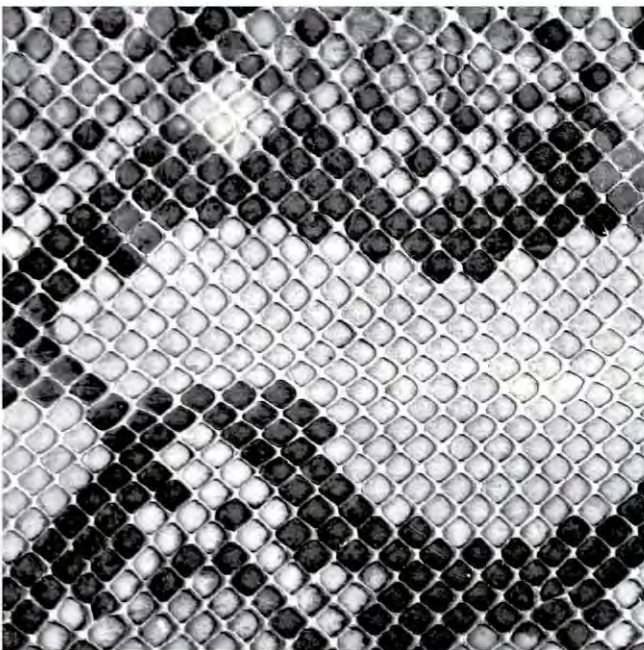




2019 Mt Holland Chuditch Monitoring



Covalent Lithium

ecoscape



COPYRIGHT STATEMENT FOR:
2019 Mt Holland Chuditch Monitoring
Our Reference: 4451-19 final 2019 Mt Holland Chuditch Monitoring
Copyright © 1987-2020
Ecoscape (Australia) Pty Ltd
ABN 70 070 128 675

Except as permitted under the Copyright Act 1968 (Cth), the whole or any part of this document may not be reproduced by any process, electronic or otherwise, without the specific written permission of the copyright owner, Ecoscape (Australia) Pty Ltd. This includes microcopying, photocopying or recording of any parts of the report.

VERSION	AUTHOR	QA REVIEWER	APPROVED	DATE
final	Bruce Turner			7/01/2020
		Andrew Fry Senior Environmental Scientist	Andrew Fry Senior Environmental Scientist	

Direct all inquiries to:
Ecoscape (Australia) Pty Ltd
9 Stirling Highway • PO Box 50 NORTH FREMANTLE WA 6159
Ph: (08) 9430 8955 Fax: (08) 9430 8977

TABLE OF CONTENTS

Acknowledgements	1
Summary.....	2
1 Introduction	3
1.1 Project Purpose	3
1.1.1 Project Scope	3
1.2 Survey Area.....	3
1.2.1 Regional Location.....	3
1.3 Statutory and Technical Framework	6
1.3.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999	6
1.3.2 Western Australian Environmental Protection Act 1986.....	6
1.3.3 Western Australian Biodiversity Conservation Act 2016.....	6
1.3.4 Western Australian Priority Fauna	6
2 Desktop Assessment	8
2.1 Previous Surveys	8
2.1.1 Western Wildlife.....	8
2.1.2 Rayner 2011	9
3 Method	10
3.1 Field Survey.....	10
3.1.1 Survey Design	10
3.1.2 Site Selection.....	10
3.2 Data Analysis.....	11
4 Results.....	14
4.1 Monitoring Sites	14
4.2 Chuditch Monitoring.....	14
4.2.1 Other Species.....	16
4.3 Data Analysis.....	16
5 Discussion and Recommendations	18
5.1 Chuditch Population	18
5.2 Recommendations for 2020 Chuditch monitoring	18
References	19
Appendix One Definitions and Criteria	20
Appendix Two Trapping Site Details.....	23

FIGURES

Figure 1: Project location.....	5
---------------------------------	---

TABLES

Table 1: Surveys undertaken by Western Wildlife between 2016 to 2017 (Western Wildlife 2017)	8
Table 2: Chuditch capture results.....	14
Table 3: Fauna species captures	16

Table 4: EPBC Act categories for flora and fauna	20
Table 5: Conservation codes for Western Australian flora and fauna (DBCA 2019)	21
Table 6: Locations and representative image of impact trap sites	23
Table 7: Locations and representative image of control trap sites.....	24

MAPS

Map 1: location of impact site trapping grids.....	12
Map 2: location of control site trapping grids	13

IMAGES

Image 1: Bait cage inside trap	10
Image 2: Female Chuditch captured at site CCMI03	15
Image 3: Pouch young.....	15
Image 4: Impact site CCMI03 typical habitat.....	16
Image 5: Typical habitat at impact site CCMI01	17
Image 6: Typical habitat at impact site CCMI02.....	17

ACKNOWLEDGEMENTS

Ecoscope would like to acknowledge the assistance and support we received from both the Covalent head office staff and the staff on-site who made us welcome and provided logistical support where needed. We look forward to returning for the next years monitoring.

SUMMARY

Ecoscape was engaged in June 2019 to provide the following services for the project:

- undertake and complete Chuditch monitoring
 - establish and monitor three control sites more than five kilometres outside of the development envelope
 - establish and monitor three impact sites within the development envelope
- record all Chuditch captures in a monitoring database including morphometrics; location of capture; health status and breeding status (e.g. number of pouch young; lactation etc.)
- undertake monitoring within the Chuditch breeding season (May to July).

The results of the 2019 Mt Holland Chuditch monitoring has provided baseline data that can be used to compare future monitoring results for the Covalent Lithium Mt Holland Project site

One female Chuditch was recorded during the 2019 survey at the Impact site (I3). A suite of small mammals were also recorded from this site. No species were recorded at the Control site within Jilbadji Nature Reserve.

The 2019 Chuditch monitoring was the first survey undertaken during the Chuditch breeding season and this may suggest a more accurate population abundance within the development envelope than the results from Western Wildlife's late November 2017 survey.

