Level 1 Vertebrate Fauna Survey
Greenbushes Infrastructure Corridors

Prepared for Talison Lithium
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EXECUTIVE SUMMARY

Talison Lithium Pty Ltd (Talison) currently operates a lithium mine at Greenbushes, situated approximately 250 km south of Perth in south-west Western Australia. Talison is proposing to increase output from the Greenbushes Mine and as part of the current expansion of mining operations, requires vertebrate fauna survey work within three proposed infrastructure corridors surrounding the mine site. Onshore Environmental Consultants Pty Ltd (Onshore Environmental) was commissioned by Talison to undertake a Level 1 vertebrate fauna survey within the proposed infrastructure corridors, herein referred to as the study area.

The field survey was completed by a Senior Zoologist from Onshore Environmental working over a three-day period between the 4th and 7th October 2018. No conservation significant fauna species were recorded from the study area during the survey. No introduced fauna species (feral animals) were observed during the survey.

A total of seven fauna habitat types were described and mapped from the study area, with a majority of the study area consisting of Hill Slope habitat type, as well as areas of historical mine rehabilitation, cleared annual pasture, and plantation.

There was no evidence of foraging, roosting or breeding by Black Cockatoos observed from within the study area. Within the study area eight (8) trees with hollows were recorded and assessed, of which one was deemed suitable for use by Black Cockatoos; however, there were no signs of this hollow being utilised.

No evidence of Western Ringtail Possums were recorded during the survey (i.e. no scats or dreys were observed during the active searches, and no individuals were observed). The majority of habitats within the study area are considered to be unsuitable for Western Ringtail Possums.

The South-western Brush-tailed Phascogale and Western Brush Wallaby were assessed as ‘likely to occur’ within the study area, however were not recorded during the survey. These species may utilise habitats within the study area on occasion.

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1.0 INTRODUCTION

1.1 Preamble

Talison is a Western Australian mining company with operations based at Greenbushes in the south-west of Western Australia. The Greenbushes Mine is located approximately 250 km south of Perth and 80 km south-east of the port of Bunbury (Figure 1).

The site comprises a number of open cut mining operations for tantalum, tin and spodumene (lithium). An underground tantalum operation has also been developed but is currently under care and maintenance. The Greenbushes pegmatitie is the world's largest hard rock tantalum resource and the largest and highest-grade lithium minerals resource in the world. Minerals produced at Talison's Greenbushes Mine can be found in many different applications including mobile phones, computers, surgical implants, electronic devices, glassware, ceramics and batteries.

Talison is proposing to undertake an expansion at the Greenbushes Mine, aimed at increasing supply of lithium to the market. To support the proposed expansion, Onshore Environmental Consultants Pty Ltd (Onshore Environmental) was commissioned by Talison to undertake a single-season Level 1 vertebrate fauna survey of three proposed infrastructure corridors (Figure 2):

- Northern Bypass road corridor (40 m corridor);
- Southern Bypass road corridor (20 m corridor); and
- Powerline corridor (40 m corridor).

1.2 Previous Surveys

There have been seven previous vertebrate fauna surveys undertaken within the adjacent Greenbushes Mine area that provide local context for the study area. These surveys are listed below and described in more detail in Section 3.1.1:

- Greenbushes Level 1 Fauna Survey (Biologic Environmental Survey 2011);
- Black Cockatoo Survey, Talison Mining, Greenbushes (Kirkby 2018);
- Black Cockatoo Habitat Quality Assessment (Ennovate 2018);
- Greenbushes Black Cockatoo Hollow Review (Harewood 2018a);
- Greenbushes Preliminary Western Ringtail Possum Surveys – June 2018 (Harewood 2018b);
- Greenbushes Vertebrate Fauna, SRE and Subterranean Fauna Desktop Assessment (Biologic Environmental Survey 2018a); and
- Greenbushes Targeted Vertebrate and SRE Invertebrate Fauna Survey (Biologic Environmental Survey 2018b).

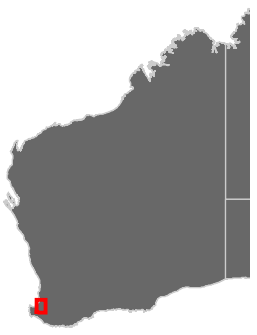
TALISON

Figure 1

Location
Greenbushes Mine

Legend

Talison Active Mining Location



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GRIFFIN SPATIAL & MAPPING

TALISON LITHIUM

Figure 2

Infrastructure Corridors Study area

Legend

- Mine Development
- Talison Tenements
- Study

M 01/5
M 01/4
M 01/9
M 01/8
M 01/11
M 01/18
M 01/16
G 01/1
G 01/2
L 01/1
M 01/2
M 01/3
M 01/6
M 01/7
M 01/10
M 70/765

SMITH ST
DARONCHS RD
WILLIAMS RD
PAPALIAS RD
MCDONALD'S L
HESTER BROOK
CARTERS RD
EASTCOTT RD
ANGUS RD
DUMPLING GULLY
Northern Bypass Road
SPRING CREEK
SALT WATER GULLY
SPRING GULLY RD
CATTERICK RD
NORILUP BROOK
ASHCROFT RD
SOUTH WESTERN HWY
HAINES RD
ROBS RD - NEW
MARANUP FORD RD
PERRY'S RD
HESTER CASCADES RD
FOREST PARK AV
Southern Bypass Road
WOLJENUP CREEK
BUCHANAN RD
HALLS RD
HESTER HALL RD
RUSSELL RD
DANIELS RD
Powerline Corridor
BLACKWOOD RIVER
HESTER BROOK
GEEGELUP BROOK

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Meters

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GRIFFIN SPATIAL & MAPPING

1.3 Climate

The study area occurs on a boundary between the dry Mediterranean region to the north which experiences six dry months per year, and the moderate Mediterranean region to the south which experiences four dry months per year (Beard 1981). The Greenbushes region has cool wet winters and hot dry summers. Average annual rainfall for the town of Greenbushes is 928.7 mm (Bureau of Meteorology [BOM] 2018), with the majority of falls occurring during the winter months of June and July associated with cold fronts moving across the south-west of Western Australia.

