



## Broken Hill Solar Plant Biodiversity Offset Site

Annual Ecological Monitoring Report Year 3 – 2019/20

1 | Final

February 7, 2020

AGL



## Broken Hill Solar Plant Biodiversity Offset Site

**Project No:** IA207500  
**Document Title:** Annual Ecological Monitoring Report Year 3 – 2019/20  
**Document No.:** 1  
**Revision:** Final  
**Document Status:**  
**Date:** February 7, 2020  
**Client Name:** AGL  
**Client No:**  
**Project Manager:** Lukas Clews  
**Author:** Timothy Maher  
**File Name:** IA207500\_monitoring report\_Broken Hill\_Year 3\_Final

Jacobs Group (Australia) Pty Limited  
 ABN 37 001 024 095  
 Level 7, 177 Pacific Highway  
 North Sydney NSW 2060 Australia  
 PO Box 632 North Sydney  
 NSW 2059 Australia  
 T +61 2 9928 2100  
 F +61 2 9928 2444  
[www.jacobs.com](http://www.jacobs.com)

© Copyright 2020 Jacobs Group (Australia) Pty Limited. The concepts and information contained in this document are the property of Jacobs. Use or copying of this document in whole or in part without the written permission of Jacobs constitutes an infringement of copyright.

Limitation: This document has been prepared on behalf of, and for the exclusive use of Jacobs’ client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this document by any third party.

### Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
Draft	20/01/2020	Draft	T. Maher	L. Clews	L. Clews	L. Clews
Final	07/02/2020	Final	T. Maher	L. Clews	L. Clews	L. Clews

## Contents

<b>Executive Summary</b> .....	<b>iv</b>
<b>1. Introduction</b> .....	<b>1</b>
1.1 Background and study area .....	1
1.2 Objectives.....	1
<b>2. Monitoring method</b> .....	<b>3</b>
2.1 Requirements .....	3
2.2 Field survey .....	3
2.2.1 Vegetation condition assessment and establishment of monitoring plots.....	4
2.2.2 Habitat evaluation .....	6
2.3 Limitations.....	6
2.3.1 Climatic conditions.....	6
2.3.2 Grazing pressure .....	7
2.3.3 Data analysis.....	7
<b>3. Monitoring results</b> .....	<b>8</b>
3.1 Plot data descriptions and benchmark comparisons .....	8
3.1.1 Black Bluebush low open shrubland .....	8
3.1.2 Mulga-Dead Finish on stony hills.....	11
3.1.3 Prickly Wattle open shrubland .....	12
3.1.4 Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland .....	14
3.1.5 Old Man Saltbush shrubland.....	15
3.2 Weeds and disturbance .....	18
3.3 Fauna Habitats .....	18
3.4 Results summary and discussion.....	21
3.4.1 Species richness .....	21
3.4.2 Cover of native and exotic vegetation .....	21
3.4.3 Discussion .....	23
3.5 Fence maintenance.....	23
<b>4. Management Actions</b> .....	<b>25</b>
<b>5. Conclusions and recommendations</b> .....	<b>28</b>
<b>6. References</b> .....	<b>29</b>
<b>Appendix A. Flora species list and opportunistic fauna list</b> .....	<b>30</b>
<b>Appendix B. Condition of Approval (COA) C5</b> .....	<b>34</b>

## Executive Summary

As per the requirements of the Conditions of Approval (COA) the Broken Hill biodiversity offset site is required to be monitored and the results reported annually to the Department of Planning, Industry and Environment (DPIE). Condition C5(b) specifically states that the biodiversity outcome to be achieved must 'improve or maintain' the biodiversity values of the site. This report outlines the results of the third monitoring survey for the offset site since the baseline study recorded in the Biodiversity Offset Management Plan (BOMP) by NGH (2013).

Overall the recent monitoring results demonstrate that biodiversity values across the site have declined with regards to floristic diversity, vegetation cover and vegetation quality when compared to the vegetation community benchmarks (as published by DECC 2008), baseline survey results recorded by NGH (2013), and the Year 1 and Year 2 monitoring surveys. The decline in condition observed is likely to be caused by ongoing drought conditions. The prolonged period of dryness has inhibited the growth of many plant species and several species were not able to be identified or relocated during this round of monitoring as reproductive features were absent or the plants were not present. However, it is likely that the absent species are present as seed in the soil stored seed bank within the ground. A return to average or higher rainfall conditions would likely allow for the recovery of the vegetation and higher floristic diversity, vegetation cover and vegetation quality scores can be expected in the future.

The management actions proposed will further assist the natural regeneration once rainfall conditions suitable for plant growth return.

Stock proof fencing around the offset site is in good condition, though there are a number of places where sheep have dug under the fence to access the site. Management actions have been suggested to remedy this. It is likely that with the fencing in place the biodiversity values of the site will continue improve through the exclusion of feral goats and any livestock, allowing for natural regeneration to occur when rainfall conditions permit.

Fauna habitats across the site are somewhat diverse and include; bare ground, chenopods, rocky patches, tussock grasses and some taller shrubs. These habitats have been maintained, except for the groundcover which has declined due to lack of rainfall. These habitats may improve with the adjustment of fencing and consequent exclusion of grazing from feral goats and a return to near average or greater rainfall. With the fences in place no further feral pest management is recommended until after a re-evaluation of vegetation condition and fauna habitats during the next monitoring event in Year 4.

Weed infestations across the site are generally low and can be maintained by spot treatment as outlined in the management actions. Weeds of concern include the state and regional priority weeds (LLS 2017) Velvet Mesquite and African Boxthorn, which are required to be eradicated from the site to prevent further spread to surrounding lands. Peppercorn Tree infestations within the centre of the site provide habitat for a variety of birds, including babbler species. There are numerous active babbler nests throughout these trees and as such complete removal is not recommended. Control of emerging saplings, selective thinning of those trees not containing nests and replacement planting with native species would allow for the infestation to be gradually reduced while maintaining fauna habitat.

## **1. Introduction**

### **1.1 Background and study area**

In 2014, AGL Energy Limited (AGL) constructed a solar photovoltaic (PV) plant with a nominal capacity of 50 MW at Broken Hill in western NSW as part of the Commonwealth Solar Flagships Program. The solar plant is located on a property to the west of the Broken Hill township at Lot 6806 DP 823918 and is approximately 200 hectares (ha) in area. The location of the solar plant, access and transmission easements and offset site are shown in (Figure 1.1). The offset site is located 1.5 km west of the solar plant site, comprising the western portion of the same lot, Lot 6806 DP 823918, covering approximately 162 ha (see Figure 1.1).

The project was approved by the Department of Planning and Infrastructure (DP&I) on the 27 March 2013. It is a condition of approval (COA) that an Offset Management Package be developed to offset the ecological values lost as a result of the project (COA C5 is provided in Appendix B).

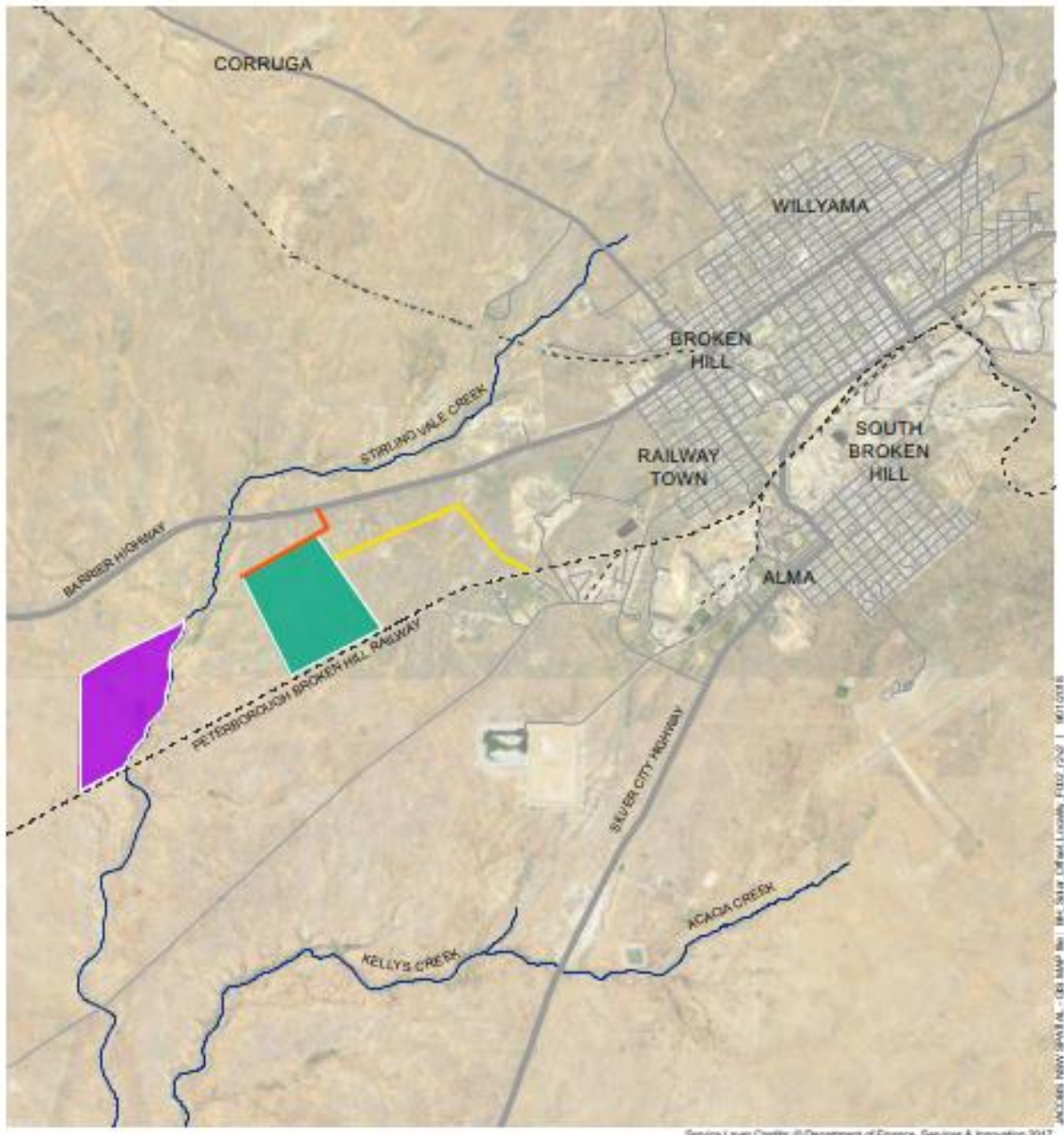
AGL engaged the existing lessee of the solar plant site to include a suitable area of land for offsetting within the scope of the project. Ownership of the plant and associated biodiversity offset was transferred from AGL PV Solar Developments Pty to PARF Company 6 Pty Limited as trustee of the Project Trust and PARF Company 4 Pty Limited as trustee of the Subhold Trust in November 2016. AGL Hydro Partnership are responsible for the ongoing operation of the plant and maintenance of the offset site, with First Solar (Australia) Pty Ltd providing maintenance services for the first five years of the plant's commercial operation.

