Willogoleche Wind Farm Offset Area

Monitoring Report 2020

Willogoleche Wind Farm Offset Area Monitoring Report 2020

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Prepared by EBS Ecology for ENGIE

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GLOSSARY AND ABBREVIATION OF TERMS

%	Percent / Percentage
BOM	Bureau of Meteorology
DSE	Dry Sheep Equivalent
DotEE	Department of the Environment and Energy (Commonwealth)
EBS	Environmental and Biodiversity Services, *trading as* EBS Ecology
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GPS	Global Positioning System
Ha	Hectares
Iron Grass NTG	Iron Grass Natural Temperate Grassland of South Australia
km	kilometre(s)
LMR	Landscape Management Region
LSA Act	*Landscape South Australia Act 2019*
m	metre(s)
m^2	square metre(s)
mm	millimetres
NY NRM	Northern and Yorke Natural Resources Management Board (superseded, now Landscape South Australia, Northern and Yorke)
NTG	Natural Temperate Grassland
OMP	Offset Management Plan
PCQM	Point-centred Quarter Method
PPH	Perennial plants per hectare
Project	the Willogoleche Wind Farm
SA	South Australia(n)
SD	Standard Deviation
sp.	species
spp.	species (plural)
ssp.	sub species
TEC	Threatened Ecological Community
WTG	Wind Turbine Generator
WWF	Willogoleche Wind Farm

EXECUTIVE SUMMARY

Background

ENGIE have established an Offset Area to meet the conditions associated with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval for the Willogoleche Wind Farm (WWF) (EPBC 2011/5850). The Offset Area is required as a result of impacts to EPBC Act listed Threatened Ecological Community (TEC) Iron-grass Natural Temperate Grassland of South Australia (Iron-grass NTG). Landscape features and management requirements for the Offset Area are outlined in the *Willogoleche Wind Farm Offset Management Plan* (OMP) (EBS 2017), which includes minimum targets for key indicators and management actions required to meet the targets, as well as monitoring and reporting requirements.

Methodology

Monitoring of the Offset Area commenced in 2018 using the Point Centre Quarter Method (PCQM) and qualitative observations in Assessment Sites. In 2019 monitoring was supplemented with additional methods including - (1) an assessment of the EPBC Act Condition Class of the Assessment Sites and (2) grassland health indicator data (percentage (%) cryptogams, % litter, % bare ground, % rock and % native cover). In 2020 all of these methods were utilised to assess the key SEB Offset monitoring indicators.

Summary of results

Following a year of increased rainfall and a break in drought conditions, the Offset Area was found to be in an improved condition since the previous survey, with a reduction in grazing pressure noticeable. In particular, Site 1 was in better condition than Site 2, with an increase in the number of perennial plants per hectare (PPH).

A total of 27 native species were found across the Offset Area in 2020. Both sites had slightly more species observed than in 2019 (when EPBC ramble survey method was introduced), indicating some regeneration of species following onset of rain and reduction in grazing pressure. Both sites were assessed to be of Class B condition, assessed under the Threatened Ecological Community (TEC) listing criteria for Commonwealth Iron-grass NTG Listing Advice (DotEE 2007).

Site health attributes were within the benchmark goal range for Site 1; however Site 2 was still in a degraded condition, with an apparent reduction in cryptogam coverage since 2019. Both sites showed a reduction in exotic litter coverage since 2019, however a significant increase in live weed coverage was observed at both sites. A high rainfall year has enabled a proliferation of weed species across the Offset Area which will need to be managed in the coming years to ensure the seed set during a good season doesn't overwhelm the gains in native species coverage and diversity.

Recommendations

The following actions are recommended:

- Resume periodic grazing in Offset Area except during late spring / early summer when no grazing is to occur (to allow native seed set) (i.e. between May and November) allowing maximum 7 days grazing followed by 4 weeks rest. Manage grazing according to seasonal conditions by:

  - Reduce grazing duration and frequency in dry conditions and do not enable grasses to be grazed to less than 5cm in height. Start grazing later in winter and stop earlier in spring.

- Weed control should focus on removal of isolated Horehound specimens, removal of Salvation Jane where the species is at low densities (or ideally eradication of the weed from the site). Invasion of new weeds such as African Boxthorn should be monitored and addressed appropriately. Additionally, isolated patches of weeds identified in the 2020 survey should be targeted for removal including:
  - Removal of two large Artichoke Thistles (Cunard cardunculus) near Site 1
  - Control small outbreak of Sowthistle (*Sonchus oleraceus)* near Site 1
  - Remove singular Lucerne (*Medicago satvia*) plant from Site 1
  - Control patch of Fennel (*Foeniculum vulgare*) along southeastern fenceline
- Management actions undertaken by the landholder in relation to the SEB Offset area should be recorded (using the Activity Record Datasheet, and Paddock Monitoring Sheets provided in Appendix 7.1 and 7.2) and reported annually to enable management actions to be linked to condition outcomes including:
  - Timing, duration and intensity (stocking rate) of grazing
  - Targeted weed control (i.e. spot spraying, hand removal)
- Survey methodology should remain largely the same in subsequent years, however several alterations to the method are suggested:
  - Remove measure of ‘canopy cover’ from PCQM methodology;
  - Measure a maximum of five dominant perennial grass species in the PCQM; and
  - Add presence / absence measure for Lomandra tussocks in 1x1m quadrats

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1 INTRODUCTION

ENGIE have established an Offset Area to meet the conditions associated with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval for the Willogoleche Wind Farm (WWF) (EPBC 2011/5850). The Offset Area is required as a result of impacts to the EPBC Act listed Threatened Ecological Community (TEC) Iron-grass Natural Temperate Grassland (NTG) of South Australia (Iron Grass NTG).

The Offset Area was established and placed under Heritage Agreement (under State legislation) and must be managed for condition improvement consistent with EPBC Offsets Policy. The main aim of the Offset Area is to protect and restore a representative patch of an Iron-grass NTG of South Australia community, to provide an overall biodiversity gain that adequately compensates for the impacts associated with the development of the WWF. Under the *EPBC Act 1999 Environmental Offsets Policy* (DSEWPaC 2012), the patch must meet a series of Offset Principles outlined in the document to deliver an overall conservation outcome that improves or maintains the health, diversity, and productivity of the environment as it relates to these matters. Management of the Offset Area is outlined within the *Willogoleche Wind Farm Offset Management Plan* (OMP) (EBS 2017) which includes minimum targets for key indicators and management actions required to meet the targets, as well as monitoring and reporting requirements. Refer to the OMP (EBS 2017) for more detail.

1.1 Objectives

The original condition of the Offset Area was established during initial assessment of the site in 2013 (EBS 2013), based on the core management objectives for the Offset Area, as listed in the Offset Management Plan (OMP) (EBS Ecology 2017). The OMP was approved by the Commonwealth Government on 17 January 2017. Permanent sites were not established in 2013, therefore quantitative baseline data was collected for the first time in 2018 during construction (EBS Ecology 2018), in 2019 (Year 1) at the commencement of the operational phase of the WWF, and in 2020 one year following operational phase (Year 2). Year 2 monitoring was undertaken using refined methods with results presented in the current report.

As per the OMP the current report aims to:

- Describe the Year 2 monitoring methodology and present the Year 2 monitoring results;
- Compare Year 2 monitoring results to baseline monitoring (2018) and subsequent annual monitoring;
- Measure the condition of the Offset Area against goals set out in the OMP;
- Provide discussion and recommendations regarding management of the Offset Area; and
- Provide discussion and recommendations regarding the monitoring program.

2 BACKGROUND

2.1 Project area

The Willogoleche Wind Farm (WWF; the Project) is located approximately six kilometres (km) west of the township of Hallett in the Mid North of South Australia. The Project comprises of 32 wind turbines, an electrical substation, operation and maintenance facility and associated access tracks and infrastructure. Construction works for the WWF commenced on 9 September 2017 and sectional completion was achieved on 4 November 2019. However, the WWF had been generating and exporting electricity to the grid during the commissioning and optimisation process for a number of months prior to the date of sectional completion.

The Offset Area is located within two kilometres in the southwest vicinity as indicated on Figure 1. The Offset Area is approximately four hectares (ha) in size and located within a larger area of *Lomandra multiflora* subsp. *dura* Open Tussock Grassland that is utilised for grazing (EBS 2017).

The Offset Area was considered to be in poor to moderate condition at the time of writing the OMP, meeting the criteria for a condition Class C Grassland (EBS 2017), based on criteria outlined in the listing advice (DoTEE 2007).

2.2 Monitoring Program Objectives

The proposed management of the Offset Area aims to address the following key Recovery Actions from the National Recovery Plan for the Iron-grass Natural Temperate Grassland of South Australia ecological community (Turner, 2012):

- Strategy 3: Increase the area of the EPBC listed Iron-grass Natural Temperate Grassland secured and managed for conservation;
- Strategy 4: Maintain or improve the condition and integrity of the EPBC listed Iron-grass Natural Temperate Grassland remnants using 'best practices' strategies;
- Strategy 5: Increase the area of occupancy of the EPBC listed Iron-grass Natural Temperate Grassland ecological community across its natural range.

Based on the Commonwealth listing Advice (DotEE 2007), the core management objectives for the Offset Area as listed in the OMP (EBS 2017) include:

- Increase the condition classification for the site from a **C Condition Class** to a **B Condition Class** (or higher);
- Increase the diversity of native species from nine to above 15 species;
- Increase the number of broad-leaved herbaceous species (in addition to disturbance resistance species) to three or more species;
- Increase the number of perennial native grass species to four or more species;
- Increase the density of tussock grass species to one per metre;
- Manage feral animal populations;
- Establish long-term scientific monitoring sites to demonstrate attainment of condition class targets.