The annual rainfall for the twelve-month period prior to the October 2018 field survey was 798 mm, which is below the long-term average (Figure 3). Temperatures experienced during the survey period were typical for the time of year and aligned with the monthly long-term averages.

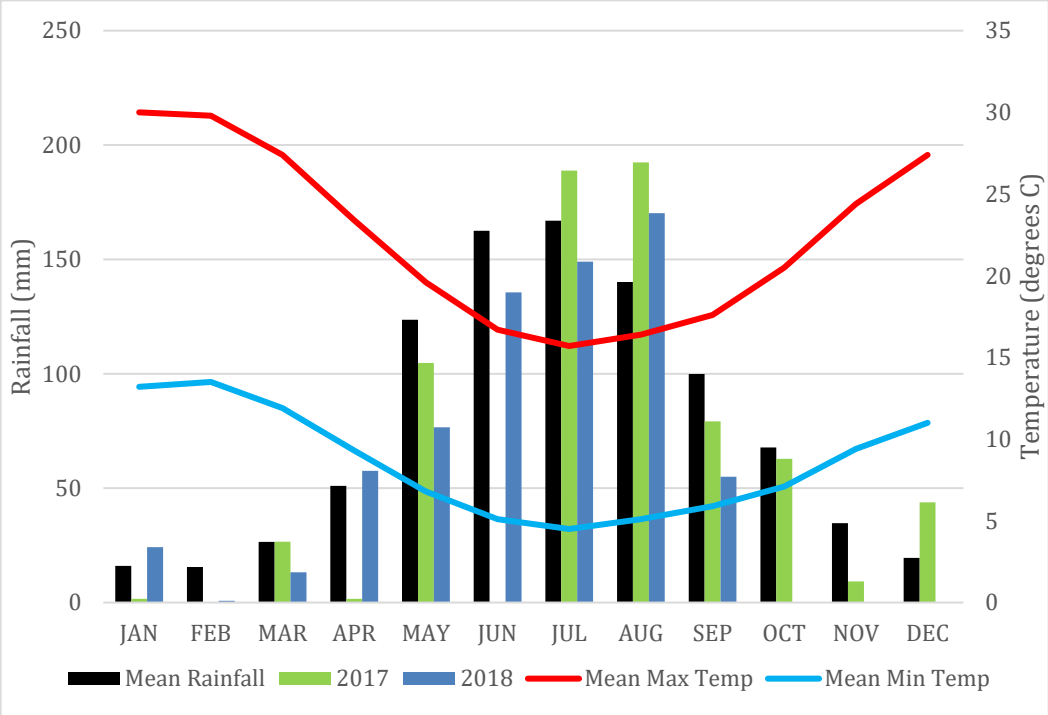


Figure 3 **Climatic data – rainfall data is from the Greenbushes Weather Station and temperature data from the Bridgetown Weather Station (BOM 2018).**

1.4 Biogeographic Regions

The latest version of the Interim Biogeographic Regionalisation for Australia (IBRA7) divides Australia into 89 bioregions based on climate, geology, landform, native vegetation and species information, and includes 419 sub-regions (Department of the Environment and Energy [DoEE] 2018a). The bioregions and sub-regions are the reporting unit for assessing the status of native ecosystems and their level of protection in the National Reserve System.

The study area is located within the Southern Jarrah Forest (JF2) sub-region within the Jarrah Forest bioregion. The Southern Jarrah Forest sub-region is described as, “Duricrusted plateau of Yilgarn Craton characterised by Jarrah-Marri forest on laterite gravels and, in the eastern part, by Marri-Wandoo woodlands on clayey soils. Eluvial

and alluvial deposits support Agonis shrublands. In areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich shrublands. The climate is Warm Mediterranean" (Hearn *et al*. 2002).

The vegetation of the sub-region is described as "Jarrah-Marri forest in the west grading to Marri and Wandoo woodlands in the east. There are extensive areas of swamp vegetation in the south-east, dominated by Paperbarks and Swamp Yate. The understory component of the forest and woodland reflects the more mesic nature of this area. The majority of the diversity in the communities occurs on the lower slopes or near granite soils where there are rapid changes in site conditions" (Hearn *et al*. 2002).

1.5 Land Use

The major land uses within the study area and surroundings are State Forest, residential, mining and agriculture. The study area predominantly traverses sections of State Forest and privately-owned farmland to the south-east. Nearby towns include Bridgetown (approximately 15 km to the south-east) and Balingup (approximately 10 km to the north-west).

1.5.1 Agriculture and Associated Industry

Bridgetown is the oldest town in the south-west of Western Australia. It was first settled by sheep farmers E. Hester and John Blechyden in 1857. The Bridgetown Agricultural Society was formed in 1885 and by this time the area had a well-established agricultural industry, including sheep, cattle, dairy products, timber, fruit and nuts. In 1889 the railway line was extended to Bridgetown allowing the expansion of the fruit and timber markets. Many of these agricultural industries are still operational with wineries and olive farms also established in the area. Currently one of the largest employers in the area is Auswest Timbers, a local timber milling company.