### **1.2 Objectives**

This report documents the results of the third annual (Year 3) ecological monitoring event for the offset site as required under Condition of Approval (COA) C5. Monitoring of the offset site is required to demonstrate an 'improve or maintain' outcome for the identified biodiversity offset values at the site and to identify any management or remedial actions required to achieve these outcomes.

Monitoring requires the collection of ecological data, consistent with the methodology described in the Biodiversity Offset Management Plan (BOMP) prepared by NGH Environmental (2013). The results are described and analysed with comparison to the baseline data from the BOMP (NGH 2013) and those of the first and second year monitoring events to determine if there have been any significant changes in the vegetation and habitat conditions and the consistency of these with the objective of improving or maintaining the biodiversity values on the site.

In addition, an evaluation was undertaken of any required management actions and their effectiveness, as outlined in the BOMP (NGH 2013) and the standard management actions required to be undertaken at offset sites outlined in the BioBanking Assessment Methodology (BBAM 2009) including management of grazing for conservation, weed control, management of fire for conservation, management of human disturbance, retention of regrowth and remnant native vegetation, replanting or supplementary planting where natural regeneration will not be sufficient, retention of dead timber, erosion control and retention of rocks.



Legend

- Offset site
- Solar plant site
- Access easement
- 22kV aboveground easement

Figure 1.1 Broken Hill Solar Plant and offset site location

## 2. Monitoring method

### 2.1 Requirements

The monitoring method is consistent with the methodologies outlined in the BOMP (NGH 2013) and meets the requirements of the COA C5. In particular, COA C5(b) stipulates the requirement of the offset site to achieve an 'improved or maintained' outcome for the biodiversity values of the site. Improved or maintained outcomes for the biodiversity values of the offset site have been evaluated through the comparison of monitoring data against the benchmark data, baseline data and the results of the first and second monitoring event for each surveyed vegetation community as well as the evaluation of weed infestation and fauna habitat. An overview of the monitoring methods used include:

- Vegetation condition assessment. Following the methodology used in the BOMP (NGH 2013), assessment was undertaken using the BioBanking Assessment Methodology (DECC 2009) to collect data on vegetation structure, cover and quality across transects and within plots. This data was then compared with the NGH (2013) baseline data where available and the benchmark data for each vegetation community type using the Vegetation Benchmarks Database (DECC 2008).
- Habitat evaluation. Notes on fauna habitat were taken across the broader site while traversing the site to reach the monitoring plots. At each monitoring plot detailed notes were taken.
- Fencing evaluation. Fences were assessed through observation by driving and walking around the perimeter of the site, looking for any areas requiring maintenance.

### 2.2 Field survey

Field survey was undertaken by two Jacobs Ecologists, Matt Consterdine and Tim Maher, on the 16th of December 2019 across the five vegetation types identified within the offset site (listed in Table 2.1 below and shown on Figure 2.2) by NGH (2013).

**Table 2.1 Vegetation types within the offset site**

Vegetation Type (DECC 2008)	PCT ID	Area in offset site (ha)	Monitoring plots sampled by NGH (2013)	Monitoring sampled by Jacobs (2017-2019)	BBAM (DECC 2009) No. of plots required (see Table 2.2)	Threat category (Benson, 2006)*
Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	221	141.8	M03 (1 plot)	M03 & M07 (2 plots)	4-6 plots	Near threatened
Prickly Wattle open shrubland of drainage lines on stony rises and plains of the arid climate zone	136	8.5	M01 (1 plot)	M01 (1 plot)	2-3 plots	Least concern
Narrow-leaved Hopbush - Scrub Turpentine - Senna	143	1.9	M04 (1 plot)	M04 (1 plot)	1 plot	Least concern

Vegetation Type (DECC 2008)	PCT ID	Area in offset site (ha)	Monitoring plots sampled by NGH (2013)	Monitoring sampled by Jacobs (2017-2019)	BBAM (DECC 2009) No. of plots required (see Table 2.2)	Threat category (Benson, 2006)*
shrubland of semi-arid and arid sandplains and dunes						
Mulga - Dead Finish on stony hills mainly of the Channel Country and Broken Hill Complex Bioregions	123	1.5	M02 (1 plot)	M02 (1 plot)	1 plot	Near threatened
Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW)	159	3.2	Not surveyed by NGH (2013)	M05 & M06 (2 plots)	2 plots	Critically Endangered*

\* This category is according to Benson (2006); none of these communities are listed under State or Commonwealth legislation

### 2.2.1 Vegetation condition assessment and establishment of monitoring plots

BioBanking plots were to be surveyed according to the BioBanking Assessment Methodology (BBAM) (DECC 2009), as outlined in COA C5 (Appendix B) and in the BOMP (NGH 2013).

Floristic data was collected to enable comparison between baseline data and benchmarks recorded in the BOMP (NGH 2013). The four monitoring plots established by NGH (2013), were located at the site using recorded GPS coordinates. These plots were previously marked in the field using wooden stakes driven into the ground to facilitate future replication. Stakes were placed at the start and end of a 50 metre transect and their coordinates recorded. Start points were delineated with a silver pin hammered into the top of the stake. A 20 x 20 metre quadrat required by the BBAM (DECC 2009) was conducted within an area bounded by the first 20 metres of the transect and extending 10 metres either side, see Figure 2.1. Where required, stakes that had deteriorated in the field over time were replaced with new, thicker stakes and pins. Photographs were taken at the start and end of each monitoring plot. The location of all vegetation types and monitoring plots are shown in Figure 2.2.

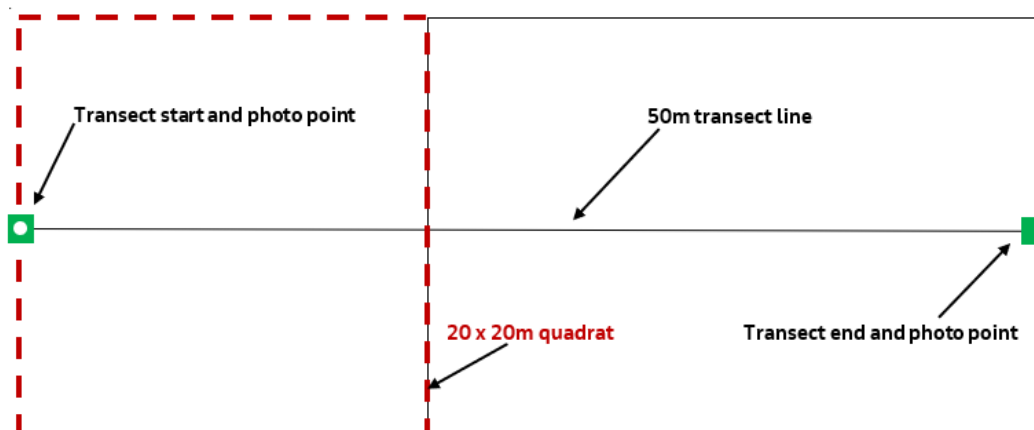
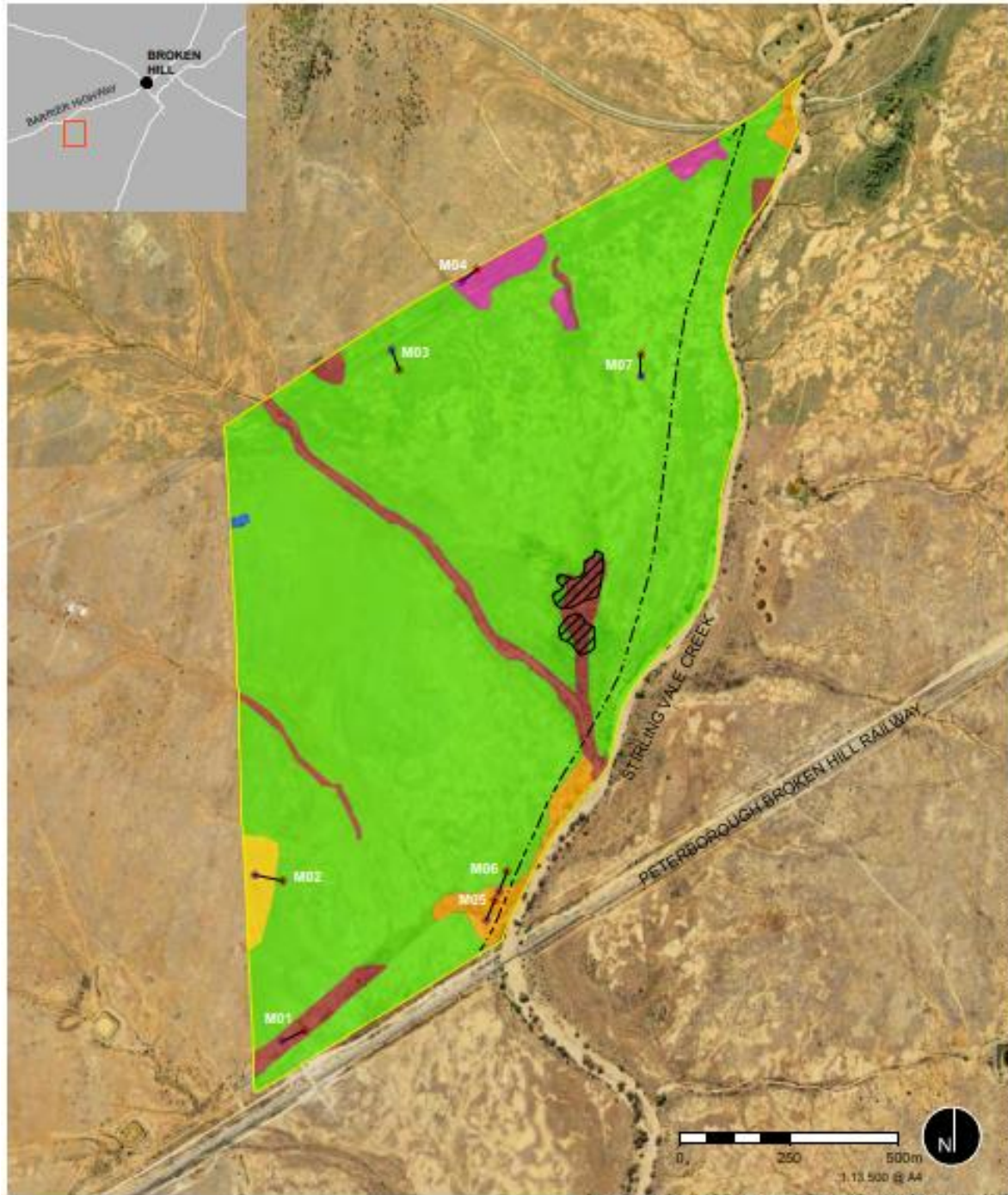


