AGL Broken Hill Solar Plant
Biodiversity Offset Site

AGL Energy

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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 NSW Office of Environment and Heritage (OEH). Condition C5(b) specifically states that the biodiversity outcome to be achieved must 'improve or maintain' the biodiversity values of the site. Following the completion of fencing, this report outlines the results of the first 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 been maintained with regards to floristic diversity, coverage and quality when compared to the vegetation community benchmarks (DECC 2008) and baseline survey results recorded by NGH (2013). Prolonged periods of dryness have inhibited the growth of many plant species and a number of species were not able to be identified. 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 has only recently been installed, approximately three months prior to the recent survey, and as such is in practically new condition. 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 further opportunities for natural regeneration to occur.

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, with the exception of the tussock grass habitat, since the NGH (2013) baseline survey. 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 may also improve the regeneration of these grassy habitats. With the fences now in place no further feral pest management is recommended until after a re-evaluation of vegetation condition and fauna habitats in the second monitoring year.

Weed infestations across the site are generally low and can be maintained by spot treatment as outlined in the management actions. Weeds of particular concern include the state and regional priority weeds (LLS 2017) Velvet Mesquite and African Boxthorn, which are required to be eradicated from the site so as 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 and selective thinning of those trees not containing nests may provide opportunities for native plant species to emerge.

It is recommended that future monitoring continue to occur in late spring and where possible be scheduled within the weeks following a rainfall event to better understand the species diversity present in the ground layer.

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. The site is located at Lot 6806 DP 823918 and is approximately 200 hectares (ha) in area with additional areas of land for linear easements for the connection of the project's electrical infrastructure to the electrical grid and for road access from the Barrier Highway. The location of the solar plant, access and transmission easements and offset site are shown in (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 detailed 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. 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 (refer Figure 1-1).

1.2 Objectives

This report documents the first of the annual ecological monitoring results for the Broken Hill 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/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 BMOP (NGH 2013) to determine if there have been any significant changes in the vegetation and habitat conditions that are not consistent with 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). BioBanking Assessment Methodology (BBAM 2009) also lists the standard management actions required to be undertaken at offset sites. These are:

- 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
- Retention of rocks.

