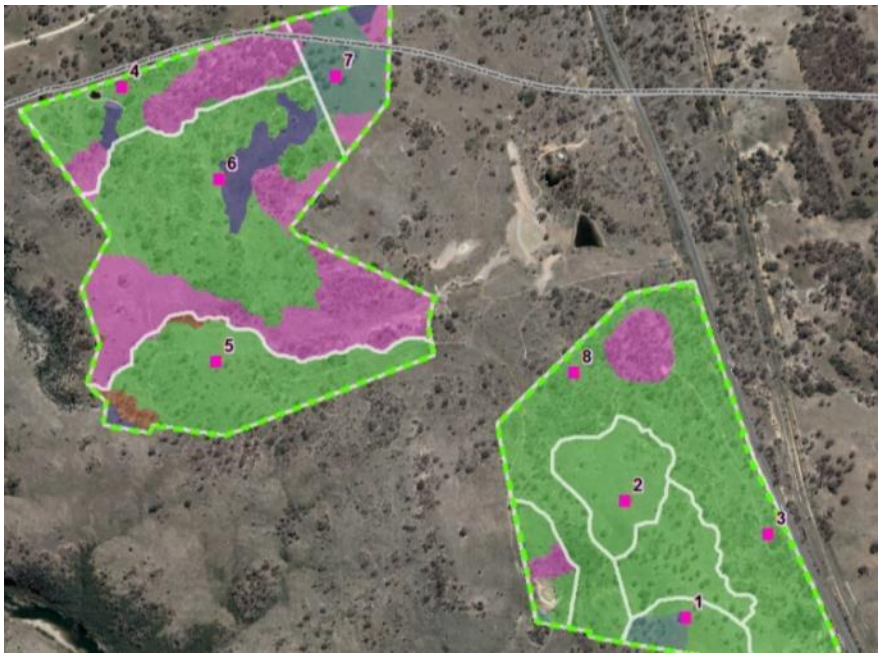
M2G Offset Property Monitoring Report

Autumn 2014

Prepared for
ACTEW Water

6 June 2014



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Abbreviations

ABBREVIATION	DESCRIPTION
BOM	Bureau of Meteorology
DBH	Diameter at Breast Height
DSE	Dry Sheep Equivalent
EIS	Environmental Impact Statement
ELA	Eco Logical Australia Pty Ltd
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)*
HBT	Hollow Bearing Tree
LMA	Land Management Agreement
LRMP	Landscape Rehabilitation Management Plan
M2G	Murrumbidgee to Googong Water Transfer Project
MU	Management Unit
ODP	Offset Delivery Plan
OEMP	Operation Environmental Management Plan
ORMP	Offset Rehabilitation Management Plan
PER	Public Environment Report
RFAC	Regional Feral Animal Control
TEMP	Terrestrial Ecology Management Plan
TSC Act	*Threatened Species Conservation Act 1995*

Executive summary

The Biodiversity Offset site was provided to compensate for impacts resulting from the development of the Murrumbidgee to Googong Water Transfer Project (M2G). The offset site was surveyed in autumn 2014 as part of a twice-yearly monitoring program implemented to inform the management and implementation of the offset.

The autumn 2014 surveys found that the offset site is in good condition and is responding well to management actions, such as the exclusion of stock, feral animal control and weed control works. Evidence for this is the abundant natural regeneration of *Eucalyptus* spp. and regeneration of a variety of typical mid-storey species across the offset site. In addition, there has been a general decrease in the abundance of exotic species observed across the site and an increase of native species diversity recorded at all vegetation monitoring plots. Targeted nocturnal fauna surveys were implemented for the first time during the 2013 spring monitoring and continued in autumn 2014. However, fauna habitat features are largely unchanged since the baseline surveys.

Primary weed control activities have been largely successful across the offset site. Follow-up control, with an emphasis on St. John's Wort control is recommended to further reduce the abundance and distribution of key weed species across the site.

Over 150 feral goats (*Capra aegagrus hircus*) were removed from the offset site in December 2013. However, a herd of up to 50 feral goats were observed during the autumn 2014 monitoring surveys. Further control is recommended to manage the goats within the offset site and surrounding properties. A small group of feral pigs (*Sus scrofa*) were observed during the current monitoring surveys. A control program is also recommended to manage the pigs within the offset site. It is recommended that monitoring for both species is implemented one-month following any control activities to determine the success of the control program and if follow-up management activities are required.

The majority of erosion monitoring points have not shown signs of erosion since the baseline surveys, despite high rainfall events occurring during this time. The lack of erosion indicates that the soil is stable with a low risk of significant erosion occurring in the future. A high vegetation cover across the offset site and the continued exclusion of stock grazing further reduces the risk of erosion occurring. The number of erosion monitoring points was reduced for the spring and autumn 2014 monitoring surveys.

The condition of the offset boundary fencing is considered adequate to exclude stock from the offset site. No immediate management actions are required to be undertaken. However, maintenance at some locations is likely to be required in the future.

Further monitoring in spring 2014 will guide additional or future management actions.

1 Introduction

1.1 Background

Eco Logical Australia Pty Ltd (ELA) was commissioned by ACTEW Water (ACTEW) to deliver terrestrial ecology services as required by the environmental approval process for the Murrumbidgee to Googong Water Transfer Project (M2G).

The M2G projects falls under the jurisdiction of the Commonwealth Department of the Environment (previously, Department of Sustainability, Environment, Water, Population and Communities), NSW (Department of Planning), and ACT (ACT Planning and Land Authority) Governments and has been subject to assessment and environmental approval processes in all three jurisdictions. Project approval (granted in 2010) has been attained from all three governments, with a considerable number of approval conditions and commitments applied.

Under the environmental approvals process, ACTEW was required to provide compensatory habitat as an offset to compensate for vegetation and habitat losses arising from the construction activities associated with the M2G pipeline. The offset was required to be delivered to meet the conditions outlined in a range of documents including but not limited to, the Environmental Impact Statement (EIS) and Public Environment Report (PER) prepared for the development and relevant approval conditions.

1.2 Purpose of document

Under Condition 2.9b of the NSW Approval and Condition 3.l of the Commonwealth approval conditions for the M2G Project (see Offset Delivery Plan (ODP) for further information), management and monitoring of the offset site is required. The ODP prepared by ELA (April 2012) describes the actions to be taken in establishing and managing the offset site under the approval conditions and commitments including the provision of monitoring actions (Eco Logical Australia 2012).

This report details the autumn monitoring surveys for 2014 that were undertaken in accordance with the methodology and aims established in the ODP. It is designed to be a standalone monitoring report consistent with the format of the previous biannual monitoring reports, but also to be read in context with the ODP. The purpose of this document is to report on the ecological condition of the site and management actions conducted throughout the previous year, in order to guide future actions within the offset site.

1.3 Study area

ACTEW own a land parcel in the southern ACT (Block 1675), referred to here as the Williamsdale property (or 'the property'). The property is approximately 208 hectares in size and is located just south of Williamsdale. The property is bounded by the Monaro Highway to the east; the NSW border to the south; Angle Crossing Road to the north; and the Murrumbidgee River corridor to the west (**Figure 1**). The monitoring surveys were conducted within the offset site (study area of approximately 110 ha), which is wholly contained within the property.

The offset site has been set aside for conservation due to its high biodiversity value; including the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed Box-Gum Woodland, threatened flora and fauna species and/or threatened species habitat.

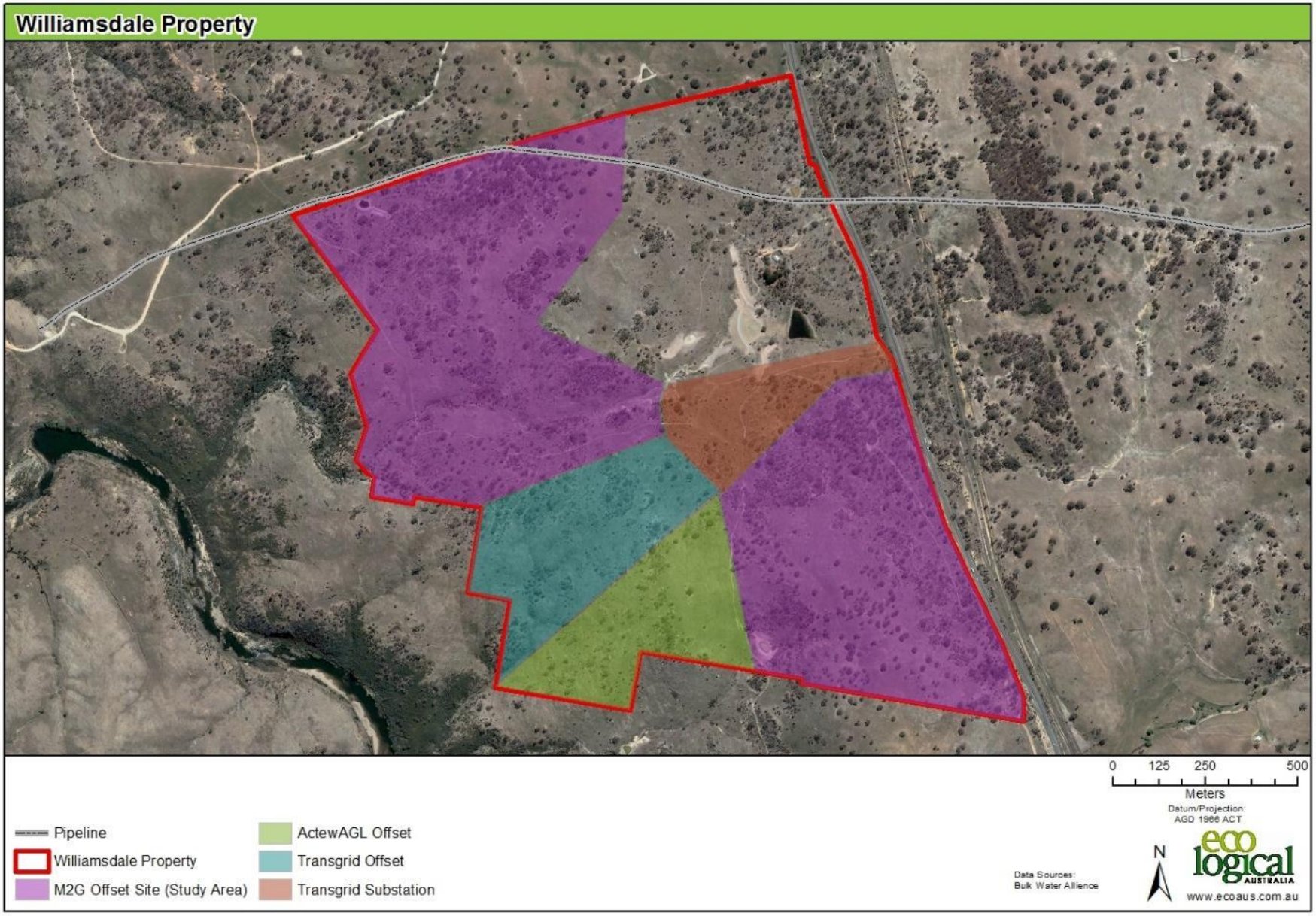

Figure 1: Study area

2 Field survey methods

The native vegetation and biodiversity values present within the offset site are managed under the ODP and its sub-plans. The ODP establishes the monitoring methodology for each of these values. A summary of the monitoring methodology outlined in the ODP is presented below, followed by the results of the autumn 2014 monitoring surveys.

2.1 Vegetation monitoring plot methodology

The monitoring methodology has been adapted from the NSW Biobanking methodology to suit the offset site management requirements. The modified Biobanking methodology proforma uses a combination of quadrat and transect surveys to establish vegetation condition, and this approach is mirrored under the monitoring methodology.

Vegetation surveys have been designed to collect the following data:

- Species diversity, including native and exotic species.
- Cover abundance of native and exotic species.
- Identification of any threatened flora.
- Condition of vegetation community.

2.1.1 Floristic quadrats

Eight 20 m x 20 m monitoring quadrats (plots) were established to collect baseline data on the condition and species composition of the offset site during autumn and spring each year (**Figure 2**). The quadrats are permanently erected and marked using a star picket at each corner tagged with flagging tape. The location of each quadrat has been referenced using a GPS device (north-west corner) and their location plotted on a map (**Figure 2**).

Each quadrat was surveyed by walking back and forth along 10 parallel transects approximately 2 m apart. A cumulative list of flora species within each quadrat was recorded and assigned a cover abundance score using the Braun-Blanquet scale.

Two of the eight plots (control plots) were chosen in order to observe natural changes in species composition over time. Both plots were located in areas of good quality EPBC Act listed Box-Gum Woodland and at the time of establishment were free from noxious weeds. Where possible, no management actions, such as weed control, erosion control, or rehabilitation are planned to occur within these monitoring plots over the duration of the monitoring period. However, it is noted that some actions such as feral animal control occurs on an offset site scale. If noxious weeds are observed within the control plots during the biannual monitoring surveys, the weeds will be identified, recorded and then removed. The removal of noxious weeds from the control plots is required to maintain the overall conservation principles of the offset site.

The other six monitoring plots were located in units where management actions were planned or likely to occur as outlined in the management sub-plans, in order to observe the effect that the actions have on ecological values and species composition over the course the monitoring program.

A description of the monitoring plots is provided in **Figures 4-11**. The GPS co-ordinates of the north-west corner of each monitoring plot are provided below in **Table 1**. A species list for each of the monitoring plots is included in **Appendix A**.

Table 1: Monitoring plot co-ordinates (GDA 1994 MGA Zone 55).

Monitoring plot	Plot location	Established	North-west corner		Transect	
			Easting	Northing	Easting	Northing
1	MU1A	October 2011	693669.49	6059272.51	693674.98	6059300.56
2	MU2B	March 2012	693529.99	6059555.34	693541.22	6059504.10
3	MU3	October 2011	693872.06	6059467.44	693874.65	6059490.73
4	MU4	October 2011	692349.35	6060568.08	692365.82	6060517.43
5	MU5	October 2011	692559.98	6059906.52	692526.40	6059902.85
6*	MU6	March 2012	692576.25	6060344.05	692622.53	6060358.54
7	MU7	March 2012	692860.59	6060583.39	692874.01	6060542.87
8*	MU3	October 2011	693414.37	6059863.02	693445.95	6059828.31

* Refers to the control plot

2.1.2 Step point transects

A 50 m transect (50 m length of tape) was established at each of the monitoring plots to compliment the floristic quadrat surveys and to determine the projected foliage cover and structural components of the community. Each transect was referenced using a GPS device and 3 photos were taken from the start of the transect (left side, centre, and right side). The 50 m transect was surveyed as follows:

- At every 1 m along the 50 m tape, the understorey layer was assessed (50 survey points per transect) as, native grass, native shrub, native other or exotic species. The understory cover was then presented as a percentage cover of each vegetation type (native or exotic).
- At every 5 m along the 50 m tape, the foliage cover of the native and exotic species in the mid and overstorey layer was recorded (10 survey points per transect). The foliage cover was then recorded as a percentage for each layer.