Figure 2.1: Monitoring plot method





Service Layer Credits: © Department of Finance, Services & Innovation 2017

Legend

Site boundary	<b>Transects</b>	<b>Vegetation</b>	
Fence line	Start	Pepper tree infestation	Old man saltbush shrubland
	Finish	<b>Vegetation communities</b>	Prickly wattle open shrubland
	Monitoring transect	Black bluebush low open shrubland	Sandhill wattle tall open shrubland
		Mulga - dead finish	Senna shrubland

Figure 2.2 Vegetation types and monitoring plots within the Broken Hill Offset Site

### 2.2.2 Habitat evaluation

Detailed habitat notes were taken at each of the monitoring plot locations and included the percentage cover of the following habitat features within the entire 50 x 20 metre plot:

- Tussock grasses
- Chenopod shrubs
- Mulga (or other overstorey species)
- Bare ground
- Cracking clay
- Rocks and logs.

## 2.3 Limitations

### 2.3.1 Climatic conditions

Broken Hill is a typically dry, semi-arid area that experiences low rainfall. However, average rainfall was not received for any month of 2019, as seen in Figure 2.3, and below average rainfall was also received in 2018. This prolonged dry weather preceding the survey had caused many plants to die making them difficult to identify, and it is likely that there are multiple species present in the seed bank that were not evident during the survey. The results of this round of monitoring surveys, and the previous round of monitoring surveys need to be interpreted against the background of below average rainfall.

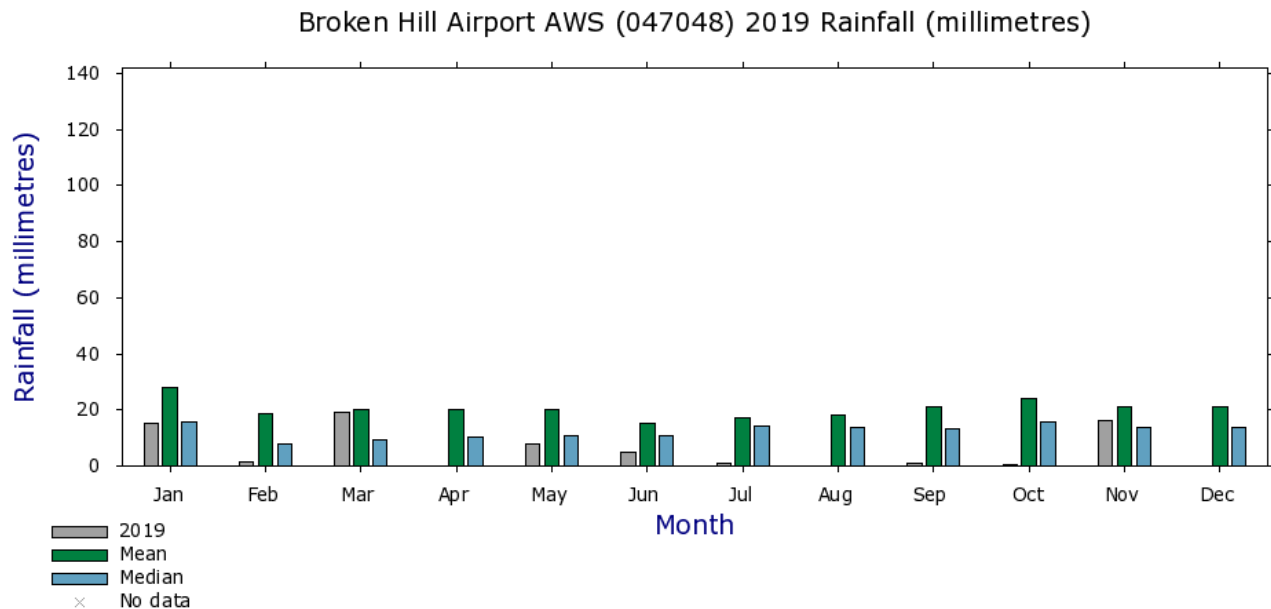


Figure 2.3: Rainfall in Broken Hill preceding the Year 3 survey (source: Australian Bureau of Meteorology)

### 2.3.2 Grazing pressure

Kangaroos were observed to be common within the site and the scats of rabbits and sheep were also observed. Grazing pressure is considered to be relatively high. The combination of grazing pressure and drought conditions made the detection and identification of plants difficult.

### 2.3.3 Data analysis

Floristic and habitat data collected within each monitoring plot were compared with the benchmark data (DECC 2008), baseline data collected by NGH (2013) and the results of the first monitoring survey. The results of these comparisons, along with the habitat data collected for each plot were evaluated to determine whether an 'improve or maintain' outcome is being achieved at the site.

Data collected during each monitoring year has been collated into one electronic database using Microsoft Excel, along with NGH (2013) baseline data and the benchmark data for each vegetation community to enable future analysis of data. Baseline data collected by NGH (2013) at the offset site was limited to a simple presence absence record of plants within monitoring plots. As such, this does not allow for a more detailed analysis to be undertaken to compare data. Jacobs has used the Modified Braun Blanquet method (see Table 2.3) for recording floristic abundance data within each monitoring plot, which allowed for more detailed analysis.

Table 2.1: Modified Braun Blanquet method used for survey

Modified Bruna Blanquet	
1	1 to a few individuals present, less than 5% cover
2	Many individuals present, but still less than 5% cover
3	5-<20% cover
4	20-<50% cover
5	50-<75% cover
6	75-100% cover

### 3. Monitoring results

#### 3.1 Plot data descriptions and benchmark comparisons

The data and description of the results for each surveyed vegetation community are listed below. The coordinates for each monitoring plot are provided in Table 3.1 to enable repeat and consistent monitoring in the future. Photographs taken at the start and end of each monitoring plot are also provided.

**Table 3.1: Coordinates for each of the monitoring plots**

Plot name	Transect start		Transect end	
	Latitude*	Longitude*	Latitude*	Longitude*
M01	533641.52	6458408.77	533693.98	6458429.85
M02	533599.64	6458791.57	533663.43	6458774.15
M03	533978.53	6459970.07	533992.65	6459922.92
M04	534146.70	6460116.23	534183.12	6460141.86
M05	534122.66	6458659.4	534144.39	6458705.5
M06	534154.88	6458721	534175.37	6458766.9
M07	534543.53	6459880.4	534546.53	6459929.4

\* Co-ordinates are in MGA zone 54 relative to the WGS84 datum

##### 3.1.1 Black Bluebush low open shrubland

This community is the dominant vegetation type within the offset site. It is dominated by Black Bluebush (*Maireana pyramidata*) with other chenopod shrubs as sub-dominants including, Saltbushes (*Atriplex* spp.) and Copperburrs (*Sclerolaena* spp.). At the time of survey, grasses were non-existent due to lack of rainfall although it is likely that there would be a range of species evident in more favourable conditions (See Photos 1 to 4).

Weed species were not extensive in this community. However, the presence of *Medicago* sp. was evident from old fruiting bodies. The monitoring plot data along with the benchmarks for this vegetation type (DECC 2008) are shown in Table 3.2 and Table 3.3. Species richness (the number of native species, shown in the table below as 'Native Spp. #') was below the benchmark and lower than that recorded in the baseline and in the Year 1 and Year 2 surveys. No overstorey or mid-storey cover was recorded as the tallest shrubs were all below one metre. Shrub cover was substantially lower than during the baseline and Year 1 surveys but the same as Year 2 and still within the benchmark range for the plant community.

The other native groundcovers (excluding grasses) category was of very low cover (<1%) in the Year 3 survey and well below benchmark condition. This result is like that of the Year 2 survey, suggesting that this component of the vegetation is the most responsive to the prevailing dry climatic conditions.

Grasses in both plots were well below the benchmark range and significantly reduced in comparison to the NGH (2013) baseline survey and Year 1 survey. Hollow Bearing Tree (HBTs) and logs were absent from this community. Overall this community is in poor condition exhibiting reduced species richness and native vegetation cover since the baseline (NGH 2013) survey, Year 1 and Year 2 surveys. This low vegetation cover is visible in both the Year 2 and Year 3 monitoring photographs for plot M07 and M03 shown in Photos 1 to 4 which is likely a result of prolonged dryness and associated grazing pressure.

