

OFFSET STRATEGY

Dudley Street Upgrade and Canberra
Brickworks Precinct Access Road
Construction

FINAL

July 2018



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Brickworks Precinct Access Road Construction

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Prepared by
Umwelt (Australia) Pty Limited
on behalf of
**Chief Minister, Treasury and Economic
Development Directorate**

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1.0 Introduction

Umwelt (Australia) Pty Limited (Umwelt) were engaged by the Chief Minister, Treasury and Economic Development Directorate of the Australian Capital Territory (ACT) Government to prepare this Offset Strategy report to support a Referral made under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The objectives of this report are to refine the offset requirements of the proposed Dudley Street Upgrade and Canberra Brickworks Access Road Construction Project (the Project, described in detail in **Section 1.1**), and determine the suitability of the North Mitchell Grasslands as a potential offset for the Project. . The suitability will be assessed against the current Commonwealth and ACT Offset Policies (described in **Section 1.2**).

1.1 Introduction

The Project is the proposed upgrade of Dudley Street in Yarralumla from a minor collector road to a major collector road, and the construction of a new access road to service the proposed future urban area of the Canberra Brickworks Precinct (CBP) as shown in **Figure 1.1**.

Despite substantial redesign to avoid impacts to matters of national environmental significance (MNES) protected under the EPBC Act within the Impact Area, the Project has been determined to have residual significant impacts on golden sun moth (*Synemon plana*), a critically endangered species; and natural temperate grassland of the South Eastern Highlands (natural temperate grassland), a critically endangered ecological community.

As such, an EPBC Referral (ref. 2017/0872) was made to the Minister for the Environment. On 1 December 2017, the Project was determined to be a controlled action due to these likely significant impacts on threatened species and communities (i.e. MNES) to be assessed on preliminary documentation. This report has been prepared to meet the information requirements of the preliminary documentation, specifically, the identification of an offset and preparation of an offset strategy.

A potential Offset Area has been identified at the North Mitchell Grasslands, Block 4, Section 47, Franklin, ACT (**Figure 1.2**). The block is currently zoned as 'NUZ: Hills Ridges and Buffer Areas' and 'PRZ1: Urban Open Space'.

This Strategy aims to refine the definition of the Project's impact, and identify whether this site is appropriate to offset the proposed impact.



Image Source: Environment and Planning Directorate, ACT Government (2016)
Data Source: AECOM (2017)

0 100 200 250 m
1:5000

Legend

- Impact Area
- Preliminary Sketch Plan (AECOM 2017)

FIGURE 1.1

Impact Area



Image Source: Environment and Planning Directorate, ACT Government (2016)

0 100 200 400m
1:7 500

Legend

Offset Area

FIGURE 1.2

Offset Area

1.2 Relevant Offset Policies

1.2.1 Commonwealth Offsets Policy

The Commonwealth Offsets Policy states that if a proposed action is considered likely to cause a significant impact to MNES, an environmental offset may be proposed. An environmental offset is a measure that compensates for a significant residual impact that cannot be avoided or mitigated. It must be in effect for the full duration of the significant impact (i.e. if the removal of habitat is permanent, then the offset must be established in perpetuity). In this instance, this entails providing for the perpetual protection and management of a location that supports like-for-like habitat for the relevant MNES.

A proposed offset strategy will only be considered under the Commonwealth Offsets Policy if avoidance and mitigation measures have demonstrably been implemented prior to the consideration of offsets. That is, the proposed offset is a last resort, which compensates for residual impacts that cannot be effectively managed through planning, design, or management measures.

The Commonwealth Offsets Policy outlines the principles upon which any proposed offset strategy should be based. This document describes and assesses the effectiveness of the offset strategy proposed as part of the Project.

This assessment has been prepared in consideration of the Commonwealth Offsets Policy, and the supporting guide and documents (SEWPaC, 2012b; DoEE, 2017).

1.2.2 ACT Offset Policy

The ACT has developed an Environmental Offsets Policy, which is consistent with the Commonwealth Offsets Policy with regard to MNES (EPD, 2015). As such, if an Environmental Offset has been established for an MNES under the EPBC Act, a separate offset is not required under the ACT Offset Policy, even if the MNES is also protected under relevant ACT legislation.

The Project will not be impacting upon any matters that are protected in the ACT and are not MNES. As such, the ACT Offset Policy will not apply and is not discussed in detail in this report.

2.0 Impact Area

2.1 Known Environmental Values

The environment of the Impact Area is generally highly disturbed and fragmented by the existing road network. Much of the Impact Area is covered with stands of exotic trees, namely *Pinus canariensis*, *P. radiata*, *P. patula*, *Ulmus procera*, and *Quercus palustris*. The majority of grassland areas are also exotic, dominated by Chilean needlegrass (*Nassella neesiana*), with some areas of mixed and native grassland (Umwelt, 2017a).

The Impact Area has been surveyed numerous times as part of the planning for the CBP development and surrounding areas (Rowell, 2012; Umwelt, 2014; Umwelt 2016; Umwelt 2017a). Two MNES are known to occur within the Impact Area:

- natural temperate grassland of the South Eastern Highlands (natural temperate grassland), a critically endangered ecological community; and
- golden sun moth (*Synemon plana*), a critically endangered invertebrate species.

2.1.1 Natural Temperate Grassland

The extent of this ecological community was most recently confirmed by Umwelt (2017a), when five (5) patches of natural temperate grassland were identified (**Table 2.1** and **Figure 2.1**), totalling 0.45 hectares (ha). The vegetation associations described relate to the Commonwealth Conservation Advice for the ecological community (TSSC, 2016) and are provided to give further context to the floristic values present at the site.

Table 2.1 Natural Temperate Grassland Patches (Umwelt, 2017a)

Patch ID	Natural Temperate Grassland Vegetation Association	Floristic Value Score	Total Area (hectares)
5	7: kangaroo grass – wallaby-grass – snow-grass moist tussock grassland of the south eastern highlands bioregion	10.01	0.11
10	5: wallaby-grass – tall speargrass – common everlasting tussock grassland of the south eastern highlands bioregion	12.56	0.12
12 + 13	7: kangaroo grass – wallaby-grass – snow-grass moist tussock grassland of the south eastern highlands bioregion	24.61	0.32 (0.27+0.05)
15	5: wallaby-grass – tall speargrass – common everlasting tussock grassland of the south eastern highlands bioregion	19.20	0.20

2.1.1.1 Avoidance and Mitigation Measures

Substantial work has been undertaken to minimise the Project's footprint on natural temperate grassland. Due to the proximity of the grassland patches to the edge of Dudley Street, complete avoidance has been impossible. As such, **Table 2.2** identifies the areas that will be unavoidably impacted by the Project.

The landscape plan developed by AECOM specifies the planting of native 'C3' grasses along the northern verge of Dudley Street, which should help to ameliorate edge effects into the retained areas of natural temperate grassland. Construction management and activities such as weed control would be specified in the project's Environmental Impact Statement, and should also work to minimise edge effects.

2.1.1.2 Indirect Impacts

Indirect impacts have also been considered in this assessment. Despite the action only removing small slivers of the community along the southern edges of the community, disturbance from this activity may result in additional edge effects which are difficult to predict. An additional buffer of 10 metres (m) from the edge of the impact has been included in the consideration of impacts, to ensure a conservative estimate of the likely impact of the action.

These areas would not be lost as a result of construction, however may experience some degradation. As the extent of this degradation is difficult to accurately predict, the entire buffer area has been assumed to be lost for the purposes of offset calculations.

2.1.1.3 Impact Assessment

Once the additional avoidance and mitigation measures have been applied, the Project is expected to result in the following impacts to natural temperate grassland:

- Direct loss of 0.12 ha as a result of the change in road alignment and construction footprint of the new access road; and
- Indirect impacts to approximately 0.16 ha affected by edge impacts and general disturbance from construction.

Table 2.2 summarises the quality of natural temperate grassland impacted by the Proposed Action.

Table 2.2 Impacted Natural Temperate Grassland

Patch ID	Habitat Quality	Area (ha)
Direct Impacts		
5	High	0.11
10	High	0.003
12	Very high	0.01
Indirect Impacts		
10	High	0.1
12	Very high	0.04
13	Very high	0.02
Total		0.28

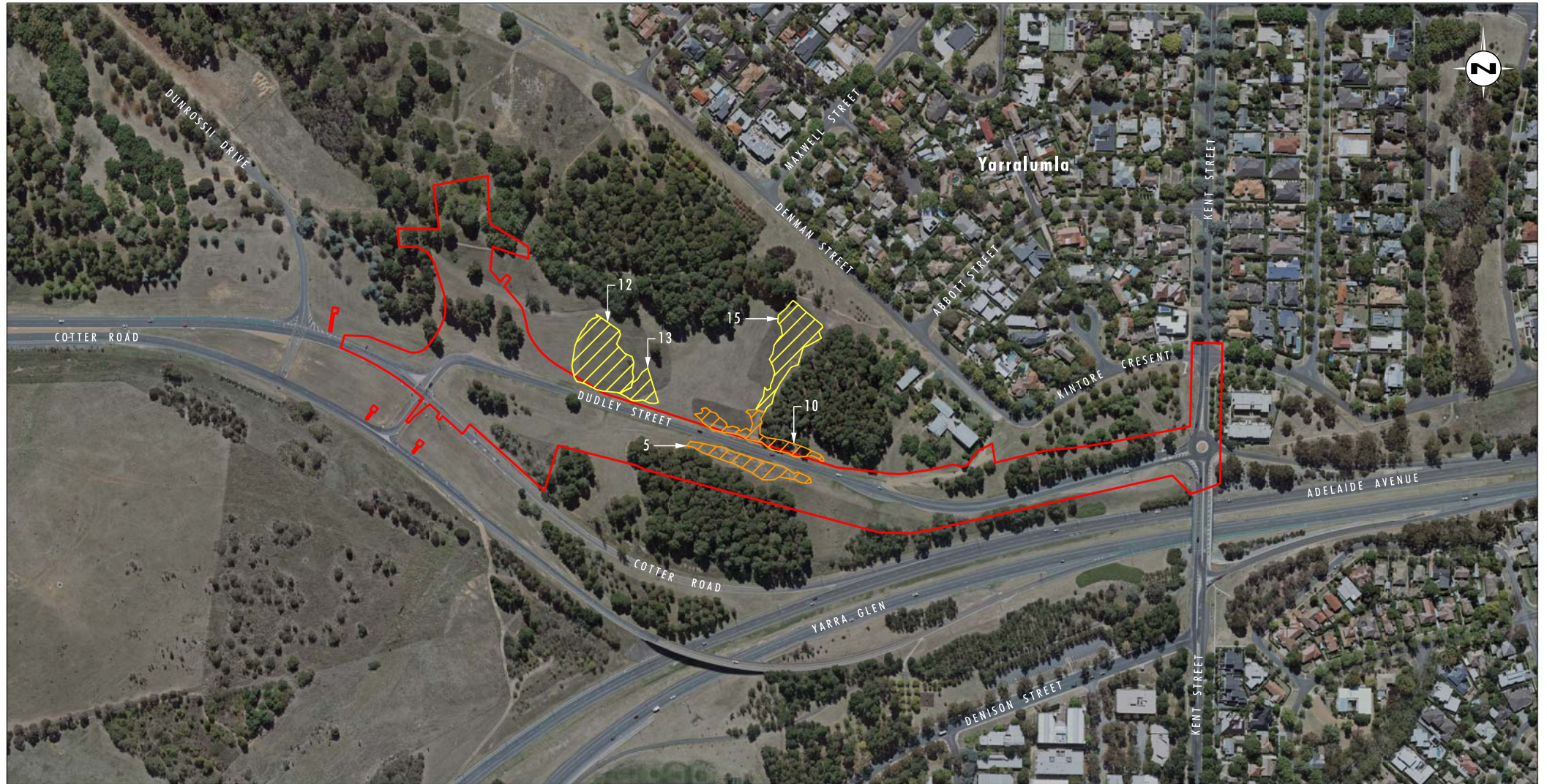


Image Source: Environment and Planning Directorate, ACT Government (2016)

0 100 200 250 m
1:5000

Legend

- Impact Area
- Current Natural Temperate Grassland - Very High
- Current Natural Temperate Grassland - High

FIGURE 2.1

Natural Temperate
Grassland Extent

2.1.2 Golden Sun Moth

Umwelt (2017a) also confirmed the presence of golden sun moth at the Impact Area; and identified 7.39 ha of golden sun moth habitat in the area surrounding Dudley Street (**Figure 2.2**). This includes nearly all grassland areas (native and exotic); except the dense *Themeda* dominated patches of natural temperate grassland (patches 12 and 13); the heavily disturbed former asphalt plant in the north (north of patch 24 on **Figure 2.2**) and a boggy drainage area on the corner of Kintore Crescent and Novar Street (north of patch 7 on **Figure 2.2**). Habitat quality varies throughout the locations where the species was recorded.

Table 2.3 summarises the habitat types and quality present within the golden sun moth 2016 survey area (Umwelt, 2017a).

Table 2.3 Golden Sun Moth Habitat at the Impact Area

Vegetation Type	Quality	Area (ha)
Exotic Grassland (Chilean needle grass dominated)	Moderate (Disturbed)	1.41
Exotic Grassland (mixed golden sun moth feed species)	Low	0.84
	Moderate (Disturbed)	2.91
Mixed Grassland	Low	0.77
	Low-Moderate	0.78
Native Grassland (<i>Rytidosperma</i> spp.)	Low	0.21
Native Grassland (<i>Rytidosperma</i> , <i>Austrostipa</i> spp.)	Low	0.05
	Moderate	0.42
Total		7.39

The highest density of moths was recorded in Exotic Grassland (Chilean needle grass dominated) and in Exotic Grassland (mixed golden sun moth feed species) in the north west of the Survey Area (patch 2 on **Figure 2.2**). Moderate numbers of golden sun moths were recorded throughout much of the remaining area. Low golden sun moth numbers were recorded on the southern verge of Cotter Road (patch 19 on **Figure 2.2**) and in moderately disturbed grassland bordering the former asphalt plant in the north (patches 24 and 26 on **Figure 2.2**).

