Camera Trapping Protocol

Sandhill Dunnart
(Sminthopsis psammophila)

Mulga Rock Uranium Project Area

October 2015

Mulga Rock Uranium Project - Public Environmental Review - December 2015
Appendix B - Terrestrial Fauna

B3

Authorship and Review

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Gerry Bradley	Reviewer – Protocol	1.3	13/02/2015
Paul Meek	Peer Reviewer – Protocol	1.3	17/02/2015
Sue Churchill	Peer Reviewer – Protocol	1.3	17/02/2015
Xavier Moreau	Authorised for distribution	1.4	09/06/2015
Gay Bradley	Update with new mining parameters and survey results	2.1	08/10/2015

Notes and Acknowledgements

This Camera Trapping Protocol has been prepared using information provided from a range of published sources, in some cases unpublished research results and material from documents submitted for EIA-assessed projects in the Great Victoria Desert in both Western Australia and South Australia. These are acknowledged in the text and referenced in Section 6.0.

Suggested Document Citation

Vimy Resources Limited (2015), Camera Trapping Protocol - Sandhill Dunnart (*Sminthopsis psammophila)* – Mulga Rock Uranium Project (2015)

Cover photo: Sandhill Dunnart (*Sminthopsis psammophila*). - Photo Credit Amanda McLean

Table of Contents

List of Tables

List of Figures

List of Plates

Appendices

1.0 Introduction

1.1 Context and Background to the Project

Vimy Resources Limited (Vimy), formerly known as Energy and Minerals Australia Limited (EMA or EAMA), is proposing to develop the remote Mulga Rock Uranium Project (MRUP) which is located 240km east-northeast of Kalgoorlie in dune fields on the western flank of the Great Victoria Desert (GVD).

Planned development will involve the shallow open pit mining of four polymetallic deposits with commercial grades of uranium hosted in carbonaceous material. Proposed disturbance of vegetated dune field and sand sheet for Project development is estimated at 3787ha for the Life of Mine (LOM) within a Development Envelope of under 10,000ha which will include habitats in which the Sandhill Dunnart (*Sminthopsis psammophila*) (SHD), a State and Federally recognised conservation significant species, has previously been recorded. The location of the Project, regional infrastructure and the proposed Development Envelope is shown on Figure 1.

The Project is a “controlled action” for the purpose of the *EPBC Act 1999,* and the potential impact to threatened species such as the Sandhill Dunnart (*Sminthopsis psammophila*) is one of the controlling provisions. The Project will be assessed by the Western Australian Environmental Protection Authority (EPA) and, in accordance with a new bilateral agreement, by the Federal Minister for the Environment under the *Environmental Protection and Biodiversity Conservation Act 1999*.

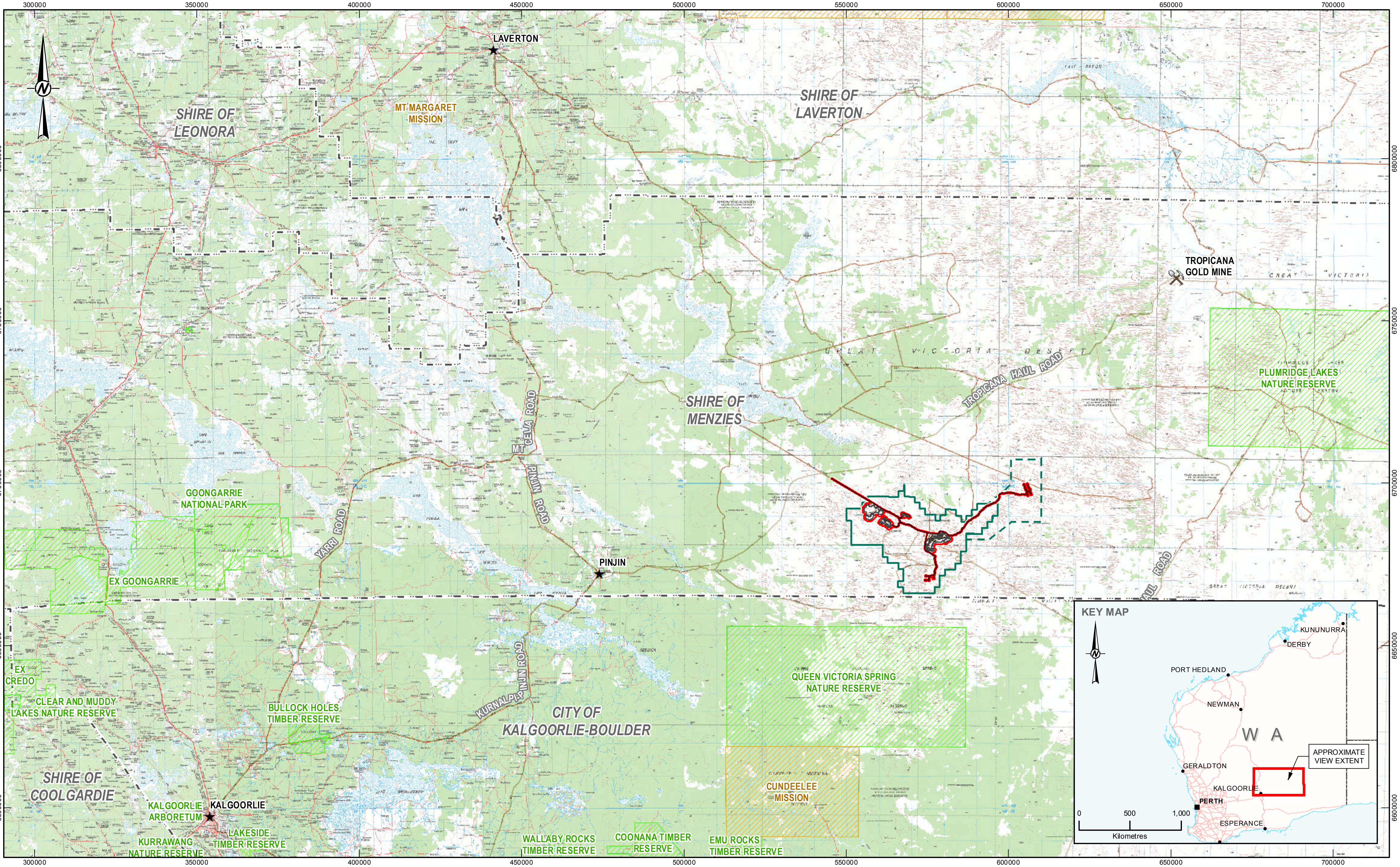
Following several conventional onsite surveys for the Sandhill Dunnart at Mulga Rock spanning 30 years, and 12 months trialling of camera trapping techniques, Vimy has commenced a ten month continuous presence/absence inventory for SHDs across a range of modified habitats using eight Bushnell Trophy Cam High Definition (HD) and thirty Reconyx 550 Hyperfire cameras. The programme will be conducted in a range of habitats considered suboptimal for Sandhill Dunnarts following the substantial wildfire which burnt through the Project area in November 2014, potentially removing suitable Sandhill Dunnart habitat for at least 10 to 15 years.

1.1.1 Previous Work in the Great Victoria Desert

The Sandhill Dunnart, a small nocturnal insectivorous marsupial, was first discovered in Western Australia at the Mulga Rock site in 1985 during EIS Baseline Studies for the Pacific Nuclear Corporation (PNC) of Japan (Martinick 1986 and Hart and Kitchener 1986).

Prior to its West Australian discovery, it was recorded in the mid-1960s from sites on the Eyre Peninsula in South Australia, and from a historic 1894 record from the Lake Amadeus region in the Northern Territory. It has since been recorded in several conservation reserves in South Australia in the upper Eyre Peninsula and in the Yellabinna Ooldea region of the southern Great Victoria Desert (Woinarski *et al.* 2014).

Since the initial PNC discovery at Mulga Rock, several ecologists have undertaken studies on the Western Australian populations of SHD including Pearson and Robinson (1990), Churchill (2001a, 2001b and 2009), Gaikhorst and Lambert (2008 and 2010), Gaikhorst and Churchill (2009), Ninox (2010) and Turpin (2014). A significant factor guiding research for the conservation of the SHD, and reported from both Western and South Australia, is that long term occupancy is not assured at sites where animals have been previously detected (Woinarski *et al.* 2014), and that the exact distribution and abundance of the taxa is uncertain, although extensive areas of potentially suitable hummock grasslands on sand terrain habitats occur in the southern GVD (Churchill 2009). Previous survey and capture locations in Western Australia are shown on Figure 2 (Gaikhorst and Lambert 2014).



LEGEND

- TROPICANA GOLD MINE
- TOWN
- ROAD
- INFRASTRUCTURE
- MRUP DEVELOPMENT ENVELOPE
- PROJECT BOUNDARY (MINING TENURE)
- PROJECT BOUNDARY (MISCELLANEOUS TENURE)
- CONSERVATION RESERVE
- ABORIGINAL LAND TRUST ESTATE
- LOCAL GOVERNMENT AUTHORITY (LGA) BOUNDARY

NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

REFERENCE

INFRASTRUCTURE DATA PROVIDED BY CLIENT
BASE DATA © WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2015)
IMAGE SOURCED FROM GEOSCIENCE AUSTRALIA 250K TOPO
INSET BASE DATA/ROADS SOURCED FROM STREET PRO DATA 2009

0 25 50
1:1,100,000 KILOMETRES

CLIENT
VIMY RESOURCES LIMITED

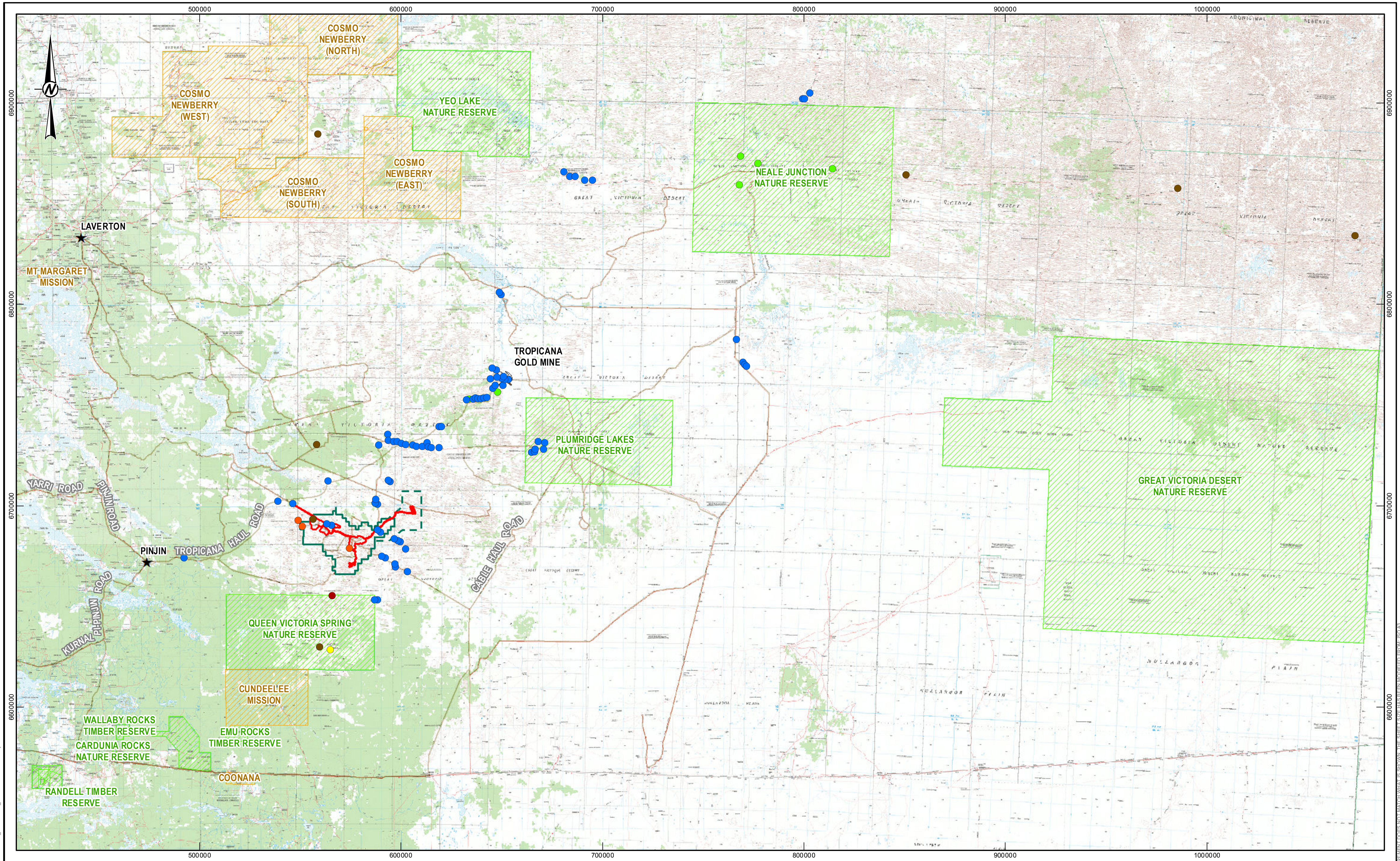
CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-27
DESIGNED	MS
PREPARED	MS
REVIEWED	GB
APPROVED	GB

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
REGIONAL LOCATION

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	B3	0	1



LEGEND

- TROPICANA GOLD MINE
- TOWN
- ROAD

SAND HILL DUNNART TRAP SITES

- BUTLER
- CHURCHILL
- ECOLOGIA
- GAIKHORST & LAMBERT
- MARTINICK & HART & KITCHENER
- PEARSON & ROBINSON
- MRUP DEVELOPMENT ENVELOPE
- PROJECT BOUNDARY (MINING TENURE)
- PROJECT BOUNDARY (MISCELLANEOUS TENURE)
- CONSERVATION RESERVE
- ABORIGINAL LAND TRUST ESTATE

NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

REFERENCE

INFRASTRUCTURE DATA PROVIDED BY CLIENT
BASE DATA © WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2015)
IMAGE SOURCED FROM GEOSCIENCE AUSTRALIA 250K TOPO
SHD TRAP SITES DIGITISED FROM FIGURE 1, GHD, 06 APR 2014

0 50 100
1:1,750,000 KILOMETRES

CLIENT
VIMY RESOURCES LIMITED

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-27
DESIGNED	MS
PREPARED	MS
REVIEWED	GB
APPROVED	GB

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
LOCATION OF PREVIOUS SANDHILL DUNNART TRAP AND CAPTURE SITES IN THE GREAT VICTORIA DESERT (SOURCE: GAIKHORST AND LAMBERT 2014)

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	B3	0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3
25mm 0

Primary threats to the Sandhill Dunnart in WA are listed as loss of spinifex habitat through clearing, extensive and frequent wildfires and predation from introduced predators such as feral cats. Both of the latter threats are currently realised in the Great Victoria Desert, although no published data on predation is available.

A Recovery Plan for the Sandhill Dunnart was published in 2001 (Churchill 2001a) and revised in 2011 (van Weenen *et al.* 2011). Gaikhorst and Lambert (2008) reported on several survey trips within 100km of the MRUP area undertaken over the period from 2000 to 2008 which returned very low numbers of specimens for the survey effort. An estimate (some capture data has not been published) of the total survey effort in the GVD 1 Shield subregion is in excess of 48,000 trap nights for 44 captures, including 14,964 trap nights for seven captures in the MRUP area. Trapping has been largely by Elliott and deep pitfall traps with the pitfall vs Elliott capture rate success ratio as approximately 3 to 1. Trapping details are summarised in Table 1.

1.2 Rationale for Use of Camera Traps

Camera trapping is becoming a more common and accepted method of fauna surveying (DSEWPaC 2011), particularly as cameras allow for the detection of species that are difficult to study due to their elusive and commonly nocturnal habits, or low density in the landscape (Meek 2012). This type of surveying is considered less costly and less invasive than long term capture and release of target species and has the advantage of being able to be utilised for longer continuous periods in remote or difficult to reach locations such as the Great Victoria Desert. Survey inventory time is an important constraint and Cowan and How (2004) conclude that conventional short-term studies infrequently encounter threatened and/or rare ground-dwelling vertebrate fauna species and therefore do not always provide adequate information to assist land managers. By comparison Mulga Rock has been surveyed by several highly experienced ecologists in five programmes over thirty years with consistently low detection rates approaching 0.05 captures per 1,000 trap nights.

Camera trapping over long time spans can potentially address this issue and allow for the collection of data on co-existing and feral species within the target community over a longer time frame and potentially identify ‘hot spots’ for further conventional trapping programmes. Under some circumstances, camera trapping methods can provide data that is more permanent and less disputable than data gathered by direct observation and less invasive than physical capture (DSEWPaC 2011).

However there is some debate in the scientific community that camera trapping, if not used in accordance with tested protocols, can affect animal behaviour, and that photo-capturing of target animals can be biased by the use of lures or attractants, although these techniques are also commonly used in conventional trapping programmes. Camera use for the monitoring of large animals is well established, however the difficulties of capturing images of sufficient quality that allow for positive identification of the small mouse-sized target species, when sympatric species are present (DSEWPaC 2011; Meek *et al.* 2013) is a matter that has been addressed in this Protocol through the utilisation of ‘fit for purpose’ cameras, robust data collection processes and the establishment of a peer review group of ecologists, experienced with *Sminthopsis* in the region, who will confirm SHD presence on images for reporting.

These issues have also been addressed in several recent studies. DSEWPaC (2011), Meek (2010) and Meek *et.al* (2014) have released guidelines on ways of increasing the success rate of detection with cameras and many of these have been adopted in this Protocol.

Following the application of conventional trapping techniques by researchers on four separate occasions (1985, 1999, 2008 and 2009) in the MRUP area, with very limited trap success for the effort expended, Vimy proposed to trial targeted camera trapping methods to attempt to confirm the presence or absence of the Sandhill Dunnart for impact assessment purposes. The success of this technique has recently been demonstrated in 2014 for a gas pipeline corridor survey to the north of Mulga Rock, where two of the four Sandhill Dunnart ‘captures’ were as a result of camera trapping (Turpin 2014).

Table 1 Summary of survey work in Sandhill Dunnart habitats in GVD 1 Shield subregion in WA

Year	Location	Trap Efficiency			Reference
		Elliott	Pitfall	SHD	
1975	Queen Victoria Spring Nature Reserve	No Record	No Record	0	Burbidge, McKenzie, Chapman and Lambert (1976)
1985	Mulga Rock – Shogun, Emperor and Ambassador	1,520	1520 (Est)	5	W.G. Martinick & Assoc. Pty Ltd (1986) Hart and Kitchener (1986)
1987-1989	Northern boundary of Queen Victoria Spring Nature Reserve	2,700	7,400	6	Pearson & Robinson (1990)
1990-1998	North of Queen Victoria Spring Nature Reserve	No Record	No Record	12	D. Pearson pers. comm. in Churchill (2001b) and van Weenen, Ward & Churchill (2011)
1999	Queen Victoria Spring Nature Reserve	390	0	0	Churchill (2009)
1999	Mulga Rock - Shogun - Emperor	714	204	0	Churchill (2009)
2000	25km NNE of Queen Victoria Spring	No Record	No Record	1	D. Pearson pers. comm. in Churchill (2001b) and van Weenen, Ward & Churchill (2011)
2000-2008	Pinjin, West MR, East MR - Rason Rd, Plumridge Nature Reserve	9957 (MR 480)	5427 (MR 680)	17 (MR 2)	Gaikhorst & Lambert (2000 to 2008)
2007	Tropicana Gold Mine Operations Area – Pinjin Infrastructure Targetted Survey #2	640	320	0	*ecologia* (2009)
2008	Tropicana Gold Mine Operations Area – Pinjin Infrastructure Targetted Survey #1	560 540	440 499	0	Gaikhorst & Lambert (2008)
2009	Tropicana Gold Mine Operations Area - Pinjin Infrastructure Targetted Survey #2	2,600	910	0	GHD (2010a)
2009	Mulga Rock Project Area Targetted Survey #1	1,336	710	0	Ninox Wildlife Consulting (2010)
2010	Tropicana Group 2/3 Exploration Area – East of Mulga Rock SHD Habitat Assessment	Field Survey	Field Survey	-	GHD (2010b)
2014	Sunrise Dam -Tropicana Gas Pipeline Corridor	1,680	693	4	Turpin (2014) and Kingfisher Environmental Consulting (2014)
2012-2014	Mulga Rock - Pilot Camera Trapping (CT)	> 4,300 (9 cameras)		0	Vimy Resources Limited Unpublished Data
2014-2015	Mulga Rock - Targetted Camera Trapping (CT)	> 2,500 (30 cameras)		0	Vimy Resources Limited Unpublished Data

1.3 Work Programmes Completed at Mulga Rock

Following consultation with Department of Environment and Conservation ecologists, Ninox Wildlife Consulting (Ninox) undertook a Level 2 targeted survey for SHDs in 2009 in the MRUP area as part of baseline studies for impact assessment. This programme included modifications to trap methodology and layout and increased deployment of Elliott traps and deep pitfalls to compensate for the reported athletic attributes of SHD's.

In addition, trapping grids were increased to ten sites over 15km and the range of habitats, based on substrate, spinifex cover and burn history, was increased to nine communities of which four were Prime Habitats using the regional vegetation criteria comparison developed by Mattiske (Table A-1 in Appendix A) as defined by Churchill (2009) and discussed in Gaikhorst (2009a). Camera traps were utilised for the first time in the Ninox survey (Ninox 2010), although no SHDs were detected.

Habitat assessments included focused field and dunal (sand pad) inspection, in conjunction with recently completed detailed vegetation mapping (Mattiske 2009), a review of regional fire data (Mattiske 2009) and a preliminary comparison of the structure of vegetation communities described by Churchill (2009) as prime habitat types in Western Australia.

In addition, part of the Ninox programme included re-trapping three old sites where habitat conditions were met, and where Sandhill Dunnarts were captured in 1985 and surveyed for without success in 1999. Two specimens were captured in the same area (Shogun and Emperor) in 2008 (Gaikhorst and Lambert 2008). No Sandhill Dunnarts were captured during the October 2009 targeted survey although reasonable trapping success was obtained with a range of small marsupials, including three other *Sminthopsis* species, recorded.

Following discussions with a Ninox, a GVD-based sand mining company and university researchers in South Australia in 2011/12, Vimy initiated a Pilot Camera Trapping Programme in 2013 to determine if passive infrared cameras, set up in selected former 1985, 2009 and new "wild card" survey site environments could provide the necessary detail on presence or absence of small marsupials. The results were encouraging; showing that with the appropriate habitat assessment and correct camera layout, small marsupials (and a host of other mammals, feral predators, birds and reptiles) could be camera trapped. However, species identification for some taxa to a standard required for impact assessment was lacking in the original methodology.

Advice was sought from the Department of Parks and Wildlife (DPaW) and Paul Meek (NSW DPI), and the programme was modified and expanded to a targeted survey commenced in late 2014. This programme was halted in mid-November 2014 when a wildfire burnt out over 85% of the Project Development Envelope and much of the surrounding area, including all the previous camera trap sites (see Plate 2). Camera trapping has recommenced in some of the burnt areas and small mammals have been recorded. The pre- and post-fire results have demonstrated (see Table 2 and Table 3) that, with the application of appropriate trap setup methodology, small mammals could be camera trapped and identified with the required level of certainty.

Table 2 Examples of small mammal images camera trapped in the 2014 MRUP trapping programme

2(a): Station M5 - Pre-burn Mulgara (*Dasycercus* sp.)

