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FORTESCUE METALS GROUP
CHRISTMAS CREEK WATER MANAGEMENT SCHEME
CONSERVATION SIGNIFICANT FAUNA BASELINE MONITORING

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FORTESCUE METALS GROUP

CHRISTMAS CREEK WATER MANAGEMENT SCHEME

CONSERVATION SIGNIFICANT FAUNA BASELINE MONITORING

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ACRONYMS

DEC	Department of Environment and Conservation
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FMG	Fortescue Metals Group
FMP	Fauna Management Plan
IBRA	Interim Biogeographic Regionalisation for Australia
MNES	Matters of National Environmental Significance
WC Act	*Wildlife Conservation Act 1950*

EXECUTIVE SUMMARY

Annual monitoring for the Night Parrot, Northern Quoll, Greater Bilby, Pilbara Leaf-nosed Bat, Mulgara and Pilbara Olive Python are required to be undertaken in accordance with the Christmas Creek Water Management Scheme Fauna Management Plan within the Christmas Creek Mine site to assist in identifying potential direct and indirect impacts on significant fauna within the project area. A baseline monitoring program was undertaken in accordance with the objectives and methodology outlined in the fauna monitoring guidelines described in the Fauna Management Plan, to assess the presence/absence of the targeted species, and determine the likelihood of occurrence of these species in the study area.

Monitoring was conducted between 27 November 2012 and 12 June 2013, over the hot and wet summer season which increased the likelihood of recording the target species as this is when they are most active. Forty Motion cameras and eight acoustic/ultrasonic SM2Bat recorders were utilised to conduct non-invasive surveys, to assess the presence/absence of the target species within the study area. By utilising methods that avoid trapping ethical constraints, that restrict survey timing during the hotter summer periods, were avoided allowing a single survey targeting all species to be conducted.

During this baseline monitoring survey, the broad scale fauna habitat types were reassessed for suitability and condition, and based on these as well as the results from the monitoring survey, the presence/ absence and a reassessment of the likelihood of occurrence of each of the targeted EPBC listed species was conducted.

Ten motion cameras assigned to target each species, and placed in the most suitable habitat within the study area. Four SM2Bat recorders with ultrasonic microphones were used to assess the occurrence of Pilbara Leaf-nosed Bat within the study area. Four SM2Bat recorders with standard acoustic microphones were used to record nocturnal bird species, in an attempt to detect Night Parrot. The ten Night Parrot motion cameras were installed with drift fences and feeding stations to increase the potential of detecting Night Parrot. Targeted walking transects and nocturnal driving transects were also completed to attempt to detect target species

Motion Cameras targeting Northern Quoll and Pilbara Olive Python were installed for two months, totalling 12,120 hrs. Motion Cameras targeting Night Parrot and Greater Bilby/Mulgara were installed for six months totalling 47,280 hours and 92,880 hours respectively. SM2Bat recorders were established at twenty two sites and 1,260 hours of recordings analysed.

The baseline monitoring survey for Night Parrot, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Greater Bilby and Mulgara has provided a significant increase to the survey effort currently conducted within the study area, and an additional assessment of the occurrence of each species within and around the study area. The habitats located within the study area are highly degraded and appear to support no detectable populations of the targeted species.

There is no evidence of the Pilbara Leaf-nosed Bat occurring within either the study area or the surrounding region.

No current evidence exists to suggest the Northern Quoll occurs within the study area, and there is also a low likelihood that Northern Quoll occurs in the surrounding region. Any populations within the surrounding region are most likely to be at such low densities that detailed ongoing monitoring is unlikely to confirm presence of the species in the study area.

Previous secondary evidence of Greater Bilby occurrence within the study area has been discredited during recent surveys by Bilby expert Dr Richard Southgate (ENV 2012a). Records from the surrounding region are very uncommon and widely distributed (DEC 2013). Any populations within

the surrounding region are expected to be at such low densities that detailed monitoring is unlikely to be possible.

Previous secondary evidence of Mulgara has not been detected from within the study area. Records from the surrounding region are uncommon and restricted to small pockets of suitable dense spinifex hummock grassland on sandy loam soils. Any populations within the surrounding region are at such low densities that detailed monitoring in the study area is unlikely to confirm presence of the species

Pilbara Olive Python has only been recorded once within the study area and the individual recorded is expected to represent a dispersing individual from the rocky habitats to the north of the study area. Any populations within the surrounding region are at such low densities that detailed monitoring is unlikely to confirm presence of the species in the study area.

The Night Parrot has not been recorded within the study area and the only relatively recent record is from the Cloudbreak area in 2005. Subsequent intensive monitoring for the Night Parrot across Cloudbreak operations since 2005 has failed to find any evidence of the species. Due to the lack of knowledge in the general ecology of this species, survey techniques are limited and their effectiveness unknown. Any populations within the surrounding region are at such low densities that detailed monitoring is unlikely to confirm presence of the species in the study area.

Based on the the findings of this baseline monitoring program, as well as previous information from previous surveys conducted in the study area which were completed since the water management scheme was assessed (Level 2 fauna survey and targeted conservation significant fauna survey (ENV 2012b)), it is unlikely that any of these species inhabit the study area, or that any significant populations exist within the study area, and *ecologia* feels that no additional annual monitoring will be required for Mulgara, Northern Quoll, Greater Bilby, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Night Parrot.

1 INTRODUCTION

Fortescue Metals Group (Fortescue) is developing the Pilbara Iron Ore and Infrastructure Project, which involves a series of iron ore mines (Cloudbreak, Christmas Creek and Solomon) in the Pilbara region of Western Australia and rail and port infrastructure required to export iron ore through Port Hedland to market in Asia.

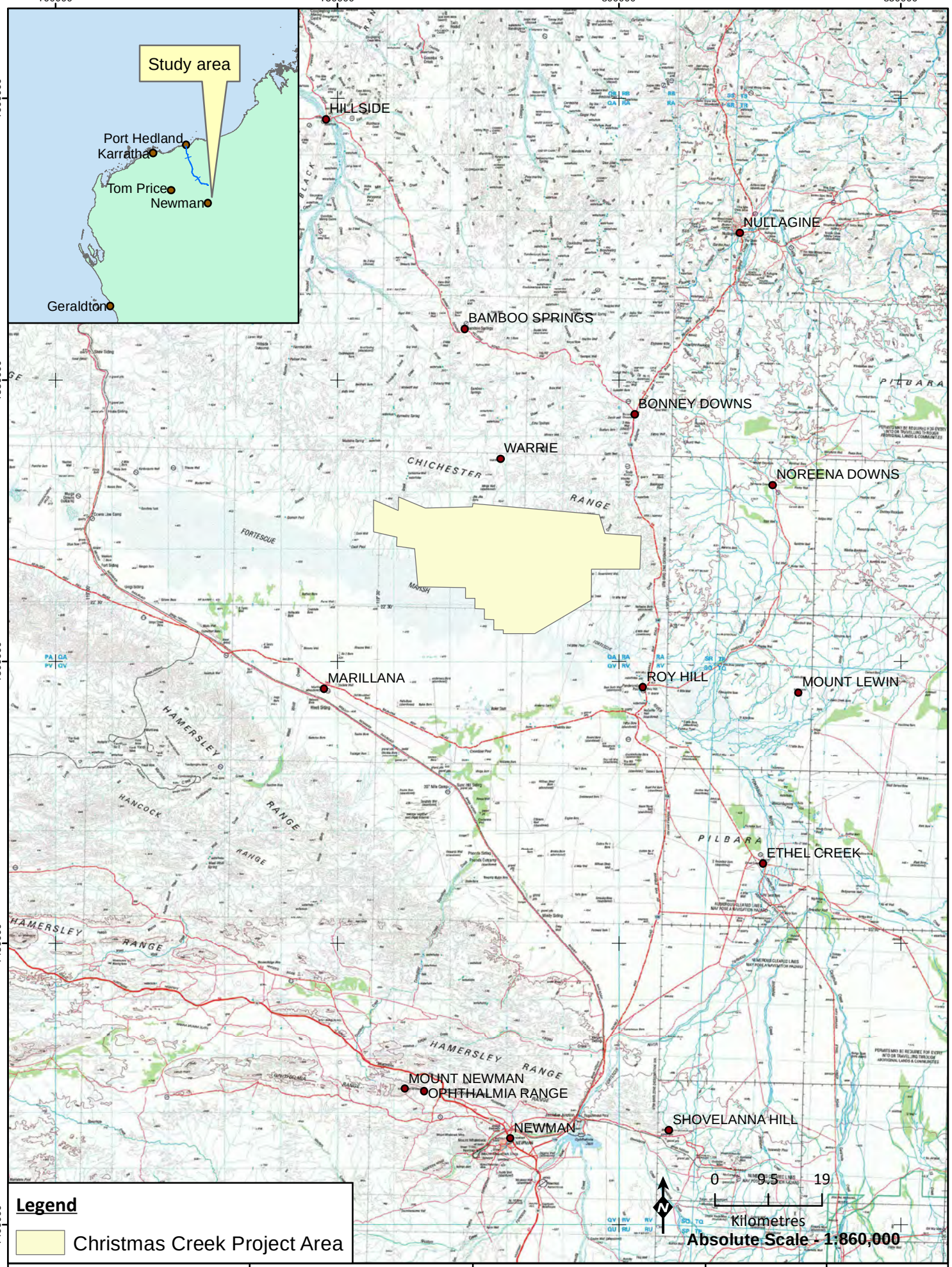
Located in the east of the Pilbara region of Western Australia, approximately 110 km north of Newman (Figure 1.1).. The Christmas Creek mine site was approved on 16 December 2005 as part of the Stage B Project: An east-west railway line and Christmas Creek and Mindy Mindy mines (Ministerial Statement 707, EPBC ref 2004/1562). Mining commenced in 2008, and has since been predominantly above the water table. To access further ore deposits (located below the water table) approval for increased dewatering was required.

The increased dewatering requirements were met through the development of the Christmas Creek Water Management Scheme (the project) which identifies three areas that are expected to experience changes in groundwater depths, either dry climate mounding or wet climate drawdown. The three areas constitute the Christmas Creek Water Management Scheme area (study area). The project was referred to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) who considered the project a "Controlled Action" and requested further information on the following Matters of National Environmental Significance (MNES):

- Night Parrot (*Pezoporus occidentalis*)
- Northern Quoll (*Dasyurus hallucatus*)
- Greater Bilby (*Macrotis lagotis*)
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) (Pilbara form)
- Mulgara (*Dasycercus cristicauda*/*Dasycercus blythi*)
- Pilbara Olive Python (*Liasis olivaceus barroni*) (Pilbara subspecies).

Additional information was provided in the document, Christmas Creek Water Management Scheme: EPBC Fauna Impact Assessment, CC-RP-EN-0013 (Fortescue 2011) and the Christmas Creek Water Management Scheme Fauna Management Plan (FMP) (CC-PL-EN-0003_Rev1)which was approved by DSEWPaC on 12 January 2012.

The FMP required annual monitoring for the Night Parrot, Northern Quoll, Greater Bilby, Pilbara Leaf-nosed Bat, Mulgara and Pilbara Olive Python to be undertaken within the study area. This will assist in identifying potential direct and indirect impacts on significant fauna within the project area, and the development of management measures that maximise the ongoing protection and long-term conservation of these species, at and adjacent to the Christmas Creek project area. This report details the results and conclusions from the baseline monitoring of the study area, undertaken by *ecologia* Environment (*ecologia*).



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FMG Fortescue The New Force In Iron Ore

Location of Christmas Creek Study Area

Figure: 1.1	**Drawn: Md'A**
Project ID: 1494	**Date: 30/01/2013**

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: BG245

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1.1 SCOPE OF WORK

The scope of work was to design and conduct annual monitoring programs for EPBC Act listed threatened species in accordance with the FMP. This report relates to the first year of the annual monitoring in the form of a baseline monitoring program for Northern Quoll, Mulgara, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Night Parrot. The baseline monitoring program was undertaken in accordance with the objectives and methodology outlined in the fauna monitoring guidelines described in the FMP.

The overarching aim of the FMP and this survey is to provide Fortescue with accurate data that will allow an assessment of the achievement of the following objectives, as a requirement of compliance:

- There will be no statistically significant reductions in the spatial distribution of EBPC Act listed species across impact sites compared to control sites.
- EPBC Act listed fauna species recorded within the area of impact for the project will continue to have an ongoing presence.

