Iron Bridge

Northern Quoll Management Plan

North Star Project

July 2020
662MI-5500-PL-EN-0001

	Northern Quoll Management Plan		662MI-5500-PL-EN-0001
Revision Number	**2A**		
Status	**IFU - ISSUED FOR REVIEW**		
Summary of Changes	Change in Rev2: • Impact Descriptions Updated to include North Star Extension • Monitoring Sites Updated • Population Monitoring Updated • Behaviour Monitoring Updated		
Author	Matt Dowling	Signature	
Revised By	Todd Edwards	Signature	
Checked	Jared Nelson	Signature	
Approved	Belinda Mccawley	Signature	
Confidentiality	**FORTESCUE STAFF ONLY**	**Publish on Extranet**	☐ Yes ☐ No

Revision History *(to be completed for each version retained by Document Control)*

Author	Checker	Approver	Rev No.	Status	Issued Date
Ecologia		**Matt Dowling**	A	**DRAFT**	27/10/2015
Matt Dowling	**Olivia Hertsted**	**Ian Zlatnik**	B	**DRAFT**	19/11/2015
Matt Dowling	**Olivia Hertsted**	**Ian Zlatnik**	0	**IFR**	14/3/2016
Matt Dowling	**Olivia Hersted**	**Ian Zlatnik**	1	**IFU**	20/06/2016

TABLE OF CONTENTS

List of Tables

List of Schematic Maps

List of Figures

List of Appendices

1. INTRODUCTION

1.1 Background

FMG Iron Bridge (Aust) Pty Ltd (FMG IB) proposes to develop the North Star Magnetite Project (the Project), located approximately 110 kilometres south of Port Hedland in the Pilbara region of Western Australia (Figure 1).

1.2 Project Description

The North Star Magnetite Project consists of the development of an open-cut iron ore mine, using traditional drill and blast methods to establish multiple pits throughout the North Star and Glacier Valley Mine Development Envelope (MDE).

Mine life is estimated at 45 years. Waste from the mine will be sent to a dedicated waste rock dump. The ore will be crushed and further processed onsite to produce a magnetite product, dry process rejects and wet tailings. All tailings will report to a dedicated Tailings Storage Facility. Magnetite ore will be transported as a slurry via pipeline to a Concentrate Handling Facility (CHF) at a dedicated FMG facility at Port Hedland for dewatering and stockpiling prior to ship loading.

To support the mine, additional infrastructure is proposed to be developed, which may include the following:

- Power station(s);
- Roads and borrow pits;
- Water processing, ponds and reticulation;
- Bulk fuel storage;
- Workshops and maintenance facilities;
- Laydown and storage facilities;
- Explosives and chemical storage; and
- Camp and administration buildings.

1.3 Management Plan Objectives

Surveys for Northern Quoll (*Dasyurus hallucatus*) were completed in 2011 (Ecologia Environment 2011a, 2012) to support environmental approvals for the Project. As part of these surveys, suitable denning and foraging habitat supporting a permanent Northern Quoll population was identified within the Project area, including from within the proposed mine

development footprint. Subsequently, monitoring undertaken under the requirements of the Stage 1 *EPBC Listed Threatened Species Management Plan NS-PL-EN-0003* have provided greater data regarding the population's size and distribution (Ecologia Environment, 2014) (Ecoscape, 2015).

The Project has the potential to have a direct impact on a resident breeding population of Northern Quoll (approximately 20 individuals), through the direct removal, and fragmentation of significant habitat (denning and foraging). This permanent loss of significant habitat in the local area has the potential to isolate portions of the local population and reduce local genetic diversity.

This Northern Quoll Management Plan (the Plan) has been developed to satisfy Condition 11 of Ministerial Statement 993. The Plan has also been developed to comply with Environmental Assessment Guidelines 17 (EAG 17) (*Preparation of management plans under Part IV of the Environmental Protection Act 1986*) (EPA, 2015).

The overarching objective of this Plan is to ensure the Project is carried out in a manner that minimises the direct and indirect impacts on the Northern Quoll. Table 1 below identifies how the Plan satisfies the conditions of Ministerial Statement 993.

Table 1: Condition Accountability Table

Condition	Where in Plan
11-1 Prior to the commencement of ground disturbing activities within 50 metres of Northern Quoll foraging and denning habitat within the Mine Development Envelope, delineated as rocky ridge/breakaway/gorge habitat in Figure 7 of Schedule 1 and defined by the geographic coordinates in Schedule 2, the proponent shall prepare a Northern Quoll Management Plan in consultation within the Department of Parks and Wildlife, to the requirements of the CEO in order to demonstrate that Condition 11-2 has been met.	This Management Plan, when approved by the CEO will satisfy this Condition.
11-2 The objective of the Northern Quoll Management Plan is to ensure that the proposal is carried out in a manner that minimises the direct and indirect impacts to the Northern Quoll (Dasyurus hallucatus)	Section 1.3 of the Plan makes it clear that this is the objective of the Plan.
11-3 The Northern Quoll Management Plan shall include: (i) Census data for the Northern Quoll population within the Mine Development Envelope as shown in Figure 1 of Schedule 2 and defined by the geographic coordinates in Schedule 2, based on available survey information; (ii) Spatial imagery detailing Northern Quoll foraging and denning habitat within the Mine Development Envelope; (iii) Detailed management measures to minimise direct and indirect loss of the habitat mapped within the Mine Development Envelope; (iv) Protocols and procedures to monitor Northern Quoll presence, abundance and behaviour adjacent to the mine pit within the Mine Development Envelope identified by conditions 11-3(ii) during construction and operation (v) Detailed contingency responses, including modified operational procedures or	(i) The census data required by condition 11-3(i) is contained in appendix 1 and is the combined data surveys and monitoring undertaken in 2011, 2014 and 2015. (ii) Figure 2 details the Northern Quoll Foraging and Denning Habitat within the Mine Development Envelope (iii) Table 4 and Table 5 outline the management measures for minimising direct and indirect loss of the habitat mapped within the Mine Development Envelope. (iv) Section 7 of this Plan provides the protocols and procedures to monitor quoll presence, abundance and behaviour. (v) Section 8.3 outlines the contingency responses required should monitoring demonstrate a decline

Condition		Where in Plan
	translocation of animals out of impact zones, if monitoring required by condition 11-3(iv) show a decrease in Northern Quoll numbers or significant changes to Northern Quoll behaviour, to ensure Condition 11-2 is met.	trend in Northern Quoll numbers or behaviours that is attributable to the Project and is independent of regional climactic factors or a Pilbara-wide decline trend.

2. RELEVANT LEGISLATION

FMG Iron Bridge employees and contractors are obliged to comply with all relevant environmental Commonwealth and State legislation. Legislation directly relevant to the management of fauna (including Northern Quoll) in Western Australia is provided in Table 2.

Table 2: Commonwealth and State Legislation Relevant to this Management Plan

Legislation	Description
Environment Protection and Biodiversity Conservation Act 1999 (Cwth)	Assesses the conservation significance of fauna species and forms the framework for significant species protection at the Federal level.
Agriculture and Related Resources Protection Act 1976 (WA)	Provides for the management, control and prevention of certain plants and animals, for the prohibition and regulation of the introduction and spread of certain plants and of the introduction, spread and keeping of certain animals, for the protection of agriculture and related resources generally, and for incidental and other purposes.
Environmental Protection Act 1986 (WA)	State environmental impact assessment and Ministerial approval process.
Biodiversity Conservation Act 2016 (WA)	State process which assesses the conservation significance of fauna species and forms the framework for significant species protection.

3. STAKEHOLDER LIAISON AND CONSULTATION

Prior to the development of the Plan, key stakeholders, including internal (Fortescue and IB Operations Pty Ltd) and external, were consulted to develop the objectives and content of the Plan. North Star Project staff were consulted to provide accurate information in regards to site infrastructure layout and key activities that could constitute potential impacts on Northern Quoll. This included up to date and accurate mapping of mine development and infrastructure areas to ensure spatial analysis of potential impacts could be completed.

Consultation was undertaken with Amy Mutton, from the Department of Parks and Wildlife (DPaW) in 2014 with regards to the use of radio collars to monitor quoll behaviour (Letter No. 100-EN-0537).

Consultation with Dr Judy Dunlop, project officer for the DPaW on the Pilbara Northern Quoll monitoring project (provided at Appendix 3) was also undertaken. Discussions included suitability of DPaW Northern Quoll regional monitoring sites as control sites, behaviour monitoring methods, suitable trigger levels for performance indicators and contingency responses. Ms Dunlop also provided suggestions regarding the creation of quoll habitat as a possible contingency response.

4. ROLES AND RESPONSIBILITIES

All FMG Iron Bridge employees and contractors are required to comply with the requirements of this Plan.

Accountability for fulfilling the requirements of this Plan is dependent on the stage of project development (construction, operations, decommissioning).

Irrespective of whether construction activities are undertaken by an external service provider or internal personnel, the Project Director (Construction) will be accountable for ensuring the requirements of the Plan are met during construction. Responsibility may be delegated to the Site Environment Manager or other personnel.

During operational, decommissioning and closure stages, the Registered Manager (Mine) is accountable for ensuring the requirements of the Plan are met. Responsibility for specific tasks may be delegated.

Where responsibilities are delegated, this must be clearly recorded and communicated.

5. POTENTIAL IMPACTS

There is the potential for both direct and indirect impacts to Northern Quoll as a result of activities associated with the Project. Key activities and resulting potential direct and indirect impacts to Northern Quoll are presented in Table 3. Potential impacts have been assessed and based on *The Action Plan for Australian Mammals – Northern Quoll* (Woinarski, et al., 2012), *The National Recovery Plan for the Northern Quoll* (Hill & Ward, 2010) and outcomes from the DPaW Northern Quoll threatened species workshop facilitated by DPaW (DPaW, Threatened species workshop - Northern Quoll). Spatial distribution of rocky ridge, breakaway and rocky gorge habitat, which has been identified as suitable Northern Quoll denning and foraging habitat, was assessed against proposed project infrastructure layout (Figure 2).

Proposed activities that directly impact on Northern Quoll habitat, as shown in Figure 2, include:

- Mining of pits associated with the Project;
- Stockpiling ore from pits associated with the Project;
- Stockpiling waste in associated Waste Rock Landforms (WRL); and
- Storage of tailings associated with the Project.