2.2 Swainsona recta monitoring

A monitoring survey is conducted during the peak flowering period for *Swainsona recta* in October each year. *Swainsona recta* monitoring is not conducted as part of the autumn surveys.

Each individual plant is assessed for its survivorship and flowering condition to determine whether:

- it is present or absent
- it is in flower
- it has flowered recently (development of seed pods)
- it is in leaf only.

In addition, the translocation plots are inspected for signs of individual recruitment. The results allow a comparison of survivorship, condition and recruitment events at the end of each monitoring period and provide a picture of the overall success of the propagation program.

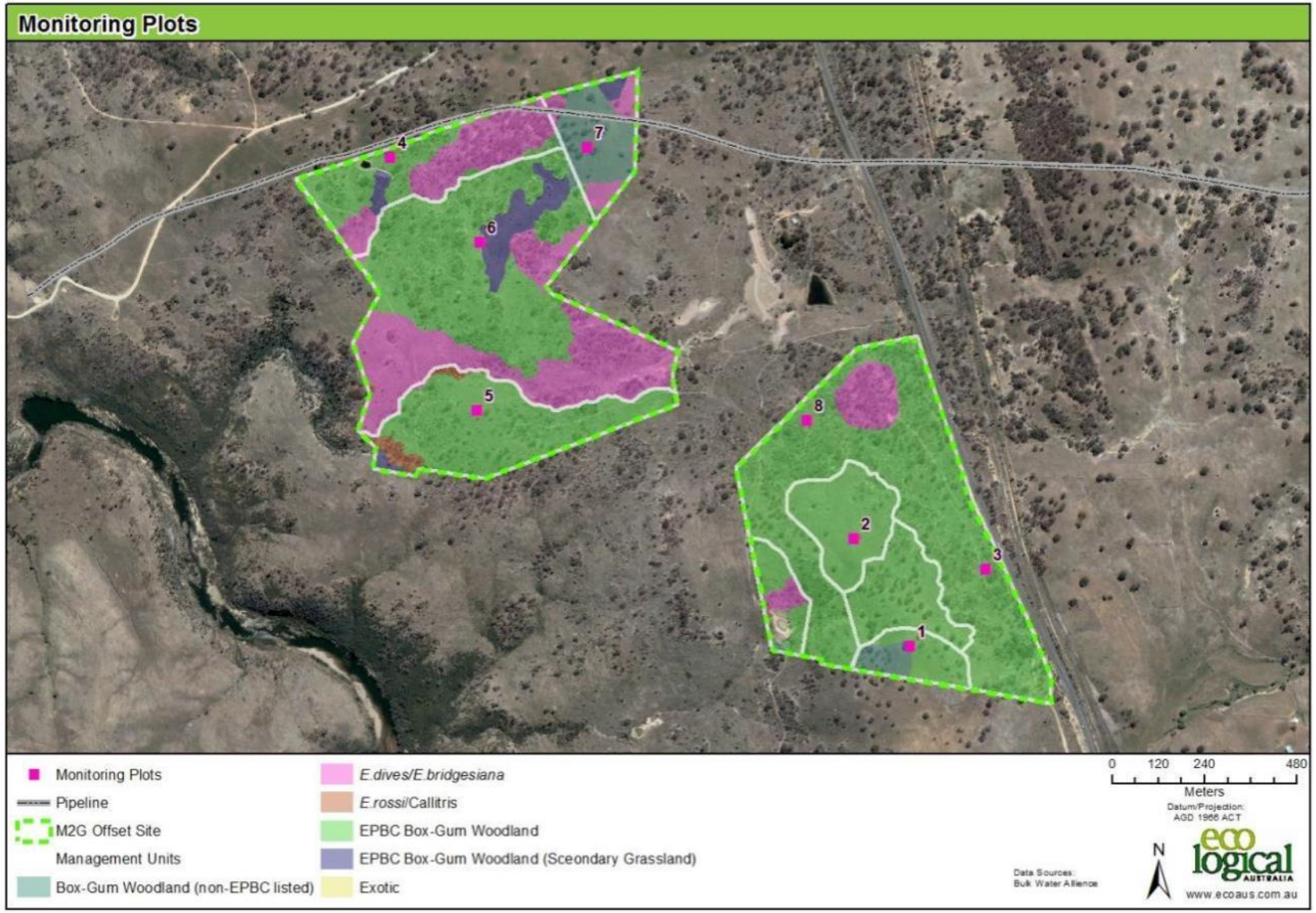

Figure 2: Monitoring plots, management units and baseline offset site ecological values

2.3 Weed monitoring methodology

The management of weeds within the M2G offset site is undertaken in accordance with the Weed Monitoring Sub-Plan. The sub-plan outlines the weed management activities to be undertaken in order to satisfy relevant approval conditions and commitments. As an action under the sub-plan, the monitoring of weeds within the offset is required on a biannual basis to incorporate the seasonal changes in weed abundance and weed control activities.

Weed monitoring is undertaken in autumn and spring using random meander transects, covering both the northern and southern offset. A GPS record is taken when a noxious or locally listed weed species is observed during transects in a patch containing multiple individuals.

2.4 Erosion monitoring methodology

Erosion monitoring sites were established during the autumn 2012 monitoring surveys. Meandering traverses were conducted across the offset site, with particular attention paid to ephemeral drainage lines and higher erosion risk areas. Points of erosion encountered were described in terms of size and their location recorded using a GPS. A photo (**Section 6**) was taken of each point in order to observe any changes over time.

It's important to note that not all points of erosion originally observed in the baseline surveys were established as a monitoring point, but rather a representative sample was chosen that encompasses each of the main drainage lines. A number of erosion monitoring points were discontinued from spring 2013 onwards, as these points did not shown signs of erosion since the baseline surveys, despite significant rain events occurring over this two year period.

2.5 Fencing monitoring methodology

Fence monitoring was undertaken by traversing the Williamsdale property border and assessing the condition of the fence. Any damaged areas observed along the fence line were noted and a GPS point taken. Fence damage was categorised into three categories to represent the level of risk of unwanted grazers (such as cattle) entering the offset site:

- *Low risk*– Small holes observed at the bottom of the fence that does not require immediate attention and allows native fauna (e.g. wombats) to pass through.
- *Moderate risk* – Small to moderate sized holes or fence damage that requires monitoring, but no immediate action. Often observed along the fence line bordering the Murrumbidgee River corridor and represents a potential goat or sheep access point. Note; there can be a small difference between the low and moderate categories. However, other evidence such as tracks and scats that may represent feral presence was used to inform the level of risk.
- *High risk* – Represents points along the fence line requiring attention. These points represent a high risk of cattle and sheep entering the property.

2.6 Fauna habitat and feral animal monitoring methodology

Feral animal monitoring, fauna habitat and fauna surveys have been undertaken using a combination of techniques, including:

- Fauna habitat assessment and random meander surveys.
- Infra-red cameras.
- Nocturnal surveys including Anabats, spotlighting and frog habitat surveys.
- Opportunistic observations.

The locations of the infra-red cameras, spot-light transects, frog surveys and Anabats are shown in **Figure 3**.

2.6.1 Fauna habitat assessment

A fauna habitat assessment was conducted within each 20 m x 50 m vegetation monitoring plot to observe the number of hollow bearing trees, length of fallen logs (greater than 10 cm width) and dominant habitat features present. In addition, a qualitative assessment of fauna habitat features was undertaken for each of the northern and southern offsets. This assessment included features such as, hollow-bearing trees, logs, litter, fallen timber, stags, surface or outcropping rocks, termite mounds, mistletoe presence, large trees, natural regeneration and exotic or native shrub thickets.

The fauna habitat assessments are outlined in **Appendix B**.

2.6.2 Infra-red camera surveys

The use of infra-red cameras was recommended as a monitoring method in the *Autumn 2012 Monitoring Report* (ELA 2012). Remote cameras have been used with success in detecting the presence of feral pigs and other exotic animals, estimating abundance, and determining trapping success (Hamrick et al., 2011).

Two infra-red camera locations were set-up within the offset site and left for a minimum of five days, one within the northern offset and the other in the southern offset. The locations of the infra-red cameras (**Figure 3**) were chosen based on fauna signs, access to water and fauna tracks, such as pig-rooting, wombat tracks and game trails.

2.6.3 Nocturnal surveys

Targeted nocturnal fauna surveys (**Figure 3**) were implemented for the first time during the 2013 spring monitoring surveys, and were conducted to further inform the list of fauna species present within the offset site. Surveys techniques included:

- *Spotlighting* – Two 30 minute transects were conducted across the offset site, one transect within the northern offset and one transect in the southern offset. Transect locations targeted stands of vegetation with a mixed-aged overstorey, hollow-bearing trees and flowering Eucalypts.
- *Frog habitat survey* – Active searches and frog call recordings were conducted at the two dams within the offset site for ten minutes each.
- *Anabat* – Four Anabat nights were conducted over the 5th and 6th May, using two Anabats to monitor bat activity through ultrasonic echolocation calls. One Anabat was set up at the southern dam and the other in a flyway to record bat activity between dusk and dawn. Each Anabat was left for two nights. Recordings were then sent off for analysis and species identification.

2.6.4 Opportunistic observations

Visual and aural observations of all vertebrate fauna species (including signs of feral animal activity) were recorded opportunistically whilst conducting targeted monitoring surveys across the offset site and using random meander techniques (species list available in **Appendix B**). Locations of conservation significant fauna and signs of feral animal presence were referenced using a GPS device.

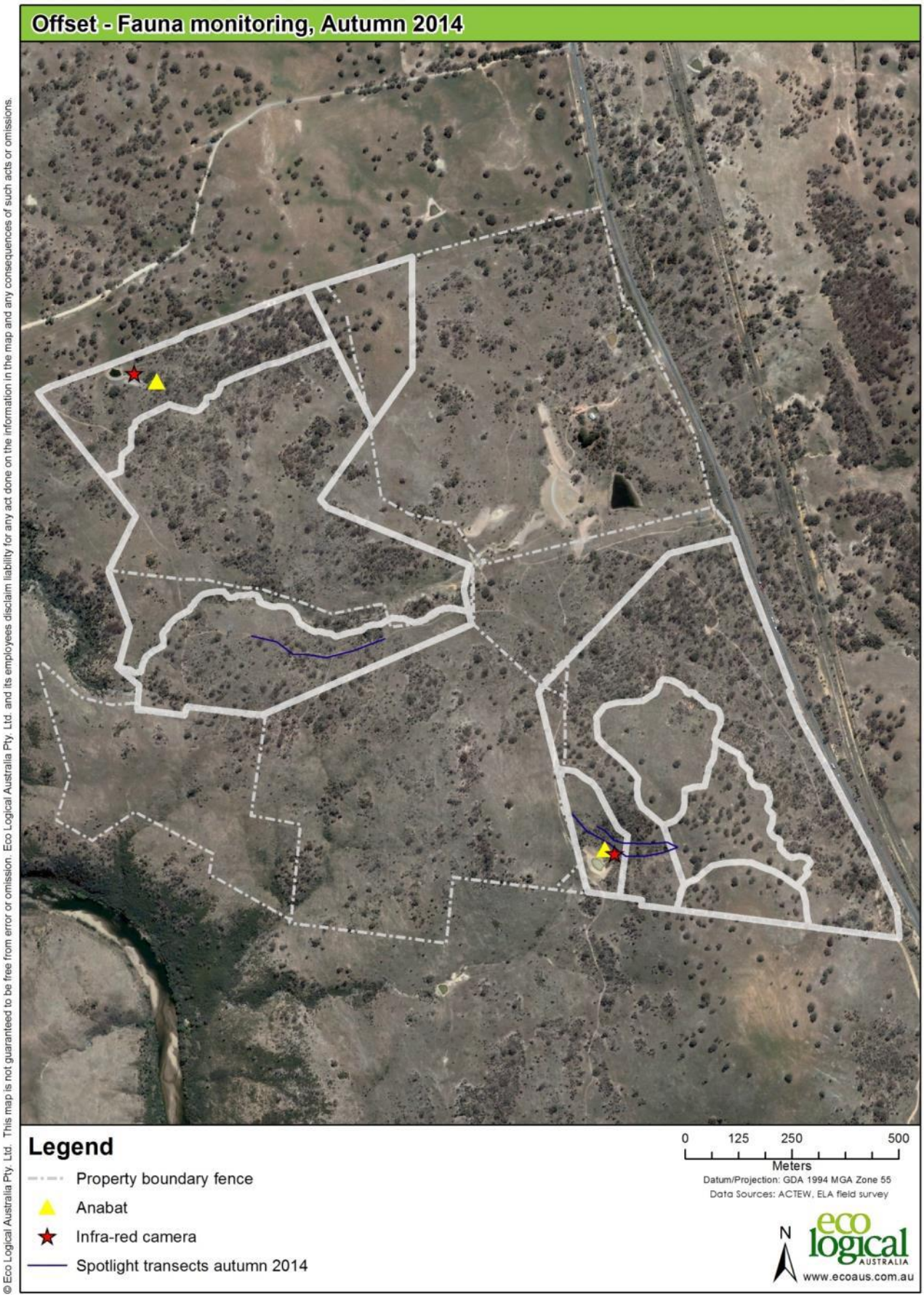

Figure 3: Fauna monitoring locations

3 Vegetation and fauna habitat monitoring

3.1 Primary on ground works

A number of primary on-ground works were undertaken throughout 2013 including:

- Erection of new fence bordering MU7 of the northern offset (June/July 2013).
- Removal of internal fencing within the offset site (June/July 2013).
- Weed control targeting African Lovegrass and Serrated Tussock (spring 2013).
- Weed control targeting Sweet Briar, Blackberry, St. John's Wort and Thistle species (late spring 2013 with follow up control in early 2014).
- *Swainsona recta* planting of 46 individuals (September 2013).
- Removal of 150 feral goats, as well as aerial surveys of the property (December 2013).
- Feral pig monitoring in December 2013 (control scheduled for winter 2014 if required).

3.2 Overview of monitoring results

The rainfall total over the period since the spring 2013 surveys was approximately 65mm above the average total (BOM 2013; Tharwa General Store, station 70083, approx. 8 km north-west). A total of 89mm of rain fell within the month leading up to the surveys, but only 6mm of this was recorded in the two weeks prior to the monitoring surveys. The largest rainfall event occurred on April 4th with over 44mm of rain recorded within 24 hours. For the purposes of this report, a high rainfall event is considered when 50mm or more of rain falls within a 24 hour period.