The results of this initial baseline survey will contribute to a review of the approach of the monitoring program and its continued development. In particular, this survey aims to make an accurate determination of the likelihood that each listed species occurs within the project area. Analysis of past fauna survey results will be included in this assessment.

1.2 LITERATURE REVIEW AND SUMMARY OF PREVIOUS WORK

Since the development of the Cloudbreak mine and the subsequent development and expansion of the neighbouring Christmas Creek Project, 60 km to the east of Cloudbreak, ten major fauna assessments have been conducted across both areas. Data from these reports was analysed and a brief summary of information specific to each of the conservation significant fauna species is provided below.

Greater Bilby (*Macrotis lagotis*)

Twenty six potential Greater Bilby diggings were previously identified within the study area (ATA 2006a; Ecoscape 2009). However, a subsequent survey specifically assessing the identified potential diggings, and conducted by Richard Southgate (a Bilby specialist), concluded that these were most likely created by goannas, and that although 23 locations were considered to provide potentially suitable habitat, no evidence of Greater Bilby was recorded (ENV 2012a). A Level 2 fauna assessment, including a targeted trapping survey conducted in autumn 2011 also failed to find any evidence of Greater Bilby (ENV 2012b).

The nearest regional potential record is from Cockeye Bore (Bamford 2005a), located on the western edge of the study area within the adjacent Cloudbreak tenement, where seven burrows were recorded that were assessed as being recently used (within the last 10 days), although these were not confirmed as definite Bilby burrows. The only other regional records include a record from Kardarderrie Well, 50 km west of the study area and a record further west on Mulga Downs Station in 1997 (DEC 2013). Some confusion surrounds the record from Kardarderrie Well as it has been attributed to both Dr Peter Kendrick, CALM Karratha, pers. comm (Biota 2004b) and “a specimen was seen on Mulga Downs station near Kardarderrie Well by FMG personnel, probably in 2004” (Bamford 2005a).

Overall, the lack of confirmed records from this region indicates that if present, Greater Bilby are likely to occur in extremely low densities. The recent survey conducted by ENV (2012) and Richard Southgate also casts doubt on the validity of records that only consist of diggings and/or burrows. No photographic evidence is available in the literature to allow confirmation of secondary evidence by relevant experts.

Pilbara Olive Python (*Liasis olivaceus barroni*)

A single Pilbara Olive Python individual has been recorded within the study area, on a haul road adjacent to drainage line habitat which was considered atypical habitat and is considered to have been a dispersing individual (ENV 2012b). There are no other records of this species nearby from any other intensive surveys (ATA 2006a, b; Bamford 2005a; Biota 2004a, b; *ecologia* 2009a, b, 2011a; ENV 2011, 2012a, b), and the lack of suitable habitat within the study area suggests that this species is unlikely to inhabit the study area and that there are unlikely to be any resident significant populations, and although isolated individuals may occasionally traverse the study area for foraging and dispersal, they are unlikely to occur frequently, if at all.

Northern Quoll (*Dasyurus hallucatus*)

There are no previous records of Northern Quoll within the study area. ENV (2012) conducted a Level 2 vertebrate fauna and a targeted NQ survey in July/August 2011 and although a very small area (74 ha) of suitable habitat was identified to the north of the study area, no evidence was recorded. There is a single confirmed record from a specimen collected in 1980 near a large creekline, 12 km west of the study area (DEC 2013), whilst two scats were also recorded approximately 10 km west (ATA 2006a) of the study area. A single scat was also recorded 55km east of the study area (Biota 2005).

Approximately 74 ha of potential suitable denning habitat, which includes rocky gorges and breakaways, was identified just outside of the study area to the north (ENV 2012b). Northern Quoll may also use the few large creeklines which run through the study area for dispersal or foraging. The distinct lack of reliable records from within the study area and in the surrounding region despite a significant amount of intensive targeted surveying, combined with the fact that the study area occurs on the south eastern edge of their distribution, indicates that if present Northern Quoll are likely to be in extremely low densities.

Mulgara (*Dasycercus blythi/D. cristicauda*)

Seven potential Mulgara (or small mammal) burrows were recorded approximately 12 km west of the study area (ATA 2006b). The nearest NatureMap record is located approximately 25 km south of the study area (recorded in 2009) on the opposite edge of the Fortescue Marsh, and secondary evidence was recorded during the Stage B rail corridor survey near Mt. Nicholas (Biota 2005), 70 km east of the study area.

All records appear to occur in areas of sandy loam soils with moderately dense spinifex hummock grassland, however the lack of direct evidence of Mulgara, as well as the lack of suitable habitat identified from within the study area indicates that they are likely to be absent.

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

The nearest Pilbara leaf-nosed Bat record was from approximately 38 km west of the study area at Thieves Well (*ecologia* 2010a). The only other confirmed records of this species occurs 80 km west of the study area in the Hamersley Range and approximately 70 km north of the study area in rocky ranges north of the Chichester Range (DEC 2013).

Despite the intensity of surveys within the study area and surrounding region, no records have been identified of this species at this stage. Based on NatureMap records the study area appears to occur outside of this species distribution with all records occurring in what is currently thought to be two distinct populations (Bob Bullen pers. comm) to the north and west of the study area. All of the above data indicates that this species is absent from the study area.

Night Parrot (*Pezoporus occidentalis*)

Although the Night Parrot is a notoriously cryptic and poorly known species, Bamford (2005a) reported a sighting of three individuals at Minga Well which is located approximately 27 km west of the study area. A further eight surveys targeting the species have been completed annually since this record, however no further evidence of the species has been reported (Bamford 2012). Potential habitat for this species includes dense spinifex hummock grassland and low samphire/chenopod shrubland and ecotone habitat (where these two communities meet), both of which have been recorded surrounding the Fortescue Marsh.

The paucity of available biological and ecological information for this species makes quantifying the effectiveness of any survey technique problematic.

1.3 FAUNA HABITATS

Mapping of fauna habitat types within the study area was previously undertaken by *ecologia* (2010b) and ENV (2011), and, along with their associated vegetation units, the habitat mapping was used during this survey to determine habitat suitability for Northern Quoll, Pilbara Olive Python, Greater Bilby, Mulgara, Pilbara Leaf-nosed Bat and Night Parrot.

Four broad habitat types and their associated vegetation have been identified from the study area (Figure 1.2, Table 1.1). The four broad habitat types comprise the following:

Drainage Line and Alluvial Plain

Drainage lines and alluvial plains have been combined as they are closely associated and provide similar fauna habitat. Drainage lines and alluvial plains intersect the study area in a north to south direction due to water flowing off the hills to the north of the study area towards the marsh in the south. The vegetation association of this habitat type comprises woodlands of fringing *Eucalyptus victrix*, *Eucalyptus camaldulensis* and *Acacia aneura* over *Acacia pruinocarpa* and *Acacia tetragonophylla* over *Triodia* and *Themeda* species.

Marsh

This habitat type occurs across the southern expanse of the study area and is characterised by low shrublands of chenopod/samphire, including *Tecticornia species* and *Muellerolimon* shrubs. Some areas of the marsh comprised isolated areas of Mulga woodland, generally on isolated calcrete knolls occurring on the edge of the marsh. During periods of high rainfall, large areas of the marsh frequently become inundated.

Low Hill

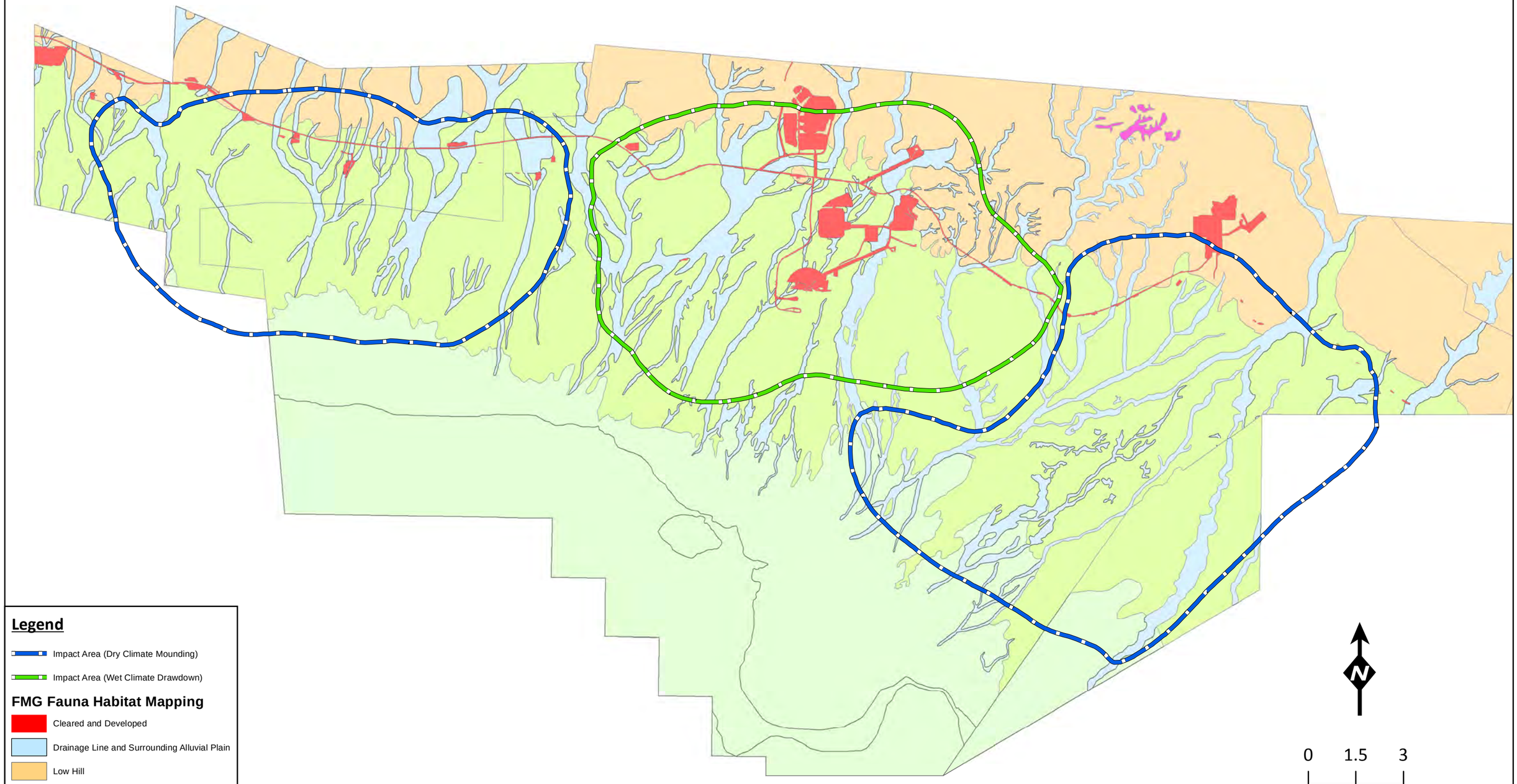
Occurring solely to the north of the study area, this habitat type is characterised by low scree slopes with some areas, particularly in the north-east, containing some small areas of rocky breakaways and rocky outcrops. The vegetation of this habitat type is characterised as hummock grassland of *Triodia basedowii* with patches of *Eucalyptus leucophloia, Corymbia deserticola, Acacia* and *Hakea* species.

Stony Plain

The Stony Plain habitat type comprises the large area of habitat dividing the Low Hills to the north from the Marsh to the south and is intersected throughout by the Drainage Line and Alluvial Plain habitat type. The Stony Plain habitat type is characterised by low woodlands consisting of *Acacia aneura*, *Acacia pruinocarpa*, *Acacia tetragonophylla* and *Acacia xiphophylla* over a mixture of *Triodia* and *Aristida* species. Soil types vary throughout this habitat type and include stony gibber, soft sandy loams and soft to hard clays.