The original Referral stated that the Project would impact upon 3.17 ha of golden sun moth habitat (Umwelt, 2017a). Since this time, work has continued to be undertaken to minimise the Project's footprint on golden sun moth habitat. This has included re-design of the road alignment, detailed consideration of construction access and land use options (i.e. placement of the site compound), and preparation of the post construction rehabilitation plans for the site.

As these changes affect the nature of the potential impacts of the Project, the impact assessment has been updated where relevant in the following sections of this report.



Image Source: Environment and Planning Directorate, ACT Government (2016)

0 100 200 250m
1:5000

Legend

- Impact Area
- Low Quality Habitat
- Low-Moderate Quality Habitat
- Moderate Quality Habitat
- Moderate (Disturbed) Quality Habitat

File Name (A4): R01/8146_005.dgn
20180420 15:58

FIGURE 2.2

Golden Sun Moth Extent

2.1.2.1 Avoidance and Mitigation Measures

Further consideration of construction access and storage requirements has identified that only one site compound will be required for the duration of the Project. As such, the secondary location north of Dudley Street, near to the Yarralumla Uniting Church, has been removed from the impact footprint. The site compound to be located south of Dudley Street, at the western end of the alignment remains. In addition, minor changes to the road alignment and design have been made. These actions have allowed for further avoidance of golden sun moth habitat, additional to that reported in the Referral, by reducing the extent of the impact area.

2.1.2.2 Indirect Impacts

Following construction, there are likely to be some changes to surface water flows as a result of the road design, particularly to the south of Dudley Street. Any small, isolated fragments downslope of the action have been considered likely to experience indirect impacts. While these areas of habitat may not be lost, they are likely to experience some degradation as a result of the action. Given the difficulty in accurately predicting the extent of degradation, all of these areas have been assumed to be lost for the purposes of the offset calculations.

2.1.2.3 Impact Assessment

Once the additional avoidance and mitigation measures (described in **Section 2.1.2.1**) have been applied, the Project is expected to result in the following impacts to golden sun moth habitat:

- Direct loss of 2.64 ha as a result of the change in road alignment and construction footprint of the new access road; and
- Indirect impacts to approximately 0.44 ha south of Dudley Street through surface water changes and fragmentation.

Table 2.4 summarises the quality of golden sun moth habitat impacted by the Proposed Action.

Table 2.4 Quality of Impacted Golden Sun Moth Habitat

Habitat Quality	Area (ha)
Direct Impacts	
Low (native grassland with a moderate component of native C3 grasses, on shallow, eroded soils; or moderately mixed grassland)	0.35
Low – Moderate (understorey includes moderate cover of native C3 grasses but is affected by shading of planted trees)	0.25
Moderate (Disturbed) (exotic grassland dominated by Chilean needlegrass)	2.0
Moderate (native grassland with a moderate component of native C3 grasses)	0.04
Indirect Impacts	
Low (exotic grassland with mixed feed species)	0.13
Moderate (Disturbed) (exotic grassland dominated by Chilean needlegrass)	0.31

2.2 Offset Requirements

As assessed by Umwelt (2017b) and in the above sections, the Project will have a significant impact on up to 0.28 ha of natural temperate grassland (**Figure 2.3**) and 3.08 ha of golden sun moth habitat (**Figure 2.4**). As these impacts are considered significant under the EPBC Act, they need to be compensated through the Commonwealth Offsets Policy.

In order to calculate the area of habitat required to compensate for the impact, the Commonwealth Offset Tool relies on an assessment of habitat quality. As described in detail in Umwelt (2017b) the habitat quality score requires consideration of patch size, connectivity, floristics, and species stocking rate (as relevant). **Table 2.5** summarises the quality of impacted habitat for natural temperate grassland and golden sun moth at the Impact Area. The methods of determining the habitat quality score for the impacted habitat in Umwelt (2017) were generally consistent with those described in **Section 4**; however a slightly modified version has been used in this report to simplify the method.

Table 2.5 Habitat Quality Scores – Impact Area

MNES	Impact Area (ha)	Quality Score
Natural temperate grassland	0.28	5 out of 10
Golden sun moth	3.08	7 out of 10

It is proposed to use the North Mitchell Grasslands as the environmental offset area. The values present at the Offset Area are described in the following **Section 3**, and **Section 4** assesses the suitability of the proposed Offset Area against the Commonwealth Offsets Policy.



Image Source: Environment and Planning Directorate, ACT Government (2016)

Legend

- Impact Area
- Natural Temperate Grassland - Direct Impact Area
- Natural Temperate Grassland - Indirect Impact Area
- Natural Temperate Grassland - No Impact

FIGURE 2.3
Natural Temperate
Grassland Impact Area



Image Source: Environment and Planning Directorate, ACT Government (2016)

0 100 200 250 m
1:5000

Legend

- Impact Area
- Golden Sun Moth Impact Area - Direct
- Golden Sun Moth Impact Area - Indirect
- Golden Sun Moth Impact Area - No Impact

FIGURE 2.4

Golden Sun Moth Impact Area

3.0 Offset Area

3.1 Understanding of the Site

The North Mitchell Grassland is located within the urban area of Franklin, ACT. It is approximately 20 ha in size, and ranges in elevation between approximately 600 and 610 m above sea level. There is a small drainage line running south-west across the south-eastern corner of the Block, which includes a dam. The broader landscape is heavily urbanised, with little remaining native vegetation (ACT Government, 2018). The site is known to have a contaminated site located along the southern edge, where uncontrolled fill has been historically dumped (refer **Section 4.2.4**).

A review of existing information was undertaken prior to site survey to develop an appreciation of the site. The following vegetation types were identified as being present:

- Tablelands Dry Tussock Grassland (meeting the definition of EPBC listed natural temperate grassland);
- *Eucalyptus melliodora* – *Eucalyptus blakelyi* Tableland Grassy Woodland; and
- exotic pasture.

The vegetation at the site is generally reflective of the site topography, with higher areas generally being more native dominated, and lower areas being wetter and weed dominated.

The 2005 ACT Lowland Native Grassland Conservation Strategy (AHE, 2005) identified 14.8 ha of natural temperate grassland within the Offset Area. In 2014, Umwelt (2015) re-surveyed the site and recorded a significant reduction in the extent of natural temperate grassland present (3.81 ha).

Golden sun moth had been recorded at moderate density at the Offset Area in 2008 (Richter *et al*, 2009). Habitat for the species was mapped as coinciding with the Tablelands Dry Tussock Grassland community (ACT Government, 2018); which had also declined from 14.8 to 3.81 ha between 2005 and 2014 (Umwelt, 2015).

The Offset Area is identified as a Category 1 Conservation Site in the ACT Native Grassland Conservation Strategy (EPSDD, 2017) as it provides habitat for one of two known populations of Ginninderra peppergrass (*Lepidium ginninderrense*), a plant that is endemic to the ACT and listed as vulnerable under the EPBC Act. In December 2017, the population count of Ginninderra peppergrass was approximately 150 plants (pers. comms. Michael Mulvaney, 4 January 2018).

Other environmental values are understood to include the following:

- a patch of Yellow Box – Red Gum Grassy Woodland in the north-east, which is an endangered ecological community under the ACT's *Nature Conservation Act 2014* (NC Act) (Umwelt, 2015);
- foraging habitat for superb parrot (*Polytelis swainsonii*), an EPBC listed vulnerable bird species. Habitat coincides with the Yellow Box – Red Gum Grassy Woodland patch (Umwelt, 2015);
- striped legless lizard (*Delma impar*), an EPBC listed vulnerable reptile species. Habitat occurs within approximately 17 ha of native and exotic grassland (Umwelt, 2015) and population estimates are between 200 and 400 (pers. comms. Michael Mulvaney, 4 January 2018); and

- perunga grasshopper (*Perunga ochracea*), a NC Act listed vulnerable invertebrate. This is a cryptic species which is difficult to survey. One grasshopper was recorded at the site in December 2017 (Canberra Nature Map, 2018).

3.2 Ecological Survey

In order to complete the assessment of the suitability of the North Mitchell Grasslands as an Offset Area under the Commonwealth Offsets Policy, a targeted ecological survey was undertaken on 10 January 2018.

The aims of the ecological survey were to:

- confirm the presence of natural temperate grassland within the Offset Area, based on the updated listing advice for the critically endangered ecological community (TSSC, 2016);
- map the extent of natural temperate grassland and golden sun moth habitat within the Offset Area; and
- assess the quality of natural temperate grassland and golden sun moth habitat.

The population of golden sun moth was not targeted as part of this survey. The flying season was finished across much of Canberra, with only a limited number of males still flying at some sites. This is not considered a major limitation as golden sun moth are known to occur at the site, and the offset calculations use habitat area as the primary metric for this species, due to the species' inherent seasonal fluctuations in population size being poorly understood.

An additional site visit with the aim of identifying further potential golden sun moth habitat was undertaken on 2 March 2018. This visit was targeted at identifying areas of native and mixed grassland that may provide additional habitat to that identified in the initial survey.

3.2.1 Methodology

3.2.1.1 Natural Temperate Grassland

The survey for natural temperate grassland was undertaken in accordance with the floristic value score (FVS) approach outlined in the EPBC Conservation Advice for the ecological community (TSSC, 2016).

Four 400 m² (generally 20 by 20 m) floristic plots were sampled throughout the Project Area to assess the vegetation type and condition present. These plots were located within areas previously identified as natural temperate grassland, and any new locations identified as being dominated by native grasses (**Figure 3.1**). Where possible, the floristic plots were located near to the locations sampled by Umwelt (2015), noting however that the plots must be located where the highest flora diversity occurs under the FVS approach.

Floristic plots were supported by a meandering search to delineate the extent of the natural temperate grassland. This was conducted at a fine scale, appropriate to the scale of the Project and as required to support the assessment. The meandering search also included four rapid vegetation assessments to assist the identification of natural temperate grassland (locations shown on **Figure 3.1**).

The quality of natural temperate grassland was assessed using the methodology and thresholds outlined in the EPBC Conservation Advice (TSSC, 2016). These thresholds are determined by the FVS, the presence of ‘indicator’¹ species, or native non-grass species.

3.2.1.2 Golden Sun Moth

Habitat for golden sun moth was mapped according to dominant vegetation type and presence of feed species (i.e. ‘C3’ grasses, namely wallaby grass (*Rytidosperma* spp.), spear grass (*Austrostipa* spp.), and Chilean needle grass (*Nassella neesiana*)).

Three 50 m step-point transects were undertaken within the areas previously identified as natural temperate grassland and golden sun moth habitat (**Figure 3.1**). Two additional 50 m step-point transects were undertaken within areas of native or mixed grassland. These step-point transects were used to identify the presence and cover of golden sun moth feed species and percent cover of bare ground.

The transect surveys were supported by a meandering search to delineate the extent of the golden sun moth habitat throughout the Offset Area.

¹ Typically disturbance sensitive, native species that are useful surrogates for conservation value. Full list of indicator species is maintained here: <http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=152&status=Critically+Endangered>



Image Source: Environment and Planning Directorate, ACT Government (2016)

0 100 200 400m
1:7 500

Legend

- Offset Area
- GSM Habitat Transects
- FVS Plot Locations
- Rapid Assessment Locations

FIGURE 3.1

Offset Area Survey Locations

3.2.2 Results

3.2.2.1 Natural Temperate Grassland

The vegetation mapping confirmed the presence of the three vegetation communities previously mapped.

Four patches of natural temperate grassland were identified, two of which were previously unmapped (Umwelt, 2015). One previously recorded patch is no longer discernible as native grassland and is dominated by Phalaris (*Phalaris aquatica*).

The remaining grassland is exotic, generally dominated by Phalaris, panic grass (*Panicum* spp.), Yorkshire Fog (*Holcus lanatus*), and wild oats (*Avena* spp.). This is consistent with previous vegetation mapping (Umwelt, 2015).

In total, 3.8 ha of natural temperate grassland was recorded (**Figure 3.2**). **Table 3.1** summarises the extent, FVS, and floristic quality of the natural temperate grassland identified using floristic plots. One new patch (0.43 ha) of natural temperate grassland was also identified through the rapid survey. The rapid results put the floristic quality of this patch as being similar to Plot 6.

Table 3.1 Natural Temperate Grassland Floristic Plot Results

Plot Number	Area (ha)	Indicator Species (No.)	Native Non-grass Species (No.)	FVS	Floristic Quality ¹
1	2.1	7	12	22.59	Very High
2		3	11	13.63	Very High
5	1	8	13	25.41	Very High
6	0.27	7	10	12.60	High

¹ Based on the Conservation Advice for natural temperate grassland (TSSC, 2016).

3.2.2.2 Golden Sun Moth

As with previous mapping (Umwelt, 2015), the 2018 surveys confirmed that golden sun moth habitat coincides with natural temperate grassland at the Offset Area. An additional 1.1 ha of native dominated grassland was identified along the eastern edge of the site which was also considered to represent golden sun moth habitat. As such, 4.9 ha of golden sun moth habitat was recorded (**Figure 3.2**).

The matrix between these patches of habitat was defined as exotic dominated or mixed grassland. At the time of survey, this area was dominated by Phalaris, and while it contained remnant native species, it did not contain an adequate cover of golden sun moth feed species to warrant being surveyed in detail.