2(b): Station M2/3 - Pre-burn Dunnart (*Sminthopsis* sp.)

2(c): Station MR-9 - Pre-burn Dunnart (*Sminthopsis* sp.)

2(d): Station MR-1 - Post-burn Mulgara (*Dasycercus* sp.)

2(e): Station MR-2 - Post-burn Hopping Mouse (*Notomys* sp.)

2(f): Station MR15 - Post-burn Dunnart (*Sminthopsis* sp.)

Table 3 Natural and introduced predators and competitors

3(a): Station MR-6 - *Varanus gouldii* (Gould's Monitor)

3(b): Station MR-6 - *Varanus tristis tritis* (Black Headed Monitor)

3(c): Station MR-14 - *Felis catus* (Feral Cat)

3(d): Station MR-6 – *Felis Catus* (Feral Cat)

3(e): Station MR-11 – *Canus lupis dingo* (Dingo)

3(f): Station MR-6 – *Oryctolagus cuniculus* (Rabbit)

1.4 Purpose of Protocol and Scope of Works

Sandhill Dunnarts were captured at four locations within the MRUP Project area in 1985 when the Project was being explored by the Pacific Nuclear Corporation (Hart and Kitchener 1986). In spite of subsequent surveys in 1991 when no specimens were captured (Churchill 2009), two specimens were captured in 2008 near previous capture sites (Gaikhorst and Lambert 2008). No SHD were captured in the Ninox Level 2 Survey (Ninox 2010), although a range of other small marsupials were recorded. This Ninox survey trapped in a range of habitats, including sites where SHDs had been previously recorded (Ninox 2010).

Regional surveys, undertaken in different seasons in dunefields surrounding the MRUP area, concentrating in long unburnt areas and conservation reserves where optimal habitat was available (Pearson and Robinson 1990, Churchill 2009, Gaikhorst and Lambert 2000-2008 and ecologia 2008), resulted in the capture of 40 individual SHDs in 48,560 trap nights spread over nine years. A further 7,800 camera trap nights have been recorded during the MRUP pilot and targeted surveys in 2013/14 (Vimy 2014). The overall survey effort in Western Australia of one capture per 1,103 trap nights suggests the target species are difficult to trap, are low in abundance and exhibit patchy distribution or seasonal fluctuations in response to wildfires or other influences. Camera trapping was seen as another monitoring tool that would complement previously implemented conventional trap methodology and was not intended to replace these techniques but is being proposed to initially provide presence/absence information in the broader dune field remnant patches for impact assessment within the Project Development Envelope, and following the November 2014 wildfire which appears to have removed suitable SHD habitat for at least 10 to 15 years.

Due to the extent of the area, the range of potential habitats and the documented difficulties in capturing these very small marsupials with conventional trapping techniques, Vimy sought to pilot the use of camera trapping methods to identify if SHDs were still present within the Project Development Area and potentially in adjacent areas, where fire histories are known and some suitable habitat was preserved. This Protocol outlines the past trapping history for SHD's and outlines the current standard to be adopted for camera trapping, recording of information, species verification and reporting of results. It incorporates adaptive management principles and procedures to manage identified limitations, and will be updated as new data on the camera trapping process is identified. In the event that SHD are identified, Vimy will advise DPaW and discuss what further action is required. This may take the form of further intensive camera trap monitoring of the site, no action or follow-up targeted surveys using conventional survey techniques, or a combination of both.

Compliance with Work Requirement of Environmental Scoping Document

This Protocol is designed to satisfy the EPA objective referenced in the Mulga Rock Uranium Project Environmental Scoping Document (2014) to maintain representation, diversity, viability and ecological function at the species, population and assemblage level. The work required was to consist of further surveys for *Sminthopsis psammophila* (Sandhill Dunnart) in the form of a targeted survey utilising specialised wildlife cameras to identify the existence or otherwise of specimens within and surrounding the proposed areas of disturbance in accordance with a Department of Parks and Wildlife approved monitoring programme.

Scope of Works

To assist in obtaining further data on the presence or absence of the Sandhill Dunnart in the Project Development Area, Vimy purchased two different camera types to trial on a continuous basis for twelve months at a range of former trap sites and new locations within the Project area, where habitat conditions were considered optimal. Individual trap stations will utilise a combination of lured and non-lured sampling for up to 60 days per site to maximise detection, with trap layouts to traverse unburnt refugia and recently burnt zones. Trap designs will cover a range of camera placements up to a maximum of four cameras per site. Site selection is based on (a) habitat information described in Churchill (2009) and in the most recent Recovery Plan (van Weenen *et al.* 2011), (b) where Sandhill Dunnarts have been captured previously (Gaikhorst and Lambert 2009) and refugia sites following the recent fires.

The aims of the Camera Trapping Programme (CTP) are to:

- confirm the presence/absence of Sandhill Dunnarts within the MRUP Development Area so as to meet the requirements of Federal and State assessment agencies in respect to minimising impacts on matters of national environmental significance and threatened fauna.

This information would assist in defining actual and potential impacts of the proposed MRUP development on the Sandhill Dunnart populations and habitat and identifying ways to mitigate any impacts.

Definition of Terms

Throughout this document three terms are used to spatially describe the Project. The '*Project area'* describes the boomerang-shaped area contained within Vimy mining tenure and covers an area of 101,804ha (See Figure 1). For assessment purposes, a second smaller area is identified as the '*Development Envelope'* in referral documentation (Figure 3). This zone covers approximately 10,000ha and envelopes the *Disturbance Footprint* which covers the proposed LOM disturbance of 3,787ha. As described in subsequent sections, prior to the November 2014 wildfire which burnt most parts of the Project area, all the recent trapping effort at MRUP was contained within the Development Envelope supported by a substantial trapping effort undertaken by others within 100km of the Project in similar habitat. After the 2014 fire, the targeted Camera Trapping Programme will be extended outside the Development Envelope to test remnant unburnt or refuge habitats and corridors. These locations are shown in Figure 8.

1.5 Conservation Status of Sandhill Dunnart

The Sandhill Dunnart is listed nationally as "Endangered" under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This classification is consistent with International Union for Conservation of Nature (IUCN) criteria of Endangered B2ab (ii, iii, iv, v) and C1 (Barton & Cowan 2001). In Western Australia, the species is listed as "Threatened" under the *Wildlife Conservation Act 1950* (WC Act).

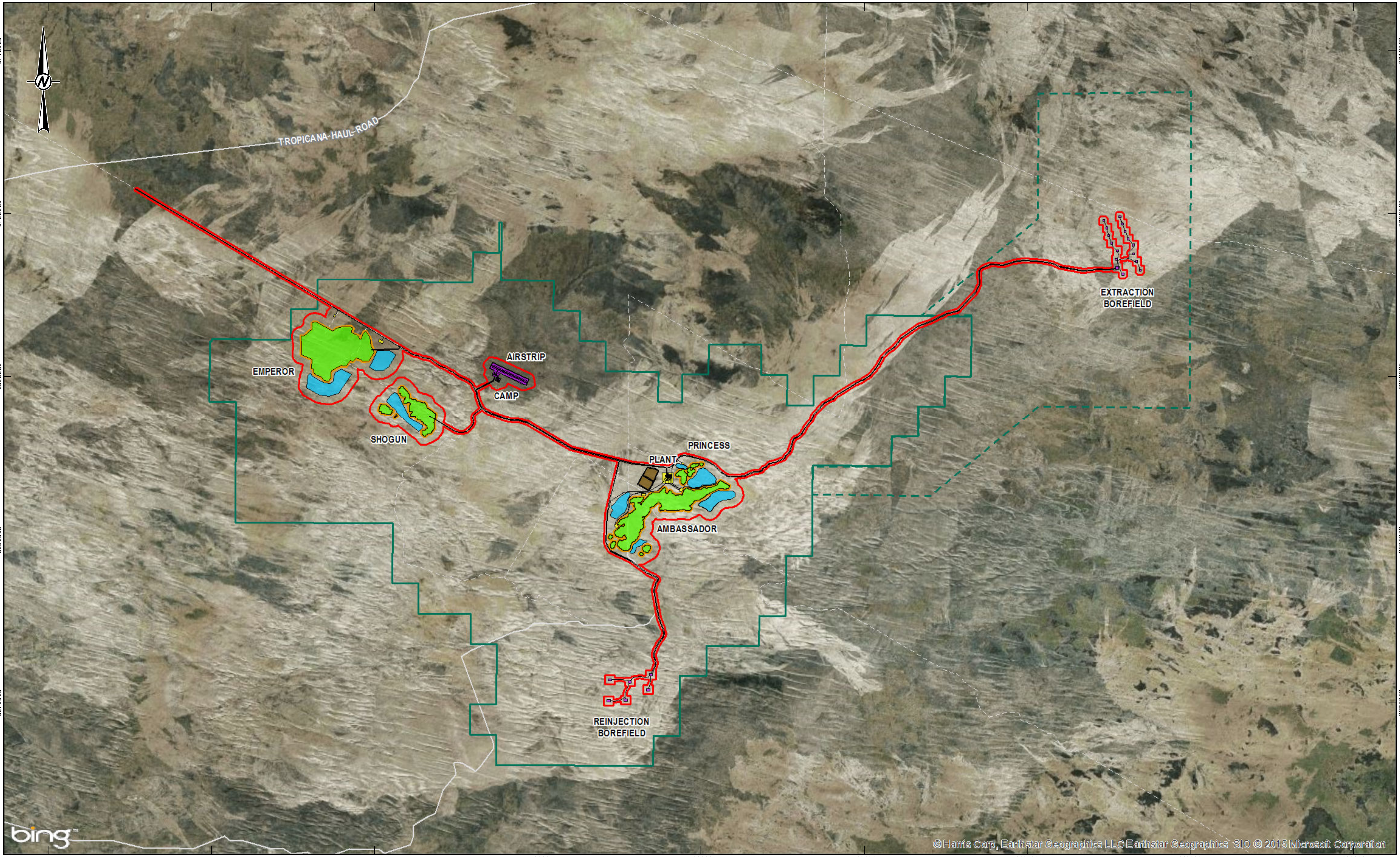
MRUP sits approximately midway between two nature reserves – Queen Victoria Springs, 35km to the south, and Plumridge Lakes 105km to the northeast. Sandhill Dunnarts have been recorded in the Queen Victoria Springs Nature Reserve (Pearson and Robinson 1989), but none have been recorded to date within the Plumridge Lake Nature Reserve, despite suitable habitat being present. The location of SHD capture sites and areas surveyed in Western Australia is shown on Figure 2 (Gaikhorst and Lambert 2014).

1.6 Permitting

Camera monitoring involves the use of remotely triggered cameras, activated when an animal passes through a motion or infrared sensor and triggers an image capture. The process is currently called camera trapping. In Western Australia, DPaW has developed a Standard Operating Procedure No. 5.2 (DPaW 2011) covering specific instructions on the use of remote cameras for monitoring of fauna.

The taking of fauna in Western Australia for scientific purposes requires a licence under *Regulation 17 of the Wildlife Conservation Act (1950).* Although Camera Trapping does not result in physical contact with the target species, advice received from the Department confirmed that no licence was required for programmes where lures (attractants) were not used.

As part of the implementation of the post-fire refuge programme, it is proposed that lures will be used as attractants at some sites and an application for a Regulation 17 licence under the *Wildlife Conservation Act (1950)* "to take" fauna for scientific purposes, was lodged with DPaW in 2015 (Appendix C). Inherent in this process is compliance, where appropriate, with obligations under the Australian Code for the care and use of animals for scientific purposes (NHMRC 2013).



LEGEND

- MINOR ROAD/TRACK
- ROAD
- MRUP DEVELOPMENT ENVELOPE
- PROJECT BOUNDARY (MINING TENURE)
- PROJECT BOUNDARY (MISCELLANEOUS TENURE)
- PIT
- OVERBURDEN LANDFORM
- PROCESSING INFRASTRUCTURE
- ABOVE GROUND TSF
- SUPPORTING INFRASTRUCTURE
- PIT CLEARING (50 m BUFFER)

NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

REFERENCE

INFRASTRUCTURE DATA PROVIDED BY CLIENT
AERIAL IMAGERY SOURCED FROM ESRI ONLINE
TOPOGRAPHY BASED ON NATIONAL DEM 1 S SOURCED FROM GEOSCIENCE AUSTRALIA

0 5 10
1:220,000 KILOMETRES

CLIENT
VIMY RESOURCES LIMITED

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-27
DESIGNED	MS
PREPARED	MS
REVIEWED	GB
APPROVED	GB

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
PROJECT TENURE, PROPOSED DEVELOPMENT ENVELOPE AND DISTURBANCE FOOTPRINT

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	B3	0	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

1.7 Guidance Documents and Advice

Guidance statements are released by the West Australian Environmental Protection Agency for the use of Project Developers and describe the EPA's position in relation to the use of best practice to protect the environment. Similar documents are provided by other State and the Federal Government departments in the form of Recovery Plans and Sampling Protocols that set out the actions necessary to stop the decline of and support the recovery of listed threatened species and to inventory such target species.

The approach adopted in this programme is generally consistent with:

- Environmental Protection Authority (EPA) Position Statement No. 3: *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002);
- EPA Guidance Statement No. 56: *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004);
- EPA & Department of Environment and Conservation *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA & DEC 2010);
- Department of Environment and Conservation: Standard Operating Procedure – *Remote Operation of Cameras SOP No. 5.2* (DEC 2011);
- Department of Sustainability, Environment, Water, Population and Communities – *Survey Guidelines for Australia's Threatened Mammals (2011)*;
- Department of Environment and Natural Resources, South Australia – *National Recovery Plan for the Sandhill Dunnart (Sminthopsis psammophila) (2011)*; and
- National Health and Medical Research Council, (2014). A Guide to the Care and use of Australian Native Mammals in Research and Teaching. EA29. Canberra.

Valuable operational advice was received from regional science staff at DPaW during the preparation of the Pilot Study for the MRUP, and from the findings from several targeted conventional SHD surveys for the Tropicana Gold Project which have been undertaken for infrastructure planning in tenure to the north, east and west of the MRUP.

Detailed guidance was also obtained from Ms Amanda McLean of the University of Adelaide on dunnart behaviour and from *An Introduction to Camera Trapping for Wildlife Surveys in Australia* (Meek *et al.* 2012). Valuable discussions have been held with Ninox Consulting Principal Ms Jan Henry on small mammal image identification, and with ecologists attending the GVD Biodiversity Workshop on Sandhill Dunnarts (DPaW 2014). The protocol was peer reviewed by Sue Churchill (Wildlife Ecologist) and Paul Meek (NSW DPI). A consultation matrix is shown in Table 4.

Table 4 Consultation matrix associated with the Mulga Rock Camera Trapping Programme

Who	Organisation	When	Matters raised
J. Henry	Ninox Wildlife Consulting	2009-2015	Habitat, methodology and identification and managed 2009 MRUP Targeted Fauna Survey (Ninox 2010)
M. Cowan	WA DPaW	May 2014	Camera specifications, trapping methodology for small mammals, surveys in arid environments
P. Meek	NSW DPI (Biosecurity NSW)	May 2014 March 2015	Camera recommendations, trapping methodology for small mammals, detectability of small mammals, peer review of protocol
D. Pearson	WA DPaW	2013-2014	Advice on SHD and fire regimes in GVD
I. Kealley, J. Futter	WA DPaW	2007, 2013-2014	Advice on fire regimes in GVD

Who	Organisation	When	Matters raised
G. Gaikhorst	GHD	2014	Discussion on habitat and methodology
A. McLean	University of Adelaide, PhD candidate	2013-2014	Research findings on SHD's in SA, hands-on advice on habitat and capture efficiency, and identification
SHD workshop	GVD Biodiversity Trust	2014	Latest research and findings presented at workshop
S. Churchill	SHD Fauna Specialist	March 2015	Peer reviewed Protocol and provided advice on identification

1.8 Fauna Identification, Nomenclature and Peer Review

The following literature sources have been used to outline nomenclature, ecology, habitat assessment fauna distribution patterns and faunal characteristics in this report:

- Hart, R.P. and Kitchener, D.J. (1986) First record of *Sminthopsis psammophila* (Marsupialia: Dasyuridae) from Western Australia. Rec West. Aust. Mus. 13 Part 1 pp 139-144;
- Churchill, S. (2009). Assessment of habitat availability for the Sandhill Dunnart *Sminthopsis psammophila* in Western Australia;
- Field Companion to the Mammals of Australia (2013). Eds S. Van Dyck, I. Gynther and A. Baker; New Holland Publishers;
- Van Dyck and Strahan (2008). Mammals of Australia 3rd Edition;
- van Weenen, J., Ward, M.J. and Churchill, S. (2011). National Recovery Plan for the Sandhill Dunnart (*Sminthopsis psammophila*). Department of Environment and Natural Resources, South Australia;
- Western Australian Museum Checklist of the Vertebrates of Western Australia. Located on the Museum website at: www.museum.wa.gov.au/research/departments.terrestrial-zoology/checklist-terrestrial-vertebrate–fauna-western -australia; and
- Woinarski, J.C., Burbridge, A.A., and Harrison, P.L. (2014). The Action Plan for Australian Mammals 2012-2014. CSIRO Publishing.

The most recent taxonomic revisions have been used within the text of this report. Identification procedures for camera images and reporting standards are discussed in Section 5.0.

Peer Review

Consistent with the protocol of continuous environmental improvement and adaptive environmental management, Vimy implemented a peer review process to ensure all the risk issues were identified at the commencement of the Camera Trapping Programme and that these were addressed to ensure an appropriate level of survey for potential impact assessment.

Review comments received during the regulatory assessment of the draft Protocol (Baker 2015) and during peer review by Sue Churchill (Wildlife Ecologist) and Paul Meek (NSW DPI) have been included in Appendices C and D. These related to identifying key characteristics of SHDs in images from other *Sminthopsis* species present in the area, along with technical aspects of the camera layout. Vimy has developed a key characteristics table (Table B-5 in Appendix B) which identifies five characteristics that should support positive identification in captured images.

In addition to promoting maximum resolution in images, modifications to camera layout will be trialled with the use of an overhead camera for sites where lures are utilised. Camera setup will include multiple image capture for each trigger and this will increase potential for identifying these key characteristics. In the event of uncertainty, the Vimy Protocol endorses consulting expertise from fauna experts for advice in respect to species identification and confirmation.

2.0 Existing Environment

2.1 Study Area

The Mulga Rock Uranium Project (MRUP) is located on unallocated Crown Land approximately 770km east-northeast of Perth in Western Australia and 240km northeast of the regional city of Kalgoorlie-Boulder. The Project area is located between the Queen Victoria Springs and Plumridge Lake Nature Reserves (Figure 1), however project activities are at some distance from the Reserves and no direct or indirect impacts are anticipated.

The Project consists of three subsurface uranium bearing carbonaceous deposits that formed in Pleistocene times and together they comprise the Mulga Rock Deposits. The Project area is located on the western margin of the Great Victorian Desert 1 (GVD1) Shield subregion, as defined in the Interim Biogeographic Regionalization of Australia (IBRA) Version 7.0 (DoTE 2014). The Project area is at an elevation of 350-400m (AHD) and is crossed by vegetated east-southeast trending, 8m to 12m high yellow, orange and red sand dunes and sand sheets. Project tenure, proposed development locations and buffers are shown in Figure 3.

As a consequence of the climate and the geographical isolation of the region, pastoralism and agriculture are not considered viable within the sandplain terrains. Consequently, there has been little land clearance or grazing by domestic stock although feral camels are present. The region is considered relatively undisturbed, with some elements of the yellow sandplains exhibiting high ecological values (Barton and Cowan 2001).

The hummock grasslands are prone to frequent, widespread and commonly hot wildfires, which have a devastating impact on the quality of Sandhill Dunnart habitat by reducing the structure and density of spinifex and ground cover. Survival of Sandhill Dunnart populations after wildfires is not documented, but information from other small mammal species suggests it can depend on aspects such as the availability and connectivity between the small unburnt vegetation patches that exist following a fire in hummock grassland environments.

2.2 Biophysical Elements

2.2.1 Climate

The Project area is located on the western edge of the Great Victoria Desert. Long term regional weather data is available from Bureau of Meteorology BOM stations at Laverton, 182km northwest of the Project area, Kalgoorlie 260km southwest and Balgair 204km to the southeast. In addition three automatic weather stations providing a range of climatic data were established on the Mulga Rock site in 2009.

The climate is arid, with mean annual rainfall ranging from below 150mm to over 250mm. Rainfall is aseasonal, but shows great variability between years with above average rainfall experienced at site in 2011 (584mm) and below average (<220mm) in 2012 to 2014. Summers are very hot, with mean maxima during summer between 32°C and 35°C. Diurnal ranges are also large, and overnight temperature minima commonly fall below 0°C during winter.

Studies by McLean (pers. comm. 2014) suggest that increased SHD activity is observed following phases of the moon and rain events. This data will be collected monthly for the monitoring project from the cameras and site weather stations and is included on the Data Recording sheet.

2.2.2 Terrain

The Project area lies wholly within the Shield Subregion of the GVD Interim Biogeographic Regionalisation of Australia (DoTE 2014).

The western part of GVD 1 is underlain by the Yilgarn Craton and a higher proportion of sandplains are present in comparison to the rest of the bioregion. To the east is an arid active sand-ridge desert of deep Quaternary Aeolian sands overlying Permian and Mesozoic strata of the Officer Basin. Regional landforms consist of isolated salt lakes and major wide valley floors with lake derived (local) dunes and sandplains with patches of longitudinal dunes running approximately east west. The subregion contains the major Ponton Creek channel.

The MRUP area consists essentially of yellow and orange sandplain communities with a diverse mammalian and reptile fauna and distinctive hummock grasslands (Barton and Cowan 2001).

The major lithostratigraphic dune forming units for the GVD appear to have been stable for a long time (Sheard *et al.* 2006) and several researchers (Hesse, P.P. *et al.* 2004) have suggested some dune ages greater than 125,000 years. Swale areas between the dunes are characterised by shallow red, earthy soils and sand from the dunes.

2.2.3 Vegetation

The MRUP area is entirely located in the Helms Botanical District. Mattiske (2014) has completed detailed mapping and identified 22 vegetation communities which Beard (1974) broadly mapped as being characterised by tree steppe of *Eucalyptus gonglocarpa* over *Eucalyptus youngiana* mallee and *Triodia basedowii.* Twelve of these communities are eucalypt woodlands over hummock grasses, eight consist of mixed shrublands with occasional emergent eucalyptus species over *Triodia*, and the final two communities are pockets of *Acacia* woodland and chenopod shrublands. Eight of these habitats were selected as core sites for the Ninox (2009) survey and two coincided with sites where Sandhill Dunnarts were captured in the 1985 Survey (Hart and Kitchener 1986) and in 2009 (Gaikhorst and Lambert 2009).

A vegetation – habitat – terrain description of each of the sites chosen for sampling during the (Ninox 2009) survey was provided by Mattiske Consulting Pty Ltd and is referenced in Appendix A –Table A-3. Habitat descriptions for refugia sites within the Development Envelope will be undertaken in 2015 when access to these sites is established.