Table 1.1 – Fauna habitats recorded from the study area

Habitat Type	% of study area	Area in study area (ha)
Drainage Line and Alluvial Plain	12.76	8,647.8
Marsh	27.17	18,409.8
Low Hill	20.29	13,748.8
Stony Plain	38.26	25,919.4
Cleared/degraded areas	1.5	1,011.9
		Total: 67,737.59



Legend

- Impact Area (Dry Climate Mounding)
- Impact Area (Wet Climate Drawdown)

FMG Fauna Habitat Mapping

- Cleared and Developed
- Drainage Line and Surrounding Alluvial Plain
- Low Hill
- Marsh
- Northern Quoll - Potential shelter/den habitat
- Stoney Plain

N

0 1.5 3

Kilometres

Absolute Scale - 1:120,000

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Previous Habitat Mapping of the Christmas Creek study area

Figure: 1.2
Project ID: 1494

Drawn: Md'A
Date: 16/06/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: DCdraft

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2 METHODOLOGY

The methodology for monitoring the targeted species was designed based on factors such as:

- the results of the baseline survey investigations and previous records;
- available habitat types;
- access and heritage (ethnographic and archaeological) constraints;
- avoidance of future infrastructure development areas;
- Fortescue environment personnel advice; and
- adherence to statistical design.

2.1 BASELINE MONITORING METHODOLOGY

General baseline monitoring methods adopted by *ecologia* are aligned with survey methodology as described in the EPA's Guidance Statement No. 56 (EPA 2004), Position Statement No. 3 (EPA 2002) and *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental impact Assessment* (EPA and DEC 2010).

Species-specific monitoring methodology for the Northern Quoll, Bilby and Mulgara were aligned with survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011c), Fortescues Christmas Creek - Water Management Scheme FMP (CC-PL-EN-0003_Rev1), as well as the following species specific guidelines and existing FMPs for each of the targeted species:

- Northern Quoll - EPBC Act Referral Guidelines for the Endangered Northern Quoll (*Dasyurus hallucatus*) (DSEWPaC 2011a);
- Greater Bilby - Fortescue's Bilby (*Macrotis lagotis*) Management Plan (45-PL-EN-0008: Attachment 7);
- Pilbara Leaf-nosed Bat - Guidelines for Australia's Threatened Bats (DSEWPaC 2011b);
- Pilbara Olive Python - Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011d);
- Night Parrot - Guidelines for Australia's Threatened Birds (DSEWPaC 2010), Night Parrot (*Pezoporus occidentalis*) Management Plan, October 2005 (CB-PL-EN-0005), Night Parrot Survey Plan, October 2006 (CB-PL-EN-0004), and also incorporating methodology from the ongoing Night Parrot monitoring at Cloudbreak (Bamford 2012), as well as through consultation with the DEC.

The baseline monitoring program was designed to meet the requirements of the Christmas Creek - Water Management Scheme FMP and to assist in making an accurate determination of the actual likelihood that each targeted EPBC listed species occurs within the study area.

Non-invasive recording techniques were utilised to assess the presence/absence of the target species within the study area. By utilising methods that avoid trapping, ethical constraints that restrict survey timing during the hotter summer period were avoided, allowing a single survey, with some long-term deployment of monitoring devices, targeting all species to be conducted.

The primary method used to determine the presence/absence of Northern Quoll, Bilby, Mulgara, Pilbara Olive Python and Night Parrot involved the use of motion cameras. Motion cameras can be used to record several species concurrently, when placed in habitat suitable to a number species. To target each species, ten motion cameras were installed in a manner specific to that species and in a similar manner to previous surveys conducted at Cloudbreak. However, all motion cameras deployed in the study area could potentially record all targeted species associated with the study area. A combination of twenty UOVISION UV565 motion cameras, and twenty Reconyx HC550

'hyperfire' motion cameras were used and either mounted to trees, or, in the absence of suitable vegetation, cameras were mounted on star pickets using specifically designed camera mounts. The cameras are triggered by movement by a highly sensitive Passive Infra-Red motion sensor and function both day and night, taking either video footage or photos. All cameras were set to record still imagery due to their deployment in the study area on a long-term basis (from two to six months) and the risk of filling the memory of the 32G SD cards that were used in each camera. Batteries and SD cards were replaced after two months in each of the 30 cameras that remained in the study area for six months.

Monitoring was conducted between 27 November 2012 and 12 June 2013, over the hot and wet summer season which increased the likelihood of recording the targeted EPBC listed species, as defined in the relevant guidelines (DSEWPaC 2010, 2011b, c, d; EPA 2004; EPA and DEC 2010). The non-invasive nature of this baseline monitoring program allows for surveying outside of these timing constraints for all species. This survey falls within recommended survey timing for each species except for Northern Quoll and Mulgara, which are generally avoided during the summer months due to the risk of stress and potentially trap deaths with the hot weather. This risk is mitigated through the use of motion cameras and surveying during this season may actually increase the likelihood of records, due to the higher mobility over the summer season when individuals and young are generally dispersing (DSEWPaC 2011a).

2.2 NIGHT PARROT

A reliable survey method for detecting the presence of Night Parrot has not yet been developed because this species has only been recorded opportunistically in the past, or as dead specimens . The species is cryptic in its behaviour and, historically, has proven difficult to record. Surveys undertaken by Fortescue near Cloudbreak have trialled numerous different methods but have not recorded any evidence of the Night Parrot over many years of monitoring.

Based on historical evidence, in Western Australia the Night Parrot is considered to be potentially associated with spinifex and samphire/chenopod ecotone habitats bordering the edge of the Fortescue Marsh. It is thought that the Night Parrot is most likely to be recorded during the hot, dry summer months when they are thought to potentially visit watering holes and wells in search of water to drink. Within the study area, there is no suitable ecotone habitat bordering the Marsh, due to the absence of spinifex in this location, therefore, survey methodology was focused more on targeting the species within suitable chenopod habitat.

Reconyx Motion cameras were established to attempt to record the Night Parrot in mixed low chenopod and samphire habitat in ten selected sites along the northern fringe of the Fortescue Marsh. Three different methods of monitoring for Night Parrot were employed: a series of drift fence arrangements, permanent feeding stations and acoustic recordings for Night Parrot calls.

Drift Fences

Based on methods developed for monitoring Night Parrot near Cloudbreak (Bamford 2005b, 2006, 2007, 2008, 2010, 2012; Bamford and Burbidge 2007), drift fence sites comprised of three 10 m long flywire mesh fences, secured at each end and in the middle for structural support, by metallic fence droppers. The flywire mesh was buried at the base to form a barrier, with each of the three fences installed in a star-like arrangement, leading to a central point (Figure 2.1). A Reconyx motion camera was then installed approximately 5 m away, facing this central point. The intent of this array was to direct any Night Parrot that might move along the ground between the low lying vegetation, into and along the drift fences towards the central point, onto which the motion camera was focused to record. Motion cameras were set to medium sensitivity in order to record small fast moving species, however reducing the quantity of false-triggers that occur with sensitivity set to high.

Figure 2.1 – Example of Night Parrot Drift Fence setup

Feeding Stations

Feeding stations comprised of a single ground-level seed dispenser, held in place by two fence-droppers and wire, and filled with 40 kg of mixed (50:50) large parrot seed and small parrot seed (Figure 2.2). Due to a risk of potential seed germination, the parrot mix was later replaced (three months after their initial installation) with a substitute crumbed chick starter pellet. This methodology was developed to potentially provide a permanent source of food that would attract Night Parrots in the same way that water sources attract fauna from the surrounding region.

Figure 2.2 – Night Parrot Feeding Station setup

Acoustic Recorders

It is hypothesised that the presence of Night Parrot in the study area may also be confirmed through successfully recording their calls. SM2Bat 384 kHz long-term passive recorders (SM2Bats) were deployed in a relatively clear and elevated area of suitable habitat (to reduce any interference from nearby vegetation) for five nights, with one recorder remaining out for an additional night. The total recording time for Night Parrot calls was 192 hours. SM2Bats are normally used to record the very high frequency echolocation calls produced by bats, however by using normal acoustic microphone designed to record bird calls, acoustic audio recordings can be made. Each SM2Bat was programmed to record from dusk to dawn (12 hours) each night.

All sound recordings were processed using the Song Scope program, which automatically processes each data file and identifies all audible recordings. Each record was then analysed by an experienced ornithologist (Nigel Jackett) to determine if calls were made by a bird species, and the identity of the species. All nocturnal bird species, with the exception of the Night Parrot (no known recording of the call exists) have a recognisable call and any unrecognised call can be detected and analysed by expert ornithologists.

2.3 NORTHERN QUOLL AND PILBARA OLIVE PYTHON

Due to the similarity of their habitat preferences (rocky gullies and major drainage lines), concurrent surveys were undertaken for both Northern Quoll and Pilbara Olive Python. Three different methods of monitoring for Northern Quoll and Pilbara Olive Python were employed: motion cameras, diurnal walking transects in search of secondary evidence and nocturnal spotlight driving.

Motion Cameras

A mixture of UOVISION and Reconyx motion cameras were installed throughout the study area, in a mixture of different habitats that were identified during this survey as being potentially suitable for Northern Quoll and Pilbara Olive Python. This included three motion cameras in the previously identified (ENV 2012) potential shelter/den rocky gorge habitat in the north of the study area, as well as seven motion cameras spread across the most suitable rocky hills, major river systems and minor creeklines that dissect the study area. Cameras were secured either by a single star picket or by cable-tie to a suitably located tree. The area directly in front of the camera was baited using a fish oil-based attractant, so as to ensure the scent would remain in place over a long period of time and continue to attract any nearby Northern Quoll to the camera site.

Diurnal Walking Transects

Diurnal walking transects were also conducted throughout the previously identified potential shelter/den habitat in the northern rock slopes of the study area, enabling any identification of secondary evidence of both species to be recorded, including sloughed skins, scats, tracks, used dens and Northern Quoll latrines.

Nocturnal Driving Transect

Survey guidelines for Pilbara Olive Python indicate that targeted spotlight searches at dawn and dusk, during suitable weather in which they are active, are suitable for detecting this species. To monitor Pilbara Olive Python populations within the study area, nocturnal road-spotting transects along a defined route undertaken. This methodology also has the potential to detect all other target species.

2.4 GREATER BILBY AND MULGARA

Mulgara and Greater Bilby tend to prefer similar habitats (spinifex on sand to sandy-loam), and therefore, concurrent monitoring was undertaken for both species, utilising the same monitoring techniques across mutually preferred habitats. Two methods of monitoring for Greater Bilby and Mulgara in the study area were employed: motion cameras placed across the study area in areas of potentially suitable habitat and diurnal walking transects through potentially suitable habitat and where previous old records were made for Bilby diggings in the area.

Motion Cameras

A mixture of thirty UOVISION and Reconyx motion cameras were installed across the entire study area, targeting potentially suitable habitat types, from creeklines to open spinifex hummock grasslands and gibber open Mulga woodlands, and any other habitat containing soft sandy or sandy-loam substrates. Cameras were secured either by a single star picket or by cable-tie to a suitably located tree (Figure 2.3). A distance of a minimum of 5 m from the target area of the camera was maintained, to ensure an increased focal length and angle of view.

Figure 2.3 – Example of Bilby and Mulgara permanent camera set-up

Diurnal Walking Transects

Diurnal walking transects were also conducted throughout areas of potentially suitable habitat, and in areas where previous potential diggings were recorded. Walking transects allows for opportunistic sightings of secondary evidence of both species to be recorded, including tracks, scats and diggings/burrows and mounds.

2.5 PILBARA LEAF-NOSED BAT

This baseline monitoring program comprised a systematic survey using SM2Bats to determine if the species is present, and, if present, to assist in locating any significant sites such as roost caves proximal to the study area.

The previous use of ANABAT echolocation devices in surveys for this species in the Christmas Creek study area (ENV 2012b), may potentially have failed to detect the species, as recently ANABATs have been demonstrated to fail to record some of the particularly high-pitched call frequencies of the Pilbara Leaf-nosed Bats (*ecologia* 2011b, c). The SM2Bat has a much higher sampling frequency, enabling the full spectrum of the calls to be recorded without being transformed, which allows for greater accuracy and sensitivity. Therefore, this baseline monitoring program employed a system of short and long-term SM2Bat monitoring sites across the study area, which was previously mapped as potential foraging habitat for the Pilbara Leaf-nosed Bat (ENV, 2012), to assist in determining species presence.

Four SM2Bat units were deployed for overnight monitoring during the initial field survey at 19 locations within suitable foraging habitat (rivers and creeklines, over waterbodies, and near lighting towers around operational areas) over a period of seven nights. Each of these units recorded for one night, before being moved to a new location. Each SM2Bat was programmed to record from dusk to dawn (12 hours). At the end of the field survey the four SM2Bat units were established at 'permanent' sites, utilising solar powered battery supplies to enable them to record continuously for approximately two months (Figure 2.4).

Analyses of bat calls were undertaken by Bob Bullen (Bat Call WA).