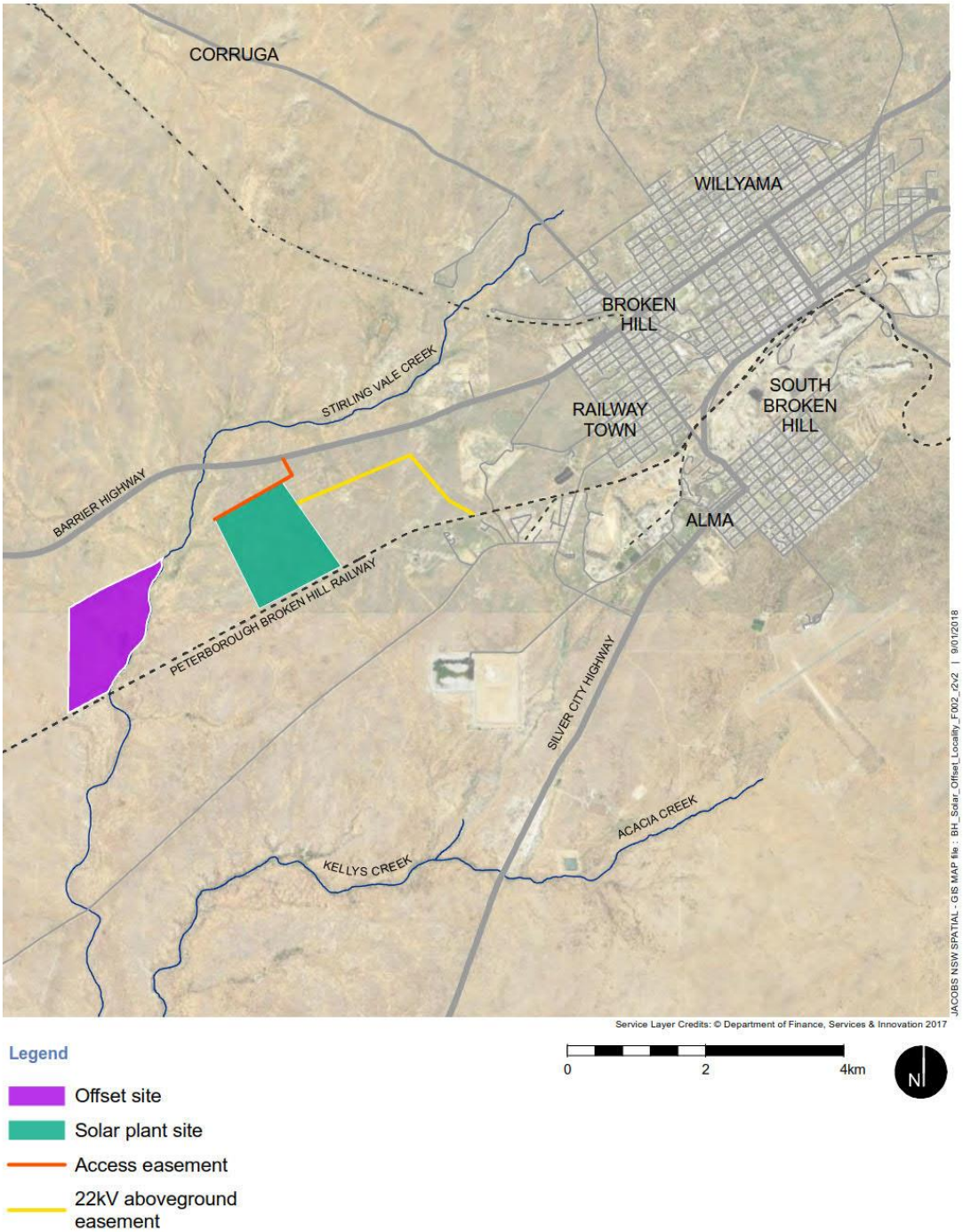

Figure 1.1 Broken Hill Solar Plant and offset site location

2. Monitoring method

2.1 Requirements

This chapter outlines the methodology used to undertake ecological monitoring at the Broken Hill offset site. Monitoring is consistent with the methodologies outlined in the BOMP (NGH 2013) and meets the requirements of the COA C5, outlined in Appendix B. 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 Broken Hill offset site have been evaluated through the comparison of monitoring data against the benchmark and baseline data 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, Paul Rossington and Jaci Tebb, on the 28 November 2017 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)	Area in offset site (ha)	Monitoring plots sampled by NGH (2013)	Monitoring sampled by Jacobs (2017)	BBAM (DECC 2009) No. of plots required (see Table 2.2)	Threat category
Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	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	8.5	M01 (1 plot)	M01 (1 plot)	2-3 plots	Least concern
Narrow-leaved Hopbush - Scrub Turpentine - Senna shrubland of semi-arid and arid sandplains and dunes	1.9	M04 (1 plot)	M04 (1 plot)	1 plot	Least concern
Mulga - Dead Finish on stony hills mainly of the Channel Country and Broken Hill Complex Bioregions	1.5	M02 (1 plot)	M02 (1 plot)	1 plot	Near threatened

Vegetation Type (DECC 2008)	Area in offset site (ha)	Monitoring plots sampled by NGH (2013)	Monitoring sampled by Jacobs (2017)	BBAM (DECC 2009) No. of plots required (see Table 2.2)	Threat category
Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW)	3.2	Not surveyed by NGH (2013)	M05 & M06 (2 plots)	2 plots	Critically Endangered*

*** This category is according to Benson (2006). This community is not 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). Baseline surveys undertaken by NGH (2013) set up just one monitoring plot per vegetation community. Jacobs has replicated their approach and added three new plots to be more consistent with the BBAM (DECC 2009), see Table 2.1.

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 as shown in Figure 3.1. 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.

Three additional plots were also established using the same technique as above, two in the Old Man Saltbush vegetation type, which previously had not been surveyed and one in the Black Bluebush vegetation type, which occupies the largest area in the offset site.

All vegetation types and monitoring plots are shown in Figure 2.2.