3.0 Species Profile

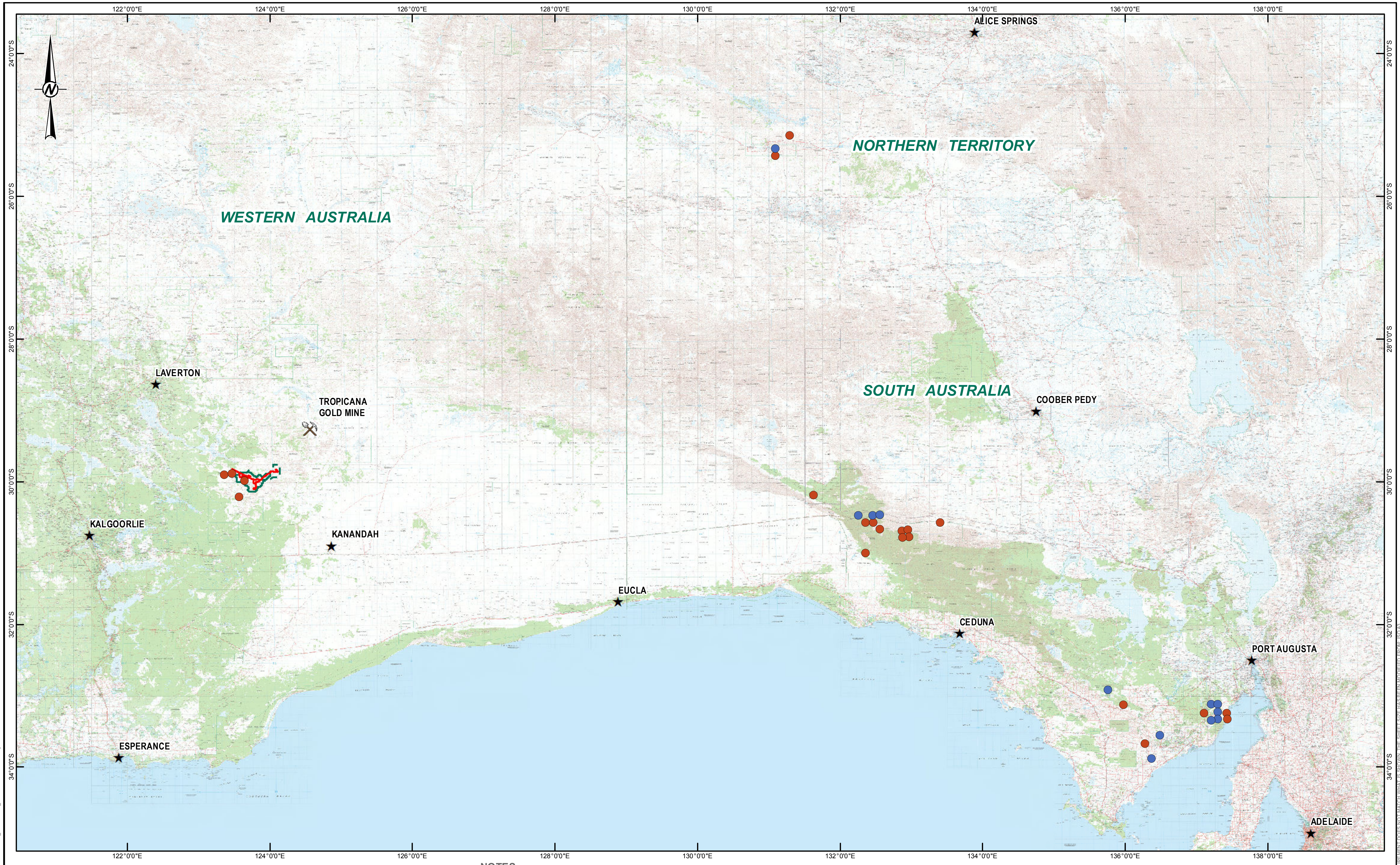
3.1 Source of Information

The following detail on the Sandhill Dunnart (*Sminthopsis psammophila*) has been substantially obtained from *Assessment of habitat availability for the Sandhill Dunnart in Western Australia* (Churchill 2009), the *National Recovery Plan for the Sandhill Dunnart* (van Weenen *et al.* 2011) and *The Action Plan for Australian Mammals - 2012* (Woinarski *et al*. 2014).

3.2 Distribution

Sandhill Dunnarts are currently known to occur from four major populations in South Australia and one in Western Australia. No recent survey information is published for the historic Lake Amadeus location in the Northern Territory.

The South Australian populations occur on the Eyre Peninsula; near Whyalla, Hincks Conservation Park and Pinkawillnie Conservation Park. Two populations occur in the Great Victoria Desert – one near Ooldea in the Yellabinna Regional Reserve in South Australia and the remaining occurrences are in Western Australia, north of the Queen Victoria Springs Nature Reserve (van Weenen *et al*. 2011). They may still exist in the south central ranges of the Northern Territory although there have been no live specimens collected since 1894. Current populations are shown on Figure 4.



LEGEND

- TROPICANA GOLD MINE
- TOWN
- HUMAN OBSERVATION
- PRESERVED SPECIMEN
- MRUP DEVELOPMENT ENVELOPE
- PROJECT BOUNDARY (MINING TENURE)
- PROJECT BOUNDARY (MISCELLANEOUS TENURE)

NOTES

1. COORDINATE SYSTEM: GCS GDA 1994

REFERENCE

INFRASTRUCTURE DATA PROVIDED BY CLIENT
BASE DATA © WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2015)
IMAGE SOURCED FROM GEOSCIENCE AUSTRALIA 250K TOPO
SANDHILL DUNNARTS DIGITISED FROM ATLAS OF LIVING AUSTRALIA

0 50 100 150 200 250
1:5,500,000 KILOMETRES

CLIENT
VIMY RESOURCES LIMITED

VIMY RESOURCES

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-27
DESIGNED	MS
PREPARED	MS
REVIEWED	GB
APPROVED	GB

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
DISTRIBUTION OF SANDHILL DUNNARTS BASED ON CAPTURES 1895-2012 (SOURCE: ATLAS OF LIVING AUSTRALIA)

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	B3	0	4

Path: G:\Spatial_Information_Group\GIS_WORKSPACE_AUSTRALIA\01_WA\SH5107_MINGWAL\1540340\Projects\APPENDIX\Rev0\1540340-B3-F004-Rev0.mxd

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25mm

3.3 Appearance

The Sandhill Dunnart (SHD) is one of nineteen species of the carnivorous marsupial genus *Sminthopsis* (Dasyuridae) that occur predominantly throughout the arid and semi-arid regions of Australia and one of five dunnart species recorded at Mulga Rock. The other four species include *Sminthopsis crassicaudata*, *S. dolichura*, *S. hirtipes* and *S. ooldea*. All species are nocturnal and insectivorous and are generally similar in appearance, characterised by their long pointed snouts, large eyes and ears and relatively long slender hind feet. The SHD differs from other members of its genus by several features, most noticeably by its larger size (30 to 55 grams) with males weighing 26-55g (mean 36g) and females 25-42g (mean 33g) and a distinctive tail that can be bicolour and has a crest of stiff black hairs along the ventral surface of the distal portion (Hart and Kitchener 1986). They lie within the 'critical weight range' (Burbidge and McKenzie 1989); for terrestrial mammals that have an elevated likelihood of extinction or significant decline, especially in arid areas.

The fur colour is generally drab grey with buff fur above and white fur on the underside of feet, a pale grey head and a black pencilling extending from the shoulders to the wedge between the eyes, large dark eyes and a black eye-ring. The ears are large and the tail is pale above and dark grey below tapering towards the crested tip. The head to body length ranges from 85-114mm long and the tail length is 107-128mm long (Pearson 1995). Tracks are quadruped with a gait of 6-8cm (Plate 1) and a foot length of approximately 22 to 26mm (Way 2008). The identification of SHD tracks from those of other *Sminthopsis* in the region is only possible after rain when moist sand may retain footpad features as described by (Gomez *et al.* 2013).

Plate 1 Sandhill Dunnart tracks at Shirrocoe sandplot site SHD_069, Eyre Peninsula, South Australia (from Way 2008)

3.4 Habitat Use

Studies of the Sandhill Dunnart (Churchill 2001b, Churchill 2009) have shown that large spinifex (*Triodia* species) hummocks are favoured for nest sites.

On Eyre Peninsula, Churchill (2001b) recorded Sandhill Dunnarts nesting in large spinifex hummocks that had started to die off in the centre. They have been observed to enter these spinifex hummocks by leaping up onto the hummock and climbing over the needles to the centre before scrambling down through the central portion of dead leaves. In the centre of the hummock, they build a circular depression or space within the dead spinifex needles usually 10 to 15cm in diameter. Adult female Sandhill Dunnarts occasionally dug burrows; starting from the inside of the spinifex with the burrows spiralling down under the plant. These burrows are up to 90cm long and had a small terminal chamber that contained nesting material of leaves and shredded bark. Male Sandhill Dunnarts were found to use a greater variety of nest sites than females, including small burrows between spinifex clumps, hollow logs and Mitchell's Hopping-mouse (*Notomys mitchelli)* burrows.

Both the West Australian and South Australian populations are known to occur on sandy substrates in arid and semi-arid regions. The most consistent features of the habitat is the presence of spinifex (*Triodia* species) hummocks associated with parallel sand dunes and sheets. The associated vegetation in the southern GVD varies but is most commonly mallee species or Marble Gum (*Eucalyptus gongylocarpa*), often with Southern Cypress Pine (*Callitris verrucosa*) over a complex shrub understorey (Hart and Kitchener 1986, Pearson and Robinson 1989) including *Acacia* sp.

Although reconnaissance surveys have been undertaken, no detailed regional habitat assessment has been made for the Sandhill Dunnart across the full expanse of the Great Victoria Desert (Churchill 2009), and there does appear to be large areas of potentially suitable habitat types throughout the southern GVD. The locations of recorded SHD trap and capture sites in the GVD in Western Australia are shown in Figure 2.

Spinifex Habitat Stages

Potential suitable habitat is recorded as consisting of areas of large spinifex hummocks. Typically, there are mixed sizes of spinifex plants but the presence of plentiful large hummocks of approximately 40 cm high and 70 to 100 cm diameter reportedly make ideal nest sites. Sandhill Dunnarts show a preference for large hummocks that form an intact mound or have just started to die off in the centre (See Table B-2 Data Recording Sheet Appendix B). Sandhill Dunnart trapping has been most successful on or adjacent to sand dunes or sheets.

The presence of large spinifex hummocks appears to be a critical factor for this species on the Eyre Peninsula where suitable spinifex occurs in areas approximately >20 years post-fire and these sites are usually associated with mallee communities. Early regrowth of mallee (less than 10 years old) appears to favour spinifex growth, but after 20-year regrowth, the spinifex have become sparse, dissected and are shaded by mallee and shrub regrowth. This is not observed to the same extent at Mulga Rock where mallee development is controlled by wildfire.

At Ooldea, in the South Australian part of the Great Victoria Desert, Churchill (2009) reported that the age of the spinifex is much older and not as suitable for nest sites, but the Dunnarts at this site reside in burrows they have dug under the spinifex. The reason for the different nesting behaviour at the two sites is unclear.

Recent variations in capture rates near Immarna in northwest Yellabinna (SA) have indicated that greater spinifex cover was correlated with greater Sandhill Dunnart densities and hence capture rates (Ward *et al.* 2008). However, additional trapping has demonstrated that spinifex cover, structure and separation are not, in isolation, reliable predictors of Sandhill Dunnart occupancy and density within their known range. Sites near Oak Valley in the Maralinga Tjarutja Lands contained equivalent spinifex cover and size to the occupied Yellabinna sites; however no Sandhill Dunnarts have been captured in the area. The lack of sand dunes or suitable sand for burrowing or differences in spinifex phenology may explain the lack of captures at the Oak Valley sites sampled (Ward *et al.* 2008).

On Eyre Peninsula, Sandhill Dunnarts were trapped and radio-tracked only in areas that had been burnt ten years earlier (Churchill 2001b). They did not use an adjacent area of habitat that had remained unburnt for approximately 30 years. This unburnt area retained vestiges of spinifex but most of the spinifex was old and its structure had broken down into large broken rings that provided little cover for Sandhill Dunnarts.

3.5 Reproduction

Recent information regarding the reproductive biology of Sandhill Dunnarts has been reported from laboratory studies conducted at the Perth Zoo (Lambert *et al.* 2011) and field observations, from the literature and examination of museum material (Hart and Kitchener 1986, Pearson and Robinson 1989, Pearson 1995). Female Sandhill Dunnarts possess eight teats and have been recorded with up to eight young. Both males and females reach sexual maturity in their first year. Studies by Lambert *et.al* (2011) show they are seasonal breeders with an average interval from mating to birth of 18 days. The pattern of reproduction appears to be mating in September; with young being born in September/October; and pouch young weaned in December/January (van Weenen, Ward and Churchill 2011).

However, young have also been captured in October and April showing that the species has a broader period of reproduction. It is likely that Sandhill Dunnarts usually produce only a single litter each year. However during a period of good seasons, they may be able to vary or extend the timing of reproduction or perhaps produce a second litter (Churchill 2001b).

3.6 Home Range Requirements

A radio-tracking study in South Australia (Churchill 2001b) of fifteen individuals found them to have an average home range size of 7.8 ha (range 1.8 ha to 19.0 ha). The males' home ranges overlap those of other males and females. The females may have exclusive home ranges. In general, tracking showed they move 200 to 300 m per foraging period but they have the ability to traverse long distances in short periods of time with one movement of 1,940 m recorded in two hours (Churchill 2001b). Limited data indicates that they remain within an area for at least eight months, but the boundaries of the home range may drift over time.

At one site in South Australia, five adult Sandhill Dunnarts occupied an area of 20ha indicating a potential density, in suitable habitat, of up to 25 Sandhill Dunnarts per square km. During trapping at Ooldea in 2008, between two and six individual Sandhill Dunnarts were caught in individual Elliott trapping grids across four sites (6.7ha each), indicating potential densities of 30 to 90 animals per square km (Ward *et al.* 2008). Trapping data for Western Australian populations suggest substantially lower densities per square km.

3.7 Threatening Processes

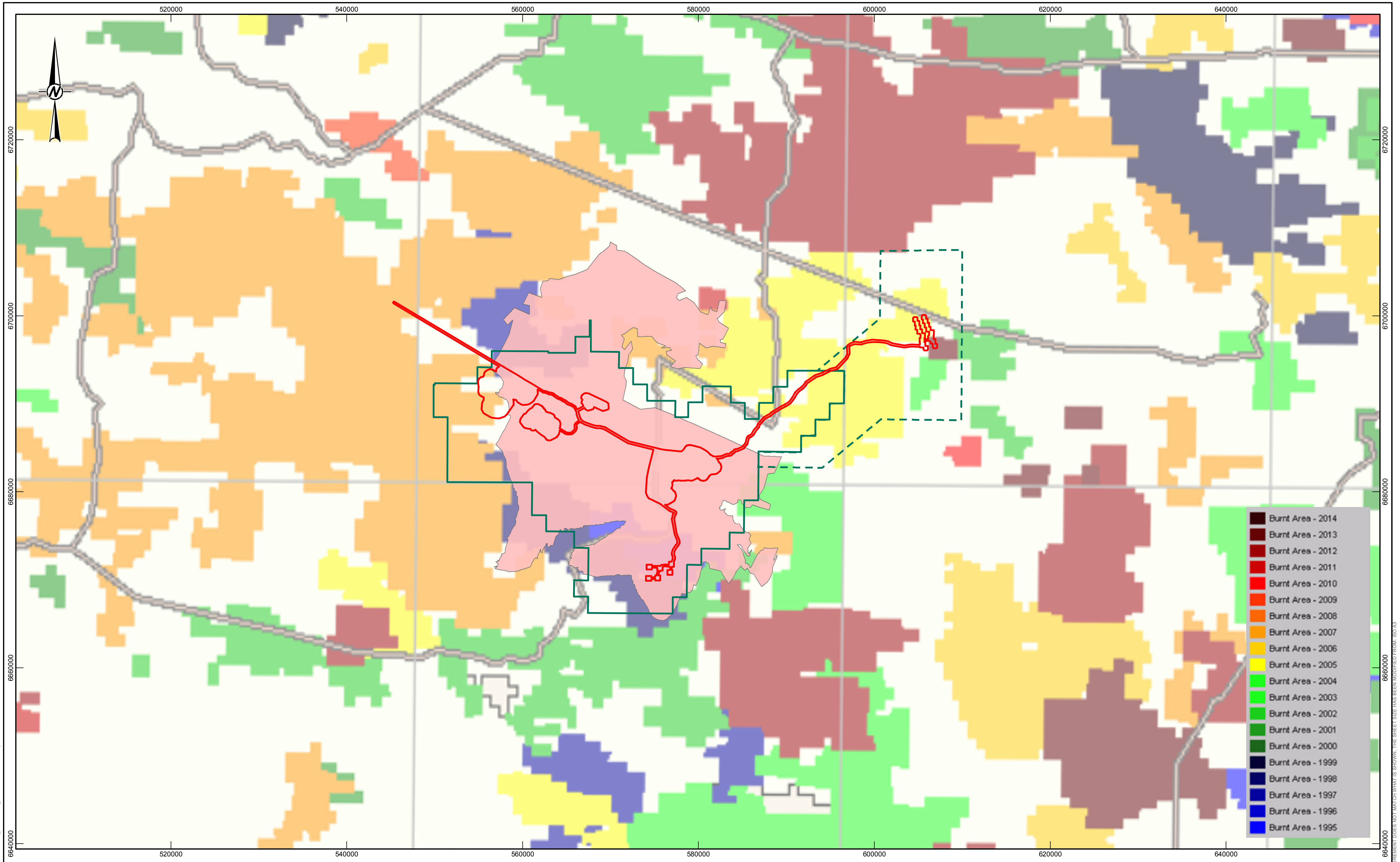
Barton and Cowan (2001) list cats and foxes as specific species threats and potential threats as clearing associated with mining, introduced herbivores such as rabbits and camels and impacts from frequent wildfires. Churchill (2001a) and van Weenen *et al.* (2011) discuss potential threats in the context of unexplained losses of small mammals in critical weight ranges, impacts from introduced species (dingo, foxes and cats) including buffel grass (*Cenchrus ciliaris*) in South Australia, changes in fire patterns and frequency and the fire age of spinifex. Indirect impacts identified included loss of specialised habitat, land clearance and inadequate survey.

Although their decline has not been substantiated, SHDs lie within the 'critical weight range' (Burbidge and McKenzie 1989), for terrestrial mammals that have an elevated likelihood of extinction or significant decline, especially in arid areas. The species' shelter behaviour inside spinifex hummocks or in burrows, would assist in limiting predation by feral cats; however, they would still be prone to predation while foraging. Extensive, hot, summer fires, which are now common in the central and western spinifex deserts, are a significant threat, as they destroy habitat over very large areas, isolating vegetation remnants, and often limiting connectivity and reoccupation as the vegetation recovers (Woinarski *et al.* 2014). Studies on the fire prone and fire adapted landscapes of the GVD and their effects on biota are limited. Hayden *et al*. (2000) suggested the average fire return interval is at least 20 years however recent records for the broader Mulga Rock area, where fires were recorded in 1999, 2005, 2007 and 2014, suggest a shorter timeframe, possibly in response to increased annual rainfall (see Figure 5, Figure 6 and Figure 7).

Fire regimes describe when and how often an area is burned as well as the intensity, size, patchiness and impact on biodiversity. In describing fires in the GVD, the layman's terms 'cool' or 'hot' fire have been used in this document based on the observed impact to vegetation and not on the typical Fireline Intensity (Bushfire Front website - 2014 http//bushfirefront.com.au) energy descriptors.

Observations following the November 2014 fire at the MRUP area, suggest that in cool fires, isolated shrub thickets, gridline/road verge vegetation and, depending on wind direction, dunal vegetation can be preserved and form connecting corridors between vegetation patches of varying sizes.

Fire history mapping has been undertaken as a targeting tool for SHD camera trapping site identification. Fire histories from Landgate for the broader region are shown in Figure 5. They show that the Project area has not received a major fire since 1999 although isolated patches have burnt. The extent of the fires in 1999 is shown in Figure 6 and those in 2005 and 2007 in Figure 7. This situation changed in November 2014 when a "cool" fire (as described in Bushfire Front 2014) burnt through the Project Development Envelope and surrounds, potentially making most of this area unsuitable for SHD habitat for the next ten years. The spatial extent of this burn is shown on Figure 7.