Ongoing monitoring of the Chuditch population within and outside of the development envelope should consider the following actions:

- establish a new control site closer to the development envelope
- continue monitoring in June 2020
- consider increasing trap numbers to 12 per grid
- consider increasing trap nights to six
- investigate possible use of trail camera arrays to provide additional information on Chuditch presence away from established monitoring trap sites and the presence of feral predators.

1 INTRODUCTION

1.1 PROJECT PURPOSE

Covalent Lithium is developing the Mt Holland Lithium Project which will include the construction and operation of a fully integrated mine, concentrator and refinery in Western Australia. The Mount Holland Lithium Project (the project) is an integrated project consisting of a mine, concentrator and refinery to produce battery quality lithium hydroxide (LiOH) for the international market. The project is centred on the Earl Grey hard-rock lithium deposit 105 km south of Southern Cross in Western Australia and approximately 500 km east of Perth (**Figure 1**). It is owned by a 50-50 joint venture (JV) between subsidiaries of Wesfarmers Pty Ltd (WES:ASX) and Sociedad Química y Minera de Chile S.A. (SQM: NYSE). Covalent is the manager for the JV and is responsible for the development and operation of the project.

The survey area intersects with habitat of two conservation significant fauna species, the Malleefowl (*Leipoa ocellata*) and the Chuditch (*Dasyurus geoffroii*). Both species are listed as vulnerable (VU) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the Western Australian *Biodiversity Conservation Act 2016* and are considered as Matters of National Environmental Significance (MNES).

The purpose of the project is to commence Chuditch monitoring prior to the construction of the mine and associated infrastructure, to determine baseline information on Chuditch population density or abundance and determine their distribution in the local region.

1.1.1 PROJECT SCOPE

The project scope was to undertake a monitoring program for the Chuditch using a before-after control-impact (BACI) design adapted to Chuditch ecology through consultation with the Department of Biodiversity Conservation and Attractions (DBCA).

Ecoscape was engaged in June 2019 to provide the following services for the project:

- undertake and complete Chuditch monitoring
 - establish and monitor three control sites more than five kilometres outside of the development envelope
 - establish and monitor three impact sites within the development envelope
- record all Chuditch captures in a monitoring database including morphometrics; location of capture; health status and breeding status (e.g. number of pouch young; lactation etc.)
- undertake monitoring within the Chuditch breeding season (May to July).

A review of relevant environmental reports (provided by Covalent Lithium) and other documents relevant to the project area and/or ecological values associated with the locality was undertaken to provide essential information on previous Chuditch capture locations and provide information necessary to plan the monitoring program.

1.2 SURVEY AREA

1.2.1 REGIONAL LOCATION

The survey area is located in the Shire of Yilgarn in the Goldfields region of Western Australia, about 100km south of Southern Cross. The development envelope is within the Great Western Woodlands (GWW) and is approximately 1 984 ha in extent (**Figure 1**). The GWW is a 16 million hectare area extending from the wheatbelt to the edge of the deserts and is the largest intact area of Mediterranean Woodland on earth (DEC 2010). The GWW includes open eucalypt woodlands (63%), Mallee eucalypt woodlands, shrublands and grasslands (Fox *et al.* 2016). Less common habitats in the GWW include granite outcrops, banded ironstone formations, salt lakes and freshwater wetlands (Fox *et al.* 2016).

The Development envelope is in the Southern Cross Subregion of the Coolgardie Bioregion of the Interim Biogeographic Regionalism for Australia (IBRA) classification system (Australian Government & Department of the Environment and Energy 2017). The dominant land-uses in this bioregion are Crown Reserves and

Unallocated Crown Land (66.7%), grazing on native pastures (17%), conservation (11.5%) and dryland agriculture (2.3%) (Cowan *et al.* 2001). The greenstone hills, alluvial valleys and broad plains of calcareous earths support diverse eucalypt woodlands. The uplands support Mallee woodlands and scrub-heaths on sandplains, gravelly sandplains and lateritic breakaways. Chains of salt lakes with dwarf shrublands of samphire occur in the valleys (Cowan *et al.* 2001).

