surveys following Rehwinkel (2015) confirmed that four of the 12 plots surveyed had a floristic value score greater than benchmark level. Native species richness and proportion of native cover were all below benchmark level. The extent of bare ground being below benchmark at all 20 x 20 m plots (aside from plot 3) is coupled with average thatch cover being above benchmark at 7/12 plots. The presence of persisting indicator species suggests that with urgent and intensive weed control some areas may be restored to natural temperate grassland.
- African lovegrass saw a large increase in extent, to its highest recorded extent since monitoring began in 2013. The extent increased by 0.96 ha since 2022, and now sits at 3.91 ha in total. Chilean needlegrass saw an increase compared to 2022, with an increase of 0.23 ha to a total of 1.63 ha and is on an upward trend in extent size. Higher soil moisture during 2022 and 2023 may have contributed to increases in weed extent across the YEP offset area.
- The total extent of golden sun moth habitat increased from 2.6 ha to 2.8 ha as a result of a small increase to low quality Chilean needlegrass habitat. Significantly, all medium quality native habitat was downgraded to low quality native habitat due to the decrease of native feed species, increase in exotic flora species, and reduction in golden sun moth favourable physical attributes (bare ground, biomass extent, broadleaf increase). This decline in golden sun moth habitat is likely primarily a result of the substantial increase in the prevalence of African lovegrass during this period, as well as the expansion of other annual grass species (fescue and oat species).
- Nine and six golden sun moth in total were recorded during the transect and rotational counts, respectively. The average total for rotational point counts (0.3) is significantly below the baseline average of 19.7 (years 2013-2015). Encouragingly, the transect count average (4.5) for 2023 shows an improvement from the previous three years of monitoring, however is also below the baseline average of 11.96. Decline in golden sun moth habitat and inadequate biomass management are likely contributing factors leading to a long term decline in golden sun moth populations across the YEP offset area.

## 6.2 Recommendations

The key recommendations of this are:

- Continued control of perennial exotic tussock grasses, specifically African lovegrass and Chilean needlegrass as a priority. The weed control program should be implemented following Umwelt (2018). This includes regular monitoring and control of weeds across the YEP offset area to ensure that new incursions are controlled as soon as possible.
- The current management of grassland structure (mowing at least twice a year in April/May and in October/November to coincide with planned equestrian events) should continue, however also needs to be increased as needed to ensure that biomass is managed to be consistent with the ecological requirements of golden sun moth habitat and native grassland communities.
- With threshold one being partially triggered and threshold 2 being triggered, plans to restore the site, specially to re-establish the natural temperate grassland is now required. It is recommended that this is undertaken following a restoration plan prepared by a suitability qualify ecologist.

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