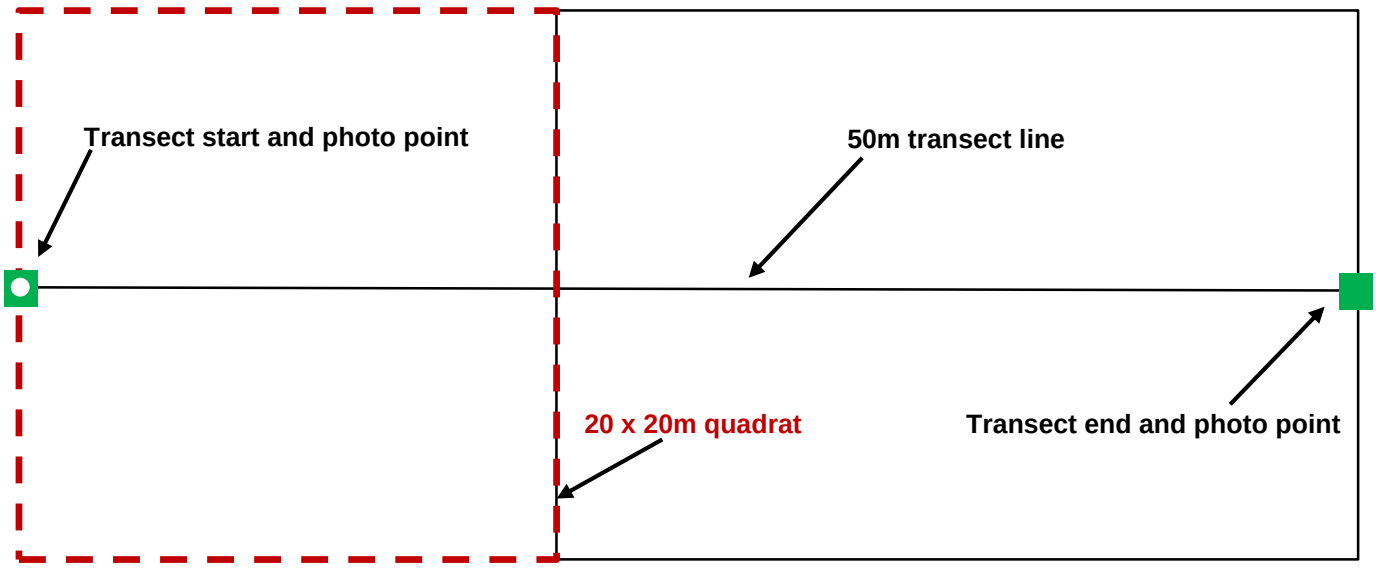

Figure 2.1 Monitoring plot layout

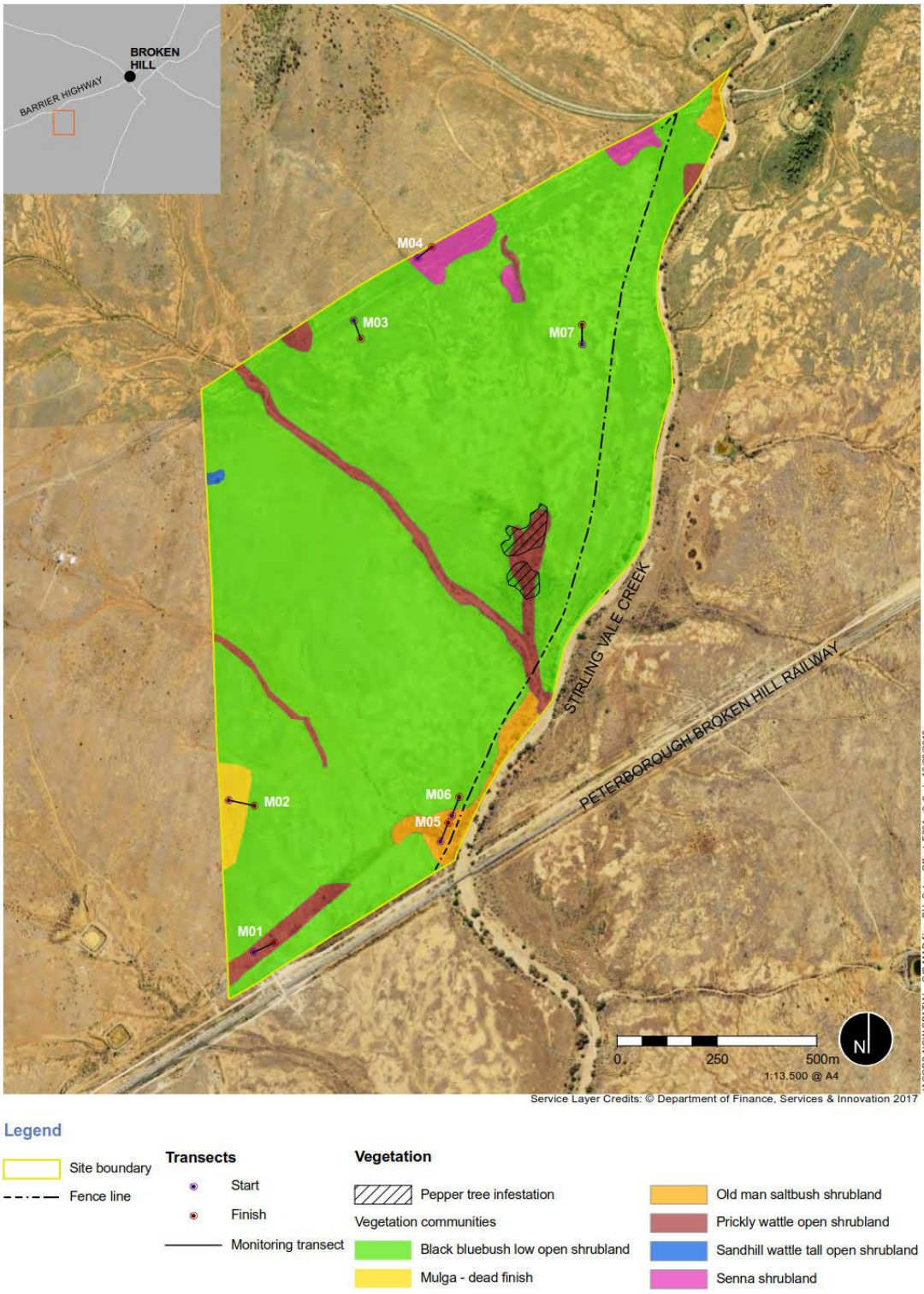

Figure 2.2 Vegetation types and monitoring plots within the Broken Hill Offset Site

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.