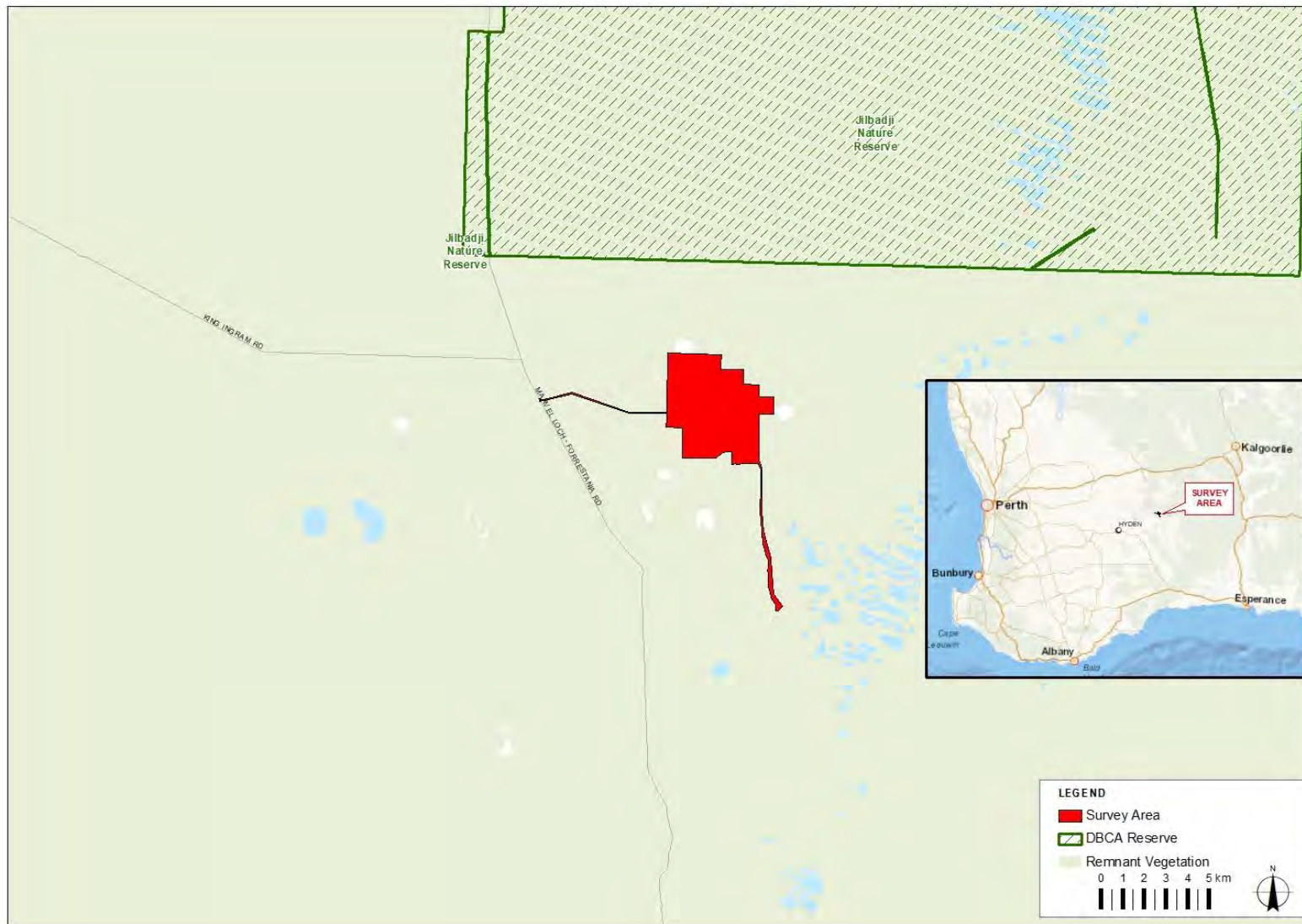


Figure 1: Project location

1.3 STATUTORY AND TECHNICAL FRAMEWORK

The requirements of the monitoring program were as follows:

- be conducted in accordance with current statutory and technical requirements and guidance;
 - Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
 - Department of Sustainability Environment Water Population and Communities (DSEWPaC 2011) *Survey guidelines for Australia's threatened mammals*
 - Western Australian *Environmental Protection Act 1986* (EP Act)
 - Western Australian *Biodiversity Conservation Act 2016* (BC Act)
 - EPA (2016a) *Technical Guidance – Terrestrial Fauna Surveys*, known as the Fauna Technical Guidance
 - EPA (2016b) *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna*
- be conducted by personnel complying with regulatory expectations in relation to holding the necessary DBCA Fauna License and years of experience.

1.3.1 COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

At a Commonwealth level, threatened taxa (flora and fauna) are protected under the EPBC Act, which lists species that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild (detailed in **Table 4** in **Appendix One**).

1.3.2 WESTERN AUSTRALIAN ENVIRONMENTAL PROTECTION ACT 1986

The Western Australian EP Act was created to provide for an Environmental Protection Authority (EPA) that has the responsibility for:

- prevention, control and abatement of pollution and environmental harm
- conservation, preservation, protection, enhancement and management of the environment
- matters incidental to or connected with the above.

The EPA is responsible for providing the guidance and policy under which environmental assessments are conducted. It conducts environmental impact assessments (based on the information included in environmental assessments and provided by the proponent), initiates measures to protect the environment and provides advice to the Minister responsible for environmental matters.

1.3.3 WESTERN AUSTRALIAN BIODIVERSITY CONSERVATION ACT 2016

The Western Australian BC Act provides for the conservation, protection and ecologically sustainable use of biodiversity and biodiversity components in Western Australia. It commenced on 1 January 2019.

Threatened species (both flora and fauna) and ecological communities that meet the categories listed within the BC Act are highly protected and require authorisation by the Minister to take or disturb. These are known as Threatened Flora, Threatened Fauna and Threatened Ecological Communities. The conservation categories of Critically Endangered, Endangered and Vulnerable have been aligned with those detailed in the EPBC Act and are detailed in **Table 5** in **Appendix One**.

Flora and fauna species may be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. Migratory species and those subject to international agreements are also listed under the Act. These are known as specially protected species in the BC Act.

The most recent flora and fauna listings were published in the Government Gazette on 11 September 2018 (Government of Western Australia 2018).

1.3.4 WESTERN AUSTRALIAN PRIORITY FAUNA

Conservation significant fauna species are listed by the DBCA as Priority Fauna where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to threatened fauna categories. Whilst Priority Fauna are not specifically listed in the BC Act, these

have a greater level of significance than other native species. The categories covering Priority Fauna species are outlined in **Table 5** in **Appendix One**.

2 DESKTOP ASSESSMENT

2.1 PREVIOUS SURVEYS

2.1.1 WESTERN WILDLIFE

Zoologists from Western Wildlife undertook a targeted EPA Level 2 survey in 2016/17 which included targeted surveys for both Malleefowl and Chuditch (Western Wildlife 2017). The surveys were undertaken over a 12 month period between October 2016 to November 2017 using a variety of techniques designed specifically to detect both Malleefowl and Chuditch (**Table 1**)

Table 1: Surveys undertaken by Western Wildlife between 2016 to 2017 (Western Wildlife 2017)

Survey	Dates of fieldwork	Level of survey	Extent of survey
1	10 – 15 Oct 2016	Level 1 fauna survey with targeted Malleefowl and Chuditch (camera trap) surveys	Survey Area A (see Figure 6)
2	21 Nov – 4 Dec 2016	Level 2 (single season) fauna survey with targeted Malleefowl and Chuditch (camera trap) surveys	Focus on survey Areas A and B, plus sites in the Regional Survey Area ('Prince of Wales' and 'Van Uden') Some targeted Chuditch and Malleefowl survey in Regional Survey Area – original extent (see Figure 6)
3	16 Jan – 25 Feb 2017	Targeted Chuditch survey (camera traps)	Regional Survey Area – original extent (see Figure 6)
4	12 – 21 Sept 2017	Targeted Malleefowl & Chuditch (camera trap) surveys	Malleefowl survey in the Development Envelope excluding Survey Areas A and B, with targeted Chuditch survey in the Regional Survey Area – final extent (see Figure 6)
5	2 – 14 Oct 2017	Level 2 (single season) fauna survey with targeted Malleefowl survey	Development envelope, excluding Survey Areas A and B (see Figure 6)
6	25 - 30 Nov 2017	Targeted Chuditch (cage trapping) survey	Regional Survey Area – final extent, with some Malleefowl and opportunistic surveys in the Development Envelope (see Figure 6)

Trapping for Chuditch only occurred in late November 2017 on two transects close to and inside the development envelope.