1.5.2 Mining

The Greenbushes Mine is situated on the oldest mining tenement in Western Australia and has a long history of mining activities dating back to 1888. Tin was first reported in 1886 in a Government geological survey, and mining commenced in 1888. Since it was first discovered, tin has been mined almost continuously in the Greenbushes area, although in recent years the lower tin prices and emergence of tantalum as the major revenue earner have relegated tin to the position of a by-product. The presence of tantalite was noted as far back as 1893 but at that time the mineral had no value in its own right and was seen as a nuisance because it downgraded the value of tin. Although open cut mining began to be practiced on a small scale in the 1900s much of the tin mined in the early years by small operators came from underground workings to access weathered pegmatite below the caprock. Shafts were blasted in the surface rock and tunnels dug out into the tin bearing alluvium. The dirt was hauled to the surface and stockpiled during the summer months then puddled and sluiced in winter when there was an abundance of water. Tin mining continued more or less as a cottage industry under the control of many small mining companies up to the early 1960s when, for the first time, a major mining company became involved in the tinfields.

For several years a dredge was used to recover surface deposits of tin and tantalum. By 1970 alluvial resources were dwindling and it was necessary to increase

exploration activity. As a direct result of this work development of the weathered pegmatite commenced in 1974. This tin/tantalum source sustained the operation until 1992. Small parcels of tantalite were sold occasionally, but it was not until 1944, when war had stimulated interest in the element tantalite, that the mineral began to be produced steadily for use in telecommunications, electronics and radar equipment.

Spodumene, the major lithium mineral, was first identified by the Western Australian Government Survey in 1949 from a specimen collected in 1928 which was initially thought to be feldspar. During the extensive diamond drilling programme for tantalum that took place between 1977 and 1980, substantial spodumene rich zones were identified. Later drilling confirmed the existence of the richest spodumene ore body ever discovered, with resources sufficient to maintain production well into the 21st Century. However, being a new product, markets had to be developed, so it was not until 1983 that the initial development of the lithium ore body at Greenbushes commended, and the first lithium processing plant was commissioned in 1985. Since that time, the lithium processing plant has been expanded several times to produce a range of lithium concentrates, with the most recent expansion of the Greenbushes operations occurring in 2012.

1.5.3 Tourism

Tourism is the other major industry in the area with the scenery, historical sites, wineries, and galleries serving as the major attractions. Events such as the annual Blues at Bridgetown Festival also draw large numbers of people to the area.

1.6 Landforms and Soils

Tille (1996) has mapped soils of the Wellington-Blackwood District, which includes the town sites of Greenbushes and Bridgetown on its southern boundary. The study area occurs within the Hester sub-system of the Darling Plateau System, and consists of undulating ridges and hill crests formed on laterite and gneiss which typically slope downwards off the main plateau into the surrounding Lowden Valleys System. The soils are mostly loamy gravels, sandy gravels and loamy earths.

In 2010 AECOM reviewed the Environmental Geology Series maps prepared by the Geological Survey of Western Australia (1980) for a nearby area (AECOM 2010). The soils and landforms described for the area are expected to be similar to those within the study area. The geology of the nearby area was described as Archean granite of the Yilgarn Block and the soils of this area are listed below:

- Bt - Shallow red and yellow earths and rock outcrops on slopes and narrow alluvial terraces;
- Ba - Red and yellow earths, duplex soils on slopes, narrow alluvial terraces, swampy floors;
- G - Grey sands and some swamps;
- Hr - Duricrust and gravels flanked by gravelly duplex soils; and
- Cc - Yellow and duplex soils and red earths on slopes, and narrow alluvial terraces.

1.7 Flora and Vegetation

The study area occurs in the Menzies sub-district of the Darling Botanical District, in the South-West Botanical Province (Beard 1981). The Menzies sub-district (Southern

Jarrah Forest) covers a total area of 26,572 km^2, of which 18,715 km^2 (70%) originally supported jarrah and jarrah-marri forest (Beard 1990). It is estimated that approximately 61% of the total area has been cleared since European settlement, mainly in the valleys which are free of laterite, leaving the forest intact on laterised higher plateau levels.

The Menzies sub-district is characterised by Jarrah stands on laterite within some Marri and Wandoo woodlands. Valley soils are often richer and Blackbutt (*Eucalyptus patens*) is more dominant in these areas. Flooded Gum (*Eucalyptus rudis*) is common along stream banks and Bullich (*Eucalyptus megacarpa*) is also present in some areas. Within the study area vegetation is dominated by Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) forest over the tall shrubs bull banksia (*Banksia grandis*) and snotty gobble (*Persoonia longifolia*). The lower understory strata contains a range of plant genera including *Hakea, Acacia, Xanthorrhoea, Adenanthos, Hovea, Leucopogon, Macrozamia, Leucopogon, Bossiaea, Daviesia, Grevillea, Patersonia, Styphelia* and *Kennedia.*

Vegetation complexes of the southern jarrah forest have most recently been defined by Heddle *et al.* (1980) and updated by Mattiske and Havel (1998). Mattiske and Havel (1998) describe vegetation of the survey area as ‘mixture of open forest of *Eucalyptus marginata - Corymbia calophylla* with some *Eucalyptus patens* on slopes’.