3.2.2.3 Other MNES

In addition to the targeted surveys for natural temperate grassland and golden sun moth, the following MNES were recorded opportunistically:

- 21 Ginninderra peppercress plants, near floristic plot 1; and
- 6 Latham's snipe (*Gallinago hardwickii*) flushed from the dam in the south-east. Latham's snipe is listed as a marine and migratory species under the EPBC Act.



Image Source: Environment and Planning Directorate, ACT Government (2016)

0 100 200 400m
1:7 500

Legend

- Offset Area
- Natural Temperate Grassland - Very High
- Natural Temperate Grassland - High
- Golden Sun Moth Habitat - Direct
- Remediate and Rehabilitate

FIGURE 3.2

Proposed Offset Strategy for
Natural Temperate Grassland
and Golden Sun Moth

4.0 Proposed Offset

4.1 Offset Strategy Elements

The proposed strategy for the use of this site as an offset would have the following basic elements:

- Secure site as a direct offset, and protect under a conservation land use zoning (apply the Pc: Nature Reserve Overlay – **Section 5.2**).
- Management of site for habitat improvement and long term resilience of MNES (**Section 4.5**):
 - weed and pest control;
 - review of grazing regimes; and
 - management of biomass.
- Investment in site infrastructure (fencing, access tracks etc.) (**Section 5.3**).
- Remediation and reseedling of spoil site on southern edge of site (**Section 4.4.4**).

4.2 Offset Analysis

This section assesses the suitability of the proposed offset strategy against the Commonwealth Offsets Policy and Guide. This has been developed with reference to the EPBC Act Offset Policy and Guide and the ecology and habitat requirements of each threatened species considered.

This assessment includes consideration of the type, importance, and size of the habitat being impacted and the scale of improvement and averted loss as a result of the offset.

The benefit of an offset should last for the duration of the impact; in this case, as the loss of MNES habitat would be permanent, the offset would require protection in perpetuity. The offset should deliver an overall conservation outcome that improves the viability of the protected matter. The offset should also be delivered in an efficient, timely, transparent, scientifically robust, and reasonable manner and have transparent governance arrangements.

This offset strategy identifies the risk of the offset not succeeding. An associated offset management plan would provide measures to monitor and recover conditions should values be found to be decreasing.

The EPBC Act Offset Guide outlines the key considerations for determining the habitat quality for threatened species. This is summarised in **Figure 4.1** below.

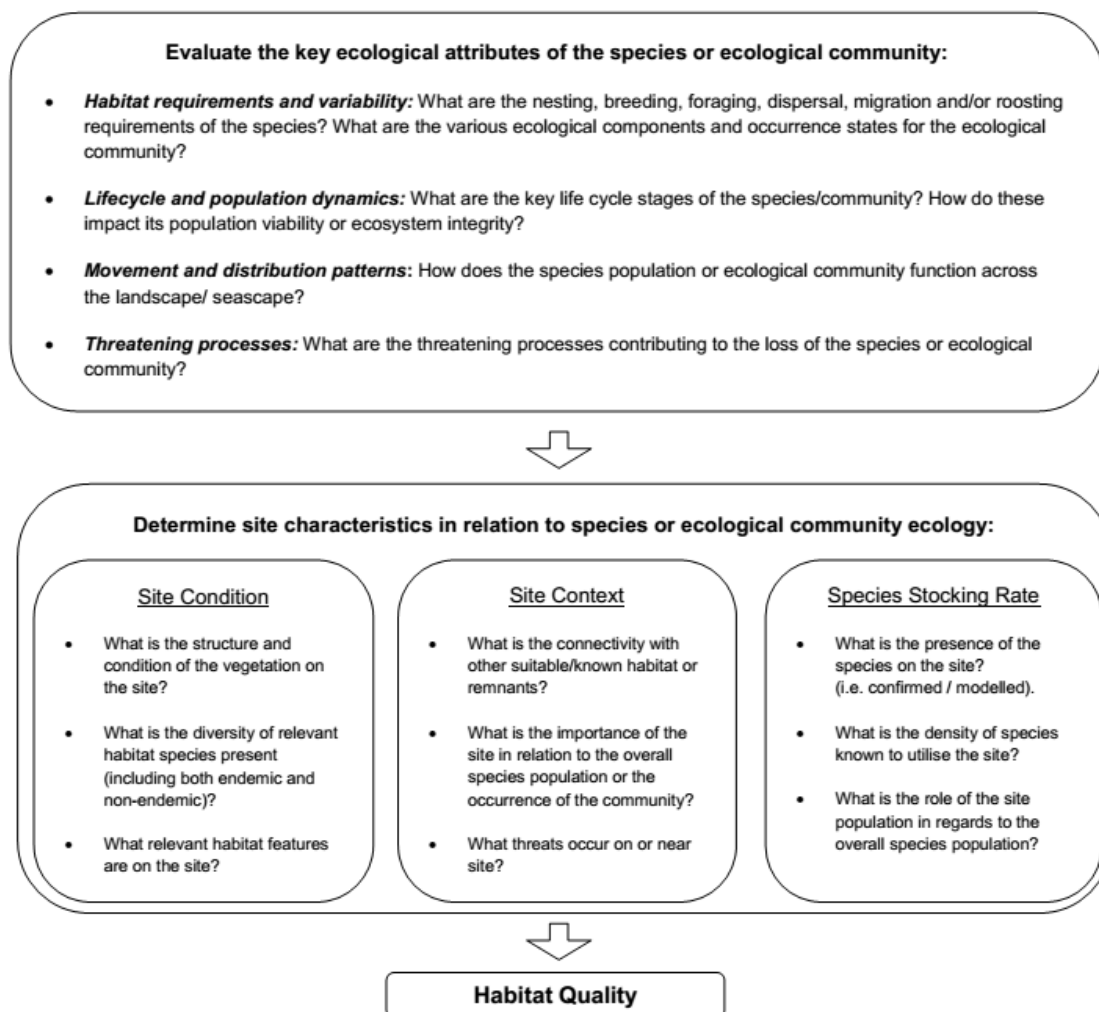


Figure 4.1 Determining Habitat Quality for an Offset (SEWPaC, 2012)

4.3 Natural Temperate Grassland

4.3.1 Metrics

The parameters used to determine the habitat quality score for natural temperate grassland are based on two site characteristics as defined in the figure above: site condition and site context. Species stocking rate is not relevant for natural temperate grassland.

Parameters selected are discussed in detail below.

Site Condition

Site condition scores (**Table 4.1**) for natural temperate grassland were based on listing criteria for the ecological community and represent a combination of:

- species diversity (including native grasses and forbs);
- presence of disturbance tolerant/sensitive species (reflecting disturbance history); and
- presence and cover of weeds.

Table 4.1 Site Condition Values for Natural Temperate Grassland

Score	Rationale
1	Low diversity of native species (mostly disturbance tolerant native grasses), very low native forb diversity, and low cover of introduced perennial species.
2	Moderate diversity and cover of native species, including disturbance tolerant species (but excluding disturbance sensitive or moderately sensitive species).
3	Moderate diversity and cover of native species, including disturbance sensitive species.
4	High diversity and cover of native species, including disturbance sensitive species and/or moderately sensitive species. Includes high diversity of forbs.
5	Native cover only, reflecting biological diversity prior to European settlement. Community dominated by perennial tussock grasses with wide variety of other herbs.

Site Context

Site context is comprised of a number of factors which create an understanding of the relative importance of the subject site and threats which might act against future potential quality.

Site context, in this assessment, has included consideration of:

- patch size;
- patch shape;
- isolation and/or connectivity; and
- threats.

The approach for patch size relates specifically to natural temperate grassland, where the minimum size for assessing the presence of the community is 0.1 hectares. The size classes have been developed to be reflective of the average size of patches present in the ACT (**Table 4.2**).

Shape complexity has been used to help determine the extent that external effects will influence a patch. A simple circular or square reserve will have a lower shape complexity and be less influenced by external effects (lower edge:core ratio), than an irregular or convoluted shaped reserve. This has been calculated using the following formula:

$$Shape\ Index = \frac{Perimeter(m)}{2\sqrt{\pi \times Area(sq\ m)}}$$

The approach for connectivity has been developed on the principle that less distance between patches is preferable, and the majority of fauna species utilising a grassland environment would generally have lower capacity to travel across unsuitable habitat and barriers than, for instance, more mobile woodland species. This metric also considers the matrix around the patch, with native pasture or grassland being more permeable than exotic grassland, trees, or development (such as buildings and roads).

Consideration of threats has been based on the presence and intensity of key threats, as identified in EPBC Act Listing Advice for natural temperate grassland. The extensive list of threats provided by the guidance material covers a wide range of land use activities and processes that are the consequence of three main categories of threat as follows:

- Land use and management change:
 - Grazing, pasture improvement and cropping;
 - Urban development and infrastructure;
- Conflicting management practices:
 - Fire regimes;
 - Soil disturbance, altered salinity and acidity; and
 - Altered hydrology.
- Degrading processes:
 - Exotic species (including pasture species).

In summary, the site context scores for natural temperate grassland as developed by this assessment are presented in **Table 4.2**.

Table 4.2 Site Context Scores for Natural Temperate Grassland

Score	Rationale
Patch Size	
1	Patch is between 0.1 and 1 ha. The minimum size for assessing the presence of natural temperate grassland under the EPBC Act is 0.1 ha.
2	Patch is less than 10 ha.
3	Patch is greater than 10 ha. It is assumed a large patch of 10 hectares or more would maintain its viability over the long term.
Patch Shape	
1	Highly irregular shape.
2	A moderately irregular shape.
3	A simple shape approaching a square or circle in configuration.
Isolation / Connectivity	
1	More than 200 m to the closest patch of natural temperate grassland. This is primarily based on the potential for movement of grassland species, and transfer of genetic material. Separated by exotic grassland, trees, or development.
2	Less than 200 m but more than 20 m between patches would indicate some potential for movement between sites. Separated by native pasture or grassland, no impermeable barriers.
3	20 m or less separation would indicate a high level of connectivity between patches.
Surrounding Threats	
0	Threat absent.
1	Low intensity threat (2 or less threats).
2	High intensity threat (3 or more threats).

4.3.2 Calculations

The following table demonstrates the performance of the proposed natural temperate grassland offset against the Commonwealth's offset calculator. A copy of the Commonwealth offset calculator is provided in **Appendix A**.

Table 4.3 Performance of the Proposed Natural Temperate Grassland Offset

Variable	Value	Rationale						
Summary of Quality								
Area of Habitat (Impact)	0.28 ha	Direct impact to 0.13 ha and indirect impact to up to 0.16 ha of natural temperate grassland of varying qualities. The condition and areas are from Umwelt (2017) as summarised in Table 2. 2 .						
		ID	Area (ha)	Site Condition	Site Context			
					Isolation	Shape	Threats	Size
		5	0.11	2/5 Moderate diversity and cover of native species, including disturbance tolerant species (but excluding disturbance sensitive or moderately sensitive species).	3/3 <20m from other patches	1/3 Very irregular	2/2 High threats	1/3 <1 ha
		10	0.012	2/5 Moderate diversity and cover of native species, including disturbance tolerant species (but excluding disturbance sensitive or moderately sensitive species).	3/3 <20m from other patches	1/3 Very irregular	2/2 High threats	1/3 <1 ha
		12	0.01	3/5 Moderate diversity and cover of native species, including disturbance sensitive species.	2/3 <200m from other patches	2/3 Moderate irregularities	2/2 High threats	1/3 <1 ha
		10 (Indirect)	0.1	2/5 Moderate diversity and cover of	3/3 <20m from	1/3 Very irregular	2/2 High threats	1/3 <1 ha

Variable	Value	Rationale						
				native species, including disturbance tolerant species (but excluding disturbance sensitive or moderately sensitive species).	other patches			
		12 (indirect)	0.04	3/5 Moderate diversity and cover of native species, including disturbance sensitive species.	2/3 <200m from other patches	2/3 Moderate irregularities	2/2 High threats	1/3 <1 ha
		13 (indirect)	0.02	3/5 Moderate diversity and cover of native species, including disturbance sensitive species.	2/3 <200m from other patches	2/3 Moderate irregularities	2/2 High threats	1/3 <1 ha
Area of Habitat (Offset)	3.8 ha	Proposed direct offset of 3.8 hectares of natural temperate grassland at the North Mitchell Grassland.						
		ID	Area (ha)	Site Condition	Site Context			
					Isolation	Shape	Threats	Size
		1	0.27	3/5 Moderate diversity and cover of native species, including disturbance sensitive species.	2/3 <200m from other patches	2/3 Moderate irregularities	2/2 High threats	1/3 <1 ha
		2	2.1	4/5 High diversity and cover of native species, including disturbance sensitive species and/or moderately sensitive species. Includes high diversity of forbs.	2/3 <200m from other patches	1/3 Very irregular	2/2 High threats	2/3 <10 ha
		3	1	4/5 Moderate diversity and cover of native species, including disturbance sensitive species.	2/3 <200m from other patches	2/3 Moderate irregularities	2/2 High threats	2/3 <10 ha