The surveys provided the following results as extracted from the Western Wildlife report. Eighteen individual Chuditch were trapped in the development envelope in 2016 (ten adult and eight dispersing young) and ten were trapped in the Regional Survey Area (three adults and seven young) in 2017. Chuditch were recorded on 52 of the 136 camera trap locations, showing a preference for unburnt habitats.

The Chuditch of the Mt Holland population appeared to occur in greater densities than those at Cosmic Boy Mine, 55 km south, despite being in the same bioregion. Factors that may have positively influenced Chuditch numbers at Mt Holland include low numbers of feral predators and the presence of long-unburnt habitats to provide shelter and denning sites. Individuals are likely to have a core home range of 2,125 ha (males) or 189 ha (females), though they are likely to range even more widely, and the core home-ranges are likely to overlap.

Chuditch are likely to occur in all habitats in the Development Envelope, and may use hollow logs, burrows and old White-browed Babbler (*Pomatostomus superciliosus*) nests as den sites, as well as man-made structures such as rocky abandonment bund walls.

Three broad fauna habitats were identified across the Earl Grey Lithium Project development envelope by the Western Wildlife team:

- Mallee woodland
- Salmon Gum woodland
- Shrubland.

The survey recorded five conservation significant fauna species in the development envelope as follows:

- Malleefowl (*Leipoa ocellata*)– VU (EPBC Act, BC Act)
- Chuditch (*Dasyurus geoffroii*) – VU (EPBC Act, BC Act)
- Peregrine Falcon (*Falco peregrinus*)– OS (BC Act)
- Inland Western Rosella (*Platycercus icterotis* subsp. *xanthogenys*) – Priority 4 (DBCA)
- Western Brush Wallaby (*Notamacropus irma*) – Priority 4 (DBCA).

Results of the November 2017 trapping period undertaken by Western Wildlife are likely to be an overrepresentation of the Chuditch population (18 captures) due to the capture of dispersing young and sub-adults.. It is difficult to determine sub-adult from a breeding adult at this time and therefore the time of year trapping is performed has a large impact on the results.

Monitoring for Chuditch to determine the size and distribution of the adult breeding population was agreed on through consultation with DBCA expert Dr Keith Morris to be from May to July. It is at this time that the population is actively mobile seeking mates and denning sites for the coming season. The consultation process also determined the design of the trapping grids by detailing trap numbers and spacing between traps within a grid. Grids were decided to be of 10 medium wire cage traps at 200 m spacings either in a transect or grid of two lines. A method for suspending bait inside a trap was discussed and agreed on in order to avoid the build-up of ants on each bait packet.

2.1.2 RAYNER 2011

Rayner *et al* (2011) undertook Chuditch population density surveys at the Cosmic Boy nickel mine located approximately 35 km south of the Mt Holland project area. Chuditch were trapped and marked for recapture and six individuals were tagged with radio collars to establish habitat use and den sites. Trapping was undertaken during the breeding season between February and July 2009.

Twelve individual Chuditch, eight males and four females, were caught during the six trapping sessions, with all age groups up to three years old represented. A total of 4138 trap-nights were used, with an average trap success of 0.8% (± 0.21 , s.e.), ranging from 0.3% in May to 1.5% in July. The population density of Chuditch at Cosmic Boy was estimated to be 0.039 individuals km⁻² or 3.9 individuals per hectare.

It is expected that similar results will be evident at the Mt Holland sites and field survey methods have been used for the 2019 monitoring that replicate those of Rayner *et al*.

3 METHOD

3.1 FIELD SURVEY

The field survey for the 2019 Chuditch monitoring program was undertaken by Ecoscape zoologists Bruce Turner and Jordan Vos with casual zoologists Holly Bradley and Kady Gosser providing assistance under DBCA Wildlife Licensing Fauna License No. BA27000085-2. The survey was conducted from 19 to 27 July 2019.

3.1.1 SURVEY DESIGN

The design of the survey was developed in conjunction with DBCA expert Dr Keith Morris and included the following elements:

- monitoring to have a BACI design element to enable potential impacts to be measured
- two sites to be established; control site and impact site
 - control site to be more than 5 km from development envelope boundary and close to 2017 capture sites if possible
 - impact site to be within the development envelope and outside of the infrastructure footprint
- each site is to consist of three grids of 10 traps each with traps to be spaced 200 m apart within a grid
- traps to be in operation for a minimum of four nights
- trap effort for each of the control and impact sites will be 10 traps x 3 grids x 4 nights = 120 trap nights.

DBCA stipulated that bait must be suspended above the ground in an effort to reduce the build-up of ants that may cause injury to any captures. Ecoscape proposed a bait cage and wire trace technique which was endorsed by DBCA (**Image 1**).