Weed control undertaken in 2013 (for African Lovegrass and Serrated Tussock) has been successful across the offset site with little regrowth observed. Control for Sweet Briar and Blackberry have also been successful, with limited regeneration of these species recorded. Further follow-up control is likely to be required for these species to ensure continued suppression. St. John's Wort was observed in the early stages of growth across large portions of the offset site, and will require follow up control to minimise its extent.

The monitoring surveys recorded a herd of approximately 50 feral goats and a small group of feral pigs (6 adults, 8 piglets) utilising the offset site. These species require control, which is currently scheduled to occur in mid-late 2014 depending on suitable conditions.

Native species diversity and cover across the offset site was observed to be higher than that recorded during the baseline surveys and the previous autumn (2013) monitoring surveys. The higher native diversity was observed in all vegetation monitoring plots except monitoring plot four. Exotic species diversity was also higher than recorded for the baseline surveys and the previous autumn monitoring surveys. This increase in exotic diversity may be attributed to seasonal rainfall events and the removal of exotic grazing practices from the offset site. The availability of fauna habitat features was consistent with the baseline monitoring surveys.

The results of the vegetation monitoring are provided in the following pages. A summary of each plot is provided in **Figure 4** to **Figure 11**. Floristic results from each plot are provided in **Appendix A**.

3.2.1 Monitoring plot 1

Plot Description				
Management unit	MU1A		*Plot number*	1
Vegetation type	Box-Gum Woodland		*Condition*	Low-mod
Plot Statistics (%)	***Baseline***	**Aut. 2014**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneration	Yes
Native midstorey cover	*0*	0	Species	*E. blakelyi*
Native understorey cover (grass)	*40*	50	**Habitat features**	
Native understorey cover (other)	*6*	16	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	0 m
Exotic understorey plant cover	*58*	38		
Other (litter, bare, rock)	*N/R*	10		
Native species diversity	*14*	19		

Monitoring plot 1 is located within MU1A on the southern offset. The plot is composed of relatively lower condition Box-Gum Woodland. Natural regeneration of the overstorey (Eucalypts) was present with a low number of saplings observed. This is in comparison to no regeneration recorded during the baseline surveys. Native species diversity was low-moderate (19 species), but an increase compared to the baseline surveys. Despite lower native diversity, the plot was marginally dominated by native species. The dominant species included *Austrostipa* spp., *Microlaena stipoides* (Weeping Grass) and *Carex inversa* (Common Sedge). It was noted that several *Nassella trichotoma* (Serrated Tussock) have undergone recent control. Fauna habitat features within MU1A have not changed noticeably since the baseline surveys.

Figure 4: Monitoring Plot 1. (Left: Baseline monitoring photo, October 2011. Right: Monitoring photo May 2014)

3.2.2 Monitoring plot 2

Plot Description				
Management unit	MU2B		*Plot number*	2
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**Aut. 2014**	**Overstorey**	
Native overstorey cover	*0*	0.25	Regeneration	Yes
Native midstorey cover	*0*	0	Species	*E. blakelyi*
Native understorey cover (grass)	*80*	72	**Habitat features**	
Native understorey cover (other)	*4*	12	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	1 m
Exotic understorey plant cover	*6*	26		
Other (litter, bare, rock)	*7*	16		
Native species diversity	*30*	44		

Monitoring plot 2 is located within MU2B within the southern offset. It is situated on a rocky hill containing Pink-tailed Worm Lizard habitat. It contains relatively good condition mature Box-Gum Woodland with scattered regeneration present. It contains a moderate to high diversity of native understorey species. Outcropping and surface rocks constitutes over 10% of the ground cover. The vegetative groundlayer is dominated by *Rytidosperma* spp., *Austrostipa* spp. and *Chrysocephalum apiculatum* (Common Everlasting). A total of 44 native species were recorded within the plot, an increase of 14 species compared to the baseline surveys. Fauna habitat features within MU2B have not changed noticeably since the baseline surveys.

Figure 5: Monitoring Plot 2. (Left: Baseline monitoring photo, March 2012. Right: Monitoring photo May 2014)

3.2.3 Monitoring plot 3

Plot Description				
Management unit	MU3		*Plot number*	3
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**Aut. 2014**	**Overstorey**	
Native overstorey cover	*3.7*	4.5	Regeneration	Yes
Native midstorey cover	*5.2*	7.3	Species	*E. blakelyi*
Native understorey cover (grass)	*80*	74	**Habitat features**	
Native understorey cover (other)	*16*	8	Tree hollows	0
Exotic midstorey plant cover	*0.2*	0	Fallen logs	11 m
Exotic understorey plant cover	*10*	16		
Other (litter, bare, rock)	*N/R*	18		
Native species diversity	*27*	40		

Monitoring plot 3 is located within MU3 in the southern offset. The plot is located in moderate to good quality Box-Gum Woodland. The plot is dominated by mature *E. blakelyi* and a significant amount of natural regeneration is present. A diverse understorey with dominant species including *Themeda australis* (Kangaroo Grass), *Rytidosperma* spp. (Wallaby Grasses) and *Bothriochloa macra* (Red-leg Grass) is present. The understorey has a high diversity of native species (40) which is a significant increase compared to the diversity recorded in the baseline monitoring surveys (27). Weed control activities were undertaken in 2013 targeting *Rosa rubiginosa* (Sweet Briar) with little regrowth observed. Native mid-storey species present include *Bursaria spinosa*. Fauna habitat features within MU3 have not changed noticeably since the baseline surveys.

Figure 6: Monitoring Plot 3. (Left: Baseline monitoring photo, October 2011. Right: Monitoring photo May 2014)

3.2.4 Monitoring plot 4

Plot Description				
Management unit	MU4		*Plot number*	4
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**Aut. 2014**	**Overstorey**	
Native overstorey cover	*4.7*	15.5	Regeneration	Yes
Native midstorey cover	*11.5*	0	Species	*E. blakelyi*
Native understorey cover (grass)	*74*	82	**Habitat features**	
Native understorey cover (other)	*18*	20	Tree hollows	0
Exotic midstorey plant cover	*2*	0	Fallen logs	22 m
Exotic understorey plant cover	*28*	14		
Other (litter, bare, rock)	*N/R*	4		
Native species diversity	*24*	25		

Monitoring plot 4 is located in the northern offset in MU4. It is located in moderate to good quality Box-Gum Woodland dominated by *E. blakelyi*. The plot supports a moderately diverse understorey composed of 25 native species. The dominant species are *Themeda australis*, *Microlaena stipoides* and *Juncus* spp. (Rushes). Woody weed control for *R. rubiginosa* is successful with little regrowth observed. A high level of regeneration exists within the management unit (particularly for *Eucalyptus* spp.) compared to the baseline monitoring, which was conducted prior to the removal of exotic grazing practices. Fauna habitat features within MU4 have not changed noticeably since the baseline surveys.

Figure 7: Monitoring Plot 4. (Left: Baseline monitoring photo, October 2011. Right: Monitoring photo May 2014)

3.2.5 Monitoring plot 5

Plot Description				
Management unit	MU5		*Plot number*	5
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**Aut. 2014**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneration	Yes
Native midstorey cover	*11*	14	Species	*E. blakelyi*
Native understorey cover (grass)	*76*	70	**Habitat features**	
Native understorey cover (other)	*14*	16	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	3 m
Exotic understorey plant cover	*4*	8		
Other (litter, bare, rock)	*16*	16		
Native species diversity	*29*	39		

Monitoring plot 5 is a control plot located in MU5. No management actions will occur within the boundaries of the plot. Plot 5 is located in moderate-good quality Box-Gum Woodland dominated by *E. blakelyi* with a significant amount of natural regeneration present. The monitoring plot supports a highly diverse understorey of grasses, herbs and forbs with 39 native species recorded in autumn 2014. The understorey is known to support some grazing intolerant species, such as *Swainsona sericea* (Silky Swainson-pea), *Microseris lanceolata* (Yam Daisy), *Arthropodium minus* (Small Vanilla Lily) and *Microtis unifolia* (Common Onion Orchid) (recorded spring 2012). Fauna habitat features within MU5 have not changed noticeably since the baseline surveys.

Figure 8: Monitoring Plot 5. (Left: Baseline monitoring photo, October 2011. Right: Monitoring photo May 2014)

3.2.6 Monitoring plot 6

Plot Description				
Management unit *Vegetation type*	MU6 Box-Gum Woodland		*Plot number* *Condition*	6 Mod-Good
Plot Statistics (%)	***Baseline***	**Spr. 2013**	**Overstorey**	
Native overstorey cover	*5.3*	10	Regeneration	yes
Native midstorey cover	*0*	0	Species	*E. blakelyi*
Native understorey cover (grass)	*80*	64	**Habitat features**	
Native understorey cover (other)	*10*	0	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	0 m
Exotic understorey plant cover	*8*	44		
Other (litter, bare, rock)	*N/R*	14		
Native species diversity	*28*	39		

Monitoring plot 6 is located in MU6 along the central ridge line of the property, in moderate-good quality Box-Gum Woodland dominated by *E. blakelyi.* The plot is situated on the ecotone between the woodland and grassland types of the ecological community. The plot supports a diverse understorey of grasses, herbs and forbs with 39 native species recorded in autumn 2014. The plot also supports natural regeneration including native shrubs that will comprise the mid-storey. The understorey was dominated by native perennial tussock grasses including *Austrostipa* spp. and *Rytidosperma* spp. *Hypericum perforatum* (St John's Wort) was observed widely within the MU and requires follow-up control. Fauna habitat features within MU6 have not changed noticeably since the baseline surveys.

Figure 9: Monitoring Plot 6. (Left: Baseline monitoring photo, March 2012. Right: Monitoring photo May 2014)

3.2.7 Monitoring plot 7

Plot Description				
Management unit	MU7		*Plot number*	7
Vegetation type	Box-Gum Woodland		*Condition*	low
Plot Statistics (%)	***Baseline***	**Aut. 2014**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneration	No
Native midstorey cover	*0*	0	Species	*N/A*
Native understorey cover (grass)	*74*	10	**Habitat features**	
Native understorey cover (other)	*0*	38	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	8 m
Exotic understorey plant cover	*34*	98		
Other (litter, bare, rock)	*N/R*	0		
Native species diversity	*13*	22		

Monitoring plot 7 is located within MU7 in the northern offset. The management unit is composed of degraded Box-Gum Woodland with the overstorey dominated by *E. blakelyi.* Native species diversity was low (22 species) in comparison with other monitoring plots, but an increase compared to the baseline surveys (13 native species). Perennial vegetation is dominated by native species (sedges and rushes, *Carex* spp.); however, exotic annual vegetation cover was higher and accounts for the majority of the exotic understorey recorded in the table adjacent. Fauna habitat features within MU7 have not changed noticeably since the baseline surveys.

Figure 10: Monitoring Plot 7. (Left: Baseline monitoring photo, March 2012. Right: Monitoring photo May 2014)

3.2.8 Monitoring Plot 8

Plot Description				
Management unit	MU3		*Plot number*	8
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**Aut. 2014**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneration	Yes
Native midstorey cover	*8.5*	7	Species	*E. blakelyi*
Native understorey cover (grass)	*80*	62	**Habitat features**	
Native understorey cover (other)	*14*	6	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	14 m
Exotic understorey plant cover	*4*	6		
Other (litter, bare, rock)	*N/R*	30		
Native species diversity	*26*	35		

Monitoring plot 8 is a control plot located in MU3. No management actions are proposed to occur within the bounds of the plot. The plot is located in good quality Box-Gum Woodland dominated by *E. blakelyi.* The plot supports a diverse understorey of grasses, herbs and forbs with 35 native species recorded in autumn 2014, an increase from the baseline surveys. The dominant understorey species included *Themeda australis*, *Rytidosperma* spp. and *Chrysocephalum apiculatum*. Photo comparison shows a healthy understorey dominated by native species with good inter-tussock spacing. Fauna habitat features have not changed noticeably since the baseline surveys.

Figure 11: Monitoring Plot 8. (Left: Baseline monitoring photo, October 2011. Right: Monitoring photo May 2014)

3.3 Fauna habitat assessment and monitoring surveys

3.3.1 Fauna habitat features

Table 2 outlines the rapid assessment for fauna habitat features observed across the offset site and **Table 3** outlines the dominant habitat features recorded within each 50 m x 20 m monitoring plot.

The following categories were used to identify abundance or frequency of each feature:

- *Abundan*t = feature occurs in an almost continuous manner.
- *Common* = feature encountered commonly, i.e. without having to search for it.
- *Occasional* = feature occurs in more than a few cases, but not encountered frequently.
- *Rare* = feature observed very infrequently, one to a few cases at most.

Table 2: Fauna habitat features observed across the offset site

Fauna habitat feature	Northern	Southern
Tree hollows	Occasional	Occasional
Large trees > 60 cm DBH	Occasional	Occasional
Dead standing trees	Occasional	Rare
Stumps (<2 m)	Rare	Rare
Mistletoes	Common	Common
Regenerating tree thickets	Abundant	Abundant
Native shrub thickets	Common	Occasional
Exotic shrub thickets	Occasional	Occasional
Logs (fallen)	Occasional	Occasional
Timber (fallen)	Occasional	Occasional
Litter (leaf, twig, bark)	Common	Common
Loose rocks	Common	Common
Outcropping rocks	Common	Common
Termite mounds	Rare	Rare
Meat ant nests	Occasional	Occasional
Earth banks/deep gully walls	Rare	Rare

Table 3: Habitat assessment within 50 m x 20 m vegetation monitoring plots

Plot	HBT	Logs	Comment	Dominant habitat features present within 50 m x 20 m plot
1	0	0 m	No change	Limited surface rocks; moderate recent grazing; canopy regeneration
2	0	1 m	No change	Surface and outcropping rocks abundant; shrub regeneration present
3	0	11 m	No change	Litter common; logs occasional; single ant's nest present
4	0	22 m	No change	Limited regeneration; occasional course woody debris
5	0	3 m	No change	Shrub and canopy regeneration; ants nest; course woody debris; limited rocks
6	0	0 m	No change	Course woody debris common; shrub and canopy regeneration present
7	0	8 m	No change	Surface rocks and course woody debris uncommon; abundant exotic annuals
8	0	14 m	No change	Litter; course woody debris; bare ground; hollow logs; surface rocks present

Key for table 3: *HBT's* = Hollow-bearing trees. *Logs* = length of fallen logs > 10 cm width. *Comment* = relates to whether a noticeable or significant change has occurred since the completion of the baseline surveys.

