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SHEFFIELD RESOURCES LTD
THUNDERBIRD PROJECT
TARGETED GREATER BILBY ASSESSMENT

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EXECUTIVE SUMMARY

Sheffield Resources Limited is undertaking biological surveys to support environmental impact assessment and environmental approvals for its Thunderbird Project. The Thunderbird Project study area (study area) is located approximately 70 kilometres west of Derby on the Dampier Peninsula and is approximately 148.8 km^2 in area, of which 17.23 km^2 is proposed disturbance area. Previous Level 1 and 2 vertebrate fauna surveys of the study area recorded the Greater Bilby (*Macrotis lagotis*). In order to gain a more comprehensive understanding of Greater Bilby occurrence, habitat utilisation and estimated size of the resident population within the study area, Sheffield commissioned *ecologia* to conduct a targeted Greater Bilby assessment.

The targeted Greater Bilby assessment was conducted by two zoologists over six days from the 22 to 27 September 2015. Prior to the field survey, secondary evidence search transects were selected to provide spatially representative and systematic coverage within the previously mapped pindan shrubland habitat type. Each transect was traversed by a zoologist, searching for secondary evidence signs of Greater Bilby (diggings, tracks, scats and burrows). Where active burrows were recorded in relatively close proximity to vehicle tracks (facilitating the collection of cameras at conclusion of field survey), motion cameras were established in an attempt obtain Greater Bilby burrow utilisation records. For a greater understanding of actual number of individuals present, DNA extraction and analysis of Greater Bilby scats was completed.

The Greater Bilby was recorded from numerous locations throughout the study area via secondary evidence in the form of diggings, scats, active burrows and motion camera records. A total of 26 scats were collected during the targeted assessment and subsequently underwent DNA extraction and analysis. Of the 26 scats collected, 15 produced viable amounts of DNA with 13 scats able to facilitate individual analysis. This analysis resulted in a total of nine individual Greater Bilbies being identified.

The DNA extrapolation analysis results suggest the study area is likely to be supporting additional individuals (to the nine individuals confirmed through DNA analysis) at the time of surveying. It is estimated the Greater Bilby population within the study area at the time of the targeted survey was approximately 25 individuals, with this population likely to fluctuate according to seasonal and annual variations in rainfall, resource availability, fire history and feral animal populations. When comparing the spatial occurrence of Greater Bilby in relation to location of proposed disturbance areas, it can be demonstrated that the Greater Bilby occurs both inside proposed mine disturbance areas and within close proximity to haul road disturbance areas. Overall, however, more Greater Bilby activity was recorded outside proposed disturbance areas. Using the estimate of 25 individuals, a home range of 3.69 km^2 per individual is calculated within the pindan shrubland habitat type.

The Greater Bilby was almost exclusively recorded from the pindan shrubland habitat type, specifically within the dense, mature *Acacia tumida* var. *tumida* woodland micro-habitat. This micro-habitat appears to be influenced by fire age, with older fire age (>2 years) then surrounding areas. The dense, mature *Acacia tumida* var. *tumida* woodland micro-habitat forms a dense canopy layer but relatively open ground cover, which is in contrast to surrounding areas which appear to have been burnt more frequently and are characterised by dense ground vegetation.

The Greater Bilby population status on Dampier Peninsula is not clear, however it has been suggested it is most likely a scattered population in low densities. Relatively few biological surveys have been completed on Dampier Peninsula, however three recent biological assessments have all recorded Greater Bilby, suggesting the species may be more common on Dampier Peninsula than previously thought. Due to the uncertainties regarding the status of the Dampier Peninsula population, the regional significance of the Greater Bilby population within the study area is difficult to determine. Using the estimated national Greater Bilby population of 10,000, should the study area contain 25 individuals, than the study area would contain 0.25% of the estimated national Greater Bilby population.

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Sheffield Resources Limited (Sheffield) is an emerging Western Australian company, with significant mineral sands, nickel, talc and iron assets, all located within the state of Western Australia. Sheffield is undertaking biological surveys to support environmental approvals for their Thunderbird mineral sand project. The Thunderbird project study area (study area) is approximately 148.8 km^2 in area, of which 17.23 km^2 is proposed disturbance area. The study area located approximately 70 kilometres west of Derby on the Dampier Peninsula (Figure 1.1).

Sheffield has previously commissioned *ecologia* Environment (*ecologia*) to undertake a two-phase Level 2 terrestrial (vertebrate and SRE invertebrate) and subterranean fauna survey of the study area. Level 2 assessments were completed in 2014. An additional Level 1 survey was completed for infrastructure areas including haul road and proposed accommodation camp in May 2015.

Both the initial Level 2 vertebrate fauna survey and the more recent Level 1 survey recorded the Greater Bilby (*Macrotis lagotis*) in the study area. In order to gain a comprehensive understanding of Greater Bilby occurrence, habitat utilisation and resident population estimate within the study area, Sheffield commissioned *ecologia* to conduct a targeted Greater Bilby assessment.

1.2 LEGISLATIVE FRAMEWORK

Commonwealth and State legislation applicable to the conservation of native flora and fauna in Western Australia (WA) includes, but is not limited to, the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the Western Australian *Wildlife Conservation Act 1950* (WC Act) and the *Environment Protection Act 1986* (EP Act). Section 4a of the EP Act requires that developments take into account the following principles applicable to native flora and fauna:

- **The Precautionary Principle:** Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
- **The Principles of Intergenerational Equity:** The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations; and
- **The Principle of the Conservation of Biological Diversity and Ecological Integrity:** Conservation of biological diversity and ecological integrity should be a fundamental consideration of development projects.

The EPBC Act was developed to provide for the protection of the environment, particularly those aspects of the environment that are matters of national environmental significance, to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources; and to promote the conservation of biodiversity. The EPBC Act includes provisions to protect native species (in particular to prevent the extinction and promote the recovery of threatened species) and to ensure the conservation of migratory species. In addition to the principles outlined in Section 4a of the EP Act, Section 3a of the EPBC Act includes the principle of ecologically sustainable development; that decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equity considerations.

The WC Act was developed to provide for the conservation and protection of wildlife in Western Australia. Under the WC Act, all native flora and fauna are protected in WA; however, the Minister may, via a notice published in the Government Gazette, declare a list of flora and fauna identified as likely to become extinct, or as rare, or otherwise in need of special protection. The current listing was gazetted on 2 December 2014.

1.3 GREATER BILBY DESCRIPTION

Conservation status: EPBC Act Vulnerable, WC Act Schedule 1 (Vulnerable), DPaW Vulnerable.

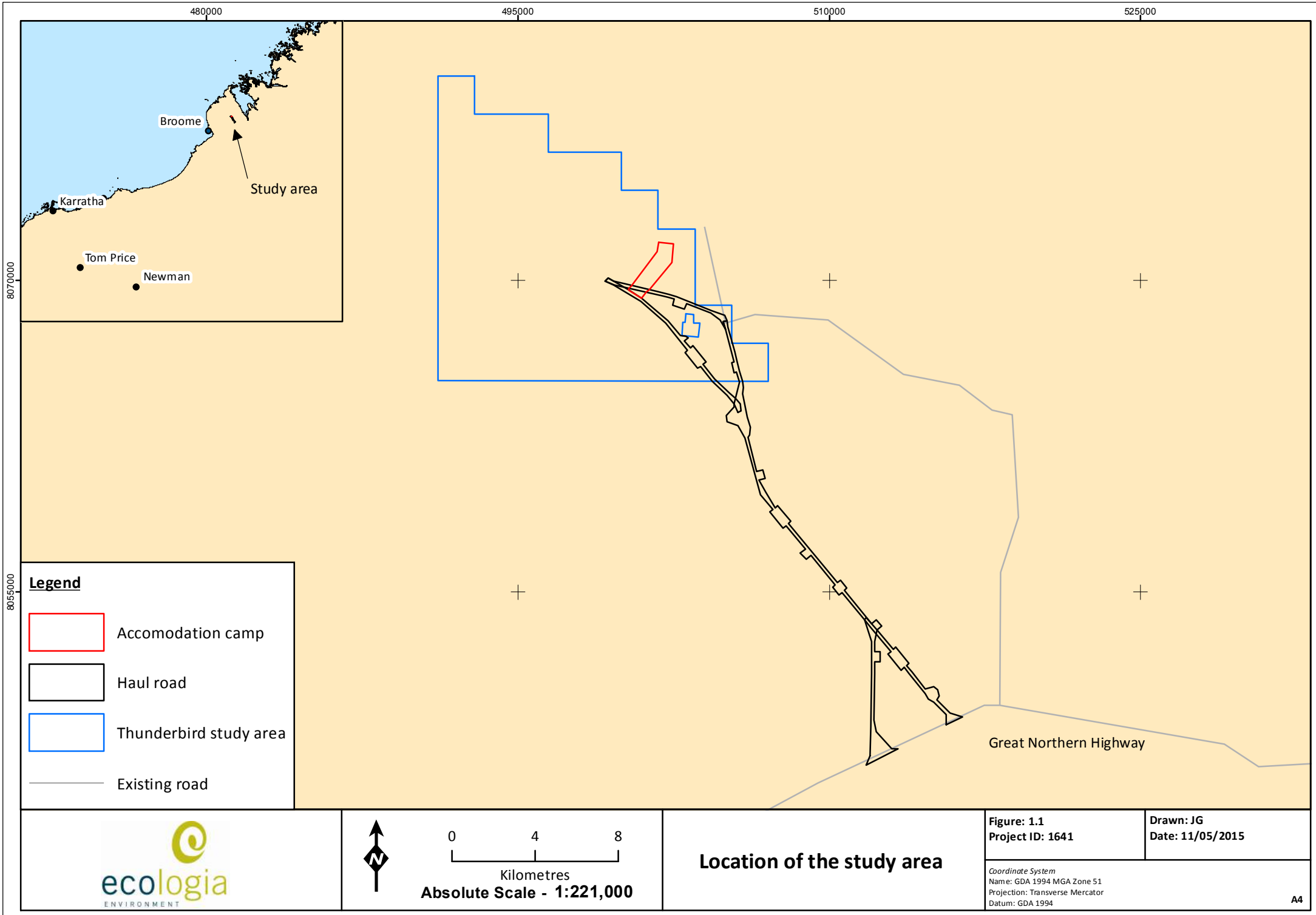
The Greater Bilby (*Macrotis lagotis*) formerly occurred over 70% of mainland Australia's arid and semiarid regions prior to European settlement (ABAS 2002). During the 20th century its range reduced significantly and is now absent from its previous southern and central range and restricted to northern Australia (Tyndale-Biscoe 2005). Woinarski *et al.* (2012) estimate the total Australian population size as 10,000 individuals, and is undergoing continual decline estimated to exceed 10% over the last three generations (12 years), that is likely to continue.