LEGEND

- MRUP DEVELOPMENT ENVELOPE
- PROJECT BOUNDARY (MINING TENURE)
- PROJECT BOUNDARY (MISCELLANEOUS TENURE)
- NOVEMBER 2014 FIRE SCAR

NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

REFERENCE

INFRASTRUCTURE DATA PROVIDED BY CLIENT
BASE DATA © WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2015)

0 10 20
1:400,000 KILOMETRES

CLIENT
VIMY RESOURCES LIMITED

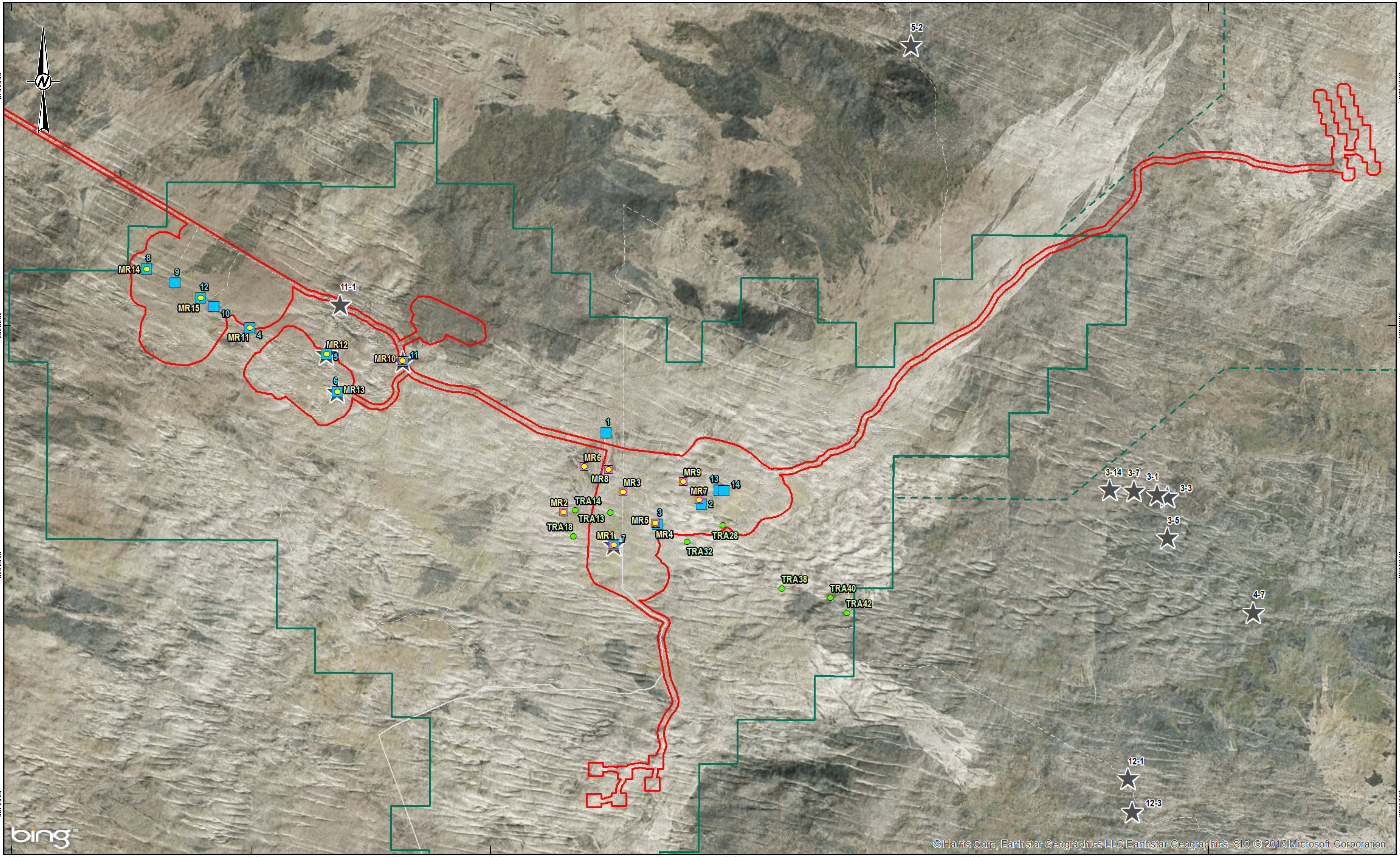
CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-27
DESIGNED	MS
PREPARED	MS
REVIEWED	GB
APPROVED	GB

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
FIRE MAPPING SHOWING BURN HISTORY OF THE WESTERN SHIELD REGION OF THE GREAT VICTORIAN DESERT 1995-2014 (DATA FROM LANDGATE 2015)

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	B3	0	5



LEGEND

TARGETED SURVEY SITE	MINOR ROAD/TRACK
PILOT SURVEY SITE	ROAD
NINOX (2009) TRAP SITE	MRUP DEVELOPMENT ENVELOPE
MARTINICK & HART (1985) TRAP SITE	PROJECT BOUNDARY (MINING TENURE)
GAIKHORST & LAMBERT (2000-2008) SHD CAPTURE SITE	PROJECT BOUNDARY (MISCELLANEOUS TENURE)

NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

REFERENCE

INFRASTRUCTURE DATA PROVIDED BY CLIENT
AERIAL IMAGERY SOURCED FROM ESRI ONLINE
TOPOGRAPHY BASED ON NATIONAL DEM 1 S SOURCED FROM GEOSCIENCE AUSTRALIA

0 5 10

1:150,000 KILOMETRES

CLIENT
VIMY RESOURCES LIMITED

VIMY RESOURCES

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-10-27
DESIGNED	MS
PREPARED	MS
REVIEWED	GB
APPROVED	GB

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
DISTRIBUTION OF CONVENTIONAL, PILOT AND TARGETTED TRAP SITES OVERLAYED ON 1999 BURN AREA IMAGE

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	B3	0	6

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25mm

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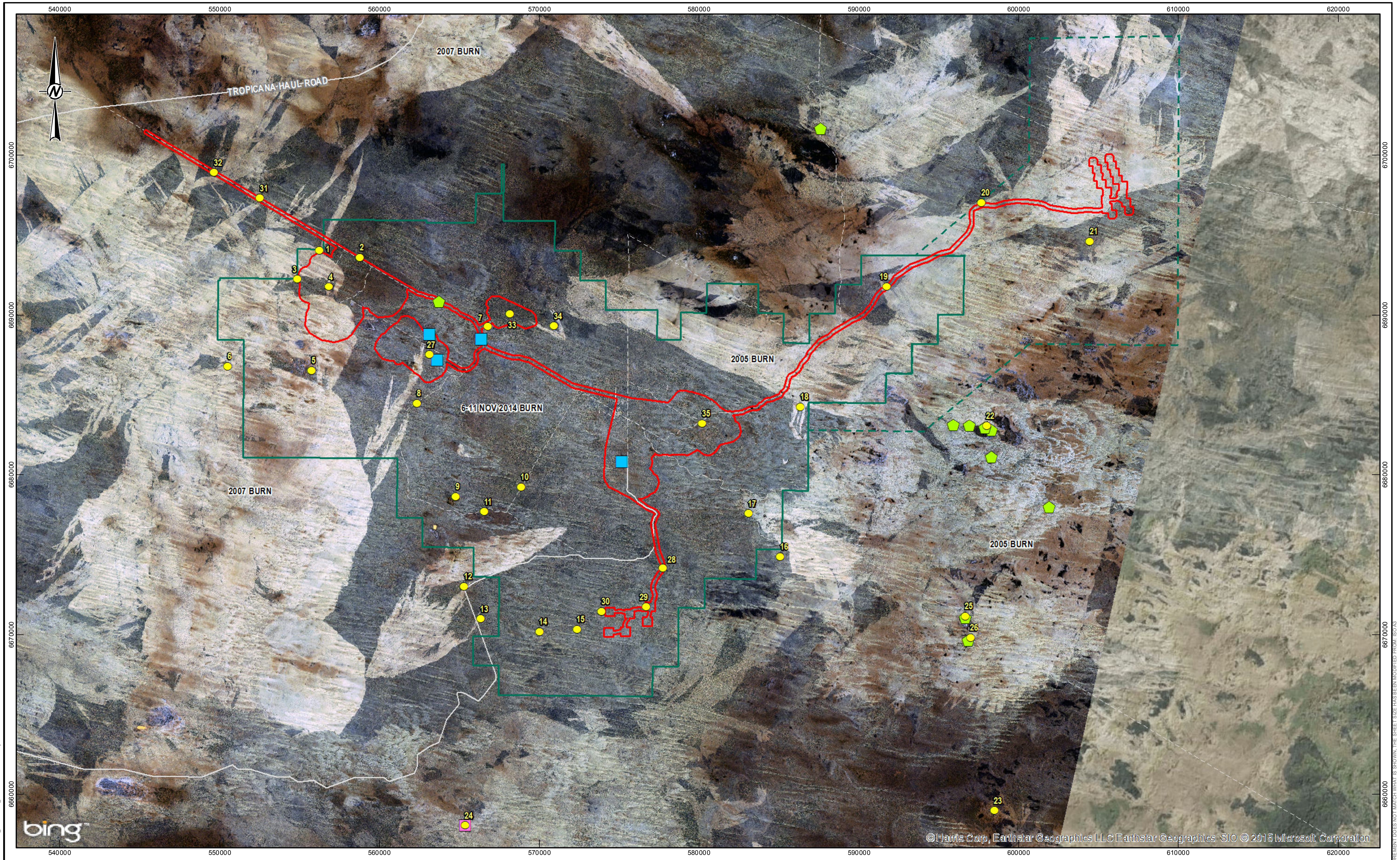


LEGEND

PROPOSED 2015/2016 TRAPPING SITE	ROAD
PEARSON (CALM) SHD CAPTURE SITE	MRUP DEVELOPMENT ENVELOPE
MARTINICK & HART (1985) SHD CAPTURE SITE	PROJECT BOUNDARY (MINING TENURE)
GAIKHORST & LAMBERT SHD CAPTURE SITE	PROJECT BOUNDARY (MISCELLANEOUS TENURE)
MINOR ROAD/TRACK	

NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

REFERENCE

2011 AERIAL IMAGERY AND INFRASTRUCTURE DATA PROVIDED BY CLIENT
AERIAL IMAGERY SOURCED FROM ESRI ONLINE
TOPOGRAPHY BASED ON NATIONAL DEM 1 S SOURCED FROM GEOSCIENCE AUSTRALIA

0 5 10

1:220,000 KILOMETRES

CLIENT
VIMY RESOURCES LIMITED

PROJECT
MULGA ROCK URANIUM PROJECT

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-28
DESIGNED	MS
PREPARED	MS
REVIEWED	GB
APPROVED	GB

TITLE
EXTENT OF FIRES SINCE 2005 AND BEFORE NOVEMBER 2014 ON FORMER CONVENTIONAL SHD TRAP SITES

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	B3	0	7

3.8 Conservation Objectives and Management

Sandhill Dunnarts are represented in conservation reserves in South Australia and Western Australia although prime habitat in both areas is prone to regular wildfires and other threatening processes. With mining development occurring in the region, the opportunity exists in Western Australia for the partnership development of a regional management plan through an organisation such as the GVD Biodiversity Trust that can promote biodiversity research on threatened species, knowledge transfer and support aspects such as long term monitoring and sound fire management.

Woinarski *et al.* (2014) describe conservation objectives for the species as:

- Conduct additional research to aid the development of management prescriptions and establish monitoring sites in Western Australia;
- Locate subpopulations and implement adaptive management strategies to promote conservation of the species,
- Assessment of relative impacts of the threats on the SHD and work with communities and mining companies to manage SHD populations.

The proposed MRUP Camera Trapping Programme will provide further inventory information on this species that will assist in better defining conservation and management requirements.

4.0 Methodology

A review on published literature and discussions with regulatory agency personnel and experienced fauna consultants and researchers who have worked in the Great Victoria Desert Bioregion for several years have highlighted that the Sandhill Dunnart is difficult to trap, and probably occurs at low densities, although potential prime habitat is considered extensive (Churchill 2009). Recovery Plans (Churchill 2001 and van Weenen *et al* 2011) have been developed citing detailed habitat requirements and conventional trap and monitoring approaches. New trapping approaches for cryptic species, using remote cameras for management and presence inventory, have been released by DSEWPaC (2011). Monitoring and evaluation for environmental management effectiveness at Mulga Rock use the principles of active adaptive management which results in continuous adjustment to camera trap programmes on the basis of new data acquisition. These aspects are managed through internal quarterly reviews, attendance of species targeted workshops and discussions with regulatory and other researchers.

Following a survey in 2009 which included a targeted survey for Sandhill Dunnarts, Ninox (2010) utilised, in addition to conventional trapping methods, camera traps in different habitats to increase trap effort. Realising the value of camera trapping in desert environments, Vimy opted to trial cameras to determine if they would be suitable for longer term monitoring.

A Pilot Programme using a modified trap layout over two 0.1ha grid areas in swale and dune environments (see Plate 3 and Plate 4), utilising Bushnell Trophy Cam HD IR cameras, was conducted in 2012. No SHDs were observed and although other small marsupials were detected, it was realised that faster trigger times and white flash were required to provide clarity of image. Camera type and techniques were modified and a new camera progressive deployment using 30 Reconyx 550 Hyperfire Led white flash was established in 2013/14.

4.1 Survey Area

The original targeted programme was established in monitoring sites set up by Ninox in 2009 which include sites from the Martinick (1985) survey where SHDs were first recorded in Western Australia. The trap site locations from the 1985 and 2009 surveys are shown in relation to the proposed Development Envelope on Figure 6 and Figure 7 and which also shows the extent of wildfires in 1999, 2005 and 2007. Understanding site burn history has been an important part of the site targeting exercise.

Following habitat assessment in 2014, some of the 1985 and 2009 monitoring sites were utilised for the camera inventory which was operational for 60 days before the study sites were burnt by a cool fire in November 2014 resulting in a review of the camera trapping programme. The extent of the impact of the November 2014 fire on monitoring sites is shown in Figure 8.

Since the fire, identification of remnant vegetation stands is in progress and the revised programme will target (a) remnant vegetation patches greater than 5ha in size, (b) road verge vegetation corridors connecting vegetation patches in the development area, and (c) unburnt optimal habitat outside Vimy's tenure. The location of the proposed sites is shown on Figure 8.

4.2 Survey Timing

The targeted camera trapping programme at former Martinick and Ninox sites commenced in August 2014 and ran continuously until the Project area was burnt out in mid-November 2014 when the programme was discontinued. A revised post-fire programme commenced in January 2015 and will run continuously until 30 October 2015 when the programme will be reviewed. .

4.3 Habitat Assessment

Habitat assessment was based on recommended survey techniques outlined in Survey Guidelines for Australia's Threatened Mammals – Sections 3.1 and 5.0 (DSEWPaC 2011), on habitat information contained in previous survey reports for the region, where SHDs were captured; Hart and Kitchener (1986), Pearson and Robinson (1989), Gaikhorst and Lambert (2009, 2010 and 2014), from National Recovery Plans (Churchill 2001, and van Weenen *et al*. 2011) and recent habitat assessments of potentially available sites in Western Australia (Churchill 2009, GHD 2010 and Turpin 2014).

Fine scale vegetation mapping of the MRUP Area (Mattiske 2009) was used by Ninox (2009) to define an additional range of habitats located across the Project area and these sites were trap tested by conventional trapping methods in 2009. Descriptions of these sites are listed in Table A-3 in Appendix A. These sites were used as the initial locations for the targeted presence/absence survey using the camera trapping protocol up to November 2014 when all camera trap sites were burned. The initial fifteen sites included three trap locations where dunnarts were captured in 1985 and two sites in 2008 (Gaikhorst and Lambert 2009).

Churchill (2009), using vegetation associations from known Western Australian SHD capture sites, identified potential habitat types for the Tropicana Gold Project area and the associated infrastructure corridors and extended this comparison to cover the broader GVD region. Due to the different vegetation survey codes used in public domain reports on likely SHD habitats in the region, and to ensure any prime habitat in the potential development areas at Mulga Rock were identified, a preliminary comparison of Churchill's vegetation communities with Mulga Rock vegetation mapping was undertaken by Mattiske (2015).

Churchill (2009) has broadly described the potential habitats of Sandhill Dunnarts into three categories:

- **Prime**: Core habitat that is functional and able to meet all the needs of a breeding population. Prime habitat has the highest likelihood of supporting a current population and therefore the highest likelihood of sampling success. Note that actual sampling events are rare (high trap effort is usually required), even in the presumed best areas of habitat in the GVD.
- **Likely**: Meets the majority of the needs of a breeding population. May contain small, disjunct areas of Prime habitat within a matrix of lower quality habitat. Medium likelihood of successful sampling.
- **Marginal**: Sandhill Dunnarts may use (and have occasionally been sampled in) marginal habitat, but they will not often live in it. Marginal habitat may be used for movement between patches of higher quality habitat, or for foraging if adjacent to appropriate cover/breeding habitat.
- **Potential**: These habitats possess several of the attributes of likely habitats but may have different burn histories, or are located as isolated communities, or exhibit different terrain features. They are worthy of trapping.

The comparison results are listed in Appendix A –Table A -1 and these will be used to cross check and code sites selected for the Refuge Programme.

4.4 Prime Habitat Criteria

Prime SHD habitat in the western GVD is defined as:

- Yellow (occasionally orange) sands ranging from very gently undulating sandplains to well defined dunes up to 30 metres in height;
- Preferred flora and vegetation structure consisting of tall mallee (10-30% cover), mixed shrubland (10-30% cover), and/or a combination of mallee, marble gum, *Callitris* and mixed shrubland (10-30% cover);
- Presence of dense, compact clumps of spinifex (at least 6-30% cover);
- Spinifex life stages of 2 to 3.5 or unburnt for eight to ten years, and
- Areas where SHDs have been trapped previously.

The presence or absence of small mammal tracks has also been used as a tool in assessing the potential of an area. However current knowledge suggests that tracks could not be used as a definitive guide to the presence of Sandhill Dunnarts as *S. hirtipes* and *S. dolichura* display similar traits.

4.5 Impact of Local Wildfires

Wildfires are dramatic natural episodic events that characterise the environment of the Great Victoria Desert. Fire events with short recurrence times can directly impact on Sandhill Dunnarts through species destruction and indirectly from loss of habitat, removal of safe movement corridors and food sources. Post-fire impacts can be equally devastating resulting in increased predation and, depending on climatic conditions, long term decline in spinifex structure and density (DENR 2013).

Patches of habitat have been preserved in recent (post-2000) site fires (Figure 8). These have identified by age from landsat imagery and it is proposed to assess their status against habitat criteria and target suitable habitat in the proposed 2015 Camera Trapping (CT) Refuge Programme as a substitute for the planned systematic 2014 Pre-fire Trapping Programme that ceased when all camera trap sites (Plate 2) were burnt. Marginal habitats and sites burnt in 1995 and 2005 will be included in the mix.

Plate 2 Post-fire image of a Ninox camera trap site

4.6 Camera Trap Methodology

4.6.1 Survey Design

The primary objective of this Camera Trapping Protocol is to provide details on the presence or absence of Sandhill Dunnarts within the MRUP proposed Development Envelope. Information on the habitat preferences of this small dasyurid have been established (Churchill 2009, van Weenen *et al.* 2011) and several surveys have captured very low numbers in a range of these habitats over the past 30 years. Recent fires have destroyed most of the “prime” habitat and the programme has refocused as (a) a stratified sampling test of unburnt or partially burnt refugia of different habitat type with replicated sampling effort in areas in proximity to previous capture sites, (b) some additional trapping around infrastructure - primary borefield and reinjection borefield areas that were not extensively burnt and have not been exhaustively tested, and (c) areas outside the Project tenure where previous SHD captures have been recorded. Some of the post-fire sites selected are in edge effects areas and have received comment from reviewers. Edge effect impacts on small mammals in most habitats in Australia are poorly understood and very limited work has been done in the arid lands. However, some trapping success has been reported for SHDs in edge environments in the GVD and for this reason this category has been included in the programme. Churchill (2001) reports that

Dave Pearson captured an adult male in a burnt area adjacent to an unburnt area in the Queen Victoria Spring Nature Reserve in September 1991 and Gaikhorst and Lambert report the capture of a juvenile male on the edge of a small unburnt remnant in 2007 (Gaikhorst & Lambert 2009a).

The strategy for trapping at the nominated sites is outlined below and is shown on Figure 8.

This new strategy for the Camera Trapping at MRUP will implemented by:

- Continue to CT existing sites where SHDs have been captured in the past if the habitat is still suitable. The November 2014 fire, although widespread in the Project area, was a cool fire and sufficient cover for small mammals may be present in some locations. Sites MR5/6 and 10/11 are the most prospective if habitat is available. Locations are shown on Figure 8;
- CT refugia areas >3ha close to sites where SHD's have been captured in past where habitat is suitable. (Sites E1, E2, E3, E4 – S7, S8, A18);
- CT refugia, or partially burnt areas, close to non-spinifex (*Melaleuca*, Mulga) bearing depressions, with the exclusion of large kopi depressions (Sites E6, E10);
- CT suitably sized (>3ha) isolated refugia that is connected by unburnt corridors (including road) and inside tenure but outside development areas (Sites E6, E9, E10, E11 ,E12, E13 ,E14, E16, E17);
- CT in infrastructure areas not previously tested such as sections of the borefield and reinjection areas (search is not restricted to SHD in these areas) but to cover gaps (Sites E15, A18, A19, A20, A21);
- CT wildcard areas (designated' X') such as unburnt site previously identified by Gaikhorst and Lambert (2008) on the PNC baseline east of Ambassador (Sites X22), Malcolm Soak - X23 and, if details are available, any of the previously trapped area by Pearson (1987) north of Queen Victoria Spring Nature Reserve (Sites X23 or X24), and
- Minesite rehabilitation area at Shogun (Site X27).

General guidelines that can increase the success of CT programmes include:

- Cameras should be set up in a location that is flat or gently sloping with limited vegetation in the field of view to reduce false triggers. However, the location chosen for placement of cameras has to be a balance between being able to capture images unimpeded and the habitat preference of the species.
- Lure stations will be located approximately 1.5–2.0m from the horizontal camera. Any vegetation between the camera and the lure, and either side of the lure should be cleared or trimmed. Where possible, any objects that may obstruct the camera's field of view will be removed.
- Station markers or identifiable features (i.e. reference scale) should be included within the camera view, to allow animal size comparisons and to ensure that any pictures can be easily verified to a specific site, if required.
- Where possible, the background (area behind the lure) should be uniform to help reduce temperature differentials between objects i.e. where possible create the optimal homogenous background temperature.
- Selected camera trap sites will have an iButton sensor located with the lure to evaluate temperature dead zones, as this will identify when Passive Infrared (PIR) sensors will not work due to temperature differentials between background and target species body temperature.
- Where camera traps are oriented in a vertical position (facing downwards), cork tile(s) will be placed centrally under the bait device to support low reflectivity from sand grains which will assist in maintaining a constant temperature surface to maximise detection of target species.
- Cameras must be fixed to a stake that will not move in the wind, and the unit should face south to avoid direct sunlight on the lens.
- Where more than two camera setups (same model) are being used, cameras should be set at least 50-75m apart from each other to ensure a reasonable area is surveyed and to maintain conformity with quadrat areas

utilised in previous successful surveys. However, the minimum distance between cameras will depend on the species known mobility and home range size. Different fence lengths will be trialled ranging from 10m to 20m.

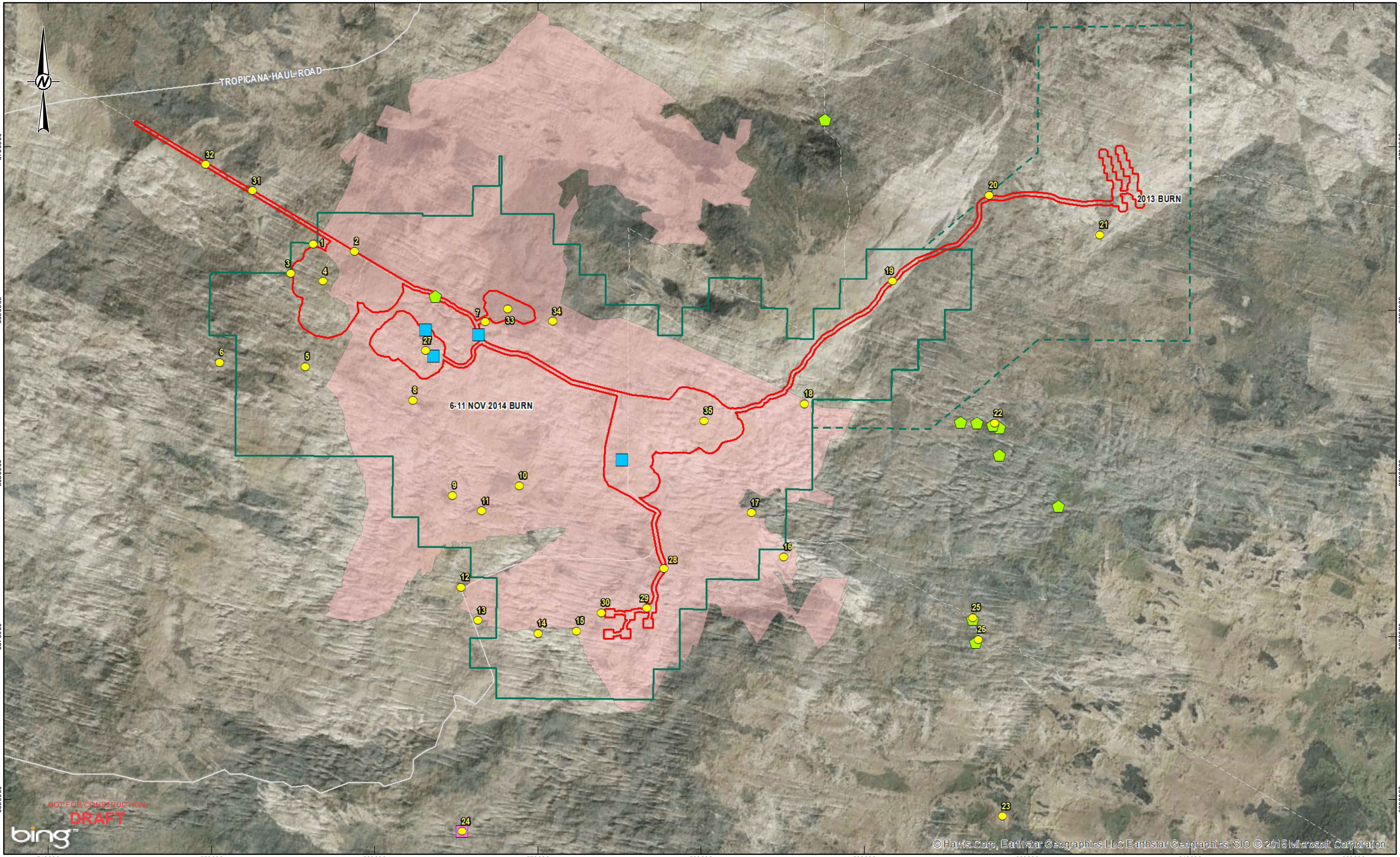
- The height of the camera should be set at a height that is specific to the target species of the survey and for SHDs horizontal cameras are located 20cm above the ground and vertical cameras 1.0m above the lure.
- Completion of the site information on the Data Sheet should be done in the field on the setup day (example in Appendix B). The camera's exact location should be recorded as a GPS coordinate on the data record sheet and will conform to the reporting guidelines specified in Meek *et al.* (2014).