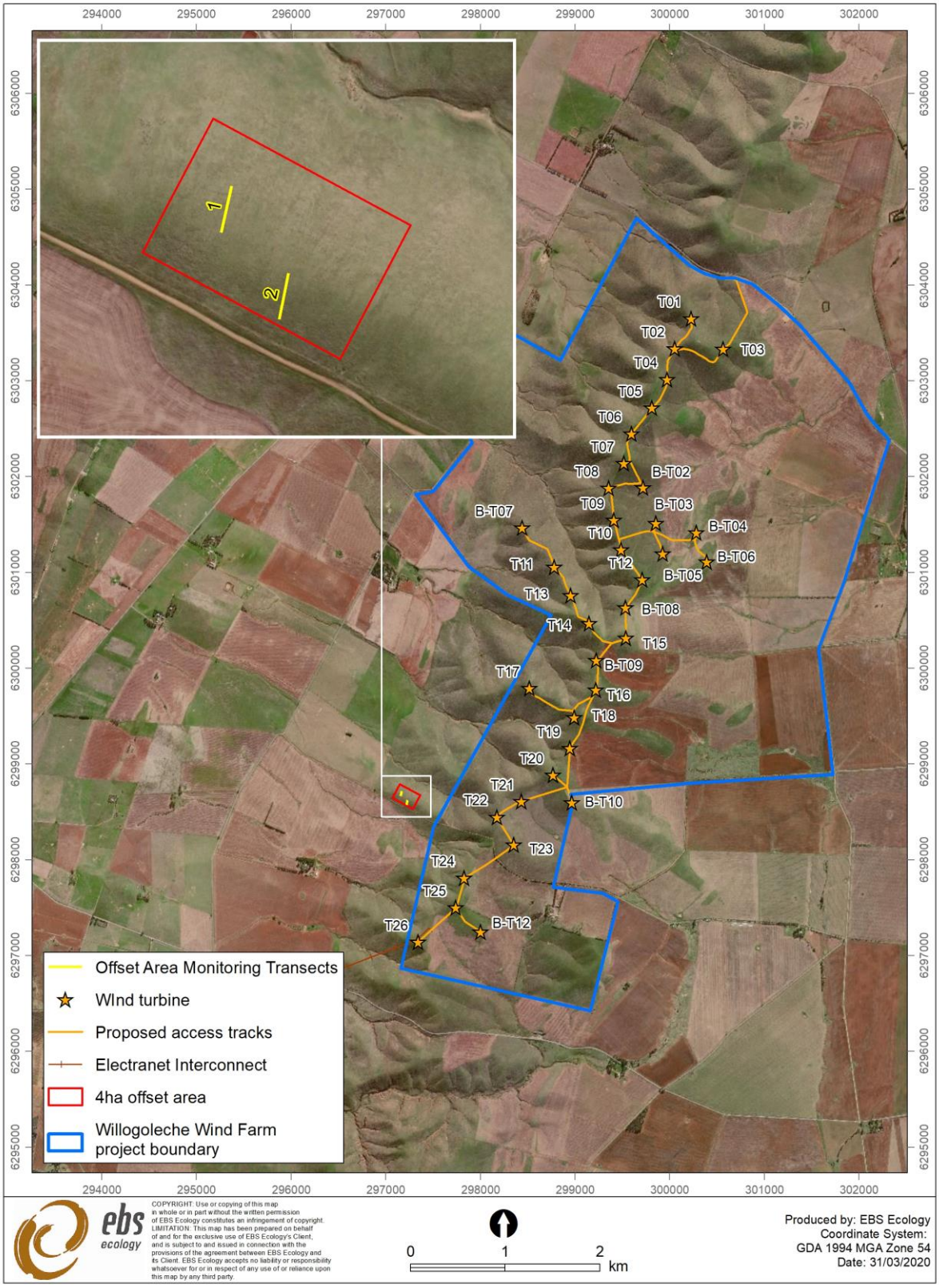

Figure 1. Location of the Willogoleche Wind Farm, including the Offset Area and monitoring transects (inset).

2.3 Climate

Climate in the Mid North region where the Offset Area is located consists of mild winters and hot summers, with rain occurring predominantly in the winter months (NY NRM 2018).

2.3.1 Rainfall

Rainfall data has been obtained from the Bureau of Meteorology (BOM) Hallett (Lorraine) weather station (# 21024) which is located approximately 7 km west-south-west of the southern extent of the WWF. Monthly rainfall data for the period of November 2016 (approximately one year prior to the initial Weed Assessment in November 2017) to the date end September 2020, is presented in (Figure 2). In 2010, the year the initial EPBC survey was conducted, the rainfall data is incomplete, but shows higher than average rainfall in most months, and is included for reference to gain an understanding of the conditions at the time of the survey (**Error! Reference source not found.**).

Average rainfall at the Hallett (Lorraine) weather station is 462.7 millimetres (mm). The last year of equal to or above average rainfall in the region was 2016, with particularly dry years experienced in 2018 and 2019, recording 23.45% and 34.8% less rainfall than average, respectively. By contrast, 2020 has thus far experienced considerably above average rainfall (17.85% January to October 2020), particularly in April, August, September and October.

Attributes of the Iron-grass NTG that may be affected by dry seasonal conditions include species diversity, floristic composition, weed cover, native recruitment, and dead material on plants.

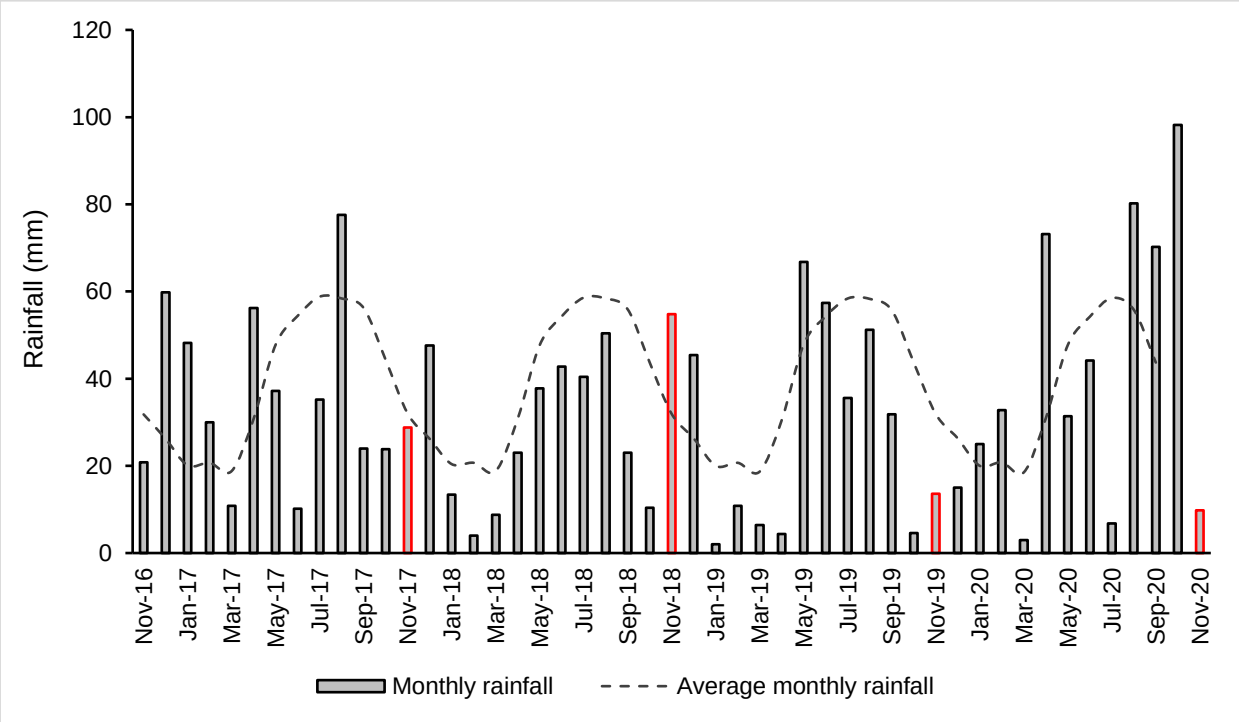

Figure 2. Monthly rainfall data from November 2016 to October 2020, red indicating survey months. Source: Hallett (Lorraine) Bureau of Meteorology (BOM) weather station #21024 (BOM 2020)

3 METHODS

3.1 Survey Timing

Field survey for the 2020 Offset Assessment was undertaken on 16-18 November 2020 by EBS Ecology staff Emma Eichler (Senior Ecologist) and Jessica Skewes (Senior Ecologist).

3.2 Assessment Sites

Two 50 metre (m) long monitoring transects have been established within the Offset Area (Table 1, Figure 1). Photographs looking along each transect were taken at the start (0 m) and end point (50 m) in 2020. Photos were only taken at the start (north) point in 2018. Photographs for each year are provided in Appendix 1).

To allow for a more rigorous assessment of vegetation, additional data in the form of a 'ramble survey' was collected in 2019 along the existing transect and across a 50 m x 50 m quadrat in the direction from the transect indicated in Table 1 (adjacent each monitoring transect). The monitoring transect and immediate surrounding area combined, is referred to as an 'Assessment Site'.

Table 1. Site and transect location details; and direction of the EPBC assessment (from the transect).

Assessment Site/ Monitoring Transect	Location	Extent of transect	Zone	Easting	Northing	TEC Condition Class (2019)	*EPBC Assessment Direction
1	Running approximately north-south in the north west vicinity of the offset.	North	54H	297168	6298716	Category B	west
		South		297156	6298666		
2	Running approximately north-south in the south east vicinity of the offset.	North	54H	297230	6298623	Category B	west
		South		297219	6298572		

3.3 Point-centred Quarter Method (PCQM) - Quadrat Sampling

In 2020, the PCQM methodology used in previous assessments was repeated. PCQM involves surveying ten (10) sample points along a 50 m transect, assessing perennial plant parameters at five metre intervals (starting at zero metres). Each sample point is further divided into four quarters by placing a range pole perpendicular to the transect line, then the distance from the sample point to the nearest native perennial plant in each of the four quarters is measured and recorded (Figure 3), resulting in assessment of 40 perennial plants per transect (Tongway & Hindley 2004). The PCQM is used instead of other methods, for example tussock counts in 1x1 m^2 quadrats, due to the number of small grasses (i.e. *Rytidosperma spp.*) making counts very time consuming.

At each sample point along the transect, the four distance measures are averaged to represent the distance (*d)* at each sample point, and then these distances are averaged to calculate the average distance of all sample points on a transect.