2.0 METHODOLOGY

2.1 Guidance Statements

The single-season Level 1 vertebrate fauna survey was carried out in a manner that was compliant with Environmental Protection Authority (EPA) requirements for the environmental surveying and reporting of vertebrate fauna in Western Australia:

- Statement of Environmental Principles, Factors and Objectives (EPA 2018);
- Environmental Factor Guideline Terrestrial Fauna (EPA 2016a);
- Technical Guidance Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016b);
- Technical Guidance Terrestrial Fauna Surveys (EPA 2016c);
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2010a) Survey Guidelines for Australia's Threatened Bats;
- DEWHA (2010b) Survey Guidelines for Australia's Threatened Birds;
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (2011a) Survey Guidelines for Australia's Threatened Mammals;
- DSEWPC (2011b) Survey Guidelines for Australia's Threatened Reptiles;
- DEWHA (2010c) Survey Guidelines for Australia's Threatened Frogs;
- DSEWPC (2012) EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species; and
- Department of Parks and Wildlife (DPaW) (2017) Western Ringtail Possum Recovery Plan.

2.2 Desktop Assessment

2.2.1 Literature Review

Regional scale reports relevant to the study area locality were reviewed, including:

- a summary of bioregional data (Hearn *et al*. 2002); and
- vegetation description and mapping by Beard (1981), and more recently by Heddle *et al.* (1980) and by Mattiske and Havel (1998).

In addition, there was a review of all publicly available literature and internal reports commissioned and held by Talison. There are seven vertebrate surveys that have previously been completed between 2011 and 2018 within the Greenbushes Mine expansions area, adjacent to the study area. The previous survey work is summarised in more detail in Section 3.1.1.

2.2.2 Database Searches

The desktop assessment included databases relating to significant fauna, Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs) previously collected or described within, or in close proximity to, the study area. For this report the search was extended beyond the study area to place vertebrate fauna values into a local and regional context. The following databases were searched:

- NatureMap: This database represents the most comprehensive source of information on the distribution of Western Australia's fauna (20 km radial search around the central point GDA94 Zone 50 - 414500E 6252000N, accessed 24 October 2018) (DPaW 2018);

- DBCA's Threatened Fauna Database was searched to confirm the NatureMap results (50 km radial search around the central point GDA94 Zone 50 - 414500E 6252000N, accessed 25 October 2018) (DBCA 2018a);
- DBCA's TEC, PEC and Environmentally Sensitive Areas (ESAs) database was searched to identify significant communities (20 km radial search around the central point GDA94 Zone 50 - 413000E 6252000N, accessed 2 March 2018) (DBCA 2018b);
- EPBC Act Protected Matters database (20 km radial search around the central point GDA94 Zone 50 - 414500E 6252000N, accessed 24 October 2018) (DoEE 2018b); and
- International Union for Conservation of Nature (IUCN) database (accessed 24 October 2018) (IUCN 2018).

2.2.3 Assessment of Conservation Significance

The conservation significance of fauna and ecological communities are classified at a Commonwealth, State and Local level on the basis of various Acts and Agreements, including:

International Level:

- IUCN: The IUCN 'Red List' lists species at risk under nine categories (status codes) (Appendix 1); and
- International Conventions: Migratory taxa listed under the Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA), Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA), and Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Commonwealth Level:

- EPBC Act: The DoEE lists Threatened fauna and ecological communities, which are determined by the Threatened Species Scientific Committee according to criteria set out in the Act. The Act lists flora that are considered to be of conservation significance under one of six categories (Appendix 2).

State Level:

- WC Act: At a State level, native fauna species are protected under the WC Act – Wildlife Conservation Notice. A number of species are assigned an additional level of conservation significance based on a limited number of known populations and the perceived threats to these locations (Appendix 3); and
- DBCA Priority list: DBCA produces a list of Priority species and ecological communities that have not been assigned statutory protection under the WC Act. Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added under Priorities 1, 2 or 3. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been removed from the threatened species list for other taxonomic reasons, are placed in Priority 4. These species require regular monitoring (see Appendix 4). The list of PECs identifies those that need further investigation before nomination for TEC status at a State level.

Local Level:

- Species may be considered of local conservation significance because of their patterns of distribution and abundance. Although not formally protected by legislation, such species are acknowledged to be in decline as a result of threatening processes, primarily habitat loss through land clearing.

2.2.4 Assessment of Likelihood of Occurrence in the Study Area

A list of conservation significant fauna species occurring within a 50 km radius of the study area was compiled during the literature review and database searches. The likelihood of each taxon occurring within the study area was assessed using a set of rankings and criteria (Table 1) based on presence of suitable landform (inferred from aerial imagery with contours overlayed, and from knowledge of the adjacent areas), and distance to known records.

Table 1 Ranking system used to assign the likelihood that a species would occur in the study area.

Rank	Criteria
Recorded	The species has been recorded in the study area.
Likely to occur	The species has previously been recorded from a landform/habitat which is present within the study area, and there are previous records within immediate surrounds of the study area.
Possible to occur	The species has previously been recorded from a landform/habitat which is present within the study area, and there are previous records within a 20 km radius of the study area.
Unlikely to occur	The landform/habitat from which the species has previously been recorded is absent within the study area, and/or there are no previous records within a 20 km radius of the study area.

2.3 Field Survey Methodology

2.3.1 Timing and Personnel

The vertebrate fauna survey was completed by Senior Zoologist from Onshore Environmental, Mr Michael Brown, working over a three-day field trip on the 4th, 6th and 7th of October 2018.