Variable	Value	Rationale																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
		4	0.43	3/5 Moderate diversity and cover of native species, including disturbance sensitive species.	2/3 <200m from other patches	2/3 Moderate irregularities	2/2 High threats	1/3 <1ha																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
Quality (Impact)	5	A weighted quality score of 5 has been determined by considering the site condition and context of the individual impact areas, weighted by the size of the patches. This data has been transparently shown in the above section.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Quality (Offset)	7	A weighted quality score of 7 has been determined for the offset areas by considering the site condition and context of the individual impact areas, weighted by the size of the patches.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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Variable	Value	Rationale
		years due to its ecological values, therefore risk of development is low, however it has not yet been placed under any formal protection nor is being actively managed. The extent of grassland has been shown to have decreased substantially since its initial mapping (refer to Section 3.1).
Risk of loss with offset	1%	Management actions implemented as a result of the transfer to offset would include a management framework designed to strategically address natural temperate grassland. Only unforeseeable factors would result in the loss from the habitat offset site.
Time until ecological benefit	10	No direct commitments to improvement have been made for natural temperate grassland, other than the mitigation of surrounding threats. Improvements would be expected as a flow on from activities such as weed control and biomass management in the habitat improvement area (refer to Section 4.4.3). Within 5 years, natural temperate grassland would experience reduced threats due to the actions targeting golden sun moth (Section 4.4.2), however this intensive management is targeted to the boundaries of the patches. Mitigation of larger, site-wide threats to the community such as African lovegrass may take longer than this initial period.
Future quality without offset	5	<i>Future quality without offset</i> is the estimate of the habitat quality based on a business as usual scenario – that is, considering current management practices, use of the site and historic trends for the quality of habitat on the site. Without the proposed offset, the calculations predict a decline in the quality of natural temperate grassland. Without the offset, and the management of the sites as nature reserve, the site is expected to experience a loss of native species diversity, loss of habitat structure and increase in weed abundance. This is based on demonstrable trends. The drop in quality from 7 to 5 is based on the following (detailed in the table below): - Site condition from 4 to 2: - Original condition score of 4 is defined by: High diversity and cover of native species, including disturbance sensitive species and/or moderately sensitive species. Including high diversity of forbs. - Future condition score of 2 is predicted by: Moderate diversity and cover of native species, including disturbance tolerant species (but excluding disturbance sensitive or moderately sensitive species). - Based on the threat of African lovegrass creating a dense monoculture within areas of natural grassland, and the continued threat of Phalaris, this is considered a reasonable prediction. - Shape complexity from 2 to 1: this predicts a further increase in the shape index (edge: core) of the habitat patches from weed encroachment.
Future quality with offset	7	<i>Future quality with offset</i> is the estimated habitat quality at the same future time incorporating the proposed offset activities. The management of land as nature reserve will result in a higher level of duty of care, in addition to increased funding for management activities. As the patches are currently of high quality, no improvement of condition has been proposed. The value of the offset will be in the retention of existing patches at their current state, and removal of threats.

Variable	Value	Rationale																																							
		Quality increase Quality decrease <table> <tr> <th></th><th colspan="2">Raw (weighted scores by area)</th></tr> <tr> <th></th><th>Offset (without)</th><th>Offset (with)</th></tr> <tr> <td>Site Condition</td><td>2</td><td>4</td></tr> <tr> <td>Site Context</td><td>6</td><td>8</td></tr> <tr> <td>Isolation</td><td>2</td><td>2</td></tr> <tr> <td>Shape</td><td>1</td><td>1</td></tr> <tr> <td>Threats</td><td>2</td><td>0</td></tr> <tr> <td>Size</td><td>2</td><td>2</td></tr> </table> <table> <tr> <th></th><th colspan="2">Transformed (scores out of 10)</th></tr> <tr> <th></th><th>Offset (without)</th><th>Offset (with)</th></tr> <tr> <td>Site Condition</td><td>4</td><td>8</td></tr> <tr> <td>Site Context</td><td>5</td><td>7</td></tr> <tr> <td>Quality</td><td>5</td><td>7</td></tr> </table>		Raw (weighted scores by area)			Offset (without)	Offset (with)	Site Condition	2	4	Site Context	6	8	Isolation	2	2	Shape	1	1	Threats	2	0	Size	2	2		Transformed (scores out of 10)			Offset (without)	Offset (with)	Site Condition	4	8	Site Context	5	7	Quality	5	7
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Site Context	5	7																																							
Quality	5	7																																							
Confidence in result	80%	Confidence in the result is high. The ACT Government has already committed to \$1.5 million of funding in the 2018/19 Budget for the establishment of the proposed offset. This will include site establishment, initial management including weed and biomass control, and rehabilitation of the spoil site. Ongoing funding will be secured through the ACT Budget Process, with Treasury understanding the importance and requirements of Environmental Offsets. The offset will be managed by the ACT Government's Offset Team. This team is dedicated to managing, monitoring and reporting on offsets established under the EPBC Act. They have an excellent track record. This offset strategy has been developed in consultation with both the Offsets Team and the ACT Government Conservation Branch, and it is considered that the commitments are achievable and realistic.																																							
Overall Performance	229%	This offset represents a surplus to what is required to offset the impact. It is considered to represent a strategically significant offset for natural temperate grassland.																																							

4.4 Golden Sun Moth

4.4.1 Metrics

The parameters used to determine the habitat quality score for golden sun moth are based on three site characteristics as defined in **Figure 4.1**: site condition, site context, and stocking rate.

Parameters selected are discussed in detail below.

Site Condition

Site condition scores for golden sun moth were based on listing criteria for the ecological community, and represent a combination of:

- structure and condition of vegetation on site (native grassland or pasture);
- presence of forage species; and
- presence and cover of weeds.

The following site condition criteria have been developed specifically for golden sun moth.

Vegetation Structure

Vegetation structure is a reflection of the habitat type (i.e. grassland or open woodland) and the amount of inter-tussock space available (i.e. rank or open grassland). Golden sun moth typically occupies grassland; therefore, grassland structures score higher than woodland.

The species also requires inter-tussock space in which the females bask to attract males during breeding (i.e. flying) season, therefore, open grassland scores higher than rank grassland (DEWHA, 2009a). The range of vegetation structure scores is shown in **Table 4.4**. Any vegetation type that does not fit into one of these categories is not considered to be golden sun moth habitat from a structural perspective and is highly unlikely to support the species.

Table 4.4 Vegetation Structure Sub-Scores for Golden Sun Moth

Score	Rationale
1	Grassy open woodland or shrubland. It is the least suitable of habitats that are occupied by golden sun moth.
2	Rank (i.e. overgrown) grassland.
3	Open grassland. Provides optimal habitat structure.

Vegetation Condition

The vegetation condition sub-score considers the proportion of exotic to native species and the availability of golden sun moth forage species at the site. Scores are determined based on dominance to give an overall impression of the types of grass species that occur. Exotic species dominance is ranked lowest as it is considered to be a sign of poor ecosystem health and a detriment to biodiversity as a whole.

Sites with mixed dominance, or dominance of native non-forage species (e.g. kangaroo grass) are given an equal score. This is considered appropriate as it is believed that the presence (not dominance) of forage

species is enough to provide habitat for golden sun moth in some circumstances. Despite this, sites with a dominance of forage species are ranked the highest as they provide the most habitat resources for golden sun moth and are considered to be of a higher quality. The range of habitat vegetation scores that may be assigned is shown in **Table 4.5**.

Table 4.5 Vegetation Condition Sub-Scores for Golden Sun Moth

Score	Rationale
1	Dominated by exotic species.
2	Mixed exotic and native forage species dominance.
3	Dominated by native forage species (e.g. short wallaby grass and spear grasses).

Forage Species Diversity

The forage species diversity sub-score demonstrates the species richness (i.e. the number of species present at a site) and the evenness of the percentage cover for each species. It is important to note the difference between species richness (total number of species present) and species diversity (a function of species richness and abundance). The range of scores presented here is outlined in **Table 4.6**.

Table 4.6 Forage Species Diversity Sub-Scores for Golden Sun Moth

Score	Rationale
1	Low species diversity.
2	Medium species diversity.
3	High species diversity.

Site Context

As above, site context (**Table 4.7**) has included consideration of:

- patch size;
- patch shape;
- isolation and/or connectivity; and
- threats.

Specifically for golden sun moth, the following site context values have been developed.

Patch size is based on the Significant Impact Guidelines for the species:

- Patch is less than 1 hectare. There is not considered to be a minimum patch size for golden sun moth habitat, however areas less than 1 hectare are considered very small, and at high risk from external influences and catastrophic events;
- Patch is between 1 and 10 hectares. The Significant Impact Guidelines refer to small or fragmented habitat area as <10 hectares; and

- Patch is greater than 10 hectares. The Significant Impact Guidelines refer large or contiguous habitat as >10 hectares.

The approach for connectivity has been developed on the understanding of golden sun moth's limited ability to disperse. Females are not able to traverse over any non-habitat substrate due to their inability or poor flying ability (ACT Government 2005), and as such any break in habitat connectivity is considered an absolute barrier that females cannot cross. The distance that males will traverse depends upon the substrate they are travelling over. A substrate that consists of non-habitat grassland will be permeable for male golden sun moths up to a distance of 200 metres (ACT Government 2005); whilst a substrate of concrete, water, bare ground or the like is taken on the basis of observation to be permeable up to a distance of 15 metres. Beyond this distance they are considered absolute barriers and male moths will not cross. In addition, features such as trees, shrubs, or buildings are an absolute barrier for male golden sun moth (DEWHA 2009b).

Based on this, any separation in habitat greater than 200 metres is considered likely to represent separate populations. The matrix surrounding each patch has also been considered, with native pasture or grassland matrix being considered of higher value than exotic grassland or development.

- 20 metres or less separation would indicate a high level of connectivity between patches;
- Less than 200 metres but more than 20 metres between patches would indicate some potential for movement between habitat;
- More than 200 metres to the closest patch of habitat. This distance is considered a barrier to movement.

Consideration of threats has been based on the presence and intensity of key threats, as identified in Significant Impact Guidelines for golden sun moth and the species' Conservation Advice. The extensive list of threats provided by the guidance material covers a wide range of land use activities and processes that are the consequence of four main categories of threat as follows:

- Land use and management change:
 - o Grazing, pasture improvement, cropping, ploughing;
 - o Overstocking;
 - o Urban development and infrastructure;
- Conflicting management practices:
 - o Fire regimes;
- Degrading processes:
 - o Exotic species (including pasture species);
 - o Loss of inter-tussock spaces;
 - o Soil compaction;
 - o Drought and climate change.

Table 4.7 Site Context Scores for Golden Sun Moth

Score	Rationale
Patch Size	
1	Patch is less than 1 ha
2	Patch is less than 10 ha
3	Patch is greater than 10 ha
Patch Shape	
1	Highly irregular shape.
2	A moderately irregular shape.
3	A simple shape approaching a square or circle in configuration.
Isolation / Connectivity	
1	More than 200 m to the nearest golden sun moth population would indicate the population is isolated and has no capacity for natural recolonisation. It should be noted however that given females are very poor fliers, recolonisation even between very closely associated sites is potentially unlikely. Regardless, this factor is considered important as the ability for males to move between occupied patches is an indication of connectivity and the potential for genetic interchange.
2	Less than 200 m but more than 20 m between patches would indicate some potential for movement between sites however this may also be limited by other factors that golden sun moth find insurmountable
3	20 m or less separation across suitable ground would indicate ready potential for movement of males between patches.
Surrounding Threats	
0	Threat absent.
1	Low intensity threat (2 or less threats).
2	High intensity threat (3 or more threats).

Species Stocking Rate

Stocking rates are based on observations of flying moths during targeted surveys. Although there is presently insufficient information to fully explain the relationship between flying moth numbers and population size, it is considered the most appropriate method for representing stocking rates.

Targeted surveys have not recently been completed during the appropriate flying season at this site, so a conservative assumption based on historical results has been made.

Table 4.8 Species Stocking Rates for Golden Sun Moth

Quality	Rationale
0	No records in potential habitat.
1	Very low numbers of golden sun moth observed during surveys (1 or less per minute)
2	Low number of moths observed (5 or less per minute)
3	Low to Moderate number of moths observed (5 - 10 per minute)
4	Moderate to high number of moths observed (10 - 20 per minute)
5	High numbers of moths observed (20 or more per minute)

4.4.2 Calculations – Existing Habitat

The following table demonstrates the performance of the proposed golden sun moth offset against the Commonwealth's offset calculator. A copy of the Commonwealth offset calculator is provided in **Appendix A**.

Table 4.9 Performance of the Proposed Golden Sun Moth Offset

Variable	Value	Rationale							
Summary of Quality									
Area of Habitat (Impact)	3.08 ha	Direct impact to 2.64 hectares and indirect impacts to up to 0.44 hectares of golden sun moth habitat of varying qualities, as described in Umwelt (2017) and Table 2.4 .							
		ID	Area (ha)	Site Condition	Site Context				Stocking Rate
					Isolation	Shape	Threats	Size	
		1	0.35	3/5 Open grassland, mixed condition, low diversity.	3/3 <20m between patches	1/3 Very irregular	2/2 High threats	2/3 <10 ha	4/5 Moderate
		2	0.25	3/5 Open grassland, mixed condition, low diversity.	3/3 <20m between patches	1/3 Very irregular	2/2 High threats	2/3 <10 ha	4/5 Moderate
		3	0.04	3/5 Open grassland, mixed condition, low diversity.	3/3 <20m between patches	1/3 Very irregular	2/2 High threats	2/3 <10 ha	4/5 Moderate
		4	2	3/5 Open grassland, mixed condition, low diversity.	3/3 <20m between patches	1/3 Very irregular	2/2 High threats	2/3 <10 ha	4/5 Moderate
		5 (Indirect)	0.13	2/5 Open grassland, exotic dominated, low diversity.	3/3 <20m between patches	1/3 Very irregular	2/2 High threats	2/3 <10 ha	2/5 Low

Variable	Value	Rationale							
		6 (Indirect)	0.31	3/5 Open grassland, mixed condition, low diversity.	3/3 <20m between patches	1/3 Very irregular	2/2 High threats	2/3 <10 ha	4/5 Moderate
Area of Habitat (Offset)	4.9 ha	Proposed direct offset of 4.9 ha of natural temperate grassland and native pasture at the North Mitchell Grassland.							
		ID	Area (ha)	Site Condition	Site Context				Stocking Rate
					Isolation	Shape	Threats	Size	
		1	0.27	5/5 Open grassland, native dominated, high diversity	2/3 <200m from other patches	2/3 Moderate irregularities	2/2 High threats	1/3 <1 ha	2/5 Low
		2	2.1	5/5 Open grassland, native dominated, high diversity	2/3 <200m from other patches	2/3 Moderate irregularities	2/2 High threats	2/3 <10 ha	2/5 Low
		3	1	5/5 Open grassland, native dominated, high diversity	2/3 <200m from other patches	1/3 Very irregular	2/2 High threats	2/3 <10 ha	2/5 Low
		4	0.43	5/5 Open grassland, native dominated, high diversity	2/3 <200m from other patches	2/3 Moderate irregularities	2/2 High threats	1/3 <1ha	2/5 Low
		5	1.1	4/5 Open grassland, native dominated, low diversity	2/3 <200m from other patches	2/3 Moderate irregularities	2/2 High threats	2/3 <10ha	2/5 Low
Quality (Impact)	7	A weighted quality score of 7 has been determined by considering the site condition, context, and stocking rates of the impact areas, weighted by the size of the patches. This data has been transparently shown in the above section.							
Quality (Offset)	6	A weighted quality score of 6 has been determined for the offset area by considering the site condition, context, and stocking rates of the individual impact areas, weighted by the size of the patches. A conservative species stocking rate of 'low' has been applied.							