4.6.2 Use of Attractants

Lures or attractants are placed to encourage animals into the detection zone of the camera (Davis 2011) and increase detection probability. To date, lures have not been used in the Pilot or Targetted Camera surveys at Mulga Rock as a review of the early pilot study images identified a robust *Varanus gouldii* and *V. tristis* population that were thought may increase predation on small mammals (see Table 2 c and d). Following the wildfire that has removed most of the ground cover and protective litter, Varanid numbers appear to have decreased.

Because the camera trapping programme has been revised to cover marginal and remnant habitats and corridors, attractants will be utilised for short periods (4-7 days) in some circumstances. The attractant to be used will be the Universal Lure (DEC 2011) (or a variation thereof) dispensed in an appropriate container to minimise ant attack. The use of the Universal Mix lure was selected due to its successful use during the Gaikhorst and Lambert and Ninox surveys in the region.

Several other attractant management methods are outlined in Meek *et al.* (2012) and these will be trialled to determine the most appropriate technique.



LEGEND

- PROPOSED 2015/2016 TRAPPING SITE
- PEARSON (CALM) SHD CAPTURE SITE
- MARTINICK & HART (1985) SHD CAPTURE SITE
- GAIKHORST & LAMBERT SHD CAPTURE SITE
- MINOR ROAD/TRACK
- ROAD
- MRUP DEVELOPMENT ENVELOPE
- PROJECT BOUNDARY (MINING TENURE)
- PROJECT BOUNDARY (MISCELLANEOUS TENURE)
- NOVEMBER 2014 FIRE SCAR

NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

REFERENCE

INFRASTRUCTURE DATA PROVIDED BY CLIENT
AERIAL IMAGERY SOURCED FROM ESRI ONLINE
TOPOGRAPHY BASED ON NATIONAL DEM 1 S SOURCED FROM GEOSCIENCE AUSTRALIA

0 5 10
1:220,000 KILOMETRES

CLIENT	VIMY RESOURCES LIMITED
PROJECT	MULGA ROCK URANIUM PROJECT
CONSULTANT	Golder Associates
YYYY-MM-DD	2015-10-27
DESIGNED	MS
PREPARED	MS
REVIEWED	GB
APPROVED	GB
TITLE	PROPOSED POST-2014 BURN TRAP SITES
PROJECT NO.	1540340
CONTROL	B3
REV.	0
FIGURE	8

Table 5 Proposed post-fire deployment plan in 2015

Camera Setup	Existing Trap Sites where Suitable Habitat Remains	Refuge Sites >3ha in Vicinity where SHD's Previously Captured	Refuge Sites >3ha outside of Buffer Zone in Project area	New Sites in Infrastructure Areas not Previously Surveyed	Wild Card Unburnt Sites outside Mulga Rock Tenure	Minesite Rehabilitation Areas
Horizontal & Vertical Camera with Drift Fence – No Lures	Sites MR5,6 and 10/11	Sites E1, E2, E3, E4 – S7, S8, A18	Sites E6, E9, E10, E11, E12, E13, E14, E15	Sites E15, A18, A19, A20, A21	Sites X26, X27	-
Horizontal & Vertical Cameras with Drift Fence – with Lures	Sites MR5,6 and 10/11	Sites E1, E2, E3, E4 – S7, S8, A18		Sites E15, A18, A19, A20, A21	Sites X22, X23, X24	Shogun Slot Rehabilitation Area – Site X27
Horizontal Camera No Drift Fences, +/- Lures	Sites MR5, 6 and 10/11	-	Sites E6, E9, E10, E11, E12, E13, E14, E15	-	Sites X22, X23, X24	-
Vertical Camera No Drift Fences,+/- Lures	Sites MR5, 6 and 10/11	-		-	Sites X22, X23, X24, X25, X26	-

4.6.3 Camera Type

Two camera types are currently used as part of the MRUP Targeted Camera Trapping Programme. These include the Bushnell Trophy Cam HD MAX with passive infra-red flash and the Reconyx Hyperfire 550 with white LED flash for colour day/night photo capture at close range. Reporting based on differences in camera models will ensure that any variance in detection probability between camera types is clearly identified. Layout design will utilise like model cameras to ensure data results can be compared. Selected settings details are outlined in Table 6.

Table 6 Detection parameters for site cameras

Parameter	Bushnell Trophy Cam	Reconyx 550 Hyperfire
Image Type	D: Color; N : Grey scale	D & N: HD Color
Pixel Resolution	5M pixel	1080p/3.1M pixel
Frames per Second	1	2
Trigger Speed (Aver. time)	1.34 Seconds	0.2 seconds
Recovery Time	N/A	N/A
Sensor	Passive infrared Motion	Passive infrared Motion
Flash Source and Range	Infrared; 15m	White Flash (LED); 10m
SDHC Card Class 2	4GB - fast write	16GB - fast write
Field of View - Width/Angle	7.0m/50°	6.7m/40°
Image Data	Station, Time/Date, T°C	Station, Time/Date, T°C

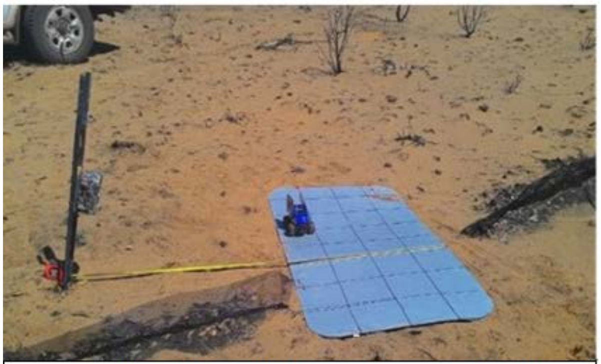
4.6.4 Camera Setup and Calibration

The precise layout and placement of cameras setup will involve several options depending upon accessibility of the site,, terrain characteristics and camera availability.

Paired cameras (same model) will be set up in stable horizontal and or vertical orientations at selected trap grid sites depending on the site slope and aspect. Single camera setup is currently the standard set up at MRUP and will continue to be used in most situations as it allows a larger number of sites to be tested. This approach is an acceptable strategy during presence /absence surveying.

In all situations, details will be entered onto the data sheet for each camera. Target species will be passively focused to travel past gaps in 10 to 20m long drift net fences (or natural constructions) where detection zones, which may include bait stations, are established. In most cases, cameras will be sited to avoid removal of vegetation. Standardisation of camera set-up is necessary to enable consistent and effective image and future programme comparisons. Cameras are set up (a) to produce five images per trigger, (b) rapid fire and (c) high sensitivity..

Heat and movement detection zones are calibrated using a combination of remote controlled car with a heat source and walk tests. Details of the calibration process for horizontal cameras are shown in Figure 9.



Grid pad used for calibration of camera (fixed to steel pole on the left)

Remote-controlled car attached with Dunnart photograph used for calibration

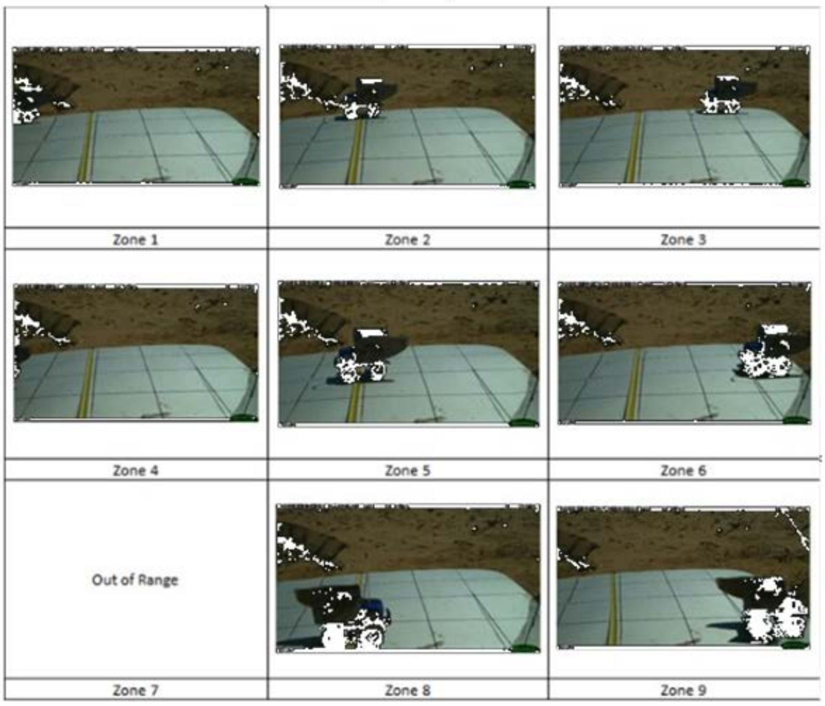


Figure 9 Calibration of camera for horizontal image capture

Vertical Placement Setup

Diagnostic identification features of the Sandhill Dunnart are the distinctive crest on the last quarter of the tail, large ears, distinctive tail body length and the black anterior colouration on the ears (see Identification Matrix - Table B-5 in Appendix B). To assist in the identification of features, it is proposed to trial, in conjunction with a horizontal camera, a vertically oriented downward directed camera targeting the lure zone. Special attention will be applied during vertical camera set-up to ensure the PIR bands cover the focal zone to ensure small mammals are detected. An example is shown in Figure 11.

4.7 Trap Layout

Four trap layout designs have been trialled to date for the CT Programme, based on the terrain evidence of small mammal activity and vegetation criteria. Fence lengths will vary depending on terrain. Trap layouts include:

- Variations on the Ninox trap quadrat layout (Figure 10) where two sides of the quadrat were fenced with aluminium fly wire approximately 30cm high and buried to a depth of 100mm. Cameras were established to target 1m windrows in the fence line at nominated distances ranging from 10-20m.

- The "X" trap layout (Plate 3) is similar in establishment to the Ninox setup, but had the camera/s located at the intersection point of the fence lines.

- The Dune Trap (Plate 4) was established on small mammal travel ways identified on dune crests. Netting fences were generally not required although placement of branches were used to direct the animal into the camera target zone.

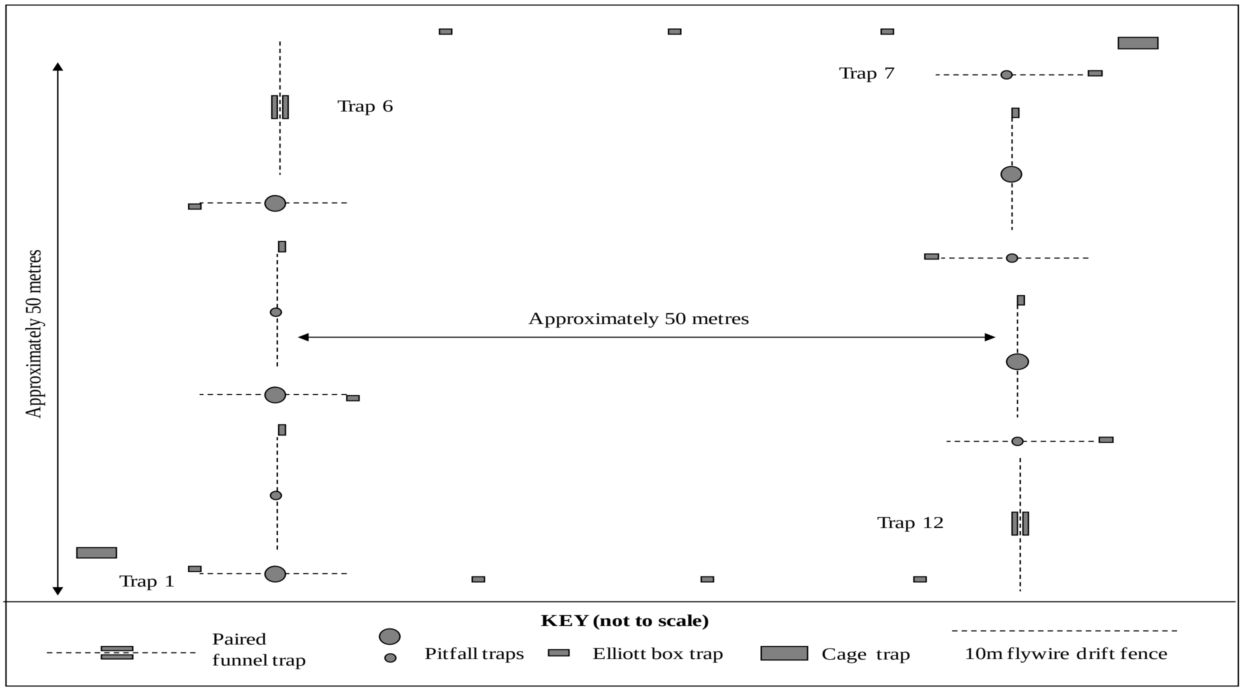


Figure 10 Diagrammatic Layout of Existing Fauna Trapline Grid

Trap layouts with vertical and horizontal cameras will be deployed in lured and non-lured configurations. The primary aim is to focus the animal's travel to within the vertical camera's field of view and relocatable barriers (i.e. timber branches), shown as brown bars in Figure 11, will be trialled.

Plate 3 ***In situ*** **camera trap layout for pilot survey in 2013**

Plate 4 ***In situ*** **dune camera trap for targeted post-fire survey in 2014**

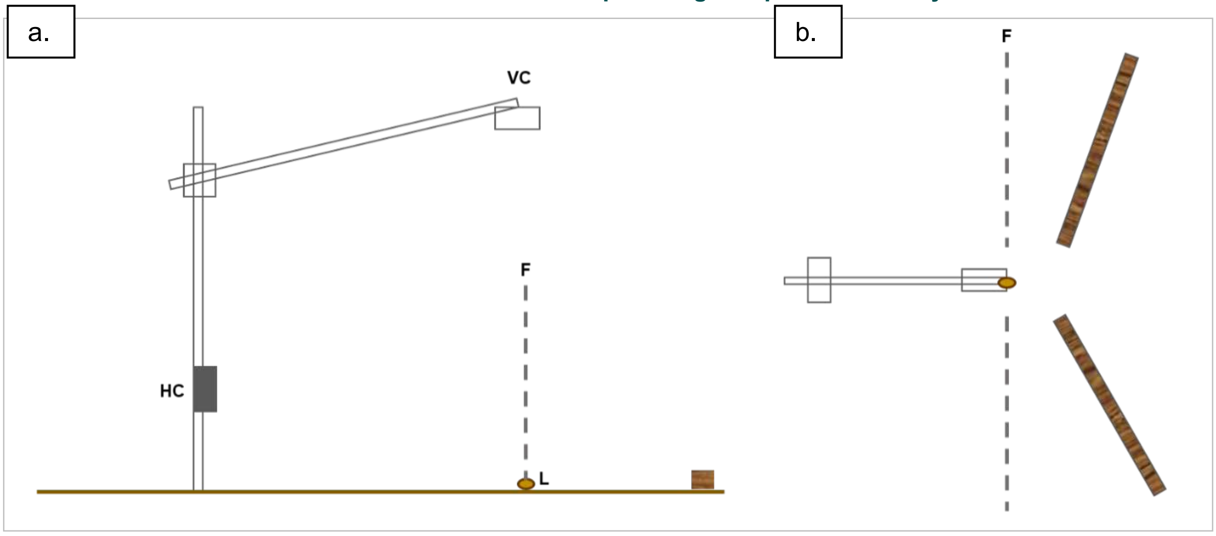


Figure 11 **Schematic of vertical (VC) and horizontal (HC) camera setup (side and vertical views) with fence (F) and lure (NTS) (a. side view; b. plan view)**

4.8 Survey Period and Camera Schedule

The post-fire review has identified 27 potential camera trapping sites to be covered by 35 cameras. Three cameras will be retained as maintenance spares. The post-fire Programme is scheduled to run for approximately nine months or until October 2015 to avoid the risk of camera loss in lightning generated fires. Provisional details are outlined in Table 7 and final deployment matrices will be finalised once habitat inspections are completed. Camera traps may be deployed for up to 60 days at each grid location.

Table 7 Deployment schedule - Camera Trapping Programme

	2012	2013	2014	2015
Mulga Rock Ninox Level 2 Survey 2009				
Mulga Rock Pilot Camera Trap – Swale Sites				
Mulga Rock - Pilot Camera Trap – Dune Sites				
Mulga Rock - Targetted Camera Ninox/Hart Sites Pre-fire - (non lured)				
Mulga Rock - Development Buffer Area Targetted Camera Post-fire Refuge Programme >5ha				
Mulga Rock - External to Development Buffer Area Targetted Fire Boundaries , Refuges and Corridors >5ha				
External Sites to Project – Targetted Camera Unburnt				
Review of Programme				

5.0 Data Collection and Reporting

5.1 Requirements to Demonstrate Presence of Sandhill Dunnarts

Sandhill Dunnarts have now been detected in the Western Australian GVD over a 30 year period by a range of mammal survey techniques. The most successful reported techniques (although detection rates are extremely low for SHDs by Australian mammal trapping standards), have been live capture in deep pitfall and Elliott traps, camera trapping and scat searches in specialised spinifex habitats on sandy terrains. Although a relatively new process, camera trapping is proposed as the most appropriate of the secondary detection methods and is potentially the most ethical (animals are not physically captured), efficient and cost-effective technique for detecting the presence of Sandhill Dunnarts at the MRUP site when appropriate habitat is present.

The process, described in previous sections, has outlined habitat assessments in accordance with the national Recovery Plan and local surveys, application of camera techniques using best available technology and survey effort, that when implemented, would have provided a reasonable opportunity of detecting SHDs if they are present. The final step in this process is to define what are reasonable records to demonstrate presence/absence and what validation mechanism is proposed. The approach adopted is similar to methodology adopted for *Dasyurus maculatus* (Spotted Quoll) presence in Victorian surveys (DSEWPaC 2011).

5.2 Acceptable Records

The absence of a physical specimen requires that a transparent protocol is established to demonstrate that the image contains the animal under review. Acceptable records in respect to camera trapping are considered to be:

- Digital images of Sandhill Dunnarts obtained from remote cameras deployed at identifiable survey sites with selected site data imprinted (including date stamping) on the frame, and
- Digital images to be retained to allow independent confirmation by experienced fauna specialist(s) that the target species is present.

Vimy have identified two specialist fauna groups who have had wide experience with small mammal dasyurids in the arid environments who will provide species verification services from camera images.

They are:

- Ninox Wildlife Consulting: Jan Henry – Principal

  Subconsultants: Andrew Chapman and Peter Orell, and
- GHD: Glen Gaikhorst - Senior Zoologist.

5.3 Reporting Standards to Confirm Presence/Absence

The data required for the presence-only reporting also needs to be provided for the presence/absence surveys. A standard reporting data sheet has been developed for the project based on the current version in the Invasive Animals CRC Camera Trapping Manual (Meek *et al.* 2012), and is referenced in Appendix B.

This information will be provided for all surveys, including those that did not detect the target species. The following data is included in the Data Record Sheet (Appendix B) and is considered necessary to support a 'presence' or 'absence' record:

- Start and end date for the survey;
- Name and contact details of the site environmental observer;

- Research permit details where required (i.e. if use of attractants are used), under the *Wildlife Conservation Act 1950*.
- Details of the target species present, number of individuals detected or number of observations;
- Date and time of record on image;
- Description of geographic location, grid size, habitat stage, burn history and cover percentage of the camera site (including GPS coordinates);
- Documentation of the size of the survey area, the number of sites surveyed, the number of camera traps deployed at each site and distance between them;
- The type of camera used and the camera settings;
- GPS co-ordinates of each camera location;
- Photographic evidence of the trap location with a fixed re-locatable feature in the frame;
- Method of observation, including the sampling effort (e.g. number of camera trap nights);
- The name and expertise of the person identifying the image is required.

5.4 Requirement to Demonstrate Absence

While it is relatively straightforward to document if the target species is present, it is generally impossible to determine if a species is truly absent if it was just not recorded during a particular survey, or if the survey was not adequate to reliably record the species or biophysical conditions precluded the likelihood of the species being present.

While there can never be complete certainty that a species is absent, for planning purposes, a species is effectively absent if it is not recorded in a nominated test area in given time frame and surveys are undertaken in accordance with approved sampling guidance documents and recovery plans.

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7.0 Glossary of Terms

Camera Trap: A camera installed in the field to automatically take photographs of animals passing in front of it. The camera trap consists of the camera, a control unit, a sensor and a memory card.

Camera Trap Array: A set of camera trap points (usually 20-30) distributed at a density according to the home range of the target species. All camera traps in the array sampled during the same 30 day period.

Trap Excel Template: A blank Excel file with predetermined worksheets and columns used to create camera trap excel files.

Camera Trap Setup: A form used in the field to record camera trap data such as date and time the camera is set, camera trap number, name of person setting up the camera trap. See Data Recording Sheet – Appendix A.

Camera Trap Point ID: A unique code, assigned on the basis of a standard convention to a particular **camera trap point** (i.e., the location, **not** the camera trap itself). See Data Recording Sheet – Appendix A.

Control Unit: An electronic camera board with a small central processor unit that turns the camera on and off in response to a signal provided by the sensor. The control unit can be programmed by a user to specify the level of sensitivity to movement, the number of photographs the camera takes when it is activated etc.

Data Recording Sheet: A paper form to check the status and maintenance, camera trap point data, camera trap metadata records of camera traps before they are deployed in the field. A blank camera trap Data Sheet appears in Appendix A.

Deployment Plan: A plan describing when, where, and how the protocol will be implemented at a specific site. The plan must contain the proposed sampling design, including the proposed geo-spatial location of each camera trap array, relevant geographic information system (**GIS**) layers (shape files) for each array (e.g. topography, access, water drainages), and a detailed chronogram of activities.

Detection Zone: The zone within which movement triggers the remote camera to take a photograph. This zone is often cone shaped and may be between 3-10m long and 15° to 72° degrees wide.

Event: The period of time between independent triggers of distinct individuals regardless of the number of images.

False Negative: Failure to detect an animal when it is in fact present.

False Positive: Incorrectly detecting an animal when none are present.

Field of View: The area captured in an image usually between 35-45°.

Focal Point: The centre of the image – the subject of interest.

Lure: A generic term referring to an attractant to encourage animals to investigate a point within the detection zones. Lures may be auditory, olfactory, visual or some combination of these in nature.

Motion Sensor: A small device mounted in front of and on the outside of the camera trap that detects movement within the area in front of the camera. Signals from the motion sensor travel to the control unit, which in turn, controls the camera.