2.3.2 Surveying of Study Area

The entire length of each corridor was walked and assessed to document habitat characteristics including evaluation of the presence of habitats suitable to support conservation significant fauna.

The survey recorded any observations of fauna species made, via primary or secondary evidence, from within the corridors. In addition, low intensity sampling was undertaken throughout the corridors, involving bird census and active foraging. Targeted searches (as detailed below) were also undertaken for conservation significant fauna species identified during the database review.

The following parameters were recorded for all conservation significant fauna:

- Co-ordinate locations;
- Description of habitat in which the species was located; and
- Photograph of the species, evidence of species and/or habitat.

Active Foraging

Active foraging, involving raking litter and turning over rocks, was completed throughout the study area. Records were captured for any conservation significant species sighted during foraging.

Bird Census

Timed bird census (45 minutes) were completed within the study area. The bird census were undertaken at the commencement of each day when conditions were more favourable for bird activity. Records were captured for any conservation significant bird species sighted during the census. Opportunistic records of bird sightings throughout the day were also recorded during the wider field survey.

2.3.3 Targeted Surveys for Conservation Significant Species

Tree Hollow searches

Tree hollows were actively searched for during transect walks within the corridors. Each tree hollow encountered was assessed for its suitability to provide habitat for conservation significant species (namely, Western Ringtail Possums and Black Cockatoos). Those hollows deemed appropriate (i.e. sufficient size) were assessed further (as per below).

Black Cockatoo searches

Habitats used by black cockatoos have been placed into three categories by DSEWPC (2012), these being:

- Breeding Habitat;
- Foraging Habitat; and
- Night Roosting Habitat.

Breeding habitat for black cockatoos was assessed by the identification of all suitable breeding trees that had a diameter at breast height (DBH) of equal to or greater than 50 cm. Target tree species included marri and jarrah and any other *Corymbia/Eucalyptus* species of a suitable size that were present. The location of each tree identified (with appropriate DBH) was recorded along with details on the number and size of hollows present (if any).

Trees were examined to identify hollows using binoculars and evidence of actual use by black cockatoos (e.g. chewing around hollow entrance, scarring and scratch marks on trunks and branches). Any potential hollows observed were further investigated using a drone to categorise the hollows, based on the size of the hollow entrance, and its suitability for black cockatoos to use (i.e. greater than 10 cm in diameter) and to nest in (i.e. deep enough).

Any evidence of foraging (e.g. chewed fruits around the base of trees) was recorded, and the type of foraging was also detailed. Potential foraging habitat was documented notwithstanding of the presence of foraging evidence.

Any evidence of roosting (e.g. branch clippings, droppings or moulted feathers) within trees was recorded.

Drey searches

Dreys were actively searched to provide evidence of the presence of Western Ringtail Possums. Each drey encountered was photographed (where possible) and a GPS point collected.

Nocturnal searches

Two 2.5 hour nocturnal searches were undertaken within suitable habitat in each corridor. The nocturnal searches involved spotlighting trees and undertaking foot

transects using a head torch with any fauna of conservation significance recorded and a GPS co-ordinate taken.

2.3.4 Fauna Habitat Mapping

Assessments of the habitat were undertaken throughout the study area to document habitat characteristics and map the fauna habitat types. The fauna habitat mapping utilised high-resolution aerial photography of the study area at a scale of 1:15,000. Ground-truthing of the study area was completed during the survey with habitat characteristics recorded at each habitat assessment site, and the habitat type selected for each polygon. Vegetation association mapping was utilised to further aid in characterising the habitat map accuracy across the full extent of the study area.

2.3.5 Species Identification and Nomenclature

Vertebrate fauna species were identified at the time of capture/observation in the field by the Senior Zoologist. All species were able to be fully identified with no specimens needed to be taken for further examination. Nomenclature and conservation significance rankings used in this report are in accordance with the current listing of WA fauna recognised by the DBCA, as listed on NatureMap.

2.4 Field Survey Constraints

The EPA Technical Guidance (EPA 2016c) list potential limitations that field surveys may encounter. Limitations associated with the Level 1 vertebrate fauna survey, are addressed in Table 2. There were no survey-specific limitations for this survey.

Table 2 Relevance of limitations, as identified by EPA (2016c), to the Greenbushes vertebrate survey.

Constraint	Relevance
Competency/experience of the consultant carrying out the survey	The Senior Zoologist working on the survey has in excess of 12 years fauna experience in the south-west, and has completed other fauna surveys for Talison in the Greenbushes area.
Scope (faunal groups sampled and were some sampling methods not able to be employed because of constraints)	The entire length of the corridors were assessment and all allocated tasks detailed in the scope of works were achieved during the survey, with foraging, bird census and targeted searches undertaken. Two nights of nocturnal searches were also undertaken as part of this survey.
Proportion of fauna identified, recorded and/or collected	All fauna species were identified and recorded in the field when observed.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data	There has been no previous survey work completed within the study area. However, there have been seven previous vertebrate fauna surveys undertaken adjacent to the study area, providing a comprehensive local database.
Proportion of the task achieved and further work which might be needed	The Level 1 vertebrate fauna survey was aimed at mapping fauna habitats within the study area and assessing their suitability to support fauna species of conservation significance, as well as targeting fauna species of conservation significance. All allocated tasks detailed in the scope of works were achieved during the survey.