**Table 3.2: Benchmark and monitoring plot data comparison for Black Bluebush low open shrubland– Broken Hill Offset site**

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Mid-storey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
<b>Benchmark</b>	13	4%	20%	0%	0%	5%	20%	2%	15%	5%	20%	0	0
<b>Baseline (NGH 2013)</b>	10	0%		0%		52%		24%		0%		0	0
<b>Year 1 Plot M03</b>	13	0%		0%		16%		20%		34%		0	0
<b>Year 2 Plot M03</b>	8	0%		0%		0%		14%		2%		0	0
<b>Year 3 Plot M03</b>	6	0%		0%		0%		14%		0%		0	0

**Table 3.3 Benchmark and monitoring plot data comparison for Black Bluebush low open shrubland M07 – Broken Hill Offset site**

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Mid-storey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
<b>Benchmark</b>	13	4%	20%	0%	0%	5%	20%	2%	15%	5%	20%	0	0
<b>Baseline (NGH 2013)</b>	n/a	n/a		n/a		n/a		n/a		n/a		0	0
<b>Year 1 Plot M07</b>	8	0%		0%		4%		12%		58%		0	0
<b>Year 2 Plot M07</b>	7	0%		0%		0%		6%		0%		0	0
<b>Year 3 Plot M07</b>	6	0%		0%		0%		5%		0%		0	0



Photo 1 Black Bluebush low open shrubland M03 Year 2



Photo 2 Black Bluebush low open shrubland M03 Year 3



Photo 3 Black Bluebush low open shrubland M07 Year 2

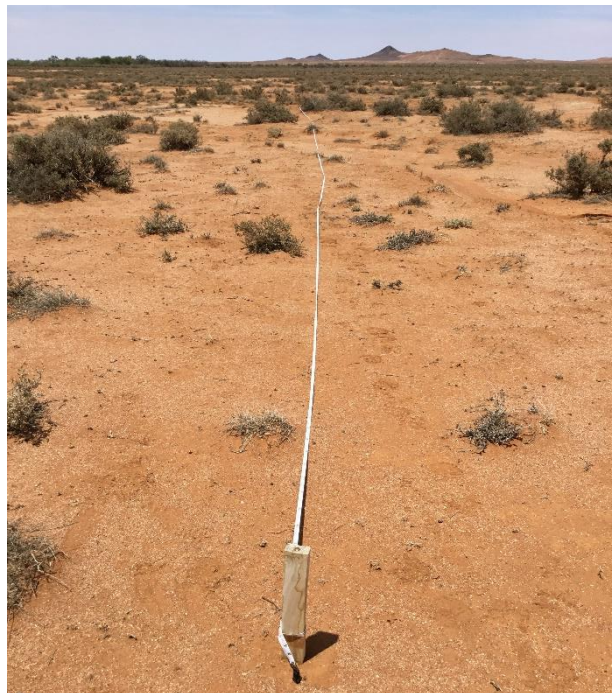


Photo 4 Black Bluebush low open shrubland M07 Year 3

### 3.1.2 Mulga-Dead Finish on stony hills

This community is restricted to a small area on a rise in the west of the site where the soils are characteristically shallow and stony. Mulga (*Acacia aneura*) is absent within the offset site however it occurs on the property to the west. Dominant shrubs include Dead Finish (*Acacia tetragonophylla*), *Senna artemisioides* subsp. *filifolia*, and *Senna phyllodinea*. The ground cover consists of a patchy distribution of grasses, forbs bare earth and scattered rock. Weed species were low, with predominately the presence of scattered *Medicago* sp. It is in moderate condition (See Photos 5 and 6).

The monitoring plot data along with the benchmarks for this vegetation type (DECC 2008) are shown in Table 3.4. Species richness is below the benchmark and below the baseline, Year 1 and Year 2 results for this variable. No overstorey cover was recorded in this community due to the absence of Mulga within the offset site, which based on the benchmark range can be typical of the community. Mid-storey cover and groundcover-shrub covers exceed the benchmarks. However, they are below the baseline and Year 1 results, but equal with the Year 2 results.

Minimal cover of grasses and other native groundcovers were recorded. This result is lower than the benchmark and much lower than the baseline and Year 1 results, but equal to the Year 2 results for this community.

Hollow Bearing Trees (HBTs) and fallen logs were absent from this community.

Overall this community is in moderate condition although there is reduced native vegetation cover since the baseline (NGH 2013) survey and Year 1 survey. The low vegetation cover is visible in both the Year 2 and Year 3 monitoring photographs for plot M07 shown in Photos 3 and 4 which is likely a result of prolonged dryness and associated grazing pressure from herbivores.



Plate 5 Mulga - Dead Finish on stony hills M02 Year 2

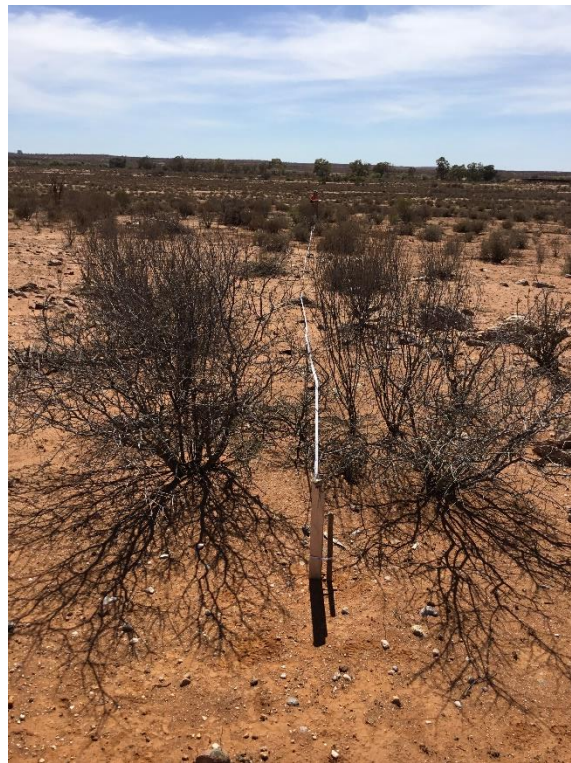


Plate 6 Mulga - Dead Finish on stony hills M02 Year 3

Table 3.4 Benchmark and monitoring plot data comparison for Mulga-Dead Finish on stony hills – Broken Hill Offset site

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Mid-storey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
<b>Benchmark</b>	17	0%	3%	1%	3%	1%	5%	1%	5%	1%	5%	0	3
<b>Baseline (NGH 2013)</b>	15	0%		8%		52%		14%		2%		0	0
<b>Year 1 Plot M02</b>	18	0%		6%		24%		32%		38%		0	0
<b>Year 2 Plot M02</b>	12	0%		4%		0%		10%		0%		0	0
<b>Year 3 Plot M02</b>	9	0%		4%		0%		8%		0%		0	0

### 3.1.3 Prickly Wattle open shrubland

This community typically occurs in drainage lines and depressions across the site. Prickly Wattle (*Acacia victoriae*) dominated the mid-storey of this community with no overstorey recorded. Dominant shrubs included; Bladder Saltbush (*Atriplex vesicaria*), Black Bluebush (*Maireana pyramidata*) and Spiny saltbush (*Rhagodia spinescens*). Groundcover is consistent and comprises of shrubs and forbs. Weed infestation was low, with occasional Burr Medic (*Medicago* sp.) present as old fruiting bodies (See Photos 7 to 8).

The monitoring plot data along with the benchmarks for this vegetation type (DECC 2008) are shown in Table 3.5. The number of native species recorded is much lower than benchmark level and much lower than that of the baseline (NGH 2013) and Year 1 and Year 2 surveys. Overstorey cover was absent from this community which is consistent with the benchmark and considered typical for this community. Mid-storey cover remains above that of the baseline survey and benchmark and is lower than that of the Year 2 survey. Groundcover-shrub cover is significantly greater than the benchmark for this community but less than that recorded in Year 1 and Year 2. The cover of grasses other native ground covers was minimal, below benchmark values and much lower than that recorded in the baseline and Year 1 surveys, but equal with the Year 2 surveys. Hollow Bearing Trees (HBTs) and fallen logs were absent from this community.

Overall this community is in poor condition. Species richness is below 50% of the benchmark levels and native vegetation cover is substantially lower, particularly that of the native grass and groundcover 'other' layer, which is likely a result of prolonged dryness.





Photo 7 Prickly Wattle low open shrubland M01 in Year 2



Photo 8 Prickly Wattle low open shrubland M01 in Year 3

Table 3.5 Benchmark and monitoring plot data comparison for Prickly Wattle open shrubland – Broken Hill Offset site

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Mid-storey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
<b>Benchmark</b>	11	0%	0.1%	0%	0%	2%	20%	1%	10%	1%	20%	0	0
<b>Baseline (NGH 2013)</b>	12	7%		5%		14%		38%		2%		0	1.5
<b>Year 1 Plot M01</b>	12	10%		16%		8%		32%		28%		0	0
<b>Year 2 Plot M01</b>	11	0%		21%		0%		22%		0%		0	0
<b>Year 3 Plot M01</b>	5	0%		15%		0%		18%		0%		0	0

### 3.1.4 Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland

This vegetation type occurs as discrete patches along the northern boundary of the site. The mid-storey is dominated by *Senna phyllodinea* and *Senna artemisioides* subsp. *filifolia*. Groundcover is dominated by a range of shrubs including; Black Bluebush (*Maireana pyramidata*), Low Bluebush (*Maireana astrotricha*), Mallee Saltbush (*Atriplex stipitata*) and Spiny saltbush (*Rhagodia spinescens*). Weed infestation is moderate within this community and includes Onion Weed (*Asphodelus fistulosus*), and Burr Medic (*Medicago* sp.). Species richness was greatest in this community. The proximity to the access road along the northern boundary may explain the greater infestation of weeds (See Photos 9 to 10).

The monitoring plot data along with the benchmarks for this vegetation type (DECC 2008) are shown in Table 3.6. The number of species recorded was lower than the benchmark, much lower than the baseline survey result (NGH 2013) and substantially lower than both the Year 1 and Year 2 surveys. Overstorey cover was absent from this community which is below the benchmark and baseline data (NGH 2013). The mid-storey cover for this community was within benchmarks, above the baseline survey (NGH 2013) but below the Year 1 value and equal to the Year 2 value. Groundcover-shrub cover was within the benchmark range but much lower than that recorded during the baseline and Year 1 surveys and lower than the Year 2 survey. The cover of grasses other native ground covers was minimal, below benchmark values and much lower than that recorded in the baseline and 2017 surveys, but equal to the Year 2 survey. Hollow Bearing Trees (HBTs) and fallen logs were absent from this community.

Overall this community is in moderate condition. Species richness is near benchmark levels, but native vegetation cover is substantially lower, particularly that of the groundcover layer, which is likely a result of prolonged dryness.