Greater Bilbies are currently patchily distributed through the Tanami, Great Sandy and Gibson Deserts, west to the Pilbara and north to Dampier Peninsula (Maxwell *et al.* 1996). Isolated populations also occur in south-west Queensland and to the north-east of Alice Springs. Greater Bilbies occur in a variety of habitats, including spinifex grassland, acacia shrubland, open woodland, fringes of salt lakes and cracking clays (Maxwell *et al.* 1996; Johnson 2008). Reasons for their population decline include predation by feral predators on both young and adult bilbies, competition from rabbits and livestock, reduced food as a result of changed fire regimes and drought (Maxwell *et al.* 1996; O'Malley 2006; Johnson 2008).

The Greater Bilby is a mainly solitary omnivorous marsupial and is the sole surviving species from the family Thylacomyidae, of which the Lesser Bilby (*Macrotis leucura*) has gone extinct (Tyndale-Biscoe 2005). As with all bandicoot species, the Greater Bilby are generalists in their diet and very effective opportunists, exploiting their environment by their wide choice of food in conjunction with fast growth and rapid reproduction, particularly when conditions are favourable (Tyndale-Biscoe 2005). Their typical diet consists of insects and larvae, seeds, bulbs, fruit and fungi (van Dyck and Strahan 2008).

Unlike other bandicoot species, the Greater Bilby constructs burrows where it shelters during the day. The burrows are up to two meters deep and descend in a spiralling direction with each individual animal utilising up to 12 burrows within its home range (ABAS 2002). Bilbies are strictly nocturnal and have been known to move up to five kilometres each night in search of food (Pavey 2006b). Home ranges are variable and temporary, with individuals responding to changes in food availability (van Dyck and Strahan 2008). Males, females and juveniles may all have overlapping home ranges, where densities in optimum habitat can be 12-16 individuals per km^2, however typically densities are 1-2 individuals per km^2 (Pavey 2006b). Estimates of short-term home ranges are relatively small, varying from 1.1 to 3.16 km^2, however females have been recorded with a home range as little as 0.18 km^2 (Pavey 2006a). Male home ranges and male-female home ranges overlap considerably, however overlap between females has not been recorded (Pavey 2006a).

The breeding season also reflects the opportunistic nature of this species, with Bilbies able to breed throughout the year whenever conditions are suitable (van Dyck and Strahan 2008). They are rapid breeders, with reproduction at faster rates than any other group of marsupials (Tyndale-Biscoe 2005).



Location of the study area

Figure: 1.1
Project ID: 1641

Drawn: JG
Date: 11/05/2015

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

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2 METHODOLOGY

2.1 GUIDING PRINCIPLES

This survey was undertaken as part of the Environmental Impact Assessment process in WA and is required to address the following government legislation and guidelines:

- EPA Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2002a);
- EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002b);
- *Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and DEC 2010); and
- Greater Bilby specific survey guidelines within *Survey guidelines for Australia's Threatened Mammals* (DSEWPaC 2011).

2.2 SURVEY TIMING

The targeted Greater Bilby assessment was conducted by two zoologists over six days from the 22 to 27 September 2015.

2.3 STUDY TEAM AND LICENCES

The targeted Greater Bilby assessment was planned, coordinated and executed by those listed in Table 2.1. The assessment was carried out under DPaW issued Regulation 17 License Number SF010517.

Table 2.1 – Study team

Project Staff			
Name	**Qualification**	**Role**	**Project role**
Shaun Grein	B. App. Sc; Grad. Dip. Nat Res.	Managing Director	QA and technical review
Matthew Macdonald	PhD	Principal Ecologist	QA and technical review
Bruce Greatwich	BSc.	Senior Zoologist	Project management, field survey and reporting
Sean White	BSc. (Hons)	Level 2 Zoologist	Field survey

2.4 GREATER BILBY SAMPLING METHODS

Greater Bilby sampling methods align with those recommended in the Commonwealth Department of the Environment guidelines (DSEWPaC 2011). Because traditional trapping methods can be unreliable in capturing Greater Bilbies, survey guidelines for the Greater Bilby focus on methods of determining presence/absence – these include secondary evidence signs (number of diggings, active burrows present) and activity captured on camera traps (DSEWPaC 2011). These methods were therefore used during this survey, and trapping was not conducted.

In the broader region of the study area, the Greater Bilby has been recorded in open woodland and open forest pindan habitats, and has also been recorded in pindan shrubland and other vegetation communities but with a lower degree of preference (Southgate 2012). Previous sampling and Greater Bilby records obtained during previous surveys of the Thunderbird study area, however, indicate that Greater Bilby predominantly occur locally in small, isolated patches of dense, mature *Acacia tumida* within the broader pindan shrubland habitat (*ecologia* 2014, 2015). This habitat was therefore targeted during survey activities, using both systematic and opportunistic methods.

2.4.1 Secondary evidence search transects

It was determined that traversing systematically spaced walking transects through the pindan shrubland habitat type would be the most effective sampling method to identify evidence of Greater Bilby activity. Other habitat types in the study area are not evidenced to be the preferred habitat of the Greater Bilby at Thunderbird (*ecologia* 2014, 2015), although isolated occurrences of the species in other habitats may exist on occasion.

Secondary evidence search transects were selected prior to the commencement of the field survey. Transects were selected to provide representative survey coverage within the previously mapped pindan shrubland habitat type. Each transect was spaced between 0.5-1 km apart and traversed by a zoologist searching for secondary evidence signs of Greater Bilby.

Secondary evidence searched for included diggings, tracks, scats and burrows. Where evidence was encountered, the immediately surrounding area (within 200 m radius) was searched in an attempt to record further evidence. Secondary evidence search transect locations are shown in Figure 2.2.

2.4.2 Camera trapping

Based on the habitats observed during surveying and the secondary evidence identified, motion-sensor camera trapping was also undertaken in order to detect the presence of the Greater Bilby (with capacity to detect other species of conservation significance if present). Camera trapping on active burrows that were located was completed using Reconyx HC500 Hyperfire motion cameras. All cameras are triggered by movement using highly sensitive, passive infra-red motion sensors that function both during the day and at night. Motion cameras were established on the entrance of active burrows that were located within relatively close proximity to vehicle tracks, allowing cameras to be collected at the conclusion of the field survey. Camera trap locations are shown in Table 2.2 and Figure 2.2. An example of camera trapping set up during the current field survey is shown in Figure 2.1.

Table 2.2 – Camera trap locations

Camera name	Easting	Northing	No. nights deployed
RC29	497065	8071777	3
RC16	497458	8071357	3
RC14	501767	8065957	5
RC32	502029	8065980	5
RC13	501663	8068089	4

GDA 94 Zone 51

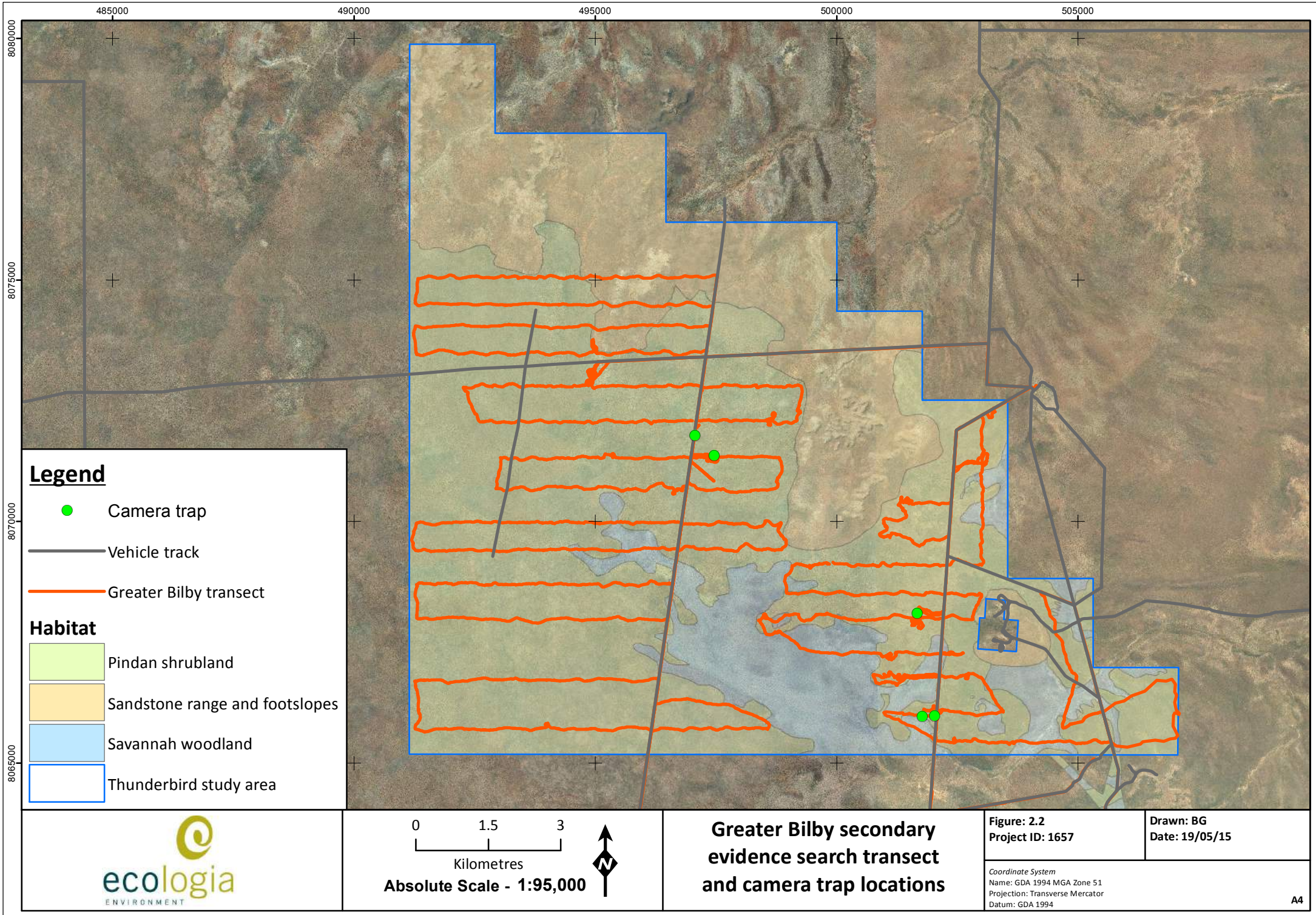
Figure 2.1 – Example of camera trap set on active Greater Bilby burrow

2.4.3 Scat collection and DNA analysis

To more accurately quantify the number of individuals present, DNA extraction and analysis was completed on Greater Bilby scats. This allowed for identification of individual Greater Bilbies.