Constraint	Relevance
Timing/weather/season/cycle	The survey was completed in October 2018 under *good* seasonal conditions with average rainfall and temperatures experienced, providing favourable conditions for the surveying of fauna species.
Disturbances which affected results of survey	There were no disturbances recorded within the study area that influenced survey outcomes.
Intensity	A Senior Zoologist working over a three-day period sampled traversed and sampled the three corridor alignments and assessed habitats during the field survey, representing an adequate survey intensity for a Level 1 survey.
Completeness	All allocated tasks detailed in the scope of works were adequately completed during the Level 1 survey.
Resources	All resources required to complete the Level 1 survey were available, with information available from numerous surveys completed from neighbouring areas.
Remoteness and/or access problems	There were no access restrictions experienced during the survey with the study area accessible by vehicle and on foot; noting that fauna habitat mapping was facilitated by high-resolution aerial photography.
Availability of contextual information on the region	There has been no previous survey work completed within the study area. However, there have been seven previous vertebrate fauna surveys undertaken adjacent to the study area, providing a comprehensive local database.

3.0 RESULTS

3.1 Desktop Assessment

3.1.1 Literature Review

The results from previous vertebrate fauna surveys completed within the vicinity of the study area are summarised below and presented in Table 3.

Greenbushes Level 1 Fauna Survey (Biologic Environmental Survey 2011)

Biologic Environmental Survey was commissioned by Talison to undertake a Level 1 vertebrate fauna survey and comprehensive literature and database review of the active mining area and all leases held by Talison.

Desktop assessments identified 196 vertebrate fauna species to have the potential to occur within the study area. Of these, the survey recorded a total of 82 species of vertebrates. Four current conservation significance fauna species were recorded from the study area:

- South-western Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) – WC Act Schedule 6, IUCN Near Threatened;
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – EPBC Act Vulnerable, WC Act Schedule 3;
- Baudin's Cockatoo (*Calyptorhynchus baudinii*) – EPBC Act Endangered, WC Act Schedule 2, IUCN Endangered; and
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – EPBC Act Endangered, WC Act Schedule 2, IUCN Endangered.

Six broad fauna habitats were identified within the Study Area:

- Jarrah (*Eucalyptus marginata*)/Marri (*Corymbia calophylla*) forest;
- Jarrah/Marri forest over Banksia dominated mid-story;
- Marri/Blackbutt (*Eucalyptus patens*) /Flooded Gum (*Eucalyptus rudis*) Woodland over *Banksia* dominated mid-story;
- *Typha* dense tall sedges;
- *Leptospermum* scrub; and
- Disturbed/rehabilitated areas.

Black Cockatoo Survey, Talison Mining, Greenbushes (Kirkby 2018)

Kirkby was commissions to locate and document feeding, breeding and roosting habitat used by black cockatoos Calyptorhynchus species at the proposed mining extension areas at the Greenbushes Mine. Breeding habitat at the study area was identified as Jarrah Eucalyptus marginata/Marri Corymbia calophylla forest with a small amount of Flooded Gum E. rudis. In the Jarrah/Marri Forest, Marri provides the vast majority (over 90%) of breeding trees.

A total of 50 trees (49 Marri, 1 jarrah) were located across the survey area which had a hollow entrance of suitable size, shape and position in the tree to be considered suitable for use as a black cockatoo breeding hollow, with 24 of these trees having entrances which showed evidence of use. The remaining 26 trees had hollows with a suitable entrance and are possibly or potentially black cockatoo breeding hollows but show no signs of past use. No roost sites were located during the survey.

Forest Red-tailed Black Cockatoo feeding residues was observed during the survey and ranged from fresh to old indicating presence throughout the year and breeding seasons. The feeding residues noted from Baudin's Cockatoo and Carnaby's Cockatoo were all classed as not recent.

Small numbers of Forest Red-tailed Black Cockatoo were seen and/or heard at most locations during the survey. Carnaby's Cockatoo were heard to the east of the study area on one occasion. Baudin's Cockatoo were not present during the survey.

Black Cockatoo Habitat Quality Assessment (Ennovate 2018)

Ennovate was commission to undertake an assessment of Black Cockatoo habitat quality. The following information was used to assign a habitat condition score to each of the separate blocks of native vegetation. The location of habitat trees, bird sightings and feeding residues was also used. Finally, historical and detailed current aerial photography was viewed to ascertain vegetation disturbance history and class structure.

Overall, the condition of the Black Cockatoo habitat within the expanded development area was assigned a median score (ranging from 5-7 out of 10) for the blocks assessed.

Greenbushes Black Cockatoo Hollow Review (Harewood 2018a)

A number of potential breeding hollows have been identified within and near the Mine Development Envelope area. Previous surveys involved the assessment of tree hollows from ground level. As this method has some limitations, Talison requested Harewood undertake an assessment of the identified trees using a drone with the aim of photographing specific hollows so that additional characteristics relating to their potential to represent actual or possible black cockatoo breeding hollows could be determined.

Of the 70 trees re-inspected 14 were positively identified as showing evidence of previous use by black cockatoos in the form of chew marks to varying degrees. An additional 16 trees were assessed as being possibly suitable but showed no conclusive evidence of actual use for nesting purposes. The remaining trees inspected (40) did not appear to have suitable hollows for black cockatoos.

Greenbushes Preliminary Western Ringtail Possum Surveys – June 2018 (Harewood 2018b)

Harewood was commissioned to undertake a preliminary Western Ringtail Possum (*Pseudocheirus occidentalis*) survey within and near the Greenbushes Mine. Day and nocturnal survey was completed with no conclusive evidence of Western Ringtail Possums found during the course of the survey in and around the mine development area.