Image 1: Bait cage inside trap

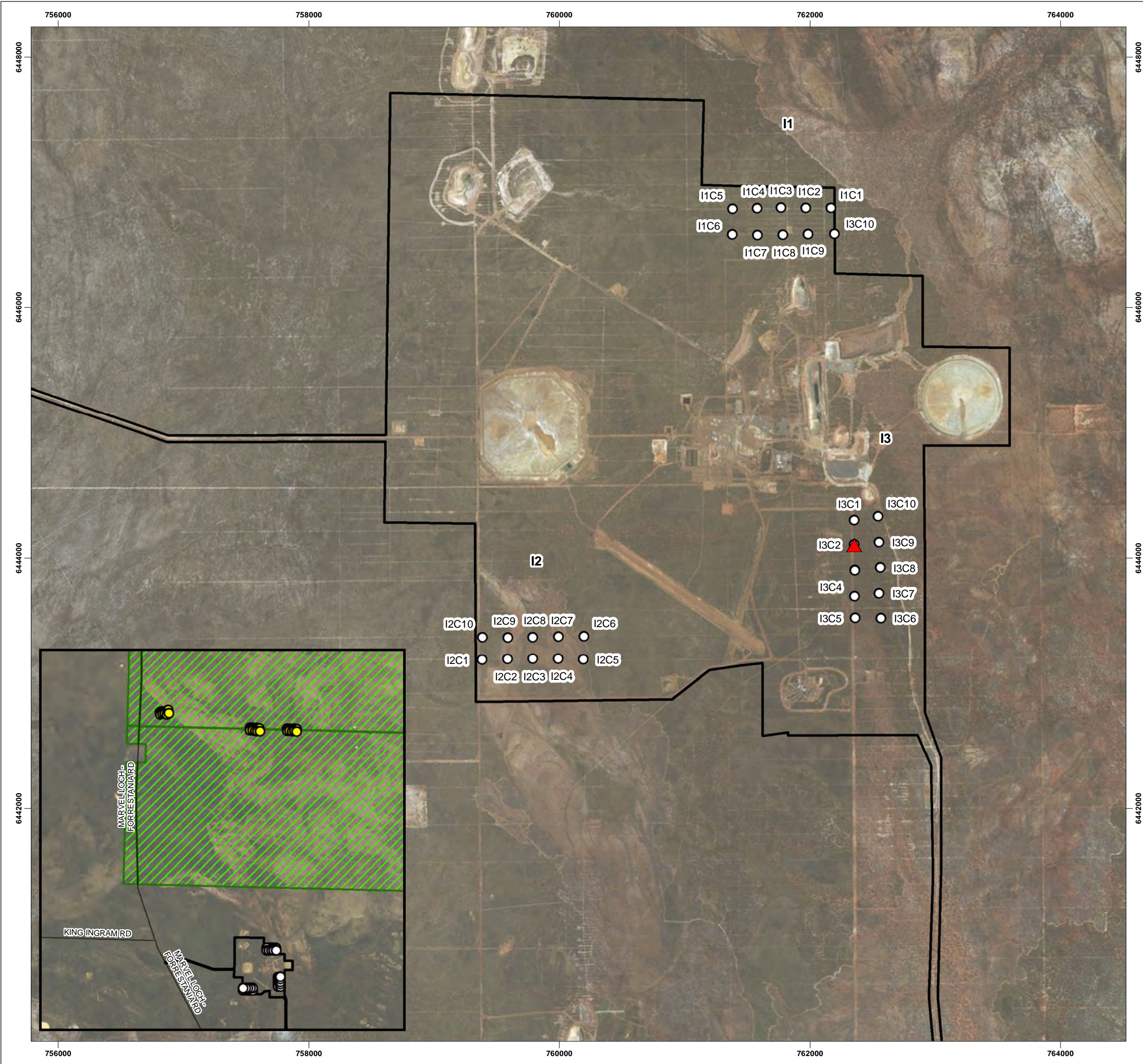
3.1.2 SITE SELECTION

The impact site was restricted to areas within the development envelope that were not planned to be cleared for the proposed mine and associated infrastructure and in areas where Chuditch were captured in 2017. A potential area was selected by desktop investigation prior to arriving on site and then ground truthed for suitability (**Map 1**).

The control site was also preselected by desktop investigation using the 2017 trapped Chuditch locations and placing a 5 km buffer around the development envelope. The location of the proposed control site was deemed to have the potential to be too close to potential future pit expansion. This resulted in relocating the control site approximately four km further north than the most northern Western Wildlife 2017 camera trap location which had a Chuditch recorded (**Map 2**). Subsequently, the future expansion may not be as large as thought and as per the recommendations for future monitoring in Section 5.2, the control site will be relocated close to the original 2017 transect north of the mine pit.

3.2 DATA ANALYSIS

The intention is to analyse capture date to provide a population density estimate using a standard mark and recapture method as that performed by Rayner *et al* (2011). Data collected in the field is entered into the MARK software (White 2014) that completes an iteration process to provide an estimate of population density based on information entered by the user.



- LEGEND**
- Control Trap Sites
 - Impact Trap Sites
 - Covalent Development Envelope
 - DBCA Legislated Lands and Waters
 - ▲ Chuditch Location (I3C2)



**CHUDITCH IMPACT TRAP
LOCATIONS COVALENT
DEVELOPMENT ENVELOPE**

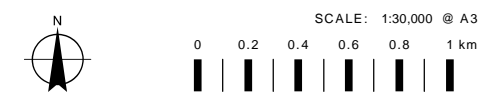
COVALENT FAUNA MONITORING

COVALENT



DATASOURCES:
 SOURCE DATA: TRAP SITES (ECOSCAPE, 2019)
 AERIAL: MOUNT HOLLAND MOSAIC (COVALENT, 2019)
 BASEMAP: GEOSCIENCE AUSTRALIA
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR, GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