When Greater Bilby evidence or burrows were encountered during transects, the surrounding area was searched in an attempt to find Greater Bilby scat. All attempts were made to find scat at each location where Greater Bilby evidence was recorded; this included sieving through spoil heap dirt associated with diggings, as scats are often produced in association with diggings. However, a number of sites where Greater Bilby evidence was recorded failed to yield any scat. Where a scat was recorded, the location was marked by GPS, with the scat scooped in to a vial using the lid to avoid contamination. Each vial contained silica gel to absorb moisture within the scat and prevent DNA degradation.

Scats were brought back to Perth, with DNA extraction and analysis completed by the Department of Parks and Wildlife (DPaW). Detailed scat extraction and analysis methodology is provided in the associated DPaW report (Appendix A).


485000
490000
495000
500000
505000
8080000
8075000
8070000
8065000
Legend
Camera trap
Vehicle track
Greater Bilby transect
Habitat
Pindan shrubland
Sandstone range and footslopes
Savannah woodland
Thunderbird study area
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0
1.5
3
Kilometres
Absolute Scale - 1:95,000
N
Greater Bilby secondary evidence search transect and camera trap locations
Figure: 2.2
Project ID: 1657
Drawn: BG
Date: 19/05/15
Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994
A4

3 RESULTS

3.1 GREATER BILBY RECORDS

The presence of the Greater Bilby in the study area was evidenced by 754 records of secondary evidence. These records comprised:

- diggings – e.g. as per Figure 3.1 – 670 records;
- scats – e.g. as per Figure 3.2 – 25 records/samples;
- active burrows – e.g. as per Figure 3.3 – 17 records; and
- inactive burrows – 42 records.

In addition, two direct records were obtained via the camera traps. In these cases, Bilbies were photographed entering and emerging from the active burrows monitored (two different burrows). The remaining three active burrows did not trigger the camera traps (Table 3.1).

Greater Bilby records from this targeted assessment, in addition to previous records from Level 1 and Level 2 assessments, and the proposed disturbance areas are shown in Figure 3.4 and in Appendix A.

Table 3.1 – Camera trap results

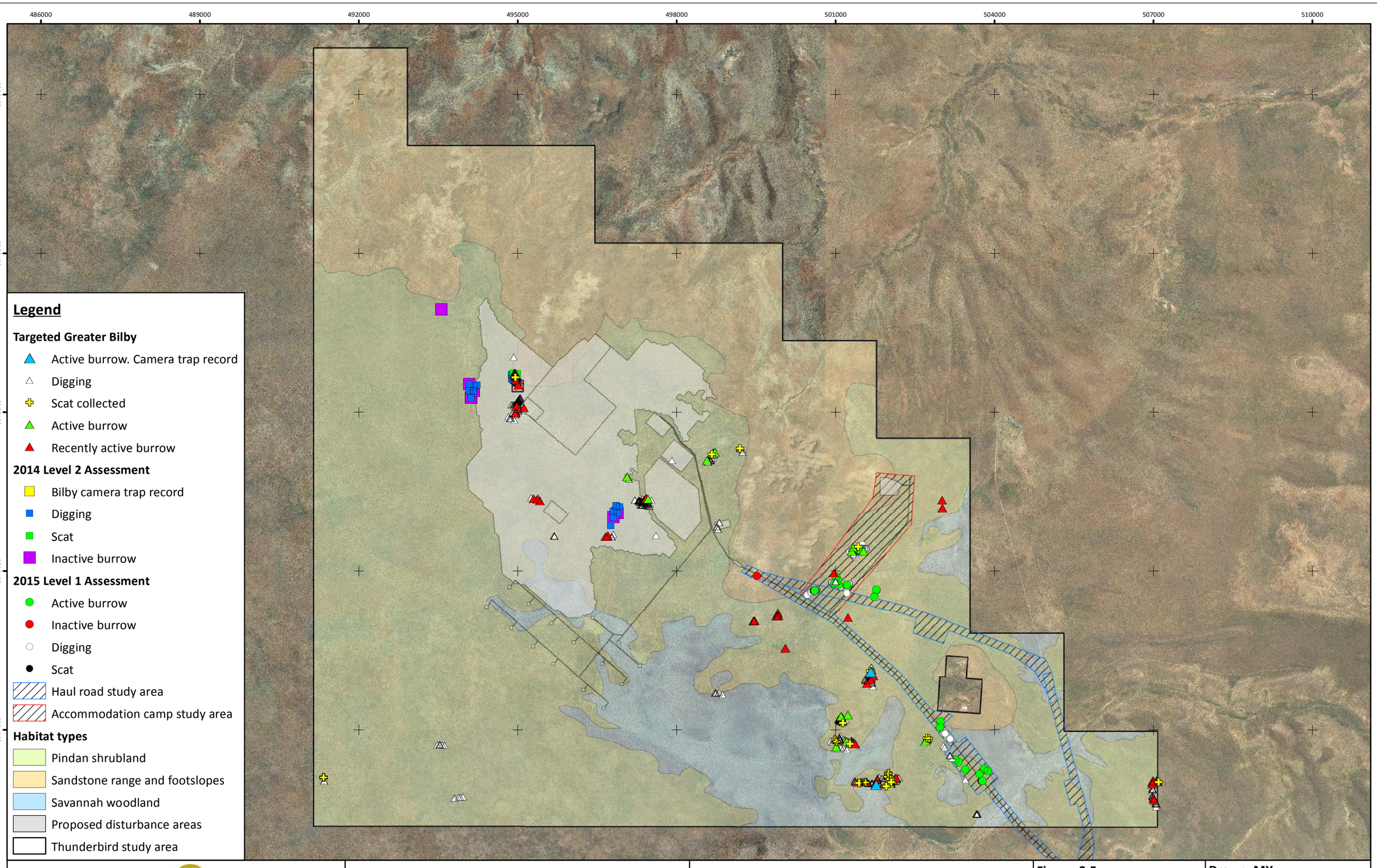
Camera name	Positioned at	Greater Bilby detected
RC29	Active burrow	NO
RC16	Active burrow	NO
RC14	Active burrow	YES
RC32	Active burrow	NO
RC13	Active burrow	YES

Figure 3.1 – A Greater Bilby digging recorded (51K 501090 mE 8067243 mN)

Figure 3.2 – A Greater Bilby scat recorded (51K 501656 mE 8068113 mN / BGS9)

Figure 3.3 – A Greater Bilby active burrow recorded (51K 0501663 mE 8068089 mN / RC13)

Figure 3.4 – A Greater Bilby recorded by camera trap (51K 0501663 mE 8068089 mN / RC13)



Legend

Targeted Greater Bilby

- Active burrow. Camera trap record
- Digging
- Scat collected
- Active burrow
- Recently active burrow

2014 Level 2 Assessment

- Bilby camera trap record
- Digging
- Scat
- Inactive burrow

2015 Level 1 Assessment

- Active burrow
- Inactive burrow
- Digging
- Scat
- Haul road study area
- Accommodation camp study area

Habitat types

- Pindan shrubland
- Sandstone range and footslopes
- Savannah woodland
- Proposed disturbance areas
- Thunderbird study area

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0 1.5 3

Kilometres

Absolute Scale - 1:65,000

N

Previous and current Greater Bilby records

Figure: 3.5
Project ID: 1657

Drawn: MY
Date: 03/06/2016

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

A3

3.2 DNA SCAT ANALYSIS

At each location where Greater Bilby secondary evidence such as diggings was recorded, an attempt was made to locate fresh scat to be able to conduct DNA analysis. Despite these efforts, it was not possible to collect Greater Bilby scats at a number of sites, despite other forms of secondary evidence being present.

A total of 26 scat samples were collected during the targeted survey, which subsequently underwent DNA extraction and analysis (Table 3.2). One was identified as probably being from a macropod and did not respond to analysis (not included hereafter in datasets in this report), but the remaining 25 were identified as being from Greater Bilby (Appendix A).

Of the 25 scats collected, 15 produced viable DNA and 13 of these provided sufficient quantities of DNA to facilitate individual identification. The remaining two amplified successfully, but not at sufficient numbers of loci to allow for individual identification. A study currently being completed by the Department of Parks and Wildlife shows that the age of scats has an effect on amplification success rate (Appendix A); therefore, the scat samples that did not yield enough DNA or did not amplify at enough loci may simply have been too old for analysis.