The mining pit(s) associated with the Project have been identified as likely to have the greatest direct impact on Northern Quoll habitat (Figure 2). Management actions to address proposed activities and potential impacts are discussed in Section 6.

Table 3: Key activities and potential direct and indirect impacts to Northern Quoll

Key Activity	Infrastructure Type	Potential Direct Impact	Potential indirect impact
Vegetation clearing	• Vehicle access tracks • North Star Hematite and Magnetite project pit(s) • Ore Stockpile • WRL(s) • Tailings facility	• Direct mortality • Habitat loss	• Reduction in foraging habitat • Introduction and spread of weeds • Increased fire risk • Habitat fragmentation
Construction	• Stage 1 and Stage 2 pit • Ore Stockpile • WRL(s) • Tailings facility	• Direct mortality	• Increased light • Increased noise • Increased vehicle activity
Linear infrastructure	• Vehicle access tracks	• Physical barrier to movements	• Increased competition • Reduced breeding interaction
Vehicle movement	• Vehicle access tracks	• Direct mortality	• Increase dust • Introduction and spread of weeds • Increased fire risk
Putrescible Waste disposal	• Accommodation camp and landfill	• Nil	• Increased feral species abundance
Mining and Processing operations	• North Star Hematite and Magnetite project pits(s)	• Nil	• Increased light • Increased noise and vibration • Altered water availability

6. MANAGEMENT APPROACH

The overarching objective of this Plan is to minimise the direct and indirect impacts on Northern Quoll as per Ministerial Condition 11 of Ministerial Statement 993. The management actions described herein aim to meet this objective. Potential direct and indirect impacts resulting from the Project have been identified in Table 3, with spatial infrastructure locations and impacts on Northern Quoll habitat mapped in Figure 2.

6.1 Management of Direct Impacts

Table 4 outlines the management actions that will be undertaken to minimise direct impacts on Northern Quoll during the life of the Project. The location of direct impact areas on Northern Quoll habitat are shown in Figure 2.

Table 4: Management Actions to Reduce Direct Impacts on Northern Quoll

Key Activity	Potential Direct Impact	Management Actions	Assessment Approach	Performance Indicators	Reporting/Evidence	Responsibility
Vegetation clearing	• Direct mortality • Habitat loss	• Where possible, direct impact areas as a result of mining activities and infrastructure have been positioned away from critical habitat areas. • Internal GDPs (ground disturbance permits) will be implemented for all clearing activities prior to commencement of works. • Clearing limits will be identified on design and construction documentation. • Clearing limits will be pegged in the field prior to commencement of clearing operations. • Clearing Northern Quoll habitats will be kept to the minimum necessary for safe construction and operation of the project.	• Compliance with GDP procedure • Impacts to priority habitat minimized. • Signage, fencing and/or flagging installed.	• Habitat disturbance remains within predicted impacts.	• Project design • GDP application and permit • Northern Quoll monitoring program and report • Signage, fencing and/or flagging • Incident reporting • Compliance reporting	• Project Director (Construction) • Registered Manager (Operations) • Site Environment Manager • Site Environmental Officers
Construction and Operations	• Direct mortality	• “Confined” blasting techniques (where inert material such as crushed stone is used to seal off or ‘stem’ the blast holes and contain the energy released by the detonation of the explosives in the blast hole inside the rock) will be used in preference to unconfined methods. • Translocation of Northern Quoll individuals if they are encountered during construction process. • Installation of fauna egress where linear infrastructure restricts Quoll movement.	• Any Northern Quoll sighting or incident reported in BMS. • Translocations are reported in BMS. • Northern Quoll behavior monitoring • Monitor usage of fauna egress	• Northern Quoll deaths are not increasing. • Egress is installed.	• Project design • Incident reports in BMS • Northern Quoll monitoring program and report	• Project Director (Mine) • Site Environment Manager
Vehicle movement	• Direct mortality	• Vehicle speed limits will be enforced for all Project roads and tracks. • Off road driving will be prohibited unless authorised or in emergency situations. • Driving at dawn, dusk or night will be minimised as far as practicable. • Any Northern Quoll road kill incidents will be reported and logged within FMG Iron Bridge’s Business Management System (BMS). • Road signage will be installed to raise awareness in areas of Northern Quoll habitat. • Site inductions for all site staff and contractors will include appropriate road driving procedures and Northern Quoll awareness.	• Compliance with sign directions. • Any Northern Quoll sighting or incident reported in BMS.	• Northern Quoll deaths are not increasing. • Appropriate signage on all roads • Awareness program included in inductions and toolbox meetings	• Site induction materials • Toolbox meetings • Incident reports in BMS • Northern Quoll monitoring program and report	• Site Environment Manager

[This page has been left blank intentionally]

6.2 Management of Indirect Impacts

Table 5 outlines the management actions that will be undertaken to minimise indirect impacts on Northern Quoll during the life of the Project. The location of indirect impact areas on Northern Quoll habitat are shown in Figure 2.

[This page has been left blank intentionally]

Table 5: Management actions to reduce indirect impacts on Northern Quoll

Key Activity	Potential Indirect Impact	Management Actions	Assessment Approach	Performance Indicators	Reporting/Evidence	Responsibility
Vegetation clearing	• Reduction in foraging habitat • Introduction and spreading of weeds • Increased fire risk • Habitat fragmentation	• Where possible, impact areas as a result of mining activities and infrastructure have been positioned away from habitat areas. • Develop and facilitate educational programs for staff and contractors about quarantine protocols and associated risks involved with invasive species. • Control weeds in high risk areas. • Educate and train staff about equipment and procedures to act on unexpected fire events. • Where possible, retain habitat corridors and linkages between areas of impact.	• Awareness program included in inductions and toolbox meetings • Compliance with Weed Management Plan • Signage, fencing and/or flagging installed	• Clearing is the minimum required to implement the Project.	• Weed Management Plan • Weed monitoring • BMS fire incident records • Signage, fencing and/or flagging	• Project Director (Mine) • Site Environment Manager • Site Environmental Officers
Construction and Operations	• Increased light • Increased noise • Increased dust • Altered surface water availability	• Direct lighting onto active construction areas to minimise the potential for light overspill. • Maintain plant and equipment to ensure they are running to specifications • Where practical, utilise top soil and waste dumps as noise barriers. • Dust suppression measures to be implemented. • Site inductions for all site staff and contractors will include appropriate road driving procedures and Northern Quoll awareness.	• Spot checks for light spill • Dust monitoring • Compliance with sign directions	• Quolls continue to utilise habitat adjacent to active mining areas • Northern Quoll behavior monitoring	• Toolbox meeting minutes • Staff induction materials • Dust Management Plan • Compliance Reporting	• Project Director (Mine) • Site Environment Manager • Site Environmental Officers
Linear infrastructure	• Physical barrier to movements • Increased competition • Reduced breeding interaction	• Installation of fauna egress where linear infrastructure restricts Quoll movement	• Monitor use of fauna egress	• Quoll monitoring demonstrates that quoll movement is not restricted by linear infrastructure.	• Project design • Northern Quoll monitoring program and report	• Project Director (Mine) • Site Environment Manager
Vehicle movement	• Increase dust • Introduction and spreading of weeds • Increased fire risk	• Dust to be managed according to Mine and Rail Dust Management Plan in relation to dust impacts on vegetation and habitat degradation. • Develop and facilitate educational programs for staff and contractors about quarantine protocols and associated risks involved with invasive species. • Control weeds in high risk areas. • Educate and train staff about equipment and procedures to act on unexpected fire events.	• Weed monitoring • Dust monitoring	• Appropriate signage on all roads • Awareness program included in inductions and toolbox meetings • There is not a statistically significant increase in total weeds cover compared to control sites.	• Incident reports in BMS • Toolbox meeting minutes • Staff induction materials	• Site Environment Manager • Site Environmental Officers
Putrescible Waste Disposal	• Increased Feral Animal Activity	• Education and awareness training will inform employees of their requirement to report sightings of feral animals, that no domestic pets are allowed onsite and that no feeding of native and or feral animals is permitted. • All opportunistic feral animal sightings will be reported through the incident reporting procedures. • Feral animals recorded during Northern Quoll monitoring will be reported in the monitoring report. • Project facilities including food and domestic water management will be managed to minimise the presence of feral fauna species. This may include covering of bins, installation of fences around putrescible waste facility and general housekeeping. • Putrescible waste facilities will be managed in a way not to encourage feral animals by ensuring no waste is available as a food source for feral animals. • Should the results of Northern Quoll monitoring or opportunistic sightings record a significant increase of feral animals in the Project area, approved control methods will be implemented.	• Feral animal control programs are implemented. • Compliance with the Waste Management Plan. • Awareness material included in site induction programs.	• No significant increase in feral animal records	• Feral species BMS records • Northern Quoll monitoring program and report • Compliance Assessment Report • Internal audit and inspection reports • Induction programs	• Site Environment Manager

[This page has been left blank intentionally]

7. NORTHERN QUOLL MONITORING PROGRAM

Management actions (as indicated in Table 4 and Table 5) have been designed to avoid, mitigate, manage or minimise potential impacts on Northern Quoll individuals and their preferred habitats. It is necessary to monitor the implementation of these actions to ensure they are effective. To achieve this, a monitoring program for Northern Quoll will be conducted to monitor the presence, abundance and behaviour of Northern Quoll.

7.1 Previous Northern Quoll Census Data

Previous surveys for Northern Quoll were completed in 2011 (Ecologia Environment, 2012) to support environmental approvals for the Project.

Additionally, Northern Quoll monitoring has been undertaken as a requirement for the North Star Hematite Project EPBC Listed Threatened Fauna Management Plan (NS-PL-EN-0003) in 2014 and 2015 (Ecologia Environment, 2014) (Ecoscape, 2015). The results of these surveys and monitoring provide baseline data on Northern Quoll abundance, distribution and behaviour prior to development of the Project and during the first two years of construction and operation. These results will be incorporated into monitoring results analysis where possible. Census data from these previous surveys are provided in Appendix 1.