Variable	Value	Rationale																																													
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Time over which loss is averted	20	This is the maximum time period over which the guide is designed to function, it is appropriate for permanent impacts.																																													
Risk of loss without offset	5%	There are a number of factors that could influence the risk of loss of a site, including: • presence and strength of formal protection mechanisms currently in place on the proposed site (e.g. zoning, restrictive covenants or state vegetation clearing laws); • presence of pending development applications, mining leases or other activities on the proposed offset site that indicate development intent and likelihood; and • average risk of loss for similar sites. The risk of loss (distinct to the future quality without offset) is considered to be low for this site, as the site has been proposed to be used as an offset for a number of years due to its ecological values, therefore risk of development is low, however it has not yet been placed under any formal protection nor is being actively managed.																																													
Risk of loss with offset	1%	Management actions implemented as a result of the transfer to offset would include a management framework designed to strategically address golden sun moth. Only unforeseeable factors would result in the loss from the habitat offset site.																																													
Time until ecological benefit	5	This assessment is considerate of the time that it would take to see a measurable improvement in quality of the existing golden sun moth habitat patches with active management. As improvement targets for this portion of the offset are based on the removal of threats, particularly weeds and biomass control, initial improvements with site establishment funding could be achieved quickly. As discussed below, this does not include the increase of condition (i.e. golden sun moth feed species), rather the increase of patch size through improved connectivity and permeability.																																													

Variable	Value	Rationale
Future quality without offset	3	<i>Future quality without offset</i> is the estimate of the habitat quality based on a business as usual scenario – that is, considering current management practices, use of the site and historic trends for the quality of habitat on the site. The extent of habitat has been shown to have decreased substantially since its initial mapping – a decline of 75% over 9 years (refer to Section 3.1), due to just the absence of active management. Without the proposed offset, the calculations predict a decline in the extent of golden sun moth habitat. Without the offset, and the management of the sites as nature reserve, the site is expected to experience a loss of habitat structure and increase in weed abundance, particularly due to the presence of <i>Phalaris</i> in between habitat patches. This vegetation is not conducive to golden sun moth, and as such, any increases in its extent reduces the permeability and suitability of the environment for golden sun moth. The presence of a threatening weed (African lovegrass (<i>Eragrostis curvula</i>)) has also been identified at the boundary of the site. African lovegrass is considered to represent a serious threat to natural grassland ecosystems. The species is aggressive; drought and frost tolerate; and is capable of invading natural temperate grassland and suppressing native groundcover (ACT Government 2005), while forming a dense monoculture. As a C4 grass, it does not provide foraging opportunities for golden sun moth (as Chilean needlegrass does). The threat of African lovegrass is highlighted in many current management plans and conservation listings, including but not limited to: - Golden sun moth SPRAT profile: “In the ACT, the following perennial and highly invasive weed species are of particular concern and are all the subject of weed control activities by land management agencies: African Lovegrass (<i>Eragrostis curvula</i>), etc.” - ACT Environmental Weeds Operations Plan for 2017-18: “African lovegrass and other invasive grasses are recognised as a critical threat to biodiversity and agriculture”. In the WOP, African lovegrass is listed as a ‘High Priority Project’ for the North Mitchell Grasslands. This is considered to be a very high risk factor for the site. The drop in quality from 6 to 3 is based on the following (detailed in the table below): - Site condition from 5 to 2: - Original condition score of 5 is determined by: open grassland / native dominated / high habitat species diversity. - Future condition score of 2 is predicted by: rank grassland / exotic dominated / low habitat species diversity. - Based on the threat of African lovegrass creating a dense monoculture within areas of natural grassland, and the continued threat of <i>Phalaris</i>, this is considered a reasonable prediction. - Shape complexity from 2 to 1: this predicts a further increase in the shape index (edge:core) of the habitat patches from weed encroachment; - Stocking rate from 2 to 1: this predicts a potential drop from low to very low numbers as a result of reduction in C3 grasses which provide habitat for the species.
Future	8	<i>Future quality with offset</i> is the estimated habitat quality at the same future time incorporating the proposed offset activities.

Variable	Value	Rationale																																													
quality with offset		The management of land as nature reserve will result in a higher level of duty of care, in addition to increased funding for management activities. The improvement of quality will include targeted actions to manage weeds, overgrazing (by stock, native and pest animals), and biomass control. Some rehabilitation works are also proposed which are expected to increase the extent of habitat on site. The site context metrics are also expected to improve with the management of the surrounding exotic vegetation to increase size and decrease shape complexity. The details of these actions are described in Section 3.3.4. The increase in quality from 6 to 8 is based on the following (detailed in the table below): - Stocking rate from 2 to 3: this predicts a potential increase from low to moderate numbers as a result of improved connectivity and increased area of habitat patches. While stocking rate is a difficult metric to measure, and it is unknown how long exactly it will take for on-ground actions to result in changes to moth numbers, it is expected in this instance to reflect an improved environment for the moths to fly and breed. - Threats from 2 to 0: The proposed management actions will eliminate the immediate threats acting on the known patches of habitat. Site wide suppression of threats on the site relate to the long-term habitat improvement targets in Section 4.4.3. - Size from 1 to 2: The improvement of habitat directly surrounding the known patches of habitat (i.e. the Management Buffer Zone) will effectively increase the size of each patch. This does not include the entire Habitat Improvement Zone, (which has a longer timeframe of 15 years). The management of biomass levels between patches will improve connectivity and allow the separate smaller patches to function as a whole larger area of habitat.																																													
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Quality	3	8																																													
Confidence in result	80%	Confidence in the result is high. The ACT Government has already committed to \$1.5 million of funding in the 2018/19 Budget for the establishment of the proposed offset. This will include site establishment, and initial management including weed and biomass control, and rehabilitation of the spoil site. Ongoing funding will be secured through the ACT Budget Process, with Treasury understanding the importance and requirements of																																													

Variable	Value	Rationale
		Environmental Offsets. The offset will be managed by the ACT Government's Offset Team. This team is dedicated to managing, monitoring and reporting on offsets established under the EPBC Act. They have an excellent track record. This offset strategy has been developed in consultation with both the Offsets Team and the ACT Government Conservation Branch.
Overall Performance	64%	This offset does not represent the required 90% direct offset for the proposed impact.

4.4.3 Calculations – Habitat Improvement

This site does not immediately offer the required direct offset for the impacted golden sun moth, however, a program of habitat improvement is proposed for the currently exotic dominated matrix between the known golden sun moth habitat patches. The method of valuing the currently unoccupied habitat in **Table 4.10** was developed in consultation with DoEE (pers. comms. Zac Neulinger, 2 March 2018). A copy of the Commonwealth offset calculator is provided in **Appendix A**.

Table 4.10 Performance of the Proposed Golden Sun Moth Offset – Habitat Improvement Areas

Variable	Value	Rationale							
Summary of Quality									
Area of Habitat (Impact)	3.08 ha	As defined in Table 4.9.							
Area of Habitat (Offset)	6 ha	Proposed direct offset of up to 6 ha of grassland at the North Mitchell Grassland for habitat improvement.							
		ID	Area (ha)	Site Condition	Site Context				Stocking Rate
					Isolation	Shape	Threats	Size	
		1	6	2/5 Rank grassland, exotic dominated, absent diversity	3/3 <20m from other patches	2/3 Moderate irregularities	2/2 High threats	3/3 >10 ha (total patch size)	0/5 Absent
Quality (Impact)	7	A weighted quality score of 7 has been determined by considering the site condition, context and stocking rates of the impact areas, weighted by the size of the patches. This data has been transparently shown in the above section (Table 4.9).							

Variable	Value	Rationale																																																
Quality (Offset)	0	The metrics developed for this project recognise the value of this area as currently a ‘4’ however based on discussions with DoEE, a value of ‘0’ has been applied. Despite this, it is considered important to highlight that the grassland between patches of ‘occupied habitat’ (natural temperate grassland and native grassland) can represent marginal habitat for golden sun moth. While not providing breeding or foraging opportunities, it allows the movement of the species between patches. The permeability of the site (i.e. the absence of any absolute barriers to movement to the species) can be considered in the offset calculations, as defined in Table 4.7.																																																
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Time over which loss is averted	20	This is the maximum time period over which the guide is designed to function, it is appropriate for permanent impacts.																																																
Risk of loss without offset	0%	As this area does not currently represent habitat, there is no risk of loss.																																																
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Time until ecological benefit	15	A long time period to meet habitat improvement targets has been applied to ensure this is an achievable target.																																																
Future quality without offset	0	Without the proposed offset, this area will remain as exotic grassland, not representing habitat for the species.																																																
Future quality with offset	5	<i>Future quality with offset</i> is the estimated habitat quality at the same future time incorporating the proposed offset activities. The management of land as nature reserve will result in a higher level of duty of care, in addition to increased funding for management																																																

Variable	Value	Rationale																																	
		activities. The improvement of quality will primarily include management of grazing regimes to reduce biomass and targeted weed control for Phalaris and other weeds of concern. The future quality commitment is considered achievable, as it includes the improvement of exotic dominated, rank grassland, to mixed native and exotic, open grassland. The improvements in context relate to the overall benefit to the site of managing the matrix between known patches.																																	
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<i>Shape</i>	2																																		
<i>Threats</i>	1																																		
<i>Size</i>	3																																		
Transformed (scores out of 10)																																			
	Offset (with)																																		
Site Condition	3																																		
Stocking Rate	2																																		
Site Context	9																																		
Quality	5																																		
Confidence in result	50%	Confidence in the result is moderate due to the inherent risks associated with restoration type activities. However, as the area was up until recently native dominated, and the commitments generally relate to the improvement of structure and prevention of further weed infestation, this is expected to be a conservative and achievable target. Furthermore, this offset strategy has been developed in consultation with both the Offsets Team and the ACT Government Conservation Branch, it is considered that the proposed approach to habitat restoration activities is achievable.																																	
Overall Performance	26%	In combination with the 64% direct offset in Section 4.4.2, this meets 90% of the required direct offset for golden sun moth. In addition, an indirect offset is being proposed.																																	

4.4.4 Indirect Offsets for Golden Sun Moth

In addition to the direct offset for golden sun moth at North Mitchell Grasslands, other compensatory measures are being proposed. These are described below.

4.4.4.1 Rehabilitation at Impact Site

A detailed Landscape Planting Plan has been developed for the Impact Site, which will see disturbed areas that are not hardstand, levelled and revegetated with native 'C3' grasses. As native 'C3' grasses provide fodder for golden sun moth, this will enable the moths to recolonise these areas, and result in the restoration of habitat consistent with, or in higher quality than that removed.

Near-annual surveys of golden sun moth at the impact site have been undertaken since 2012 (Rowell, 2012; Umwelt, 2014; Umwelt, 2016; Umwelt, 2017); and have consistently demonstrated an increased range of the species each year, into disturbed roadside environments. Based on these observations the species has the propensity for expanding into new habitat at this site, it is considered highly likely that with appropriate landscaping, the area disturbed by roadworks could be restored into appropriate habitat for the species.

Appendix B shows the proposed landscaping plan.

This indirect offset is expected to benefit golden sun moth in three ways:

- Firstly, by rehabilitating the roadside verges of Dudley Street with 'C3' grasses, up to 2.2 ha of golden sun moth habitat impacted by the works would be restored.
- Secondly, the activity, whether successful or unsuccessful, will help to contribute to the understanding of golden sun moth habitat rehabilitation, particularly in roadside environments. This will help to increase the ACT Government, and DoEE's confidence in proposing and approving rehabilitation actions for the species.
- Finally, by reseeding with native grasses, and including weed control in the post-construction maintenance program, there is potential that the infestation of Chilean needlegrass, which is currently threatening natural temperate grassland patches, can be contained. While Chilean needlegrass currently appears to provide habitat for golden sun moth, there are no long term studies to demonstrate the resilience and longevity of the species utilising this type of habitat.

The proposed approach to ensure the success of this measure is as follows:

1. flatten and seed disturbed areas using a mix of native 'C3' grasses (golden sun moth feed species);
2. include weed management in post-construction maintenance program for 12 months, or until grasses established;
3. undertake annual combined golden sun moth and weed surveys for up to 5 years to confirm golden sun moth are utilising the area during the flying season. Once moths are observed flying in rehabilitated areas, monitoring can cease; and
4. prepare report detailing the findings of the indirect offset, including any successes and failures for future learnings.

As the areas proposed for rehabilitation currently comprise low to moderate quality, primarily exotic grassland areas, which have only been recently been observed to be occupied (Umwelt, 2016), it is

assumed that these areas are not critical breeding habitat. As such, the restoration of flying habitat is considered to represent like-for-like habitat. This offset does not include any commitments for the long conservation of the area as a nature reserve.