Table 3.6 Benchmark and monitoring plot data comparison for Senna shrubland – Broken Hill Offset site

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Mid-storey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
<b>Benchmark</b>	12	1%	14%	1%	8%	5%	25%	2%	15%	2%	25%	0	2
<b>Baseline (NGH 2013)</b>	23	3%		0%		48%		24%		2%		0	0
<b>Year 1 Plot M04</b>	20	0%		10%		0%		34%		24%		0	0
<b>Year 2 Plot M04</b>	19	0%		4%		0%		6%		0%		0	0
<b>Year 3 Plot M04</b>	11	0%		4%		0%		5%		0%		0	0



Photo 9 Narrow-leaved Hopbush – Scrub Turpentine - Senna Shrubland M04 in Year 2



Photo 10 Narrow-leaved Hopbush – Scrub Turpentine - Senna Shrubland M04 in Year 3

### 3.1.5 Old Man Saltbush shrubland

This community occurs adjacent to the drainage line along the eastern side of the offset site and has spread to the man-made drainage line in the south of the site following disturbance. Natural occurrences of this community are rare within the landscape and due to its reduction in extent and poor representation within the reserve system, it is of conservation concern (Benson 2006) (See Photos 11 to 14).

The mid-storey of this community is dominated by Old Man Saltbush (*Atriplex nummularia*) and Black Bluebush (*Maireana pyramidata*). Bladder Saltbush (*Atriplex vesicaria*), Ruby Saltbush (*Enchylaena tomentosa*) and Spiny Saltbush (*Rhagodia spinescens*) make up the shrub component of the ground layer. Weed infestation is moderate in this vegetation community and includes Ward's Weed (*Carrichtera annua*), Prostrate Heliotrope (*Heliotropium supinum*), and African Boxthorn (*Lycium ferocissimum*).

The monitoring plot data along with the benchmarks for this vegetation type (DECC 2008) are shown in Table 3.7 and Table 3.8. This community was not surveyed by NGH (2013) so no baseline data has been collected and as such, the Jacobs (2017) survey data will form the baseline for this community. On average across the two monitoring plots for this community, the number of species recorded decreased in comparison with the Year 1 survey and remained below the benchmark.

Overstorey cover was absent from this community which is below the benchmark data and equal to the Year 2 value. Mid-storey cover was significantly greater than the benchmark, but less than the Year 2 survey value. No native grass cover was recorded across the transect which is comparable to the lower end of the benchmark value range. Groundcover-shrub cover was at the upper end of the benchmark range and other native groundcovers (excluding grasses) was within the benchmarks but towards the lower end of the range. Overall this vegetation community is in moderate condition.



Photo 11 Old Man Saltbush shrubland M05 in Year 2



Photo 12 Old Man Saltbush shrubland M05 in Year 3



Photo 13 Old Man Saltbush shrubland M06 in Year 2



Photo 14 Old Man Saltbush shrubland M06 in Year 3

Table 3.7 Benchmark and monitoring plot data comparison for Old Man Saltbush shrubland – Broken Hill Offset site

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Mid-storey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
<b>Benchmark</b>	15	2%	20%	0%	3%	0%	10%	1%	20%	0%	5%	0	0
<b>Baseline (NGH 2013)</b>	n/a	n/a		n/a		n/a		n/a		n/a		n/a	n/a
<b>Year 1 Plot M05</b>	9	0%		64%		0%		34%		16%		0	0
<b>Year 2 Plot M05</b>	10	0%		39%		0%		20%		2%		0	0
<b>Year 3 Plot M05</b>	4	0%		30%		0%		20%		0%		0	0

Table 3.8 Benchmark and monitoring plot data comparison for Old Man Saltbush shrubland – Broken Hill Offset site

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Mid-storey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
<b>Benchmark</b>	15	2%	20%	0%	3%	0%	10%	1%	20%	0%	5%	0	0
<b>Baseline (NGH 2013)</b>	n/a	n/a		n/a		n/a		n/a		n/a		n/a	n/a
<b>Year 1 Plot M06</b>	11	0%		3%		0%		74%		16%		0	0
<b>Year 2 Plot M06</b>	13	0%		10%		0%		22%		0%		0	0
<b>Year 3 Plot M06</b>	11	0%		8%		0%		18%		0%		0	0

### 3.2 Weeds and disturbance

Overall weed infestation across the site was low. Monitoring plots M01 and M06, recorded the greatest coverage and diversity of weeds. This is likely to be due to disturbances related to the construction of the man-made drainage line at the southern end of the site.

The centre of the site (see Figure 2.2) also has a significant infestation of Peppercorn tree (*Schinus molle* var. *areira*). The Peppercorn trees, being the only overstorey vegetation (>3m) within the offset site and providing shelter from predators and the harsh climatic conditions, are currently providing habitat for a number of active babbler (*Pomatostomus* sp.) nests and other bird species. As such, complete removal of this infestation is not recommended at this stage. Management may instead require thinning of mature trees without active nests, herbicide treatment of any emerging saplings and replacement planting with taller native species once rainfall conditions allow (e.g. *Casuarina pauper*, *Alectryon oleifolius* subsp. *canescens*, *Acacia victoriae*, *Acacia aneura* and *Acacia tetragonophylla*).

Two of the weeds recorded within the site, Velvet Mesquite (*Prosopis velutina*) and African Boxthorn (*Lycium ferocissimum*) are declared as state and regional priority weeds under the *Biosecurity Act 2015*, as listed in Appendix 1.1 and 1.2 of the Western Regional Strategic Weed Management Plan 2017-2022 (LLS 2017). Both weeds are also listed as Weeds of National Significance and are required to be eradicated from the land and the land is to be kept free of the plant to mitigate the risk of the plant spreading. These weed species are also recorded on the Office of Environment and Heritage (OEH) 'High Threat' weeds list. Only two specimens of Velvet Mesquite were found in the survey plots, one in M01 and one in M06. One specimen of African Boxthorn was detected in M05 within the man-made drainage depression in the south of the site. The abundance of living Velvet Mesquite and African Boxthorn was substantially lower than during the Year 2 survey and dead individuals were observed, indicating either that management of these species has been effective, or that drought has caused their dieback. Management of these weeds needs to continue in order to achieve eradication and prevention of re-establishment, especially once drought subsides.

In general spot herbicide-treatment is required for weed species across the site (see Appendix A), concentrating on perennial weeds and those areas identified as having the greatest need, i.e. around disturbance areas such as the man-made drainage line to the south of the site, along site boundaries adjacent to access roads and other areas disturbed by the formation of tracks.

Note: targeted weed spraying was conducted by an AGL contractor in late November 2019, with box thorn, mesquite and some emerging peppercorn trees treated.

A complete list of weeds that may be targeted for management, including, spot spraying are listed in Appendix A.

### 3.3 Fauna Habitats

Table 3.9 show the percentage habitat cover at each of the monitoring plots surveyed and compares these to the baseline data recorded in the BOMP (NGH 2013). Throughout the offset site chenopods and bare ground provide the greatest habitat, which is comparable to the baseline survey results recorded by NGH (2013). Tussock grass habitat has decreased across the site in general which may be a result of grazing by kangaroos during what has been a prolonged dry period with little alternative food resources. Grasses may have also decreased due to the drier climatic conditions experienced since the baseline survey (NGH 2013). Rocky habitat occurs towards the southern end of the site. Numerous skinks were observed using the various habitats across the site during the survey.

A Peppercorn tree infestation towards the centre of the site (see Figure 2.2) provides habitat in the form of shelter from predators and the harsh climatic conditions as well as for nesting, as evident by the numerous babbler's nests observed.

Overall habitat appears to have been maintained since the baseline surveys undertaken by NGH (2013), except for the reduction in tussock grasses and other groundcover vegetation across the site. The fencing will assist in excluding goats and any livestock from the site, which may assist in the natural regeneration of the site when drought conditions subside and hence improve habitat condition.

**Table 3.9 Habitat cover assessment – Broken Hill Offset site**

Habitat component	Cover estimates to nearest 5%																										
	BL MO 1	Year 1 MO 1	Year 2 MO 1	Year 3 MO 1	BL MO 2	Year 1 MO 2	Year 2 MO 2	Year 3 MO 2	BL MO 3	Year 1 MO 3	Year 2 MO 3	Year 3 MO 3	BL MO 4	Year 1 MO 4	Year 2 MO 4	Year 3 MO 4	Year 1 MO 5	Year 2 MO 5	Year 3 MO 5	Year 1 MO 6	Year 2 MO 6	Year 3 MO 6	Year 1 MO 7	Year 2 MO 7	Year 3 MO 7		
Tussock grasses	5%	0%	0%	0%	70%	0%	0%	0%	50%	5%	0%	0%	60%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Chenopods	40%	50%	25%	20%	5%	20%	15%	15%	20%	50%	15%	15%	20%	25%	10%	10%	10%	10%	10%	10%	10%	5%	10%	10%	5%	10%	
Trees/tall shrubs	15%	15%	10%	10%	0%	5%	5%	5%	0%	0%	0%	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	0%	0%	0%	
Bare ground	60%	45%	50%	60%	30%	25%	65%	70%	50%	50%	75%	80%	40%	40%	70%	80%	10%	30%	60%	10%	40%	70%	45%	75%	75%		
Cracking clay	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Rocks/logs	5%	10%	10%	10%	10%	10%	10%	10%	10%	5%	5%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	

\*BL = baseline

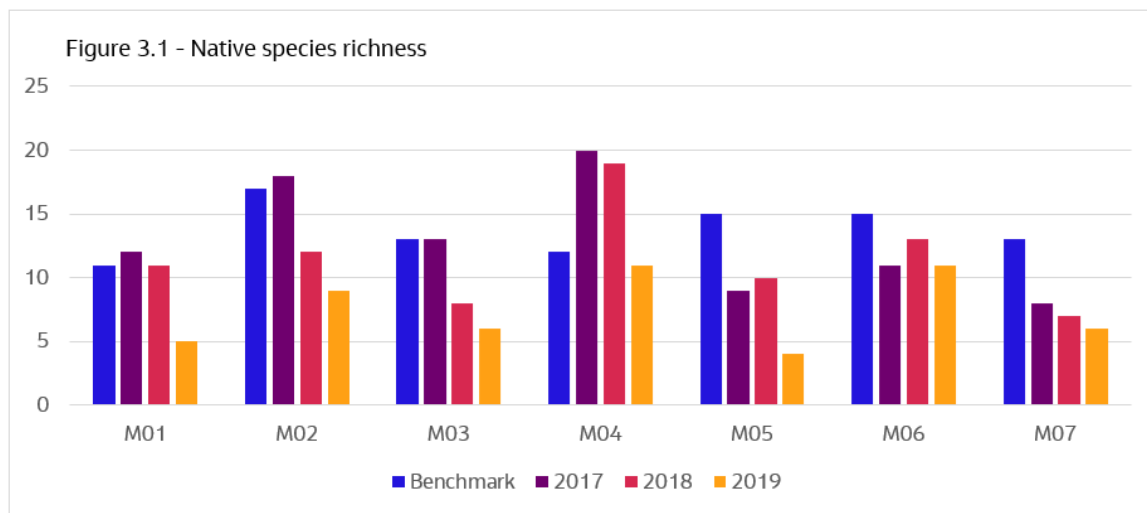


### 3.4 Results summary and discussion

The observed changes in the vegetation of the site are summarised and discussed below.