7.2 Monitoring Program Objectives

The broad objective for the monitoring plan is to monitor and measure the success of management measures in protecting Northern Quoll. Specific objectives include:

- Measure the impacts of the Project over time;
- Measure the success of management measures (based on Northern Quoll monitoring results) against performance indicators to inform an adaptive management approach that may be implemented during the life of the Project.

7.3 Monitoring Site Selection

To ensure that the monitoring program is consistent with, and builds on data previously collected at North Star, monitoring will continue to utilise Northern Quoll monitoring sites established during Stage 1 and Stage 2 of the project (Ecologia Environment, 2014) (Ecoscape, 2015).

A review of the monitoring data from the first two monitoring events, including radio collar tracking data (Appendix 2) and consideration of future disturbance of the Project has identified two current impact sites that will continue to be monitored. These impact monitoring site locations are shown in Figure 3. Monitoring sites should remain consistent between monitoring periods unless unforeseen circumstances render sites inappropriate.

Previous Northern Quoll monitoring completed at the Project area incorporated site specific control sites (Ecologia Environment, 2014) (Ecoscape, 2015). It is proposed that the monitoring program aligns with DPAW's Regional Pilbara Northern Quoll monitoring project. This project currently incorporates 14 monitoring sites across the Pilbara (Appendix 3). Due to consistency between Northern Quoll monitoring methods at Project area impact sites and DPAW regional Pilbara Northern Quoll monitoring sites, the DPAW control sites will now be utilised instead of the current North Star control sites. This will allow for an independent assessment of Northern Quoll population trends at the Project area in comparison to regional control sites.

Should DPAW monitoring sites no longer be available, or are deemed unsuitable as part of management review, then site specific control sites should be re-established, with careful consideration given to the proximity of the control sites to the Project and nearby Projects such as the Abydos Iron Ore Mine.

7.4 Monitoring Program Design

Previous Northern Quoll surveys and monitoring programs have been completed for the North Star Project area to both facilitate environmental approvals and to satisfy approval conditions. Subsequent to the surveys and monitoring programs, DPaW have released *Pilbara Northern Quoll Project, Surveying and Monitoring Dasyurus hallucatus in the Pilbara, Western Australia* (Dunlop, et al., 2014) (Appendix 3). The Northern Quoll monitoring program design for the Project will align with the current DPaW Northern Quoll Program (April 2014), allowing for results to be comparable with the ongoing Pilbara regional monitoring program. In addition, the *Survey guidelines for Australia's threatened mammals, EPBC Survey Guideline 6.5* (DSEWPAC, 2011a) and *Referral guidelines for the endangered Northern Quoll* (DSEWPAC, 2011b) have also been considered.

7.4.1 Population Monitoring

Trapping Methodology

As Northern Quolls often occur in linear rocky habitats, population monitoring is undertaken using trapping transects rather than grids. Transects are configured to achieve optimal cover of the sites. Two parallel lines of 25 traps each are laid within Northern Quoll habitat.

Each monitoring site to consist of:

- Trap type: wire cage traps covered with hessian or similar (e.g. small cage traps: 45 cm x 17 cm x 17 cm).
- Bait type: Universal bait (peanut butter, oats) with sardines.
- Layout: 50 traps, each spaced 50 m apart, in two lines of 25 traps, with at least 50 m between each transect.

- Duration: Traps opened for four consecutive nights at each site (200 trap nights). Traps are checked and closed in accordance with DPAW license requirements.
- Marking: Individual trap locations are fixed and marked (GPS) for the duration of the monitoring program.
- Searches: To verify a zero-capture record, personnel should also undertake a total of 10 person-hours of track and scat searches per site.
- A sample of scats is collected where possible for dietary analysis (stored in a paper envelope, lodged with DPaW) (if DPAW require);
- Habitat data sheets should be completed for each trapping site(if DPAW require).

Information Collected From Trapped Individuals

Morphometric, survivorship, dietary, breeding and genetic information will be collected for comparison between monitoring events. Data collected will be made available to DPaW to incorporate in to DPaW's regional population monitoring of Northern Quolls in the Pilbara and across Australia. Information to be collected includes:

- All captured individuals are implanted with a subcutaneous microchip (PIT) for individual identification;
- Standard measurements collected from all captured individuals (body weight, short pes length, head length, age class, sex and reproductive condition);
- A small amount of ear tissue is collected from all individuals at initial capture for genetic analysis (stored in 100% ethanol, to be lodged with DPaW);

Alternative Trapping Method

Recent advances in motion camera monitoring have demonstrated that Northern Quoll can be identified by downward facing cameras (Harry A. Moore, 2021)(Jesse Rowland A C, 2020). This method is less invasive than cage trapping and poses less risks to harming Northern Quoll.

Each monitoring site to consist of:

- Trap type: downward facing motion cameras (or equivalent design to allow Spot recognition)
- Bait type: Universal bait (peanut butter, oats) with sardines or similar in bait pod (non-reward)
- Layout: 5 motion cameras approx. 200 m apart
- Duration: four consecutive nights at each site.
- Marking: Individual trap locations are fixed and marked (GPS) for the duration of the monitoring program.

- Searches: To verify a zero-capture record, personnel should also undertake a total of 10 person-hours of track and scat searches per site.
- A sample of scats is collected where possible for dietary analysis (stored in a paper envelope, lodged with DPaW) (if DPAW require);
- Habitat data sheets should be completed for each trapping site (if DPAW require).

Supplementary Camera Trapping

Remote camera methods include motion sensors that only activate the camera when an animal is in the field of view and close to the camera. Cameras can be left to operate for days/months, depending on batteries. Cameras can be used around targeted resources (i.e. breeding habitat/den entrances, water resources) to monitor northern quoll populations and behaviour.

For this monitoring program, motion cameras will also be used to determine feral predator presence and activity levels. Cameras will be set up in areas where quolls and predators are most likely to interact, such as putrescible waste storage areas and permanent water sources, or locations where predators are likely use preferentially, such as roads, access tracks and culverts. The location of motion cameras may change for each monitoring event and therefore, their locations have not been included in Figure 3.

Survey Timing

Northern Quoll trapping should be conducted between 1 April to 30 September to avoid the periods of the year when females have large pouch young or denned young (Dunlop, et al., 2014).

Monitoring should be undertaken annually in the non-breeding season, with a review of the program after the first two years of monitoring. Should the monitoring results indicate species absence or indicate an unexpected decline in the local population size and/or spatial distribution, the frequency of future monitoring will be re-assessed as well as the methodology and effort on annual monitoring.

Environmental Data

Standardised data sheets developed by DPaW (Appendix 3) for Northern Quoll will be completed for each monitoring site during each monitoring event. Weather data will be obtained on site by permanent weather stations and will be incorporated in to analysis of Northern Quoll monitoring results.

7.5 Behaviour Monitoring

Direct observations of natural Northern Quoll behaviour are hampered by the cryptic and nocturnal behaviour of the species. It is therefore difficult to quantify and measure behaviour of Northern Quoll using standard behaviour monitoring methods, as a response to the Project.

In consultation with DPaW, previous behaviour monitoring incorporated the use of radio collar tracking (Ecologia Environment, 2014) (Ecoscape, 2015). The results from this monitoring demonstrated Northern Quoll continued to utilise habitat areas in close proximity to direct impact areas (Appendix 2), and should form baseline data for future behaviour monitoring assessments.

If it can be demonstrated that Northern Quoll individual movements are not hindered by the key activities identified in Table 3, then it can therefore be assumed that the Project is not having a significant impact on behaviour. A qualitative assessment will be made, comparing Northern Quoll movements in relation to blast times and other operations and whether any barriers or avoidance movements are observed, when compared to previous North Star behaviour monitoring (Ecologia Environment, 2014) (Ecoscape, 2015).

During monitoring events that involve trapping, attempts will be made to monitor quoll movements via radio collar tracking. This will preferably consist of one female individual, however trapping results and DPAW licensing will determine how many, if any, Northern Quolls will be collared each monitoring event. Remote cameras should be used as an alternative to monitoring behaviour, when radio collar tracking is not undertaken.

Table 6: Summary of Northern Quoll Monitoring Program

Monitoring Parameters	Methodology	Minimum Annual Monitoring Effort	Timing and Frequency
Population	Trapping	Minimum Effort: • Two parallel lines of 25 traps each (50 traps in total) • 4 nights at each site Alternative Effort (or suitable equivalent): • Motion cameras: 5 cameras per sampling site. 4 nights.	April to September Annually
	Active searches for scats and other signs	• 10 hours per site	
	Remote Cameras	• 10 cameras per hectare sampling site • 12 nights at each site during the trapping program	
Behaviour	Radio Tracking	• 6 weeks	April to September Annually (if cage trapping)
	Remote cameras	• 10 cameras per hectare sampling site • 12 nights at each site	April to September Annually
Meteorological Data	Data from weather stations near monitoring locations	NA	NA
Environmental Threats	Observation, mapping, photographs	NA	NA

8. DATA ANALYSIS AND INTERPRETATION

8.1 Data Analysis

Monitoring data will be analysed to determine whether the resident Northern Quoll population at North Star has been impacted between monitoring events. The number of Northern Quoll individuals trapped will be compared over time. However, it is recognised trap captures alone are unlikely to be fully representative of trends due to variability in trap success. Monitoring methods proposed herein are consistent with capture-mark-recapture methodology and therefore appropriate models should be used to calculate population densities based on Northern Quoll capture results.

Incorporation of environmental data (Section 7.4.1), including habitat attributes and climate will be incorporated in to data analysis. Northern Quoll populations are known to fluctuate naturally according to resource availability (Cook, 2010). Therefore site climate data, particularly rainfall (as an indicator of resource availability) should be interrogated in conjunction with Northern Quoll monitoring results to determine if population decline trends are independent from climatic variables.

8.2 Performance indicators

Data collected from previous North Star Northern Quoll monitoring has been assessed and forms the basis of performance indicators used to develop population trigger and threshold levels to determine if the management approach is successful in minimising impacts on Northern Quoll. Should the results from Northern Quoll monitoring exceed the performance indicators, then contingency responses outlined in Section 8.3 will be implemented.