3.3.2 Nocturnal surveys

The results of the offset site nocturnal surveys are outlined in **Table 4**. Two frog species were recorded (aural) during frog habitat surveys within the Williamsdale property (outside of the offset site). Calls were recorded from a single individual of each species. A frog survey was undertaken at the southern dam within the offset site. However, no frogs were recorded. It is noted that the peak season for amphibians within the ACT is September to October. As such, a frog surveys was not undertaken at the northern dam within the offset site.

A single species, Common Brushtail Possum (*Trichosurus vulpecula*) was recorded during the spotlight surveys at transect one (northern offset). Sugar Glider (*Petaurus breviceps*) was recorded within the broader Williamsdale property outside of the offset areas (adjacent to old cottage).

Anabats recorded a total of seven species over the four survey nights (**Table 4**).

Table 4: Fauna species recorded during targeted nocturnal surveys

Frog habitat survey			
Amphibians	Latin name	Threatened status	Observed
Eastern Common Froglet	*Crinia signifera*	Not listed	Williamsdale property
Plains Froglet	*Crinia parinsignifera*	Not listed	Williamsdale property
Spotted Marsh Frog	*Limnodynastes tasmaniensis*	Not listed	Opportunistic
Spotlighting			
Arboreal Mammals	Latin name	Threatened status	Observed
Brushtail Possum	*Trichosurus vulpecula*	Not listed	North and South transect
ANABAT survey*			
Microchiroptera	Latin name	Threatened status	Observed
Gould's Wattled Bat	*Chalinolobus gouldii*	Not listed	North and South
Chocolate Wattled Bat	*Chalinolobus morio*	Not listed	North
Free-tailed Bat	*Mormopterus* species	Not listed	North
White-striped Sheathtail Bat	*Tadarida australis*	Not listed	North and South
Little Forest Bat	*Vespadelus vulturnus*	Not listed	North

*** Table 4** only includes bat species identified with a definite call. **Appendix B** provides a full list of possible and definite calls. The autumn 2014 surveys recorded a possible call of the Large-Footed Myotis (*Myotis macropus*), which is listed as Vulnerable under the NSW *Threatened Species Conservation Act 1995* (TSC Act), but is not listed under Territory legislation. This species primarily forages over water and along drainage lines.

3.3.3 Infra-red camera surveys

All species detected by infra-red cameras have previously been recorded. A full list of fauna species observed during the monitoring surveys is outlined in **Appendix B**.

4 Weed monitoring

4.1 Weed management actions undertaken to date

Weed management on site has included control of *Eragrostis curvula* (African Lovegrass) and *Nassella trichotoma* (Serrated Tussock) in mid-2012 and mid to late-2013 as well as woody weed control for *Rosa rubiginosa* (Sweet Briar), *Rubus* sp. (Blackberry), *Hypericum perforatum* (St. John's Wort) undertaken over the summer 2012 / 2013 and summer 2013 / 2014 periods.

Follow-up control for all weeds is scheduled for mid to late-2014 and the summer 2014 / 2015 period. The weed control will be consistent with previous efforts and timings. For further detail on the management actions recommended, refer to the ODP and sub-plans.

4.2 Weed monitoring results

A summary of the weed occurrences across the offset site and the autumn 2014 monitoring results is provided in **Table 5** below.

The relative distribution of key weed species across the offset site is mapped in **Figure 12** and **13**.

Table 5: Summary of prior weed occurrence and autumn 2014 monitoring results

Species	Weed occurrence prior to current surveys (baseline)	Autumn 2014 monitoring results
African Lovegrass (*Eragrostis curvula*)	Low, localised areas of dominance. Present across the offset site in isolated patches. Where it occurs, it forms a dense mat of tussocks and dominates the understory.	A number of isolated individuals observed across the offset site with some heavier infestations around main drainage line. Most areas across the offset site exhibited a high level of control for this species. **MU occurrence**: MU3, 4, 5 & 6. **Recommendation**: Follow-up weed control to target drainage lines and isolated individuals.
Serrated Tussock (*Nassella trichotoma*)	Low, scattered individuals in some areas. Present in open areas of the offset site. Primarily present as a number of scattered individuals within MU1 along the southern boundary.	Control for this species was highly successful with a single plant observed within the southern offset (MU1). **MU occurrence**: MU1A, 2A, 3 & 4. **Recommendation**: Maintain weed control program as outlined in the sub-plan.
Blackberry (*Rubus fruticosus*)	Low, localised areas of dominance. Predominantly found within the northern offset, and was more or less restricted to the drainage lines or moist areas.	Primary control for this species occurred in late 2012-early 2013. Control for this species looks highly successful with minimal regrowth observed. **MU occurrence**: MU4, 5 & 6. **Recommendation**: Follow-up control.

Species	Weed occurrence prior to current surveys (baseline)	Autumn 2014 monitoring results
Woody Weeds (*Hawthorn, Prunus, Pyracantha, Cotoneaster & Pinus* sp.)	Very low, isolated individuals. Present within the study area as isolated individuals.	Control for these species was scheduled for late 2012-early 2013; however, some individuals were missed. **MU occurrence**: MU4 & 6. **Recommendation**: Targeted control of isolated individuals.
St John's Wort (*Hypericum perforatum*)	Scattered and moderate occurrence across the offset site.	Control for this species occurred over summer 2012/2013 and 2013/2014. This species was extensively distributed across both the northern and southern offsets. **MU occurrence**: MU1B, 2A, 3, 4, 6 & 7. **Recommendation**: Follow up control required prior to seed set.
Thistles (*Carthamus lanatus, Carduus* sp. & *Onopordum* spp.)	Moderate, localised areas of dominance.	Thistles were recorded in disturbed areas. MU1 has a substantial cover of young thistles that will become the dominant species as the season progresses. The adjacent property to the south also has a high cover of thistles, which makes any corrective action within the offset site difficult, as the seed will readily due to the offset sites down slope position. **MU occurrence**: MU1B & 4. **Recommendation**: Consider control within a broader program encompassing the adjacent property.
Sweet Briar (*Rosa rubiginosa*)	Moderate, widely distributed at low density with scattered individuals, some areas of dominance. Present across the offset site, often with larger infestations under mature trees.	Control for this species looks excellent with most individuals targeted during the works. A few isolated individuals were missed and others are re-sprouting. **MU occurrence**: MU1B, 2A, 2B, 3, 4, 5, 6 & 7. **Recommendation**: Follow up control including spot spraying of individuals.

The autumn 2014 surveys also recorded a patch of *Briza maxima* (Quaking Grass), an exotic annual grass, within the southern offset. While Quaking Grass is not a declared pest plant species, it can act as an invasive exotic species. Across the offset site, areas that contain a high cover of exotic annual grasses are relatively rare. However, it was noted during the monitoring surveys that there is an increase in the dominance of exotic annual grasses under large eucalypt trees, which have previously had an infestation of Sweet Briar. It is possible that the application of herbicide to control the Sweet Briar is encouraging the growth of exotic annual grass species in these areas. It is not uncommon for exotic annual species to be the first colonisers in a disturbed area. However, the

slower growing native species can eventually out-compete exotic annuals, particularly if adjacent areas contain a good cover of natives. At this stage, control of exotic annuals is not required.

4.3 Adaptive management recommendations

ELA recommends that follow-up control for Sweet Briar, Blackberry, St. John's Wort, Thistles and other woody weeds be undertaken, as outlined in the weed management sub-plan. In most instances control works to date have been highly successful, with the exception of St John's Wort, which has been moderately successful. Follow up control works are required and should target re-sprouting individuals and localised clumps.

ELA recommends that a control program considers a broad approach for Thistles (particularly for MU1B) that includes control within the adjacent southern property (NSW DPI 2008).

It is noted that the control of exotic annual grasses is not required in the ACT under the ACT Weeds Strategy. However, it would be prudent to monitor the abundance of exotic annuals in future surveys and undertake control activities if exotic annuals become invasive.

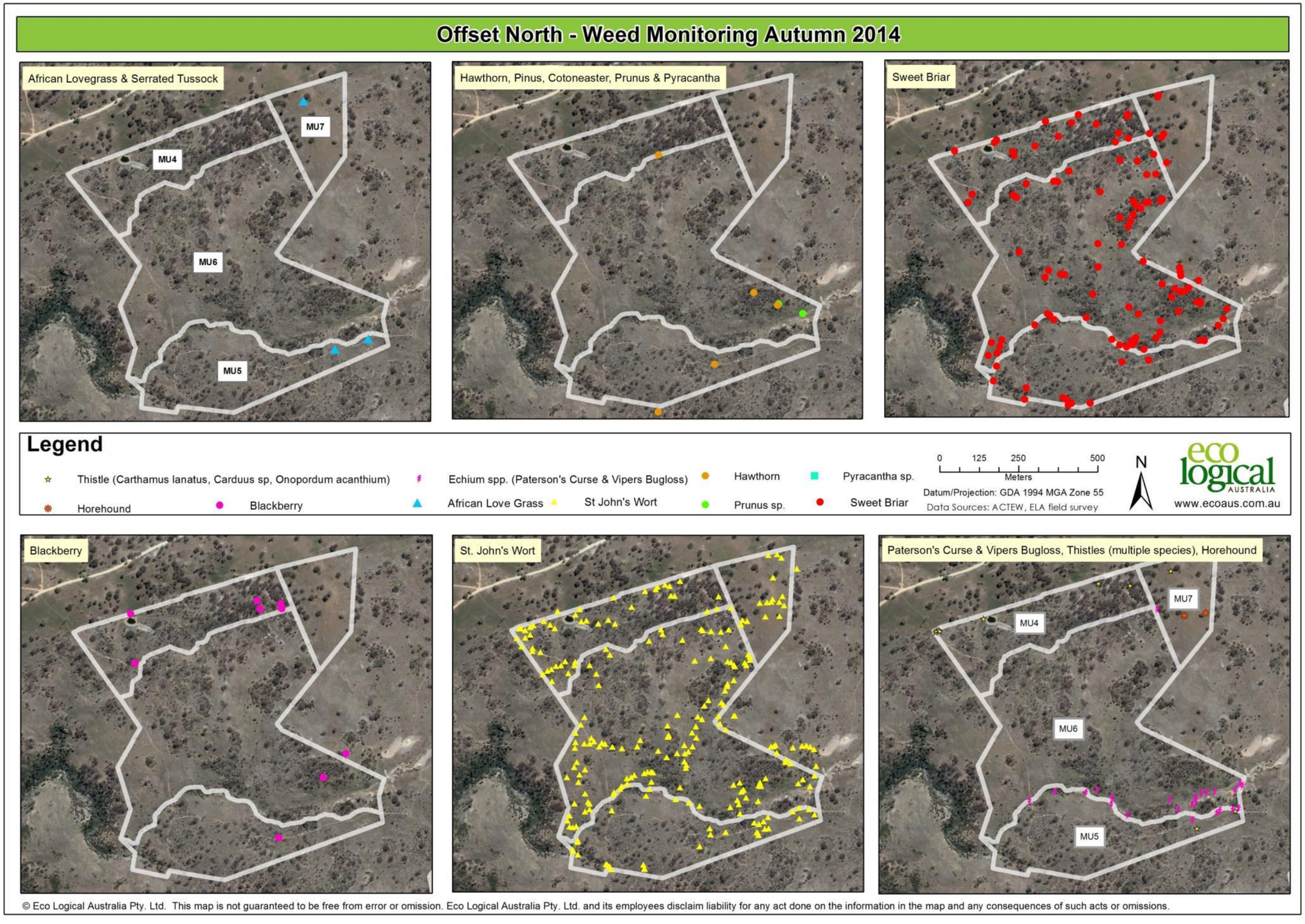

Figure 12: Relative weed distribution, northern offset

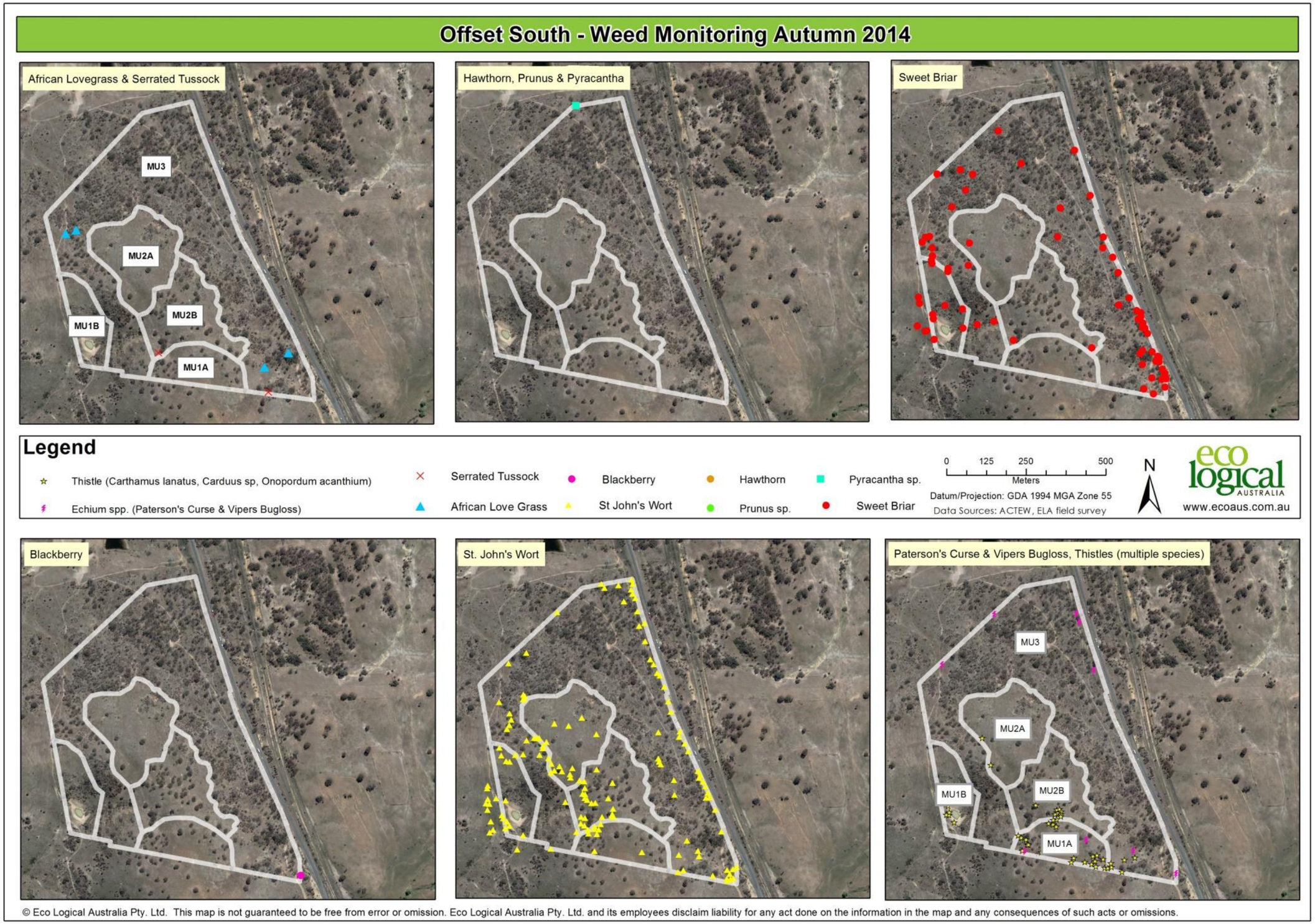

Figure 13: Relative weed distribution in the southern offset

5 Erosion monitoring

5.1 Erosion management actions undertaken to date

It should be noted that no on-ground erosion management activities have been undertaken to date. For further detail on management actions recommended refer to the ODP and Erosion Management Sub-plan.