Night Mode: This setting allows the device to be set to maximize clarity at night by reducing the illumination power and increasing the speed of the shutter, thus reducing blur.

PIR Sensor: Passive detectors of infrared light.

Pilot Study: Replication of an activity on a small scale to check design of an experiment, prior to commencing it on a larger scale

Processed Image: A photograph that has been annotated using the camera software available and recorded to the Data Recording Sheet and Database.

Rapidfire: A camera trap setting that allows images to be taken continuously following a trigger event.

Recovery Time: The time it takes for a remote camera to return to a state where it can take another image. This can vary between 0.1 to 4 seconds depending on the model.

Refugia (Refuge): An area where conditions have enabled a species or a community of species to survive after extinction in a surrounding area from an agent such as wildfire

Sampling Cycle: A period of 15 to 30 days during which a set of camera traps is active (sampling) in a given area.

Sampling Design: Refers to the number of camera traps (sample size), their locations (spatial distribution), the time of year and frequency of successive sampling periods (temporal distribution), and the length of time the cameras are deployed in the field during each sampling period (effort).

Sampling Period: A specified period of time (e.g. week, month, climatic season) during which all camera trap points are sampled.

SD Card: The acronym for Secure Digital cards. A removable digital storage medium that is currently the standard in camera traps.

Sensitivity: A setting, often adjustable, that reflects the camera's response to heat in motion for PIR sensors. Higher sensitivity is associated with more images, and lower sensitivity with fewer images. Increased sensitivity, however, does not guarantee detection of a target.

Sequence: A series of still images or video taken in rapid succession but separated by a time interval less than the set independence interval and forming an animated record of a triggering event.

Targetted Survey The aim of a targeted survey is to detect the presence of a significant species.

Time Lapse: A program function available on some camera traps. The time-lapse function typically allows a user to prescribe times of day/night when the camera is inactive, regardless of activity within the detection zone. Some time-lapse cameras do not have a PIR and, instead, capture images at prescribed times or intervals.

Time to First Trigger:	The speed of the camera from detection by the PIR sensor to the first image captured.
Trigger time	The time it takes for a remote camera to take a photo after an animal has moved into the detection zone.
Trigger or Capture Speed:	The time difference between detecting heat in motion and capturing an image. Also known as response time. Slower trigger speed (i.e. more time elapsing between trigger and image capture) may decrease the likelihood of capturing a target.
Walk Test:	A program function available on some camera traps. Walk test, or similar, can be used to identify where a camera will respond to heat in motion. Consequently, it can be used to 'focus' the camera's detection zone, as desired.
White LED:	A white flash consisting of white LED's in an array similar to an infra-red array that illuminates the subject at night in full colour and is faster than xenon flash technology.

8.0 List of Abbreviations

Abbreviation	Description
BOM	Bureau of Meteorology
DPaW	Department of Parks and Wildlife (formerly Department of Environment and Conservation – DEC, formerly Department of Conservation and Land Management – CALM)
DPI	Department of Primary Industries
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EAMA or EMA	Energy and Minerals Australia Limited
Ecologia	Ecologia Environmental Pty Ltd
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
GHD	GHD
GVD	Great Victoria Desert
HD	High Definition
IBRA	Interim Biogeographic Regionalisation of Australia
IUCN	International Union for Conservation of Nature
Mattiske or MCPL	Mattiske Consulting Pty Ltd
MRUP	Mulga Rock Uranium Project
Ninox	Ninox Wildlife Consulting
NSW	New South Wales
PIR	PIR Sensor: passive detectors of infrared light
PNC	Pacific Nuclear Corporation of Japan
QVS NR	Queen Victoria Springs Nature Reserve
SHD	*Sminthopsis psammophila* (Sandhill Dunnart)
SPRAT	Species Profile and Threats Database
Vimy	Vimy Resources Limited
WC Act	The *Wildlife Conservation Act 1950* (WA) (WC Act)

Appendix A

Habitat Review of Sampling Sites and Assessment of what constitutes a preferred Sandhill Dunnart Habitat

Appendix A1

Comparison of GVD habitat descriptions with Mattiske MRUP vegetation types

TABLE A-1: SANDHILL DUNNART HABITAT PREFERENCES: PRELIMINARY COMPARISON BETWEEN VEGETATION COMMUNITIES DEFINED IN THE SOUTH WEST OF THE GREAT VICTORIA DESERT

Note: Text in Orange is the overlap points.

Sandhill Dunnart Habitat Likelihood	Other Code	Other Vegetation Description	Most Similar: MRUP Code	Most Similar VRL: MRUP Vegetation Description	MCPL Confidence On Similarity
Prime	**E04 (AGA0902)**	Low Woodland to Low Open Woodland of *Eucalyptus gongylocarpa* with *Callitris preissii* and *Eucalyptus* spp. over mixed shrubs over *Triodia* spp. This community occurs on orange, red-orange, yellow-orange and yellow sandy loams on mixed topographies	**E3**	Low open woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana, Eucalyptus ceratocorys, Grevillea juncifolia*, *Hakea francisiana* and *Callitris preissii* over *Acacia helmsiana*, *Cryptandra distigma* and mixed low shrubs over *Triodia desertorum*, *Chrysitrix distigmatosa* and *Lepidobolus deserti*. This community occurs on yellow and yellow-orange sands on flats, slopes and between dunes.	**MEDIUM** The more common *Eucalyptus* community with mixed *Eucalyptus* spp. and common shrub spp. occurring on most sand types.
Prime	**e19L.t2t7H** including subtype e19L.d3er1St2t7H and e19exL.xSt7H **(ecologia)**	*Eucalyptus gongylocarpa* over *Triodia desertorum* or *Triodia basedowii* open hummock grasses on swales and lower dune slopes or over *Dodonaea viscosa*, *Eremophila platythamnos* open shrubland over *Triodia* or with *Eucalyptus youngiana* or *Eucalyptus concinna* over mixed open shrubland	**E3**	Low open woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana, Eucalyptus ceratocorys*, *Grevillea juncifolia*, *Hakea francisiana* and *Callitris preissii* over *Acacia helmsiana*, *Cryptandra distigma* and mixed low shrubs over *Triodia desertorum*, *Chrysitrix distigmatosa* and *Lepidobolus deserti*. This community occurs on yellow and yellow-orange sands on flats, slopes and between dunes.	**MEDIUM** Could be the common (E3) *Eucalyptus gongylocarpa* community that occurs in the MRUP area.
Prime	**xS.t2t7H (ecologia)**	Isolated trees of *Eucalyptus gongylocarpa* over mixed shrub and *Triodia desertorum* and or *Triodia basedowii* sparse hummock grassses on longitudinal dunes	**S6**	Low shrubland of *Thryptomene biseriata*, *Allocasuarina spinosissima*, *Allocasuarina acutivalvis* subsp. *acutivalvis*, *Jacksonia arida*, *Calothamnus gilesii*, *Acacia fragilis*, *Conospermum toddii* (P4), *Pityrodia lepidota*, *Lomandra leucocephala*, *Anthotroche pannosa* and mixed low shrubs over *Triodia desertorum* with *Lepidobolus deserti* with emergent *Eucalyptus gongylocarpa, Eucalyptus youngiana*, *Eucalyptus ceratocorys* and *Eucalyptus mannensis* subsp. *mannensis*. This community occurs on yellow sand dunes.	**HIGH** Longitudinal dune presence determines vegetation community. This community might also match E11 from AGA0902 which didn't mention *Triodia* presence.
Likely	**E13 (AGA0902)**	Open Shrub Mallee to Very Open Shrub Mallee of *Eucalyptus leptophylla* with *Eucalyptus trivalva*, *Eucalyptus youngiana* and *Callitris preissii* over *Acacia helmsiana*, *Hakea francisiana* over *Triodia rigidissima*. This community occurs on orange-yellow sandy loam on flats and undulating plains	**E8**	Open scrub mallee to very open scrub mallee of *Eucalyptus ceratocorys* and *Eucalyptus mannensis* subsp. *mannensis* with *Eucalyptus youngiana*, *Hakea francisiana* and *Grevillea juncifolia* over *Acacia fragilis*, *Acacia helmsiana* and mixed low shrubs over *Triodia desertorum*, *Chrysitrix distigmatosa* and *Lepidobolus deserti* with emergent *Eucalyptus gongylocarpa*. This community occurs on yellow sands on flats and slopes.	**HIGH** Mixed *Eucalyptus* woodlands with mixed shrubs which were not myrtaceaous on yellow sand flats.

Sandhill Dunnart Habitat Likelihood	Other Code	Other Vegetation Description	Most Similar: MRUP Code	Most Similar VRL: MRUP Vegetation Description	MCPL Confidence On Similarity
Likely	**E15 (AGA0902)**	Very Open Shrub Mallee of *Eucalyptus youngiana* and mixed *Eucalyptus* spp. over *Acacia desertorum* var. *desertorum*, *Bertya dimerostigma*, *Westringia cephalantha*, *Cryptandra distigma* with mixed shrubs over *Triodia desertorum*. This community occurs on orange sandy loams on lower slopes	**E13**	Low open mallee woodland of *Eucalyptus youngiana* over low shrubland of *Grevillea didymobotrya* subsp. *didymobotrya*, *Cryptandra distigma*, *Banksia elderiana*, *Calothamnus gilesii*, *Acacia desertorum* var. *desertorum* and other *Acacia* spp. over open *Triodia* spp. hummock grassland with *Chrysitrix distigmatosa* and some low myrtaceous shrubs (and occasional emergent *Eucalyptus gongylocarpa*). This community occurs on orange-yellow sandy loams on lower slopes and flats	**MEDIUM** *Eucalyptus youngiana* woodland with mixed shrubs on orange sandy loams on lower slopes.
Marginal	**E14 (AGA0902)**	Very Open Shrub Mallee of *Eucalyptus rosacea* with *Callitris preissii* over *Acacia sibina*, *Phebalium laevigatum* and low *Myrtaceous* shrubs over *Triodia* spp. This community occurs on orange sandy loams on flats	**S5**	Shrubland to open shrubland of *Acacia sibina* with *Phebalium* tuberculosum over *Enekbatus eremaeus*, *Bertya dimerostigma*, *Homalocalyx thryptomenoides*, *Baeckea* sp. Great Victoria Desert (A.S. Weston 14813), *Melaleuca hamata* and mixed low shrubs over *Triodia desertorum* and *Chrysitrix distigmatosa* with occasional emergent *Eucalyptus gongylocarpa* and *Eucalyptus youngiana*. This community occurs on yellow-orange sands on flats and lower slopes.	**HIGH** *Myrtaceaceous* heath on orange flats with emergent *Eucalyptus* spp.
Marginal	**E12 (AGA0902)**	Open Shrub Mallee to Very Open Shrub Mallee of *Eucalyptus platycorys*, *Eucalyptus oleosa*, *Eucalyptus horistes* and other *Eucalyptus* spp. over *Westringia cephalantha*, *Acacia sibina*, *Acacia hemiteles* over *Triodia* spp. This community occurs on orange sandy loam on flats.	**E2**	Low woodland to open scrub mallee of *Eucalyptus trivalva* and *Eucalyptus platycorys* with *Callitris preissii* and *Hakea francisiana* over *Acacia colletioides*, *Acacia hemiteles*, *Melaleuca hamata*, *Westringia cephalantha*, *Bertya dimerostigma* and mixed shrubs over *Triodia desertorum* with occasional emergent *Eucalyptus gongylocarpa*. This community occurs on red-orange sandy loams on flats.	**LOW** Mixed woodlands over mixed *Acacia* on orange sand flats
Marginal	**exL.t2H** including subtypes exL.a20S.t2H and e20p2L.xSt2H **(ecologia)**	*Eucalyptus* spp, woodlands over open shrublands over *Triodia basedowii*, or with *Eucalyptus youngiana*, *Eucalyptus trivalva* or *Eucalyptus leptopoda* open mallee woodland over *Acacia murrayana* over *Triodia*, or with *Callitris preissii*	**E2**	Low woodland to open scrub mallee of *Eucalyptus trivalva* and *Eucalyptus platycorys* with *Callitris preissii* and *Hakea francisiana* over *Acacia colletioides*, *Acacia hemiteles*, *Melaleuca hamata*, *Westringia cephalantha*, *Bertya dimerostigma* and mixed shrubs over *Triodia desertorum* with occasional emergent *Eucalyptus gongylocarpa*. This community occurs on red-orange sandy loams on flats.	**LOW** This community has multiple *Eucalyptus* spp. over *Acacia* shrublands with *Callitris preissii* and *Triodia* grasslands.
Marginal	**e71L.xZt8H (ecologia)**	*Eucalyptus concinna* open mallee woodland over sparse to open low shrubs over *Triodia scariosa* open hummock grassland on undulating plains.	**E1, E2, E4, E10, E11**	Too vague	**UNSURE** Maybe E10 or E11 which are *Eucalyptus concinna* over shrublands and *Triodia* (*T. desertorum* and *T. rigidissima*).

Sandhill Dunnart Habitat Likelihood	Other Code	Other Vegetation Description	Most Similar: MRUP Code	Most Similar VRL: MRUP Vegetation Description	MCPL Confidence On Similarity
Potential	**Veg Assoc 84 (Beard 1974)**	*Eucalyptus gongylocarpa*, *Mallee*, *Triodia basedowii* between dunes	**E5**	Low open woodland of *Eucalyptus gongylocarpa* over *Eucalyptus rigidula* and *Eucalyptus* sp. Mulga Rock (K.D. Hill & L.A.S. Johnson KH 2668) with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha*, *Acacia helmsiana, Acacia rigens*, *Eremophila platythamnos* subsp. *platythamnos*, *Cryptandra distigma* and mixed low shrubs over *Triodia desertorum, Triodia rigidissima* and *Chrysitrix distigmatosa*. This community occurs on yellow and orange sands on flats and slopes.	**MEDIUM** Dominated by *Eucalyptus gongylocarpa*, without *Eucalyptus youngiana*, with other *Eucalyptus* spp. mallees and *Triodia* spp. between dunes.
Potential	**Veg Assoc 85 (Beard 1974)**	*Eucalyptus gongylocarpa*, *Mallee*, *Triodia basedowii* on sandplain	**E5**	Low open woodland of *Eucalyptus gongylocarpa* over *Eucalyptus rigidula* and *Eucalyptus* sp. Mulga Rock (K.D. Hill & L.A.S. Johnson KH 2668) with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha*, *Acacia helmsiana*, *Acacia rigens*, *Eremophila platythamnos* subsp. *platythamnos*, *Cryptandra distigma* and mixed low shrubs over *Triodia desertorum, Triodia rigidissima* and *Chrysitrix distigmatosa*. This community occurs on yellow and orange sands on flats and slopes.	**MEDIUM** Dominated by *Eucalyptus gongylocarpa* without *Eucalyptus youngiana* with other mallees and *Triodia* on flat sand.
Potential	**Veg Assoc 109 (Beard 1974)**	*Eucalyptus youngiana* mallee over shrubs and *Triodia basedowii*	**E13**	Low open mallee woodland of *Eucalyptus youngiana* over low shrubland of *Grevillea didymobotrya* subsp. *didymobotrya*, *Cryptandra distigma*, *Banksia elderiana*, *Calothamnus gilesii*, *Acacia desertorum* var. *desertorum* and other *Acacia* spp. over open *Triodia* spp. hummock grassland with *Chrysitrix distigmatosa* and some low myrtaceous shrubs (and occasional emergent *Eucalyptus gongylocarpa*). This community occurs on orange-yellow sandy loams on lower slopes and flats	**LOW** *Eucalyptus youngiana* dominated community, however this species is common with or without other mallees. The shrubland in this community is also common but hard to compare with the veg. association 'shrubs', and has y spp.
Potential	**Veg Assoc 110 (Beard 1974)**	*Eucalyptus oleosa* mallee over shrubs and *Triodia scariosa*	**-**		**N/A** Occurs further east of the MRUP area, MCPL has not defined a *Eucalyptus oleosa* community for MRUP.
Potential	**Veg Assoc 239 (Beard 1974)**	*Eucalyptus gongylocarpa* and *Eucalyptus youngiana* mallee over *Triodia basedowii* between dunes	**E3**	Low open woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana,* *Eucalyptus ceratocorys*, *Grevillea juncifolia*, *Hakea francisiana* and *Callitris preissii* over *Acacia helmsiana*, *Cryptandra distigma* and mixed low shrubs over *Triodia desertorum*, *Chrysitrix distigmatosa* and *Lepidobolus deserti*. This community occurs on yellow and yellow-orange sands on flats, slopes and between dunes.	**MEDIUM** This community has both *Eucalyptus gongylocarpa* and *Eucalyptus youngiana* over *Triodia* between dunes.

Appendix A2

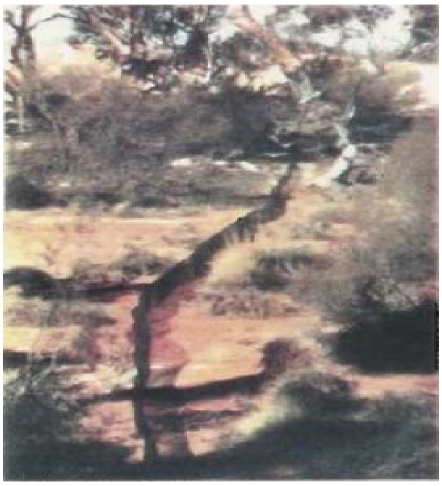
Mulga Rock – 1985 Survey (Martnick 1986)

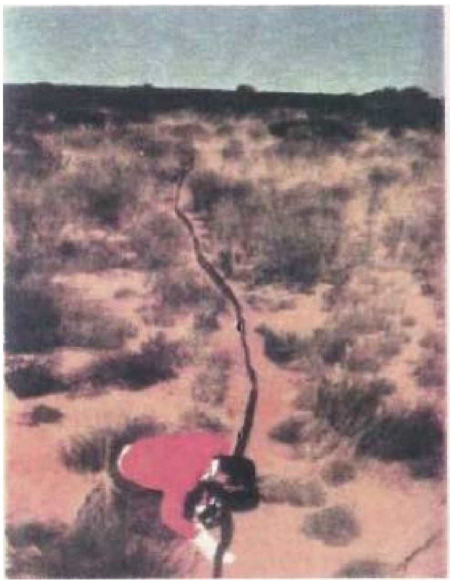
Table A-2: Mulga Rock Uranium Project – Sandhill Dunnart Capture Sites (Martinick 1986)[1]

Fauna Site Code	Mattiske Plant Community Code	Description	Easting Northing
M-05	E7	Marble Gum (*E. gonylocarpa*) Tree Steppe – *Callitris collumellaris, E. incrassata, E. leptophylla* – 3-6m, 30% *Acacia justonii, Bertya dimerostigma, Santalum acuminatum, Eremophila platythamnos*. 0.5-1.5m, <30%, *Triodia basedowii* <30%. Bare ground >50%. Deep yellow sand.	563,110 mE 6,688,790 mN
M-06	E5	Mallee (*E. leptophylla var. floribunda* – shrubland, *E. concinna* – 2-4m, 1-10%; *Melaleuca uncinata, Grevillea* sp*. Bertya dimerostigma* 0.8-1.5m, 10%. *Triodia basedowii*, *Chrystitirix distigmatosa* 20%. Bare ground >50%.	563,520 mE 6,687,290 mN
M-07	E5	Narrow leafed Mallee (*E. leptophylla*), shrubland – open 2.5-3.0m, 1% *Acacia jutsonii* shrub, *Leptospermum fastigiatum* 0.8-1m, 10-30%, *Grevillea* sp.*affhakeoides*, *Allocasuarina corniculata, Cryptandra* sp*., Bertya dimerostigma, Triodia basedowii* - 30% Bare ground - 50%.	575,160 mE 6,682,830 mN
M-11	S1	Broombush (*Melaleuca uncinata*) Thicket adjacent to *Eucalyptus Euc-concinna* <1%, *Acacia colletioides, Olearia* sp. 1-2m >30%. *Triodia basedowii* – 1%. Bare ground 50%.	566,340 mE 6,688,500 mN

[1] The one male Sandhill Dunnart reported in Gaikhorst and Lambert (2008) for site 11-1 (563,860 mE/ 6,691,015 mN) was captured on Mattiske Plant Community Code S8 characterised by Low Open Shrubland of *Calothamnus gilesii*, *Persoonia pertinax*, *Thryptomene biseriata*, and *Leptospermum fastigiatum* with *Anthtroche pannosa*, *Acacoa helmsiana*, *Microcorys macredieana*, *Micromyrtus stenocalyx*, and mixed low shrubs over *Triodia desertorum* with *Lepidobolus deserti*, *Chrysitrix distigmatosa* and *Caustis dioica* with emergent *Eucalyptus youngiana* and *Eucalyptus gongylocarpa*. This community occurs on yellow sands flats adjacent to yellow sands dunes and undulating plains.