Figure 2.4 – Example of Long-term SM2Bat monitoring site

2.6 ADDITIONAL MONITORING TECHNIQUES

Opportunistic collection of predator scats (canine, feline and varanid species, as well as any regurgitated owl and raptor pellets) observed during walking transects, motion camera and SM2Bat installation, as well as any other opportunistic observation of scats were collected and analysed for any traces of Greater Bilby, Mulgara and Night Parrot. All collected scat samples were sent for analysis to Georgeanna Story at 'Scats About', who specializes in the analysis of vertebrate scat, pellet and hair samples.

2.7 SITE SELECTION

Site selection was based on habitat information from previous studies (*ecologia* 2010b; ENV 2012b) and the expected suitability of the habitats for each species. These are described below.

Drainage Line and Alluvial Plain

Based on the vegetation associations, known ecological information and previous records of Pilbara Olive Python, Northern Quoll and Pilbara Leaf Nosed Bat from within this habitat type in other areas across the Pilbara region, this habitat type was targeted for the above listed species through long-term monitoring of both minor and major drainage lines and alluvial plains utilising motion cameras and through both long- and short-term SM2Bat recorders.

Marsh

The marsh habitat is only thought to provide potential suitable habitat for the Night Parrot. The ecotone between dense spinifex habitats and samphire/chenopod in fringing marsh habitat is thought to be most suitable, however as this type of ecotone is not present within the study area, areas of dense to moderate chenopod and samphire vegetation communities were targeted for Night Parrot.

Low Hill

This habitat type has been known in other areas of the Pilbara as potentially providing suitable denning and cave habitat for the Northern Quoll and the Pilbara Leaf-nosed Bat, as well as potentially providing suitable habitat for the Pilbara Olive Python. Despite the lack of permanent water and few substantial caves in this habitat type, which are necessary to support these species, this habitat type was targeted utilising motion cameras and through both long and short-term SM2Bat recorders, as well as by conducting walking transects in search of secondary evidence of presence of these species.

Stony Plain

This habitat type has been previously identified as potentially providing areas of suitable habitat for Greater Bilby and Mulgara (*ecologia* 2010b; ENV 2012b) (although the quality of the habitat has been consistently described as poor) and thus was targeted for these species, as well as for Pilbara Olive Python (which may traverse this habitat type periodically). This habitat type was also identified as potential foraging habitat type for Pilbara Leaf-nosed Bat (along with the rest of the study area) (ENV 2012b) and, thus, both long and short-term SM2Bat recorders were established in this habitat type.

2.8 ANALYSIS OF DATA

All data was analysed by specialists in the respective fields. Photos captured on motion camera were analysed by a team of mammalogists, herpetologists and ornithologists at *ecologia*; bat calls were analyses by Bob Bullen (Bat Calls WA), acoustic Night Parrot recordings were analysed by Nigel Jackett (*ecologia*) and scats were analysed by Georgeanna Story (Scats About). Details are listed in Table 2.1.

2.9 ANIMAL ETHICS

Surveying was conducted as per *ecologia*'s Animal Ethics Code of Practice, which conforms to Section 5 of the *Australian code of practice for the care and use of animals for scientific purposes* (NHMRC 2004).

No invasive capture/trapping methodology was utilised during this survey.

2.10 MONITORING TEAM AND LICENCES

Field survey team members and external consultants are listed in Table 2.1. The survey was conducted under DEC Regulation 17 Licence SF008974.

Table 2.1 – Field Survey Personnel

Survey Member	Expertise	Relevant Qualification	Experience
Damien Cancilla	Mammalogy	B.Sc. (Hons)	8 years
Mimi d'Auvergne	Mammalogy	B.Sc. (Hons)	4 years
Bruce Greatwich	Ornithology	B.Sc.	4 years
Jesse Forbes-Harper	Herpetology	B.A., B.Sc. (Hons)	3 years
Additional Data Analyses			
Nigel Jackett	Ornithology	B.Sc. (Hons)	7 years
External consultant			
Bob Bullen - Bat Call WA	Bat call analysis		16 years – bat call IDs
Georgeanna Story - Scats About	Scat analyses	B.Sc. (Hons)	7 years – diet and scat analyses

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3 RESULTS

3.1 NIGHT PARROT

3.1.1 Survey Effort

A total of 10 motion cameras were installed along the border of the Fortescue Marsh in areas of potential suitable habitat for Night Parrot, with six cameras installed at Drift Fence sites, and four cameras at Feeding Stations (Table 3.1). These cameras were left to record continuously for approximately six months (December 2012 – May 2013), with a minimum total recording time of 39,312 hours (Table 3.2). Additionally, three Acoustic recording sites were monitored for Night Parrot calls over a total of 192 hours.

Table 3.1 – Night Parrot Monitoring site locations

Site	Northing	Easting
Drift Fence Site 1	772244	7515622
Drift Fence Site 2	762695	7518398
Drift Fence Site 3	784175	7509649
Drift Fence Site 4	770196	7517141
Drift Fence Site 5	779915	7513034
Drift Fence Site 6	774776	7516018
Feeding Station Site 1	764540	7519699
Feeding Station Site 2	770229	7517317
Feeding Station Site 3	783636	7509399
Feeding Station Site 4	779936	7513111
Acoustic Recording Site 1	779865	7513144
Acoustic Recording Site 2	770196	7517141
Acoustic Recording Site 3	784176	7509649

Table 3.2 – Survey effort for Night Parrot monitoring (Motion Cameras)

Site	Date installed	Date last photo recorded	Date cameras/recorders removed	Total days of footage	Total hours of footage
Drift Fence Site 1	28/11/12	13/06/2013	13/06/2013	198	4,752
Drift Fence Site 2	28/11/12	30/03/2013	12/06/2013	122	2,928
Drift Fence Site 3	29/11/12	08/04/2013	13/06/2013	130	3,120
Drift Fence Site 4	28/11/12	06/04/2013	13/06/2013	129	3,096
Drift Fence Site 5	28/11/12	08/06/2013	13/06/2013	193	4,632
Drift Fence Site 6	28/11/12	11/06/2013	13/06/2013	196	4,704
Feeding Station Site 1	01/12/12	29/03/2013	12/06/2013	118*	2,832

Site	Date installed	Date last photo recorded	Date cameras/recorders removed	Total days of footage	Total hours of footage
Feeding Station Site 2	28/11/12	05/06/2013	13/06/2013	190	4,560
Feeding Station Site 3	03/12/12	12/06/2013	13/06/2013	191	4,584
Feeding Station Site 4	02/12/12	22/05/2013	13/06/2013	171	4,104
Acoustic Recording Site 1	28/11/12	N/A	04/12/12	6 (nights)	72
Acoustic Recording Site 2	29/11/12	N/A	04/12/12	5 (nights)	60
Acoustic Recording Site 3	29/11/12	N/A	04/12/12	5 (nights)	60
				Total survey effort (hours):	39,504

* Total recording time affected by cameras being disturbed by cattle (knocking cameras out of place)

3.1.2 General Habitat Assessment

The marsh habitat of the Christmas Creek study area, which has previously been identified as potentially containing suitable habitat for the Night Parrot(*ecologia* 2010b; ENV 2012b) was assessed during this survey as being in good to excellent condition, with some areas demonstrating low to medium degradation by cattle. The absence of recent records of Night Parrot within this habitat type and in the region may suggest this species is not a resident of these areas, however little is known of this cryptic and apparently elusive species, and no known survey methodology has proven effective in recording this species despite ongoing attempts and monitoring programs in FMG's nearby Cloudbreak mine site (Bamford 2012).

3.1.3 Results

No Night Parrots were recorded either on camera or through acoustic call recordings, and no other evidence (feathers, tracks, remains etc.) of their presence was identified during this baseline monitoring survey.

NP Feeding Station site 1
NP Drift Fence site 2
NP Feeding Station site 2
Acoustic Site 2
NP Drift Fence site 4
NP Drift Fence site 6
NP Drift Fence site 1
NP Feeding Station site 4
Acoustic Site 1
NP Drift Fence site 5
Acoustic Site 3
NP Drift Fence site 3
NP Feeding Station site 3

Legend

- Night Parrot Drift Fence Sites
- Night Parrot Feeding Station Sites
- Acoustic Monitoring Sites
- Impact Area (Dry Climate Mounding)
- Impact Area (Wet Climate Drawdown)

FMG Fauna Habitat Mapping

- Cleared and Developed
- Drainage Line and Surrounding Alluvial Plain
- Low Hill
- Marsh
- Northern Quoll - Potential shelter/den habitat
- Stoney Plain

N

0 2.5 5

Kilometres

Absolute Scale - 1:113,166

ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

Night Parrot Monitoring Sites

Figure: 3.1
Project ID: 1494

Drawn: Md'A
Date: 17/06/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: MXXX

A3

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3.2 NORTHERN QUOLL, PILBARA OLIVE PYTHON AND PILBARA LEAF-NOSED BAT

3.2.1 Survey Effort

A total of 10 motion cameras were installed in areas of potentially suitable habitat for Northern Quoll and Pilbara Olive Python across the study area (Table 3.3, Figure 3.2). These cameras were left in-situ for approximately two months (1st December 2012 – 9th February 2013) with a total recording time of 12,120 hours (Table 3.4).

Four long-term Pilbara Leaf-nosed Bat monitoring sites were established in areas of potentially suitable foraging habitat, and were also left in-situ for approximately two months (1st December 2012 – 9th February 2013). A further 19 sites were monitored across the study area, targeting creeklines and any creek or river systems with remnant water which were determined to be potentially favourable areas for foraging (Figure 3.5). SM2Bat's were installed in these sites for a single night each (12 hours of continual recording), to increase the area of survey, resulting in a total of 1,248 hours of recordings across the survey area (Table 3.5).

Table 3.3 – Northern Quoll, Pilbara Olive Python and Pilbara Leaf-nosed Bat monitoring sites

Site	Easting	Northing
Northern Quoll/ Pilbara Olive Python Monitoring Sites		
NQ 1	792083	7525120
NQ 2	791496	7525162
NQ 3	777196	7525968
NQ 4	791797	7525462
NQ 5	794800	7518209
NQ 6	781812	7519035
NQ 7	783397	7524267
NQ 8	760366	7524779
NQ 9	760750	7521612
NQ 10	785018	7526052
Pilbara Leaf-nosed Bat (SM2Bat) Monitoring Sites		
Long-term Bat Monitoring site 1	796061	7518968
Long-term Bat Monitoring site 2	791023	7521452
Long-term Bat Monitoring site 3	777267	7525966
Long-term Bat Monitoring site 4	762548	7525655
Bat 1	775957	7523634
Bat 2	795026	7519183
Bat 3	770321	7522403
Bat 4	765262	7521265
Bat 5	775818	7525796
Bat 6	770316	7524251
Bat 7	765646	7523753
Bat 8	778152	7518151
Bat 9	781806	7520182

Site	Easting	Northing
Bat 10	784108	7513344
Bat 11	770332	7520138
Bat 12	763390	7524205
Bat 13	775288	7526997
Bat 14	777253	7518587
Bat 15	783485	7518595
Bat 16	774837	7518692
Bat 17	770282	7517267
Bat 18	760702	7524717

Table 3.4 – Survey effort for Northern Quoll and Pilbara Olive Python monitoring (Motion Cameras)

Site	Date recording commenced	Date recording ended	Date cameras removed	Total days of footage	Total hours of footage
NQ 1	03/12/12	09/02/2013	10/02/2013	68	1632
NQ 2	03/12/12	09/02/2013	10/02/2013	68	1632
NQ 3	05/12/12	08/02/2013	10/02/2013	65	1560
NQ 4	03/12/12	03/01/2013	10/02/2013	62	1488
NQ 5	02/12/12	08/01/2013	10/02/2013	68*	1632
NQ 6	03/12/12	26/01/2013	10/02/2013	54*	1296
NQ 7	04/12/12	13/12/2012	10/02/2013	9*	216
NQ 8	01/12/12	29/12/2012	10/02/2013	28*	672
NQ 9	01/12/12	05/02/2013	10/02/2013	66*	1584
NQ 10	04/12/12	21/12/2012	10/02/2013	17*	408
				Total survey effort (hours):	12,120

*Total recording time affected by uncontrollable factors such as cameras being disturbed by cattle, adverse weather effects, memory cards filling up quicker than expected (by false triggers) and/or batteries running out quicker than anticipated due to high temperatures reducing life expectancy of batteries.