5.2 Erosion monitoring results

A total of 18 erosion points were recorded during the autumn 2012 monitoring surveys with all points falling within Erosion Management Zone 1 (see ODP). An additional three monitoring points were established in spring 2012, one in autumn 2013 and one in spring 2013. A number of erosion monitoring points (1, 3, 5, 11, 12, 14, 15, 16, 17, 19 and 20) were recommended to be discontinued after the spring 2013 surveys. This was due to a lack of erosion activity at these points and the large number of points used in the monitoring surveys.

Erosion point locations included in the autumn 2014 monitoring surveys are mapped in **Figure 14** and **Figure 15**.

The rainfall total over the period since the spring 2013 surveys was approximately 65mm above the average total (BOM 2013; Tharwa General Store, station 70083, approx. 8 km north-west). A total of 89mm of rain fell within the month leading up to the surveys, but only 6mm of this was recorded in the two weeks prior to the monitoring surveys. No significant rainfall events were considered to have occurred since the spring 2013 monitoring surveys. The largest rainfall event occurred on April 4th with over 44mm of rain recorded within 24 hours.

The majority of erosion points are located along ephemeral drainage lines in the northern offset. The erosion points are in a variety of conditions; however vegetative cover surrounding each point is generally very high. All of the points are currently stable, but some may require minor remediation works in the future if they are found to be continuously active and/or active following a significant rain event. To date (since baseline surveys), only very minor erosion activity has been observed across the offset site. It should be noted that approval is required to undertake any remediation works within a drainage line (see erosion sub-plan), and may influence the type of work to be undertaken. A summary of the erosion points monitored within the offset property is provided below with a detailed description of each point and an accompanying photo.

5.3 Recommendations

The majority of points have not shown signs of erosion since the baseline surveys, despite high rainfall events occurring during this time. The lack of erosion at these points indicates that the soil is stable with a low risk of significant erosion occurring in the future. A high vegetation cover across the offset site and the continued exclusion of stock grazing further reduces the risk of erosion occurring. However, it is recommended that continued monitoring occurs at erosion points; 2, 4, 6, 7, 8, 9, 10, 13, 18, 21 and 22.

Erosion Point 2:

Description: Situated within an ephemeral drainage line in MU4, northern offset.

Size: Approximately 4 m across, 0.8 m deep and 2.0 m in length.

Change: No significant change observed since baseline monitoring survey.

Action required: No works required at this stage. Continue bi-annual monitoring.

Autumn 2012 (baseline)

Autumn 2014

Erosion Point 4:

Description: Located within an ephemeral drainage line within MU4, northern offset.

Size: Approximately 2.0 m wide, 0.5 m deep, 2.5 m long.

Change: No significant change observed since baseline monitoring survey. Heighten animal activity (tracks) adjacent to the erosion point.

Action required: No works required at this stage. Continue bi-annual monitoring.

Autumn 2012 (baseline)

Autumn 2014

Erosion Point 6:

Description: Located within an ephemeral drainage line within MU4, northern offset. Evidence of sheet erosion along bank and some rilling.

Size: Approximately 6 m long, 1.5 m deep and 2.5 m wide.

Change: No change observed since baseline monitoring survey.

Action required: Consider removing erosion point from future monitoring surveys.

Autumn 2012

Autumn 2014

Erosion Point 7:

Description: Located along the main creek line within northern offset. Photo taken from Photo Point 1 (co-ordinates; 6059835, 692700) looking north-west (315^{o}) and showing the north bank.

Size: Approximately 20 m long and 1.0 m deep.

Change: No significant change observed since baseline monitoring period. However, low active erosion maybe occurring at identified points (red circles). Eucalypt samplings (overstorey regeneration) have been removed in the background of the photo, underneath power line.

Action required: Targeted monitoring at photo point following extreme rainfall event and continue bi-annual monitoring.

Autumn 2012 (baseline)

Autumn 2014

Erosion Point 8:

Description: Located along the main creek line within northern offset. Photo taken from Photo Point 1 (co-ordinates; 6059835, 692700) looking north-east (45^{o}) and showing the north bank (upstream from erosion point 7).

Size: Approximately 15 m long and 1.0 m deep.

Change: No significant change observed since baseline monitoring survey. However, small amounts of erosion may be occurring on the northern bank (red circle). Evidence of heighten animal activity (tracks) were observed in autumn 2013.

Action required: Targeted monitoring at photo point following extreme rainfall event and continue bi-annual monitoring.

Autumn 2012 (baseline)

Autumn 2014

Erosion Point 9:

Description: Situated near the western boundary of the southern offset.

Size: Approximately 20 m long and 1 m deep.

Change: No significant change observed since baseline monitoring survey. However, minor changes were observed in the spring 2013 surveys, including slight deepening and exposure of smaller rocks on the left hand side of the channel from the autumn 2013. Minor slumping may have occurred on the left.

Action required: Continued bi-annual monitoring.

Autumn 2012 (baseline)

Autumn 2014

Erosion Point 10:

Description: Situated along the western fence line of the southern offset. Small area of erosion due to upslope runoff.

Size: Approximately 5.0 m long and 0.5 m deep.

Change: Some minor erosion has occurred adjacent to the new fence line since the baseline surveys (this is within the neighbouring property to the south of the offset site).

Action required: No immediate action required. Continued bi-annual monitoring.

Autumn 2012 (baseline)

Autumn 2014

Erosion Point 13:

Description: Moderately sized erosion point in northern offset. Evidence of existing slumping.

Size: Approximately 4.0 m long, 1.5 m deep and 2-3.5 m wide.

Change: Some minor slumping at gully head previously occurred. No change since spring 2012.

Action required: No immediate action required. Continue bi-annual monitoring.

Autumn 2012 (baseline)

Autumn 2014

Erosion Point 18:

Description: Located along an ephemeral drainage line within the northern offset. Evidence of stream bed exposure, pooling and in-stream vegetation.

Size: Approximately1.5 m deep, 3.0 m wide, 4.0 m long.

Change: No significant erosion has occurred since the baseline monitoring period. However, some slumping and erosion activity evident (red circle).

Action required: No ground works required at this stage. Continue bi-annual monitoring.

Autumn 2012 (baseline)

Autumn 2014

Erosion Point 21:

Description: Located west (just downstream) from the access track running along the western boundary in the northern offset. The site has developed a plunge pool, which has exposed the bedrock in some parts.

Size: 1-2 m wide, 0.6 m deep, 1.5-3 m long.

Change: No change since previous survey.

Action required: No action is required at this stage. Continual bi-annual monitoring.

Spring 2012 (baseline)

Autumn 2014

Erosion Point 22: Point established at overflow point of southern dam during the spring 2013 monitoring surveys.

Description: Southern dam overflow – flowing water causing erosion at exit point.

Size: 20 cm wide, 30 cm deep, 1.5 m long.

Change: Water flow has caused the erosion point to deepen and widen. This point is susceptible to further erosion.

Action required: No works required at this stage. Continual bi-annual monitoring and if a similar change is observed, then action will be required to reduce the speed of water flow exiting the overflow pipe.

Spring 2013 (baseline)

Autumn 2014

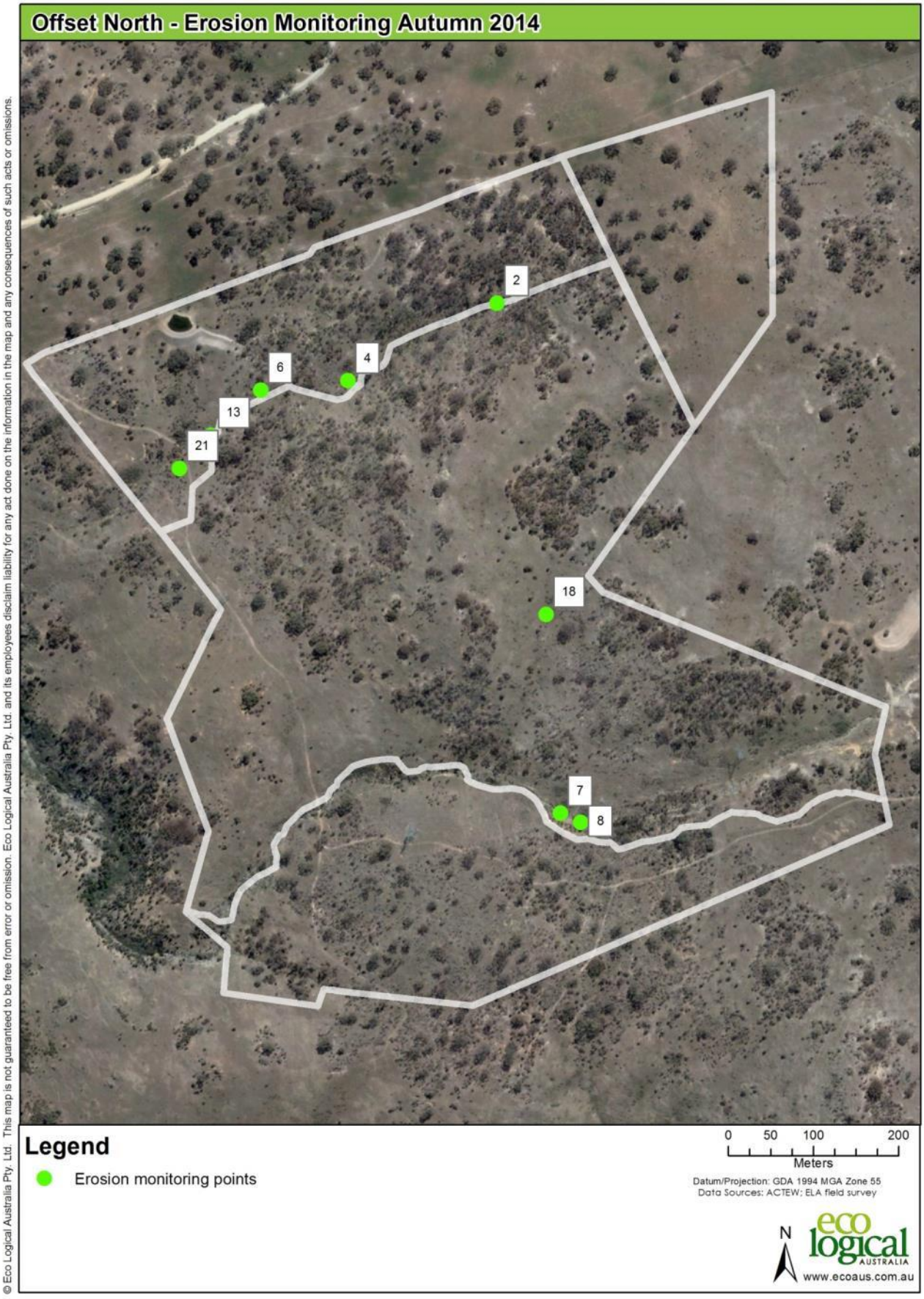

Figure 14: Erosion monitoring points in northern offset

Figure 15: Erosion monitoring points in southern offset

6 Feral animal monitoring

In accordance with the Feral Animal Sub-plan (see ODP) monitoring of the offset site for feral animal activity is being undertaken on a bi-annual basis to inform feral animal control actions. The monitoring results for spring 2013 are presented below.

6.1 Management actions to date

6.1.1 Feral pigs

The autumn and spring 2012 monitoring surveys identified feral pigs within the offset property. Prior to the autumn 2012 monitoring, this species had not been observed. Disturbance within the offset included pig rooting, often in areas associated with a forage source, and tracks through boggier areas of the site. The disturbance caused by the pigs was locally significant, but pig activity was at a low density across the whole of the offset.

It was recommended that the level of disturbance be monitored and appropriate action taken if the level of disturbance increased significantly. In response to the recommendation, Regional Feral Animal Control (RFAC) was engaged to conduct control activities at the M2G offset site from 11th September 2012 to 3rd October 2012. A total of 21 pigs were trapped and destroyed over the control period. Follow-up monitoring conducted by RFAC two weeks following control period did not record any fresh signs of feral pigs.

6.1.2 Feral goats

Two herds of 60+ goats were observed within the offset site (also within adjacent property to the south) during the spring 2013 monitoring surveys. The species was considered likely to be utilising a large area, including the offset site, neighbouring properties and Murrumbidgee River corridor. The lack of disturbance (agriculture activities) within the offset site is likely to provide a refuge for the goats. The spring 2013 monitoring surveys observed localised goat camps (e.g. under a stand of trees) and increased grazing pressures at these points. Though, the overall quality and condition of the offset site did not appear to be impacted significantly.

However, ACTEW Water undertook goat control activities in December 2013. A total of 150 feral goats were removed from the offset site. Subsequent aerial monitoring did not record any goats within the offset site.

6.2 Feral animal monitoring results – autumn 2014

Monitoring of feral animals using infra-red cameras (**Figure 3**) and opportunistic observations was conducted as part of the monitoring surveys. Targeted searches were undertaken around drainage lines, permanent water sources and along animal tracks for fresh signs (scats & tracks) of feral animal activity. The observations (**Figure 16**) included:

- Feral pigs: A small group of pigs including six adults and eight piglets were observed during the monitoring surveys. In addition, pig disturbance was observed to be relatively minor, but common and wide spread across the offset site. Pigs were also recorded via remote camera in the southern offset.
- Feral goats: Approximately 50 goats were observed within the offset site. The species is considered likely to be utilising a large area, including the offset site, neighbouring properties

and Murrumbidgee River corridor. A small number of goats were also recorded via remote camera in both the northern and southern offsets.