Trap Site Locations (Martinick 1986)

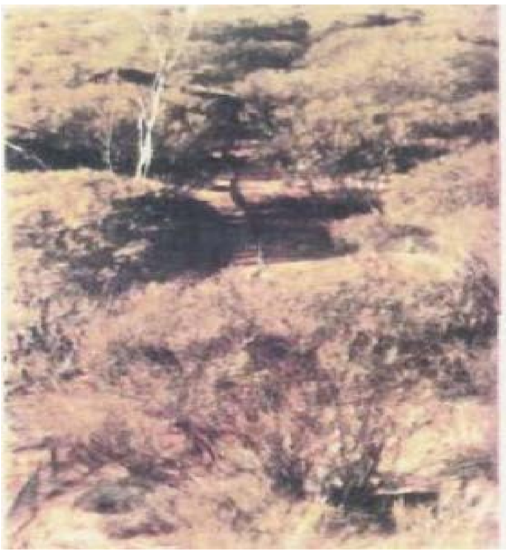
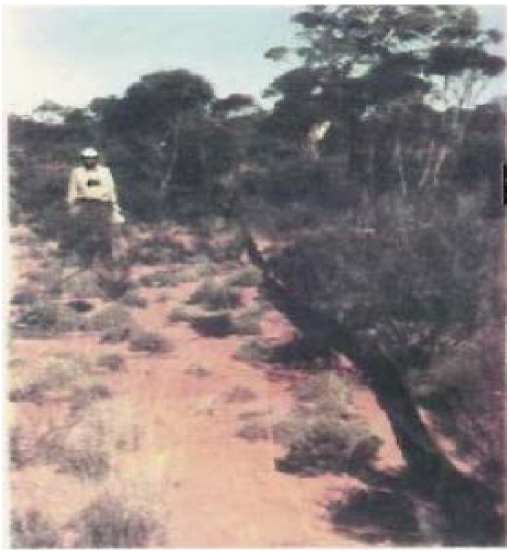
	
Trap Site M-01	**Trap Site M-02**
	
Trap Site M-03	**Trap Site M-04**
	
Trap Site M-05	



Trap Site M-06 | **Trap Site M-07**

Trap Site M-08 | **Trap Site M-09**

Trap Site M-10a | **Trap Site M-10b**

	
Trap Site M-11	**Trap Site M-12a**
	
Trap Site M-12b	**Trap Site M-13**
	
Trap Site M-14	

Appendix A3

Mulga Rock – 2009 Survey (Ninox 2010)

Table A-3: List of Sampling Sites within the Mulga Rock Project Area (Ninox 2009)

Fauna Site Code	PNC Site Code	Mattiske Plant Community Code	Description	Easting Northing
MR01	M-07	E6 with influence E5 species	E6 Open Scrub Mallee to Very Open Scrub Mallee of *Eucalyptus rigidula* over *Westringia rigida*, *Grevillea acuaria* and mixed low shrubs over *Triodia desertorum* with *Halgania cyanea*. E5 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus rigidula* with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha*, *Eremophila platythamnos* subsp. *platythamnos* and mixed low shrubs over *Triodia desertorum*.	575 160 6 680 830
MR02		E8	E8 Open Scrub Mallee to Very Open Scrub Mallee of varying *Eucalyptus* spp. with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha*, *Acacia hemiteles*, *Acacia fragilis*, *Acacia helmsiana* and mixed low shrubs over *Triodia desertorum* with emergent *Eucalyptus gongylocarpa*.	573 052 6 682 213
MR03		E3	E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Grevillea juncifolia*, *Callitris preissii* and *Hakea francisiana* over mixed low shrubs over *Triodia desertorum* with *Chrysitrix distigmatosa* and *Lepidobolus deserti* (P4).	575 537 6 683 050
MR04	M-03	E6	E6 Open Scrub Mallee to Very Open Scrub Mallee of *Eucalyptus rigidula* over *Westringia rigida*, *Grevillea acuaria* and mixed low shrubs over *Triodia desertorum* with *Halgania cyanea*.	576 919 6 681 716
MR05		S6	S6 Low Shrubland of *Thryptomene biseriata, Allocasuarina spinosissima, Jacksonia arida* (ms), *Calothamnus gilesii, Acacia fragilis, Conospermum toddii* (R), *Pityrodia lepidota, Lomandra leucocephala, Anthotroche pannosa* and mixed low shrubs over *Triodia desertorum* with *Lepidobolus deserti* (P4) and occasional emergent *Eucalyptus* spp. This community occurs on yellow sand dunes.	576 869 6 681 745
MR06		Near ecotone of E5 and E3	E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Grevillea juncifolia*, *Callitris preissii* and *Hakea francisiana* over mixed low shrubs over *Triodia desertorum* with *Chrysitrix distigmatosa* and *Lepidobolus deserti* (P4). E5 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus rigidula* with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha, Eremophila platythamnos* subsp. *platythamnos* and mixed low shrubs over *Triodia desertorum*.	573 908 6 684 097
MR07		E5	E5 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus rigidula* with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha*, *Eremophila platythamnos* subsp. *platythamnos* and mixed low shrubs over *Triodia desertorum*.	578 700 6 682 698
MR08		S7 next to track, then moves into E3	S7 Low Shrubland to Low Open Shrubland of *Enekbatus eremaeus*, *Acacia desertorum* var. *desertorum*, *Verticordia helmsii*, *Homalocalyx thryptomenoides*, *Leptospermum fastigiatum*, *Baeckea* sp. Great Victoria Desert (A.S. Weston 14813) (P2), *Leptosema chambersii* and mixed low shrubs over *Triodia desertorum* and *Chrysitrix distigmatosa* with occasional emergent mallee *Eucalyptus* species, *Grevillea juncifolia* and *Hakea francisiana*. E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Grevillea juncifolia*, *Callitris preissii* and *Hakea francisiana* over mixed low shrubs over *Triodia desertorum* with *Chrysitrix distigmatosa* and *Lepidobolus deserti* (P4).	574 930 6 683 986
MR09		S8 at top of slope, E3 at bottom	S8 Low Open Shrubland of *Calothamnus gilesii*, *Persoonia pertinax* and mixed low shrubs with occasional emergent *Eucalyptus youngiana* and *Eucalyptus gongylocarpa*. E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Grevillea juncifolia*, *Callitris preissii* and *Hakea francisiana* over mixed low shrubs over *Triodia desertorum* with *Chrysitrix distigmatosa* and *Lepidobolus deserti* (P4).	578 057 6 683 470
MR10	M-11	S1	S1 Shrubland of *Melaleuca hamata* with *Hakea francisiana* and mixed shrubs over *Triodia desertorum* with emergent *Eucalyptus* spp.	566 315 6 688 517

Trap Site Photographs (Ninox 2010)

Trap Site N-01

Trap Site N-02

Trap Site N-03

Trap Site N-04

Trap Site N-05

Trap Site N-06

	
Trap Site N-07	**Trap Site N-08**
	
Trap Site N-09	**Trap Site N-10**

Appendix B

Data Recording Sheets

CAMERA MONITORING DATA SHEET

Fill out a data sheet for each station and record data by circling relevant information

Location and Site Code:		Date Set:	Date Retrieved: No of Observation Days:
OBSERVER/S			Insert Site Photo Here
LOCATION DESCRIPTION: Landscape Photopoint: Orientation: Photo File No:			
MGA COORD (GDA 94 - Zone 51)	Easting:		
	Northing:		
	RL:		
	Accuracy:		

Landform Type	Soils	Drainage	Vegetation Community	Fire History	Spinifex Stage and % Cover
☐ Longitudinal Dune ☐ Complex (Tuning Fork) ☐ Network Dune ☐ Sandsheet ☐ Crest ☐ Flank ☐ Swale Dune Height: m Dune Separation: m	☐ Red Sands ☐ Orange Sands ☐ Yellow Sands ☐ Kopi ☐ Red Earth ☐ Other	☐ Claypan ☐ Lunette ☐ Kopi ☐ Mounds ☐ Swale ☐ Other	☐ Open Woodland ☐ Woodland ☐ Low Woodland ☐ Thicket ☐ Shrubland ☐ Hummock Grasslands ☐ Mechanically Disturbed	☐ > 30 years unburnt ☐ Burnt in last 20 to 30 years ☐ Burnt in last 10 to 20 years ☐ Burnt in last 1-10 years ☐ Burnt in last year Distance to nearest burn area Reference:	
HABITAT DESCRIPTION VEGETATION TYPE from attached legend					

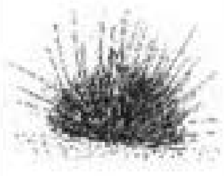
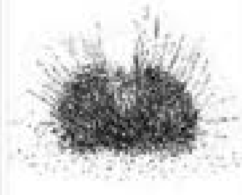
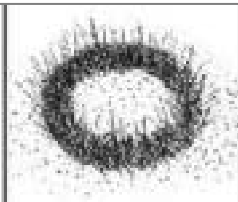
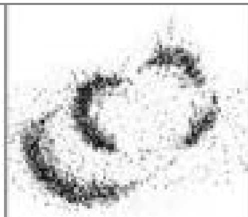
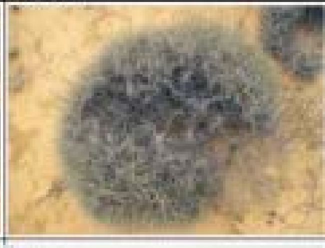
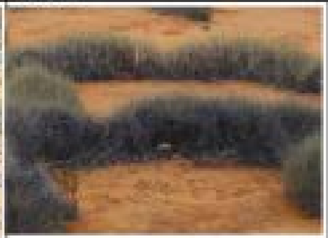
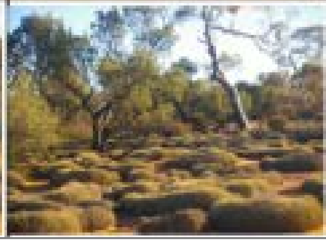
Camera Type:	Camera Code:	Lock Key: #
ASPECT TO TARGET ZONE FACING DOWN: ☐ Yes ☐ No LANDSCAPE: ☐ Yes ☐ No	CAMERA HEIGHT: cm CAMERA ORIENTATION: ANGLE TO GROUND:	DISTANCE TO TARGET ZONE: m LURE RECIPE: LURE TYPE/PLACEMENT :
CAMERA SETTINGS: ☐ Animal Trail ☐ Fence Gap ☐ Other		Lens Cleaned: ☐ Yes ☐ No
BATTERY TYPE: NO:	BATTERY REPLACEMENT DATE:	
CARD TYPE: CAPACITY:	REPLACEMENT DATE:	No. of IMAGES:
Camera Type :	Camera Code:	Lock Key: #
ASPECT TO TARGET ZONE FACING DOWN: ☐ Yes ☐ No LANDSCAPE: ☐ Yes ☐ No	CAMERA HEIGHT: cm CAMERA DIRECTION: ANGLE TO GROUND:	DISTANCE TO TARGET ZONE: m LURE RECIPE: LURE TYPE/PLACEMENT :
CAMERA SETTINGS: ☐ Animal Trail ☐ Fence Gap ☐ Other		Lens Cleaned: ☐ Yes ☐ No
BATTERY TYPE: NO:	BATTERY REPLACEMENT DATE:	
CARD TYPE: CAPACITY:	REPLACEMENT DATE:	No of IMAGES:
Weather Station # 1, 2, 3 Data File:	Synopsis during Monitoring Period:	
GENERAL COMMENTS: Presence of tracks, scats, significant sand disturbance and positioning of trap in respect to animal passage.		

Data sheet modified after Meek P.D., Ballard G., Fleming P. (2012), Pestsmart Toolkit

TABLE B-1: MULGA ROCK PROJECT AREA - MATTISKE VEGETATION CODES

Fauna Site	Site Description	Mattiske Vegetation Community Code	Vegetation Description described by Mattiske (2008)
MR01	Open Scrub Mallee of *Eucalyptus rigidula* over low shrubs and *Triodia.*	E6 with influence E5 species	E6 Open Scrub Mallee to Very Open Scrub Mallee of *Eucalyptus rigidula* over *Westringia rigida*, *Grevillea acuaria* and mixed low shrubs over *Triodia desertorum* with *Halgania cyanea*. E5 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus rigidula* with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha*, *Eremophila platythamnos* subsp. *platythamnos* and mixed low shrubs over *Triodia desertorum*.
MR02	Open Scrub Mallee of *Eucalyptus ceratocorys* over *Grevillea juncifolia*, *Acacia* spp., and mixed shrubs over *Triodia desertorum* with occasional emergent *Eucalyptus gongylocarpa*	E8	E8 Open Scrub Mallee to Very Open Scrub Mallee of varying *Eucalyptus* spp. with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha*, *Acacia hemiteles*, *Acacia fragilis*, *Acacia helmsiana* and mixed low shrubs over *Triodia desertorum* with emergent *Eucalyptus gongylocarpa*.
MR03	Low Open Woodland of *Eucalyptus gongylocarpa over Eucalyptus youngiana, Eucalyptus ceratocorys, Eucalyptus mannensis, Callitris preissii and Hakea francisiana over Acacia helmsiana and mixed shrubs over Triodia.*	E3	E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Grevillea juncifolia*, *Callitris preissii* and *Hakea francisiana* over mixed low shrubs over *Triodia desertorum* with *Chrysitrix distigmatosa* and *Lepidobolus deserti* (P4).
MR04	Open Scrub Mallee of *Eucalyptus rigidula* over low shrubs and *Triodia*	E6	E6 Open Scrub Mallee to Very Open Scrub Mallee of *Eucalyptus rigidula* over *Westringia rigida*, *Grevillea acuaria* and mixed low shrubs over *Triodia desertorum* with *Halgania cyanea*.
MR05	Low Mixed Shrubland over *Triodia* with emergent *Eucalyptus* spp. on dune.	S6	S6 Low Shrubland of *Thryptomene biseriata*, *Allocasuarina spinosissima*, *Jacksonia arida* (ms), *Calothamnus gilesii*, *Acacia fragilis*, *Conospermum toddii* (R), *Pityrodia lepidota*, *Lomandra leucocephala, Anthotroche pannosa* and mixed low shrubs over *Triodia desertorum* with *Lepidobolus deserti* (P4) and occasional emergent Eucalyptus spp. This community occurs on yellow sand dunes.
MR06	Low Open Woodland of *Eucalyptus gongylocarpa over Callitris preissii* and mixed *Eucalyptus* species over *Bertya dimerostigma*, *Acacia elmsiana* and mixed shrubs over *Triodia*.	Near ecotone of E5 and E3	E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Grevillea juncifolia*, *Callitris preissii* and *Hakea francisiana* over mixed low shrubs over *Triodia desertorum* with *Chrysitrix distigmatosa* and *Lepidobolus deserti* (P4). E5 Low Open Woodland of Eucalyptus gongylocarpa over Eucalyptus rigidula with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha*, *Eremophila platythamnos* subsp. platythamnos and mixed low shrubs over *Triodia desertorum*.
MR07	Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus rigidula* over *Westringia cephalantha*, *Hakea francisiana*, *Acacia* spp. over *Triodia*.	E5	E5 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus rigidula* with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha*, *Eremophila platythamnos* subsp. *platythamnos* and mixed low shrubs over *Triodia desertorum*.
MR08	Next to track is patch of Myrtaceous Shrubland then moves into unburnt Low Open Woodland of *Eucalyptus gongylocarpa over Eucalyptus mallees over shrubs over Triodia.*	S7 next to track, then moves into E3	S7 Low Shrubland to Low Open Shrubland of *Enekbatus eremaeus*, *Acacia desertorum* var. *desertorum*, *Verticordia helmsii*, *Homalocalyx thryptomenoides*, *Leptospermum fastigiatum*, *Baeckea* sp. Great Victoria Desert (A.S. Weston 14813) (P2), *Leptosema chambersii* and mixed low shrubs over *Triodia desertorum* and *Chrysitrix distigmatosa* with occasional emergent mallee *Eucalyptus* species, *Grevillea juncifolia* and *Hakea francisiana*. E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Grevillea juncifolia*, *Callitris preissii* and *Hakea francisiana* over mixed low shrubs over *Triodia desertorum* with *Chrysitrix distigmatosa* and *Lepidobolus deserti* (P4).
MR09	At top of slope vegetation is Low Open Shrubland of *Calothamnus gilesii* with mixed shrubs over *Triodia* and *Lepidobolus*. At bottom of slope vegetation is Low Open Woodland of *Eucalyptus gongylocarpa over shrubs over Triodia.*	S8 at top of slope, E3 at bottom	S8 Low Open Shrubland of *Calothamnus gilesii*, *Persoonia pertinax* and mixed low shrubs with occasional emergent *Eucalyptus youngiana* and *Eucalyptus gongylocarpa*. E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Grevillea juncifolia*, *Callitris preissii* and *Hakea francisiana* over mixed low shrubs over *Triodia desertorum* with *Chrysitrix distigmatosa* and *Lepidobolus deserti* (P4).
MR10	Shrubland of *Melaleuca hamata* over *Triodia* with occasional emergent *Eucalyptus* Mallees	S1	S1 Shrubland of *Melaleuca hamata* with *Hakea francisiana* and mixed shrubs over *Triodia desertorum* with emergent *Eucalyptus* spp.

TABLE B-2: SPINIFEX LIFE STAGE

Triodia life stage (Sketches by V Reynolds from Churchill 2001)					
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Triodia life stages in life					
On a landscape scale					

from Gaikhorst and Lambert (2014)

TABLE B-3: COMMENTS AND ADDITIONAL INFORMATION CAMERA PERFORMANCE

Poor camera battery performance	☐ Yes	☐ No	…………………………………………………………………………
None or few images	☐ Yes	☐ No	…………………………………………………………………………
Camera programming faults	☐ Yes	☐ No	…………………………………………………………………………
Numerous false triggers	☐ Yes	☐ No	…………………………………………………………………………
Camera interference	☐ Yes	☐ No	…………………………………………………………………………
Vandalism/Animal Damage	☐ Yes	☐ No	…………………………………………………………………………
Other Comments:			

TABLE B-4: IDENTIFICATION

Photo ID	Species ID and Numbers	Identified by	Date / Time	Event

SKETCH MAP OF CAMERA LOCATION

TABLE B-5: *SMINTHOPSIS* SPECIES FOUND IN MULGA ROCK URANIUM PROJECT AREA WITH DISTINGUISHING FEATURES HIGHLIGHTED

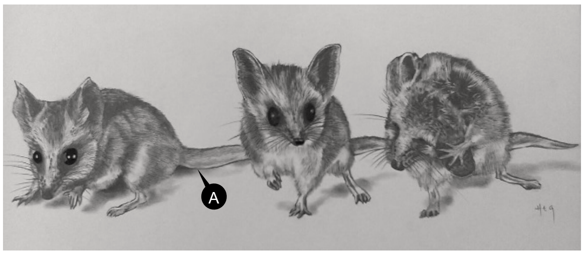
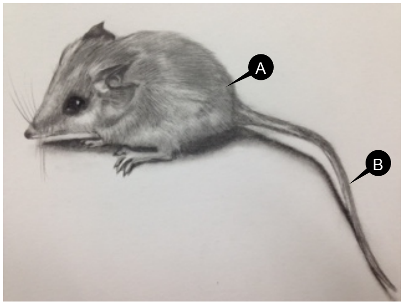
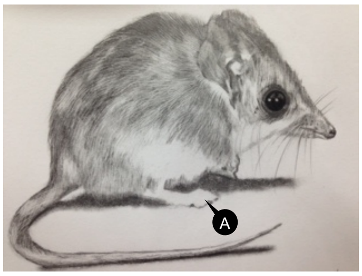
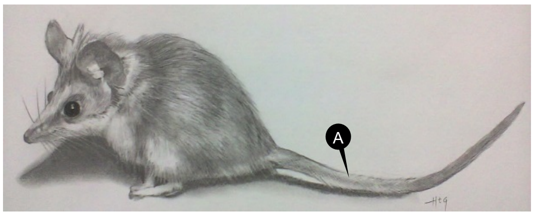
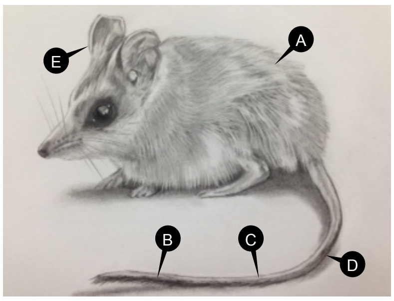
<table>
<tr><th rowspan="2">Species</th><th colspan="4">Physical Characteristics and Identifying Features</th></tr>
<tr><th>Head / ears / feet</th><th>Tail</th><th colspan="2">General body</th></tr>
<tr><td rowspan="4">S. crassicaudata

</td><td rowspan="4">Large eyes, blaze patch but in WA generally no pronounced head stripe, prominent ears extended and large (15mm)</td><td rowspan="4">A Tail fat, carrot-shaped and less than H/B length (mean 55mm)</td><td>Weight:</td><td>15gm</td></tr>
<tr><td>Head/Body (H/B) length:</td><td>75mm</td></tr>
<tr><td>Body size:</td><td>Very small</td></tr>
<tr><td>Colour:</td><td>Dorsal surface sandy pale brown to grey, ventral fur white</td></tr>
<tr><td rowspan="4">S. dolichura

</td><td rowspan="4">Large eyes with thin black eye-ring. Ears large, mean length 18mm</td><td rowspan="4">B Tail thin, 20% longer than head/body length (mean 90mm). Dorsal surface grey with white base</td><td>Weight:</td><td>13gm</td></tr>
<tr><td>H/B length:</td><td>74mm</td></tr>
<tr><td>Body size:</td><td>Very small</td></tr>
<tr><td>Colour:</td><td>A Dorsal fur pale to dark grey.
Cheeks brownish. Ventral fur – white</td></tr>
<tr><td rowspan="4">S. hirtipes

</td><td rowspan="4">Large eyes.
A Long broad hind feet (16-19mm) covered with silvery hairs. Ears 15mm</td><td rowspan="4">Base of tail thickened. Tail length - mean 85mm. Tail colour pinkish white</td><td>Weight:</td><td>15gm</td></tr>
<tr><td>H/B length:</td><td>77mm</td></tr>
<tr><td>Body size:</td><td>Very small</td></tr>
<tr><td>Colour:</td><td>Brown to yellow brown above white fur below</td></tr>
<tr><td rowspan="4">S. ooldea

</td><td rowspan="4">Large eyes and ears, triangular dark patch on crown and forehead in front of eyes</td><td rowspan="4">A Tail thickened, slightly longer than body (mean 78mm)</td><td>Weight:</td><td>11gm</td></tr>
<tr><td>H/B length:</td><td>72mm</td></tr>
<tr><td>Body size:</td><td>Very small</td></tr>
<tr><td>Colour:</td><td>Greyish/brown yellow above, white below</td></tr>
<tr><td rowspan="4">S. psammophila

</td><td rowspan="4">Large eyes, black eye rings
E Large ears with black anterior bristles.
Dark patch on forehead.
Long rear legs. All legs and underbelly white fur.</td><td rowspan="4">C Tail thin and tapered, longer than H/B length (mean 118mm).
B Black grey ventral hair fin in final quarter.
D Tail bi-colour – dorsal light grey/buff, with darker grey base</td><td>Weight:</td><td>36gm</td></tr>
<tr><td>H/B length:</td><td>97mm</td></tr>
<tr><td>Body size:</td><td>A Larger body than any other Dunnart recorded in the region</td></tr>
<tr><td>Colour:</td><td>Dorsal fur grey to brindle, underside white</td></tr>
</table>

TABLE B-6: VOUCHER IMAGES SHOWING SANDHILL DUNNART
(*Sminthopsis psammophila)* Identifying Features




Photos by Amanda McLean (2014)

TABLE B-6: IMAGE IDENTIFIER UNCERTAINTY MATRIX
(FIELD COMPANION TO MAMMALS OF AUSTRALIA 2013)

Feature	Present	Absent	Not Determined	Comment
Large eyes and dark eye rings				
Anterior half of external ear black				
Dark head patch to centre of eyes				
Dorsal fur - brindle colour				
Buff cheeks and flanks				
White underside				
White feet				
Rear legs - long and slender				
Pointed Snout and large ears				
Tail - dorsal pale grey				
Tail - ventral dark grey				
Tail tapering to crested tip				
Tail – ventral fin of grey hair final quarter				Diagnostic feature
Head to body length (Mean 97mm)				
Tail Length (Mean 118mm)				
Body Size				

TABLE B-7: CAMERA TRAP IMAGES

Insert Image	**Insert Image**
Insert Image	**Insert Image**

Attachment A

Churchill review of Draft Camera Trapping Protocol

Sue Churchill
Wildlife Ecologist
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australianbats@yahoo.com.au
PO Box 1170
Port Douglas,
QLD 4877
Ph 0481 335839

Review of Vimy Resources Limited, Draft Camera Trapping Protocol, Sandhill Dunnart, *Sminthopsis psammophila*, Mulga Rock Uranium.

Sue Churchill

7 April 2015

The accepted technique for capturing and identifying Sandhill Dunnarts is live capture in pitfall and Elliott traps. To be effective pitfall traps need to be deeper than those used for comparable small mammals. Elliott traps are less useful but are effective in areas where there is a reasonably high density of these animals.

Sandhill Dunnarts are patchily distributed over a wide area. They also appear to move around and may be absent from an area where they were previously captured. They are a difficult species to capture, typically being captured at a rate of less than one Sandhill Dunnart per 1,000 trap nights. This requires immense resources for very limited results and can have a deleterious impact on the other fauna in the area if conducted long term. Another consideration is that live trapping techniques will be less effective following the widespread fire that went through the study area in November 2014.

The proposed study involves the use of camera trapping which, although a relatively new method, could prove to be efficient and cost effective.

It also has an ethical advantage in that the animals are not so disturbed.

Being a relatively new technique it is not certain how reliable the results may be but given these advantages it is certainly worth undertaking this project. Camera trapping may highlight the effect of local rainfall or moon phase on dunnart activity patterns and perhaps discover hot spots for further live trapping surveys.