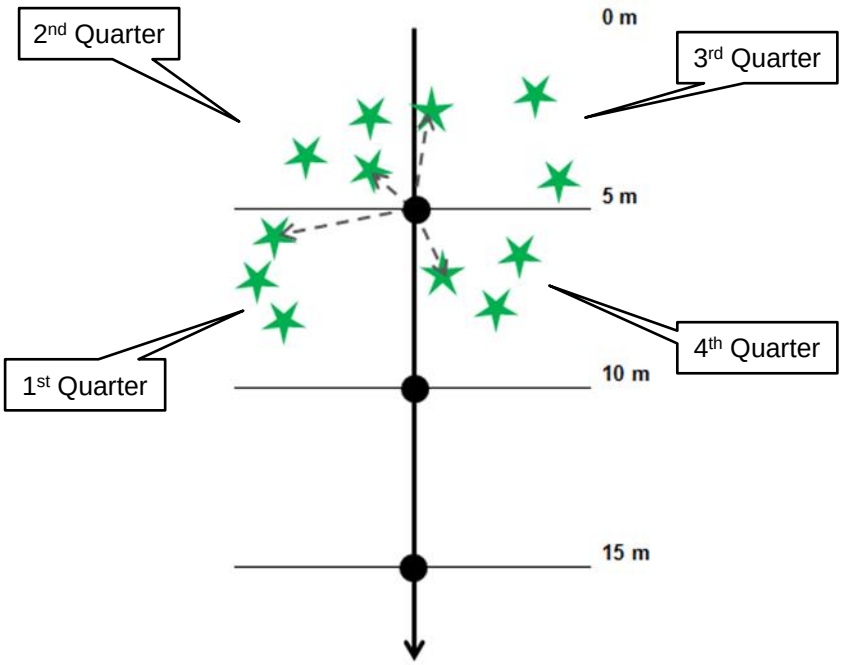

Figure 3. The Point-centred Quarter Method involves collecting data on the closest native perennial plant (indicated by a green star) in four quarters at each sample point (image adjusted from Tongway & Hindley, 2005).

In addition to the species, the canopy width (in cm), plant height (in cm) and basal width (in cm) of each of the 40 perennial plants is recorded (Tongway & Hindley 2005). Previously, the PCQM data has been used to calculate percentage cover and volume of perennial plants in metres cubed (m^3), however, given that canopy width is highly variable dependent on seasonal conditions and is sensitive to grazing, it is considered that trends may be more evident and meaningful if basal area (m^2) is used, which also provides an indication of land function, and influences the relative importance of a species within an ecosystem. Table 2 provides a summary of data collected as part of the PCQM in 2020 for the WWF and how the data was then analysed. The purpose of data collection, the desired data trends to indicate grassland health, potential data limitations and a recommendation for future monitoring is also provided in Table 2 (on the following page).

From the data collected the following indices can be derived:

1. The density of plants per unit area for each species;
2. Basal cover per unit area (m^2/ha)
3. Importance value of each species

Table 2. Data collected as part of the PCQM in 2020 for the Offset Area, analysis approaches, purpose of data collection, desired data trends and recommendation.

Parameter	*Data collected	Analysis	Purpose	Desired trend	Undesirable trend	Comment	Recommendation
Cover (m^2)	Basal width	PCQM	Determine basal cover (m^2) of perennial plants.	Stable or slight increase.	Significant increase or decrease.	Based on several years of monitoring, it was deemed that PCQM had some limitations. Therefore in 2019, the method was supplemented with additional data collection methods. In 2020 these PCQM measures were reviewed again to determine a more appropriate and indicative method moving forwards.	Continue to monitor using PCQM. However, supplement with collecting total percentage native cover data (as undertaken in 2019). Eg. measure using % native cover in 1m x 1m quadrats. In 2020 basal width was used to calculate cover (m^2) to provide information on maturity of perennial plants, and the actual ground cover, rather than projected canopy cover which is highly variable depending on seasonal conditions and/or grazing.
Volume (m^3)	Canopy width breadth, height and canopy density (%)	PCQM	Determine volume of vegetation in metres cubed (m^3).	Ideally stable or increase, but data is not meaningful.	Ideally stable or increase.		Excluded in 2020 due to highly variable and inconsequential results. Recommend to **stop** collecting.
Density (PPH)	Distance from PCQM centre point	PCQM	Determine the number of perennial plants per hectare.	Stable or slight increase.	Significant increase or decrease.		Continue to monitor using PCQM. However, consider supplementing with counts of total number of grass tussocks in 1m x 1m quadrat at each PCQM point to calibrate. Consider selecting the four most dominant or important indicator species to measure (ie *Lomandra, Aristida, Austrostipa spp., Rytidosperma spp*.)
% dead material	Percentage of green material on tussocks (canopy density)	Average % dead material	Determine tussock dieback, a useful indicator in grassland health.	Stable or decreasing	Increasing	Potentially useful indicator of plant health.	**Continue** to measure percentage dead material of 40 plants per transect.

Canopy size of tussock (in cm)	Canopy width	Average canopy width	Aims to changes on the canopy size of tussocks (will detect grazing pressure and seasonal conditions).	Stable or increasing size	Decreasing	Potentially useful indicator of plant size.	**Stop** measuring canopy size, as it is more indicative of seasonal conditions. Height is deemed a more robust and suitable indicator of grazing pressure.
Height of plant (in cm)	Height of plant	Average height	Aims to detect changes in height – useful for determining grazing pressure.	Stable or increasing height	Decreasing	Valuable to collect data on plant size trends.	**Continue** to measure plant height of 40 plants per transect (from ground to tip of leaves, not seed/flower head)

3.4 EPBC Condition Ramble Survey

In addition to the PCQM sampling outlined above a ramble survey was undertaken across a 0.25 ha (50 x 50 m) quadrat in the immediate area of the Assessment Site to record any native species present and their estimated cover. The data from this search can then be used to determine the condition class of Iron-grass NTG patches as outlined in the *EPBC Act Policy Statement 3.7. Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia'*. (DEWR 2007) (Table 3. EPBC Iron-grass TEC condition score parameters (DEWR 2007). and if they have remained stable or otherwise since the baseline assessment was undertaken in 2017.

Table 3. EPBC Iron-grass TEC condition score parameters (DEWR 2007).

Condition class	Minimum size	Diversity of native species[1]	No. broad-leaved herbaceous species[1] in addition to identified disturbance resistant species[2]	No. perennial grass species[1]	Tussock count[3]
Listed ecological community					
A	0.1ha	>30	+10	>5	1/m
B	0.25ha	>15	+3	>4	1/m
Degraded patches amenable to rehabilitation					
C		>5	No minimum	>1	No minimum

*[1] as measured in a 50 x 50 m quadrat; [2] disturbance resistant species: *Ptilotus spathulatus, Sida corrugata, Oxalis perennans, Convolvulus erubescens, Euphorbia drummondii,* and *Marieana enchylaenoides;* and, [3] as measured along a 50m transect.

3.5 Grassland Health Indicators

Following on from the methods introduced in 2019, the 2020 survey measured the following five grassland health indicator attributes in each of the 10 quadrats indicated in Figure 4 at each site, to further inform trends in grassland condition and health:

- percentage (%) cryptogams;
- % litter (including alive and dead exotic plants);
- % bare ground;
- % total native cover; and
- % rock.

An overview of the purpose of the data collected, the desirable result trends and comments / recommendations for future monitoring are provided in **Error! Reference source not found.**.

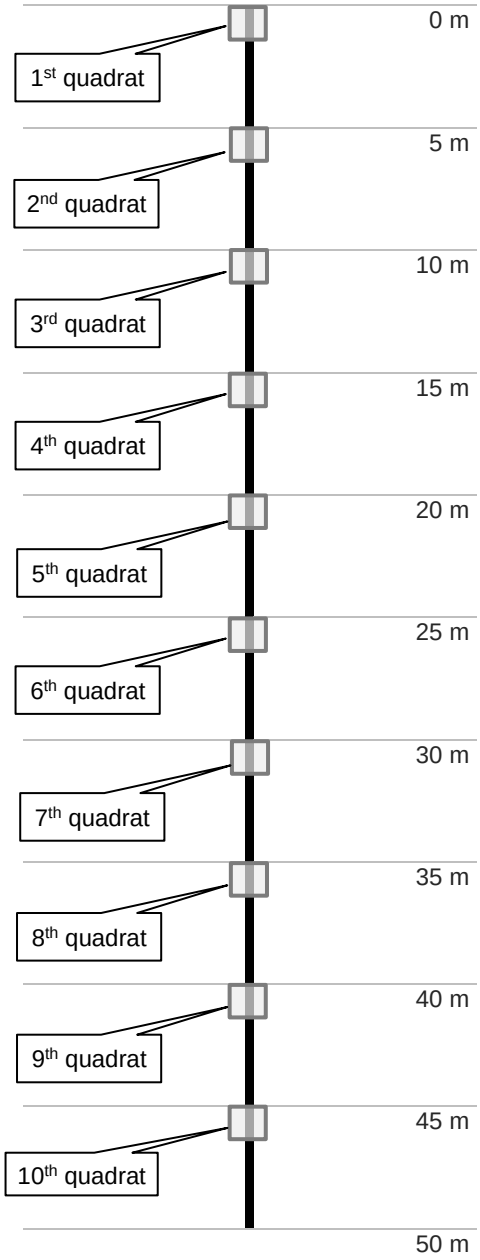

Figure 4. Schematic of a 50 m long transect with ten 1 m^2 quadrats, surveyed at 5 m intervals (not to scale).

Table 4. Grassland health indicators.