- European Fox (*Vulpes vulpes*): Foxes were recorded on both remote cameras within the offset site and opportunistically.
- European Rabbits (*Oryctolagus cuniculus*): Signs (scats and infrequently used warren) of low rabbit presence / abundance were observed within the southern offset.
- Feral Fallow Deer (*Dama dama*): One individual was opportunistically observed within the offset site in December 2013. No individuals were observed during the autumn 2014 monitoring surveys.
- Cattle (*Bos Taurus*): Recent signs (scats and tracks) of a Cow were present within the southern offset. It is likely that an individual or two were unable to be captured when stock were excluded from the offset site. A cow skeleton was also observed within the northern offset.

6.3 Recommendations and actions

6.3.1 Goats

It is recommended that action be taken to limit and/or control the number of goats within the offset site. It is also recommended that a monitoring survey for this species be undertaken, one-month from the conclusion of the control activities to determine if follow-up goat control is required.

6.3.2 Pigs

Despite the generally low activity of feral pigs observed within the offset site, it is recommended that pig control be implemented. This will prevent numbers reaching the heights observed during 2012 and prevent vegetation damage within the offset site. It is understood (since completing the autumn monitoring surveys) that a contractor has been scheduled to undertake pig control over the winter 2014 period (late May / early June).

Continued bi-annual monitoring of pigs within the offset site is recommended and will be important to determine the success of the control activity, and if additional follow-up control is required.

6.3.3 Other species

Overall, the incidence of feral animals (excluding goats) within the offset site is low. It is recommended to continue monitoring as outlined in the Feral Animal Management Sub-Plan, particularly in relation to the presence and abundance of foxes and rabbits. If evidence of an increase in of these species is observed through-out the year, it is recommended that control be undertaken. This is of particular importance if the dry weather is experienced as these species have the ability to heavily impact on vegetation suffering from water stress. It is recommended that control for these species be incorporated into any control programs undertaken for adjacent ACTEW lands.

In addition, reporting of feral animal activity (for goat, pig and deer) to the local control agencies is recommended. This will assist with information that may guide any broad or landscape scale control activities.

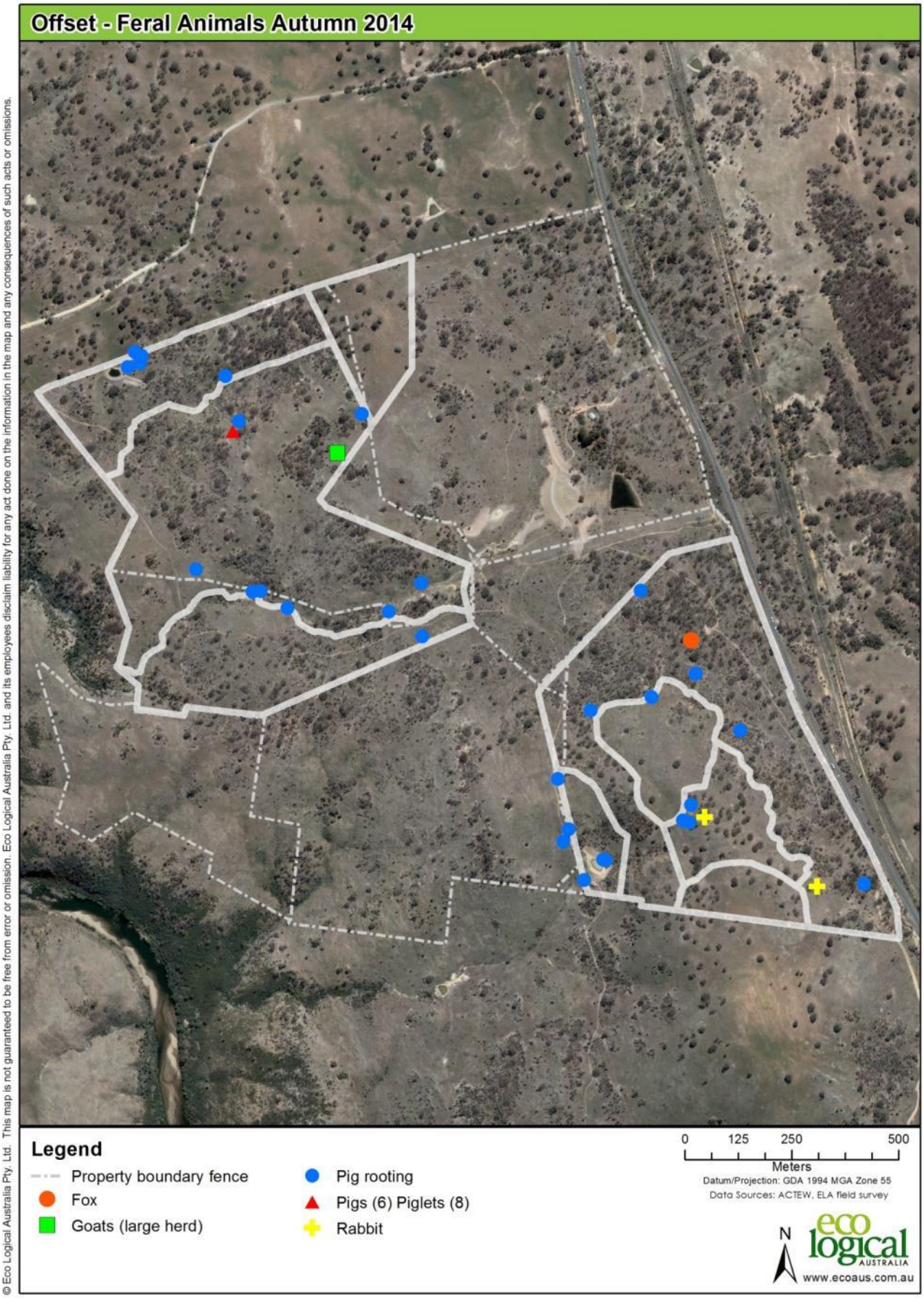

Figure 16: Feral animal observations

7 Fencing monitoring

7.1 Management actions to date

Fencing of the offset site was one of the actions highlighted to be undertaken in the ODP. Fencing is required to prevent grazers, such as sheep and cattle entering the offset site from the neighbouring properties. The primary aim of a stock proof fence is to keep grazing stock out of an area (e.g. conservation area) where it is bordered by a private rural property. This type of fencing generally consists of 4 or 5 stranded wire (including 2 or 3 barbed wire strands) with wooden posts and/or star-pickets, approximately 1.2 m high.

In July 2012, Tennant Rural undertook works to remove the existing fence and erect a new fence along the southern boundary of the Williamsdale property (**Figure 17**). The fence was built to specifications to exclude both cattle and sheep (5 wires and 2 barbed wires). The fence was approximately 1.6km in length and included the replacement of 3 gateways.

In June 2013, the erection of new fencing along the eastern border of MU7 in the northern offset was undertaken. This completed the fencing requirements of the offset site (fully enclosed within the Williamsdale property). The fencing arrangements has enabled low intensity grazing to occur within a small proportion of the Williamsdale property, whilst excluding grazing within the offset site in order to satisfy the ACT Government Land Management Agreement (LMA).

In response to recommendations in previous monitoring reports, all internal fencing within the offset site was removed in June 2013 to enhance the wildlife friendly nature of the offset site, and be consistent with the biodiversity conservation ideals of the ODP and associated sub-plans.

7.2 Fencing monitoring results

The autumn 2013 fencing monitoring results has been outlined below based on the main boundaries:

- *Northern boundary*: The northern boundary fence is considered adequate along its length. Small holes at the base of the northern boundary fence were recorded and require continued monitoring. The small holes allow the free movement of wombats and small kangaroos across property boundaries. Minor maintenance maybe required at these points once the pipeline fence has been removed (currently acting as an additional barrier), if sheep are grazed in the paddock north of the Williamsdale property and holes become large enough for individuals to enter the offset site.
- *Eastern boundary*: The eastern boundary fence of the Williamsdale property, adjacent to the Monaro Highway is mostly considered adequate. One section approximately five metres in length where the fence crosses a drainage line (north of the entrance to the sub-station) requires replacing (refer to **Figure 17**). However, it does not pose an immediate risk to stock entering the offset site. Grazing of stock does not occur along the Monaro Highway and other internal fencing within the Williamsdale property (e.g. boundary of the sub-station and newly erected section along MU7) provide a barrier to the offset site. Small holes similar to those observed along the northern boundary were also recorded at points on the eastern boundary and require continued monitoring.
- *Western boundary*: The western boundary fence is adequate to exclude stock. However, minor maintenance is recommended for consideration for a few points where animals (e.g. wombats, kangaroos and potentially goats) have created small to moderate sized holes.

These points are identified as low risk damage in **Figure 17**. There is no risk of stock entering the offset site at these points as the western boundary borders the Murrumbidgee River corridor where grazing does not occur. However, some of these points may be used by goats to enter the property and should be considered as an additional action following the removal of the goats from the offset site (see **Section 6**). A gate leading to the Murrumbidgee River corridor was observed open during the monitoring surveys.

- *Southern boundary*: The southern boundary fence is adequate to exclude stock. However, Small holes at the base of the southern boundary fence were recorded and require continued monitoring. Two gates along the southern boundary fence were observed to be open during the monitoring surveys.

7.3 Recommendations

The overall condition of the Williamsdale property and offset boundary fencing is considered adequate to exclude grazing by stock within the offset site. However, the gates along the southern boundary and adjacent to the Murrumbidgee River corridor provide an access point for stock and feral animals such as pigs and goats.

Management actions recommended to be undertaken in 2014 by ACTEW Water include:

- Ensure all boundary fences are closed at all times.
- Continued monitoring at all points identified in **Figure 17.**
- Consider maintenance actions of points identified as moderate in **Figure 17.**
- Replacement of a small section of fence along the eastern boundary.

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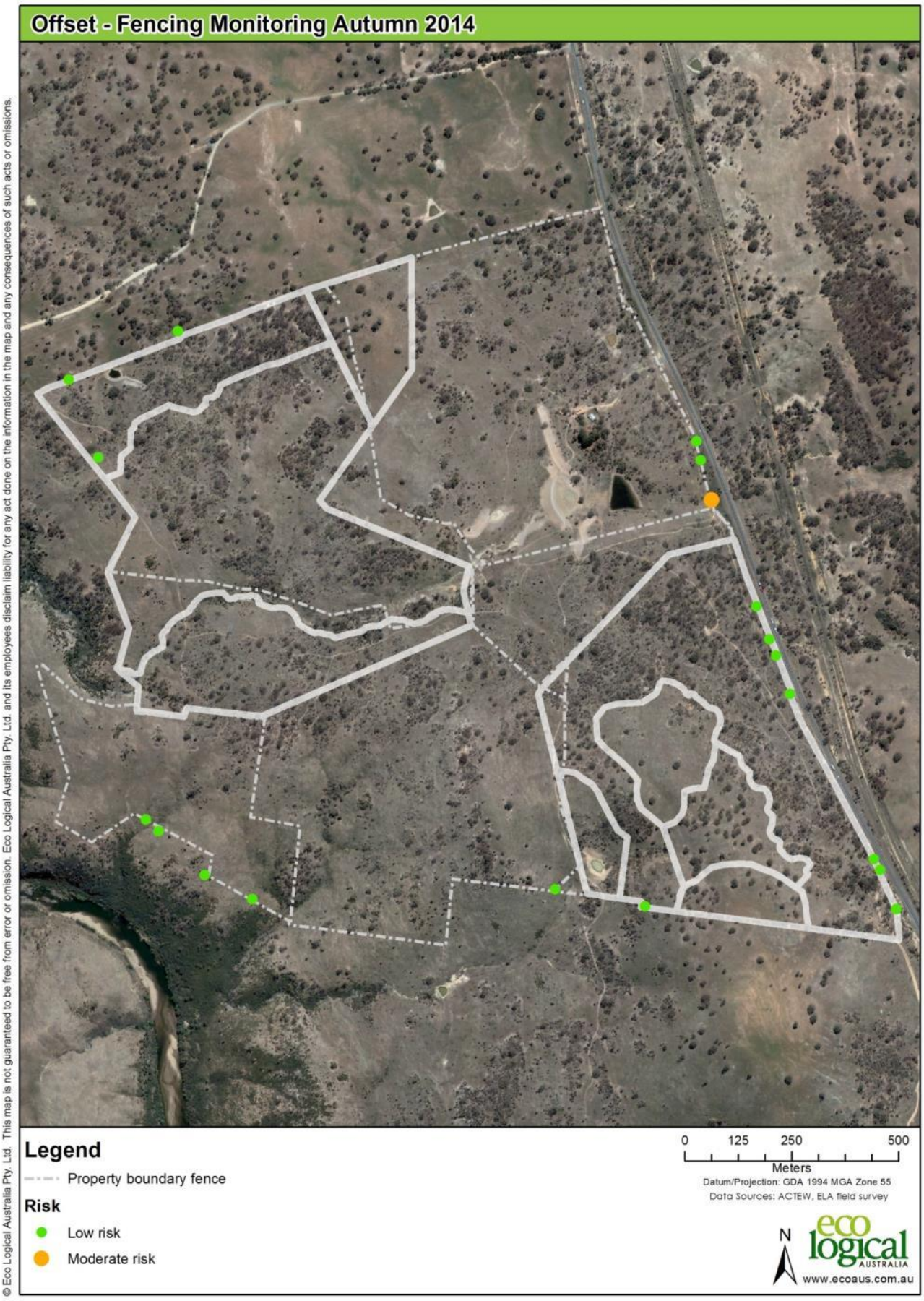

Figure 17: Williamsdale property fence with points recommended for repair

8 Summary & recommendations

8.1 General summary

A number of management actions have been undertaken across the offset site to date, including:

- Primary on-ground works and actions undertaken in 2012:
  - Erection of new Williamsdale property southern boundary fence (July 2012).
  - Feral pig control (September 2012).
  - Weed Control for African Lovegrass and Serrated Tussock (July 2012).
  - Weed Control for other weed species (late 2012- early 2013).
- Primary on-ground works and actions undertaken in 2013:
  - Erection of new fence bordering MU7 of the northern offset (June/July 2013).
  - Removal of internal fencing within the offset site (June/July 2013).
  - Weed control targeting African Lovegrass and Serrated Tussock (spring 2013).
  - Weed control targeting Sweet Briar, Blackberry, St. John's Wort and Thistle species (late spring 2013 with follow up control in early 2014).
  - Bushfire track maintenance.
  - *Swainsona recta* planting of 46 individuals (September 2013).
  - Control for feral goats and aerial surveys of property (December 2013).
  - Feral pig monitoring in December 2013 (control scheduled for winter 2014).

Based on the autumn 2014 monitoring surveys, the offset site is in good condition and is responding well to management actions implemented. The recommended primary works for the offset site for the remainder of 2014 include; follow-up weed control to maintain suppression of noxious exotic species (particularly St John's Wort) across the offset site and feral animal control for goats and pigs.