This compensatory measure would be funded as a component of the Project budget.

4.4.4.2 Remediation of Spoil Site

In addition to the golden sun moth habitat improvement, it is proposed that the contaminated site to the south of the offset area be remediated. This will include re-profiling the stockpiles, and revegetation with native grasses to promote the suppression of weeds, and occupation of the area by golden sun moth.

This represents additional value as an experimental exercise which may result in overall conservation gains and improve the long term resilience and viability of the site.

This compensatory measure would be funded as a component of the offset site establishment by both the proponent and the proposed land manager (PCS).

4.5 Management for Improvement of MNES

The following section describes the range of strategies that would be included in the Offset Management Plan and implemented by the land manager, PCS, upon establishment of the Offset.

PCS has prepared an outline of the initial management actions for the North Mitchell Grasslands. These actions will be further reviewed during the preparation of the Offset Management Plan, but demonstrate an understanding of the initial works that will be required to achieve the outcomes of this offset strategy and their costs (see **Appendix C**).

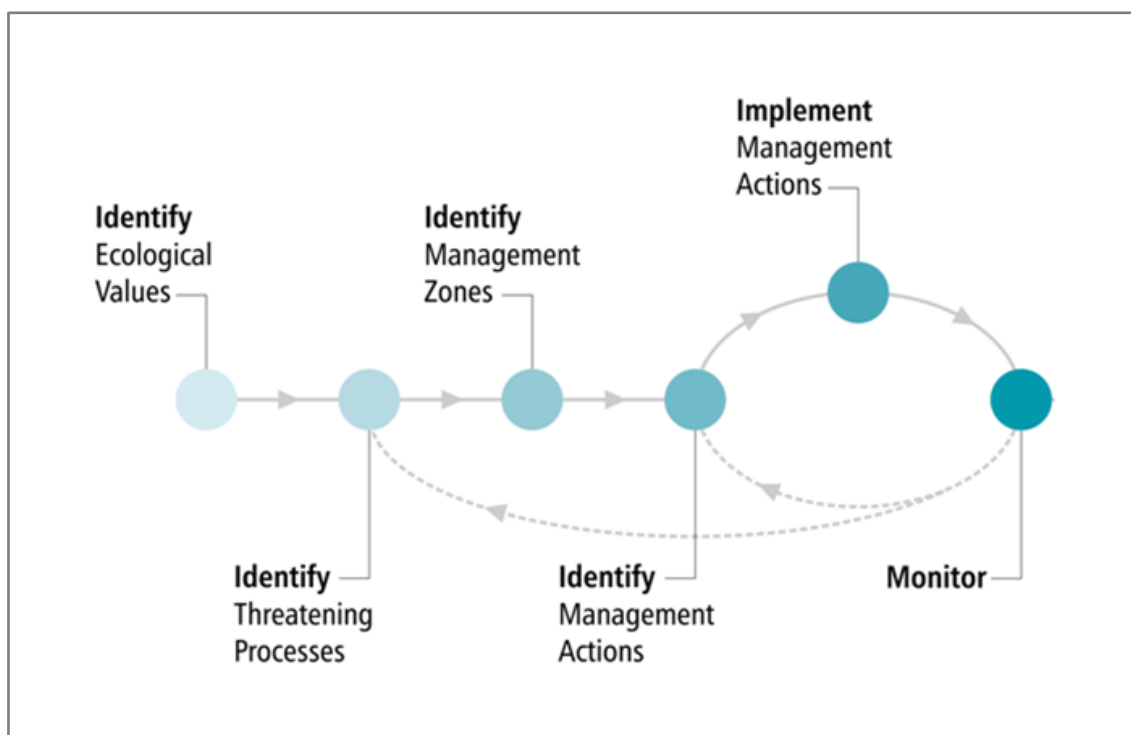
4.5.1 Outcomes Based Approach

The Offset Strategy as presented above has three major proposed outcomes:

- Maintain natural temperate grassland;
- Improve good quality golden sun moth habitat; and
- Increase area of golden sun moth habitat in currently exotic dominated areas.

These outcomes have been developed through an understanding of threatening processes (both currently and historically active), combined with an appreciation of ecological values. This enables the identification of management zones and correlating actions.

The following flowchart represents the process that has been undertaken to date, and will continue to be undertaken while managing the offset. Ongoing monitoring will be used to inform ongoing management actions and reporting requirements for the Offset.



4.5.1.1 Golden Sun Moth Habitat Improvement

A key aspect of the offset strategy is the improvement of the currently exotic dominated grassland areas forming the matrix between the known golden sun moth habitat patches. These areas were up until recently (<10 years) native grassland, and still contain a minor component of native grasses.

It is proposed that with appropriate regimes to manage biomass, and targeted weed management, this area can be improved to mixed, or native dominance. This would increase the permeability of the landscape to golden sun moth, to allow the utilisation of all habitat patches by the species, and reduce threats to both grassland MNES.

Based on advice from the ACT Government's Conservation Planning Branch (pers. comms. Michael Mulvaney, 28 February 2018), the site has high potential for improvement, with up to six additional hectares of the site capable of representing golden sun moth habitat within the medium term (refer **Section 4.4.3**).

4.5.1.2 Management Zones and Strategies

Although detailed management will be developed by PCS in the Offset Management Plan, the following objectives and strategies have been developed to demonstrate the range of management activities that may be undertaken to achieve the proposed offset outcomes.

A number of zones have been described in **Table 4.11** below. These zones have been defined by the ecological conditions identified by Umwelt (2018), and general site features, including topography and drainage. These zones (or their equivalent, as defined by PCS) will be used to target management activities.

Table 4.11 Proposed Management Zones and Objective

Zone	Description	Zone Objective	Time to Ecological Benefit
A	Native grassland patches	Maintain and enhance native grassland to achieve required improvement in existing golden sun moth habitat. Maintain the quality of natural temperate grassland values.	5 years
B	Management buffer around native grassland patches	Mitigate immediate surrounding threats on native grassland patches that contain golden sun moth and/or natural temperate grassland. Promote increased size, and reduced shape complexity of golden sun moth habitat patches through reduction of threats and improved permeability.	5 years
C	Higher slopes, mixed dominance	Increase native dominance to promote expansion of golden sun moth habitat.	15 years
D	Drainage lines, exotic dominated	Contain weeds (primarily Phalaris).	Ongoing
E	Box gum woodland	Maintain – <i>not part of this offset strategy</i> .	N/A
F	Spoil Site	Remediate and monitor - <i>see Section 4.2.4</i> .	10 years

These zones are shown in **Figure 4.2**. The key management activities will be focused around weed management, and biomass control. These are detailed further below.



Image Source: Environment and Planning Directorate, ACT Government (2016)

0 50 100 200m
1:4 000

Legend

- ▬ Offset Area
- ▬ Zone A: Native Grassland Patches
- ▬ Zone B: Management Buffer
- ▬ Zone C: Higher Slopes, Mixed Dominance
- ▬ Zone D: Drainage Lines, Exotic Dominated
- ▬ Zone E: Box Gum Woodland
- ▬ Zone F: Spoil Site

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20180614 11.49

FIGURE 3.3

Proposed Management Zones

Weed Management

Weed management will be key to reducing threats to natural temperate grassland and golden sun moth. The intensity of weed management objectives are defined by the overall zone objective, as either: intensive management; suppression; or containment, as shown in **Table 4.12** and **Figure 4.3**.

Table 4.12 Weed Management Objectives

Zone	Weed Management Objectives		
	Intensive Management	Suppression	Containment
A	X	-	-
B	X	-	-
C	-	X	-
D	-	-	X
E	-	X	-
F	-	X	-

To achieve the outcomes described in **Table 4.11**, a number of management strategies may be implemented. **Table 4.13** outlines key management measures that may be incorporated into the Offset Management Plan.

Table 4.13 Management Actions – Weed Control

Management Method	Target Species			Scenario / Timing	Zone	MNES Outcome	Offset Calculation Outcome
	African lovegrass	Phalaris	Woody Weeds				
Grazing	X	X	-	A grazing plan with feed budget will be developed for the site. This will inform stock grazing requirements to maintain habitat structure for the MNES and to suppress the cover of weed species (particularly Phalaris). Target species: Phalaris and African lovegrass (and exotic annual grasses) May also be used in conjunction with herbicide application if greater suppression is required. Grazing can also be applied to knock down Phalaris prior to burning.	C	Reduce competition and suppression from invasive weed species. Allows native species, including existing GSM feed species, to compete and establish.	- Threat - Isolation
					D	Reduce seed set in Zone D, which is currently a source of seed for the remainder of the Offset Area.	
Spot-spraying	X	-	X	During active growth period of target weed species. May apply multiple times a season if required.	A, B	Intensive management of significant threat (i.e. African lovegrass) from within and adjacent to existing patches of NTG and GSM habitat.	- Threat
					C	Suppression of significant threat (i.e. weed invasion).	

Management Method	Target Species			Scenario / Timing	Zone	MNES Outcome	Offset Calculation Outcome
	African lovegrass	Phalaris	Woody Weeds				
Burning		X		Ecological burns also will be used to further assist control Phalaris. Burns can be applied in conjunction with grazing.	C	Reduce competition, suppression, and seed dispersal from invasive weed species. Allow native species, particularly GSM feed species, to compete and establish in areas where GSM habitat expansion is a primary management aim. Will improve permeability and habitat structure.	- Threat + Size - Isolation
Profile and reseed	-	-	-	Spring Change the profile of the existing waste stockpile in accordance with the Preliminary Site Investigation recommendations (Jacobs, 2018). A concept plan will be developed to determine how to best utilise this site, from both a community recreation/engagement and restoration perspective. Restoration works will include re-seeding the spoil site to increase the area of GSM habitat.	F	Removal of invasive species' seed bank in the soil; allowing seeded natives a greater chance of establishing and out-competing the weeds over time. Result in increased cover of GSM feed species throughout the Offset Area.	N/A

Biomass Control

Biomass control will be the other key management activity undertaken. Biomass control will assist in maintaining the open grassland structure, to promote golden sun moth habitat expansion, and allow competition by native grasses, currently being overshadowed by exotics.

Table 4.14 Management Actions – Biomass Control

Management Method	Scenario / Timing	Target Zone	MNES Outcome	Offset Calculation Outcome
Grazing	A grazing plan with appropriate feed budget will be developed by a qualified agronomist to inform stock levels required to meet the required habitat structure for the MNES. The grazing plan will be followed by PCS staff. Specific timing and intensity of grazing will be managed by vegetation cover thresholds (both minimum and maximum) (see Section 3.3.3).	A, C, E, F	Control of biomass accumulation, maintaining an open grassland structure for NTG and GSM. Open grasslands promote grassland diversity (both floral and faunal); and are important for GSM reproduction. Reduce overshadowing to promote GSM expansion.	- Threat + Condition + Size - Isolation
		B	Control of biomass in Zone B will promote the establishment of native species within these areas, resulting in better connectivity throughout the Offset Area.	



Image Source: Environment and Planning Directorate, ACT Government (2016)

0 50 100 200m
1:4 000

Legend

- Offset Area
- Zone A: Weed Mitigation; Protect from Overgrazing
- Zone B: Weed Mitigation; Biomass Control
- Zone C: Weed Suppression; Biomass Control
- Zone D: Weed Containment
- Zone E: Maintain
- Zone F: Remediate and Monitor

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20180711 16.46

FIGURE 3.4
Proposed Management Objectives

4.6 Establishment of Baselines and Targets

This offset strategy commits to maintaining habitat quality within the natural temperate grassland patches; improving the existing golden sun moth habitat quality; and increasing the extent of golden sun moth habitat by six hectares.

The mapping included in this Offset Strategy will form the baseline for the purposes of demonstrating improvement over time. These baselines and targets are defined in the following sections.

4.6.1 Habitat Extent

The Offset Strategy commits to maintaining the overall extent of natural temperate grassland throughout the Offset Area. This will be measured in total hectares present within the site, which will allow for the natural movement of boundaries and fluctuations inherent to a natural system.

Similarly, the six hectare increase in golden sun moth habitat will be measured according to the total extent of habitat present after 15 years, compared with the current extent defined in this Offset Strategy.

Table 4.15 Habitat Extent Baseline and Targets

MNES	Outcome	Baseline (2018)	Target	Timeframe
Natural temperate grassland	Maintain quality and extent of natural temperate grassland	3.8 ha	3.8 ha	15 years
Golden sun moth	Increase extent of golden sun moth habitat	4.9 ha	10.9 ha	15 years

4.6.2 Habitat Quality

The Offset Strategy commits to maintaining the quality of natural temperate grassland; and improving the quality of golden sun moth habitat (**Table 4.16**).

This improvement is proposed through the removal of threats to the existing habitat; particularly targeting weed control and biomass management on the edges of the patches, which would result in improved condition, patch size and long term viability.

Table 4.16 Habitat Quality Baseline and Targets

MNES	Outcome	Baseline (2018)	Target	Timeframe
Natural temperate grassland	Maintain quality and extent of natural temperate grassland	7/10	7/10	15 years
Golden sun moth	Improve quality of golden sun moth habitat	6/10 (4.9 ha)	8/10 (4.9 ha)	5 years

MNES	Outcome	Baseline (2018)	Target	Timeframe
Golden sun moth	Increase extent of golden sun moth habitat	0/10 (6 ha)	5/10 (6 ha)	15 years

4.6.3 Definition of Thresholds

To allow monitoring and reporting on the success (or otherwise) of the Offset, baselines and targets will be established for factors such as biomass state (i.e. high, medium, or low), amount of inter-tussock space, and species richness. These thresholds, including the methodology for measurement, will be defined in the OMP.