The performance indicator approach and hierarchy has been developed in accordance within EAG 17 (EPA, 2015). Two levels of performance indicators have been developed:

1. Trigger level; and

2. Threshold level.

The trigger level has been established to forewarn of the approach to threshold criteria level, and therefore “trigger” the response of actions in an attempt to prevent a threshold level from being reached. Exceedance of the threshold level represents an unacceptable impact and that the outcomes of Ministerial Condition 11 are not being met.

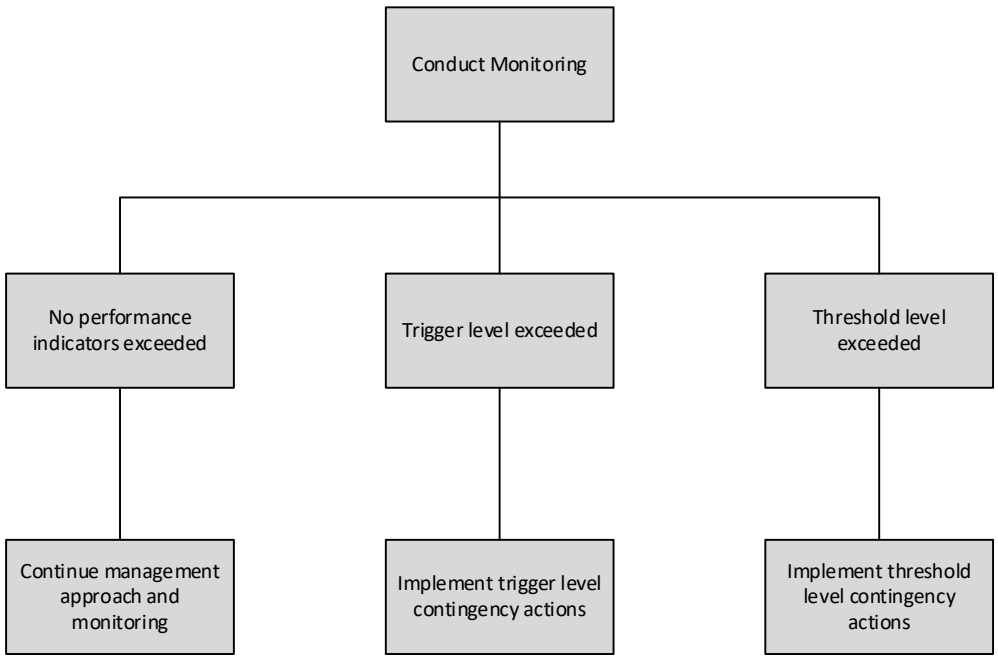
Performance indicators have been developed in consultation with DPaW (Section 3). It has been determined that Northern Quoll trap captures and estimated density can be used as measurable performance indicators. Performance indicators are displayed in Table 7. The performance indicator process is presented in Schematic 1.

Table 7: Performance indicators

Performance Indicator	Description	Response
Trigger level	A 25% decline in Northern Quoll trap captures and estimated density over three monitoring events that is attributable to the Project and is independent of climate trend and DPAW regional Northern Quoll control site population trend.	Implement trigger level contingency actions.
Threshold level	A 50% decline in Northern Quoll trap captures and estimated density over three monitoring events that is attributable to the Project and is independent of climate trend and DPAW regional Northern Quoll control site population trend.	Implement threshold level contingency actions.

Note, the DPAW program recognises that due to low capture rates and seasonal fluctuations in quoll population abundance, it will be necessary to monitor sites over 10 years to detect trends in abundance and other demographic parameters. This is also true of the North Star site, where population and demographic statistics have only been collected on three occasions (2011, 2014, 2015). For this reason, the decline trend needs to be observed over three monitoring events to provide a margin of error given the lack of certainty that exists regarding what is considered within the range of a normal population size and demographic at North Star.

Schematic Map 1: Performance Indicator Flow Chart



8.3 Contingency Responses

Should a Northern Quoll population decline trend be determined by the identified performance indicators described in Table 7, the first action is to compare the North Star data against regional climate data and DPAW regional Northern Quoll data to determine whether the trend observed is part of a larger Pilbara-wide decline in Northern Quoll. If this is demonstrated to be the case, then it is possible that the population at North Star would be placed under additional stress due to the presence of the Project. In these instances, effort should be put into management measures to assist the population to cope with sub-optimal seasonal conditions, such as increased predator control programs.

Where a population decline trend is observed that is not supported by regional data, the decline is more likely to be as a result of the Project. In these instances, where the decline is greater than 25% over three monitoring events, the contingency responses outlined in Section 8.3 will be implemented. Contingency responses are additional to management actions already discussed in Section 6. Trigger level responses will result in an internal review and course of actions to take place.

8.3.1 Trigger Level Contingency Response

Trigger level contingency responses are provided in Table 8. Column 1 identifies the project related impacts that have caused the decline. Column 2 provides the management response. As outlined above, these responses are to be implemented where the decline is attributable to the impact from the Project.

Table 8: Trigger level contingency responses

Impact	Response
Road kill	• Investigate any Northern Quoll road kill incidents and implement preventative actions as identified. • Increase frequency of site information release regarding Northern Quoll to raise awareness. • Review speed limits in Northern Quoll habitat areas. • Increase Northern Quoll road signage for awareness and adjust if required. • Limit non-essential night driving, especially during Northern Quoll breeding season.
Increased feral predator abundance	• Review feral predator abundance data from Northern Quoll monitoring. • Complete predator scat analysis to confirm predation. • Review putrescible waste storage and availability as a food source. • If an increase in feral predator abundance is demonstrated, implement feral predator control program.
Habitat degradation	• Investigate habitat mapping data • Investigate dust and other site specific environmental data monitoring. • Take corrective action where required. • Increase or bring forward vegetation rehabilitation areas.
Loss of habitat	• Review disturbance activities since previous monitoring event. • Investigate whether any breaches of Ground Disturbing Land User Certificates (LUC) occurred. • Ensure BMS is effectively capturing LUC process.

8.3.2 Threshold Level Contingency Response

Similar to Section 8.3.1 above, where the 50% threshold is exceeded, the first action is to compare the North Star data against regional climate data and DPAW regional Northern Quoll data to determine whether the trend observed is part of a larger Pilbara-wide decline in Northern Quoll. Should it be concluded that the exceedance is a result of the impacts from the Project, it has been determined, in consultation with DPaW (Section 3), that the creation of artificial denning habitat is the contingency response that is likely to have the most tangible benefit for the local Northern Quoll population.

Northern Quoll populations have previously been demonstrated to colonise artificial habitats, including old quarries and rocky support structures associated with bridge infrastructure over major rivers (Ecologia Environment 2009, 2013). These habitats provide the suitable rocky crevices and voids required by Northern Quoll for denning.

Specific artificial habitat creation for Northern Quoll, including location, design and amount of habitat will be determined in consultation with DPaW prior to implementation. Initial discussions with DPaW suggest artificial habitat can be created by utilising earthmoving equipment to gather large rock material, woody debris and previously cleared vegetation to form a mound with multiple cavities and entrance opportunities. Mounds should be up to two metres high and four to five metres in diameter and should be positioned within two kilometres of existing denning habitat (DPaW, 2014).

Should threshold level performance indicator be exceeded requiring the creation of artificial Northern Quoll habitat, the monitoring program will incorporate monitoring of the artificial habitat.

9. REPORTING

9.1 Northern Quoll Monitoring Report

Following the completion of Northern Quoll monitoring, a monitoring report will be completed and submitted to regulators as part of FMG Iron Bridge's compliance reporting commitments. The Northern Quoll monitoring report will contain all reporting requirements as stated within EAG 17 (EPA, 2015), and will include:

- Reporting of monitoring trends against performance indicators;
- Reporting any exceedance of performance indicators; and
- Reporting on review and revision of management actions and proposal activities which have been implemented when required.

Data to be presented within monitoring reporting will include number of trap captures, density estimates and morphological data on captured individuals. Suitable data analysis will be completed allowing for an assessment against performance indicators as identified in Section 8.2. Collation of previous Northern Quoll records will be presented within each monitoring report.

9.2 Performance Reporting and Auditing

Performance reporting will be implemented to produce systematic, comprehensive and informative reports on the environmental management and monitoring activities of the Project. Monitoring data will be collected as per this monitoring plan and FMG Iron Bridge will undertake annual internal audits to ensure monitoring commitments are being met. Where auditing finds environmental management actions are not being effective, the audits may recommend changes to procedures.

Internal auditing of activities associated with this management plan will be carried out in accordance with FMG Iron Bridge's internal audit schedule.

Where trigger level or threshold performance indicators are exceeded, or opportunities for improvement are identified relating to general management actions identified in Section 6, these will be documented and tracked via FMG Iron Bridge's Business Management System.

9.3 Adaptive Management

The methodologies in the Plan will be reviewed to determine whether they are adequate to ensure the data obtained from the monitoring program will adequately test the performance indicators developed above.

FMG Iron Bridge believes that the methodology provided in Section 7 (and detailed in Appendix 3) is specifically detailed to allow adequate data to be collected to ensure that the performance indicators can be tested.

Continued improvement of the plan will occur in response to environmental incident resolutions, audit findings, monitoring results, continuous improvement and changes in regulatory and corporate requirements.

REFERENCES

Cook, A., 2010. *Habitat use and home-range of the Northern Quoll, Dasyurus hallucatus: effect on fire.,* s.l.: School of Animal Biology, Faculty of Natural and Agricultrual Sciences, University of Western Australia.

DPaW, 2014. *Artificial Fauna Habitat Creation - Draft,* s.l.: Unpublished Report, Western Australia Department of Parks and Wildlife.

DPaW, Threatened species workshop - Northern Quoll. *2013,* s.l.: Unpublished workshop notes.

Dunlop, J., Cook, A. & Morris, K., 2014. *Pilbara Northern Quoll Project. Surveying and monitoring Dasyurus hallucatus in the Pilbara, Western Australia,* s.l.: Department of Parks and Wildlife.

Ecologia Environment, 2009. *RGP5 Northern Quoll Monitoring,* s.l.: Unpublished report for BHPBIO Pty Ltd.

Ecologia Environment, 2011a. *North Star Project Targeted Conservation Significant Fauna Survey,* s.l.: Unpublished report prepared for Fortescue Metals Group Ltd.