Generally speaking, much of the vegetation observed seems to represent poor or marginal habit for Western Ringtail Possums. This conclusion is based on the fact that much of the area has been historically logged and lacks a coherent mid-story component, a structural unit most often favoured by Western Ringtail Possums.

Greenbushes Vertebrate Fauna, SRE and Subterranean Fauna Desktop Assessment (Biologic Environmental Survey 2018a)

Biologic Environmental Survey was commissioned by Talison to undertake a desktop assessment for terrestrial vertebrate fauna, short-range endemic (SRE) invertebrate

fauna and subterranean fauna within and surrounding the Greenbushes Mine. The study area comprised 1,989 hectares, comprising the current mining area and an indicative expansion area.

The vertebrate fauna desktop assessment reviewed a total of seven literature sources and four databases were searched. A total of eight fauna habitats have previously been recorded and mapped across the study area, comprising four naturally occurring habitat types (Jarrah/Marri Forest, Jarrah/Marri Forest over Banksia, Marri/Blackbutt/Flooded Gum Woodland over Banksia, and Waterbodies).

The desktop assessment identified a total of 44 conservation significance fauna species which have previously been recorded and/or have the potential to occur within the study area, of which seven have been recorded within the study area:

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – EPBC Act Endangered, WC Act Schedule 2, IUCN Endangered;
- Baudin's Cockatoo (*Calyptorhynchus baudinii*) – EPBC Act Endangered, WC Act Schedule 2, IUCN Endangered;
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – EPBC Act Vulnerable, WC Act Schedule 3;
- South-western Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) – WC Act Schedule 6, IUCN Near Threatened;
- Chuditch (*Dasyurus geoffroii*) – EPBC Act Vulnerable, WC Act Schedule 3, IUCN Near Threatened;
- Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) – DBCA Priority 4; and
- Western Brush Wallaby (*Notamacropus irma*) – DBCA Priority 4.

One additional species, Western Ringtail Possum (*Pseudocheirus occidentalis*) (Vulnerable EPBC Act, Critically Endangered, WC Act), was considered highly likely to occur in the study area.

Five databases were searched for SRE invertebrate fauna records within and surrounding the study area. Broad fauna habitats were also reviewed for their ability to support SRE species. Of the four naturally occurring habitats present in the Study Area, three were assessed as having a moderate potential for SRE fauna: Jarrah/ Marri Forest, Jarrah/Marri Forest over Banksia, Marri/Blackbutt/Flooded Gum Woodland over Banksia. Only one terrestrial invertebrate (a widespread species) has previously been recorded within the study area to date.

Five databases were searched for subterranean fauna records. Geology and hydrogeology of the study area was also reviewed. Three broad surface geology types have been mapped, with the dominant geological groups being the undivided sediments and ferruginous duricrust, both of which are sedimentary in nature. The study area is situated in the Blackwood River catchment within the Karri groundwater sub-area. Based on the available information, it was concluded that a number of prospective habitats for troglofauna and stygofauna may potentially occur within the study area.

<u>Greenbushes Targeted Vertebrate and SRE Invertebrate Fauna Survey (Biologic Environmental Survey 2018b)</u>

Biologic Environmental Survey was commissioned by Talison to undertake a targeted survey for vertebrate fauna of conservation significance and short-range endemic (SRE) invertebrate fauna within and surrounding the Greenbushes Mine. The study

area comprised 1,989 hectares, comprising the current mining area and an indicative expansion area.

The survey was undertaken between the 12th and 21st of February 2018. Twelve motion camera sites were established in the Study Area, each consisting of five baited cameras. Twelve additional motion cameras were deployed opportunistically throughout the Study Area. Targeted searches for vertebrate fauna were conducted at 27 locations within the Study Area. Spotlighting searches were undertaken at ten locations over four nights.

A total of 43 species were recorded during the survey directly and/or via secondary evidence, including five species of conservation significance:

- Chuditch (*Dasyurus geoffroii*) – EPBC Act Vulnerable, WC Act Schedule 3, IUCN Near Threatened;
- South-western Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) – WC Act Schedule 6, IUCN Near Threatened;
- Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) – DBCA Priority 4;
- Western Brush Wallaby (*Notamacropus irma*) – DBCA Priority 4; and
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – EPBC Act Vulnerable, WC Act Schedule 3.

Scats possibly belonging to the Western Ringtail Possum (*Pseudocheirus occidentalis*) (listed as EPBC Act Critically Endangered, WC Act Schedule 1, and IUCN Critically Endangered) were also recorded but could not be confirmed as belonging to the species.

SRE sampling comprised sampling at 12 sites for a total of 18 personnel hours. Each site was subject to active foraging, leaf and soil sieving and burrow excavations (if found). Three invertebrate taxa recorded during the survey were identified as 'Potential SRE'. In all three cases, a precautionary level of Potential SRE was allocated as a precise taxonomic identification could not be made. This comprised two specimens identified as Nemesiidae sp. indet, two specimens of Paradoxosomatidae sp. indet., and one specimen belonging to the family Siphonotidae.

Table 3 Results from vertebrate fauna surveys previously completed within the vicinity of the study area.