2.2.3 Fencing evaluation

Fences were observed for any maintenance issues whilst driving around the perimeter of the site and whilst traversing the site by foot during monitoring plot surveys.

2.3 Limitations

2.3.1 Survey timing

Surveys were undertaken in late spring as per the recommendations in the BOMP (NGH 2013) to optimise the opportunity of identifying many spring and summer flowering species which are difficult to identify in their vegetative state.

2.3.2 Climatic conditions

Broken Hill is a typically dry, semi-arid area that experiences low rainfall. Prolonged dry weather preceding the survey also meant that many plant individuals had died making them difficult to identify and it is likely that there are species present in the seed bank that were not evident during the survey.

Table 2.2 Rainfall in Broken Hill (source: 13/12/2017 http://www.eldersweather.com.au/nsw/lower-western/broken-hill)

Average rainfall to Dec	259.4mm	49.5 day(s)
Total for 2017	**108.6mm**	35 day(s)
Total to this day 2016	340.0mm	75 day(s)
Wettest day	**11.4mm**	Nov 16
Lowest temperature	**-2.9°C**	Jul 1
Highest temperature	**45.5°C**	Feb 11

2.3.3 Grazing pressure

The offset site has only recently been fenced (fencing is approximately 2 to 3 months old) and as such, high grazing pressure was evident within the vegetation communities. Kangaroos were observed within the site and the scats of a variety of animals such as goats, rabbits and kangaroos were observed.

2.3.4 Data analysis

Floristic and habitat data collected within each monitoring plot were compared with the benchmark data (DECC 2008) and baseline data collected by NGH (2013). 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 will be collated into one electronic database using Microsoft Excel, along with NGH (2013) baseline data and the benchmark data for each vegetation community so as to enable future analysis of data. Baseline data collected by NGH (2013) at the Broken Hill offset site was limited to a simple presence absence record of plants within monitoring plots. As such, this does not allow for a more sophisticated statistical 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 will allow for the use of statistical software such as PRIMER to be used to analyse data in subsequent years.

Table 2.3 Modified Braun Blanquet

Modified Braun 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	
	Easting*	Northing*	Easting*	Northing*
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 GDA94 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 Crown Fissure-weed (*M. coronata*), Saltbushes (*Atriplex* spp.) and Copperburrs (*Sclerolaena* spp.). At the time of survey grasses were very sparse although it is likely that there would be a range of species evident in more favourable conditions. See Plate 1.

Weed species were not extensive in this community, *Medicago spp*. being the most prolific. 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. #') is on average across the two plots just below the benchmark for this variable. No overstorey or midstorey cover was recorded as the tallest shrubs were all below one metre. Shrub cover and other native groundcovers (excluding grasses), were on par with or exceeded the benchmarks and baseline survey data. Grasses on average across the two plots were at the lower end of the benchmark range and significantly reduced in comparison to the NGH (2013) baseline survey, which may be a result of prolonged dryness. Hollow Bearing Tree (HBTs) and logs were absent from this community.

Overall this community is considered to be in high condition and has maintained native vegetation cover, with the exception of grass cover, since the baseline survey (NGH 2013). The opportunity for improvement in this community is possible, with the offset site now fenced in the 3 months prior to this survey. Rainfall amounts and timing over the next year will also influence the likelihood of an improved outcome in the future.

Plate 1 Black Bluebush low open shrubland M03

Table 3.2 Benchmark and monitoring plot data comparison for Black Bluebush low open shrubland M03 – Broken Hill Offset site

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Midstorey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	0	0
Benchmark	13	4%	20%	0%	0%	5%	20%	2%	15%	5%	20%	0	0
Baseline	10	0%		0%		52%		24%		0%		0	0
Yr 1 Plot M03	13	0%		0%		16%		20%		34%		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		Midstorey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	0	0
Benchmark	13	4%	20%	0%	0%	5%	20%	2%	15%	5%	20%	0	0
Baseline (NGH 2013)	n/a	n/a		n/a		n/a		n/a		n/a		0	0
Yr 1 Plot M07	8	0%		0%		4%		12%		58%		0	0

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,* Black Bluebush *(Maireana pyramidata)* and Spiny Saltbush (*Rhagodia spinescens)*. The ground cover consists of a patchy distribution of grasses, bare earth and scattered rock and a more extensive range of forbs. Weed species were low, with predominately the presence of scattered *Medicago* spp. It is considered to be in moderate condition. See Plate 2.

The monitoring plot data along with the benchmarks for this vegetation type (DECC 2008) are shown in Table 3.4. Species richness is just above the benchmark and baseline data for this variable. No overstorey cover was recorded in this community due to the general absence of Mulga within the offset site, which based on the benchmark range may be typical of the community. Midstorey cover exceeds the benchmark however, is just below the baseline data. Shrub cover and other native ground covers (excluding grasses) are significantly greater than the benchmark and baseline data for this community. Grass cover was above the benchmark for this community however, significantly less than the baseline survey (NGH 2013).