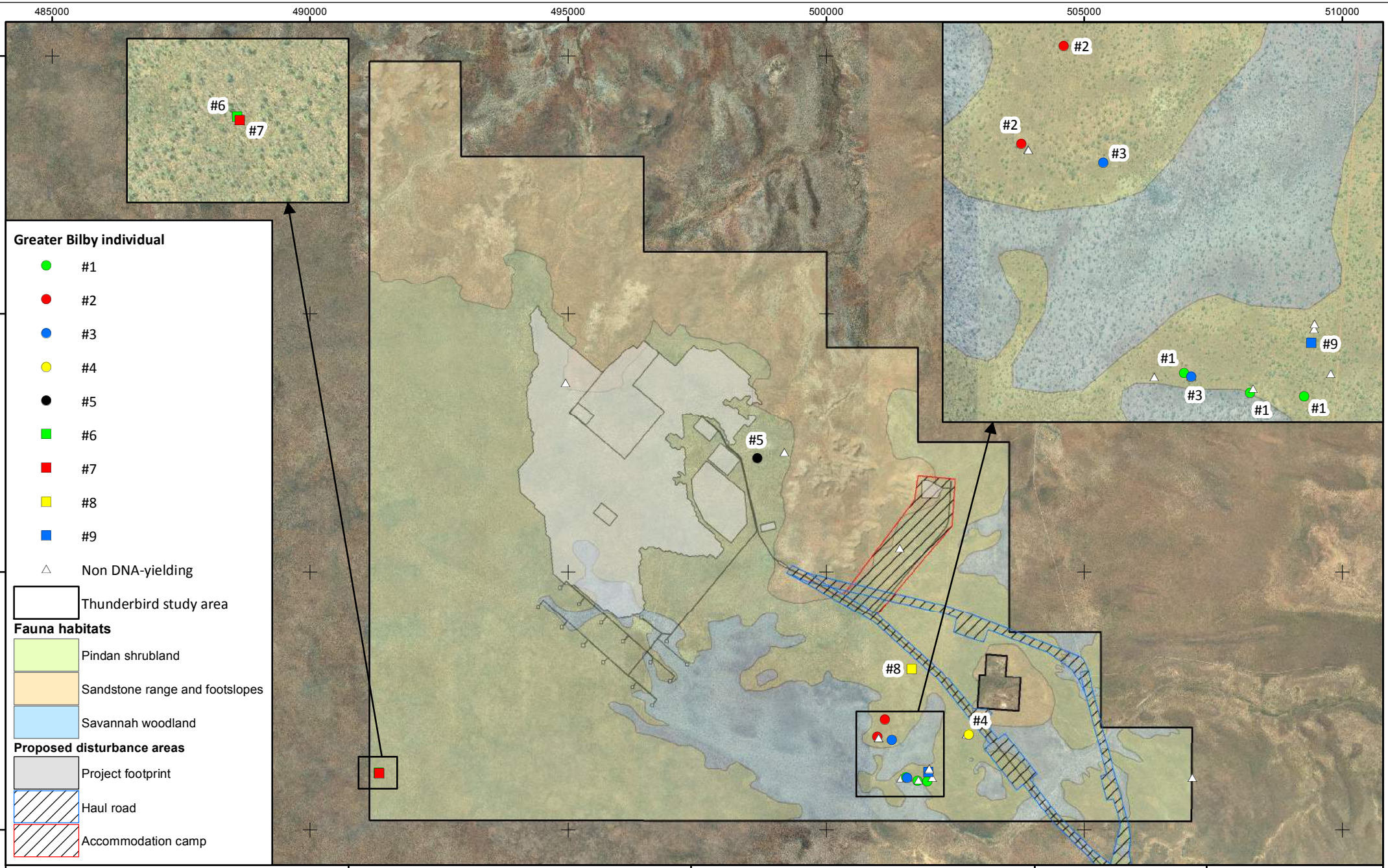
This analysis resulted in a total of nine individual Greater Bilbies being identified as occurring within the study area at the time of surveying (Figure 3.6).

Table 3.2 – Greater Bilby scat collection locations and DNA analysis results

Evidence	Scat ID	Sufficient DNA	Greater Bilby individual	Easting	Northing
Scat	BGS2	No	-	501446	8065999
Scat	BGS3	Yes	#1	501548	8066014
Scat	BGS4	No*	-	501573	8066002
Scat	BGS5	Yes	#3	501572	8066001
Scat	BGS6	Yes	#1	501775	8065945
Scat	BGS7	Yes	#1	501959	8065934
Scat	BGS8	No	-	502049	8066012
Scat	BGS9	Yes	#8	501656	8068113
Scat	BGS10	Yes	#2	501136	8067133
Scat	BGS11	Yes	#3	501271	8066734
Scat	BGS12	Yes	#2	500991	8066798
Scat	BGS13	No	-	501014	8066778
Scat	BGS14	No	-	501015	8066777
Scat	BGS15	No	-	494953	8073657
Scat	BGS16	No	-	501426	8070457
Scat	BGS17	No	-	501784	8065961
Scat	BGS18	Yes	#9	501982	8066117
Scat	BGS19	No	-	501993	8066164
Scat	BGS20	No	-	501995	8066181
Scat	Sws1	No*	-	502724	8066845
Scat	Sws2	Yes	#4	502759	8066841
Scat	Sws3	No	-	499192	8072315
Scat	Sws4	Yes	#5	498667	8072199
Scat	Sws5	Yes	#6	491331	8066102
Scat	Sws6	Yes	#7	491335	8066096

GDA 94 Zone 51

*DNA amplified but not in sufficient quantity to allow for individual identification



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0 1.5 3

Kilometres

Absolute Scale - 1:95,000

N

Greater Bilby DNA scat analysis results

Figure: 3.6
Project ID: 1657

Drawn: MY
Date: 10/06/16

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

A4

4 DISCUSSION

4.1 OCCURRENCE OF GREATER BILBY WITHIN THE STUDY AREA

The current targeted Greater Bilby assessment, in conjunction with previous Thunderbird Project fauna assessments (*ecologia* 2014, 2015), has given a good understanding of spatial occurrence and activity levels of Greater Bilby in the study area. The DNA scat analysis has provided quantitative data as to the minimum number of individuals present at the time of the targeted survey.

The DNA analyses suggest the study area was supporting, at the time of surveying, at least nine individuals (unique individual animals confirmed through DNA analysis). The results of this assessment overall generally show that each of these uniquely identified individuals was associated with an isolated, discrete cluster of records of Greater Bilby activity (Figure 3.6).

As noted earlier (Section 2.4.3), efforts to locate scat were made at every area of Greater Bilby activity. However, at many locations where activity was recorded, no scats were available to collect (Figure 3.5). Given that individual clusters of activity were generally associated with unique individual animals in the cases where genetic identifications could be made, it is possible that locations where identifications could not be made are also associated with unique individuals. These would therefore be over and above the nine individuals conclusively identified during this assessment; based on this hypothesis, it is possible that the total number of individuals present in the study area at the time of the assessment was in the vicinity of 25 animals.

It is possible this is an underestimate; transects during this assessment were selected to provide representative coverage of the pindan shrubland habitat type in the study area, and were spaced 0.5-1 km apart (Figure 2.2). As a result of the width of the spaced transects, it is possible that Greater Bilby activity in some areas remained undetected at the time of surveying. Equally this may be an overestimate, due to difficulty in interpreting the age of secondary evidence that is not obviously fresh. The population is also likely to fluctuate according to seasonal and annual variations in rainfall, resource availability, predator presence and fire history (Section 4.2). Only a highly-intensive survey conducted over multiple seasons would produce an absolute, quantitative baseline estimate of the Greater Bilby population size in the study area..

When comparing the spatial occurrence of Greater Bilby in relation to location of proposed disturbance areas, it can be demonstrated that the Greater Bilby occurs both inside proposed mine disturbance areas and within close proximity to haul road disturbance areas (Figure 3.5). Overall, however, more Greater Bilby activity was recorded outside proposed disturbance areas (Figure 3.5). All individuals identified from DNA scat analysis were outside proposed disturbance areas (Figure 3.6), with only a single scat collected from inside the proposed disturbance area (despite numerous locations of secondary evidence), which did not yield DNA.

On the basis of existing habitat mapping and estimated Greater Bilby population number within the study area, an approximate home range of Greater Bilby within the study area can be estimated. Approximately 92.2 km^2 of pindan shrubland habitat type has been calculated to occur within the study area. Applying the estimate of 25 individuals, this equates to a home range of 3.69 km^2 per individual. This home range estimate is likely to be actually slightly lower, given Greater Bilbies preference towards micro-habitat within the study area (Section 4.2). This home range estimate is close to previous calculations of Greater Bilby short-term home ranges of 1.1 to 3.16 km^2 (Pavey 2006a).

4.2 HABITAT ASSOCIATION

As within the previous fauna assessments for the Thunderbird Project (*ecologia* 2014, 2015), the Greater Bilby was recorded predominately within the pindan shrubland habitat type (Figure 3.5), and more specifically within the dense, mature *Acacia tumida* var. *tumida* woodland micro-habitat

(Figure 4.1). This micro-habitat appears to be influenced by fire age, with older fire age (>2 years) then surrounding areas. The dense, mature *Acacia tumida* var. *tumida* woodland micro-habitat forms a dense canopy layer but relatively open ground cover, which is in contrast to surrounding areas which appear to have been burnt more frequently and are characterised by dense ground vegetation.

The intensity of fire also appears to have an important influence on suitability of habitat. A number of areas of dense, mature *Acacia tumida* var. *tumida* woodland were encountered that had been burnt by large scale fire and that result in the loss of *Acacia tumida* var. *tumida* plants (evident by lack of regeneration) (Figure 4.2). Burnt areas included patches where Greater Bilby evidence had been recorded previously. The regeneration process within these areas will consequently take longer and be unsuitable habitat for Greater Bilby in the short to medium term, than if lower intensity fires occurred. The potential benefits of fire to Greater Bilby are not well known, although Southgate and Carthew (2006) determined fire-promoted plant growth contributed significantly to the amount of dietary plant material, concluding spatial and temporal heterogeneity of fire age beneficial to Greater Bilby populations. Fire age and intensity is therefore likely to be an important local factor in determining suitability of habitat for Greater Bilby, with small scale and mosaic fire patterns likely to be of greatest benefit.

Figure 4.1 – Dense, mature *Acacia tumida* var. *tumida* within pindan shrubland

Figure 4.2 – Damage from high-intensity fire in dense, mature *Acacia tumida* var. *tumida* habitat

This assessment identified a strong Greater Bilby feeding association with *Acacia tumida* var. *tumida* plants. It was observed diggings were commonly made at the base of this plant species (Figure 3.1), with extractions of root dwelling larvae made from the roots. Shell casings of Witjuti grub larvae (*Endoxyla* spp.) was observed at the base of *Acacia tumida* var. *tumida* plants (Figure 4.3), suggesting Witjuti grubs as an important food source for the local Greater Bilby population.