Ecologia Environment, 2012. *North Star Project Level 2 Terrestrial Vertebrate Fauna Assessment,* s.l.: Unpublished report prepared for Fortescue Metals Group Ltd.

Ecologia Environment, 2013. *Additional Rail Infrastructure Project Conservation Significant Fauna Monitoring Program (2012/2013),* s.l.: Unpublished Report for Fortescue Metals Group Ltd.

Ecologia Environment, 2014. *North Star Haematite Project, EPBC Listed Threatened Fauna Monitoring,* s.l.: Unpublished report for Fortescue Metals Group Ltd.

Ecoscape, 2015. *North Star Conservation Significant Fauna Monitoring Report,* s.l.: Unpublished Report for IB Operations Pty Ltd.

EPA, 2015. *Environmental Assessment Guideline 17: Preparation of Management Plans under Part IV of the Environmental Protection Act 1986,* s.l.: Environmental Protection Authority.

FMG, 2012. *EPBC Listed Threatened Fauna Management Plan - North Star Haematite Project NS-PL-EN-0003,* s.l.: Fortescue Metals Group Ltd.

Hill, B. M. & Ward, S. J., 2010. *National Recovery Plan for the Northern Quoll Dasyurus hallucatus. ,* s.l.: Department of Natural Resources, Environment, The Arts and Sport, Darwin.

Jesse Rowland A C, C. J. H. B. a. S. B., 2020. *Camera traps are an effective method for identifying individuals and determining the sex of spotted-tailed quolls (Dasyurus macuylatus gracilis).* Vol 42(3) ed. s.l.:Australian Mammalogy.

Woinarski, J., Burbidge, A. & Harrison, P., 2012. *The Action Plan for Australian Mammals,* s.l.: CSIRO Publishing.

[This page has been left blank intentionally]

Figure 1: Project Location

This page has been left blank intentionally

650,000 700,000 750,000 800,000 850,000

7,750,000

7,700,000

7,650,000

Port Hedland

Mount Goldsworthy

Marble Bar

★ NORTH STAR

13 km from North Star to Woodstock/Abydos Reserve

LEGEND

★ Towns and Project Area

FMG Rail

Data Source(s):
Aerial Imagery: Landgate
All other data: FMG, 2014

N

0 5 10 15 20 25

Kilometres

Requested By: M. Dowling
Drawn By: R. Slevin
Revised By: rslevin
Approved By: P. Mastalir
Scale: 1:600,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 611CO_0000_MP_EN_0037.004_r1

Date: 23/12/2015
Size: A3L
Revision: 1
Confidentiality: 0

Location Plan

Iron Bridge

Figure 2: Impact areas and Northern Quoll Habitat

This page has been left blank intentionally

710,000

720,000

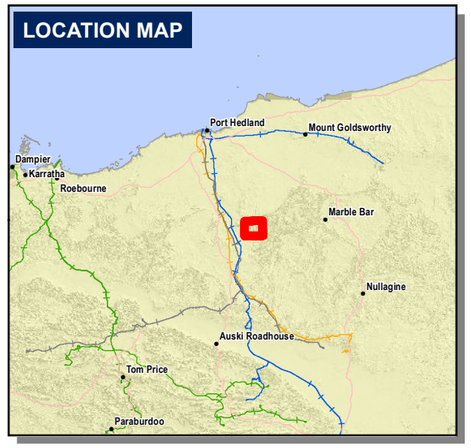
7,650,000

7,650,000

710,000

720,000

LOCATION MAP



LEGEND

- Mine Developement Envelope
- Revised Proposal Area
- Disturbance Footprint

Northern Quoll Habitat

- direct impact area (within disturb. footprint)
- indirect impact area (within 500m from disturb. footprint)
- no impact area

Data Source(s):
All data, FMGL, 2021

N

0 0.5 1 1.5 2 2.5
Kilometres

Northern Quoll Impact Area

Requested By: Todd Edward
Drawn By: Sang Li
Revised By: sanli
Approved By:
Scale: 1:58,624
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 662NS_0000_MP_EN_0226.001_r0

Date: 5/08/2021
Size: A3L
Revision: 0
Confidentiality: 0

GDA94

Iron Bridge

Figure 3: Monitoring Locations

This page has been left blank intentionally

710,000

720,000

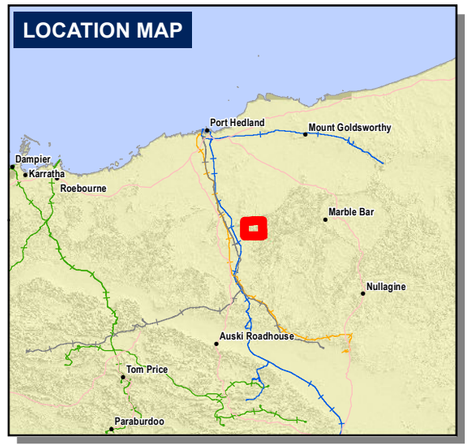
7,650,000

7,650,000

710,000

720,000

LOCATION MAP



LEGEND

- Mine Developement Envelope
- Revised Proposal Area
- Disturbance Footprint
- Monitoring Sites
- Indicative Monitoring Site

Northern Quoll Habitat

- direct impact area (within disturb. footprint)
- indirect impact area (within 500m from disturb. footprint)
- no impact area

Data Source(s):
All data, FMGL, 2021

N

0 0.5 1 1.5 2 2.5
Kilometres

Northern Quoll Impact Monitoring Sites

Requested By: Todd Edward
Drawn By: Sang Li
Revised By: sanli
Approved By:
Scale: 1:58,624
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 662NS_0000_MP_EN_0226.002_r0

Date: 5/08/2021
Size: A3L
Revision: 0
Confidentiality: 0

GDA94

Iron Bridge

Appendix 1: Previous North Star Northern Quoll Census Data

This page has been left blank intentionally

Microchip/ID	sex	date	Record	site		trap	Easting	Northing	WAM Tissue No.	Weight (g)	short peds (mm)	head length (mm)	Scrotum (mm)	Caudal (mm)	health rating	Comments	Vegetation Condition	Local impacts	Rainfall seasonality
Impact sites																			
2011				**Old site nan**	**New site nearby**														
M1	Male	8-Jul-11	capture	A	-	C04	711537	7651137	TM381	705	33.2	77.3	-	17.5	**5**	No signs of fighting	Excellent	Low, cleared tracks	Dry
		9-Jul-11	recapture	B	NS I1	C13	712167	7650597											
		10-Jul-11	recapture			C11	712029	7650678											
		11-Jul-11	recapture			C11	712029	7650678											
		12-Jul-11	recapture			C13	712167	7650597											
		13-Jul-11	recapture			C11	712029	7650678											
		14-Jul-11	recapture			C11	712029	7650678											
M2	Male	8-Jul-11	capture	A	-	C06	711648	7651037	TM382	615	32.7	70.1	-	13.5	**3**	Thin fur, few signs of fighting	Excellent	Low, cleared tracks	Dry
		10-Jul-11	recapture			C06	711648	7651037											
		12-Jul-11	recapture			C02	711578	7651211											
M5	Male	10-Jul-11	capture	C	NS I2	C23	712918	7648805	TM385	595	34.6	70.9	-	16.4	**55**	No signs of fighting	Excellent	Low, cleared tracks	Dry
		11-Jul-11	recapture			C24	713028	7648914											
		12-Jul-11	recapture			C23	712918	7648805											
		13-Jul-11	recapture			C22	712893	7648932											
F6	Female	10-Jul-11	capture	B	NS I1	C10	711957	7650706	TM386	330	30.8	63.5	-	15	**5**	No signs of fighting	Excellent	Low, cleared tracks	Dry
		12-Jul-11	recapture			C11	712029	7650678											
		14-Jul-11	recapture			C13	712167	7650597											
M7	Male	11-Jul-11	capture	A	-	C03	711476	7651205	TM387	630	35.4	75	--	17.1		Pouch not developed	Excellent	Low, cleared tracks	Dry
		12-Jul-11	recapture			C03	711476	7651205											
		13-Jul-11	recapture			C02	711578	7651211											
M10	Male	13-Jul-11	capture	B	NS I1	C14	712257	7650549	TM390	778	40	75.7	-	18.5		No signs of fighting	Excellent	Low, cleared tracks	Dry
		14-Jul-11	recapture			C14	712257	7650549											
2014																			
941000016595571	Female	27/08/2014	capture	NQ I1		21	712261	7650571	WAMTS326	395	2.75	5.7	N/A	11	2.5	-	Very good	Some noise and dust from nearby mining activities	Dry
		29/08/2014	recapture			17	712230	7650449											
		30/08/2014	recapture			5	712303	7650321											
941000016595479	Female	29/08/2014	capture	NQ I2		18	712924	7648751	WAMTS326	360	3.77	4.68	N/A	17	3.5	appears to have been mated, no young in pouch, large scars on both thighs, small patch of hair missing on back	Very good	Some noise and dust from nearby mining activities	Dry
941000016202872	Male	25/08/2014	capture	NQ I2		21	712261	7650571	WAMTS326	275	36.5	6.9	-	11.5	4	Slender and small	Very good	Some noise and dust from nearby mining activities	Dry
		26/08/2014	recapture			18	712924	7648751											
		27/08/2014	recapture			17	712924	7648726											
		28/08/2014	recapture			16	712928	7648696									Very good	Some noise and dust from nearby mining activities	Dry
		29/08/2014	recapture			14	712934	7648633											
		30/08/2014	recapture			14	712934	7648633											
		31/08/2014	recapture			7	713050	7648530											