Overall this community is considered to be in moderate to high condition and has maintained and in some instances improved floristic cover, with the exception of grass cover, since the baseline survey (NGH 2013). The opportunity for further improvement in this community is possible, with the offset site now fenced in the 3 months prior to this survey. Rainfall over the next year will also influence the likelihood of an improved outcome in the future.

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

Plate 2 Mulga - Dead Finish on stony hills M02

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		Midstorey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	0	0
Benchmark	17	0%	3%	1%	3%	1%	5%	1%	5%	1%	5%	0	3
Baseline (NGH 2013)	15	0%		8%		52%		14%		2%		0	0
Yr 1 Plot M02	18	0%		6%		24%		32%		38%		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 midstorey 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 *Medicago* spp. present. See Plate 3.

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 just above the benchmark and equal to the baseline survey (NGH

2013). Overstorey cover was absent from this community which is consistent with the benchmark and considered typical for this community. Overstorey cover varies from the baseline data (NGH 2013), which is likely due to the allocation of the Prickly Wattle into this category whereas Jacobs has allocated this species to the midstorey category based on the average height of shrubs at approximately one metre. Shrub cover and other native ground covers (excluding grasses) are significantly greater than the benchmark for this community. In comparison to the baseline data (NGH 2013), the shrub groundcover is on par whilst other ground covers (excluding grasses) are significantly greater than the baseline. Grass cover was at the lower end of the benchmark for this community and significantly less than the baseline survey (NGH 2013).

Overall this community is considered to be in high condition and has maintained and in some instances improved floristic cover, with the exception of grass cover, since the baseline survey (NGH 2013). The opportunity for further improvement in this community is possible, with the offset site now fenced in the 3 months prior to this survey. Rainfall over the next year will also influence the likelihood of an improved outcome in the future.

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

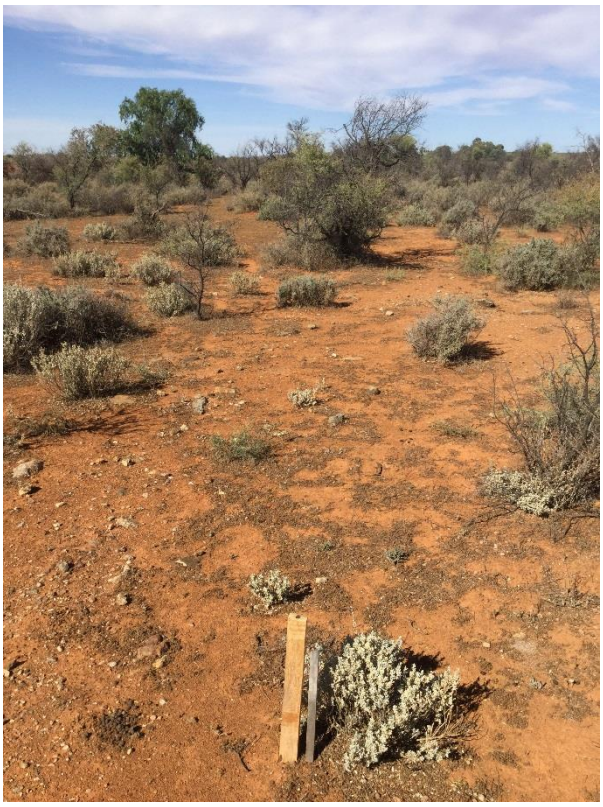

Plate 3 Prickly Wattle low open shrubland M01

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		Midstorey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	0	0
Benchmark	11	0%	0.1%	0%	0%	2%	20%	1%	10%	1%	20%	0	0
Baseline (NGH 2013)	12	7%		5%		14%		38%		2%		0	1.5
Yr 1 Plot M01	12	0%		26%		8%		32%		28%		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 midstorey 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) and Spiny saltbush (*Rhagodia* spinescens). Other native groundcovers include a range of forbs. Weed infestation is moderate within this community and is dominated by Onion Weed (*Asphodelus fistulosus*), Saffron thistle (*Carthamus lanatus*) and to a lesser extent by burr medics (*Medicago* spp). Species diversity was greatest in this community. The proximity to the access road along the northern boundary may explain the greater infestation of weeds and native species diversity. See Plate 4.

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 considerably higher than the benchmark and just under the baseline survey result (NGH 2013). As discussed above, this may be due to the proximity of the site to the access road along the northern boundary. Overstorey cover was absent from this community which is below the benchmark and baseline data (NGH 2013). The midstorey cover for this community was just above the benchmark and significantly above the baseline survey (NGH 2013). The difference in the baseline and current survey data for the midstorey may be attributable to the allocation of some species to the overstorey by NGH (2013) and understorey by Jacobs (2017). Jacobs (2017) recorded the average height of the tallest shrubs, *Senna* spp., as approximately one metre and as such these species were categorised as midstorey plants. Shrub cover exceeded the benchmark and baseline data whilst other native groundcovers (excluding grasses) were at the upper end of the benchmark and well above the baseline data (NGH 2013). Grass cover was significantly lower than both the benchmark and baseline survey (NGH 2013), which may be attributable to the prolonged dry period prior to the current survey.