Figure 4.3 – Example of Witjuti grub (*Endoxyla* spp.) larvae casing from the study area

4.3 GREATER BILBY OCCURRENCE ON THE DAMPIER PENINSULA

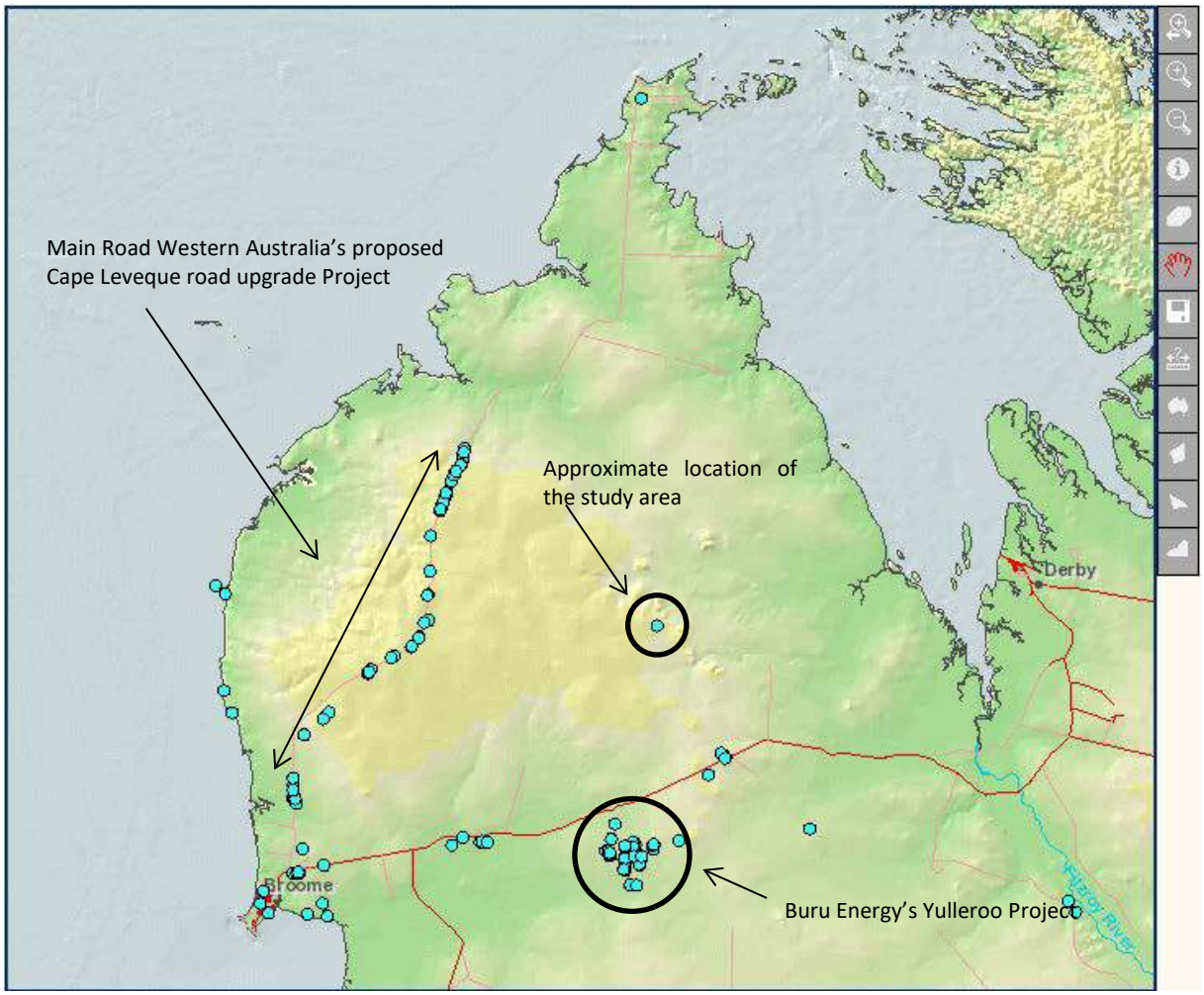
The Dampier Peninsula is a geographic region recognised as supporting a remnant, patchily distributed Greater Bilby population following the range contraction of this species in the early 1900's (Johnson 2008; Woinarski *et al.* 2012). The Greater Bilby population status on Dampier Peninsula is not clear, however Dr. Rick Southgate (GHD 2015) suggests it is most likely a scattered population in low densities. The northern edge of the Greater Bilby distribution (Dampierland and northern edges of the Great Sandy and Tanami Deserts) is thought to be of considerable importance to the conservation of the species, because it represents the only part of its range where populations can persist without the need of intensive management (Southgate 2012).

Relatively few biological surveys have been completed on Dampier Peninsula, however recent biological assessments including James Price Point (*ecologia* 2011), Buru Energy's Yulleroo Project (Ogburn 2013) and Main Road Western Australia's proposed Cape Leveque road upgrade Project (GHD 2013) all recorded Greater Bilby on the Dampier Peninsula. Previous records from NatureMap in relation to the study area are shown in Figure 4.4.

The impacts of development on Greater Bilby populations continue to be studied. Bilbies have been noted to be able to tolerate disturbance; however, it is important that indirect threats are also considered, in addition to the more obvious impacts of habitat removal (Southgate 2012).

Of particular importance in understanding Greater Bilby occupation of Dampier Peninsula are previous records associated with Main Road Western Australia's Cape Leveque road upgrade project (GHD 2013). These records can be seen in Figure 4.4, displayed as the linear collection of records west of the study area. The continued presence of Greater Bilby throughout the Cape Leveque road upgrade project area (approximately 100 km in length) suggests the Greater Bilby may be more common on the Dampier Peninsula then previously considered.

Due to the uncertainties regarding the status of the Dampier Peninsula population, the regional significance of the Greater Bilby population within the study area is difficult to determine. Using the estimated national Greater Bilby population of 10,000 (Woinarski *et al.* 2012), should the study area contain 25 individuals, then it is estimated that it would contain approximately 0.25% of the total national Greater Bilby population.



Source:(DPaW 2015)

Figure 4.4 – Previous Greater Bilby records on Dampier Peninsula

4.4 SURVEY LIMITATIONS

While this Targeted Bilby survey was conducted over a single season in 2015, a comprehensive Level 2, two-season terrestrial (vertebrate and SRE invertebrate) and subterranean fauna assessment was previously conducted for the Thunderbird Project in 2013 (*ecologia*, 2016a). Therefore the single season Targeted survey is no considered a limitation.

There were no major field constraints during the field survey. Survey methodology was conducted in accordance with the Commonwealth Guidelines for Survey for Australia's Threatened Mammals (DSEWPaC, 2011), with a focus on evidence of the presence and absence including secondary evidence of presence (ie scats, burrows and digging) and activity recorded from motion camera's within preferred habitat identified during the 2013 Level 2 survey (ie stands of mature *Acacia tumida* within the broader Pindan shrubland habitat).

5 CONCLUSION

The main conclusions from this targeted Greater Bilby assessment of the Thunderbird study area are:

- The Greater Bilby was recorded in the Thunderbird study area. A total of 754 Greater Bilby records were obtained, comprising secondary evidence in the form of diggings, scats, active burrows and inactive burrows;
- Direct confirmation of the contemporary presence of the Greater Bilby in the study area was obtained, with camera traps detecting the species at two out of the five active burrows that were monitored using this technique.
- Of the 25 scats collected, 15 produced viable DNA with 13 of these providing DNA that amplified at a sufficient number of loci to facilitate individual identification. This analysis resulted in a total of nine individual Greater Bilbies being recognised as occurring within the study area at the time of surveying;
- Extrapolating DNA scat analysis results suggests the study area is likely to be supporting additional individuals at the time of surveying. It is estimated the local Greater Bilby population within the study area at the time of the targeted survey is approximately 25 individuals;
- The size of this population is likely to fluctuate according to environmental factors including, but not limited to, seasonal and annual variations in rainfall, resource availability, fire history and the size of sympatric feral animal populations;
- When comparing the spatial occurrence of Greater Bilby in regards to location of proposed disturbance areas, it can be seen Greater Bilby occurs inside proposed mine disturbance areas, and in close proximity to haul road disturbance areas. However, overall more Greater Bilby activity was recorded outside proposed disturbance areas;
- Using the estimate of 25 individuals, a home range of 3.69 km^2 per individual is calculated within the pindan shrubland habitat type. This home range estimate is likely to be actually slightly lower, given the Greater Bilbies preference towards the micro-habitat recorded within the study area. This home range estimate is close to previous calculations of Greater Bilby short-term home ranges of 1.1 to 3.16 km^2;
- As per previous fauna assessments of the Thunderbird Project, the Greater Bilby was recorded almost exclusively within the pindan shrubland habitat type, and more specifically within the dense, mature *Acacia tumida* var. *tumida* woodland micro-habitat. This micro-habitat appears to be influenced by fire age, with older fire age (>2 years) then surrounding areas;
- The Greater Bilby population status on Dampier Peninsula is not clear, however it has been suggested it is most likely a scattered regional population in low densities. Relatively few biological surveys have been completed on Dampier Peninsula, however three recent biological assessments have all recorded Greater Bilby on the Dampier Peninsula, suggesting the species may be more common on Dampier Peninsula than previously thought; and
- Due to the uncertainties regarding the status of the Dampier Peninsula population, the regional significance of the Greater Bilby population within the study area is difficult to quantify. Using the estimated national Greater Bilby population of 10,000 (Woinarski *et al.* 2012), and the estimated study area population of 25 individuals, then the study area may support up to 0.25% of the estimated total national Greater Bilby population.

6 REFERENCES

ABAS. 2002. Bilby Facts and Figures. The Australian Bilby Appreciation Society.

DPaW. 2015. NatureMap: Mapping Western Australia's Biodiversity. Available at http://naturemap.dpaw.wa.gov.au/. Department of Parks and Wildlife.