ACTEW Water is also undertaking additional African Lovegrass control within the Williamsdale property, in areas adjacent to the old cottage. The extra weed control is consistent with the overall conservation principles of the Williamsdale property and offset site.

8.1.1 Bushfire

The access track through the offset site is in a satisfactory condition. It is recommended that the track continues to be maintained in a condition to facilitate bush fire management. If track management is required in the future, it is recommended that care is taken to ensure that the track remains in good condition and does not widen due to overuse, incorrect maintenance, or result in erosion. The track would ideally remain a grassed track to limit impacts on the environment.

8.1.2 Rehabilitation works

Significant natural regeneration of the overstorey (particularly, *E. blakelyi*) was observed during the baseline surveys and continues to be recorded. Mid-storey regeneration (shrubs) was observed for the first time during autumn 2013 and was observed more extensively during the spring 2013 surveys. However, similar natural regeneration has not been observed within MU7 to date.

The pattern of regeneration across the offset site is likely correlated with the removal of stock. Stock was removed in 2012; however a herd of sheep was observed within MU7 in autumn 2013. Since then, all sheep have been removed and there have been no records of stock grazing.

No rehabilitation works or plantings are recommended for 2014. However, consideration could be given to low density scattered plantings within MU7 following the spring 2014 surveys, if no signs of natural regeneration are observed. Plantings could include overstorey (*E. blakelyi, E. melliodora, E. dives* and *E. bridgesiana*) and shrubs such as, *Bursaria spinosa, Acacia* spp., *Cassinia* sp., *Dodonaea* sp. Box-Gum Woodland, the dominant vegetation community within MU7 is an open woodland community with a typically absent or scattered mid-storey of native shrubs. Any plantings considered should mimic the structure and species diversity present in the remainder of the offset site. There are likely to be suitable locations to collect seed within the offset site to ensure that local provenance is preserved.

8.1.3 Swainsona recta propagation program

A total of 112 individuals have been planted across three translocation plots (66 in July 2012 and 46 in September 2013). An overall survivorship of 79 % (88 of 122) was observed during the spring 2013 monitoring surveys. Monitoring was not undertaken during the autumn 2014 surveys.

8.1.4 Weed

Weed control activities are following the management actions outlined in the relevant sub-plan. Successful suppression of previously dominant species has been observed, particularly for Sweet Briar, Blackberry, African Lovegrass and Serrated Tussock. All species require follow-up control as outlined in the sub-plan, with concerted focus on St. John's Wort regrowth.

8.1.5 Erosion

Erosion points are generally considered stable and do not require active works at this stage. Continued monitoring is required.

8.1.6 Feral animal

It is recommended that feral animal control be implemented for feral goats and pig, with follow-up monitoring one month following any control activities.

8.1.7 Fencing

The condition of the Williamsdale property and offset boundary fencing is considered adequate to exclude grazing by stock within the offset site. Recommended actions to be undertaken in 2014 include, monitoring at all identified damaged points, consider maintenance at moderate damaged points and consider replacement of a small section of fence along the eastern boundary (**Figure 17**).

8.1.8 Grazing

No action is required under the grazing plan other than the continued exclusion of stock and feral goat control (outlined above). Opportunistic observations of grazing pressure within and adjacent to the *Swainsona recta* plots indicate that the offset site is grazed at a low-moderate intensity, consistent with the conservations principles outlined in the ODP. The diversity of native herbs and forbs has increased substantially since the baseline surveys, supporting the continuation of current grazing pressures.

Regular counts of 10-30 Kangaroos were made during the autumn 2014 surveys. However, it is estimated that up to 100 kangaroos maybe utilising the offset site and surrounding properties at any one time. The LMA (ACT Government) for the Williamsdale property does not outline a suitable grazing level for the 'Active Conservation' rural enterprise. Previously, the grazing intensity for the Williamsdale property was set at a Dry Sheep Equivalent (DSE) of 600. The ACT Kangaroo Management Plan (ACT Government, 2010) indicates that a direct comparison between sheep and kangaroos in terms of DSE is inaccurate due to inherent ecological differences between the two

species. However, the Kangaroo Management Plan (KMP) suggests that a DSE of 0.6 per Kangaroo for an unharvested population is probably a reasonable comparison for the ACT region. Using this DSE, the Williamsdale property has the capacity to support up to 360 Kangaroos. An alternative measure to calculate the number of Kangaroos that a property can support is to look at the relative density. The KMP suggests a density of between 0.6 and 1.5 Kangaroos per hectare. The Williamsdale property is approximately 208 ha in size, which means that using the density calculation, the property could support between 124 – 312 kangaroos in total.

The population of feral animals such as goats and pigs present within the property also needs to be taken into consideration to determine the total grazing pressure. The autumn 2014 monitoring opportunistically estimated that 100 kangaroos may be using the property plus up to 50 goats. The planned control of feral goats and pigs will assist is reducing the total grazing pressure across the property.

8.2 Management unit recommendations

A summary of the recommended adaptive management actions relating to the offset site is provided in **Table 6** below. The actions relate to the appropriate ODP sub-plan and are based on the results presented in the above sections.

Table 6: Summary of proposed actions relating to the ODP

ODP Sub-Plan	Action status	Recommended management actions
Weed	On-going control and monitoring.	Maintain weed control program as outlined in ODP and weed sub-plan. Follow-up targeted control for all species with an emphasis on St. John's Wort regrowth. Weed management activities are applicable to all Management Units.
Rehabilitation	To be considered following 2014 spring monitoring surveys.	Overstorey and mid-storey planting for consideration in MU7 following the 2014 spring monitoring surveys. If no natural regeneration is observed within the management unit, then implement a low-density planting / rehabilitation program. Natural regeneration recorded across all other Management Units.
Sediment and erosion Control	No action required. On-going monitoring	No sediment and erosion required at present. Reduced the number of erosion monitoring points to a representative sample for the autumn 2014 surveys and in order to target points at greatest risk. Applicable to MU's 1B, 3, 4 & 6.
Bushfire	Complete. On-going monitoring.	The main access track through the offset site is in a satisfactory condition. It is recommended that the access track be maintained in a condition suitable to facilitate bush fire management requirements. Applicable to MU's 3, 4 & 6.
Feral animal control	On-going control and monitoring	Feral animal control required for goats and pigs in 2014. Low rabbit numbers continue to exist, but are currently considered a low risk. Continue monitoring to establish if further control activities are required in the future. Applicable to all Management Units.
Fencing	Completed in August 2012 and June 2013. Monitoring on-going	No immediate major actions required. Management activities for 2014 include: monitoring at all damaged points, consider maintenance at moderate damaged points and consider replacement of a small section of fence along the eastern boundary. In addition, keep all boundary gates closed.
Grazing	On-going monitoring	No immediate actions required. Grazing level should be continually monitored and control measures considered if necessary.

References

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Department of Sustainability, Environment, Water, Population and Communities, 2011, The Feral Goat (*Capra hircus*), Department of Sustainability, Environment, Water, Population and Communities, Australian Government, Canberra.

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Appendix A: Flora species list

+ = few, small cover (<5%)

r = solitary, small cover (<5%)

1 = numerous (up to 5%)

2 = 5-25%

3= 25-50%

4= 50-75%

5=>75%

Note: The species cumulative list includes all species observed over all monitoring surveys.

Native									
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Autumn 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3**
Acacia dealbata									
Acacia mearnsii									
Acacia rubida	✓								
Acaena novae-zelandiae									
Acaena echinata	✓				+	r	r		
Acaena ovina	✓	1	+	+			+		+
Ajuga australis									
Alternanthera sp. A	✓	r						+	
Aristida ramosa	✓		1	+		+	+		1
Arthropodium minus	✓		r	r	+				
Asperula conferta	✓		+	1	1	+	r		1
Asplenium flabellifolium									
Astroloma humifusum									
Austrodanthonia caespitosa									
Austrodanthonia carphoides									
Austrodanthonia racemosa	✓				+	+	1	r	
Austrodanthonia sp.		1		r					1
Austrostipa bigeniculata	✓	+	2						
Austrostipa densiflora	✓								
Austrostipa scabra	✓	1	1		+		2		
Austrostipa sp.									2
Bossiaea buxifolia	✓						r		
Bossiaea prostrata	✓					1			
Bothriochloa macra	✓	1	3		1		2	+	
Brachycome sp.	✓								
Brachyloma daphnoides	✓								
Brachyscome dentata	✓								
Bulbine bulbosa									
Bursaria spinosa	✓			r					

Callistemon sieberi	✓								
Callitris endlicheri	✓								
Calocephalus citreus	✓			r					r
Calotis scabiosifolia var. *integrifolia*									
Carex appressa	✓							+	
Carex breviculmis									
Carex inversa	✓	2		+				2	+
Carex sp.									
Cassinia aculeata									
Cassinia quinquefaria									
Cassinia longifolia									
Cheilanthes sieberi	✓		1	+		r	+		1
Chrysocephalum apiculatum	✓		1	1		1	1		1
Chrysocephalum semipapposum							+		
Clematis microphylla	✓			r			r		
Convolvulus erubescens	✓	r	+	r		r	r		r
Cotula australis	✓	+						r	
Craspedia variabilis	✓				1				
Crassula helmsii	✓								
Crassula sieberana	✓	1	1					1	
Cryptandra amara	✓					+	r		
Cymbonotus lawsonianus	✓		1	r		+	+	r	r
Cymbopogon refractus	✓		r	r			+		
Cynoglossum suaveolens									
Daucus glochidiatus	✓		+	+		1	1	+	1
Desmodium varians	✓	r	r	+		+	1		+
Dianella revoluta	✓								
Dichelachne sp.	✓		r	1	+				+
Dichondra repens	✓		1						
Dichopogon fimbriatus									
Dillwynia sericea									
Diuris semilunulata									
Dodonaea sp.									
Drosera peltata	✓								
Dysphania pumilio	✓	r						r	
Einadia nutans	✓	r	r				+		
Eleocharis acuta	✓								
Elymus scaber	✓	+	r	+		+			
Enneapogon nigricans	✓					r	1		r
Epilobium billardiereanum									
Eragrostis brownii	✓				1				
Erigeron karvinskianus									
Erodium crinitum	✓	1					+	+	
Eryngium ovinum	✓								
Eucalyptus blakelyi	✓		2	2	2	2	+		2
Eucalyptus bridgesiana	✓								
Eucalyptus dives	✓								
Eucalyptus mannifera	✓								

Eucalyptus melliodora	✓								
Eucalyptus rossii	✓								
Euchiton japonicus	✓				r	r	+		
Euchiton sphaericus	✓						1		
Euchiton sp.	✓		1	r					
Fimbristylis sp.	✓		r						
Galium gaudichaudii									
Geranium retrorsum	✓		+		1	+	+		
Geranium solanderi	✓		+	1			+	+	
Geranium sp.	✓								r
Glycine clandestina	✓		r						
Glycine tabacina	✓		1	r		+			
Gonocarpus tetragynus	✓			+		+			
Goodenia hederacea									
Haloragis heterophylla	✓				1				
Hibbertia obtusifolia	✓								
Hydrocotyle laxiflora	✓		+	+	+	1	+	+	+
Hypericum gramineum	✓		r	1		1			1
Indigofera australis	✓								
Isolepis sp.									
Joycea pallida									
Juncus sp.									
Juncus australis	✓							1	
Juncus filicaulis	✓				+			1	
Juncus homalocaulis	✓				1			+	
Juncus subsecundus	✓		r	r	1				
Juncus usitatus	✓								
Kunzea ericoides	✓								
Leptorhynchos squamatus	✓		r	1		1			1
Leptospermum continentale									
Leucochrysum albicans var. *tricolor*									
Linum marginale									
Lomandra bracteata									
Lomandra coriacea	✓		r	+	+	+	+		+
Lomandra filiformis	✓								
Lomandra longifolia	✓								
Lomandra multiflora	✓								
Luzula densiflora	✓					+			+
Melichrus urceolatus	✓					+	r		+
Microlaena stipoides	✓	2	1	2	2	1	1	2	1
Microseris lanceolata									
Microtis unifolia									
Myosotis sylvatica									
Ophioglossum lusitanicum	✓		1						1
Oreomyrrhis eriopoda	✓		r						
Oxalis perennans	✓	1	+	r		r	1	r	+
Oxalis sp.									
Panicum effusum	✓	+	r			r	1	r	r

Pellaea calidirupium	✓								
Persicaria prostrata	✓								
Pimelea curviflora									
Plantago gaudichaudii	✓			1		r			
Plantago varia	✓			1		r			
Poa labillardieri									
Poa sieberiana	✓			1	+	+			+
Poa sp.									
Pseudognaphalium luteoalbum									
Pultenaea procumbens									
Ranunculus sp.	✓								
Rumex brownii	✓	r		r	r		+	1	
Schoenus apogon	✓				+	r			
Scleranthus biflorus	✓								
Sebaea ovata									
Senecio quadridentatus	✓						r		
Solenogyne dominii	✓		+	r	+	r	r	r	1
Solenogyne gunnii	✓				+				
Spergularia brevifolia									
Sporobolus sp.									
Stackhousia monogyna	✓					r			
Swainsona monticola	✓								
Swainsona recta (propagated)									
Swainsona sericea	✓			r					
Thelymitra pauciflora	✓								
Thelymitra sp.	✓								
Themeda australis	✓		r	3	3	3			4
Thysanotus patersonii	✓								
Thysanotus tuberosus	✓								
Tricoryne elatior	✓			r					r
Tripogon loliiformis	✓		+				1		1
Triptilodiscus pygmaeus	✓						1		
Veronica calycina	✓		r			r			
Veronica sp.									
Vittadinia cuneata	✓		+						
Vittadinia muelleri	✓		+			+	+		1
Wahlenbergia communis	✓		+	r		1	1		1
Wahlenbergia gracilis	✓		+						
Wahlenbergia multicaulis	✓			+					
Wahlenbergia sp.	✓							r	
Wahlenbergia stricta									
Wurmbea dioica	✓								1
Xerochrysum viscosum	✓								
Zornia dyctiocarpa	✓								
Total Native Species	**115**	**19**	**44**	**40**	**25**	**38**	**39**	**22**	**35**
Baseline total native species	66	14	27	26	24	30	28	19	13