#### 3.4.1 Species richness

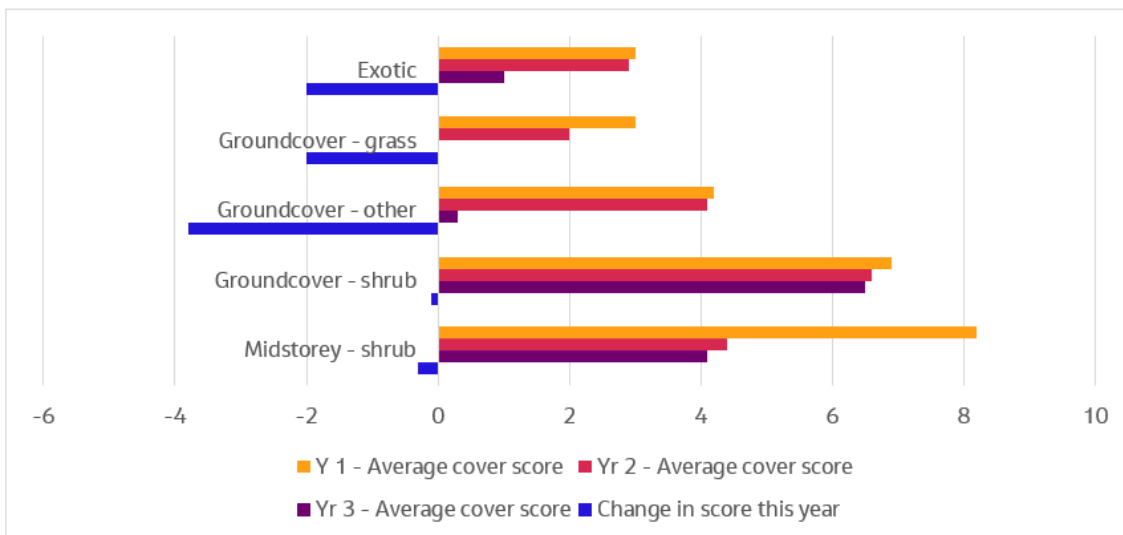
Species richness was below year 2 and benchmark levels for all plots and the mean species richness was also lower (refer Figure 3.1). The groundcover forb component of the vegetation seems to have been the most reduced with many previously recorded annual and short-lived perennial species no longer apparent.



#### 3.4.2 Cover of native and exotic vegetation

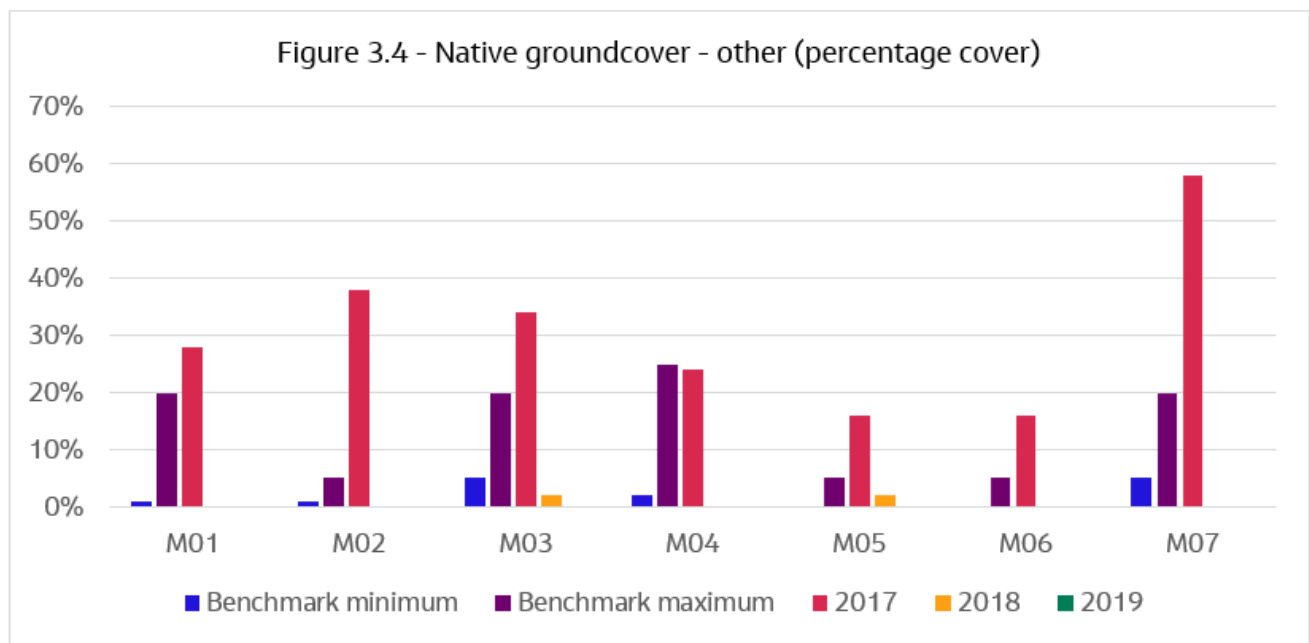
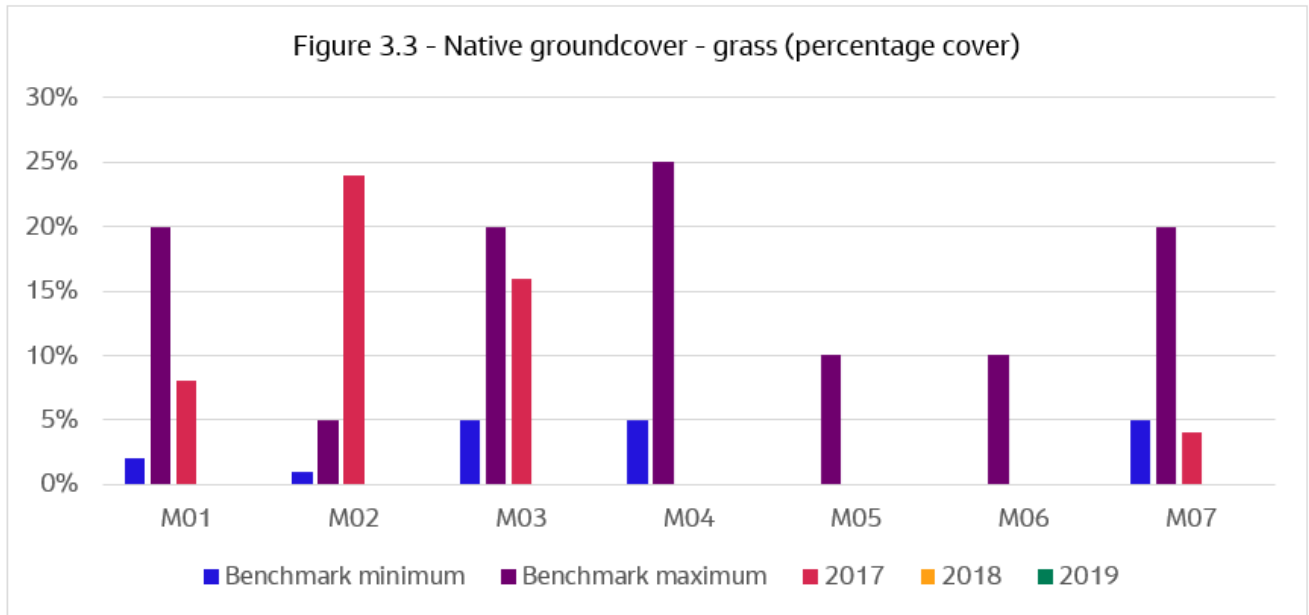
The cover of native vegetation has reduced in comparison with Year 2 levels for all structural layers with the most pronounced reduction observed in the cover of mid-storey shrubs, groundcover grasses and other groundcover plants (See Figure 3.2).