Table 3.5 – Survey effort for Pilbara Leaf-nosed Bat monitoring (SM2Bats)

Site	Date recording commenced	Date recording ended	Total nights of recording	Total hours of recording (12 hours per night)
Long-term Bat Monitoring Site 1	03/12/12	06/12/12	3*	36
Long-term Bat Monitoring Site 2	03/12/12	31/12/12	28	336
Long-term Bat Monitoring Site 3	03/12/12	28/12/12	25	300
Long-term Bat Monitoring Site 4	05/12/12	04/01/13	30	360
Bat 1	01/12/12	02/12/12	1	12
Bat 2	28/11/2012	29/11/2012	1	12
Bat 3	29/11/2012	30/11/2012	1	12
Bat 4	30/11/2012	01/12/2012	1	12
Bat 5	01/12/2012	02/12/2012	1	12

Site	Date recording commenced	Date recording ended	Total nights of recording	Total hours of recording (12 hours per night)
Bat 1	01/12/12	02/12/12	1	12
Bat 2	28/11/2012	29/11/2012	1	12
Bat 3	29/11/2012	30/11/2012	1	12
Bat 4	30/11/2012	01/12/2012	1	12
Bat 5	01/12/2012	02/12/2012	1	12
Bat 6	29/11/2012	30/11/2012	1	12
Bat 7	30/11/2012	02/12/2012	1	12
Bat 8	01/12/2012	02/12/2012	1	12
Bat 9	02/12/2012	03/12/2012	1	12
Bat 10	28/11/2012	29/11/2012	1	12
Bat 11	29/11/2012	30/11/2012	1	12
Bat 12	30/11/2012	01/12/2012	1	12
Bat 13	02/12/2012	03/12/2012	1	12
Bat 14	01/12/2012	02/12/2012	1	12
Bat 15	02/12/2012	03/12/2012	1	12
Bat 16	28/11/2012	29/11/2012	1	12
Bat 17	29/11/2012	30/11/2012	1	12
Bat 18	30/11/2012	01/12/2012	1	12
			Total survey effort (hours):	1,248

* Lower than anticipated recording time due to microphone being damaged by cattle.

A diurnal walking transect was conducted, searching for secondary evidence (tracks, scats, latrines and any other secondary evidence) in areas of rocky gorge type habitat to the north of the study area for Northern Quoll and Pilbara Olive Python; as well as nocturnal spotlighting road transects for Pilbara Olive Python, but also looking for Northern Quoll and Pilbara Leaf-nosed bat individuals that may also be observed through night spotting across the study area. Transects were conducted in areas identified during this survey as having the potential to provide suitable habitat for Northern Quoll and Pilbara Olive Python, as well as targeting areas previously identified (*ecologia* 2010b; ENV 2012b) as potential suitable habitat for these species. Generally these sites were situated within the areas of rocky outcropping and gullies and gorges identified by ENV (2012) as potential shelter/den habitat in the north-east of the study area.

Table 3.6 –Northern Quoll diurnal walking transects

Site	Date of transect	Survey effort (hours)
Northern Quoll foraging transect		
NQ Transect	03/12/12	12
	Total survey effort (hours)	12

Table 3.7 – Pilbara Olive Python night driving transects

Site	Date of transect	Survey effort (hours)
Pilbara Olive Python night driving transects		
POP Night Transect 1	30/11/12	120
POP Night Transect 2	02/12/12	120
	Total survey effort (hours):	240

3.2.2 General Habitat Assessment

On the whole, the habitat types identified as being potentially suitable for Northern Quoll and Pilbara Olive Python within the study area were assessed as being in relatively good condition, with some degradation of the smaller and medium sized creeklines by cattle. The potential shelter/denning rocky gorge habitat identified in the north-east of the study area is of good to excellent quality with little disturbance, however it is relatively isolated from other gorge areas and the lack of previous records of Northern Quoll in this area would suggest it is unlikely Northern Quoll will reside in this area. Pilbara Olive Python may potentially occur in these areas if passing through, however the lack of any permanent water sources in the area would likely result in any individuals recorded as being transient visitors to the area. Representative habitat photos of the rocky gorge habitat identified in the north-east are presented in Appendix B.

3.2.3 Results

No Northern Quoll or Pilbara Olive Python individuals or secondary evidence was recorded from the study area, either on motion camera or during diurnal walking transects and night time driving transects, furthermore, no Pilbara Leaf-nosed Bat were recorded through short and long term SM2Bat deployment. No other evidence of either of these three species was identified during this baseline monitoring survey.

NQ 3
NQ 10
NQ 4
NQ 2
NQ 1
NQ 8
NQ 7
NQ 9
NQ 6
NQ 5

Legend

Northern Quoll and Pilbara Olive Python Monitoring Sites

FMG Fauna Habitat Mapping

- Cleared and Developed
- Drainage Line and Surrounding Alluvial Plain
- Low Hill
- Marsh
- Northern Quoll - Potential shelter/den habitat
- Stoney Plain

N

0 1.5 3

Kilometres

Absolute Scale - 1:121,000

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FMG Fortescue The New Force in Iron Ore

Northern Quoll and Pilbara Olive Python Monitoring Sites

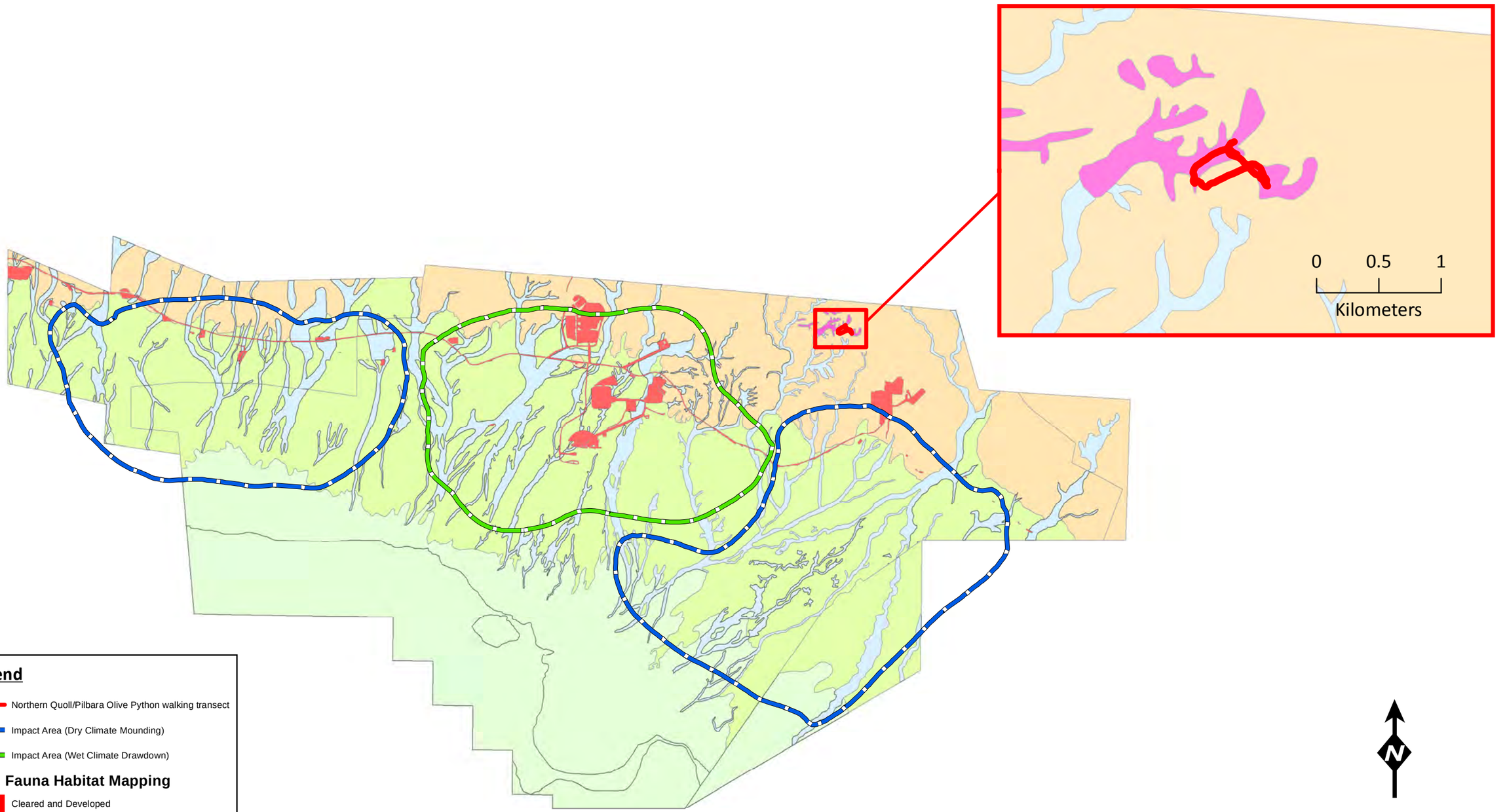
Figure: 3.2
Project ID: 1494

Drawn: Md'A
Date: 16/06/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: DCdraft

A3



Legend

- Northern Quoll/Pilbara Olive Python walking transect
- Impact Area (Dry Climate Mounding)
- Impact Area (Wet Climate Drawdown)

FMG Fauna Habitat Mapping

- Cleared and Developed
- Drainage Line and Surrounding Alluvial Plain
- Low Hill
- Marsh
- Northern Quoll - Potential shelter/den habitat
- Stoney Plain

Absolute Scale - 1:170,000

ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

Northern Quoll and Pilbara Olive Python WalkingTransect Site

Figure: 3.3
Project ID: 1494

Drawn: Md'A
Date: 16/06/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: DCdraft

A3

Legend

- POP spotlight transect
- Impact Area (Dry Climate Mounding)
- Impact Area (Wet Climate Drawdown)

FMG Fauna Habitat Mapping

- Cleared and Developed
- Drainage Line and Surrounding Alluvial Plain
- Low Hill
- Marsh
- Northern Quoll - Potential shelter/den habitat
- Stoney Plain

N

0 2 4

Kilometres

Absolute Scale - 1:122,000

ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

Pilbara Olive Python Nocturnal DrivingTransect

Figure: 3.4
Project ID: 1494

Drawn: Md'A
Date: 16/06/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: DCdraft

A3

Bat 13
Bat 5
Long-term Bat Monitoring site 3
Long-term Bat Monitoring site 4
Bat 18
Bat 12
Bat 7
Bat 6
Bat 1
Bat 3
Bat 4
Long-term Bat Monitoring site 2
Bat 11
Bat 9
Bat 2
Long-term Bat Monitoring site 1
Bat 16
Bat 14
Bat 8
Bat 15
Bat 17
Bat 10

Legend

- Pilbara Leaf-nosed Bat Monitoring Sites
- Long-term Bat Monitoring Sites
- Impact Area (Wet Climate Drawdown)
- Impact Area (Dry Climate Mounding)

FMG Fauna Habitat Mapping

- Cleared and Developed
- Drainage Line and Surrounding Alluvial Plain
- Low Hill
- Marsh
- Northern Quoll - Potential shelter/den habitat
- Stoney Plain

N

0 3 6

Kilometres

Absolute Scale - 1:121,000

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FMG Fortescue The New Force in Iron Ore

Pilbara Leaf-nosed Bat Monitoring Sites

Figure:3.5
Project ID: 1494

Drawn: Md'A
Date: 09/01/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID:MD007

A3

3.3 BILBY AND MULGARA

3.3.1 Survey Effort

A total of 20 motion cameras were installed in areas of potentially suitable habitat for both the Greater Bilby and the Mulgara, across the study area (Table 3.8, Figure 3.6). These cameras were left to record continuously for approximately six months (December 2012 – June 2013), with a total recording time of 70,776 hours (Table 3.9). Although targeting Greater Bilby and Mulgara, these motion cameras also have the potential to detect all other target species if they were to pass through a motion camera monitoring site area.