Attribute	Purpose	Desired trend	Undesirable trend	Comment / recommendation
% cryptogams	Presence of cryptogams indicates, soil health, stability and nutrient cycling.	Increasing/ benchmark	Decreasing The unofficial benchmark values for cryptogams (with moss and lichen cover) comprises up to 50% for Grasslands in the Northern Lofty botanical region (Pedler, Croft & Milne, 2007).	Continue to monitor.
% litter including exotic annual grass (the majority of litter)	Will monitor percentage of the site covered in dead annual grass material which indicates a high % of weeds, some loss of patchiness and may inhibit germination of native species.	Decreasing	Increasing (generally indicates increased weeds in the grassland system). The unofficial benchmark values for % litter for Grasslands in the Northern Lofty botanical region is approximately <25%.	Continue to monitor.
% bare ground (meaning exposed dirt free of litter, moss, plants (dead or alive), rock or cryptogams)	Will monitor soil disturbance and potential for soil loss or erosion. Can increase due to dry conditions, increased livestock or weed invasion.	Decreasing/ benchmark (native species often germinate in bare ground so some may be desirable).	Increasing. The unofficial benchmark values for % bare ground in Grasslands in the Northern Lofty botanical region is approximately <5% (Pedler, Croft & Milne, 2007).	Continue to monitor.
% total native cover (all perennial and annual species)	Will determine trends in the total native cover and determine if site becomes overgrown or experiences significant losses of vegetation.	Stable or slight increase	Significant increase (loss of patchiness) or significant decrease.	Continue to monitor. Consider also collecting percentage cover of grasses.
% rock	Data collected to obtain full picture of structural attributes. Rock cover does not need to be collected in future years.	Stable	Stable	Monitor every 5 years.

3.6 Statistical Analysis

At each of the two Iron-grass NTG sites within the offset area, PCQM data was used to calculate the following parameters:

- density (plants/ha) - perennial plants per hectare (PPH);
- ground cover (m^2/ha) (basal width)
- Plant height; based on averages of plants measured; and
- % dead material; based on averages of plants assessed.

The data is analysed using the methods described by K. Mitchell (2015) in addition to using standard averages to determine trends. Percentage cover data collected including litter, bare ground, cryptogams and rock were calculated across the site and WWF based on average values using Microsoft Excel. As the LGM program commenced in 2017, and new methods were added in 2019, it is too early in the program to undertake any meaningful statistical analysis. Descriptive data and any observations of changes or constants between 2017 and 2020 are reported in Section 3 (Results) and 4 (Discussion). Statistical analysis will be conducted in future years when there is enough data to ascertain if any changes within the

seven patches of Iron-grass NTG are occurring over the period of the monitoring program and if they are related to WWF operational practices or seasonal variation.

3.7 Weed Survey

To assess weed cover in the Offset Area 2020, the methodology used for the WWF Weed Assessment was applied at the two monitoring transects. This involved recording the individual weed species and coverage (as a percentage of area covered) within a quadrat one square metre (1 m^2) in size, at five metre intervals (starting at zero metres) (Figure 4), resulting in a total of ten quadrats being assessed per 50 m transect.

General notes on weed cover were also made whilst traversing the Offset Area and during the Ramble survey. It is of note that the total percentage litter was also determined as part of the grassland health data. In grassland sites, this largely represents dead exotic species.

3.8 Limitations

The PCQM is most commonly used in woodland ecosystems, where trees and shrubs remain relatively stable over time, and as such, the same individuals are measured repeatedly. In grassland environments, perennial plants are subject to considerable seasonal variation, with grass regeneration likely to strongly influence the composition and density estimates, which may not be reflective of a healthy or otherwise ecosystem, but rather of a fluctuating one. The PCQM can be influenced by aggregated (clumped) species, and estimates of PPH could vary significantly if the transect is not placed in the same location each year, or if seasonal variation resulted is a proliferation of regenerating species. For example, *Lomandra multiflora ssp. dura* was not recorded at Site 2 using the PCQM at all in 2017, but in subsequent years was detected at a density of 3062 to 3815 PPH. This does not suggest that it was not present at the Site in 2017, but rather than the methods failed to detect it, either by the placement of the transect, or various seasonal factors.

Similarly, grassland ecosystems are highly variable according to seasonal conditions and therefore visual estimates of cover, which can already be subjective due to observer experience, can cause variation and error in the data which may not necessarily be caused by the effects of WWF or management. Measures that should remain relatively stable over time (such as rock cover), can be used as indicators of this kind of observer variation, and cover of more permanent and or slow growing features, such as cryptogamic crust and *Lomandra spp.* could be used with more confidence in the long term.

4 RESULTS

4.1 Iron-grass NTG Offset Summary

The results of the 2020 monitoring are summarised in Table 5, Table 6 and Table 7, and explained and discussed in relation to previous years in further detail in the relevant sections below. Some results reported in previous years have been eliminated from the 2020 data due to irrelevance and inconsistencies in measuring/data usefulness.

Table 5. Summary of Iron-grass NTG monitoring results based on PCQM and ramble survey.

Monitoring Transect	Perennial plants per hectare (PPH)	Spacing of perennial plants (cm)	Basal width (cm)	Plant Height (cm)	% dead material	Rare flora (# of species)	Species diversity
2020							
1	194,708	22.70	16.50	16.74	23.78	1	20
2	56,892	41.90	18.03	21.53	48.74	0	21

Table 6. Number of species of each lifeform based on the 2020 (0.25 ha) ramble survey at each site.

*Lifeform	Number of species of each lifeform at each of the 50m x 50m ramble quadrats	
	Site 1	Site 2
Broad-leaf Herb	7	6
Disturbance resistant Broad-leaf Herb	5	5
Grass / Sedge	7	7
Shrub	1	3
Total	**20**	**21**
Tussock density	**Approx. 19.5 / m² (PCQM)**	**5.7 / m² (PCQM)**
***EPBC Class**	**Class B**	**Class B**

***Refer to Error! Reference source not found. for condition classes and lifeform descriptions.**

Table 7. Summary of results relating to grassland health baseline data and comparison with benchmark.

Monitoring Transect	% cryptogams	% Litter	% Bare ground	% Rock	% native cover
2020					
1	55	24	1.7	8.2	26
2	16.5	39.5	7.6	6.8	24.7
Offset Area Mean	**35.75**	**31.75**	**4.65**	**7.5**	**25.35**
***Benchmark (goal)**	**50%**	**<25%**	**<5%**	**NA**	**NA**

*** Unofficial benchmark values for Grasslands in the Northern Lofty botanical region (Pedler, Croft & Milne, 2007). Green highlights where goal has been met.**

4.2 PCQM

Table 8 summarises the findings of the PCQM survey in 2020 with an annual comparison of results since the initial survey in 2018. Results of each attribute are discussed further in sections 4.2.1 to 4.2.7.

Table 8. Summary of Iron-grass NTG monitoring results based on PCQ and ramble survey.

Monitoring Transect	Perennial plants per hectare (PPH)	Spacing of perennial plants (cm)	Basal width (cm)	Plant Height (cm)	% dead material	Rare flora (# of species)	Species diversity
2020							
1	194,708	22.70	16.50	16.74	23.78	1	20
2	56,892	41.90	18.03	21.53	48.74	0	21
2019							
1	118,497	29.05	8.30	9.60	49.80	1	17
2	60,221	40.75	11.60	11.10	50.40	1	19
2018							
1	33,916	54.30	8.90	2.75	53.50	0	9
2	52,485	43.65	8.60	2.40	53.75	0	9
Mean	**107,579**	**38.73**	**11.9**	**10.7**	**46.7**		

4.2.1 Spacing of perennial plants

Spacing of perennial plants can be used to determine the density of plants on a site and can be an indicator of changes in tussock density which may relate to seasonal conditions or long-term changes at a site. The smaller the spacing of perennial plants from the centre point, the higher the density of perennial plants, and so a downward trend would indicate an increase in perennial plant density.

The average perennial plant distance from centre point in 2020 was 22.7 centimetres (cm) ± 13.9 cm (standard deviation) at Site 1, and 41.92 centimetres (cm) ± 16.09 cm (standard deviation) at Site 2. At both sites, the standard deviation from the mean was marginally lower in 2020 than in all other years inferring that density of perennial plants was more consistent across the site (i.e. no large bare patches). Offset Site 1 is showing a downward trend in plant spacing, indicating a higher density of perennial plants since 2018, while Site 2 has remained stable.

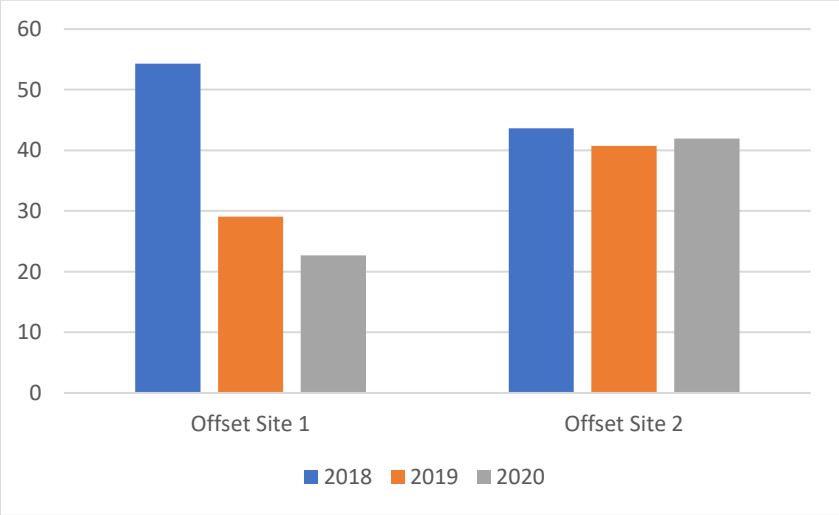

Figure 5. Average distance (cm) of grass tussocks from centre point

4.2.2 Perennial plants per hectare (PPH)

Absolute density of perennial plants is defined as the number of plants per unit area. The distances measured using the PCQM method are used to calculate density without having to count every perennial plant in an area. The estimate works by calculating the mean distance from the centre-point (sum of the nearest point-to-perennial distances in the quarters surveyed, divided by the number of quarters), for each site, and for all sites combined in any given year.

Using this calculation, density per metre squared (m^2) is calculated using the formula 1/mean density^2. This number can then be extrapolated to calculate the average number of perennial plants per hectare by multiplying the result by 10,000 (as there are 10,000m^2 in a hectare).

In 2020 the perennial plant density varied significantly between the two sites, with estimate of 194,708 plants per hectare (PPH) for Site 1, and 56,829 PPH for Site 2. The increase in PPH is consistent with the tighter spacing of perennial plants observed in 2020 at Site 1. PPH has remained steady at Site 2, but has increased exponentially at Site 1 for unexplained reasons.