The aims of these measures will be to provide a quantitative and repeatable method of assessing the change in quality of habitat over time, based on consideration of the existing and preferred thresholds for natural temperate grassland and golden sun moth habitat.

The thresholds will also be used to define management action triggers for adaptive management (e.g. adjust grazing management plan if biomass accumulation exceeds the allowable limit).

5.0 Offset Establishment and Management

5.1 Offset Responsibilities

The offset will be managed by the ACT Government's Offset Team, part of the Parks and Conservation Service in the Environment, Planning and Sustainable Development Directorate (EPSDD).

This team is dedicated to managing, monitoring and reporting on offsets established under the EPBC Act.

Any reporting for the impact area or against development conditions will be undertaken by the Project Proponent. The Offset Team will work closely with the Proponent to ensure that all reporting requirements are co-ordinated effectively.

To align with all other ACT offset reporting timeframes, annual reports would be submitted on 30 August, beginning at least 12 months after a decision from DoEE.

5.2 Site Security

Land use in the ACT is governed by the Territory Plan, which defines zoning and allowable uses. The legal mechanism to ensure the protection of the offset site in perpetuity will be a land use zoning variation through the Territory Plan.

A 'Nature Reserve Overlay' (Pc) will be applied over the currently non-urban NUZ3 zoned land. The overlay will apply additional objectives (as defined by Schedule 3 of the PD Act) to:

- Conserve the natural environment (primary objective); and
- Provide for public use of the area for recreation, education and research (secondary objective).

The change in zoning will result in a change in land management objectives and responsibilities, and subsequent increase duty of care. Land management will be the responsibility of Parks and Conservation Services (PCS), the ACT Government's land manager.

The variation under the Territory Plan will be completed following EPBC Approval.

5.3 Offset Funding

The Offset will be funded by the ACT Treasury through the Government's annual budget bid process.

Initial funding for offset establishment, including site infrastructure (fencing, gates, stock watering points, access tracks) and remediation of the contaminated site (**Section 4.4.4**) has already been secured in the 2018/19 budget through the funding for the Dudley Street Project.

Funding for ongoing management would be secured by the future land manager annually, and would include costs for weed management, biomass control, monitoring and reporting. This is a mature process, with offsets funded annually.

5.4 Offset Management Plan

An Offset Management Plan (OMP) would be prepared for the site by the Offset Team to guide management, monitoring, and ongoing improvement activities.

As the OMP needs to be a live, adaptive document, it is appropriate that it is prepared by the land manager. As such, this offset strategy does not aim to define all the requirements of the OMP, however has provided the range of activities to be undertaken to achieve the offset commitments. These activities would be further defined by the land manager to ensure consistency with their existing processes.

6.0 Assessment of Suitability

For natural temperate grassland, the proposed offset represents a surplus to what is required to directly offset the proposed impact. It is considered to represent a high quality offset, replacing like-for-like and also protecting other important MNES values.

For golden sun moth, the combined proposed offsets would provide 90% of the required direct offset. The habitat improvement component is considered to be a long term value add for the offset site, and would increase the long term resilience and viability of habitat within the North Mitchell Grasslands.

Acknowledging that habitat restoration activities may generally be difficult to achieve, this target has been developed in consultation with the ACT Government Conservation and Research Branch, in addition to the future land manager of the site, and is considered to have a moderate to high likelihood of being successful (as demonstrated in **Section 4.4.3**). Setting realistic targets for the area, to improve habitat to increase site permeability and resilience, rather than recreating natural grassland, will help to ensure this is a commitment that can be achieved.

In addition to the 90% direct offset supplied by the North Mitchell Grasslands; this offset strategy also includes other compensatory measures in the rehabilitation of Dudley Street road reserves, and the North Mitchell spoil site. These indirect offsets will contribute to the current understanding of the rehabilitation of golden sun moth habitat through reseeded with native C3 grasses. In conjunction with the direct offset, these other compensatory measures are considered adequate and appropriate to fully offset the direct loss to golden sun moth.

The North Mitchell Grassland site would provide a high value offset for the MNES values lost from the development of the Project. It is recommended that this site is used to offset the proposed impact.

7.0 References

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Umwelt (2016) *Canberra Brickworks and Environs Project – Golden Sun Moth Survey and Ecological Assessment of the Dudley Street Road Reserve*, Briefing Note to Irena Sharp of the Land Development Agency, Canberra.

Umwelt (2017a) *Canberra Brickworks Access Road Ecological Surveys 2016*, briefing note prepared for Gerard Coffey, Chief Minister, Treasury and Economic Development Directorate, ACT Government, Canberra.

Umwelt (2017b) *Impact Assessment Report: Canberra Brickworks Access Road and Dudley Street Upgrade Area, Yarralumla, ACT*, unpublished report prepared for the Chief Minister, Treasury and Economic Development Directorate, ACT Government, Canberra.



APPENDIX A

Offset Calculator Spreadsheets

Offsets Assessment Guide

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

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Natural Temperate Grassland of the
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

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

Impact calculator							
Impact calculator	Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
	Ecological communities						
	Area of community	Yes	Dudley Street and surrounds.	Area	0.28	Hectares	Umwelt (2017a and 2017b)
				Quality	5	Scale 0-10	
				Total quantum of impact	0.14	Adjusted hectares	
	Threatened species habitat						
	Area of habitat	No		Area			
				Quality			
				Total quantum of impact	0.00		
	Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
	Number of features e.g. Nest hollows, habitat trees	No					
	Condition of habitat Change in habitat condition, but no change in extent	No					
	Threatened species						
	Birth rate e.g. Change in nest success	No					
	Mortality rate e.g. Change in number of road kills per year	No					
	Number of individuals e.g. Individual plants/animals	No					

Offset calculator																						
Offset calculator	Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)		% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source
	Ecological Communities																					
	Area of community	Yes	0.14	Adjusted hectares	North Mitchell Grasslands	Risk-related time horizon (max. 20 years)	20	Start area (hectares)	3.8	Risk of loss (%) without offset	5%	Risk of loss (%) with offset	1%	0.15	75%	0.11	0.03	0.24	169.08%	Yes		
						Future area without offset (adjusted hectares)	3.6	Future area with offset (adjusted hectares)	3.8													
						Time until ecological benefit	15	Start quality (scale of 0-10)	7	Future quality without offset (scale of 0-10)	5	Future quality with offset (scale of 0-10)	7									
	Threatened species habitat																					
	Area of habitat	No				Time over which loss is averted (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset										
						Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0													
						Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)										
	Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start value		Future value without offset		Future value with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value		% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source
	Number of features e.g. Nest hollows, habitat trees	No																				
	Condition of habitat Change in habitat condition, but no change in extent	No																				
	Threatened species																					
	Birth rate e.g. Change in nest success	No																				
	Mortality rate e.g. Change in number of road kills per year	No																				
	Number of individuals e.g. Individual plants/animals	No																				

Summary								
Summary	Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)		
						Direct offset (\$)	Other compensatory measures (\$)	Total (\$)
	Birth rate	0				\$0.00		\$0.00
	Mortality rate	0				\$0.00		\$0.00
	Number of individuals	0				\$0.00		\$0.00
	Number of features	0				\$0.00		\$0.00
	Condition of habitat	0				\$0.00		\$0.00
	Area of habitat	0				\$0.00		\$0.00
	Area of community	0.14	0.24	169.08%	Yes	\$0.00	N/A	\$0.00
							\$0.00	\$0.00

Offsets Assessment Guide

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

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Golden Sun Moth (<i>Symenon plana</i>)
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

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

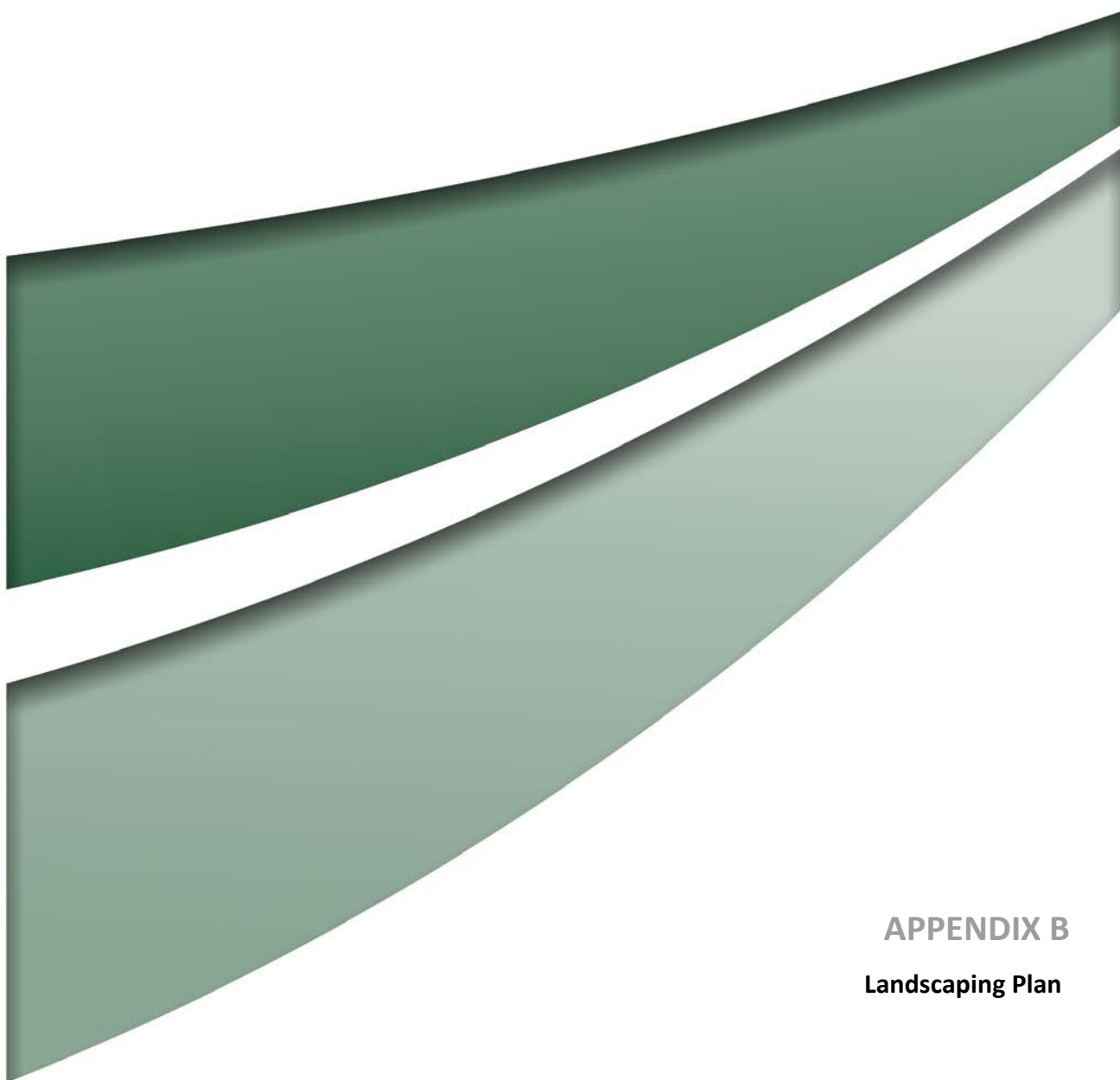
Impact calculator							
Impact calculator	Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
	Ecological communities						
	Area of community	No		Area			
				Quality			
				Total quantum of impact	0.00		
	Threatened species habitat						
	Area of habitat	Yes	Dudley Street and surrounds.	Area	3.08	Hectares	Umwelt (2017a and 2017b)
				Quality	7	Scale 0-10	
				Total quantum of impact	2.16	Adjusted hectares	
	Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
	Number of features e.g. Nest hollows, habitat trees	No					
	Condition of habitat Change in habitat condition, but no change in extent	No					
	Threatened species						
	Birth rate e.g. Change in nest success	No					
	Mortality rate e.g. Change in number of road kills per year	No					
	Number of individuals e.g. Individual plants/animals	No					

Offset calculator																						
Offset calculator	Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source	
	Ecological Communities																					
	Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset	0.0	Risk of loss (%) with offset	0.0									
										Future area without offset (adjusted hectares)		Future area with offset (adjusted hectares)										
						Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)										
	Threatened species habitat																					
	Area of habitat	Yes	2.16	Adjusted hectares	North Mitchell Grasslands	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	4.9	Risk of loss (%) without offset	5%	Risk of loss (%) with offset	1%	0.20	75%	0.15	0.04	1.37	63.62%	No		
										Future area without offset (adjusted hectares)	4.7	Future area with offset (adjusted hectares)	4.9									
						Time until ecological benefit	5	Start quality (scale of 0-10)	6	Future quality without offset (scale of 0-10)	3	Future quality with offset (scale of 0-10)	8	5.00	80%	4.00	2.88					
	Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start value		Future value without offset		Future value with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source	
	Number of features e.g. Nest hollows, habitat trees	No																				
	Condition of habitat Change in habitat condition, but no change in extent	No																				
	Threatened species																					
	Birth rate e.g. Change in nest success	No																				
	Mortality rate e.g. Change in number of road kills per year	No																				
	Number of individuals e.g. Individual plants/animals	No																				