Table 3.8 – Grerater Bilby/Mulgara Monitoring sites

Site	Northing	Easting
BM 1	762536	7525746
BM 2	770294	7522549
BM 3	777226	7518554
BM 4	782208	7513557
BM 5	783468	7518553
BM 6	770294	7520297
BM 7	765598	7522382
BM 8	782757	7515671
BM 9	778148	7518123
BM 10	768623	7522889
BM 11	774851	7518703
BM 12	788306	7512162
BM 13	762503	7525517
BM 14	770281	7524217
BM 15	795863	7515062
BM 16	784466	7514582
BM 17	794214	7516327
BM 18	786012	7515431
BM 19	792399	7510667
BM 20	765203	7523850

Table 3.9 – Survey effort for Bilby/Mulgara monitoring (Motion Cameras)

Site	Date recording commenced	Date recording ended	Date Cameras removed	Total days of footage	Total hours of footage
BM 1	01/12/12	11/06/2013	12/06/2013	192	4608
BM 2	01/12/12	02/05/2013	12/06/2013	152	3648
BM 3	03/12/12	11/06/2013	12/06/2013	190	4560
BM 4	03/12/12	03/03/2013	12/06/2013	90*	2160
BM 5	03/12/12	26/05/2013	12/06/2013	181	4344
BM 6	01/12/12	15/02/2013	12/06/2013	76*	1824
BM 7	01/12/12	05/02/2013	12/06/2013	66	1584
BM 8	02/12/12	09/06/2013	12/06/2013	189	4536
BM 9	01/12/12	08/06/2013	12/06/2013	188	4512
BM 10	30/11/12	11/06/2013	12/06/2013	187	4488
BM 11	01/12/12	22/04/2013	12/06/2013	142*	3408
BM 12	02/12/12	11/06/2013	12/06/2013	185	4440
BM 13	03/12/12	01/04/2013	12/06/2013	119*	2856
BM 14	30/11/12	12/06/2013	12/06/2013	192	4608
BM 15**	02/12/12**	09/02/2013**	09/02/2013**	69**	1656**
BM 16	02/12/12	11/06/2013	12/06/2013	191	4584
BM 17	03/12/12	09/04/2013	12/06/2013	127*	3048
BM 18	02/12/12	18/03/2013	12/06/2013	106*	2544
BM 19	02/12/12	11/06/2013	12/06/2013	191	4584
BM 20	01/12/12	27/03/2013	12/06/2013	116*	2784
				Total survey effort (hours):	70,776

* Total recording time affected by uncontrollable factors such as cameras being disturbed by cattle, adverse weather effects, memory cards filling up quicker than expected (by false triggers) and/or batteries running out quicker than anticipated due to high temperatures lowering life expectance of batteries.

**Motion Camera BM15 was missing when it was due to be collected on the 12/06/2013. Footage recorded from this site was only available from beginning of installation (02/12/2012) to the 09/02/2013, when memory card and batteries were replaced.

Additionally, five walking transects were conducted searching for secondary evidence (tracks, scats, diggings and any other secondary evidence) of Greater Bilby and Mulgara in areas of potentially suitable habitat throughout the study area (Figure 3.7, Appendix C). Transects were conducted in areas identified during this survey as supporting potential, albeit low, suitable habitat for Bilby and Mulgara, as well as targeting areas previously identified (ENV 2012a) as potentially harbouring old diggings from Bilbies. Representative habitat photos for each of the transects that were conducted during this survey are included in Appendix C, but generally these sites were situated within areas of the Stony Plain habitat type that are dissected by the Drainage Line and Alluvial Plain habitat type.

These areas generally contained softer sandier loams (particularly along the edges of creeklines and alluvial deposits) that would allow burrowing for both species, as well as containing generally denser grass cover than elsewhere in the study area, which provides the species with more cover shelter and refuge sites.

3.3.2 General Habitat Assessment for Bilby and Mulgara

On the whole, the habitat type as mapped by ENV (2012), from where previous potential records of Greater Bilby were recorded within the entire study area was found to be unsuitable for harbouring and maintaining permanent populations of either species, due to a number of factors including:

- the quality of the habitat (mostly very degraded to completely degraded due to cattle);
- isolation from other areas identified as potentially suitable habitat for these species; and
- comprising incorrect substrate for building of the intricate burrow systems produced by these species.

Representative habitat photos were taken from various locations across the study area during walking transects (Figure 3.7 and Appendix C.

Table 3.10 –Bilby and Mulgara diurnal walking transects

Site	Date of transect	Survey effort (hours)
BM Transect 1	29/11/12	4
BM Transect 2	11/02/13	180
BM Transect 3	08/02/13	4
BM Transect 4	02/12/12	120
BM Transect 5	09/02/13	4
	Total survey effort (hours):	312

3.3.3 Results

No Greater Bilby or Mulgara were recorded either on camera or through diurnal walking transects and no other evidence of presence of either of these species was identified during this baseline monitoring survey.

BM 13
BM 1
BM 20
BM 14
BM 10
BM 2
BM 7
BM 6
BM 11
BM 3
BM 9
BM 5
BM 8
BM 18
BM 17
BM 15
BM 16
BM 4
BM 12
BM 19

Legend

- Bilby and Mulgara Monitoring Sites
- Impact Area (Dry Climate Mounding)
- Impact Area (Wet Climate Drawdown)

FMG Fauna Habitat Mapping

- Cleared and Developed
- Drainage Line and Surrounding Alluvial Plain
- Low Hill
- Marsh
- Northern Quoll - Potential shelter/den habitat
- Stoney Plain

N

0 1.5 3

Kilometres

Absolute Scale - 1:121,000

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FMG Fortescue The New Force in Iron Ore

Bilby and Mulgara Monitoring Sites

Figure:3.6
Project ID: 1494

Drawn: Md'A
Date: 21/06/2013

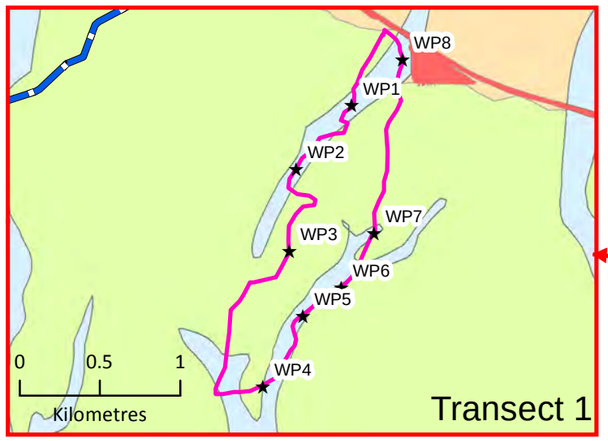
Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

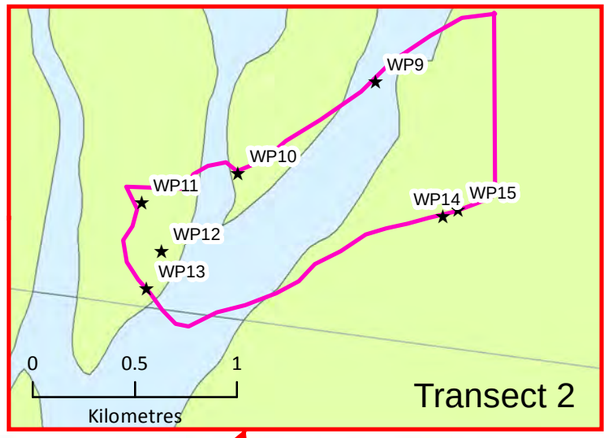
Unique Map ID: MD008

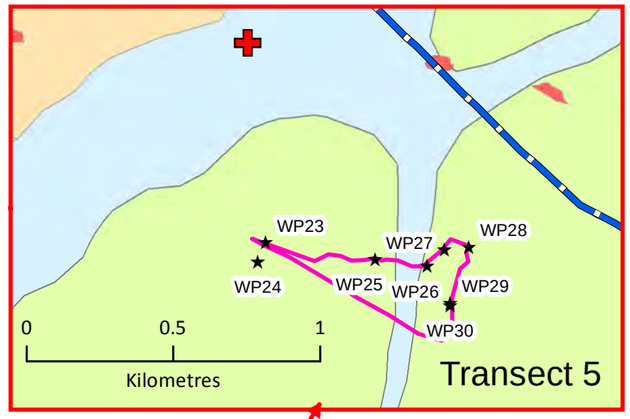
A3

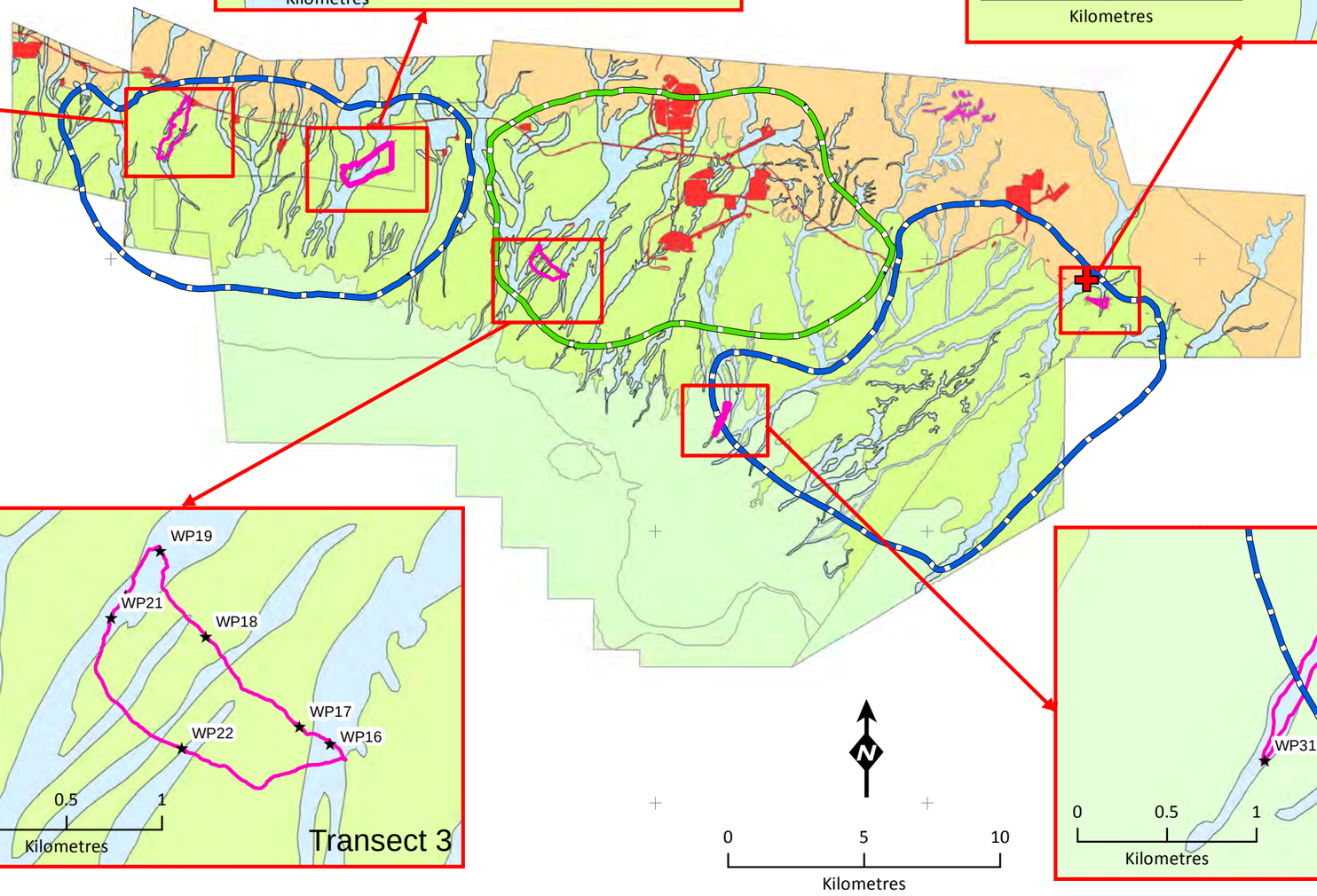
740000 750000 760000 770000 780000 790000 800000 810000