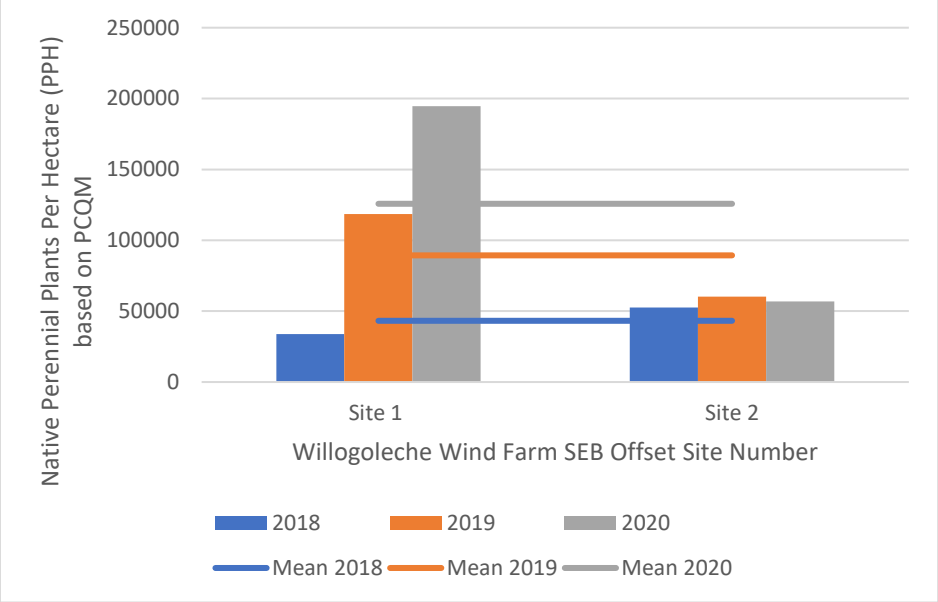

Figure 6. PPH at each Offset Site based on PCQM.

4.2.3 Plant cover

In previous years plant cover has been reported as percent canopy/foliage cover. Going forward this measure will no longer be reported due to its sensitivity to seasonal and grazing effects. Instead basal cover will be reported as it is regarded as a more stable measure of cover than canopy, particularly for perennial grasses, as the tussock bases persist even in drought conditions (DPIRD, 2020).

4.2.4 Basal cover

Basal cover or basal area is determined by considering the cross-sectional area of plants near the ground, where the diameter at ground level of a perennial plant (such as a grass tussock) is measured and then converted to calculate an approximate area (m^2) or 'footprint' of the individual plant (based on a circular tussock). It can be sensitive to factors such as stage of growth, but can also be used as an indicator of grassland maturity and regeneration. It is hoped that over the life of the project, basal area can be used to

track variation due to seasonal conditions, as well as to detect changes in the dominance of perennial plants over time. In order to increase the sample size at each site, it is recommended that the four most prevalent or important grasses be selected going forwards, to increase sample size and to track their relative importance.

In 2020, Site 1 had significantly higher basal coverage than previous years, with 59.8%% perennial plant basal coverage per hectare. Basal coverage had also increased at Site 2, to 13.45% (Figure 7), indicating that although there were slightly less plants per hectare (PPH) than previous years, plants were generally larger in size, with an average basal area of 53.68 cm^2 across both sites in 2020 compared to the three year average of 37.48 cm^2.

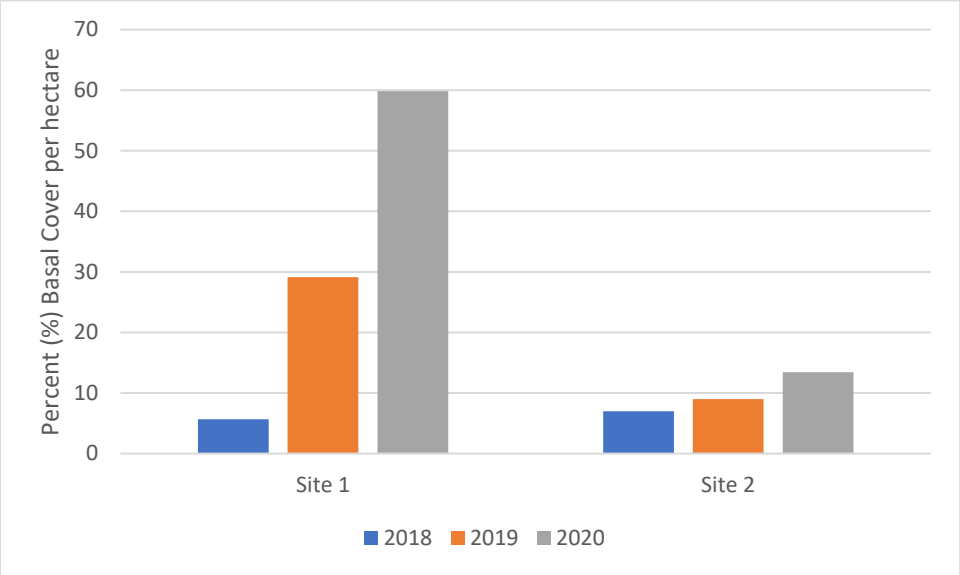

Figure 7. Percent basal cover, representing the percent of each hectare covered by a perennial plant species, measured using PCQM.

In a dry year you might expect to have a higher average basal width, but lower density due to greater distance from the centre point to the nearest plant. Whereas in good seasons, you might expect the opposite, due to a denser coverage of emergent grasses. Plants such as *Lomandra sp*, which are long lived and slow growing, should remain relatively stable in basal width, but may be variable in their relative frequency, appearing less in good years due to the presence of numerous other grasses filling in the space close to the PCQM point. Iron-grass is a long lived tussock with deep roots which hold soils together, also acting as a seed trap and providing protection from heavy grazing due to their unpalatability (NRMDB 2019). It is recommended that a frequency score for *Lomandra spp*. presence/absence be added to the 1 x 1 m2 quadrat sampling method in future years to gain a better understanding of its distribution across each site and provide an accuracy comparison for the PCQM.

4.2.5 Plant height

In previous years, heavy grazing of all perennial plants was observed across the SEB Offset site. The average perennial plant height in 2020 was 19.13cm (Site 1: 16.74 cm; Site 2: 21.53 cm), almost double that of the previous year (10.29 cm), and significantly more than the first year of survey in 2018 (2.62cm). All previous years of survey have had average or lower than average rainfall, which when combined with grazing, causes a doubled effect of reduced fodder leading to increased completion, resulting in higher grazing pressure. High rainfall in 2020 resulted in abundant feed available for both native and farmed

herbivores. Though the increased height of perennial grass within the SEB may also be reflective of a reduction in grazing pressure at the site, the seasonal conditions make it difficult to separate, and increased grass height was observed across all windfarm monitoring sites in 2020.

All of the five most common grass species have increased in height over the course of the three monitoring years. Lomandra sp. was not picked up on survey in 2020, likely due to a high density of other regenerating perennial grasses due to a higher rainfall year (Figure 8)

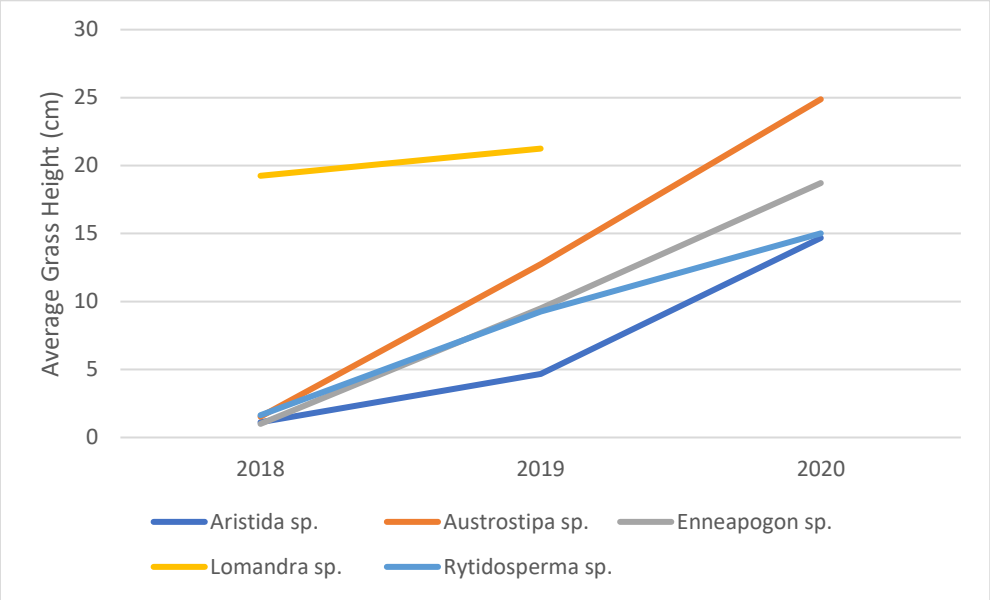

Figure 8. Average perennial grass height (five most common grasses) across monitoring years

All of the five most common grass species have increased in height over the course of the three monitoring years. Lomandra sp. was not picked up on survey in 2020, likely due to a high density of other regenerating perennial grasses due to a higher rainfall year (Figure 8)

4.2.6 Percentage dead plant material

Percentage dead material is an indicator of plant health, but can vary widely depending on factors such as seasonal conditions, time of year, and grazing pressure. A stable or downward trend is desirable over a long-term dataset, however from year to year, it is likely to be highly variable.

In 2020 the percentage of dead plant material estimated per tussock was lower than in other years, with an average of 36.10 % across both sites (Site 1: 23.78%; Site 2: 48.74%), consistent with good seasonal conditions in the months leading up to the survey. This was predominantly influenced by Site 1 which had only 23.78% dead material, compared to an average of 51% across all other monitoring periods.

4.2.7 Species composition

The most frequently recorded perennial plant species was *Rytidosperma sp*. which accounted for 38.75% of all perennial plants recorded in the PCQM survey across both sites, followed closely by *Austrostipa sp*. at 36.25% of sample points.

Lomandra was not detected using PCQM methods at either site in 2020, and as such, no density per hectare was recorded. Lomandra was detected in the ramble survey, and was noted to be in better condition than previous years, with reduction in grazing pressure evident, however it was also noted that Lolium sp. (Rye Grass) was having a smothering impact across the SEB site.