Overall this vegetation community is considered to be in moderate condition and has maintained and in some instances improved floristic cover, with the exception of grass cover, since the baseline survey (NGH 2013). The opportunity for further improvement in this community is possible, with the offset site now fenced in the 3 months prior to this survey. Rainfall over the next year will also influence the likelihood of an improved outcome in the future. In addition, some targeted spot weeding for Onion weed and Saffron thistle may assist the natural regeneration of this community.

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

Plate 4 Narrow-leaved Hopbush – Scrub Turpentine - Senna Shrubland M04

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		Midstorey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	0	0
Benchmark	12	1%	14%	1%	8%	5%	25%	2%	15%	2%	25%	0	2
Baseline (NGH 2013)	23	3%		0%		48%		24%		2%		0	0
Yr 1 Plot M04	20	0%		10%		0%		34%		24%		0	0

3.1.5 Old Man Saltbush shrubland

This community appears to occur naturally 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 considered to be of conservation concern (Benson 2006). See Plates 5 and 6.

The midstorey of this community is dominated by Old Man Saltbush (*Atriplex nummularia*). Scattered occurrences of Black Bluebush (*Maireana pyramidata*), Bladder saltbush (*Atriplex vesicaria*) and Spiny saltbush (*Rhagodia spinescens*) make up the shrub ground layer. Weed infestation is high in this vegetation community and includes; Onion weed *(Asphodelus fistulosus*), Saffron thistle (*Carthamus lanatus),* African boxthorn (*Lycium ferocissimum*) and Velvet mesquite (*Prosopis velutina*).

The monitoring plot data along with the benchmarks for this vegetation type (DECC 2008) are shown in Table 3.7 and Table 3.8. On average across the two monitoring plots for this community the number of species recorded was below the benchmark. This community was not surveyed by NGH (2013) so no baseline data has been collected and as such, this current survey data will form the baseline for this community. Overstorey cover was absent from this community which is below the benchmark data. Midstorey cover was significantly greater than the benchmark. No native grass cover was recorded across the transect which, is comparable to the lower end of the benchmark data whilst shrub and other native groundcovers (excluding grasses) were significantly higher than the benchmark.

Overall this vegetation community is considered to be in moderate condition. The maintain or improve status cannot be defined until the next annual survey, where data collected will be compared to the current data (2017 baseline). Given that a number of the recorded data for floristic cover in the current survey (Jacobs 2017) exceeded the benchmark for this community, the opportunity for further improvement in this community is possible, with the offset site now fenced in the 3 months prior to this survey. Rainfall over the next year will also influence the likelihood of an improved outcome in the future. In addition, some targeted spot weeding for the dominant weed species listed above may assist the natural regeneration of this community.

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

Plate 5 Old Man Saltbush shrubland M05

Plate 6 Old Man Saltbush shrubland M06

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		Midstorey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	0	0
Benchmark	15	2%	20%	0%	3%	0%	10%	1%	20%	0%	5%	0	0
Baseline (NGH 2013)	n/a	n/a		n/a		n/a		n/a		n/a		n/a	n/a
Yr 1 Plot M05	9	0%		64%		0%		34%		16%		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		Midstorey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	0	0
Benchmark	15	2%	20%	0%	3%	0%	10%	1%	20%	0%	5%	0	0
Baseline	n/a	n/a		n/a		n/a		n/a		n/a		n/a	n/a
Yr 1 Plot M06	11	0%		3%		0%		74%		16%		0	0

3.2 Weeds and disturbance

Overall weed infestation across the site was considered to be low to moderate. Monitoring plots M05 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. In general spot spraying of a list of targeted weed species across the site (see Appendix A), concentrating on 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.

The centre of the site (see Figure 2.2 and Plate 7) also has a significant infestation of Peppercorn tree (*Schinus molle var. areira*). The Peppercorn trees, being the only overstorey vegetation (>1m) 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 more common bird species. A broken, solitary, Emu egg was also recorded within this infestation, suggesting that it may provide nesting habitat for this species. As such, complete removal of this infestation is not recommended. Management may instead require thinning of mature trees without active nests and spot spraying of any emerging saplings. A complete list of weeds that may be targeted for management, including, spot spraying are listed in Appendix A.

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). Velvet Mesquite is common within the drainage lines in the east of the site. African Boxthorn was detected within the man-made drainage depression in the south of the site. Both of these 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 so as 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.

Plate 7 Pepper Tree infestation towards the centre of the site (see Figure 2.2)

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 kangaroos and goats 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 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 babblers' nests observed.

Overall habitat appears to have been maintained since the baseline surveys undertaken by NGH (2013), with the exception of the reduction in tussock grasses across the site. The installation of fencing 3 months prior to the current survey will assist in eliminating goats and any livestock from the site, which may assist in the natural regeneration of the site and hence improve the vegetative habitats.