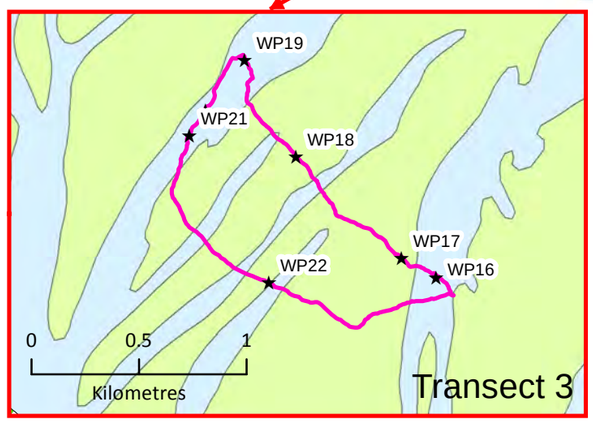
7540000 7530000 7520000 7510000 7500000

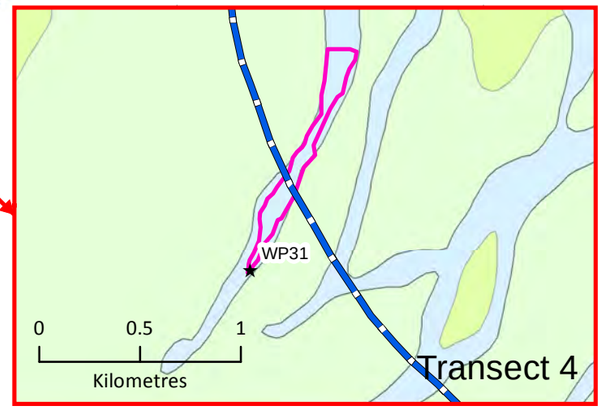












Legend

- Waypoints from Walking Transects (Appendix C)
- Pilbara Olive Python Record
- Bilby / Mulgara Walking Transects
- Impact Area (Dry Climate Mounding)
- Impact Area (Wet Climate Drawdown)

FMG Fauna Habitat Mapping

- Cleared and Developed
- Drainage Line and Surrounding Alluvial Plain
- Low Hill
- Marsh
- Northern Quoll - Potential shelter/den habitat
- Stoney Plain

Absolute Scale - 1:200,000

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FMG Fortescue The New Force in Iron Ore

Bilby and Mulgara Walking Transects (Waypoints listed in Appendix C)

Figure: 3.7
Project ID: 1494

Drawn: Md'A
Date:15/06/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: MD009

A3

3.4 TARGETED EPBC LISTED SPECIES RECORDS

Despite the significant survey effort (a combined total of 153,792 hours) with 40 motion cameras installed across the study area and covering all habitat types within the study area, over a period of up to six months, none of the targeted EPBC listed species were recorded, and no evidence of their presence was observed during the survey.

There was a large frequency of non-target by-catch species recorded on the motion cameras, including a range of small, medium and large sized mammals and birds, as well as a number of non-conservation significant bat species recorded across the study area on the SM2Bats, indicating that the methodology utilised in this monitoring survey was suitable for recording the presence of a range of different species at each survey site, and that if present at each survey site, the targeted species would have been recorded also.

3.5 SCAT COLLECTIONS AND RESULTS

Opportunistic collection of carnivore scats was also undertaken during the survey, and sent away for analysis of content. These scats were identified as those of either feral cats, dogs/dingos or varanid species, which are all known to prey on a range of native species including small to medium sized mammals, reptiles and birds.

Scat analysis was conducted on a total of 10 samples collected from opportunistic sightings across the study area (Table 3.11). Analysis of these samples found no evidence of any of the targeted species.

Table 3.11 – Opportunistic Scat collections from the study area

Scat Sample	Northing	Easting
Sample 1	7521612	760750
Sample 2	7521612	760750
Sample 3	7515622	772244
Sample 4	7522549	770294
Sample 5	7522549	770294
Sample 6	7520297	770294
Sample 7	7524704	762714
Sample 8	7525106	762229
Sample 9	7509649	784175
Sample 10	7501667	792399

3.6 LIMITATIONS AND CONSTRAINTS

Some unavoidable limitations were encountered which affected the results from the motion cameras during the baseline monitoring program. The factor most affecting some of the monitoring sites was the proportion of false triggers captured on the motion cameras. In some sites (indicated with an asterisk in Table 3.2, Table 3.4 and Table 3.9 above) this resulted in memory cards filling up and batteries running out quicker than anticipated due to false triggers setting the motion cameras off. False triggers were recorded by events such as: growing and moving grasses, trees and shadows, adverse weather causing flash flooding and the large amount of cattle in the study area moving cameras so they no longer focus on the monitoring site and/or triggering cameras.

All motion cameras were set to a medium-sensitivity in order to ensure if present, the target species would be recorded (using a low-sensitivity may risk not recording small, fast moving species such as Mulgara, Greater Bilby and Night Parrot, and using a high-sensitivity would result in too many false triggers). Thus, to ensure the maximum monitoring time was achieved for the longer-term motion cameras (Night Parrot, Greater Bilby and Mulgara sites), motion cameras were serviced to replace batteries, change memory cards and fix/re-align any cameras that had been moved by cattle. This was done approximately 10 weeks (2.5 months) after the motion cameras were first installed.

Battery life for all cameras is estimated by the manufacturer as being greater than 6 months, and typically up to 12 months. Temperature extremes are known to reduce to effective life of batteries and temperatures over 45°C were regularly recorded by the motion cameras. The exact impact that the high temperatures had on battery life is not known however it is expected to have caused some cameras to not function as long as expected

Some access constraints were encountered when conducting walking transects and installing monitoring sites through the previously identified (ENV 2012b) potential shelter/denning habitat for Northern Quoll. The northern and western-most extent of this small 74 ha area was inaccessible due to very steep gorges or deemed as not preferable Northern Quoll habitat (large open gully floors). The areas that were accessible and that were targeted during this baseline survey were thoroughly searched for secondary evidence of both Northern Quoll and Pilbara Olive Python and a total of 3 hours by three zoologists (12 hours total) was expended in this area.

No further limitations or constrains affecting results were encountered.

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4 DISCUSSION

During this baseline monitoring survey, the broad scale fauna habitat types were reassessed for suitability and condition, and based on these as well as the results from the monitoring survey, the presence/absence and a reassessment of the likelihood of occurrence of each of the targeted EPBC listed species was conducted.

4.1 FAUNA HABITATS

Suitability of fauna habitats within the study area have been previously described for each of the target species based on the level of current knowledge. As information collected relating to each target species increases, more certainty can be attributed to the expected likelihood of occurrence. Suitability of habitat for each species is based on a combination of habitat structure, habitat condition, location of resources and expected occurrence based on each species distribution. Based on increased knowledge of these attributes from this recent survey we can now provide a more relevant assessment of the potential occurrence of each species within the study area.

Night Parrot

The Night Parrot was recorded at Cloudbreak in 2005 as two to three individuals were observed to be drinking at a location near Minga Well, north of the Fortescue Marsh. Despite a large amount of survey and monitoring effort for this species in this region over the consecutive years (Bamford 2005b, 2006, 2007, 2008, 2010, 2012; Bamford and Burbidge 2007), there have been no further records of this species. Suitable habitat for the Night Parrot is not well known, but, based on some limited available knowledge, Night Parrots are thought to prefer areas of ecotone between spinifex hummock grassland and dense chenopod shrubland surrounding ephemeral lakes and water courses. This ecotone habitat type has been recorded proximal to the study area, however not observed within the study area during this baseline monitoring program or previous surveys (*ecologia* 2010b; ENV 2012b). Thick chenopod shrubland habitat surrounding the Fortescue Marsh was present in the study area, and was assessed to be in good condition.

The large amount of survey effort, using standard motion camera survey methods, as well as new experimental techniques such as the acoustic recording and feeding stations (installed for 6 months), expended within the study area during this assessment adds to the growing body of work conducted in the region surrounding the study area. The cryptic nature of this species and the almost complete lack of knowledge that exists regarding the Night Parrot's biology and ecology, severely limits the ability to predict its occurrence. Similar species, such as the Western Ground Parrot, whilst also rare, cryptic and at low densities, are currently being successfully monitored elsewhere in the state using similar monitoring techniques, thus it is assumed only extremely low population density would result in such a lack of records.

Northern Quoll

Northern Quoll have never been recorded in the study area and based on regional records (DEC 2013), the study area occurs at the far south-eastern extent of their distribution. Potentially suitable habitat has been recorded proximal to the study area, towards the north-east and extends north into the Chichester Ranges. Deeply incised gorges were recorded just outside of the study area (monitoring sites NQ1, NQ2 and NQ4, Appendix B) which contained habitat features such as boulder piles, crevices and steep cliffs; habitat features commonly associated with Northern Quoll, however no evidence of this species was recorded. In areas where Northern Quoll occur, secondary evidence such as scats and footprints can be found and no such evidence were recorded from these areas of habitat indicating that although structurally the habitat is suitable, some unknown influencing factor (be it meteorological (rainfall), lack of food resources isolation etc.) may potentially be limiting the suitability of this habitat for this species in the study area.

The positioning of the three motion camera monitoring sites in the previously identified potential Northern Quoll habitat (sites NQ1, NQ2 and NQ4) was to test for the occurrence of this species in an area of highly suitable habitat. After a significant amount of survey time (4,824 hours of motion camera monitoring), no evidence of Northern Quoll was recorded indicating that they are not present in this area of the Chichester Ranges, this is also supported by previous target Northern Quoll searches throughout this identified habitat area in 2011 by ENV (2012b). All other habitat within the study area; including major creek lines, are not considered suitable for this species as the majority consists of very open woodland, with few large eucalypts supporting no suitable tree hollows to support this species. The creek lines were also assessed to be highly degraded by cattle.

Although two potential scats were recorded from the Cloudbreak project (ATA 2006a, b), the complete lack of records or other secondary evidence within the study area and in surrounding suitable habitat, combined with the significant level of survey effort expended both during previous surveys (ENV 2012b) and the current assessment, it is highly unlikely that Northern Quoll occur in the study area.

Pilbara Olive Python

Pilbara Olive Python has been recorded on a single occasion (ENV 2012b), from a haul road adjacent to a major drainage line located to the north-east of the study area. Despite the high intensity of survey effort previously conducted in the study area (ENV 2012b), this record remains the only observation of this species in the study area and surrounding region. Pilbara Olive Python are rarely encountered during surveys, however, in areas of suitable habitat, if present, several can be recorded over a relatively short period of time (*ecologia* 2011b). No suitable high quality rocky gorge habitat containing permanent to semi-permanent water sources are known from the study area and therefore, it is predicted that, if recorded in the future, any Pilbara Olive Python's occurring within the study area are expected to be dispersing individuals only.

Pilbara Leaf-nosed Bat

Previous surveys conducted in the study area used Anabat devices, with no success in recording the species within the study area. This survey used SM2Bat recorders and a level of survey effort which far exceeds normal baseline surveys for this species (DSEWPaC 2011b). Nineteen sites were surveyed overnight using a number of SM2Bats spread across the survey area during the December 2012 field survey, during the ideal time for surveying Pilbara Leaf-nosed Bat's. Four systems were also setup to record every night for two months using solar panels and large battery packs. Over 1,200 hours of recordings were analysed, with no Pilbara Leaf-nosed Bat calls recorded.

Based on the current distribution of this species and the lack of any evidence from past and current surveys, Pilbara Leaf-nosed Bats are not expected to occur in the study area nor in the surrounding region.

Greater Bilby

Previously identified potential Greater Bilby diggings and burrows within the study area were confirmed, by Richard Southgate (Bilby expert) as unlikely to be from this species and more likely to be from either Goanna or Rabbit (ENV 2012a), both of which were recorded regularly on motion camera during this baseline monitoring survey.

The suitability and quality of potential Greater Bilby habitat within the study area was reassessed during this survey, and found to be in very poor condition due to high levels of degradation by cattle, as well being unsuitable for Greater Bilby due to the majority of the study area consisting of soil types and vegetation not generally favoured by the Greater Bilby, predominantly stony clay loam soils, with little to no vegetation cover. Despite an extraordinarily high level of survey effort expended during this survey (92,880 hours or motion camera recording, and 312 hours of active

searching through walking transects across the study area) no Greater Bilby were recorded on motion camera, and no secondary evidence was observed.

In areas where small populations of Greater Bilby are known to occur (such as the Abydos Plain), there is generally a small but regular number of sightings reported and burrow complexes can be located and numerous diggings recorded. Based on the lack of any confirmed sightings in the study area and in the surrounding region, and the majority of past secondary evidence records being disproved, Greater Bilby are not expected to occur in the study area. Greater Bilby are highly nomadic and dispersing individuals may potentially occasionally use areas of the Fortescue Marsh, however no permanent populations are expected to occur within the study area.