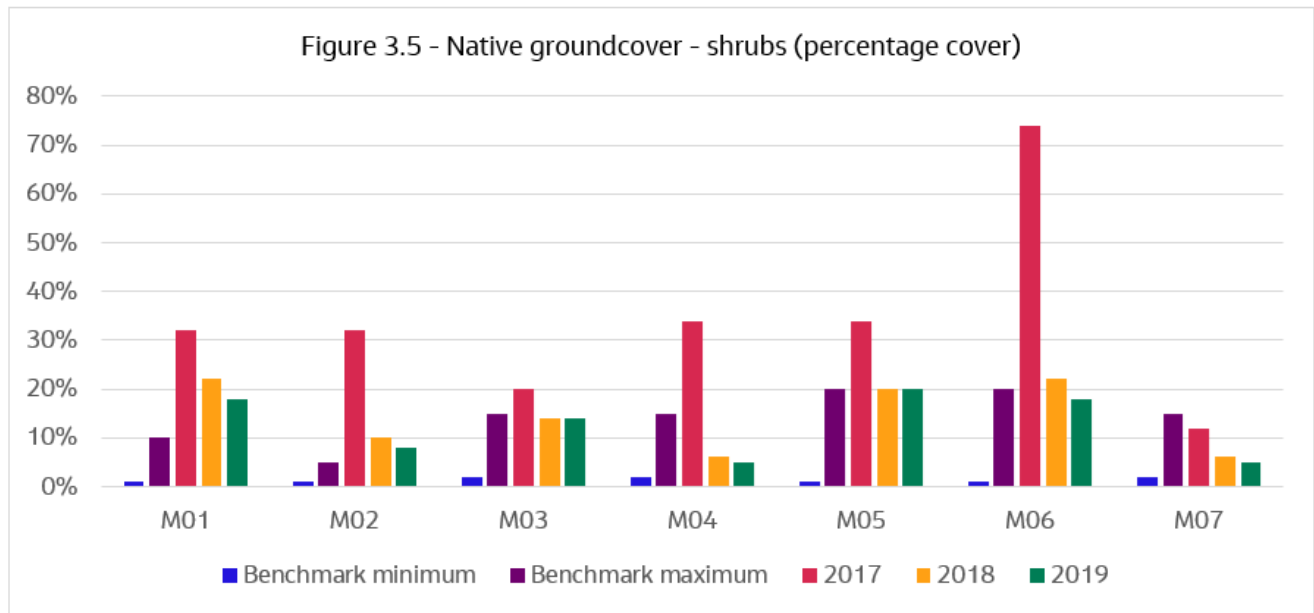
Figure 3.2 - changes in the cover (Braun Blanquet scores) of native and exotic vegetation



Mid-storey and groundcover shrub cover values decreased slightly upon the Year 2 values and were within the benchmark levels for each plant community. The covers of grasses and other groundcovers were much lower than Year 2 levels and below benchmark levels for all communities (refer Figure 3.3 and Figure 3.4).

There has been a small reduction in the abundance of exotic species. This change is likely to be attributable to a combination of drought conditions and weed management on the site.





### 3.4.3 Discussion

The observed reduction in species richness and native vegetation cover is most likely a result of prolonged below average rainfall at the site. For the past two years there has been substantially below average rainfall. These annual and short-lived perennial groundcover species are likely to naturally fluctuate in abundance in response to rainfall and are likely to persist on the site in the form of a soil-stored seedbank during unfavourable conditions. Grasses seem to have been affected by kangaroo and sheep grazing in addition to drought and were generally reduced to shortly-cropped small clumps. Compared to Year 2, more specimens of mid-storey shrubs have died due to drought and more have lost many of their leaves, resulting in reduced foliage cover. A future return to an extended period of average or higher rainfall will likely see a return of annual and short-lived perennial groundcover species and recovery of the foliage cover of grasses and shrubs.

The monitoring has shown a reduction in the diversity and abundance of native plants and the overall condition of native vegetation on the site. This change is likely to be caused primarily by the prevailing drought conditions and any effect of site management is difficult to detect under these conditions. Additional monitoring under such drought conditions is unlikely to yield meaningful information regarding the improvement or maintenance of biodiversity values.

## 3.5 Fence maintenance

Stock proof fences were installed around the entire offset site approximately in mid-2017. A combination of ring lock style of fencing and plain and barbed wire strand fencing has been used around the offset site. Fences are generally located on the boundary of the site (i.e. the perimeter of the site), except for the eastern fence which is between about 50m and 150m west of the eastern site boundary as mapped in the Biodiversity Offset Management Plan, Broken Hill Solar Plant (NGH Environmental, 2013). Livestock and feral goats were absent from the site during fencing installation but have since returned to site via gaps underneath the fencing (see Photo 15 to 18). The fence is not designed to be rabbit-proof, and rabbit-proofing is not required. Red Kangaroos and Western Red Kangaroos were observed within the site and were seen to traverse the fences. Fencing is likely to improve the natural regeneration of the site through the exclusion of livestock and feral goats.



Photo 15 Sheep accessing site under fence. Wool snagged on fence.



Photo 16 Sheep accessing site under fence. Wool snagged on fence.



Photo 17 Sheep accessing site under fence. Wool snagged on fence.



Photo 18 Sheep droppings present on-site

## 4. Management Actions

The following management measures in Table 4.1 were outlined in the BOMP (NGH 2013) and were to be actioned and adapted based on annual monitoring results. Table 4.1 provides an evaluation of the need for each management action, the timing, and who is required to undertake the action. Actions undertaken since previous monitoring session and recommended adaptive measures are also described.

Table 4.1 : Management Actions undertaken and required at the Broken Hill offset site

Management measure	Objective	Action	Timing	Who	Actions undertaken since baseline	Adaptive measures if required
Weed control	Target state and regional priority weeds (Mesquite and African Boxthorn) to eliminate from site and prevent spread as required under the <i>Biosecurity Act 2015</i> and the Western Regional Strategic Weed Management Plan 2017 – 2022 (LLS 2017)	Spot herbicide treatment; foliar spraying or cut/scape and paint methods	During active growth season, which is generally in Spring to early Summer, particularly after rainfall. Should be undertaken in suitable low wind conditions to prevent spray drift to other native species.	Professional bush regeneration contractor with appropriate chemical use certification.	Initial spraying of Mesquite and African Boxthorn completed across site in 2018. Targeted spraying of weeds conducted in November 2019.	Dry conditions are likely to have limited the effectiveness of herbicide treatment. Monitoring and treatment of re-shooting plants and seedlings required.
	Target Peppercorn Tree infestation	Thinning of mature trees without active nests and new saplings to be targeted using hand removal and cut and paint techniques.  Replacement planting of mature trees removed with native trees and tall shrubs.	During active growth season, which is generally in Spring to early Summer, particularly after rainfall.  Planting to be undertaken after drought conditions subside and several successive months of average or above average rainfall.	Professional bush regeneration contractor with appropriate chemical use certification.	Contracted inspected peppercorn trees during November 2019.  No removal occurred as the landowner was concerned about impacts on habitat for birds and other wildlife.	Contractor to discuss further with AGL and, with agreement, undertake limited treatment in April-May 2020 in conjunction with planting.  Gradual thinning of mature trees without active nests only as these trees are currently providing habitat for native birds. Target all saplings.

Management measure	Objective	Action	Timing	Who	Actions undertaken since baseline	Adaptive measures if required
	Target onion weed and saffron thistle in general weeding across the site	Spot spraying	During active growth season, which is generally in Spring to early Summer, particularly after rainfall. Should be undertaken in suitable low wind conditions to prevent spray drift to other native species.	Professional bush regeneration contractor with appropriate chemical use certification.	Some emerging peppercorn trees were treated.  None undertaken as plants are withered and reduced to underground parts and seeds during current dry conditions.  Targeted spraying of weeds conducted in November 2019.	Target these species when they reappear following rain in 2020.
Cat and/or fox control	To minimise the presence of cats and foxes within the offset site.	Conduct baiting or trapping if evidence of cats or foxes is detected within the offset site.  None required at this stage. Re-evaluate during next monitoring event; spotlighting and/or camera trap surveys are recommended to be undertaken during 2019-2020 to inform management.	Annual monitoring.  Control in response to detection of cats or foxes.	Professional animal control contractor with appropriate qualifications and permits.	-	-
Rabbit control	To control rabbit numbers within the site and thereby prevent rabbits from substantially impacting on native flora and habitat values.	None required at this stage. Allow native vegetation to regenerate over the next year. Re-evaluate during next monitoring event.	Annual monitoring.  Control in response to detection of cats or foxes.	Professional animal control contractor with appropriate qualifications and permits.	-	-

Management measure	Objective	Action	Timing	Who	Actions undertaken since baseline	Adaptive measures if required
Exclusion of feral goats and livestock	To continuously exclude large non-native herbivores from the site and reduce grazing on native flora	A fence to exclude goats and livestock is present, no further actions required at this stage. Allow native vegetation to regenerate over the next year and then re-evaluate fencing effectiveness during next monitoring event.	In response to detection of feral goats or livestock	Landowner or contractor	-	Fence monitoring and repair of any damage observed.
Implementation of controlled burns	To improve the natural regeneration of native flora	None required at this stage. Allow native vegetation to regenerate over the next year. Re-evaluate during next monitoring event.	-	-	-	-
Monitoring plot survey	Repeat monitoring plot surveys to evaluate the 'improve or maintain' outcome of biodiversity values at the site	Repeat monitoring of all plots within the offset site	Late spring	Two qualified Ecologists	-	Where possible time survey events to occur within four weeks of a significant rainfall event to better identify the diversity of plant species dormant within the ground layer

## 5. Conclusions and recommendations

Overall the recent monitoring results show a reduction in biodiversity values across the site with regards to floristic diversity, coverage and quality when compared to the vegetation community benchmarks (DECC 2008), baseline survey and year 1 and Year 2 results. This decline is likely a result of prolonged periods of dryness which have inhibited the growth of many plant species and made the identification of a number of species impossible. It is likely that seed stock lay dormant within the ground. Adequate rainfall would further increase the species diversity at the site. The management actions outlined in Table 4.1 will further assist the natural regeneration of the site over the next 12 months, an overview of these is provided below.

Stock proof fencing around the offset site is in good condition, though there are several places where sheep have dug under the fence to access the site and management actions have been suggested to remedy this. It is likely that with the fencing in place the biodiversity values of the site will continue to improve through the exclusion of feral goats and any livestock, allowing further opportunities for natural regeneration to occur once normal rainfall conditions return.

Fauna habitats across the site are somewhat diverse and include; bare ground, chenopods, rocky patches, tussock grasses and some taller shrubs. These habitats have been maintained, except for the groundcover habitat. Tussock grass habitats may improve with the installation of fencing and consequent exclusion of grazing from feral goats. Any return to near average or greater rainfall is also likely to improve the regeneration of groundcover vegetation. With the fences now in place no further feral pest management is recommended until after a re-evaluation of vegetation condition and fauna habitats following a return to normal rainfall conditions.

Weed infestations across the site are generally low and can be maintained by spot treatment as outlined in the management actions. Weeds of concern include the state and regional priority weeds (LLS 2017) Velvet Mesquite and African Boxthorn, which are required to be eradicated from the site to prevent further spread to surrounding lands. Pepper Tree infestations within the centre of the site provide habitat for a variety of birds. There are numerous active babbler nests throughout these trees and as such complete removal is not recommended. Control of emerging samplings, selective thinning of those trees not containing nests and replacement planting with native trees and tall shrubs would allow for the maintenance of fauna habitat while gradually removing the Pepper Trees.