Data from the PCQM can be used to calculate an 'importance value', which provides an indication of distribution of species across the site. The measure weighs up factors of relative density (percentage of sample points species identified at), relative cover (basal area as a percentage of all species recorded at the site) and relative frequency (a measure of distribution along the transect). The relative importance value can have a maximum of 100 which would represent for example, a single species found at every sample point.

Relative importance is shown for the dominant species found across sites (if present), *Rytidosperma spp.* (Wallaby Grass), *Austrostipa spp*. (Spear-grass), *Aristida behriana* (Brush-wire Grass), *Lomandra multiflora ssp dura* (Hard Mat-rush), and *Enneapogon nigricans* (Purpletop Grass) and *Chrloris truncata* (Windmill Grass).

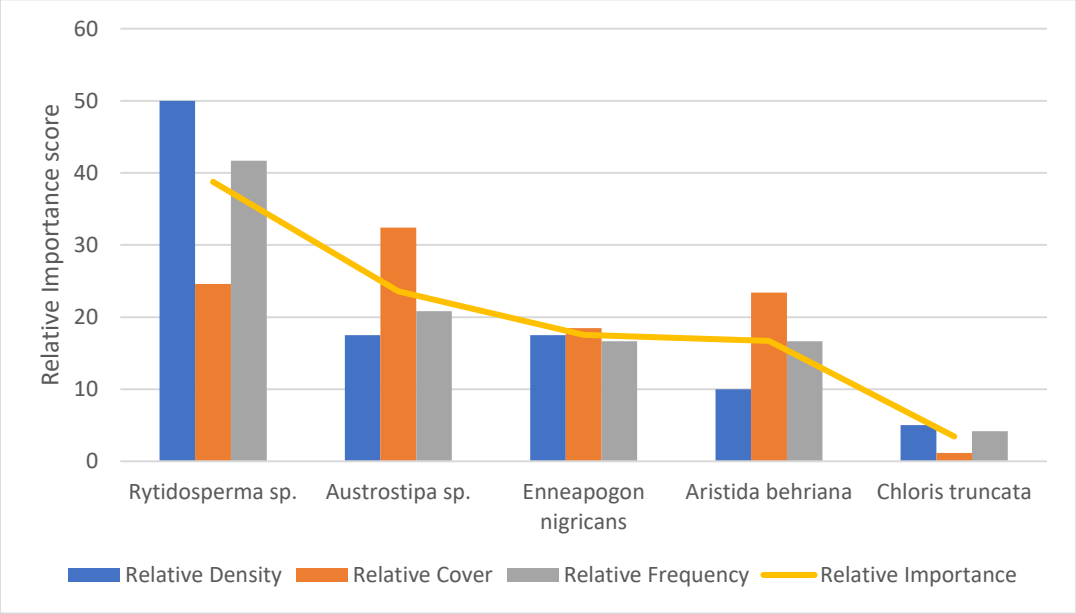

Figure 9. Offset Site 1, PCQM analysis scores for 2020 for each dominant perennial grass species.

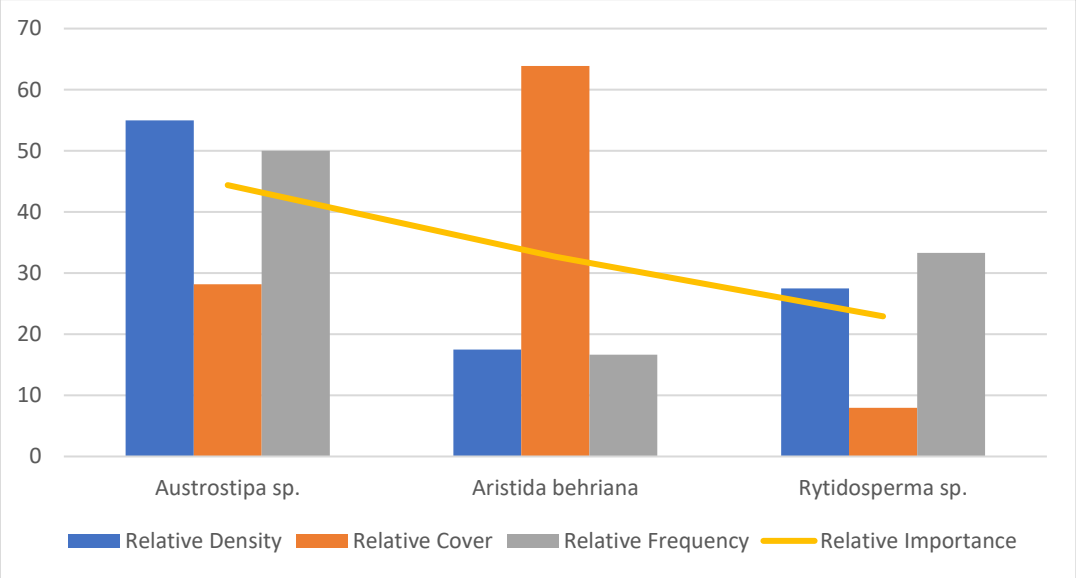

Figure 10. Offset Site 2, PCQM analysis scores for 2020 for each dominant perennial grass species.

At Site 2, *Austrostipa spp.* was the dominant species in all years, and at Site 1, *Austrostipa spp*. was most dominant in 2018, but was replaced by *Rytidosperma spp*. in 2019 and 2020. These were also the two most frequently recorded species at both sites, while *Aristida behriana* (Site 2 2020) *and Lomandra multiflora* (Site 1 2019) had the highest relative cover followed by *Austrostipa spp.*

In future, it is recommended that measurements be restricted to up to six perennial grass species (listed previously, excluding *Chrlois truncata*), to increase the robustness of the data, and other common perennial species be surveyed for presence/absence in the 1 x 1 m2 quadrats to produce a frequency score.

4.3 EPBC Ramble Survey

The 50x50m ramble search survey continues to add value to the survey effort, with a total of 27 native species observed at the SEB Offset Area in 2020, an increase from 21 species in 2019.The two sites were found to be in Condition Class B, an improvement from class C recorded in 2018. Table 9 **Error! Reference source not found.**summarises the findings at each site in relation to the EPBC Criteria across all years to date and Table 10 lists the native species and their lifeform for each site in 2020.

Table 9. EPBC Criteria by site for each year of the survey since baseline assessment in 2010, EPBC minimum criteria at top of table in red

Site (Size)	Year	Native species	Non-disturbance resistant herbaceous species	Native Grasses (excluding Lomandra)	Tussocks per m²	Condition
>0.1ha	**-**	**≥30**	**≥10**	**≥5**	**≥1/m²**	**A**
>0.25ha	**-**	**≥15**	**≥3**	**≥4**	**≥1/m²**	**B**
No min.	**-**	**≥5**	**-**	**≥1**	**-**	**C**
Site 1	2018	9	NA	7	**~3.39 / m²**	C
	2019	17	3	4	**~11.85 / m²**	B
	2020	**20**	**7**	**7**	**~19.47 / m²**	**B**
Site 2	2018	9	NA	4	**~5.25 / m²**	C
	2019	19	4	5	**~6.02 / m²**	B

	2020	**20**	**5**	**7**	**~5.69 / m²**	**B**

*Condition class estimated without all EPBC criteria values available

^ Value falls short of EPBC Class B listing.

Table 10. Native species recorded at each Lomandra Grassland Monitoring Site in 2020

Lifeform	Scientific	Native	1OFF	2OFF
Broad-leaf Herb	*Arthropodium strictum*	Common Vanilla Lily		✓
	Boerhovia dominii	Tarvine	✓	✓
	Chenopodium desertorum ssp. microphyllum	Small leaved Goosefoot	✓	
	*Rumex dumosus**	Wiry Dock	✓	
	Salsola australis	Rolypoly	✓	
	Stackhousia monogyna	Creamy candles		✓
	Vittadinia blackii	Narrow-leaf New Holland Daisy	✓	✓
	Vittadinia cuneata var.	Fuzzy New Holland Daisy	✓	✓
	Vittadinia gracilis	Woolly New Holland Daisy	✓	✓
Disturbance Resistant Broad-leaf Herb	*Convolvulus erubescens*	Grassy Bindweed		✓
	Euphorbia drummondii group	Spurge	✓	✓
	Maireana enchylaenoides	Wingless Fissure-plant	✓	
	Oxalis perennans	Native Sorrel	✓	✓
	Ptilotus spathulatus	Pussy-tails	✓	✓
	Sida corrugata var.	Corrugated Sida	✓	✓
Grass / Sedge	*Aristida behriana*	Brush Wire-grass	✓	✓
	Austrostipa blackii	Crested Spear-grass	✓	✓
	Austrostipa sp.	Spear-grass	✓	✓
	Chloris truncata	Windmill-grass	✓	
	Enneapogon nigricans	Purpletop Grass	✓	✓
	Lomandra multiflora ssp. dura	Hard Mat-rush	✓	✓
	Lomandra sororia	Small mat-rush		✓
	Rytidosperma sp.	Wallaby-grass	✓	✓
Shrub	*Atriplex semibaccata*	Berry Saltbush		✓
	Bursaria spinosa	Sweet Bursaria		✓
	Maireana aphylla	Cotton-bush		✓
	Scleranthus pungens	Prickly Knawel	✓	

*NPW Act 1972 SA Rare species

4.3.1 Rare Flora

One NPW Act listed Rare species, *Rumex dumosus* (Wiry Dock) was found across the offset area and was present at both monitoring sites. This species was also observed in previous years.

4.3.2 Grassland Health Indicators – baseline data

Table 11 provides a summary of the grassland health indicator results in comparison to the baseline survey data from 2019, and benchmark scores. Site 1 was on par with the benchmark condition scores outlined for Mid-North Grasslands (Pedler, Croft and Milne, 2007), with scores in the ideal range for cryptogam cover, litter and bare ground, indicating it is in good condition. This was an improvement from 2019, however the lower litter and bare ground scores are possibly indicative of a higher rainfall year, with a much higher (live) weed cover (described in section 4.3.3).

Interestingly Site 2 showed a significant decrease in cryptogam cover, possibly obscured by the dense weed coverage in 2020. Continuing to monitor these attributes will provide an indication of meaningful change over time, and ideally these scores will be consistently within the benchmark range regardless of seasonal conditions.

Table 11. Summary of results relating to grassland health baseline data and comparison with benchmark.