Mulgara

Mulgara have not previously been recorded from within the study area. Seven potential Mulgara/small mammal burrows were previously recorded from the Cloudbreak area (ATA 2006a, b), however these have since been discounted as Mulgara diggings by Richard Southgate. No individuals have been recorded in any of the trapping surveys conducted in the region (ENV 2012b), and none were recorded during this baseline monitoring survey, despite a huge survey effort. Much like the Greater Bilby, no typically preferable habitat for Mulgara (dense spinifex grassland with soft red sandy loams) was observed in the study area, and what areas of habitat might be considered as maybe suitable (sandy clay loams with buffel grass and some areas of gibber spinifex grassland) was either highly degraded by cattle or isolated to a tiny are of the study area. It is unlikely based on this previous lack of records, the lack of suitable habitat, and the results from this baseline monitoring survey that Mulgara are present in the study area.

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5 CONCLUSION

The baseline monitoring survey for Night Parrot, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Greater Bilby and Mulgara within the Christmas Creek Water Management Scheme study area has provided a significant increase in the extent of effort for each of these species within the study area. The habitats located within the study area are relatively degraded with some areas highly degraded, and appear to support no detectable populations of the targeted species.

There is no evidence of the Pilbara Leaf-nosed Bat occurring within either the study area or the surrounding region.

No current evidence exists to suggest the Northern Quoll occurs within the study area, and there is also a low likelihood that Northern Quoll occurs in the surrounding region. Any populations within the surrounding region are most likely to be at such low densities that detailed ongoing monitoring is unlikely to confirm presence of the species in the study area.

Previous secondary evidence of Greater Bilby occurrence within the study area has been discredited during recent surveys by Bilby expert Dr Richard Southgate (ENV 2012a). Records from the surrounding region are very uncommon and widely distributed (DEC 2013). Any populations within the surrounding region are expected to be at such low densities that detailed monitoring is unlikely to be possible.

Previous secondary evidence of Mulgara has not been detected from within the study area. Records from the surrounding region are uncommon and restricted to small pockets of suitable dense spinifex hummock grassland on sandy loam soils. Any populations within the surrounding region are at such low densities that detailed monitoring in the study area is unlikely to confirm presence of the species

Pilbara Olive Python has only been recorded once within the study area and the individual recorded is expected to represent a dispersing individual from the rocky habitats to the north of the study area. Any populations within the surrounding region are at such low densities that detailed monitoring is unlikely to confirm presence of the species in the study area.

The Night Parrot has not been recorded within the study area and the only relatively recent record is from the Cloudbreak area in 2005. Subsequent intensive monitoring for the Night Parrot across Cloudbreak operations since 2005 has failed to find any evidence of the species. Due to the lack of knowledge in the general ecology of this species, survey techniques are limited and their effectiveness unknown. Any populations within the surrounding region are at such low densities that detailed monitoring is unlikely to confirm presence of the species in the study area.

Based on the the findings of this baseline monitoring program, as well as previous information from additional surveys conducted in the study area which were completed since the water management scheme was assessed (Level 2 fauna survey and targeted conservation significant fauna survey (ENV 2012a, b)), it is unllikely that any of these species inhabit the study area, or that any significant populations exist within the study area, and *ecologia* feels that no additional annual monitoring will be required for Mulgara, Northern Quoll, Greater Bilby, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Night Parrot.

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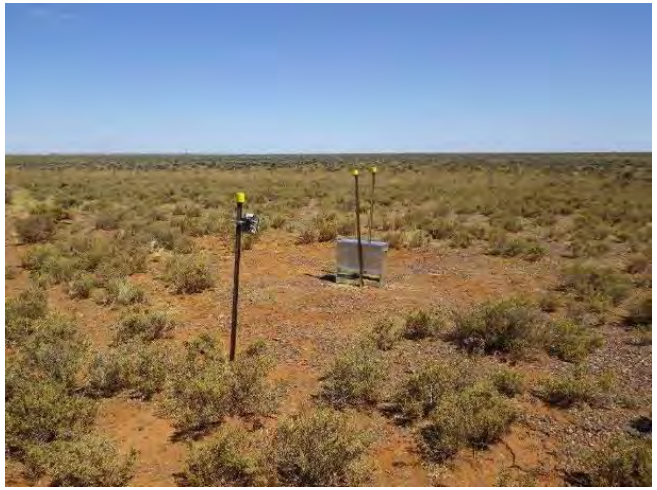
APPENDIX A MONITORING SITE PHOTOS

Monitoring Site	Easting	Northing	Site photo
Night Parrot Monitoring Sites			
NP Drift Fence Site 1	772244	7515622	
NP Drift Fence Site 2	762695	7518398	

Monitoring Site	Easting	Northing	Site photo
NP Drift Fence Site 3	784175	7509649	
NP Drift Fence Site 4	770196	7517141	

Monitoring Site	Easting	Northing	Site photo
NP Drift Fence Site 5	779915	7513034	
NP Drift Fence Site 6	774776	7516018	

Monitoring Site	Easting	Northing	Site photo
NP Feeding Station Site 1	464540	7519699	
NP Feeding Station Site 2	770229	7517317	

Monitoring Site	Easting	Northing	Site photo
NP Feeding Station Site 3	783636	7509399	
NP Feeding Station Site 4	779936	7513111	

Monitoring Site	Easting	Northing	Site photo
Bilby/Mulgara Monitoring Sites			
BM 1	762536	7525746	
BM 2	770294	7522549	

Monitoring Site	Easting	Northing	Site photo
BM 3	777226	7518554	
BM 4	782208	7513557	

Monitoring Site	Easting	Northing	Site photo
BM 5	783468	7518553	
BM 6	770294	7520297	

Monitoring Site	Easting	Northing	Site photo
BM 7	765598	7522382	
BM 8	782757	7515671	

Monitoring Site	Easting	Northing	Site photo
BM 9	778148	7518123	
BM 10	768623	7522889	

Monitoring Site	Easting	Northing	Site photo
BM 11	774851	7518703	
BM 12	788306	7512162	

Monitoring Site	Easting	Northing	Site photo
BM 13	762503	7525517	
BM 14	770281	7524217	

Monitoring Site	Easting	Northing	Site photo
BM 15	795863	7515062	
BM 16	784466	7514582	

Monitoring Site	Easting	Northing	Site photo
BM 17	794214	7516327	
BM 18	786012	7515431	

Monitoring Site	Easting	Northing	Site photo
BM 19	792399	7510667	
BM 20	765203	7523850	

Monitoring Site	Easting	Northing	Site photo
Northern Quoll/Pilbara Olive Python Monitoring Sites			
NQ 1	792083	7525120	
NQ 2	791496	7525162	

Monitoring Site	Easting	Northing	Site photo
NQ 3	777196	7525968	
NQ 4	791797	7525462	

Monitoring Site	Easting	Northing	Site photo
NQ 5	794800	7518209	
NQ 6	781812	7519035	

Monitoring Site	Easting	Northing	Site photo
NQ 7	783397	7524267	
NQ 8	760366	7524779	

Monitoring Site	Easting	Northing	Site photo
NQ 9	760750	7521612	
NQ 10	785018	7526052	
Pilbara Leaf-nosed Bat Long Term Monitoring Sites			

Monitoring Site	Easting	Northing	Site photo
Long-term Bat Monitoring site 1	796061	7518968	
Long-term Bat Monitoring site 2	791023	7521452	

Monitoring Site	Easting	Northing	Site photo
Long-term Bat Monitoring site 3	777267	7525966	
Long-term Bat Monitoring site 4	762548	7525655	

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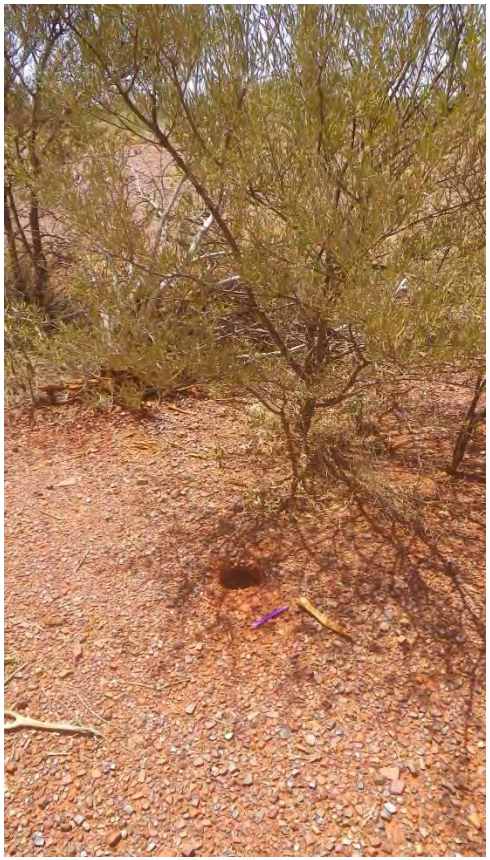
APPENDIX B REPRESENTATIVE HABITAT PHOTOS OF POTENTIAL SUITABLE HABITAT FOR NORTHERN QUOLL (AND PILBARA OLIVE PYTHON)

APPENDIX C HABITAT PHOTOS AND DIGGINGS OBSERVED DURING GREATER BILBY AND MULGARA WALKING TRANSECTS

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
Walking Transect 1			
WP1	762575	7525501	
WP2	762229	7525106	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP3	762185	7524590	
WP4	762022	7523745	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP5	762272	7524190	
WP6	762510	7524365	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP7	762714	7524704	
WP8	762892	7525787	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
Walking Transect 2			
WP9	769737	7523906	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP10	769064	7523456	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP11	768592	7523313	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP12	768690	7523077	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP13	768616	7522890	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP14	770068	7523244	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP15	770140	7523277	
Walking Transect 3			
WP16	776643	7519453	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP17	776482	7519545	
WP18	775990	7520019	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP19	775753	7520467	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP20	775572	7520232	
WP21	775497	7520115	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP22	775865	7519434	
Walking Transect 4			
WP23	795928	7518534	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP24	795901	7518471	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP25	796301	7518477	
WP26	796478	7518454	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP27	796537	7518509	
WP28	796620	7518518	

Monitoring Site	Easting	Northing	Habitat photo/diggings and burrows recorded during walking transects
WP29	796557	7518327	
WP30	796557	7518320	

Walking Transect 5			
WP31	782200	7513568	

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APPENDIX D ACTIVITY LEVELS IN BAT RECORDINGS

Activity levels in bat recordings

Site Number	Date	Easting	Northing	Recording time (Hours)	*Chaerephon jobensis*	*Chalinolobus gouldii*	*Nyctophilus geoffroyi*	*Saccolaimus flaviventris*	*Scotorepens greyii*	*Taphozous georgianus*	*Vespadelus finlaysoni*	*Mormopterus beccarii*
Bat 1	1/12/2012	775957	7523634	12	High	High	Medium	Low	High	Low	High	Low
Bat 2	28/11/2012	795026	7519183	12	Low	Low	-	Low	-	Low	-	-
Bat 3	29/11/2012	770321	7522403	12	Low	Low	-	Low	Low	Low	Low	-
Bat 4	30/11/2012	765262	7521265	12	Low	Low	-	Low	Low	Low	Low	-
Bat 5	1/12/2012	775818	7525796	12	-	Low	-	Low	Low	-	Low	-
Bat 6	29/11/2012	770316	7524251	12	-	Low	Low	Low	Low	Low	Low	-
Bat 7	30/11/2012	765646	7523753	12	Low	Low	Low	Low	Low	Low	Low	-
Bat 8	1/12/2012	778152	7518151	12	Low	Low	-	Low	Low	-	Low	-
Bat 9	2/12/2012	781806	7520182	12	-	-	-	-	-	-	-	-
Bat 10	28/11/2012	784108	7513344	12	Low	Low	Low	Low	Low	Low	Low	-
Bat 11	29/11/2012	770332	7520138	12	Low	Low	Low	-	Low	Low	Low	-
Bat 12	30/11/2012	763390	7524205	12	Low	Low	-	-	Medium	Low	Low	-
Bat 13	2/12/2012	775288	7526997	12	Low	Low	-	Low	Low	-	Low	-
Bat 14	1/12/2012	777253	7518587	12	Low	Medium	Medium	Low	Low	-	Low	-
Bat 15	2/12/2012	783485	7518595	12	High	Low	Low	-	Low	-	Low	-
Bat 16	28/11/2012	774837	7518692	12	Low	Low	Low	Low	Low	-	Low	-
Bat 17	29/11/2012	770282	7517267	12	Medium	Low	Low	Low	Low	-	-	-
Bat 18	30/11/2012	760702	7524717	12	Medium	Medium	Low	-	Medium	-	Medium	-