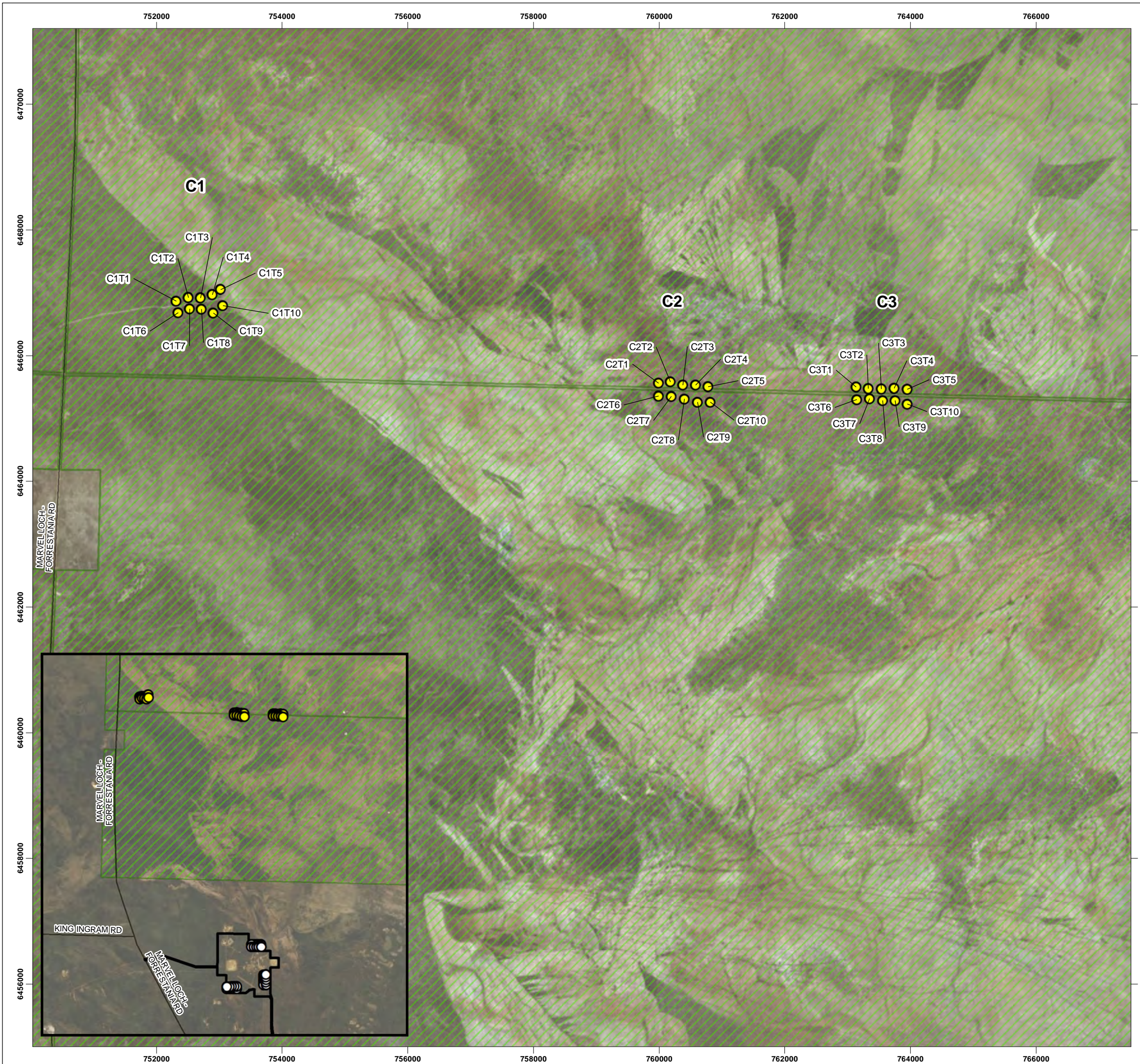
COORDINATE SYSTEM: GDA 1984 MGA ZONE 50
 PROJECTION: TRANSVERSE MERCATOR
 DATUM: GDA 1984
 UNITS: METER



PROJECT NO: 4451-19

REV	AUTHOR	APPROVED	DATE
00	SB	BT	11/11/2019

**MAP
01**



LEGEND

-  Control Trap Sites
-  Impact Trap Sites
-  Covalent Development Envelope
-  DBCA Legislated Lands and Waters



**CHUDITCH CONTROL TRAP
LOCATIONS COVALENT
DEVELOPMENT ENVELOPE**

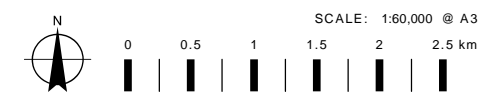
COVALENT FAUNA MONITORING

COVALENT



DATASOURCES:
 SOURCE DATA: TRAP SITES (ECOSCAPE, 2019)
 AERIAL: MOUNT HOLLAND MOSAIC (COVALENT, 2019)
 BASEMAP: GEOSCIENCE AUSTRALIA
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR, GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

COORDINATE SYSTEM: GDA 1984 MGA ZONE 50
 PROJECTION: TRANSVERSE MERCATOR
 DATUM: GDA 1984
 UNITS: METER



PROJECT NO: 4451-19

REV	AUTHOR	APPROVED	DATE
00	SB	BT	11/11/2019

**MAP
02**

4 RESULTS

4.1 MONITORING SITES

The field teams established two monitoring sites to capture and record data on the target species Chuditch (*Dasyurus geoffroii*). An Impact site (**Map 1**) was established within the development envelope and a Control site was established within the Jilbadji NR, some 20 km to the north of the Impact site (**Map 2**).

Monitoring sites were comprised of three grids of 10 wire cage traps totalling 30 traps per site. Traps were set for a total of four nights giving a total of 120 trap nights/site. Traps were baited with a universal bait mix with added sardines to attract Chuditch in a suspended bait cage. Traps were checked each morning within three hours of sunrise. Trap locations are listed in **Table 6** and **Table 7** in **Appendix Two**.

Weather conditions were cold mornings and cool days with early morning fog. Traps were covered with hessian bags and solar reflectors to provide shelter.

4.2 CHUDITCH MONITORING

No captures were recorded at the Control site for the entire monitoring event.

There was one capture of a female Chuditch (**Image 2**) on 25 July at Impact Site I3 at trap I3C2 (**Table 2**). No other Impact site traps recorded Chuditch.

The capture was weighed, measured and tagged with a Passive Implant Transponder (PIT) tag (**Table 2**). The female had two unhaired pouch young within the pouch indicating a successful mating season had been completed a few weeks before the monitoring event (**Image 3**). The animal was in good condition with no recorded bite marks or parasites and did not exhibit any previous capture marks or tags. Tissue samples taken from the capture were preserved in ethanol and labelled for subsequent delivery to the DBCA DNA database team.