Microchip/ID	sex	date	Record	site	trap	Easting	Northing	WAM Tissue No.	Weight (g)	short peds (mm)	head length (mm)	Scrotum (mm)	Caudal (mm)	health rating	Comments	Vegetation Condition	Local impacts	Rainfall seasonality
941000016595484	Male	31/08/2014	capture	NQ I2	18	712924	7648751	WAMTS326	640	3.2			20		signs of combat suggesting reproductive	Very good	Some noise and dust from nearby mining activities	Dry
941000016595499	Male	29/08/2014	capture	Site office	Additiona	712658	7650700	WAMTS326	530	3.73	5.9	-	15	3.5	-	Very good	Some noise and dust from nearby mining activities	Dry
		30/08/2014	recapture	NQ I2	18	712924	7648751											
941000016595477	Male	26/08/2014	capture	NQ I2	6	713065	7648513	WAMTS326	800	3.85	7.9	-	15.5	4	Equipped with radio collar	Very good	Some noise and dust from nearby mining activities	Dry
		28/08/2014	recapture	NQ I3	4	713383	7647871											
		30/08/2014	recapture		6	713319	7647876											
		31/08/2014	recapture		6	713319	7647876											
941000016595575	Female	25/08/2014	capture	NQ I3	5	713352	7647875	WAMTS326	375	2.7	6.2	N/A	15.5	3.5	Healing wound	Very good	Some noise and dust from nearby mining activities	Dry
		27/08/2014	recapture		4	713383	7647871											
		29/08/2014	recapture		12	713192	7647903											
		30/08/2014	recapture		5	713352	7647875											
941000016595478	Male	25/08/2014	capture	NQ I4	17	715813	7649275	WAMTS326	560	2.13	6.29	1.6	7	3.5	reproductive male, signs of combat, missing fur on head and tail	Very good	Some noise and dust from nearby mining activities	Dry
		29/08/2014	recapture		15	715837	7649277											
941000016595496	Male	26/08/2014	capture	NQ I4	19	715772	7649294	WAMTS326	370	3.45	69.5	-	11	4.5	-	Very good	Some noise and dust from nearby mining activities	Dry
		27/08/2014	recapture		19	715772	7649294											
		28/08/2014	recapture		15	715837	7649277											
		29/08/2014	recapture		15	715837	7649277											
2015																		
941000016202842	Female	24/08/2015	capture	NQ I2	1	712924	7648751		345	33	-	-	13	4	missing fur on both sides indicating signs of mating	-	-	-
		25/08/2015	recapture		5	712934	7648633											
941000016595571	Female	22/08/2015	capture	NQ I1	2	712296	7650382		410	30			13	4	mated and has missing furn in sides			
941000017452055	Female	25/08/2015	capture	NQ I1	24	712443	7650130		403	32			15	4	developed pouch with small embryos in it. some sores and signs of fighting but pretty good			
941000017452056	Male	26/08/2015	capture	NQ I1	11	712350	7650282		524	36			14	3	some fighting and mating			
941000017452060	Male	23/08/2015	capture	NQ I4	6	716171	7649355		565	36	76		12	3.5	skinny			
		24/08/2015	recapture		6	716171	7649355											
		25/08/2015	recapture		5	716198	7649334											
941000017452061	Male	22/08/2015	capture	NQ I3	7	713295	7647886		613	36	84		15	3	wounds			
941000017452063	Female	25/08/2015	capture	NQ I4	8	716106	7649354		347	31			10	4	None			
941000017452064	Female	24/08/2015	capture	NQ I3	9	713264	7647912		445	40.8			15	4	developed pouch, no embryos			
		22/08/2015	capture		13	715935	7649279											

Microchip/ID	sex	date	Record	site	trap	Easting	Northing	WAM Tissue No.	Weight (g)	short peds (mm)	head length (mm)	Scrotum (mm)	Caudal (mm)	health rating	Comments	Vegetation Condition	Local impacts	Rainfall seasonality
941000017452071	Male	23/08/2015	recapture	NQ I4	13	715935	7649279		547	48.9			15.5	3.5	mating and fighting; some hair loss			
		25/08/2015	recapture		19	715813	7649275											
		26/08/2015	recapture		18	715815	7649288											
		27/08/2015	recapture		21	715772	7649294											
Control sites																		
2011				**Old site nan**	**New site nearby**													
M3	Male	9-Jul-11	capture	D	-	C28	713394	7643895	TM383	590	35.6	71.3	-	15.5	**5**	No signs of fighting	Excellent	Low, cleared tracks	Dry
		10-Jul-11	recapture			C28	713394	7643895										
		11-Jul-11	recapture			C31	713490	7643914										
		12-Jul-11	recapture			C29	713410	7643903										
		13-Jul-11	recapture			C32	713551	7643910										
		14-Jul-11	recapture			C30	713423	7643918										
M4	Male	10-Jul-11	capture	E	NS C2	C36	713311	7644664	TM384	727	36.1	80	-	15.6	5	Coat thick with no patches, some body fat	Excellent	Low, cleared tracks	Dry
		11-Jul-11	recapture			C37	713278	7644659										
		12-Jul-11	recapture			C39	713233	7644651										
		13-Jul-11	recapture			C36	713311	7644664										
		14-Jul-11	recapture			C37	713278	7644659										
M8	Male	11-Jul-11	capture	S4	-	C47	713117	7646259	TM388	605	34.5	78.5	-	13.4	5	some body fat, no missing fur	Excellent	Low, cleared tracks	Dry
		12-Jul-11	recapture			C47	713117	7646259										
		13-Jul-11	recapture			C48	713098	7646325										
F9	Female	11-Jul-11	capture	E	-	C36	713311	7644665	-	320	32.1	59.2	-	14.8	5	Pouch not developed	Excellent	Low, cleared tracks	Dry
AAM1	Male	25-Jul-11	capture	S9	NS C4	C135	718348	7655633	TM391	660	35.9	83.2	-	-	4.5	No signs of fighting	Excellent	Low, cleared tracks	Dry
AAM2D	Male	27-Jul-11	capture	S3	NS C3	C75	713229	7657185	TM392	795	35.2	74.3	-	17.9	4	No signs of fighting	Excellent	Low, cleared tracks	Dry
AAM2B	Male	27-Jul-11	capture	S9	NS C4	C140	718069	7655602	TM393	575	35.8	68	-	-	4.5	No signs of fighting	Excellent	Low, cleared tracks	Dry
AAF3	Female	25-Jul-11	capture	S8	-	C124	718914	7658171	TM394	385	33	62.6	N/A	-	4.5	Pouch not developed	Excellent	Low, cleared tracks	Dry
AAF4	Female	25-Jul-11	capture	S8	-	C127	718680	7658073	TM395	405	30	68.5	-	-	4.5	Pouch not developed	Excellent	Low, cleared tracks	Dry
		28-Jul-11				C132	718628	7658202								Pouch not developed	Excellent	Low, cleared tracks	Dry
AAM5	Male	26-Jul-11	capture	S9	NS C4	C140	718069	7655602	TM396	690	36.6	74.6	-	-	4.5	No signs of fighting	Excellent	Low, cleared tracks	Dry
		27-Jul-11	recapture			C139	718134	7655582		705									
		28-Jul-11	recapture	S8	-	C128	718659	7658149		685									
		29-Jul-11	recapture			C126	718765	7658124		680									
		26-Jul-11	recapture	S9	NS C4	C140	718069	7655602		690									
AAM6	Male	26-Jul-11	capture	S8	-	C124	718914	7658171	TM397	800	36.6	80.8	-	-	4.5	No signs of fighting	Excellent	Low, cleared tracks	Dry
		27-Jul-11	recapture			C127	718680	7658073		780									
		28-Jul-11	recapture			C126	718765	7658124		830									
		29-Jul-11	recapture			C128	718659	7658149		-									

Microchip/ID	sex	date	Record	site		trap	Easting	Northing	WAM Tissue No.	Weight (g)	short peds (mm)	head length (mm)	Scrotum (mm)	Caudal (mm)	health rating	Comments	Vegetation Condition	Local impacts	Rainfall seasonality
AAM7	Male	29-Jul-11	capture	S8	-	C124	718914	7658171	TM398	730	37.6	78.2	-	-	4.5	No signs of fighting	Excellent	Low, cleared tracks	Dry
AAM8	Male	27-Jul-11	capture	S8	-	C126	718765	7658124	TM399	610	36.2	75	-	-	4.5	No signs of fighting	Excellent	Low, cleared tracks	Dry
		29-Jul-11	recapture			C127	718680	7658073											
AAM9	Male	24-Jul-11	capture	S8	-	C127	718680	7658073	TM400	655	36.8	74.5	-	-	4.5	No signs of fighting	Excellent	Low, cleared tracks	Dry
2014																			
941000016595482	Male	26/08/2014	capture	NQ C1		4	713392	7646226	WAMTS326	860	40	67.8	-	16.5	-	adult male, reproductive	Very good	Low, some noise from nearby mine activities, cleared tracks	Dry
		28/08/2014	recapture			17	713099	7646318											
		27/08/2014	recapture			18	713087	7646363											
941000016595486	Female	24/08/2014	capture	NQ C1		9	713247	7646030	WAMTS326	340	17.4	54.4	N/A	17.4	4	-	Very good	Low, some noise from nearby mine activities, cleared tracks	Dry
		25/08/2014	recapture			5	713371	7646193											
		28/08/2014	recapture			9	713247	7646030											
941000016595485	Male	26/08/2014	capture	NQ C2		19	713106	7644714	WAMTS326	580	38	65.5	-	12	3.5		Very good	Low, some noise from nearby mine activities, cleared tracks	Dry
941000016595495	Male	28/08/2014	capture	NQ C2		10	713236	7644684	WAMTS326	635	34	65	-	16.5	3.5	Average, missing fur on tail	Very good	Low, some noise from nearby mine activities, cleared tracks	Dry
		30/08/2014	recapture			21	713223	7644656											
941000016595497	Female	28/08/2014	capture	NQ C2		4	713509	7644697	WAMTS326	385	26	6	N/A	11.5	4	No pouched young	Very good	Low, some noise from nearby mine activities, cleared tracks	Dry
		29/08/2014	recapture			8	713322	7644657											
		30/08/2014	recapture			8	713322	7644657											
941000016595498	Female	28/08/2014	capture	NQ C2		18	713101	7644777	WAMTS326	365	28	51	N/A	14	3.5	-	Very good	Low, some noise from nearby mine activities, cleared tracks	Dry