DSEWPaC. 2011. Survey guidelines for Australia's Threatened Mammals. Department of Sustainability, Environment, Water, Population and Communities.

ecologia Environment. 2011. James Price Point: Light Industrial Area, Worker's Accommodation Camp and Souther Pipeline. Vertebrate Fauna Assessment. Report prepared for Woodside Energy Limited.

ecologia Environment. 2014. Thunderbird Project Terrestrial and Subterranean Fauna Assessment. Unpublished report for Sheffield Resources Ltd.

ecologia Environment. 2015. Thunderbird Haul Road and Accommodation Camp Flora and Fauna Assessment. Unpublished report for Sheffield Resources Ltd.

EPA. 2002a. Terrestrial Biological Surveys as an Element of Biodiversity Protection *in* Environmental Protection Authority, ed, Perth.

EPA. 2002b. Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3. Environmental Protection Authority, Western Australia.

EPA and DEC. 2010. Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment. Environmental Protection Authority and Department of Environment and Conservation *in* Hyder, B. M., Dell, J., Cowan, M. A., ed. Environmental Protection Authority and Department of Environment and Conservation.

GHD. 2013. Cape Leveque Road Upgrade Targeted Greater Bilby Assessment. Unpublished Report for Main Roads Western Australia.

GHD. 2015. Main Roads Western Australia, Cape Leveque Road Upgrade (SLK 25 - 102.6). Response to comments on the Draft Preliminary Documentation.

Johnson, K. A. 2008. Bilby, *Macrotis lagotis*. pp. 191-193 *in* van Dyck, S., and Strahan, R., eds. The Mammals of Australia. Reed New Holland, Sydney.

Maxwell, S., Burbidge, A. A., and Morris, K. D., eds. 1996. The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia, Canberra.

O'Malley, C. 2006. Australian Threatened Species, Greater Bilby, *Macrotis lagotis*.

Ogburn, D. 2013. Developing a model for Bilby habitat preference in the Western Sandlands. Buru Energy.

Pavey, C. 2006a. National Recovery Plan for the Greater Bilby *Macrotis lagotis*. Northern Territory Department of Natural Resources, Environment and the Arts.

Pavey, C. 2006b. Threatened Species of the Northern Territory: Greater Bilby *Macrotis lagotis in* Department of Natural Resources Environment and the Arts, ed. Parks and Wildlife Commission - Northern Territory Government.

2012. Peer review of the Browse Bilby Review, a report detailing the consolidated information relating to the occurrence of the Bilby *Macrotis lagotis* near the proposed Browse LNG Precinct (close to James Price Point) and more broadly on the Dampier Peninsula.

Southgate, R. and Carthew, M. 2006. Diet of the bilby (*Macrotis lagotis*) in relation to substrate, fire and rainfall characteristics in the Tanami Desert. Wildlife Research. 33:507-519.

Tyndale-Biscoe, H. 2005. Life of Marsupials. CSIRO Publishing, Melbourne.

van Dyck, S. and Strahan, R. 2008. *The Mammals of Australia*. Reed New Holland, Sydney.

Woinarski, J., Burbidge, A., and Harrison, P. 2012. The Action Plan for Australian Mammals. CSIRO Publishing.

APPENDIX A DPAW GREATER BILBY SCATS ANALYSIS REPORT

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Science and Conservation Division

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Genotyping of bilby scats collected from Dampier Peninsula, Kimberley
Fiona Carpenter and Martin Dziminski

Ecologia provided 26 scat samples for genotyping, of which 25 were confirmed to be greater bilby (*Macrotis lagotis*) scats (Table 1). Sample BGS1 looked like a macropod scat and did not amplify. Samples were stored dry, at room temperature, in 30ml tubes, approximately 1/3-filled with silica gel beads, until DNA extraction was undertaken.

DNA extractions were undertaken on the 21 October 2015. Genomic DNA was extracted from scats using the Qiagen QIAamp Fast DNA Stool Mini Kit with some modifications from Piggott and Taylor (2003) to the recommended procedures included in the kit. DNA was screened using seven highly polymorphic microsatellite markers (Table 2). These were multiplexed into two polymerase chain reactions (PCR) using the Qiagen Multiplex PCR Plus Kit. PCR amplification was performed using cycling conditions modified from the Qiagen Multiplex PCR Plus Kit. The PCR product was then analyzed on an ABI3730XL Sequencer, sized using Genescan-500 LIZ internal size standard, and genotyped using Genemapper software (version 5.0.0).

Of the 25 supplied samples, 15 samples yielded DNA and 13 amplified at enough loci to include in identity analysis (Table 3). Genotyping using the seven loci identified nine distinct individuals present across the survey (Table 4). Overall the average genotyping success rate of 52 % was higher than the expected rate of 20-25 % from initial trials. A study that is currently being completed by Parks and Wildlife shows that age of scats has an effect on amplification success rate. The scats that did not yield DNA or did not amplify at enough loci to be included in identity analysis may have been too old.

Further analyses of these data can reveal the relatedness of individuals within these populations (for example if individuals are full- or half-siblings, or other levels of relatedness). When monitoring is completed at other sites across Western Australia and genetic data is available, population genetic analyses can be completed. These analyses can reveal isolation or connectivity between populations using gene flow and transfer. Furthermore, the data gained from these two monitoring sites can be used in distance analysis techniques to gain accurate measures of the numbers and densities of individuals within monitored populations.

Sincerely,
Dr Martin Dziminski.

References

Moritz, C., A. Heideman, E. Geffen, and P. Mcrae. 1997. Genetic population structure of the Greater Bilby Macrotis lagotis, a marsupial in decline. Mol. Ecol. 6:925–936.

Piggott, M. P., and A. C. Taylor. 2003. Extensive evaluation of faecal preservation and DNA extraction methods in Australian native and introduced species. Aust. J. Zool. 51:341–355.

Smith, S., P. McRae, and J. Hughes. 2009. Faecal DNA analysis enables genetic monitoring of the species recovery program for an arid-dwelling marsupial. Aust. J. Zool. 57:139–148.

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Table 1. Bilby scat samples supplied by Ecologia.

Ecologia ID	DPaW ID	
SWS1	KIM0001	
SWS2	KIM0002	
SWS3	KIM0003	
SWS4	KIM0004	
SWS5	KIM0005	
SWS6	KIM0006	
BGS1	KIM0007	Not bilby.
BGS2	KIM0008	
BGS3	KIM0009	
BGS4	KIM0010	
BGS5	KIM0011	
BGS6	KIM0012	
BGS7	KIM0013	
BGS8	KIM0014	
BGS9	KIM0015	
BGS10	KIM0016	
BGS11	KIM0017	
BGS12	KIM0018	
BGS13	KIM0019	
BGS14	KIM0020	
BGS15	KIM0021	
BGS16	KIM0022	
BGS17	KIM0023	
BGS18	KIM0024	
BGS19	KIM0025	
BGS20	KIM0026	

Table 2. Microsatellite markers used in PCR.

Locus	Primer set	Fluorescent label	Reference
Multiplex 1			
B02	BIL02	6-FAM	Moritz et al. (1997)
B17	Bil17intF	VIC	Moritz et al. (1997) and Smith et al. (2009)
B56	Bil56intF	PET	Moritz et al. (1997) and Smith et al. (2009)
Multiplex 2			
B55	BIL55	6-FAM	Moritz et al. (1997)
B22	BIL22	VIC	Moritz et al. (1997)
B41	BIL41intF	PET	Moritz et al. (1997) and Smith et al. (2009)
B63	BIL63	NED	Moritz et al. (1997)

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Table 3. Bilby scat samples successfully genotyped.	
Scats yielding DNA	Scats with enough loci amplified
KIM0001	KIM0002
KIM0002	KIM0004
KIM0004	KIM0005
KIM0005	KIM0006
KIM0006	KIM0009
KIM0009	KIM0011
KIM0010	KIM0012
KIM0011	KIM0013
KIM0012	KIM0015
KIM0013	KIM0016
KIM0015	KIM0017
KIM0016	KIM0018
KIM0017	KIM0024
KIM0018	
KIM0024	

Table 4. Individuals identified from scat samples.

Individual #	Sample
1	KIM0009
1	KIM0012
1	KIM0013
2	KIM0016
2	KIM0018
3	KIM0011
3	KIM0017
4	KIM0002
5	KIM0004
6	KIM0005
7	KIM0006
8	KIM0015
9	KIM0024

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APPENDIX B GREATER BILBY RECORDS FROM ALL THUNDERBIRD PROJECT SURVEYS

Evidence Type	Easting	Northing	Date
Greater Bilby Targeted Assessment (2015)			
Active burrow	501102	8067252	23/09/2015
Active burrow	500995	8066824	23/09/2015
Active burrow	501211	8066777	23/09/2015
Active burrow	501527	8070381	25/09/2015
Active burrow	501325	8070444	25/09/2015
Active burrow	501307	8070375	25/09/2015
Active burrow	502049	8066093	27/09/2015
Active burrow	501232	8067278	23/09/2015
Active burrow	501012	8066679	23/09/2015
Active burrow	502703	8066787	23/09/2015
Active burrow	498572	8072093	24/09/2015
Active burrow	498722	8072240	24/09/2015
Active burrow	497065	8071777	24/09/2015
Active burrow	497458	8071357	24/09/2015
Active burrow. Camera trap record	501767	8065957	22/09/2015
Active burrow	502029	8065980	22/09/2015
Active burrow. Camera trap record	501663	8068089	23/09/2015
Digging	507060	8066048	22/09/2015
Digging	507060	8066048	22/09/2015
Digging	507061	8066056	22/09/2015
Digging	507067	8066054	22/09/2015
Digging	507072	8066060	22/09/2015
Digging	507086	8066046	22/09/2015
Digging	507085	8066033	22/09/2015
Digging	507087	8066032	22/09/2015
Digging	507085	8066028	22/09/2015
Digging	507084	8066025	22/09/2015
Digging	507101	8066009	22/09/2015
Digging	507093	8066010	22/09/2015
Digging	507090	8066003	22/09/2015
Digging	507079	8066004	22/09/2015
Digging	507049	8066019	22/09/2015
Digging	507037	8066025	22/09/2015
Digging	506984	8066029	22/09/2015
Digging	506981	8066014	22/09/2015
Digging	506984	8065998	22/09/2015
Digging	506976	8065985	22/09/2015
Digging	506979	8065982	22/09/2015
Digging	506977	8065887	22/09/2015
Digging	506981	8065885	22/09/2015
Digging	506983	8065875	22/09/2015
Digging	506986	8065871	22/09/2015
Digging	506991	8065874	22/09/2015
Digging	506987	8065860	22/09/2015
Digging	506969	8065842	22/09/2015
Digging	506976	8065772	22/09/2015
Digging	506977	8065750	22/09/2015
Digging	506979	8065744	22/09/2015
Digging	506989	8065738	22/09/2015
Digging	506991	8065731	22/09/2015
Digging	506997	8065729	22/09/2015
Digging	506996	8065717	22/09/2015
Digging	507006	8065686	22/09/2015
Digging	507040	8065647	22/09/2015
Digging	507043	8065623	22/09/2015
Digging	507045	8065615	22/09/2015
Digging	507037	8065608	22/09/2015
Digging	507042	8065603	22/09/2015