Monitoring Transect	% cryptogams	% Litter	% Bare ground	% Rock	% native cover
2020					
1	55	24	1.7	8.2	26
2	16.5	39.5	7.6	6.8	24.7
2019					
1	56.50	56.00	12.90	7.00	20.80
2	42.50	73.45	13.50	12.80	15.30
Offset Area Mean	**42.6**	**48.23**	**8.9**	**8.7**	**21.7**
***Benchmark (goal)**	**50%**	**<25%**	**<5%**	**NA**	**NA**

*** Unofficial benchmark values for Grasslands in the Northern Lofty botanical region (Pedler, Croft & Milne, 2007). Green highlights where goal has been met.**

Figure 11. Snapshot of ground cover at Site 1 showing healthy a Lomandra tussock interspersed with *Arthropodium spp.* and weedy *Avena barbata*.

4.3.3 Weeds

Based on the cover Ratings assessed in 1m x 1m transects along Offset Area Monitoring Transects, the total mean average percentage weed cover is 57.43%, with Site 2 having a higher percentage of weed cover (66.3%) compared with 18.08% at site 1 (48.5%) (**Error! Reference source not found.**). These figures are significantly higher than weed cover observed in 2019, with a total average weed cover of 29.66%. Average weed cover at both sites was more than double, with Site 1 increasing from 18.08% to 48.55%, and at Site 2 increasing from 33.04% to 66.3%. In 2019 weeds were noted to have predominantly died off by the time of survey and therefore exotic litter cover was more representative of weed cover, showing a similar weed density of 64.73%. Two weed species, Brome (*Bromus sp.*) and Cut-leaf Herons Bill (*Erodium cicutarium*), were not recorded at either site in 2020, likely unobservable due to seasonal differences / timing. The most common weed species were Oat grass (*Avena sp*.) and Burr Medic (*Medicago polymorpha*), followed by Rye grass (*Lolium sp.*) and Clover (*Trifolium sp*.). Despite widespread proliferation of Declared weed Salvation Jane (*Echium plantagineum*) across the region following a higher rainfall year, the SEB Offset did not show a significant increase in this species at either of the monitoring sites.

Table 12. Average coverage (%) of weed species (quadrat sampling) at each Assessment Site (Site) in 2020.

Species	Common	Site 1 (%)	Site 2 (%)	Overall Weed cover per species (%)
Avena barbata	Bearded Oat	10.9	14.2	12.55
*Echium plantagineum**	Salvation Jane	4.7	1	2.85
Lepidium africanum	Common Peppercress	1.75	0	0.875
Lolium sp.	Rye Grass	2.4	13	7.7
Medicago polymorpha var. *polymorpha*	Burr-medic	12	12.3	12.15
Moraea setifolia	Thread Iris	1	0.5	0.75
Romulea rosea	Onion grass	3.7	3.7	3.7
Salvia verbenaca	Wild Sage	0	8	4
Sonchus oleraceus	Sow Thistle	0	0.05	0.025
Trifolium angustifolium	Narrow-leaved clover	0.5	6.6	3.55
Trifolium arvense	Rabbitfoot clover	10.9	2.8	6.85
Vulpia sp.	Fescue	0.7	3.65	2.175
Total weed coverage (%)		**48.55**	**66.3**	**57.425**

***Declared plant under the Landscape South Australia Act 2019.**

Three new weeds were identified in the Offset Area in 2020:

- Lucerne *(Medicago satvia*) along the transect at Site 1 (Figure 12);
- Sowthistle (Sonchus oleraceus) small outbreak within Site 1 (Figure 13); and
- Wild Fennel *(Foeniculum vulgare)* in the southeast corner along the fence-line (Figure 14, Figure 15)

It is recommended that these two weeds be targeted for removal, along with scattered Horehound (*Marrubium vulgare*), Artichoke Thistle (*Cynara cardunculus*) and Sowthistle (*Sonchus oleraceus*) which occur in low numbers but have the potential to become invasive within the Offset Area.

In general Site 1 was noted to be in fair condition, with healthy and regenerating native grasses, though sparse Lomandra tussocks and limited non-disturbance resistant broad-leaf herbs, reasonable cryptogam cover, and moderate weed coverage dominated by Wild Oats (*Avena*) and Clover species (*Trifolium spp*.)

Site 2 was noted to be in poor to fair condition, with abundant weeds dominated by Wild Oats (*Avena*), Clover (*Trifolium spp*), Rye Grass (*Lolium spp*.) plus scattered Salvation Jane (*Echium plantagineum*) and Wild Sage (*Salvia verbenaca*). Native grasses were however observed to be healthy, regenerating and producing seed.

-

Figure 12. Lucerne (*Medicago satvia*) observed for the first time at Site 1 within the Offset area.

Figure 13. Small outbreak of Sowthistle (*Sonchus oleraceus*) at Site 1 within the Offset area.

Figure 14. Fennel (*Foeniculum vulgare*) in relation to southern fenceline.

Figure 15. Close-up of Fennel within Offset area.

5 DISCUSSION

5.1 Summary of Condition

The Offset Area is still in its early years of establishment and significant improvements are expected to become more evident in years to come. The 2020 survey was undertaken following a break in drought conditions and therefore many of the changes observed in the survey can be attributed to this. Assessment Site 1 remains in better condition than Site 2, with higher native species diversity, lower weed cover, higher perennial grass tussock density and grassland condition indicators in line with benchmark conditions.

The Offset Area has visibly improved in terms of a reduction in grazing pressure. In previous years, the combination of drought and unrestricted grazing was evident in the poor health and condition of perennial grass tussocks and PCQM plant attributes such as height and percentage dead material. In 2019 it was noted that grazing pressure had reduced since 2018, but with continued drought conditions the improvement was minimal. In 2020 the combination of reduced grazing and increased rainfall made a significant improvement to the Offset Area, and demonstrates the importance of continued management to maintain the positive trajectory.

The increased rainfall in 2020 created opportunities for weed species to set seed, with weed cover observed to be higher than all previous surveys and three new species observed in the Offset Area. Therefore, a carefully implemented and managed grazing regime as outlined in the Offset Management Plan (OMP) (EBS 2017) is imperative to continue to the positive trend, and to limit the likelihood of weedy species dominating the grassland and shading out opportunities for new growth of broad-leaved herbaceous species.

The PCQM results indicate an improvement in condition since the 2018 survey with increases in tussock height and width. The number of perennial tussocks had also increased with more tussocks per hectare and decreased plant spacing (Table 13). This may indicate an improvement in the size and quantity of individual grasses in the Offset Area, or may be due to data variability. Long term trends may be more relevant.

Table 13. Summary of Iron-grass NTG monitoring results based on the PCQM and ramble surveys.

Year	Perennial plants per hectare (PPH)	Spacing of perennial plants (cm)	Basal width (cm)	Plant Height (cm)	% dead material	Rare flora (# of species)	Species diversity
Mean 2018	43,201	48.98 cm	8.8 cm	2.6 cm	53.6 %	0	Not collected
Mean 2019	89,359	34.9 cm	10 cm	10.4 cm	50.6 %	1	18 species
Mean 2020	125,800	32.3	17.27	19.14	36.3%	1	20.5 species
*Trend	+ ve	+ ve	+ ve	+ ve	+ ve	+ve	+ve

***+ ve: indicates desirable (positive) trend. – ve indicates undesirable trend (no undesirable trends observed).**

The baseline data collected in 2018, together with additional data collected in 2019 and 2020, indicate low to moderate species diversity and a moderate diversity of lifeforms. However, less resilient plant types such as broad-leafed herbs are occurring at very low abundance, whilst grasses particularly *Rytidosperma* spp. dominate over other species (**Error! Reference source not found.**, **Error! Reference source not found.**). A change in the composition of perennial grass species dominance (as indicated by the Relative

Importance score) may be indicative of improved grassland health, however it is also likely that seasonal conditions may have caused this change. Both Sites remain as Class B Iron-grass NTG communities (**Error! Reference source not found.**).

There remains significant improvement that can occur at the Offset Area and it is important to monitor grassland attributes, grazing pressure and weed cover and ensure livestock are removed timely in spring to allow herbs to set seed and regenerate and ensure that vulnerable species are not lost from the system. It may be desirable to remove livestock in mid (rather than late) spring to facilitate regeneration, particularly during times of dry climatic conditions when there is reduced available feed. Conversely, following years of higher rainfall, livestock should be introduced earlier in the season to enable grazing of annual weedy species before they set seed.

5.2 Progress against minimum targets for key indicators in the OMP

The key indicators that have been set as targets for the management of the Offset Area (Refer OMP (EBS Ecology 2017)), the current status of the site and the trend are indicated in Table 14. Values indicate that the Offset Area has maintained benchmark goals for listing as a Class B Iron-grass NTG site and has improved in condition since establishment. However, the site remains in poor condition and further increases in diversity, native cover and the abundance of broad-leaf herbs are desirable, particularly of non-disturbance resistant broad-leafed herbs (**Error! Reference source not found.**). Without further restriction of grazing animals, it is unlikely that herbaceous species will be able to flourish given that these are more often the most palatable species.

Table 14. Status of the Offset Area in relation to TEC condition indicators as per the Iron-grass NTG listing criteria and OMP (DotEE 2007).

Attribute Description	Goal	Current status		Reached benchmark for Class B Iron-grass NTG site
		Site 1	Site 2	
Increase the diversity of native species from nine (baseline value) to above 15.	15 (or more)	20	21	Yes
Increase the number of broad-leaved herbaceous species (in addition to disturbance resistance species) to three or more.	3 (or more)	7	5	Yes
Increase the number of perennial native grass species to four or more species.	4 (or more)	7	7	Yes
Increase the density of tussock grass species to one per metre.	>1 / m²	19.5 / m²	5.7 / m²	Yes
Status		**Class B**	**Class B**	

5.3 Recommendations

5.3.1 Grazing Management

Grazing management recommendations remain largely the same as previous reporting periods (repeated for clarity below).