Microchip/ID	sex	date	Record	site	trap	Easting	Northing	WAM Tissue No.	Weight (g)	short peds (mm)	head length (mm)	Scrotum (mm)	Caudal (mm)	health rating	Comments	Vegetation Condition	Local impacts	Rainfall seasonality
941000016202871	Male	24/08/2014	capture	NQ C2	19	713106	7644714	WAMTS326	725	27.5	70	-	16.5	5	-	Very good	Low, some noise from nearby mine activities, cleared tracks	Dry
		25/08/2014	recapture		8	713322	7644657											
		28/08/2014	recapture	NQ C1	18	713087	7646363											
941000016595535	Male	25/08/2014	capture	NQ C3	1	713202	7657203	WAMTS326	560	23.5	61	17	14	3	-	Excellent	Low, some cleared tracks	Dry
941000016595534	Male	25/08/2014	capture	NQ C4	3	718449	7655567	WAMTS326	480	20	51	17	9.2	3.5	Young male, missing fur on tail but no sign of fighting	Excellent	Low, some cleared tracks	Dry
		26/08/2014	recapture		4	718429	7655572											
		27/08/2014	recapture		4	718429	7655572											
		28/08/2014	recapture		5	718387	7655606											
2015																		
941000016595486	Female	23/08/2015	capture	NQ C1	25	713219	7646475		420	32			17	4	recapture from prev year			
		24/08/2015	recapture		17	713099	7646318											
		23/08/2015	recapture		18	713087	7646363											
941000016595497	Female	24/08/2015	capture	NQ C2	6	713503	7644693		446	35			15	4	None			
		25/08/2015	recapture		14	713283	7644663		451									
941000016595533	Female	23/08/2016	capture	NQ C1	11	713191	7646070		337	27			13	4	None			
		26/08/2016	recapture		11	713191	7646070		335									
941000017452062	Male	23/08/2015	capture	NQ C4	7	718404	7655595		406	36			16	3	fur missing			
		24/08/2015	recapture		17	718182	7655616											
		26/08/2016	recapture		21	718110	7655604											
		27/08/2015	recapture		25	718062	7655604											
941000017452068	Male	22/08/2015	capture	NQ C4	9	718359	7655616		662	37.2			17.5	3.5	None			
		26/08/2015	recapture		7	718404	7655595											
985170002967064	Male	21/08/2015	capture	NQ C4	1	718547	7655513		489	37	80		13	2.5	few fight wounds			
		25/08/2015	recapture		6	718424	7655577											
		26/08/2015	recapture		12	718289	7655612											
985170002971079	Male	21/08/2015	capture	NQ C4	8	718381	7655612		522	35	70		12	3	fighting wounds			
		22/08/2015	recapture		4	718464	7655559											
		23/08/2015	recapture		4	718464	7655559											
		24/08/2015	recapture		13	718272	7655599											
		25/08/2015	recapture		10	718338	7655602											
		26/08/2015	recapture		5	718445	7655570											
		27/08/2015	recapture		13	718272	7655599											

Appendix 2: Previous North Star Northern Quoll Radio Tracking Results

This page has been left blank intentionally

705000 708000 711000 714000 717000 720000

7653000

7650000

7647000

7644000

Legend

- Northern Quoll location (6 week period)
- North Star Magnetite Project Part IV boundary
- Northern Quoll habitat direct impact area
- Northern Quoll habitat indirect impact area
- Infrastructure area

ecologia ENVIRONMENT

0 1 2

Kilometres

Absolute Scale - 1:45,000

N

Previous North Star Northern Quoll radio tracking and behaviour results

Figure: Appendix B
Project ID: 1649

Drawn: BG
Date: 17/09/2015

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

A3

712000
713000
714000
7651000
7650000
7649000

Night 10 (Fix #30)
MC I8
MC I6
Night 19 (Fix #57)
Night 23 (Fix #68)
Night 11 (Fix #33)
Night 6 (Fix #17)
Night 5 (Fix #14)
Night 24 (Fix #70)
Night 14 (Fix #40)
Night 11 (Fix #31)
MC I7
NS NQ I1
Night 9 (Fix #10)
Night 8 (Fix #9)
Night 7 (Fix #8)
Night 13 (Fix #15)
Night 14 (Fix #16)
Night 11 (Fix #14)
Night 6 (Fix #7)
Night 9 (Fix #11)
Night 3 (Fix #4)
Night 4 (Fix #6)
Night 2 (Fix #3)
Night 1 (Fix #2)
Night 1 (Fix #1)
Night 11 (Fix #13)
Night 4 (Fix #5)

LEGEND

Point Linkage

Individual

Female Northern Quoll (Collar #3,Freq:150.139)

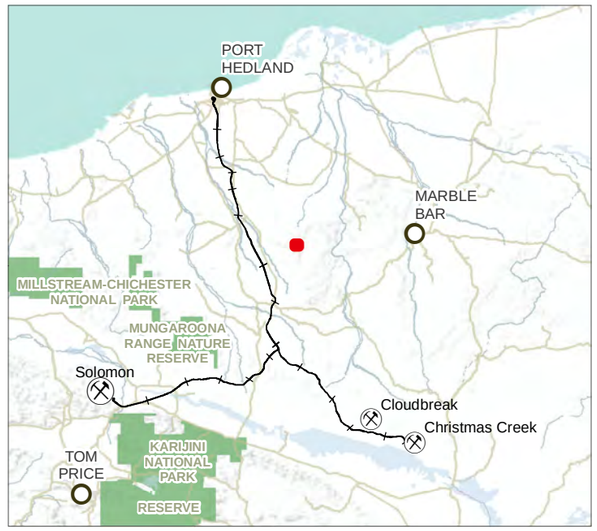
Male Northern Quoll (Collar #1,Freq:150.99)

Monitoring Sites

Motion Camera

Northern Quoll

OVERVIEW



Service Layer Credits: Sources: Esri, USGS, NOAA

ecoscape

AUTHOR: CP
DATE: SEP-15 PROJECT NO: 3501-15

NORTH STAR NORTHERN QUOLL WINTER MONITORING

CLIENT: FORTESCUE

COLLAR DATA

MAP 1

SCALE 1:10,000 @ A3

0 250 500 M

Appendix 3: DPAW Pilbara Northern Quoll Project

This page has been left blank intentionally

Pilbara northern quoll project

Surveying and monitoring *Dasyurus hallucatus* in the Pilbara, Western Australia

Judy Dunlop, Annette Cook and Keith Morris

April 2014

Department of
Parks and Wildlife

Science and Conservation Division
Department of Parks and Wildlife
Western Australian Wildlife Research Centre
Woodvale, Western Australia
Phone: (08) 9405 5104

www.dpaw.wa.gov.au

Written April 2014
Updated October 2014

This report/document/publication was prepared by J. Dunlop, A. Cook, K. Morris

Questions regarding the use of this material should be directed to:
Pilbara Northern Quoll Research Scientist
Science and Conservation Division

The recommended reference for this publication is:
Dunlop, J., Cook, A., Morris, K.D., 2014, *Pilbara northern quoll project - Surveying and monitoring Dasyurus hallucatus in the Pilbara, Western Australia* Department of Parks and Wildlife, Perth.

This document is available in alternative formats on request.

Cover image: Annette Cook

Contents

Appendices

1.1 Scope

This document outlines the objectives of the Department of Parks and Wildlife Pilbara northern quoll project, and provides methodologies to be used to achieve these specific objectives. Other organisations undertaking quoll monitoring projects can then align with these methods and contribute comparable data in to the regional survey.

1.2 Background

The northern quoll, *Dasyurus hallucatus*, is the smallest of all Australian quolls (300–1200g) and is restricted to five regional populations across Queensland, the Northern Territory and Western Australia, both on the mainland and offshore islands. The species appears to have declined in number and distribution over the last 50 years with a number of threats either directly or in combination with each other, contributing to the species decline. Threats include mortality caused by poisoning from cane toads, introduced predators, inappropriate fire regimes (predation after fire) and the removal, degradation and fragmentation of habitat as a result of development actions, mining activities and pastoralism. The northern quoll is listed as a threatened ('Endangered') species under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999.*

The Pilbara northern quoll survey and monitoring project commenced in 2012 and will be conducted over 10 years with the aim of improving our understanding of distribution, ecology, abundance and demographics of the northern quoll in the region. The project aims to provide information to environmental regulators, biological consultants, resource development companies and other land managers that will allow appropriate management to ensure the persistence of resident northern quoll populations in the Pilbara region.

1.3 Objectives of the northern quoll project

1. To determine the northern quoll distribution in the Pilbara (including updating NatureMap records), and enhance our understanding of processes influencing distribution.
2. To estimate northern quoll abundance in the Pilbara and how this changes temporarily and spatially.
3. To improve understanding of northern quoll ecology and other demographic parameters in the Pilbara and allow comparison with studies in the Kimberley, Northern Territory and Queensland.
4. To inform management actions with regard to the persistence of northern quoll populations in and around mining sites and other developments in the Pilbara.
5. To clarify the taxonomic and conservation status of the Pilbara northern quoll population.

1.3.1 Desktop review

A desktop review of northern quoll distribution was undertaken in 2010 in order to update NatureMap records (Objective 1) and identify suitable quoll habitat for further survey (Objectives 2 & 3). Records included landholder sightings, museum specimens and capture records by environmental consultants and Parks and Wildlife staff. The review helped to inform placement of long-term monitoring sites. This report and the associated data will be available on the NatureMap Pilbara Threatened Fauna portal located at:
www.naturemap.dpaw.wa.gov.au/threatenedfauna

1.3.2 Presence survey and distribution modelling

To inform species distribution modelling (Objectives 1 & 4), Parks and Wildlife has commenced a survey of quoll presence at 100 sites throughout the Pilbara. At each site, staff will undertake scat searches and establish transects of baited remote motion sensor cameras in rocky areas to detect quoll presence. Habitat characteristics of each site are recorded according to Appendix A. Additional presence records and habitat data from environmental consultants, pastoralists and mine site environmental staff will be used to build and validate models of distribution.

1.3.3 Long term monitoring sites

Parks and Wildlife is also undertaking annual trapping at 10 sites throughout the Pilbara in order to achieve more detailed information on population demographics and abundance (Objectives 2 & 3). Those selected include Indee Station, Millstream Chichester National Park, Mt Florance Station, Mallina Station, De Grey Station,

Cane River Conservation Park, Yarrie Station, Red Hill Station, Dolphin Island Nature Reserve and Karijini National Park. The land tenure and security of the site has been taken into consideration, as these sites will need to remain free of mining and / or major pastoral disturbance for the duration of the project. Because of anticipated low capture rates and seasonal fluctuations in quoll population abundance it will be necessary to monitor sites over a long period (10 years) to detect trends in abundance and other demographic parameters.