Table 2: Chuditch capture results

Characteristic	Result
Site ID	I3
Trap ID	I3C2
Date	25/07/2019
Species	<i>Dasyurus geoffroii</i>
Sex	Female
PIT No.	941000019576584
Trap type	wire cage
Weight (g)	575
Pes (mm)	47
Head length (mm)	81.8
Reproductive status	2 unhaired pouch young 12 mm in length
Comments	good condition; no bite marks or parasites; no previous PIT tag or ear notches/tattoos



Image 2: Female Chuditch captured at site I3



Image 3: Pouch young

Map 1 shows the location of the capture site (I3C2) which is mid-way between the demolished camp site and the decommissioned processing plant along the existing powerline corridor. Habitat at this site was Mallee woodland on undulating laterite hills cut by minor drainage lines (**Image 4**).



Image 4: Impact site I3 typical habitat

4.2.1 OTHER SPECIES

The nontarget species list is shown in **Table 3**. All captures were recorded at the impact sites. The suite of small mammal captures indicate a healthy ecosystem is present. The presence of these species, which are prey for introduced predators suggests a low abundance of Red Fox and Feral Cat.

Table 3: Fauna species captures

Species	Common name	Site ID	Trap ID	Date
<i>Notomys mitchellii</i>	Mitchell's Hopping-mouse	Impact I1	I1C7	22/07/2019
<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart	Impact I1	I1C2	2207/2019
<i>Dasyurus geoffroii</i>	Chuditch	Impact I3	I3C2	25/07/2019
<i>Notomys mitchellii</i>	Mitchell's Hopping-mouse	Impact I2	I2C1	25/07/2019

Habitat quality within the development envelope was considered to be in very good condition with the impact sites trapping grids being located across the habitat types present (**Image 5; Image 6**).

4.3 DATA ANALYSIS

No analysis was able to be performed as there was only a single capture recorded.



Image 5: Typical habitat at impact site I1



Image 6: Typical habitat at impact site I2

5 DISCUSSION AND RECOMMENDATIONS

5.1 CHUDITCH POPULATION

The results of the 2019 Mt Holland Chuditch monitoring has provided baseline data that can be used to compare future monitoring results for the Covalent Lithium Mt Holland Project site. It is not possible to estimate a population abundance with only one capture. The 2019 Chuditch monitoring was the first survey undertaken during the Chuditch breeding season and this may suggest a more accurate population abundance within the development envelope than the results from late November 2017. The November 2017 results were undertaken during the juvenile dispersal season and therefore returned a higher rate of Chuditch captures.

The timing of the 2019 monitoring was not optimal being late July whereas Late May to mid-June is likely to be the optimal time to monitor for the breeding adult population. Increasing either the number of traps or the number of trap nights would provide more captures. Increasing the trap numbers will increase the collection areas of the grids while increasing the trap nights may allow for trap shy animals to be captured.

The control site traps did not record any captures of any species i.e. none of the traps were triggered. This is not surprising as Jilbadji NR has no DBCA records of small mammals with only one Western Brush Wallaby being recorded, it is acknowledged that the area is likely to be under surveyed. These records are comprised of the departments own surveys and records returned via the wildlife licensing system.

5.2 RECOMMENDATIONS FOR 2020 CHUDITCH MONITORING

The Chuditch monitoring is expected to be repeated on an annual basis using the same site locations and trap sites. However, due to the control sites recording no Chuditch captures, Ecoscape suggests that a new control site be established closer to the project area, within a similar habitat type to where the female was captured and preferably closer to capture locations recorded in 2017.

Monitoring of the Chuditch population within and outside of the development envelope should consider the following actions:

- establish a new control site closer to the development envelope that will replace the 2019 control site
- continue monitoring in June 2020
- consider increasing trap numbers to 12 per grid
- consider increasing trap nights to six
- investigate possible use of independent trail camera arrays to provide additional information on Chuditch presence and introduced predators away from established monitoring trap sites.

REFERENCES

- Australian Government. *Environment Protection and Biodiversity Conservation Act 1999*.
- Australian Government & Department of the Environment and Energy. 2017. *Australia's bioregions (IBRA)*. Available from: <http://www.environment.gov.au/land/nrs/science/ibra>.
- Cowan, M., Graham, G., & McKenzie, N. 2001, "Coolgardie 2 (COO 2 – Southern Cross Subregion).," in *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*, J. E. May & N. L. McKenzie eds., Department of Conservation and Land Management.
- Department of Biodiversity Conservation and Attractions. 2019. *Conservation codes for Western Australian Flora and Fauna (3 January 2019)*. Available from: <https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Conservation%20code%20definitions.pdf>.
- Department of Environment and Conservation. 2010. *A Biodiversity and Cultural Conservation Strategy for the Great Western Woodlands*. Available from: <http://www.dpaw.wa.gov.au/images/documents/conservation-management/off-road-conservation/gww/gww-strategy.pdf>.
- Department of Sustainability Environment Water Population and Communities. 2011. *Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Available from: <http://www.environment.gov.au/epbc/publications/pubs/survey-guidelines-mammals.pdf>.
- Environmental Protection Authority. 2016a. *Technical Guidance - Terrestrial Fauna Surveys*. Available from: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Tech%20guidance-%20Terrestrial%20Fauna%20Surveys-Dec-2016.pdf.
- Environmental Protection Authority. 2016b. *Technical Guidance: Sampling methods for terrestrial vertebrate fauna*. Available from: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Tech%20guidance-%20Sampling-TV-fauna-Dec2016.pdf.
- Fox, E., Mcnee, S., & Douglas, T. 2016, *Birds of the Great Western Woodlands. Report for The Nature Conservancy*, BirdLife Australia, Melbourne.
- Government of Western Australia. *Environmental Protection Act 1986*.
- Government of Western Australia. *Biodiversity Conservation Act 2016*.
- Government of Western Australia. 2018. *Government Gazette No. 135, 11 September 2018*. Available from: [https://www.slp.wa.gov.au/gazette/gazette.nsf/searchgazette/EF556EEFA23C70FA482583040013E0FC/\\$file/Gg135.pdf](https://www.slp.wa.gov.au/gazette/gazette.nsf/searchgazette/EF556EEFA23C70FA482583040013E0FC/$file/Gg135.pdf).
- Rayner, K., Chambers, B., Johnson, B., Morris, K., & Mills, H.R. 2011. Spatial and dietary requirements of the chuditch (*Dasyurus geoffroi*) in a semiarid climatic zone. *Australian Mammalogy*
- Western Wildlife. 2017. Earl Grey Lithium Project: Level 2 vertebrate fauna survey with targeted Chuditch and Malleefowl surveys, 2016 - 2017.
- White, G. 2014. MARK. Colorado State University.