Digging	507049	8065601	22/09/2015
Digging	507052	8065602	22/09/2015
Digging	507061	8065596	22/09/2015
Digging	507050	8065543	22/09/2015
Digging	501359	8066034	22/09/2015
Digging	501361	8066036	22/09/2015
Digging	501369	8066032	22/09/2015
Digging	501368	8066026	22/09/2015
Digging	501374	8066007	22/09/2015
Digging	501378	8066004	22/09/2015
Digging	501380	8066002	22/09/2015
Digging	501379	8065999	22/09/2015
Digging	501416	8066009	22/09/2015
Digging	501429	8066008	22/09/2015
Digging	501428	8066005	22/09/2015
Digging	501437	8066005	22/09/2015
Digging	501443	8065999	22/09/2015
Digging	501450	8065999	22/09/2015
Digging	501464	8066014	22/09/2015
Digging	501476	8066023	22/09/2015
Digging	501480	8066020	22/09/2015
Digging	501496	8066024	22/09/2015
Digging	501509	8066016	22/09/2015
Digging	501532	8066009	22/09/2015
Digging	501549	8066010	22/09/2015
Digging	501560	8066005	22/09/2015
Digging	501565	8066007	22/09/2015
Digging	501585	8066005	22/09/2015
Digging	501585	8066007	22/09/2015
Digging	501600	8066005	22/09/2015
Digging	501604	8065999	22/09/2015
Digging	501604	8065999	22/09/2015
Digging	501612	8065994	22/09/2015
Digging	501622	8065990	22/09/2015
Digging	501630	8065988	22/09/2015
Digging	501676	8065992	22/09/2015
Digging	501679	8065991	22/09/2015
Digging	501682	8065986	22/09/2015
Digging	501688	8065982	22/09/2015
Digging	501688	8065989	22/09/2015
Digging	501696	8065986	22/09/2015
Digging	501704	8065990	22/09/2015
Digging	501730	8065974	22/09/2015
Digging	501729	8065978	22/09/2015
Digging	501742	8065972	22/09/2015
Digging	501757	8065967	22/09/2015
Digging	501758	8065960	22/09/2015
Digging	501758	8065957	22/09/2015
Digging	501773	8065946	22/09/2015
Digging	501776	8065947	22/09/2015
Digging	501789	8065955	22/09/2015
Digging	501807	8065965	22/09/2015
Digging	501806	8065967	22/09/2015
Digging	501815	8065976	22/09/2015
Digging	501814	8065975	22/09/2015
Digging	501821	8065977	22/09/2015
Digging	501822	8065981	22/09/2015
Digging	501830	8065980	22/09/2015
Digging	501864	8065977	22/09/2015
Digging	501888	8065979	22/09/2015

Digging	501930	8065974	22/09/2015
Digging	501945	8065962	22/09/2015
Digging	502007	8065973	22/09/2015
Digging	502019	8065970	22/09/2015
Digging	502022	8065972	22/09/2015
Digging	502038	8065985	22/09/2015
Digging	502039	8065979	22/09/2015
Digging	502040	8065980	22/09/2015
Digging	502041	8065979	22/09/2015
Digging	502045	8065973	22/09/2015
Digging	502047	8065976	22/09/2015
Digging	502040	8065976	22/09/2015
Digging	502049	8065979	22/09/2015
Digging	502055	8065984	22/09/2015
Digging	502056	8065978	22/09/2015
Digging	502057	8066012	22/09/2015
Digging	502052	8066010	22/09/2015
Digging	502048	8066011	22/09/2015
Digging	502053	8066015	22/09/2015
Digging	501670	8068002	23/09/2015
Digging	501671	8068003	23/09/2015
Digging	501676	8067980	23/09/2015
Digging	501681	8067968	23/09/2015
Digging	501672	8067957	23/09/2015
Digging	501655	8067940	23/09/2015
Digging	501657	8067950	23/09/2015
Digging	501656	8067953	23/09/2015
Digging	501645	8067923	23/09/2015
Digging	501596	8067879	23/09/2015
Digging	501596	8067876	23/09/2015
Digging	501639	8067883	23/09/2015
Digging	501604	8067918	23/09/2015
Digging	501604	8067928	23/09/2015
Digging	501596	8067933	23/09/2015
Digging	501594	8067936	23/09/2015
Digging	501562	8067939	23/09/2015
Digging	501561	8067932	23/09/2015
Digging	501558	8067928	23/09/2015
Digging	501548	8067961	23/09/2015
Digging	501566	8067953	23/09/2015
Digging	501591	8067936	23/09/2015
Digging	501632	8067940	23/09/2015
Digging	501663	8067969	23/09/2015
Digging	501682	8067952	23/09/2015
Digging	501670	8067885	23/09/2015
Digging	501676	8067891	23/09/2015
Digging	501680	8067889	23/09/2015
Digging	501685	8067883	23/09/2015
Digging	501688	8067880	23/09/2015
Digging	501706	8067821	23/09/2015
Digging	501707	8068041	23/09/2015
Digging	501689	8068074	23/09/2015
Digging	501676	8068078	23/09/2015
Digging	501674	8068092	23/09/2015
Digging	501701	8068114	23/09/2015
Digging	501700	8068118	23/09/2015
Digging	501687	8068129	23/09/2015
Digging	501661	8068115	23/09/2015
Digging	501660	8068110	23/09/2015
Digging	501657	8068112	23/09/2015

Digging	501654	8068087	23/09/2015
Digging	501666	8068071	23/09/2015
Digging	501669	8068036	23/09/2015
Digging	501667	8068030	23/09/2015
Digging	498720	8067693	23/09/2015
Digging	498726	8067696	23/09/2015
Digging	498743	8067703	23/09/2015
Digging	498749	8067698	23/09/2015
Digging	498782	8067688	23/09/2015
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Digging	498702	8072189	24/09/2015
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Digging	498712	8072203	24/09/2015
Digging	498720	8072226	24/09/2015
Digging	498703	8072242	24/09/2015
Digging	503653	8065411	22/09/2015

Digging	498686	8072240	24/09/2015
Digging	498676	8072244	24/09/2015
Digging	498668	8072203	24/09/2015
Digging	498676	8072193	24/09/2015
Digging	497909	8072093	24/09/2015
Digging	494848	8072878	25/09/2015
Digging	494851	8072880	25/09/2015
Digging	503018	8071193	23/09/2015
Digging	494870	8072884	25/09/2015
Digging	494874	8072882	25/09/2015
Digging	494961	8072950	25/09/2015
Digging	494972	8072962	25/09/2015
Digging	494979	8072973	25/09/2015
Digging	494993	8073010	25/09/2015
Digging	495008	8073015	25/09/2015
Digging	495016	8073039	25/09/2015
Digging	494932	8073116	25/09/2015
Digging	494917	8073141	25/09/2015
Digging	499439	8069038	23/09/2015
Digging	494896	8072969	25/09/2015
Digging	494823	8072912	25/09/2015
Digging	494934	8072851	25/09/2015
Digging	494942	8072974	25/09/2015
Digging	494944	8072973	25/09/2015
Digging	494951	8072978	25/09/2015
Digging	494972	8073012	25/09/2015
Digging	494965	8073014	25/09/2015
Digging	494998	8073041	25/09/2015
Digging	494932	8073027	25/09/2015
Recently active burrow	506993	8066047	22/09/2015
Recently active burrow	506978	8066018	22/09/2015
Recently active burrow	506975	8065973	22/09/2015
Recently active burrow	507000	8065704	22/09/2015
Recently active burrow	507009	8065672	22/09/2015
Recently active burrow	501418	8066007	22/09/2015
Recently active burrow	501588	8066013	22/09/2015
Recently active burrow	501819	8065968	22/09/2015
Recently active burrow	502040	8065984	22/09/2015
Recently active burrow	495010	8073509	24/09/2015
Recently active burrow	501716	8068019	23/09/2015
Recently active burrow	501593	8067872	23/09/2015
Recently active burrow	502138	8066090	23/09/2015
Recently active burrow	497420	8071371	24/09/2015
Recently active burrow	495420	8071323	25/09/2015
Recently active burrow	495372	8071351	25/09/2015
Recently active burrow	495298	8071369	25/09/2015
Recently active burrow	496663	8070648	25/09/2015
Recently active burrow	496701	8070664	25/09/2015
Recently active burrow	494960	8072987	26/09/2015
Recently active burrow	495114	8073082	26/09/2015
Recently active burrow	501788	8066045	27/09/2015
Recently active burrow	501999	8066145	27/09/2015
Recently active burrow	501995	8066155	27/09/2015
Recently active burrow	500970	8069964	25/09/2015
Recently active burrow	494961	8072990	25/09/2015
Recently active burrow	502728	8066833	23/09/2015
Recently active burrow	494976	8073107	25/09/2015
Recently active burrow	499455	8069061	23/09/2015
Recently active burrow	499898	8069152	23/09/2015
Recently active burrow	494968	8073609	24/09/2015