## 6. References

Benson J.S. (2006) New South Wales Vegetation Classification and Assessment: Part 1 Plant communities of the NSW Western Plains, *Cunninghamia* 9(3): 383-450, Botanic Gardens Trust, Sydney.

DECC (2008) Vegetation Benchmarks Database. Department of Environment and Climate Change NSW. <http://www.environment.nsw.gov.au/biobanking/VegTypeDatabase.htm>

DECC (2009) BioBanking Assessment Methodology and Credit Calculator Operational Manual. NSW Department of Environment and Climate Change, Sydney.

LLS (2017) Western Regional Strategic Weed Management Plan 2017 – 2022. New South Wales Local Land Services Western Region [http://western.lls.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0006/722391/Western-RSWMP-web.pdf](http://western.lls.nsw.gov.au/__data/assets/pdf_file/0006/722391/Western-RSWMP-web.pdf)

NGH Environmental (2013) Biodiversity Offset Management Plan, Broken Hill Solar Plant. Report prepared for AGL Energy Limited.

OEH (2012) Vegetation types database. Office of Environment and Heritage NSW. <http://www.environment.nsw.gov.au/biobanking/VegTypeDatabase.htm>

SKM (2012) AGL Energy Broken Hill Solar Power Plant – Flora and Fauna Assessment. Report prepared for AGL Energy Limited.

## Appendix A. Flora species list and opportunistic fauna list

Table A.1 Flora species list and 20m x 20m plot survey Modified Braun Blanquet scores

Family	Scientific Name	Common Name	MO 1	MO 2	MO 3	MO 4	MO 5	M 06	M 07	Previously recorded on site
Aizoaceae	<i>Sarcozona praecox</i>	Sarcozona						1	1	
Amaranthaceae	<i>Alternanthera angustifolia</i>									x
Anacardiaceae	<i>Schinus molle</i> var. <i>areira</i> *	Peppercorn Tree								x
Apocynaceae	<i>Rhyncharhena linearis</i>	Purple Pentatropae								x
Asphodelaceae	<i>Asphodelus fistulosus</i> *	Onion weed								
Asphodelaceae	<i>Bulbine</i> sp.	Bulbine lily								x
Asteraceae	<i>Sonchus oleraceus</i> *	Common Sowthistle								
Asteraceae	<i>Brachyscome ciliaris</i> var. <i>lanuginosa</i>									
Asteraceae	<i>Brachyscome dentata</i>									x
Asteraceae	<i>Leiocarpa semicalva</i>									
Asteraceae	<i>Senecio lanibracteus</i>									x
Asteraceae	<i>Xanthium spinosum</i> *	Bathurst Burr								x
Asteraceae	<i>Carthamus lanatus</i> *	Saffron thistle								
Asteraceae	<i>Vittadinia cuneata</i>	Fuzzweed								x
Boraginaceae	<i>Heliotropium supinum</i> *	Prostrate Heliotrope								
Boraginaceae	<i>Echium plantagineum</i> *	Paterson's Curse								x
Brassicaceae	<i>Arabidella</i> sp.									
Brassicaceae	<i>Carrichtera annua</i> *									
Chenopodiaceae	<i>Atriplex stipitata</i>	Mallee Saltbush	1	1		2		1		
Chenopodiaceae	<i>Atriplex vesicaria</i>	Bladder Saltbush	1					1	1	
Chenopodiaceae	<i>Atriplex nummularia</i>	Old Man Saltbush					4	1	1	
Chenopodiaceae	<i>Dissocarpus paradoxus</i>	Cannonball Burr			1	1		1		

Family	Scientific Name	Common Name	MO 1	MO 2	MO 3	MO 4	MO 5	M 06	M 07	Previously recorded on site
Chenopodiaceae	<i>Enchylaena tomentosa</i>	Ruby Saltbush		1	1	1		2		
Chenopodiaceae	<i>Maireana astrotricha</i>	Low Bluebush				1				
Chenopodiaceae	<i>Maireana pyramidata</i>	Black Bluebush	2	1	3	2	2	3	2	
Chenopodiaceae	<i>Maireana</i> sp.								1	
Chenopodiaceae	<i>Sclerolaena</i> sp.	Copperburr			1	1			1	
Chenopodiaceae	<i>Rhagodia spinescens</i>	Spiny saltbush	2	1		2	1	1		
Chenopodiaceae	<i>Maireana coronata</i>	Crown Fissure-weed								
Chenopodiaceae	<i>Salsola australis</i>			1		1		1		x
Chenopodiaceae	<i>Sclerolaena divaricata</i>	Tangled Copperburr			1					
Convolvulaceae	<i>Convolvulus remotus</i>									
Crassulaceae	<i>Crassula tetramera</i>									x
Euphorbiaceae	<i>Euphorbia multifaria</i>									x
Fabaceae	<i>Vicia</i> sp.*									
Fabaceae	<i>Acacia tetragonophylla</i>	Dead finish		2						
Fabaceae	<i>Acacia victoriae</i>	Prickly wattle	1	1		1		1		
Fabaceae	<i>Acacia burkittii</i>	Sand hill wattle								x
Fabaceae	<i>Acacia oswaldii</i>	Umbrella wattle								x
Fabaceae	<i>Medicago</i> sp.*		1	1	1			1		
Fabaceae	<i>Prosopis velutina</i> **	Velvet mesquite	1					1		
Fabaceae	<i>Senna phyllodinea</i>			2		3	1			
Fabaceae	<i>Senna artemisioides</i> subsp. <i>filifolia</i>			2		1		1		
Lamiaceae	<i>Salvia verbenaca</i> *	Vervain								x
Loranthaceae	<i>Lysiana exocarpi</i>									x

Family	Scientific Name	Common Name	MO 1	MO 2	MO 3	MO 4	MO 5	M 06	M 07	Previously recorded on site
Malvaceae	<i>Sida corrugata</i>	Corrugated sida								
Malvaceae	<i>Sida</i> sp.									
Myrtaceae	<i>Eucalyptus camaldulensis</i>	River Red Gum								x
Pittosporaceae	<i>Pittosporum angustifolium</i>	Weeping pittosporum								x
Poaceae	<i>Chloris truncata</i>	Windmill grass								x
Poaceae	<i>Cymbopogon ambiguus</i>	Scent grass								x
Poaceae	<i>Rytidosperma caespitosum</i>	Ringed Wallaby Grass								
Poaceae	<i>Tragus australianus</i>	Small Burr grass								
Poaceae	<i>Austrostipa scabra</i> subsp. <i>scabra</i>	Speargrass			1					
Poaceae	<i>Enneapogon avenaceus</i>	Bottle Washers								
Polygonaceae	<i>Rumex crispus</i> *	Curled dock								x
Portulacaceae	<i>Portulaca oleracea</i>	Pigweed								x
Scrophulariaceae	<i>Eremophila sturtii</i>	Narrow-leaf Emu Bush								x
Scrophulariaceae	<i>Myoporum montanum</i>	Western Boobialla								x
Solanaceae	<i>Lycium ferocissimum</i> **	African boxthorn					1			
Solanaceae	<i>Solanum esuriale</i>	Quena								
Solanaceae	<i>Solanum</i> sp.									
Zygophyllaceae	<i>Tribulus minutus</i>									x
* general weed										
**state and regional weeds to be targeted (Biosecurity Act 2015)										

**Table A.2 Opportunistic fauna species list**

<b>Class</b>	<b>Species</b>	<b>Common Name</b>
Aves	<i>Rhipidura leucophrys</i>	Willie wagtail
Aves	<i>Malurus leucopterus</i>	White-winged Fairy-wren
Mammalia	<i>Macropus fuliginosus</i>	Western Grey Kangaroo
Reptilia	<i>Tiliqua rugosa</i>	Shingleback lizard

## Appendix B. Condition of Approval (COA) C5

### Biodiversity Offset Management Plan

- C5. Following final design and prior to the commencement of construction, or as otherwise agreed to by the Director-General, the Proponent shall develop and submit a Biodiversity Offset Management Package for the approval of the Director-General. The package shall detail how the ecological values lost as a result of the Project will be offset. The Biodiversity Offset Management Package shall be developed in consultation with the OEH and shall (unless otherwise agreed by the Director-General) include, but not necessarily be limited to:
- (a) an assessment of all native vegetation communities, threatened species habitat and Willyama Common land that will either be directly or indirectly impacted by the proposal;
  - (b) the objectives and biodiversity outcomes to be achieved (including 'improve or maintain' biodiversity values), and the adequacy of the proposed offset considered;
  - (c) the final suite of the biodiversity offset measures selected and secured including but not necessarily limited to;
    - i) an offset proposal which is supported by a suitable metric method (such as the Biobanking Assessment Methodology);
    - ii) details of the relative condition and values of communities on the offset site in comparison to those to be impacted, including all areas of native shrubland in moderate to good condition;
    - iii) proposed management actions and expected gains;
  - (d) the monitoring requirements for compensatory habitat works and other biodiversity offset measures proposed to ensure the outcomes of the package are achieved, including:
    - i) the monitoring of the condition of species and ecological communities at offset locations;
    - ii) the methodology for the monitoring program(s), including the number and location of offset monitoring sites, and the sampling frequency at these sites;
    - iii) provisions for the annual reporting of the monitoring results for a set period of time as determined in consultation with the OEH; and
  - (e) timing and responsibilities for the implementation of the provisions of the Package.

Land offsets shall be consistent with the *Principles for the use of Biodiversity Offsets in NSW* (NSW Office of Environment and Heritage, June 2011). Any land offset shall be enduring and be secured by a conservation mechanism which protects and manages the land in perpetuity. Where land offsets cannot solely achieve compensation for the loss of habitat, additional measures shall be provided to collectively deliver an improved or maintained biodiversity outcome for the region.

Where monitoring referred to in condition (d) indicates that biodiversity outcomes are not being achieved, remedial actions shall be undertaken to ensure that the objectives of the Biodiversity Offset Package are achieved.

Within one month from approval from the Director-General the Proponent shall, in conjunction with the lessee of Western Lands Lease 14240, apply to the Crown Lands Division of the Department of Trade and Investment for a Change of Lease Purpose of Western Land Lease 14240 to appropriately record the biodiversity offset on title and within the lease conditions as a conservation area.