Plate 8 Shingleback lizard (*Tiliqua rugosa)* observed within the offset site

Table 3.9 Habitat cover assessment – Broken Hill Offset site

Habitat component	% cover										
	Baseline M01	Year 1 M01	Baseline M02	Year 1 M02	Baseline M03	Year 1 M03	Baseline M04	Year 1 M04	Year 1 M05	Year 1 M06	Year 1 M07
Tussock grasses	<5%	0%	70%	0%	50%	<5%	60%	0%	0%	0%	0%
Chenopods	40%	50%	5%	20%	20%	50%	20%	25%	10%	10%	10%
Trees/tall shrubs	15%	15%	0%	<5%	0%	0%	0%	<5%	<5%	<5%	0%
Bare ground	60%	45%	30%	25%	50%	50%	40%	40%	10%	10%	45%
Cracking clay	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Rocks/logs	<5%	10%	10%	10%	0%	0%	0%	0%	0%	0%	0%

3.4 Fence maintenance

Stock proof fences were installed on the offset site approximately three months prior to the current survey (November 2017) and as such are in new condition (refer to Plates 9 and 10) requiring no maintenance at present. A combination of ring lock style of fencing and plain and barbed wire strand fencing have been used across the site. The fences appear not to have been placed on the site boundary. Emus and Western Red Kangaroos were observed within the site, however, no goats were observed. Fencing is likely to improve the natural regeneration of the site through the exclusion of livestock and feral goats.

Plate 9 Ring-lock fencing along northern boundary of the site

Plate 10 Plain wire and barbed wire fencing along the western boundary of the 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.

Table 4.1 : Management Actions required at the Broken Hill offset site Year 1 (2017/2018)

Management measure	Objective	Action	Timing	Who	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 *Biosecurity Act* 2015 and the Western Regional Strategic Weed Management Plan 2017 – 2022 (LLS 2017)	Spot foliar spraying	During active growth season, which is generally in Spring to early Summer, particularly after rainfall. Should be undertaken in suitable low wind conditions so as to prevent spray drift to other native species.	Professional bush regeneration consultant with appropriate chemical use certification.	Nil
	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	During active growth season, which is generally in Spring to early Summer, particularly after rainfall.	Professional bush regeneration consultant with appropriate chemical use certification.	Gradual thinning of mature trees without active nests only as these trees are currently providing habitat for native birds. Target all saplings.
	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 so as to prevent spray drift to other native species.	Professional bush regeneration consultant with appropriate chemical use certification.	Nil

Cat and/or fox control	To eliminate feral pests from within the site and improve opportunities for native fauna to inhabit the site	None required at this stage. Allow habitats to regenerate over the next year with new fencing. Re-evaluate in Year 2	-	-	-
Rabbit control	To eliminate feral pests from within the site and reduce grazing on native flora	None required at this stage. Allow native vegetation to regenerate over the next year with new fencing. Re-evaluate in Year 2	-	-	-
Exclusion of feral goats	To eliminate feral pests from within the site and reduce grazing on native flora	None required at this stage. Allow native vegetation to regenerate over the next year with new fencing. Re-evaluate in Year 2	-	-	-
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 with new fencing. Re-evaluate in Year 2	-	-	-
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 two weeks of a significant rainfall event so as to better identify the diversity of plant species dormant within the ground layer

5. Conclusions and recommendations

As per the requirements of the Conditions of Approval (COA) the biodiversity offset site is required to be monitored and the results reported annually to the NSW Office of Environment and Heritage (OEH). Condition C5(b) specifically states that the biodiversity outcome to be achieved must 'improve or maintain' the biodiversity values of the site. Following the completion of fencing, this report outlines the results of the first 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 been maintained with regards to floristic diversity, coverage and quality when compared to the vegetation community benchmarks (DECC 2008) and baseline survey results recorded by NGH (2013). Prolonged periods of dryness have inhibited the growth of many plant species and a number of species were not able to be identified. 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 has only recently been installed, approximately three months prior to the recent survey, and as such is in practically new condition. 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.

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, with the exception of the tussock grass habitat, since the NGH (2013) baseline survey. 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 may also improve the regeneration of these grassy habitats. With the fences now in place no further feral pest management is recommended until after a re-evaluation of vegetation condition and fauna habitats in the second monitoring year.

Weed infestations across the site are generally low and can be maintained by spot treatment as outlined in the management actions. Weeds of particular concern include the state and regional priority weeds (LLS 2017) Velvet Mesquite and African Boxthorn, which are required to be eradicated from the site so as to prevent further spread to surrounding lands. Pepper 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 samplings and selective thinning of those trees not containing nests may provide opportunities for native species to emerge.

It is recommended that future monitoring continue to occur in late spring and where possible be scheduled within the weeks following a rainfall event to better understand the species diversity present in the ground layer.