I have no experience in Camera Trapping technique but the authors of this protocol have clearly taken the best advice and set up a well considered survey.

The Data Recording Sheets are good. There are no problems with the Matiske Vegetation Codes or the Spinifex Life Stage Categories. I do see a problem with respect to Table B-5 and B-6 the Image Identifier Uncertainty Matrix. I think that it may prove very difficult to identify dunnarts to the species level from photographs. The technique would work very well if the target animal were as distinctive as the Mulgara. It is relatively easy to identify a dunnart from other small mammals but there is a greater problem in identifying it as a Sandhill Dunnart rather than one of the other dunnarts potentially present. I feel that the image identifier needs to list the features of all 7 dunnart species that may occur at Mulga Rock. If you only list the identifying features for one species it is too easy to convice yourself that this is what you are looking at.

Photographs of all dunnart species are needed in addition to those of the Sandhill Dunnart. Perhaps it would be possible to develop a key based on external characteristics that can be seen on a photograph.

Potentially there are 7 species of dunnarts that could occur in the area.
S crassicaudata, Fat-tailed Dunnart
S macroura, Stripe-Faced Dunnart
S dolichura, Little Long-tailed Dunnart
S hirtipes, Hairy-footed Dunnart
S ooldea, Ooldea Dunnart
S longicaudata, Long-tailed Dunnart
S psammophila, Sandhill Dunnart

I think that the protocol is well conceived and worth carrying out. The project has the potential to highlight areas where dunnarts of any species are present, absent, common or uncommon.

Attachment B

Email of Vimy Resources response to DPaW queries (June 2015)

Mr Murray Baker
Department of Parks and Wildlife
Environmental Management Branch
Locked Bag 104
Bentley Delivery Centre WA 6983

12th June 2015

Dear Murray

RE: SANDHILL DUNNART- CAMERA TRAPPING PROTOCOL

Thank you for your review comments of the 26th May 2015 in respect to aspects and procedures proposed by Vimy Resources (Vimy) regarding their ongoing Camera Trapping (CT) Programme for the Sandhill Dunnart (*Sminthopsis psammophila*) which has been trialled at the Mulga Rock Uranium Project (the Project) since 2013. Responses to your queries regarding Protocol Procedures are provided in bold italics.

The presentation provided to DPAW on the 15th January 2015 and during the site visit in March 2015 stressed that, in view of the four previous conventional targeted surveys undertaken at Mulga Rock with limited capture success and the November 2014 fire that burnt through the Project area removing suitable Sandhill Dunnart (SHD) habitat for at least 10 to 15 years, the primary CT focus and methodology could only be directed towards demonstrating presence/absence to a level to satisfy impact assessment requirements. The CT methodology is considered as another fauna survey tool and was not intended to replace conventional trapping techniques. It remains experimental and subject to adaptive management processes as available Western Australian regulatory technical guidelines provide limited advice in this area. Vimy have consulted with researchers in South Australia and Western Australia with experience in dunnarts and have initiated an external image review process and a programme peer review process for both Sandhill Dunnarts and camera trapping.in the Project Development Envelope to a level necessary to satisfy impact assessment requirements.

Fauna surveying has traditionally required multiple assessment techniques and Vimy considers that CT methodology, while it currently does have some reported limitations, is another fauna survey tool, albeit with some distinct advantages in respect to fauna welfare, coverage and cost. It was not intended to replace, but rather to augment, conventional trapping techniques. Some aspects are experimental for small mammals and current trials need to remain flexible and subject to adaptive management processes as available Western Australian regulatory technical guidelines have limited advice in this area. Vimy, in addition to conducting their own trials since 2013, have consulted with researchers and consultants in South Australia and Western Australia with experience in dunnart capture and research. They have initiated an external identification review of images for SHDs and a peer review process covering camera trapping procedures. The current baseline camera trapping programme for environmental impact assessment purposes will run continuously until the start of the next fire season in November 2015 when the cameras will be recovered.

- 1. Based on the limited amount of testing in environments where there are confirmed populations of Sandhill dunnarts, the Department considers the use of camera trapping as a primary detection / survey tool for this species as experimental for this purpose at this time (i.e. unproven).

  Response: The records show that there has been extensive targeted surveying for SHDs in and around the Project area since five animals were discovered there in 1985. Table 1 of the Protocol shows that five conventional surveys, one conducted over an extended period of 8 years (Gaikhorst and Lambert 2001-2008), have been undertaken within 30km of the original capture sites up to 2014, resulting in the capture of 18 adult Sandhill Dunnarts (22 animals). Additional animals have been captured in the surrounding regional dune fields and conservation reserves. Trapping has been largely by Elliot Traps (15,178 trap nights) and deep pitfalls (11,821 trap nights). Vimy's camera trapping effort for the period 2012-2015 is 6,880 trap nights with no SHDs identified. Reported data suggests the capture rate - Pitfall vs Elliot is-approximately 3 to 1.

- 2. The proposed survey work, if well designed and documented, is likely to assist in the determination of an appropriate survey methodology to apply to this species rather than providing for definitive conclusions about the presence / absence or suitability of the project area as habitat for Sandhill Dunnart.

  Response: There is a growing body of evidence that suggests that remote cameras are a cost effective, fauna friendly and efficient means of collecting presence/absence data over an extended timeframe (see Meek and Ballard 2014 - Camera Trapping – Wildlife Management and Research). Camera trapping undertaken at the Project is not intended to replace other conventional trapping techniques but is being used as another tool to initially provide presence/absence information for impact assessment in the Project Development Envelope, and following the November 2014 wildfire, in the broader dune field remnant patches.

- 3. It is currently unclear from the document, if a specimen not definitively identified but believed to be Sandhill Dunnart identified via camera traps, would trigger a conventional survey response.

  Response: During the current baseline programme, field camera data recovery is undertaken after approximately 30 days, the images are checked for small mammals, entered into the database and those image sequences with small mammals forwarded to the fauna specialist for identification. Following advice from the consultant fauna specialist that an image containing a SHD has been identified, Vimy will advise the Department of Parks and Wildlife and discuss what further action is required. This may take the form of further intensive camera trap monitoring of the site, no action or follow-up targeted surveys using conventional survey techniques, or a combination of both. This advice is included in Section 5.5 of the Protocol.

- 4. It appears that some key characteristics to discriminate a specimen of Sminthopsis psammophila from other Sminthopsis species, (e.g. the crested hairs on the ventral surface of distal quarter of the tail) may not be able to be distinguished or may only occasionally be visible in photographs.

  Response: Following discussions with Sue Churchill, and other fauna specialists who have had extensive experience with Dasyurid species found coexisting with the Sandhill Dunnart, Vimy have developed a key characteristics table (See Table B-5) which identifies five characteristics that should support positive identification. Modifications to camera layout with the addition of an overhead camera for sites where lures are utilised, and multiple image capture for each trigger will increase potential for identifying these key characteristics. In addition, it is proposed that camera placement would be for an extended period up to 30 days and, due to the mobility of SHDs and the limited size of the SHD's home range, further image capture would likely occur in this time. As outlined in Section 5, in the event of uncertainty, Vimy have included in the Protocol, access to consultants whose advice would be sought in respect to species identification and confirmation.

- 5. The document indicates that two different models of camera will be used as a part of the methods. The use of two different models of camera has the potential to diffuse the power of the experimental design as the results gathered using the different models may not be directly comparable.

  Response: The use of 2 different cameras types at the same trap site was not intended (See Section 4.6.3) and the text has been revised to counter this perception.

- 6. The document also does not appear to compare the different methods of trapping in relation to effectiveness and efficiency. It is currently difficult to determine the level of effort being applied to the different trapping methods (e.g. camera traps versus Elliot/pitfall traps) and trapping parameters being tested (e.g. configuration of site layouts, use of horizontal versus vertical camera settings, use of lures, habitat type, time since last fire, etc.). It is, therefore, recommended that Vimy develops a simplified summary of the methodology including effort required, for example the table below.

  Response: Vimy does not believe there is a need to compare the efficiency of cameras with other trapping methods in the Protocol, as again it is a tool for detecting the presence or absence of a particular taxa. The Data Recording Form in Appendix B includes all of the nominated aspects outlined above and this form is completed for each trap location/deployment.

- 7. In general, there should be caution in targeting preferred habitat as low detections of species can occur due to unknown habitat preferences even after extensive sampling.

Response: Mark Cowan has previously made this point during consultation in 2014. CT site selection prior to the extensive fire in November 2014 was centred on:
(a) re-trapping previous sites where SHDs had been captured in 1985,
(b) a range of sites selected by Ninox following their review of habitat mapping by Mattiske (2009) that recorded burn history and
(c) "X" sites within the dune field that were based on the presence of small mammal track densities on sand dunes.
The post November burn landscape within the Project Development Envelopment is very different and trap site selection as part of the current Refugia Programme has included testing of a restricted range of habitats associated with small remnant vegetation stands that are not considered quality SHD habitats and would not have previously been considered.

- 8. Table 1, p. 10 should indicate which method and amount of effort (Elliot or pit traps) was responsible for past captures.

Response: Trap effort data for Pitfall and Elliot traps is shown in Table 1 where available. This data was obtained from Hart and Kitchener (1986), Pearson and Robinson (1990), Churchill (2001, 2009), Gaikhorst and Lambert (2000 to 2008, 2014) Ninox (2010), ecologia (2009) and GHD (2010a, 2010b). All references covering survey data for Queen Victoria Spring Nature Reserve has not been located although Gaikhorst and Lambert (2014) list a total of 40 adult animals captured for the Western Australian portion of the GVD. Published SHD capture data for the GVD suggests 7 Elliot Trap captures for 23,939 trap nights and 21 by Pitfall for 18,123 trap nights. The Table has been updated to include capture details for the 2 methods.

- 9. Section 3.3, p. 22 indicates that Sminthopsis psammophila has a "…foot length of approximately 10mm", this is unlikely. The smallest of the species in that area, Sminthopsis ooldea, has an average pes length of around 13.4mm and slightly larger species, Sminthopsis macroura and Sminthopsis crassicaudata are around 15.3mm. These are all much smaller species than Sminthopsis psammophila;

Response: Correct, the typo error has been corrected to 22mm to 26mm.

- 10. Section 4.6.1 p. 33 states that "The strategy is to increase the sampling effort (number of sites multiplied by the number of survey days) and reduce the error associated with occupancy estimation (Shannon et.al 2014)." It is unclear what error the document is referring to and how the error will be ameliorated given the information provided in the document, particularly if there are no detections/captures. This should be further explained in the document.

Response: Trap effort data for Pitfall and Elliot traps is shown in Table 1 when available. This data was obtained from Hart and Kitchener (1986), Pearson and Robinson (1990), Churchill (2009), Gaikhorst and Lambert (2000 to 2008) Ninox (2010), ecologia (2009) and GHD (2010a, 2010b). References covering survey data for Queen

Victoria Spring Nature Reserve has not been located, with only one reference to that site documented on p. 3 of Gaikhorst and Lambert's June 2001 report to CALM, showing a location just north of the Queen Victoria Spring Nature Reserve. Capture data for the GVD has identified 7 Elliot Trap captures and 21 by pitfall.

- 11. Section 4.6.1 p. 34 states that "Lure stations should be located approximately 1.5–2.0m from the horizontal camera". The document should indicate that in some circumstances lures may increase the detection of some species at the expense of other species. How this is determined should be explained in the document.

  Response: As noted by various specialists in the field and consistent with DPaW's guidelines on the matter, lures have the potential to affect behavioural patterns of vertebrate fauna and the same would be expected from the small mammals present in the southwest GVD. However, this is not relevant to the scope of the CT trapping protocol, which primary aim to confirm presence or absence of the Sandhill Dunnart on the project.
  Camera trapping activities to date have been undertaken at the Project since 2013 without the use of lures. It has been proposed that lures (Universal Mix) would be trialled under some circumstances in the Refugia Habitat Programme. Long deployment of lures is labour intensive and is not proposed due to management considerations and the vibrant ant population. The use of the Universal Mix lure was selected due to its successful use during the Gaikhorst and Lambert and Ninox surveys in the region.

- 12. Section 4.6.1 p. 34 states that "Where camera traps are oriented in a vertical position (facing downwards), cork tiles will be placed centrally under the bait device to maximise detection of target species." It is unclear how large the tile will need to be to ensure the passive detectors of infrared light covers the actual bait for a camera at a height of 1.5m. It is also unclear if this method has been tested to determine its effectiveness in detection.

  Response: The purpose of the ~45cmx30cm cork tile is to provide a low reflectivity, constant temperature surface for image collection within the detection zone and allow the inclusion of a reference scale in the photo frame to aid identification. The process has been described by Meek et al. (2012) and Welbourne (2013), however, it requires calibration to identify the optimal detection zone for the layout selected. Comment on this aspect was provided by Paul Meek following his peer review of the Protocol.

- 13. Section 4.6.1 p. 34 indicates that "Where more than two camera setups are being used, cameras should be set at least 50-75m apart from each other to ensure a reasonable area is surveyed…". It appears from the document that placing the cameras 50 to 75m apart is an arbitrary value. The document should clearly indicate the reasoning for this spacing.

  Response: The distances between cameras in the same quadrat were not arbitrary. Previous conventional trapping programmes at Mulga Rock (Marti nick 1985 and Ninox

2009) had used quadrat sizes of approximately 50mx70m. The original camera trapping strategy (prior to the November 2014 Project area wildfire) was to incorporate the Ninox (and Martinick) trap sites and drift fence layout into the CT programme because they represented what was considered to be optimal SHD habitat (Martinick 1986, Churchill 2009, and Gaikhorst and Lambert 2001-2008, Ninox 2009). Furthermore, animal inventories for these sites were known from the previous classic trapping programmes and this information would assist in species identification. Separate trials of drift fence layout and camera placement were undertaken in 2013, depending on terrain layout and these are shown in Figures 11 to 13 of the Protocol. Trap layout in the post November 2014 fire remnants will continue to be modified to fit the habitat and circumstances in this regard, they are considered experimental, although standardised quadrat size and camera placement is not considered necessary for presence / absence survey, all site the data will be collected on the Data Recording Sheet and validated in Vimy's environmental database for future analysis.

Vimy also drew on some advice provided by DEC with regards to Sandhill Dunnart trapping the Tropicana Joint Venture and documented on p.26 of GHD's 2010 SHD survey report, published as a supplementary study to the Tropicana PER: "Trapping for Sandhill Dunnarts usually position Elliott traps in excess of 20m intervals".

- 14. Figure 10, p. 36 indicates that several of the proposed trapping sites are to be located on the edge of remnant (i.e. unburnt vegetation). The location of these sites should be further clarified in relation to potential edge effects.

Response: Figure 10 shows there are only 5 small (<3ha) patches (Sites 2, 3, 4, 7 and 19) of recently unburnt habitat in the Project Development Envelope (PDE) and following field inspection, none are considered suitable habitat for SHD's using the Churchill and Gaikhorst criteria, however for impact assessment purposes these remain the primary focus and will be tested in accordance with this protocol. Based on the evidence that SHD distribution and survival is governed by the presence of spinifex hummocks of specific maturity and structure, the remainder of the Project Development Envelope is unlikely to provide suitable post burn habitat for 10 to 15 years. External to the PDE, within the Vim's Project Area are a similar number of patches of remnant vegetation, some of larger area where CT monitoring is proposed.

Edge effect impacts on small mammals in most habitats in Australia is poorly understood and very limited work has been done in the arid lands, however some trapping success has been reported for SHDs in edge environments in the GVD and for this reason it has been included in the programme. Churchill (2001) reports that Dave Pearson captured an adult male in a burnt area adjacent to an unburnt area in the Queen Victoria Spring Nature Reserve in September 1991 and Gaikhorst and Lambert report the capture of a juvenile male on the edge of a small unburnt remnant at Station 3 in 2007 (Station 25 on Figure 10). Post-fire CT monitoring in 2015 at several former Ninox and Martinick sites have continued to record a range of small mammals that clearly survived the fire. Vimy believes that unburnt edge monitoring fits the Programme's objective of monitoring all available habitats.

- 15. Section 4.6.4 p. 38 indicates that “There may be situations where only one camera will be established.” It is unclear, why only one camera would be used at some sites and two at others. As mentioned above (use of two different models of camera), the use of two different methods has the potential to diffuse the power of the experimental design.

  Response: Based on the review of the camera image data collected over the past 2 years, Vimy believe that identification of SHDs by species knowledgeable fauna specialists using the key criteria outlined in Table B5B-5 of the Protocol is sufficiently robust using one horizontal camera and is adequate for the intended presence - absence objective. The use of the vertical camera at some sites is considered experimental and believed to be only of value when in ground lures are used (potentially allowing a dorsal view of ear colouration and size comparison against a fixed scale) or as insurance against single camera failure. The one camera approach provides for a greater number of sites to be tested – an advantage in presence-absence surveying.

Please do not hesitate to contact the undersigned or Vimy's Environmental Advisor - Colin Woolard (08 9368 5019) if further information is required.

Yours sincerely
Vimy Resources Limited

Xavier Moreau
General Manager – Geology and Exploration

Attachment A – Camera Trapping Protocol Rev1.4

Appendix C

Wildlife Conservation Act 1950, Section 17 Fauna licence to take fauna for scientific purposes (for use of attractants)

DEPARTMENT OF PARKS AND WILDLIFE

Department of
Parks and Wildlife

Enquiries: 17 DICK PERRY AVE, KENSINGTON, WESTERN AUSTRALIA
Telephone: 08 9219 9000
Facsimile: 08 9219 8242

Correspondence: **Locked Bag 30**
Bentley Delivery Centre WA 6983

PAGE	1
NO.	SF010472
PERSON NO.	52425

RECEIPT NO.	**AMOUNT**
	$0.00

WILDLIFE CONSERVATION ACT 1950
REGULATION 17

LICENCE TO TAKE FAUNA FOR SCIENTIFIC PURPOSES

THE UNDERMENTIONED PERSON MAY TAKE FAUNA FOR RESEARCH OR OTHER SCIENTIFIC PURPOSES AND WHERE AUTHORISED, KEEP IT IN CAPTIVITY, SUBJECT TO THE FOLLOWING AND ATTACHED CONDITIONS, WHICH MAY BE ADDED TO, SUSPENDED OR OTHERWISE VARIED AS CONSIDERED FIT.

DIRECTOR GENERAL

CONDITIONS

1 The licensee shall comply with the provisions of the Wildlife Conservation Act 1950, Wildlife Conservation Regulations 1970 and any notices in force under this legislation.

2 Unless specifically authorised in the Conditions of this Licence or otherwise in writing by the Director General, species of fauna declared as likely to become extinct, rare or otherwise in need of special protection shall not be captured or otherwise taken.

3 No fauna shall be taken from any Nature Reserve, National Park, Marine Park, Marine Nature Reserve, Timber Reserve or State Forest without prior written approval of the Director General. No fauna shall be taken from any other public land without the written approval of the Government Authority managing that land.

4 No entry or collection of fauna to be undertaken on any private property or pastoral lease without the consent in writing of the owner or occupier, or from any Aboriginal lands without the written approval of the Department of Aboriginal Affairs.

5 No fauna or their progeny shall be released in any area where it does not naturally occur, nor be handed over to any other person or authority unless approved by the Director General, nor shall the remains of such fauna be disposed of in such manner as to confuse the natural or present day distribution of the species.

6 This licence and the written permission referred to at conditions 3 & 4 must be carried by the licensee or authorised agent at all times for the purpose of proving their authority to take fauna when questioned as to their right to do so by a Wildlife Officer, any other State or Local Government employee or any member of the public.

7 Any interaction involving Gazetted Threatened Fauna that may be harmful and/or invasive may require approval from the Department of the Environment ph 02 6274 1111. Interaction with such species is controlledby the Commonwealth Government's "Environment Protection and Biodiversity Conservation Act 1999" and "Environment Protection and Biodiversity Conservation Regulations 2000" as well as this Department's Wildlife Conservation Act 1950 and Wildlife Conservation Regulations 1970.

8 No bioprospecting involving the removal of sample aquatic and terrestrial organisms (both flora and fauna) for chemical extraction and bioactivity screening is permitted to be conducted without specific written approval by the Director General.

9 Further conditions (numbered 1 to 9) are attached.

PURPOSE	FAUNA SURVEY TARGETING THE SANDHILL DUNNART (SMINTHOPSIS PSAMMOPHILA) VIA CAMERA TRAPPING USING LURES AND REMOTE ACTIVATED CAMERAS AT SELECTED SITES AT THE MULGA ROCK PROJECT AREA, 240KM NORTHEAST OF KALGOORLIE IN THE GREAT VICTORIA DESERT, IN ACCORDANCE WITH THE VIMY RESOURCES LTD CAMERA TRAPPING PROTOCOL.
AUTHORISED PERSONS	XAVIER MOREAU MORRIS WU

WILDLIFE CONSERVATION REGULATIONS 1970

Regulation 17:- Licence to Take Fauna for Scientific Purposes

FURTHER CONDITIONS (OF LICENCE NUMBER SF010472)

1. The licensee shall take fauna only in the manner stated on the endorsed Regulation 17 licence application form and endorsed related correspondence.

2. Except in the case of approved lethal traps, the licensee shall ensure that measures are taken in the capture and handling of fauna to prevent injury or mortality resulting from that capture or handling. Where traps or other mechanical means or devices are used to capture fauna these shall be deployed so as to prevent exposure of trapped animals to ants and debilitating weather conditions and inspected at regular intervals throughout each day of their use. At the conclusion of research all markers etc and signs erected by the licensee and all traps shall be removed, all pitfalls shall be refilled or capped and the study area returned to the condition it was in prior to the research/capture program. During any break in research, cage traps should be removed and pitfalls either removed, capped or filled with sand.

3. No collecting is to be undertaken in areas where it would impinge on pre-existing scientific research programs.

4. Any form of colour marking of birds or bats shall only be undertaken in accordance with the requirements of the Australian Bird and Bat Banding Scheme.

5. Any inadvertently captured specimen of fauna which is declared as likely to become extinct, rare or otherwise in need of special protection is to be released immediately at the point of capture. Where such a specimen is injured or deceased, the licensee shall contact Department of Parks and Wildlife licensing staff at Kensington (08 9219 9831) for advice on disposal. Records are to be kept of any fauna so captured and details included in the report required under further condition 6 below.

6. Within one month of the expiration of this licence, the holder shall submit an electronic return detailing the locality, site, geocode, date and number of each species captured, sighted or vouchered during the currency of the licence, into the Department of Parks and Wildlife Fauna Survey Database (FSD). A copy of any paper, report or thesis resulting from the research shall on completion be lodged with the Director General. If a renewal of this licence is required, the licensee shall submit a written progress report for activities undertaken during this licence period prior to the expiry of this licence.

7. Not more than ten specimens of any one protected species shall be taken and removed from any location less than 20km apart. Where exceptional circumstances make it necessary to take large series in order to obtain adequate statistical data the collector will proceed with circumspection and justify their actions to the Director General in advance.

8. All holotypes and syntypes and a half share of paratypes of species or subspecies permitted to be permanently taken under this licence shall be donated to the Western Australian Museum. Duplicates (one pair in each case) of any species collected which represents a significant extension of geographic range shall be donated on request to the Western Australian Museum.

9. To prevent any unnecessary collecting in this State, all specimens and material collected under the authority of this license shall, on request, be loaned to the Western Australian Museum. Also, the unused portion or portions of any specimen collected under the authority of this license shall be offered for donation to the Western Australian Museum or made available to other scientific workers if so required.