Exotic									
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Autumn 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3B**
Acetosella vulgaris	✓		+				+	1	
Aira sp.	✓		1	1		+	1		+
Anagallis arvensis									
Aphanes sp.									
Arctotheca calendula									
Avena sp.	✓			1				+	
Briza minor									
Bromus diandrus	✓			1				+	
Bromus hordeaceus	✓	1					1	2	
Bromus sp.	✓				1				
Capsella bursa-pastoris									
Carduus sp.	✓							+	
Carthamus lanatus	✓	4							
Centaurium erythraea	✓		r	r		r			r
Cerastium sp.									
Cirsium vulgare	✓				r			1	
Conyza sp.	✓	r							
Cotoneaster sp.									
Crataegus monogyna									
Cynosurus echinatus	✓		r						
Cyperus eragrostis	✓							r	
Cyperus sp.	✓								
Echium plantagineum	✓								
Eragrostis cilianensis									
Eragrostis curvula	✓				+			r	
Erodium botrys									
Erodium cicutarium	✓						1	1	
Erodium sp.									
Geranium ? Molle	✓							1	
Hirschfeldia incana	✓							+	
Holcus lanatus									
Hordeum glaucum									
Hordeum sp.	✓							1	
Hypericum perforatum	✓	+	+	1	+		1	r	r
Hypochaeris glabra	✓		1	1	1	1	1		1
Hypochaeris radicata	✓	1	+	r		+	1	+	
Lepidium sp.	✓							r	
Linaria arvense	✓		+						
Linaria pelisseriana	✓						1		
Lolium rigidum									
Malva nicaeensis									
Malva parviflora	✓	+						1	
Marrubium vulgare									
Modiola caroliniana	✓							+	
Myosotis discolor									

Nassella trichotoma	✓	r							
Onopordum acanthium	✓								
Orobanche minor									
Parentucellia latifolia									
Paronychia brasiliana	✓	1	r					1	
Petrorhagia nanteuilii	✓	+	+				1		
Phalaris aquatica									
Plantago lanceolata	✓		r	+	1	+	+	r	
Poa pratensis									
Polygonum aviculare	✓							+	
Prunus sp.									
Rosa rubiginosa	✓	r	r	+	+		r	r	
Rubus fruticosus	✓	r	r						
Sanguisorba minor									
Solanum nigrum	✓						r	r	
Sonchus oleraceus	✓					r			
Sonchus sp.									
Stellaria sp.	✓							1	
Taraxacum officinale	✓						+	r	
Tolpis umbellata	✓						1		
Trifolium arvense	✓				1		+		1
Trifolium angustifolia	✓				r				
Trifolium campestre									
Trifolium dubium									
Trifolium glomeratum									
Trifolium repens	✓							2	
Trifolium sp.	✓	1	1	1		1	1		1
Trifolium subterraneum	✓	1			1		1	2	
Urtica urens	✓							+	
Verbascum thapsus	✓		r						
Verbena bonariensis	✓				r			r	
Vicia sp.									
Vulpia sp.	✓	+	r	+		1	1		
Total Exotic Species	**50**	**14**	**16**	**11**	**11**	**8**	**18**	**28**	**6**
Baseline total exotic species	46	18	7	14	16	8	17	15	26

Appendix B: Fauna lists and habitat features

Fauna observations

Fauna species recorded during the biannual monitoring surveys from spring 2011 to autumn 2014, either through opportunistic observations or targeted survey are outlined below.

A = autumn, B = spring.

Common Name	Latin Name	2011	2012A	2012B	2013A	2013B	2014A
Australasian Grebe	*Tachybaptus novaehollandiae*		✓		✓	✓	✓
Australian Magpie	*Gymnorhina tibicen*	✓	✓	✓	✓	✓	✓
Australian Raven	*Corvus coronoides*	✓	✓	✓	✓	✓	✓
Australian Wood Duck	*Chenonetta jubata*			✓	✓	✓	
Black-faced Cuckoo-Shrike	*Coracina novaehollandiae*		✓	✓		✓	
Brown Falcon	*Falco berigora*					✓	
Common Bronzewing	*Phaps chalcoptera*	✓			✓		✓
Crested Pigeon	*Ocyphaps lophotes*				✓	✓	✓
Diamond Firetail	*Stagonopleura guttata*	✓			✓		
Double Barred Finch	*Taeniopygia bichenovii*				✓		
European Goldfinch	*Carduelis carduelis*				✓		
Fan-tailed Cuckoo	*Cacomantis flabelliformis*					✓	
Galah	*Eolophus roseicapillus*	✓		✓		✓	
Grey Butcherbird	*Cracticus torquatus*		✓	✓			
Grey Fantail	*Rhipidura albiscapa*	✓	✓	✓		✓	✓
Grey Shrike-Thrush	*Colluricincla harmonica*		✓		✓	✓	✓
Hard Head	*Aythya australis*			✓	✓		
Honeyeater, White-Eared	*Lichenostomus penicillatus*	✓	✓		✓		
Honeyeater, White-Plumed	*Lichenostomus penicillatus*				✓	✓	
Honeyeater, Yellow Faced	*Lichenostomus chrysops*			✓			
Jacky Winter	*Microeca fascinans*	✓		✓		✓	
Kookaburra	*Dacelo novaeguineae*	✓		✓			
Leaden Flycatcher	*Myiagra rubecula*			✓			
Magpie Lark	*Grallina cyanoleuca*	✓	✓	✓	✓	✓	✓
Masked Lapwing	*Vanellus miles*					✓	
Nankeen Kestral	*Falco cenchroides*					✓	
Noisy Friarbird	*Philemon corniculatus*			✓		✓	
Noisy Miner	*Manorina melanocephala*	✓	✓	✓	✓	✓	✓
Pacific Black Duck	*Anas superciliosa*			✓	ü	✓	
Pardalote, Spotted	*Pardalotus punctatus*	✓	✓	✓	✓		✓
Pardalote, Striated	*Pardalotus striatus*	✓		✓	✓	✓	✓
Pied Currawong	*Strepera graculina*	✓	✓	✓	✓	✓	✓

Quail	*Coturnix* sp.	✓				✓	
Red-Browed Finch	*Neochmia temporalis*			✓	✓	✓	
Red Wattlebird	*Anthochaera carunculata*					✓	
Robin, Eastern Yellow	*Eopsaltria australis*						✓
Robin, Flame	*Petroica phoenicea*	✓					✓
Robin, Hooded	*Melanodryas cucullata cucullata*	✓					
Robin, Scarlet	*Petroica boodang*	✓	✓		✓		✓
Rosella, Crimson	*Platycercus elegans*	✓	✓	✓	✓	✓	✓
Rosella, Eastern	*Platycercus adscitus*	✓	✓	✓	✓	✓	
Sacred Kingfisher	*Todiramphus sanctus*			✓			
Southern White-face	*Aphelocephala leucopsis*						✓
Speckled Warbler	*Chthonicola sagittatus*				✓		✓
Sulphur-Crested Cockatoo	*Cacatua galerita*	✓				✓	✓
Superb Fairy Wren	*Malurus cyaneus*	✓	✓	✓	✓	✓	✓
Thornbill, Brown	*Acanthiza pusilla*	✓		✓	✓	✓	
Thornbill, Yellow-Rumped	*Acanthiza chrysorrhoa*	✓	✓	✓	✓	✓	✓
Tree Martin	*Petrochelidon nigricans*					✓	
Wedge-Tailed Eagle	*Aquila audax*	✓	✓		✓		✓
Weebill	*Smicrornis brevirostris*				✓		
Whistler, Golden	*Pachycephala pectoralis*	✓	✓			✓	
Whistler, Rufous	*Pachycephala rufiventris*			✓	✓	✓	
White-bellied Sea-Eagle	*Haliaeetus leucogaster*					✓	
White Throated Tree Creeper	*Cormobates leucophaeus*	✓	✓	✓	✓	✓	✓
White-fronted Gerygone	*Gerygone olivacea*			✓		✓	
White-winged Chough	*Corcorax melanorhamphos*		✓	✓		✓	
Willie Wagtail	*Rhipidura leucophrys*	✓	✓		✓	✓	
Yellow Tailed Black Cockatoo	*Calyptorhynchus funereus*				✓		
	Total	**27**	**22**	**30**	**33**	**38**	**23**

Mammals	Latin Name	2011	2012A	2012B	2013A	2013B	2014A
Brushtail Possum	*Trichosurus vulpecula*					✓	✓
Cow	*Bos Taurus*	✓					✓
European Rabbit	*Oryctolagus cuniculus*	✓	✓	✓	✓	✓	✓
Feral Goat	*Capra aegagrus hircus*		✓	✓	✓	✓	✓
Feral Pig	*Sus scrofa*		✓			✓	✓
Fox	*Vulpes vulpes*	✓	✓	✓	✓	✓	✓
Kangaroo	*Macropus giganteus*	✓	✓	✓	✓	✓	✓
Sheep	*Ovis aries*				✓	✓	
Sugar Glider*	*Petaurus breviceps*					✓	✓
Swamp Wallaby	*Wallabia bicolor*					✓	✓
Wombat	*Vombatus ursinus*	✓	✓	✓	✓	✓	✓
	Total	**5**	**6**	**5**	**6**	**10**	**10**

Other	Latin Name	2011	2012A	2012B	2013A	2013B	2014A
Eastern Bearded Dragon	*Pogona barbata*			✓			
Eastern Common Froglet	*Crinia signifera*		✓	✓	✓	✓	✓
Eastern Long-necked Tortoise	*Chelodina longicollis*		✓		✓	✓	✓
Echidna	*Tachyglossus aculeatus*					✓	
Mountain Dragon	*Rankinia diemensis*	✓					
Peron's Tree Frog	*Litoria peronii*					✓	
Plains Froglet	*Crinia parinsignifera*			✓	✓	✓	✓
Smooth Toadlet	*Uperoleia laevigata*					✓	
Spotted Marsh Frog	*Limnodynastes tasmaniensis*			✓	✓	✓	✓
Whistling Tree Frog	*Litoria verreauxii*			✓		✓	
Total		**1**	**2**	**5**	**4**	**8**	**4**

Anabat Results

Four Anabat nights were conducted using two separate Anabats on the nights of 5th and 6th May 2014.

Bat calls were analysed using the program AnalookW (Version 3.8 25 October 2012, written by Chris Corben, www.hoarybat.com). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al. 2004); and south-east Queensland and north-east New South Wales (Reinhold et al. 2001) and the accompanying reference library of over 200 calls from north-eastern NSW. Available: (http://www.forest.nsw.gov.au/research/bats/default.asp).

Bat calls are analysed using species-specific parameters of the call profile such as call shape, characteristic frequency, initial slope and time between calls (Rinehold et al. 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd et. al. 2006) were followed:

- Search phase calls were used in the analysis, rather than cruise phase calls or feeding buzzes (McKenzie et al. 2002).
- Recordings containing less than three pulses were not analysed and these sequences were labeled as short (Law et al. 1999).
- Four categories of confidence in species identification were used (Mills et al. 1996):
    - definite – identity not in doubt
    - probable – low probability of confusion with species of similar calls
    - possible – medium to high probability of confusion with species with similar calls
    - unidentifiable – calls made by bats that cannot be identified to even a species group.
- *Nyctophilus* spp. are difficult to identify confidently from their calls and no attempt was made to identify this genus to species level (Pennay et al. 2004).
- Sequences not attributed to microbat echolocation calls were labeled as junk or non-bat calls and don't represent microbat activity at the site.
- Sequences labelled as low were of poor quality and therefore not able to be identified to species, they can however be used as an indicator of microbat activity at the site.

There were 150 sequences recorded from two Anabat detectors placed within the M2G offset site. Approximately 66% of sequences submitted were able to be identified to species with the remainder being too short or of low quality preventing positive identification. General microbat activity was low at both sites with calls recorded less often than every ten minutes on average throughout each evening.

There were at least 7 species identified, potentially including one vulnerable species (*Miniopterus schreibersii oceanensis;* Eastern Bentwing Bat) listed under the NSW TSC Act 1987 (**Tables 7 & 8** below). The most recorded species were the Chocolate Wattled Bat (*Chalinolobus morio*), Gould's Wattled Bat (Chalinolobus gouldii) and White-striped Freetailed Bat *(Tadarida australis*), accounting for 69% of positively identified sequences.

The calls of Gould's Wattled Bat and the Freetailed Bats (*Mormopterus* spp.) can be difficult to separate. Calls were identified as Gould's Wattled Bat with a frequency of 27.5 – 32.5 kHz and alternation in call frequency between pulses. Those calls that did not show regular alternation, had a characteristic frequency in the range 24 – 26kHz and had OPS of less than 100 were identified as Freetailed Bat. These calls matched the flat shape of *Mormopterus* species 4 calls (South-eastern Freetailed Bat), but there are no documented references for calls of this description in the area. Calls displaying intermediate characteristics were grouped together.

Calls of the Chocolate Wattled Bat and Little Forest Bat can be difficult to separate when either species is not calling in a characteristic pattern. When calls displayed a down-sweeping tail they were identified

as Chocolate Wattled Bat and when the calls had a clearly up-sweeping tail they were identified as Little Forest Bat. If there was no tail these species were grouped together.

Calls of the Large Forest Bat (*Vespadelus darlingtoni*) overlap in frequency with those of the Eastern Forest Bat (*V. regulus)* in this geographic region. Recorded calls could not be separated and have been grouped together.

Calls of the threatened Large-footed Myotis (*Myotis macropus*) are very similar to all Nyctophilus species and it is often difficult to separate them. Calls can only be identified as *Nyctophilus* spp. when the time between calls (TBC) is higher than 95 ms and the initial slope (OPS) was lower than 300. Calls can only be identified as Large-footed Myotis when the TBC was lower than 75 ms and the OPS was greater than 400. There were no calls that fell clearly within the range of either species and they have been grouped together.

Table 7: Species recorded on Anabat within the southern offset, Williamsdale on 5-7 May 2014.

Species name	Common name	# Calls	Definite	Probably	Possible
Chalinolobus morio	Chocolate Wattled Bat	2	1		1
Tadarida australis	White-striped Sheathtail Bat	4	4		
Vespadelus darlingtoni / Vespadelus regulus	Large Forest Bat / Southern Forest Bat	2			
Short		2			
	Total sequences	**10**			

Table 8: Species recorded on Anabat within the northern offset, Williamsdale on 5-7 May 2014*

Species name	Common name	# Calls	Definite	Probably	Possible
Chalinolobus gouldii	Gould's Wattled Bat	17	12	2	3
Chalinolobus gouldii /	Gould's Wattled Bat / A	5			
Chalinolobus morio	Chocolate Wattled Bat	35	25	5	5
Chalinolobus morio / Vespadelus	Chocolate Wattled Bat / Little	5			
Mormopterus species	A Freetailed Bat	6	3		3
Myotis macropus / Nyctophilus* spp.	Large-footed Myotis / Long-eared Bats	2			
Tadarida australis	White-striped Freetail Bat	16	15		1
Vespadelus darlingtoni /	Large Forest Bat / Southern	1			
Vespadelus vulturnus	Little Forest Bat	10	2	4	4
Low		10			
Short		33			
	Total sequences	**140**			

* Threatened species (NSW)

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