Recently active burrow	501368	8066727	23/09/2015
Recently active burrow	503007	8071336	23/09/2015
Recently active burrow	503016	8071190	23/09/2015
Recently active burrow	501233	8069124	23/09/2015
Recently active burrow	499918	8069152	23/09/2015
Recently active burrow	499907	8069205	23/09/2015
Recently active burrow	499884	8069146	23/09/2015
Recently active burrow	499468	8069060	23/09/2015
Recently active burrow	500046	8068540	23/09/2015
Recently active burrow	499471	8069057	23/09/2015
Recently active burrow	501661	8067941	23/09/2015
Scat BGS2 Bilby ID – Non DNA yielding	501446	8065999	27/09/2015
Scat BGS3 Bilby ID#1	501548	8066014	22/09/2015
Scat BGS4 Bilby ID – Non DNA yielding	501573	8066002	22/09/2015
Scat BGS5 Bilby ID#3	501572	8066001	22/09/2015
Scat BGS6 Bilby ID#1	501775	8065945	22/09/2015
Scat BGS7 Bilby ID#1	501959	8065934	22/09/2015
Scat BGS8 Bilby ID – Non DNA yielding	502049	8066012	22/09/2015
Scat BGS9 Bilby ID#8	501656	8068113	23/09/2015
Scat BGS10 Bilby ID#2	501136	8067133	23/09/2015
Scat BGS11 Bilby ID#3	501271	8066734	23/09/2015
Scat BGS12 Bilby ID#2	500991	8066798	23/09/2015
Scat BGS13 – Non DNA yielding	501014	8066778	23/09/2015
Scat BGS14 – Non DNA yielding	501015	8066777	23/09/2015
Scat BGS15 – Non DNA yielding	494953	8073657	24/09/2015
Scat BGS16 – Non DNA yielding	501426	8070457	25/09/2015
Scat BGS17 – Non DNA yielding	501784	8065961	27/09/2015
Scat BGS18 Bilby ID#9	501982	8066117	27/09/2015
Scat BGS19 – Non DNA yielding	501993	8066164	27/09/2015
Scat BGS20 – Non DNA yielding	501995	8066181	27/09/2015
Scat Sws1 – Non DNA yielding	502724	8066845	23/09/2015
Scat Sws2 Bilby ID#4	502759	8066841	23/09/2015
Scat Sws3 – Non DNA yielding	499192	8072315	24/09/2015
Scat Sws4 Bilby ID#5	498667	8072199	24/09/2015
Scat Sws5 Bilby ID#6	491331	8066102	27/09/2015
Scat Sws6 Bilby ID#7	491335	8066096	27/09/2015
Haul Road and Accommodation camp Level 1 survey (*ecologia* 2015)			
Scat	501573	8070421	13/05/2015
Scat	501449	8070406	13/05/2015
Active burrow	501452	8070397	13/05/2015
Active burrow	501769	8069648	14/05/2015
Active burrow	501734	8069517	14/05/2015
Active burrow	501060	8069737	14/05/2015
Active burrow	501051	8069815	14/05/2015
Active burrow	501011	8069889	14/05/2015
Active burrow	501222	8069733	15/05/2015
Active burrow	500978	8069759	14/05/2015
Active burrow	500606	8069630	15/05/2015
Digging	501261	8069764	14/05/2015
Digging	501261	8069767	14/05/2015
Digging	501259	8069761	14/05/2015
Digging	501258	8069748	14/05/2015
Digging	501227	8069724	14/05/2015
Digging	501219	8069740	14/05/2015
Digging	501216	8069742	14/05/2015
Digging	501203	8069755	14/05/2015
Digging	501128	8069761	14/05/2015
Digging	501129	8069756	14/05/2015
Digging	501114	8069750	14/05/2015

Digging	500956	8069749	14/05/2015
Digging	500934	8069766	14/05/2015
Digging	500926	8069776	14/05/2015
Digging	500933	8069786	14/05/2015
Digging	500934	8069790	14/05/2015
Digging	500621	8069649	14/05/2015
Digging	500649	8069649	14/05/2015
Digging	500647	8069651	14/05/2015
Digging	500642	8069641	14/05/2015
Digging	500638	8069647	14/05/2015
Digging	500620	8069648	14/05/2015
Digging	500629	8069630	14/05/2015
Digging	500624	8069628	14/05/2015
Digging	500617	8069627	14/05/2015
Digging	500594	8069611	14/05/2015
Digging	500592	8069613	14/05/2015
Digging	500581	8069620	14/05/2015
Digging	500568	8069633	14/05/2015
Digging	500584	8069642	14/05/2015
Digging	500584	8069638	14/05/2015
Digging	500594	8069634	14/05/2015
Digging	500594	8069636	14/05/2015
Digging	500600	8069636	14/05/2015
Digging	500468	8069541	14/05/2015
Digging	500536	8069590	14/05/2015
Digging	500540	8069599	14/05/2015
Digging	501499	8070386	14/05/2015
Digging	501496	8070400	14/05/2015
Digging	501502	8070417	14/05/2015
Digging	501497	8070418	14/05/2015
Digging	501511	8070434	14/05/2015
Digging	501529	8070422	14/05/2015
Digging	501544	8070419	14/05/2015
Digging	501552	8070430	14/05/2015
Digging	501565	8070424	14/05/2015
Digging	501575	8070418	14/05/2015
Digging	501577	8070411	14/05/2015
Digging	501488	8070363	14/05/2015
Digging	501478	8070364	14/05/2015
Digging	501471	8070370	14/05/2015
Digging	501474	8070377	14/05/2015
Digging	501452	8070386	14/05/2015
Digging	501460	8070390	14/05/2015
Digging	501452	8070402	14/05/2015
Digging	501444	8070408	14/05/2015
Digging	501440	8070400	14/05/2015
Digging	501428	8070412	14/05/2015
Digging	501426	8070409	14/05/2015
Digging	501406	8070403	14/05/2015
Digging	501389	8070395	14/05/2015
Digging	501374	8070395	14/05/2015
Digging	501406	8070446	14/05/2015
Digging	501415	8070448	14/05/2015
Digging	501783	8069629	14/05/2015
Digging	501781	8069632	14/05/2015
Digging	501733	8069530	14/05/2015
Digging	501740	8069517	14/05/2015
Digging	501758	8069498	14/05/2015
Digging	501777	8069510	14/05/2015
Digging	501213	8069580	14/05/2015

Digging	501097	8069683	14/05/2015
Digging	501087	8069688	14/05/2015
Digging	501096	8069697	14/05/2015
Digging	501099	8069701	14/05/2015
Digging	501096	8069712	14/05/2015
Digging	501049	8069748	14/05/2015
Digging	501037	8069780	14/05/2015
Digging	501044	8069795	14/05/2015
Digging	501048	8069798	14/05/2015
Digging	501048	8069830	14/05/2015
Digging	501024	8069893	14/05/2015
Digging	501006	8069888	14/05/2015
Digging	500980	8069821	14/05/2015
Digging	501006	8069811	14/05/2015
Digging	501013	8069801	14/05/2015
Digging	501000	8069771	14/05/2015
Digging	500960	8069749	14/05/2015
Digging	501369	8070264	14/05/2015
Digging	501350	8070271	14/05/2015
Digging	501347	8070279	14/05/2015
Digging	501334	8070295	14/05/2015
Digging	501330	8070296	14/05/2015
Digging	501327	8070303	14/05/2015
Digging	501323	8070308	14/05/2015
Digging	501290	8070326	14/05/2015
Digging	501263	8070350	14/05/2015
Digging	501321	8070418	14/05/2015
Digging	501372	8070394	14/05/2015
Digging	501396	8070387	14/05/2015
Digging	501416	8070384	14/05/2015
Digging	501424	8070373	14/05/2015
Digging	501438	8070372	14/05/2015
Digging	501438	8070381	14/05/2015
Digging	501446	8070388	14/05/2015
Digging	501445	8070392	14/05/2015
Digging	501508	8070488	14/05/2015
Digging	501462	8070400	13/05/2015
Digging	500977	8069946	13/05/2015
Scat	503748	8066030	14/05/2015
Active burrow	503721	8066163	14/05/2015
Active burrow	503450	8066252	14/05/2015
Active burrow	503322	8066391	14/05/2015
Active burrow	503257	8066429	14/05/2015
Active burrow	503807	8066263	14/05/2015
Active burrow	503872	8066222	14/05/2015
Active burrow	503775	8066033	14/05/2015
Digging	503165	8066826	14/05/2015
Digging	503071	8066928	14/05/2015
Active burrow	502969	8067046	14/05/2015
Active burrow	502980	8067161	14/05/2015
Inactive burrow	499512	8069908	15/05/2015
Level 2 Thunderbird Project Assessment (*ecologia* 2014)			
Digging	495011	8073550	22/10/2013
Digging	495005	8073572	22/10/2013
Digging	494999	8073578	22/10/2013
Digging	494994	8073571	22/10/2013
Digging	494978	8073558	22/10/2013
Digging	494918	8073595	22/10/2013
Digging	494891	8073627	22/10/2013

Digging	494889	8073642	22/10/2013
Digging	494885	8073708	22/10/2013
Digging	495002	8073513	22/10/2013
Digging	494992	8073488	22/10/2013
Digging	494985	8073445	22/10/2013
Digging	496862	8071229	22/10/2013
Digging	496862	8071232	22/10/2013
Digging	494999	8073486	22/10/2013
Digging	496881	8071087	22/10/2013
Digging	494116	8073268	22/10/2013
Digging	494166	8073394	22/10/2013
Digging	494085	8073523	22/10/2013
Digging	495000	8073487	22/10/2013
Digging	494169	8073407	22/10/2013
Digging	494180	8073485	22/10/2013
Digging	494230	8073512	22/10/2013
Digging	494086	8073400	22/10/2013
Digging	496756	8070856	22/10/2013
Digging	496804	8071125	22/10/2013
Digging	496807	8071018	22/10/2013
Scat	495015	8073510	19/10/2013
Scat	494911	8073733	19/10/2013
Scat	494996	8073723	20/10/2013
Digging	496928	8071212	22/10/2013
Digging	495019	8073532	22/10/2013
Active burrow. Camera rap record.	495001	8073488	22/10/2013
Inactive burrow	496881	8071087	19/10/2013
Inactive burrow	494116	8073268	10/04/2013
Inactive burrow	494166	8073394	10/04/2013
Inactive burrow	496807	8071018	20/10/2013
Inactive burrow	494085	8073523	20/10/2013
Inactive burrow	495000	8073488	20/10/2013
Inactive burrow	494116	8073268	20/10/2013
Inactive burrow	494166	8073394	20/10/2013
Inactive burrow	493555	8074935	11/04/2013