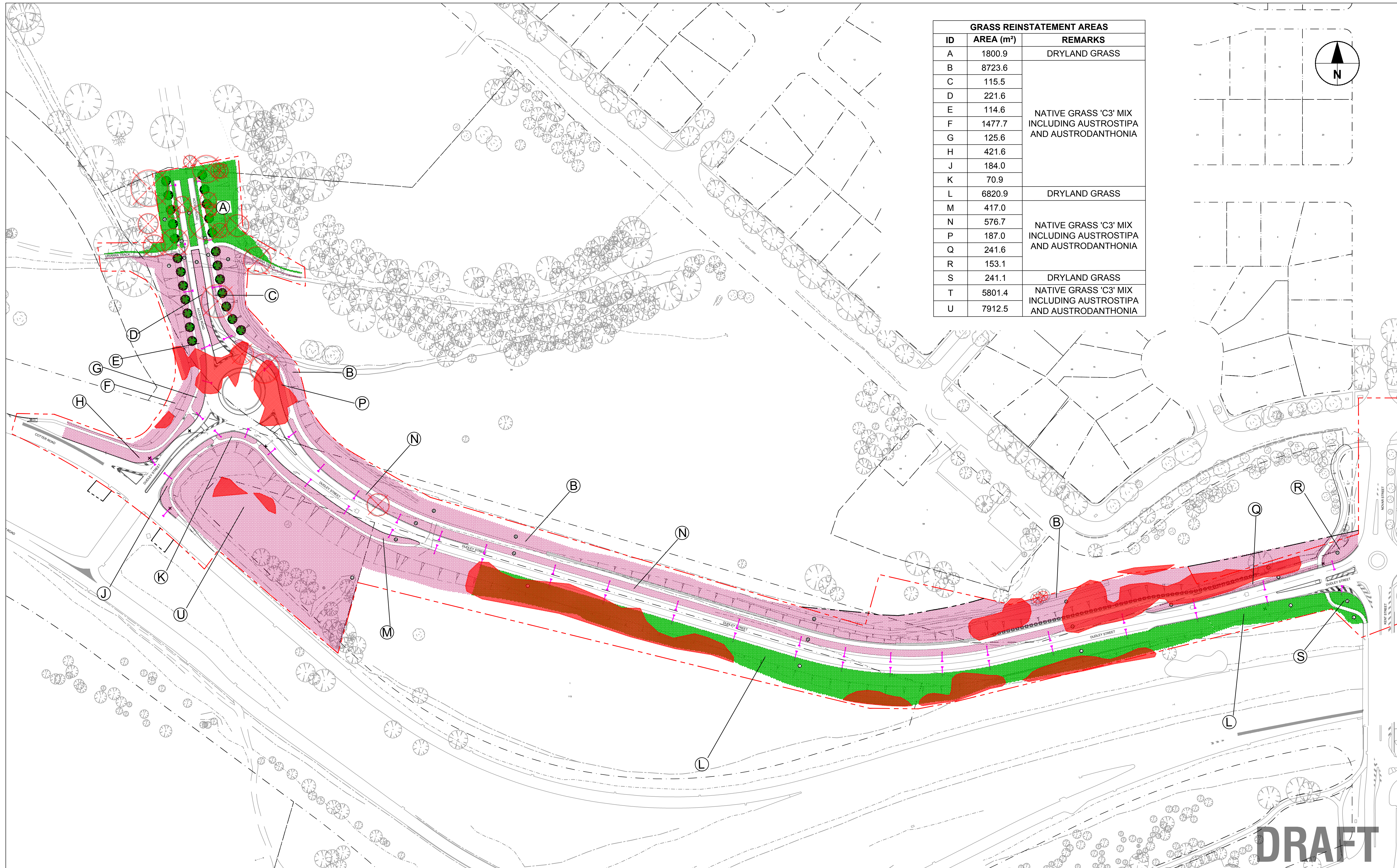
Summary							
Summary	Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)	
						Direct offset (\$)	Other compensatory measures (\$)
	Birth rate	0				\$0.00	
	Mortality rate	0				\$0.00	
	Number of individuals	0				\$0.00	
	Number of features	0				\$0.00	
	Condition of habitat	0				\$0.00	
	Area of habitat	2.156	1.37	63.62%	No	\$0.00	#DIV/0!
	Area of community	0				\$0.00	
						\$0.00	#DIV/0!

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

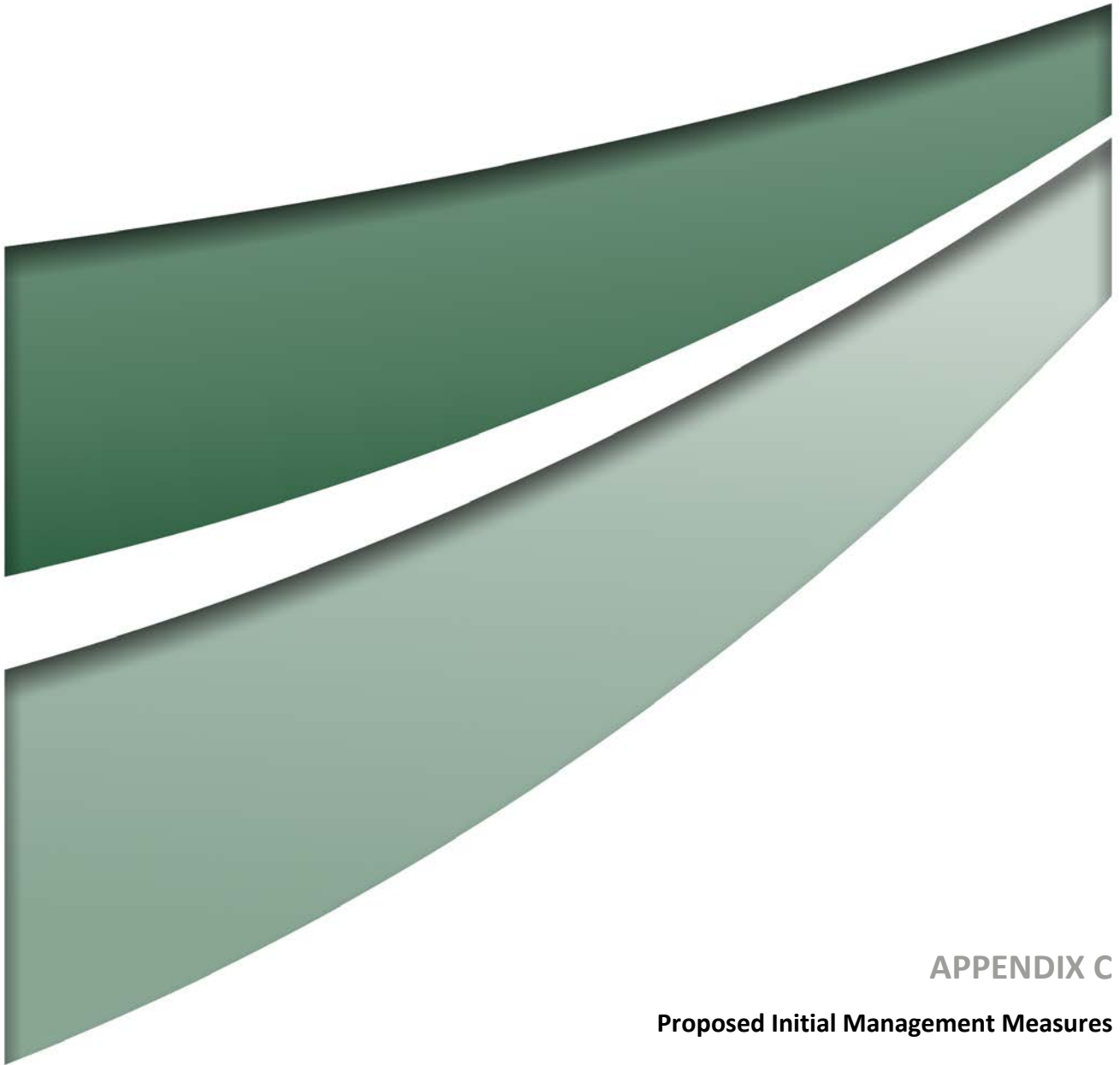
This guide relies on Macros being enabled in your browser.



APPENDIX B
Landscaping Plan



This drawing is confidential and shall only be used for the purpose of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM quality assurance system to ISO 9001-2000.



APPENDIX C

Proposed Initial Management Measures

Initial Proposed Management Actions for North Mitchell Grasslands

This amount is for plans and works undertaken over the first 2 years. It includes planning required for the long term management of the site and for actions required in preparation for delivering restoration works identified in the offsets strategy (noting the short timeframes for delivery) and staff costs.

Costs have been calculated over 2 years to factor in delays in approval timelines which may result in the process misaligning with the budget bid cycle for 2019/20 (i.e. it will provide a buffer in case we are unable to secure funding through the ACT budget until 2020/21).

The total funding PCS are seeking to undertake the works and cover associated costs: \$482,000.

Planning

Activity	Description	Responsibility	Estimated Costs 2018-2020
Spatial analysis of site characteristics to inform biomass management (decision tree) and associated grazing plan (for ecological and fuel management purposes)	Develop a spatial plan with decision tree that will help inform habitat structure management requirements (biomass management) for sites. Decisions based on site characteristic (soil, species composition and values present and bushfire fuel management requirements). A Grazing Plan (with feed budget) will guide how the biomass management requirements will be monitored and delivered.	PCS to engage a suitably qualified consultant	\$15,000 Includes soil testing and agronomy
Concept Plan	A concept plan will be developed to inform how to engage community within grassland ecosystems. The plan will include options for recreational and interpretation infrastructure. The plan will align with the PCS Landscape Classification System, which classifies reserves based on recreational and community engagement opportunity and related levels of service. PCS will seek funding through a business case to roll out infrastructure etc as guided by this planning process	PCS	\$20,000
Cultural Heritage Assessment Reporting and Management requirements and Ngunnawal naming	To incorporate traditional ecological knowledge will also inform land management planning via the PCS Healthy Country team and RAOs. RAOs will also be engaged to develop a new reserve name from the Ngunnawal language.	PCS	Delivered on house. Covered under staff costs

Activity	Description	Responsibility	Estimated Costs 2018-2020
Offset management plan and restoration project plans	An offset management plan will be required for the area (required by DoEE). This will be developed after the above planning process are complete (with the exception of the concept plan, which can be done after, depending on DoEE's time lines for when they want the OMP to be completed). In addition given the short time for the restoration efforts to be realised, a detailed restoration project plan will also be required. Future iterations to be developed by PCS	PCS to engage a consultant	\$20,000

Capital Improvement and Maintenance

Activity	Description	Responsibility	Estimated costs 2018 2018-20
Fences	All fencing and associated grazing infrastructure needs to be guided by the reserve values spatial analysis and grazing plan. Cost estimates have been calculated based on re-aligning boundary fences, one internal fence, 2 troughs and steps overs.	PCS	\$50,000
Management tracks / recreational trails etc.	To be informed by the concept plan and Landscape Classification System. To be funded via budget bid.	PCS	-
General Information Signage	General park signs and prohibited activity signage (as is required under the under the Nature Conservation Act 2014) will be installed on the offset boundary. 1 large reserve sign and 1 smaller reserve sign sufficient	PCS	\$5000

Environmental Enhancement and Operational Works

Activity	Description	Responsibility	Estimated# Budget 2018- 2020
Protection of Natural Regeneration	Tree guards and temporary fencing to protect natural eucalypt regeneration from grazing cattle. Regeneration limited to BGW management area	PCS	\$1000

Activity	Description	Responsibility	Estimated# Budget 2018- 2020
Spoil site: levelling in prep for revegetation	Spoil site: It is recognised that the EPA determined that they stockpile does not have to be removed from site. It is also recognised that removing soil is costly to Government. The site however needs to be remediated and will be actively managed in-perpetuity. Site remediation needs to align with management requirements including for revegetation and ongoing management access. TCCS has agreed to fund an analysis of the final foot print of the site post levelling (with sides battered to 1:4 ratio – including any capping material and revegetation substrate). The footprint must not go into areas identified as NTG or native grasslands on the maps (excess soil to be removed). Any cement must be deeply buried or removed from site. Top layer of soil must be free of rock, which would make on-going management difficult. Capping material is TBC by TCCS, however for any revegetation to occur additional soil (or 'B' horizon quality – as advised by Greening Australia) is required. The soil currently on site is inadequate for this purpose.	TCCS	Covered by TCCS under separate contract (s)
Revegetation	To secure sufficient seed to undertake restoration works (and tight timeframes), PCS needs to engage seed collectors asap.	PCS	\$40,000
Weed control	An intensive and highly targeted weed control program delivered in house is proposed for 3 years. After this time, the site can be incorporated into the offsets weed control program utilising highly trained weed control contractors or in house (risk dependant). Target weed: ○ CNG ○ Serrated Tussock ○ St Johns Wort ○ Blackberry and other woodies ○ Phalaris ○ African Lovegrass <i>PCS will also accept responsibility for weed incursions along road verge</i>	PCS	\$80,000

Activity	Description	Responsibility	Estimated# Budget 2018-2020
Invasive Animals (Rabbits)	Rabbits can be monitored and controlled annually in Autumn and Spring, in conjunction with the North District Rabbit Control Program (VOP).	PCS	Delivered on house. Covered under staff costs
Bushfire fuel reduction	Bushfire fuel will be assessed in to ensure that it meets the standards applicable for Strategic Bushfire Abatement and appropriate action to reduce fuel load undertaken as required.	PCS	Delivered on house. Covered under staff costs

Monitoring Program and Review

Proposed Activity	Description of Proposed Works	Responsibility	Estimated# Budget 2018-2020
MNES monitoring	Engage a suitably qualified expert to deliver the mapping and monitoring program – part of developing long term baseline quality assessment	PCS to engage a suitably qualified expert	\$16,000

Management Resources

Proposed Activity	Description of Proposed Works	Responsibility	Estimated# Budget 2018-2020
Staffing	- To deliver the actions outlined in this, plan resources to support a part-time a Senior Ranger (Ranger Grade 3) and Field Officer and vehicle. - Funding will also be required to support the on-going planning and ecological support. - Funding calculated on a pro rata amount based on site size and level of commitments. - The amount calculated for the field officer is without time for weed control, noting that funding has been allocated for that purpose above.	PCS	\$235,000



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