Ideally a grazing management plan that allows for indigenous species to set seed and compete a full lifecycle, while reducing the density of annual invasive species which smother and outcompete indigenous species for light and moisture resources is undertaken on a rotational basis. The following approach is recommended;

- Minimum food on offer in any paddock at any time should be 1000 kg ha/DM. If there is less dry matter than 1000kg (assuming 50% utilisation), then grazing should not occur.
- At no time should animals be left in any paddock for longer than seven days, irrespective of the amount of feed in the paddock. After seven days, any actively growing plants will be in danger of being overgrazed, and animal performance will be compromised. Moving the animals onto fresh native grassland pasture, and allowing the grazed pastures to rest and plants to recover, with a return grazing later in the season, will result in healthier grassland and better animal performance.

- The grazing period is between 30 April and 15 November at the latest. However during dry conditions, it is recommended that livestock are introduced later (i.e. mid-winter) and removed earlier (e.g. mid-spring). Spring is the growing season for most plants in the grassland and in favourable conditions a week should be acceptable as a maximum grazing period provided there is enough feed. The time allowed for spelling between grazing events will vary according to the conditions and the time of year. An average of 35 days is likely to be adequate. However, longer spelling and shorter grazing durations will assist in facilitating native plants and herbaceous species to flower and set seed.

Grazing management requires adjusting to reflect climatic conditions and although it is a useful tool in weed control and reducing thatch on grasses, during extreme dry conditions livestock numbers require adjusting accordingly to enable plants to reshoot and retain enough green plant material to survive.

5.3.2 Weed management

Weeds should be managed opportunistically and without the use of selective herbicides due to sensitivity of native species. Woody weed and targeted herbaceous species can be manually managed within the Offset Area. Based on the 2020 survey the following weed control measures are recommended:

- Use short term winter grazing to control winter active grassy weeds such as Wild Oats.
- Graze earlier (i.e. late autumn) in above average rainfall years, and later (i.e. mid-late winter) in lower than average rainfall years.
- Remove Declared Weed Horehound through hand pulling (grubbing out) or spot spraying (observed at monitoring Site 1, and in large patches on the eastern side of the paddock).
- Remove small patch of Artichoke Thistle near Site 1 by hand pulling, ensuring trap root is removed to prevent re-establishment. Alternatively/additionally cut flower stems opportunistically before reaching maturity to reduce seed production.
- Remove small patch of Fennel from south-eastern edge of Offset Area by hand pulling and continue to monitor disturbed patch to prevent re-establishment in these areas.
- Where feasible target Declared Weed Salvation Jane, prioritising areas where the weed is at low abundance.
- Remove any emergent woody weeds such as African Boxthorn (not observed).
- Monitor the site for new weeds and control promptly to avoid spread.

There is potential for the introduction of additional weeds associated with the introduction of new stock to the property. Sheep can readily carry weed seed in the wool from a previous property which can be accidentally deposited on the new property. There may a need for a quarantine procedure before introducing new stock into the Offset Area, where stock could be kept outside the site for a minimum period of seven days prior to entry to the Offset Area paddocks. A quarantine procedure would not be necessary when the sheep are from the same property.

5.3.3 Methodology

Methodology should remain largely the same in subsequent years, however several alterations to the method are suggests:

- Remove measure of ‘canopy cover’ from PCQM methodology, as it does not provide a useful guide and is highly susceptible to seasonal conditions.
- Measure a maximum of five dominant perennial grass species in the PCQM methodology to allow for a more robust measure of plants per hectare (Lomandra, Rytidosperma, Austrostipa, Aristida, Enneapogon).
- Add presence / absence measure for Lomandra tussocks within the grassland health monitoring indicators to provide an idea of density and frequency of Lomandra tussocks per hectare.

6 REFERENCES

Bureau of Meteorology (BOM) (2020) Climate Data Online: Monthly rainfall: Hallett (Lorraine) # 21024. Retrieved from:

http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=21024 [Accessed 7/02/2020].

Cunningham, GM. Mulham, WE. Milthorpe, PL. Leigh, JH. (1992) Plants of Western New South Wales CSIRO Publishing 37:451-460.

DEH, 2003 Mokota Conservation Park Management Plan Mid-North, Government of South Australia

DotEE 2007 EPBC Act Policy Statement 3.7 for Nationally Threatened Species and Ecological Communities: Peppermint Box Woodland of South Australia and Iron-grass Natural temperate Grasslands of South Australia.

DotEE 2012 Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy

EBS Ecology (2012) Willogoleche Wind Farm Regional Lomandra Assessment. Report to Client. EBS Ecology, Adelaide.

EBS Ecology (2013) Willogoleche Hill EPBC Offset area Investigation. Report to Client. EBS Ecology, Adelaide.

EBS Ecology (2017) Willogoleche Wind Farm Offset Management Plan (OMP). Report to ENGIE. EBS Ecology, Adelaide.

EBS Ecology (2018) Willogoleche Wind Farm Offset Monitoring 2018, Report to ENGIE. EBS Ecology, Adelaide.

Pedler, J.A., Croft, S.J. & Milne, T.I (2007) Bushland condition monitoring manual: Northern Agricultural & Yorke Peninsula regions. Published by Nature Conservation Society of South Australia

Northern and Yorke Natural Resources Management Board (NY NRM) (2018) Northern and Yorke Regional NRM Plan: Strategic Plan 2019-2029. Natural Resources, Northern and Yorke, Government of South Australia. Available at: https://www.naturalresources.sa.gov.au/files/sharedassets/northern_and_yorke/corporate/board/2019-29-strategic-plan-signed.pdf [Accessed 21/02/2020].

Tongway, D.J., and Hindley, N.L. (2005) Landscape Function Analysis: Procedures for monitoring and assessing landscapes. With special reference to Mine sites and Rangelands. CSIRO Sustainable Ecosystems, Canberra.

Turner, J. (2012). National Recovery Plan for the Iron-grass Natural Temperate Grassland of South Australia ecological community 2012. Department of Environment and Natural Resources, South Australia.

7 APPENDICES

7.1 Appendix 1. Photo points

Figure 16. Transect 1 start (looking south) 2018

NA

Figure 17. Transect 1 end 2018

Figure 18. Transect 1 start (looking south) 2019

Figure 19. Transect 1 end (looking north) 2019

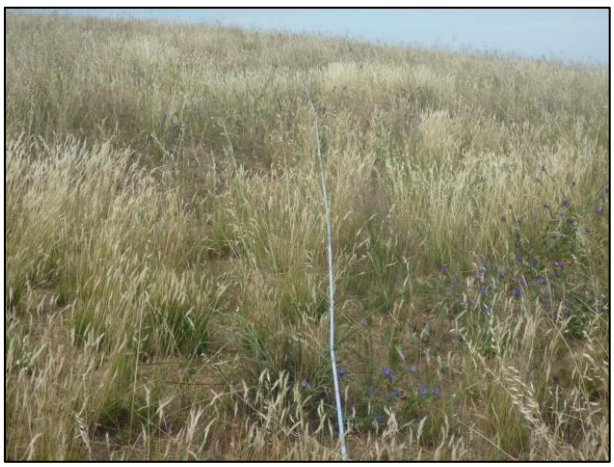

Figure 20. Transect 1 start (looking south) 2020

Figure 21. Transect 1 end (looking north) 2020

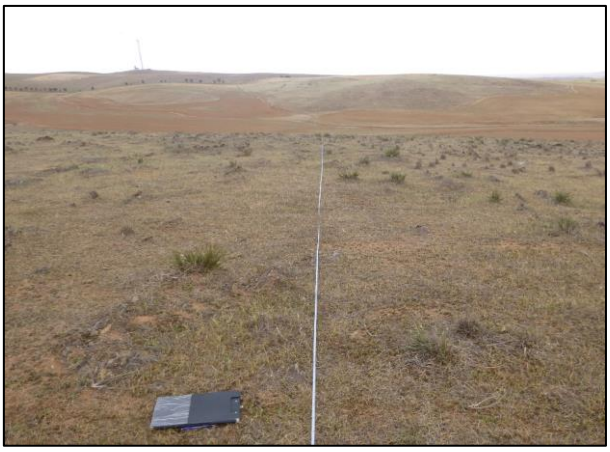

Figure 22. Transect 2 start (looking south) 2018

NA

Figure 23. Transect 2 end 2018

Figure 24. Transect 2 start (looking south) 2019

Figure 25. Transect 2 end (looking north) 2019

Figure 26. Transect 2 start (looking south) 2020

Figure 27. Transect 2 end (looking north) 2020

Figure 28. SE corner looking north along fence

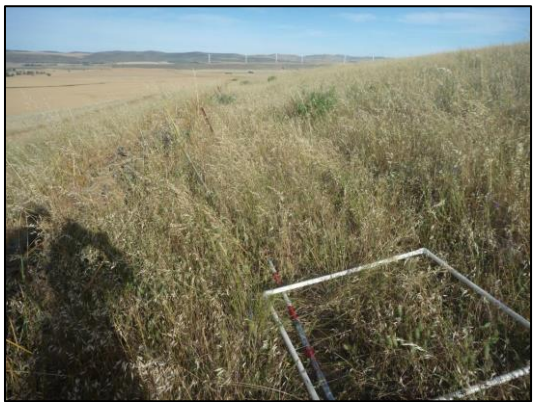

Figure 29. SE corner looking west along fence

Figure 30. NW corner looking east

Figure 31. NW corner looking south

Figure 32. NE corner looking south

Figure 33. NE corner looking west

Figure 34. SW corner looking north

Figure 35. SW corner looking east

7.2 Appendix 2. Activity Record Datasheet

Activity Record Datasheet - ***To be filled in by landholders as work progresses, then issued to ENGIE at the end of each financial year***

Management Action (e.g. fox baiting / shooting, boxthorn control, horehound control)	**Date**	**Time spent on task (hrs / days)**	**Comments (Completed/more remaining/ follow up required – provide estimate of time remaining)**

7.3 Appendix 3. Paddock Monitoring Sheet

Paddock Monitoring Sheet - *To be filled in by landholders as grazing management progresses*

Source: Mid North Grasslands Working Group and Land Water & Wool (1986)

Paddock Name:.....											
Paddock Size	**Date in**	**Date out**	**A. Grazing Days**	**B. Estimate of feed left (kg/DM/ha)**	**C. Sheep number and type**	**D. DSE rating**	**E. Total DSE of mob**	**F. Feed utilised (kg)**	**G. Rest Period (days)**	**I. DSE days/ha**	**J. DSE days/ha/yr**

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