We anticipate that there will be opportunities for ecological research projects such as examining den and feeding habitat use, movements across the landscape, impact of introduced predators, interactions with mine-sites and characteristics of natural den sites in order to inform artificial habitat creation. Collaborations with Murdoch University, University of Queensland and Edith Cowan University are underway.

1.4 Methods

1.4.1 Trapping

Once a quoll population has been identified, the following methods should be used for ongoing monitoring to be comparable to the Department's regional survey.

Northern quoll trapping should be conducted from 1 April to 30 September to avoid times when females have large or denned pouch young.

As northern quolls frequently live in linear rocky habitats, population monitoring is undertaken using trapping transects rather than grids. Transects are configured to achieve optimal cover of the sites. Two parallel lines of 25 traps each are laid across broader habitat types such as breakaways or granite outcrops.

Specific quoll trapping methods:

- Trap type: wire cage traps covered with hessian or similar (e.g. small Sheffield traps: 45 cm x 17 cm x 17 cm, Sheffield Wire co, Welshpool WA)
- Bait type: Universal bait (peanut butter, oats) with sardines
- Layout: 50 traps, each spaced 50 m apart, in two lines of 25 traps, with at least 50 m between each transect.
- Duration: Traps opened for four consecutive nights at each site (200 trap nights). Traps are checked and closed within three hours of sunrise, rebaited and opened in the late afternoon.
- Marking: Individual trap locations are fixed and marked (GPS) for the duration of the monitoring program. Sites are marked with permanent markers such as metal site tags.
- Searches: To verify a zero-capture record, personnel should also undertake a total of 10 person-hours of scat searches per site, and use at least five remote cameras at the site/surrounding area during the four nights of trapping.

Information collected from trapped animals:

Morphometric, survivorship, dietary, breeding and genetic information is collected for comparison with populations of northern quolls in the Pilbara and across Australia.

- All captured quolls are implanted with a subcutaneous microchip (PIT) for individual identification.
- Standard measurements collected from all captured quolls (body weight, short pes length, head length, age class, sex and reproductive condition) (see example datasheet in Appendix B)
- A small amount of ear tissue is collected from all individuals at initial capture for genetic analysis (stored in 100% ethanol, to be lodged with Department of Parks and Wildlife).
- A sample of scats is collected where possible for dietary analysis (stored in a paper envelope, lodged with Department of Parks and Wildlife).

- An estimation of fox/cat/dog/dingo activity at each site will be derived using visual signs and remote cameras.
- Habitat data sheets (Appendix A) should be completed for each trapping site and submitted to the Department of Parks and Wildlife.

These protocols outline the methods for regular monitoring of a population of northern quolls, in order to answer questions about abundance, survivorship and breeding demographics. More information on surveying for threatened mammals can be found here: http://www.environment.gov.au/system/files/resources/b1c6b237-12d9-4071-a26e-ee816caa2b39/files/survey-guidelines-mammals.pdf

1.4.2 Camera trapping

Remote cameras can be useful to supplement trapping, for initial area searches to detect quolls and to assess quoll presence and activity in an area. Unlike traps, cameras can be used at any time of year. Duration of camera trapping will depend on the circumstances and goals of the individual project, but more information is collected from a longer set time. In general, camera traps should not be baited with food rewards for longer than five consecutive nights, to prevent impacts on normal animal behaviour (See Parks and Wildlife standard operating procedure 5.2 available from http://www.dpaw.wa.gov.au/plants-and-animals/96-monitoring/standards/99-standard-operating-procedures). Scent lures with no associated food reward may be useful, for example burley oil.

For our presence survey (Objective 1), standard methods are as follows;

- Transects of ten baited remote motion sensor cameras spaced at least 100 m for four nights.
- 10 person hours of scat searches in rocky areas
- Habitat data sheet (Appendix A) completed

It is important to note that this does not confirm absence, and proponents managing species-specific surveys will need to undertake more extensive searches.

1.4.3 Habitat monitoring and distribution modelling

Habitat attributes will be recorded at all sites (including camera survey and monitoring sites) and will be analysed to help predict the spatial distribution of suitable habitat and the probability of quolls occupying locations based on environmental attributes. Fire history and other disturbances such as livestock impact will also be assessed and monitored. Photo points and digital rain gauges will be established at all long-term monitoring sites. Site characteristics will be correlated with quoll presence or likely absence in order to inform predictive models. Standard data sheets used to record habitat attributes are in Appendix A.

1.5 Reporting

Much of the survey and monitoring data collected will be suitable for comparison with studies for quolls in the Kimberley, Northern Territory and Queensland. An annual report on population and habitat monitoring will be prepared, and peer reviewed papers prepared throughout the duration of the project.

All presence records, including those from the grey literature review and historical record, will be uploaded to NatureMap. Environmental consultants, mine-site environmental staff and others encountering Pilbara priority species (northern quoll, bilby, mulgara, Pilbara leaf-nosed bat and Pilbara olive python) are also encouraged to add records to NatureMap, via the Pilbara Threatened Fauna theme

www.naturemap.dpaw.wa.gov.au/threatenedfauna .

Appendices

PILBARA NORTHERN QUOLL DATA SHEET – Habitat Survey

Site name:		Recorder/s:
Date:	Time:	Contact email:
GPS datum:		GPS Accuracy:
GPS Co-ords:		Height above sea level:

Please consider a 50m x 50m patch for all questions. Many of these categories are derived from: National Committee on Soil and Terrain (2009) 'Australian Soil and Land Survey Field Handbook', CSIRO Publishing, Melbourne

1. *LANDFORM ELEMENT*

Morphological type 13

C	*Crest*	F	*Flat*
U	*Upper slope*	V	*Open depression (vale)*
M	*Mid slope*	D	*Closed depression*
L	*Lower slope*	H	*Hillock*
S	*Simple slope*	R	*Ridge*

2. *ROCK OUTCROP*

TYPE (e.g. granite)

Abundance 101

0	*No bedrock exposed*	
1	*Very slightly rocky*	*<2%*
2	*Slightly rocky*	*2-10%*
3	*Rocky*	*10-20%*
4	*Very rocky*	*20-50%*
5	*Rockland*	*>50%*

3. *SOIL*

Colour

R	*Red*	Y	*Yellow*
O	*Orange*	G	*Grey*
B	*Brown*	D	*Dark*

Type **116**

1	*Clay*	5	*Coarse sand*
2	*Fine silt*	6	*Fine gravel*
3	*Coarse silt*	7	*Coarse gravel*
4	*Fine sand*	8	*None; rock only*

4. *GROUND COVER*

% Cover Leaf Litter

% Cover Bare Ground
(including litter, rock cover
and bare soil, excluding live vegetation)

5. *COARSE FRAGMENTS ON THE SURFACE*

Rock Abundance **97**

0	*No coarse fragments*	0
1	*Very slightly; very few*	<2%
2	*Slightly; few*	2%-10%
3	*No qualifier; common*	10%-20%
4	*Moderately; many*	20%-50%
5	*Very; abundant*	50%-90%
6	*Extremely; very abundant*	>90%

Rock Size **99**

3	*Gravelly*	>60 mm
4	*Cobbly; or cobbles*	60-200 mm
5	*Stony; stones*	200-600 mm
6	*Bouldery; or boulders*	600 mm-2 m
7	*Large boulders*	>2 m

6. *LAND SURFACE*

Disturbance of site **88**

0	*No effective disturbance*
1	*No effective disturbance except grazing by hoofed animals*
2	*Limited clearing*
3	*Extensive clearing*
8	*Highly disturbed, e.g. mining, urban*

7. *EVIDENCE OF RECENT FIRE*

Frequency		**Intensity**	
0	*Long unburnt*	0	*No damage*
1	*Several years since burn*	1	*Minor*
2	*Burnt before last rainfall*	2	*Some defoliated*
3	*Burnt after last rainfall*	3	*Most defoliated*
		4	*Unknown*

Distance to nearest unburnt patch (>5 ha)

1	<100 m	2	100-500 m
3	500m – 1 km	4	>1 km

Patchiness, % of area burnt:

8. *NEARBY WATER BODIES*

		R	*River*
1	*Permanent*	S	*Soak/spring*
2	*Seasonal*	C	*Creek*
3	*Ephemeral*	P	*Pool*
		B	*Bore / windmill / dam*

Distance (m):

9. *EVIDENCE OF FERAL / INTRODUCED SPECIES (please list)*

Please collect any cat, dingo or quoll scats
Place into an envelope (not plastic),
label with collector's name, date, species, GPS location
and lodge with DPaW for dietary analysis.

10. *SITE PHOTOS (please attach)*

Photo number:

Direction facing:

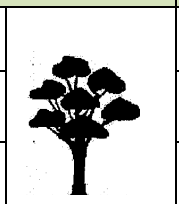
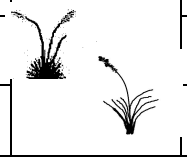
11. *VEGETATIVE GROWTH STAGE*

1	*Early regeneration*
2	*Advanced regeneration*
3	*Mature vegetation*
4	*Senescent phase*

12. *NATIVE FIG (FICUS) PRESENCE*

0	*Absent*
1	*1–10 plants*
2	*> 10 plants*

13. ***VEGETATION***

Please tick 1 box in each row, and record dominant species where known			**Absent**	**Isolated <2%**	**Very sparse 2–10%**	**Sparse 10–30%**	**Mid-Dense 30–70%**	**Dense 70–100%**
TREES	**Dominant species**							
	> 30 m							
	10–30 m							
	<10 m							
MALLEES	**Dominant species**							
	Over 8 m							
	Under 8m							
SHRUBS	***Dominant species***							
	Over 2 m							
	1–2 m							
	Under 1 m							
HERBS & SEDGES	***Dominant species***							
								
GRASSES	***Dominant species***							
	Hummock							
	Tussock							
	Bunch							

SITE MAP
Showing relevant landforms, vegetation types, creeks, landmarks etc as well as an indication of trap/camera placement

TOP VIEW

SIDE VIEW