6. References

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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	M01	M02	M03	M04	M05	M06	M07	Across site
Aizoaceae	*Sarcozona praecox*	Sarcozona		1		1	1	2	2	
Amaranthaceae	*Alternanthera angustifolia*						1			
Anacardiaceae	*Schinus molle var. areira**	Peppercorn Tree					1			
Apocynaceae	*Rhyncharrhena linearis*	Purple Pentatrope		1						
Asphodelaceae	*Asphodelus fistulosus**	Onion weed				3	2	1		
Asphodelaceae	*Bulbine* sp.	Bulbine lilt								
Asteraceae	*Brachyscome ciliaris var. lanuginosa*		2	1	1				1	
Asteraceae	*Brachyscome dentata*			1						
Asteraceae	*Carthamus lanatus**	Saffron thistle				2	1			
Asteraceae	*Senecio lanibracteus*									x
Asteraceae	*Vittadinia cuneata*	Fuzzweed		1	1	1				
Asteraceae	*Xanthium spinosum**	Bathurst Burr								x
Boraginaceae	*Echium plantagineum**	Paterson's Curse					1			
Chenopodiaceae	*Atriplex nummularia*	Old Man Saltbush					4	3	1	
Chenopodiaceae	*Atriplex stipitata*	Mallee Saltbush	1	1	1	2				
Chenopodiaceae	*Atriplex vesicaria*	Bladder Saltbush	3	1	1	2		3		
Chenopodiaceae	*Dissocarpus paradoxus*	Cannonball Burr			1	2		1		
Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush	1	1	1	1				
Chenopodiaceae	*Maireana astrotricha*	Low Bluebush		1		3				
Chenopodiaceae	*Maireana coronata*	Crown Fissure-weed			1		1			
Chenopodiaceae	*Maireana pyramidata*	Black Bluebush	3	3	4	4	3	4	3	
Chenopodiaceae	*Maireana* sp.									
Chenopodiaceae	*Rhagodia spinescens*	Spiny saltbush	3	2		3	3	2		
Chenopodiaceae	*Salsola australis (dead)*									x
Chenopodiaceae	*Sclerolaena divaricata*	Tangled Copperburr		1	1					
Chenopodiaceae	*Sclerolaena* sp.	Copperburr	1			1	2	2	3	
Crassulaceae	*Crassula tetramera*			1					1	
Euphorbiaceae	*Euphorbia multifaria*		1			1	1			
Fabaceae	*Acacia burkittii*	Sand hill wattle								x
Fabaceae	*Acacia oswaldii*	Umbrella wattle		1						
Fabaceae	*Acacia tetragonophylla*	Dead finish		3						
Fabaceae	*Acacia victoriae*	Prickly wattle	3		1	1		1		
Fabaceae	*Medicago* sp.*		1	1	1	1	1	1		
Fabaceae	*Prosopis velutina***	Velvet mesquite						1		
Fabaceae	*Senna artemisioides* sp.subsp. *filifolia*			3		3		1		

Fabaceae	*Senna phyllodinea*					3				
Fabaceae	*Vicia* sp.*									
Lamiaceae	*Salvia verbenaca**	Vervain								
Loranthaceae	*Lysiana exocarpi*									
Malvaceae	*Sida corrugata*	Corrugated sida				1				
Malvaceae	*Sida* sp.		1		1	1				
Myrtaceae	*Eucalyptus camaldulensis*	River Red Gum								x
Pittosporaceae	*Pittosporum angustifolium*	Weeping pittosporum								x
Poaceae	*Austrostipa scabra* sp.subsp. *scabra*	Speargrass		2	2	2		1		
Poaceae	*Chloris truncata*	Windmill grass								x
Poaceae	*Cymbopogon ambiguus*	Scent grass								x
Poaceae	*Enneapogon avenaceus*	Bottle Washers	2	3	2	1	1	1	1	
Poaceae	*Rytidosperma caespitosum*	Ringed Wallaby Grass	2							
Polygonaceae	*Rumex crispus**	Curled dock					1			
Portulacaceae	*Portulaca oleracea*	Pigweed							1	
Scrophulariaceae	*Eremophila sturtii*	Narrow-leaf Emu Bush								x
Scrophulariaceae	*Myoporum montanum*	Western Boobialla								x
Solanaceae	*Lycium ferocissimum***	African boxthorn						1	1	
Solanaceae	*Solanum esuriale*	Quena				1				
Zygophyllaceae	*Tribulus minutus*					1				
* general weed										
**state and regional weeds to be targeted (Biosecurity Act 2015)										

Table A.2 Opportunistic fauna species list

Class	Species	Common Name
Aves	*Pomatostomus spp.*	Babbler spp.
	Dromaius novaehollandiae	Emu
	Corvus coronoides	Australian Raven
	Eolophus roseicapilla	Galah
Mammalia	*Macropus rufus*	Red Kangaroo
Reptilia	*Tiliqua rugosa*	Shingleback lizard
		Skink spp.

Appendix B. Condition of Approval (COA) C5