APPENDIX ONE

DEFINITIONS AND CRITERIA

Table 4: EPBC Act categories for flora and fauna

<i>EPBC ACT 1999 category</i>	Definition
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Table 5: Conservation codes for Western Australian flora and fauna (DBCA 2019)

Conservation Codes for Western Australian Flora and Fauna	
<p>Threatened, Extinct and Specially Protected fauna or flora¹ are species² which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.</p> <p>The <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> and the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> have been transitioned under regulations 170, 171 and 172 of the <i>Biodiversity Conservation Regulations 2018</i> to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the <i>Biodiversity Conservation Act 2016</i>.</p> <p>Categories of Threatened, Extinct and Specially Protected fauna and flora are:</p>	
T	<p>Threatened species</p> <p>Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the <i>Biodiversity Conservation Act 2016</i> (BC Act).</p> <p>Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> for Threatened Fauna.</p> <p>Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for Threatened Flora.</p> <p>The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.</p>
CR	<p>Critically endangered species</p> <p>Threatened species considered to be "<i>facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines</i>".</p> <p>Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> for critically endangered fauna or the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for critically endangered flora.</p>
EN	<p>Endangered species</p> <p>Threatened species considered to be "<i>facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines</i>".</p> <p>Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> for endangered fauna or the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for endangered flora.</p>
VU	<p>Vulnerable species</p> <p>Threatened species considered to be "<i>facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines</i>".</p> <p>Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> for vulnerable fauna or the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for vulnerable flora.</p>
<p>Extinct species</p> <p>Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.</p>	
EX	<p>Extinct species</p> <p>Species where "<i>there is no reasonable doubt that the last member of the species has died</i>", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).</p> <p>Published as presumed extinct under schedule 4 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> for extinct fauna or the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for extinct flora.</p>
EW	<p>Extinct in the wild species</p> <p>Species that "<i>is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form</i>", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).</p> <p>Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.</p>
<p>Specially protected species</p> <p>Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.</p> <p>Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.</p>	

Conservation Codes for Western Australian Flora and Fauna	
MI	<p>Migratory species</p> <p>Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).</p> <p>Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the <i>Convention on the Conservation of Migratory Species of Wild Animals</i> (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.</p> <p>Published as migratory birds protected under an international agreement under schedule 5 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i>.</p>
CD	<p>Species of special conservation interest (conservation dependent fauna)</p> <p>Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).</p> <p>Published as conservation dependent fauna under schedule 6 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i>.</p>
OS	<p>Other specially protected species</p> <p>Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).</p> <p>Published as other specially protected fauna under schedule 7 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i>.</p>
P	<p>Priority species</p> <p>Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.</p> <p>Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.</p> <p>Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.</p>
1	<p>Priority 1: Poorly-known species</p> <p>Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation.</p> <p>Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.</p>
2	<p>Priority 2: Poorly-known species</p> <p>Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.</p>
3	<p>Priority 3: Poorly-known species</p> <p>Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.</p>
4	<p>Priority 4: Rare, Near Threatened and other species in need of monitoring</p> <p>(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.</p> <p>(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>
<p>¹ The definition of flora includes algae, fungi and lichens.</p> <p>² Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).</p>	

APPENDIX TWO TRAPPING SITE DETAILS

Table 6: Locations and representative image of impact trap sites







Site Type	Site Number	Trap Number	Easting	Northing	Representative habitat
Impact Sites	I1	I1C1	6446794	762168	
		I1C2	6446794	761968	
		I1C3	6446796	761770	
		I1C4	6446793	761578	
		I1C5	6446788	761382	
		I1C6	6446580	761381	
		I1C7	6446577	761582	
		I1C8	6446578	761784	
		I1C9	6446585	761985	
		I1C10	6446585	762195	
	I2	I2C1	6443185	759384	
		I2C2	6443189	759588	
		I2C3	6443192	759787	
		I2C4	6443192	759991	
		I2C5	6443189	760193	
		I2C6	6443372	760198	
		I2C7	6443370	759994	
		I2C8	6443366	759789	
		I2C9	6443363	759589	
		I2C10	6443366	759386	
	I3	I3C1	6444301	762353	
		I3C2	6444106	762354	
		I3C3	6443900	762359	
		I3C4	6443696	762356	
		I3C5	6443518	762360	
		I3C6	6443516	762566	
		I3C7	6443718	762552	
		I3C8	6443921	762561	
		I3C9	6444125	762551	
		I3C10	6444329	762544	

Table 7: Locations and representative image of control trap sites

Site Type	Site Number	Trap Number	Easting	Northing	Representative habitat
Control Sites	C1	C1T1	6466865	752315	
		C1T2	6466919	752506	
		C1T3	6466913	752700	
		C1T4	6466965	752887	
		C1T5	6467046	753022	
		C1T6	6466681	752345	
		C1T7	6466741	752528	
		C1T8	6466739	752717	
		C1T9	6466675	752902	
		C1T10	6466794	753058	
	C2	C2T1	6465557	759988	
		C2T2	6465579	760179	
		C2T3	6465529	760377	
		C2T4	6465528	760579	
		C2T5	6465501	760776	
		C2T6	6465358	759988	
		C2T7	6465353	760194	
		C2T8	6465309	760401	
		C2T9	6465259	760610	
		C2T10	6465260	760811	
	C3	C3T1	6465497	763135	
		C3T2	6465473	763330	
		C3T3	6465469	763536	
		C3T4	6465476	763742	
		C3T5	6465465	763947	
		C3T6	6465298	763147	
		C3T7	6465314	763349	
		C3T8	6465282	763554	
		C3T9	6465285	763754	
		C3T10	6465230	763946	