Survey	Consultant	Field Survey Date	Survey Level	Conservation Significant Fauna Species
Greenbushes Level 1 Fauna Survey	Biologic Environmental Survey	13 – 17 Oct 2011	Level 1	South-western Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) – WC Act Schedule 6, IUCN Near Threatened Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – EPBC Act Vulnerable, WC Act Schedule 3 Baudin's Cockatoo (*Calyptorhynchus baudinii*) – EPBC Act Endangered, WC Act Schedule 2, IUCN Endangered Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – EPBC Act Endangered, WC Act Schedule 2, IUCN Endangered
Black Cockatoo Survey	Kirkby	22 Jan – 12 Feb 2018	Targeted	Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – EPBC Act Vulnerable, WC Act Schedule 3 Baudin's Cockatoo (*Calyptorhynchus baudinii*) – EPBC Act Endangered, WC Act Schedule 2, IUCN Endangered Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – EPBC Act Endangered, WC Act Schedule 2, IUCN Endangered
Black Cockatoo Habitat Quality Assessment	Ennovate Consulting	Not relevant	Desktop	Not recorded
Greenbushes Black Cockatoo Tree Hollow Review	Harewood	11 – 19 Jun 2018	Targeted	None
Greenbushes Preliminary Western Ringtail Possum Surveys	Harewood	11, 13 & 15 Jun 2018	Targeted	South-western Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) – WC Act Schedule 6, IUCN Near Threatened
Greenbushes Vertebrate Fauna, SRE and Subterranean Fauna Desktop Assessment	Biologic Environmental Survey	Not relevant	Desktop	Not recorded

Survey	Consultant	Field Survey Date	Survey Level	Conservation Significant Fauna Species
Greenbushes Targeted Vertebrate and SRE Invertebrate Fauna Survey	Biologic Environmental Survey	12 – 21 Feb 2018	Targeted	Chuditch (*Dasyurus geoffroii*) – EPBC Act Vulnerable, WC Act Schedule 3, IUCN Near Threatened Western Ringtail Possum (*Pseudocheirus occidentalis*) – EPBC Act Critically Endangered, WC Act Schedule 1, IUCN Critically Endangered[1] South-western Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) – WC Act Schedule 6, IUCN Near Threatened Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) – DBCA Priority 4 Western Brush Wallaby (*Notamacropus irma*) – DBCA Priority 4 Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – EPBC Act Vulnerable, WC Act Schedule 3

[1] This record is of scats possibly belonging to the species, and therefore the record is unconfirmed.

3.1.2 Database Searches

Threatened Fauna listed under the EPBC Act

A search of the EPBC Act Protected Matters database was undertaken for a 20 km buffer around the study area (DoEE 2018b). The database search listed 11 Threatened fauna species, or species habitat, that may occur in the study area:

Mammals:

- Woylie (*Bettongia penicillata*) – listed as Endangered;
- Chuditch (*Dasyurus geoffroii*) – listed as Vulnerable;
- Numbat (*Myrmecobius fasciatus*) – listed as Endangered;
- Western Ringtail Possum (*Pseudocheirus occidentalis*) – listed as Critically Endangered; and
- Southern Brown Bandicoot (*Setonix brachyurus*) – listed as Vulnerable.

Birds:

- Australasian Bittern (*Botaurus poiciloptilus*) – listed as Endangered;
- Curlew Sandpiper (*Calidris ferruginea*) – listed as Critically Endangered;
- Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) – listed as Vulnerable;
- Baudin's Cockatoo (*Calyptorhynchus baudinii*) – listed as Endangered;
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – listed as Endangered; and
- Eastern Curlew (*Numenius madagascariensis*) – listed as Critically Endangered.

The database search also identified eight Migratory bird species, or species habitat, that may occur in the study area:

- Fork-tailed Swift (*Apus pacificus*);
- Grey Wagtail (*Motacilla cinerea*);
- Common Sandpiper (*Actitis hypoleucos*);
- Sharp-tailed Sandpiper (*Calidris acuminata*);
- Curlew Sandpiper (*Calidris ferruginea*);
- Pectoral Sandpiper (*Calidris melanotos*);
- Eastern Curlew (*Numenius madagascariensis*); and
- Osprey (*Pandion haliaetus*).

Threatened Fauna listed under the WC Act

The DBCA Threatened Fauna database search (DBCA 2018b) and NatureMap search (DPaW 2018) identified 13 species listed as Scheduled species under the WC Act from a 20km radius around the study area:

Mammals:

- Woylie (*Bettongia penicillata ogilbyi*) – listed as Schedule 1;
- Chuditch (*Dasyurus geoffroii*) – listed as Schedule 3;
- Bilby (*Macrotis lagotis*) – listed as Schedule 3;
- Numbat (*Myrmecobius fasciatus*) – listed as Schedule 2;
- Red-tailed Phascogale (*Phascogale calura*) – listed as Schedule 6;
- South-western Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) – listed as Schedule 6;
- Western Ringtail Possum (*Pseudocheirus occidentalis*) – listed as Schedule 1; and
- Quokka (*Setonix brachyurus*) – listed as Schedule 3.

Birds:

- Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) – listed as Schedule 3;

- Baudin's Cockatoo (*Calyptorhynchus baudinii*) – listed as Schedule 2;
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – listed as Schedule 2;
- Peregrine Falcon (*Falco peregrinus*) – listed as Schedule 7; and
- Wood Sandpiper (*Tringa glareola*) – listed as Schedule 5.

Priority Fauna recognised by the DBCA

The DBCA Threatened Fauna database search (DBCA 2018b) and NatureMap search (DPaW 2018) identified seven Priority fauna species as potentially occurring within a 20 km radius of the study area:

Mammals:

- Western False Pipistrelle (*Falsistrellus mackenziei*) – listed as Priority 4;
- Water-rat (*Hydromys chrysogaster*) – listed as Priority 4;
- Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) – listed as Priority 4; and
- Western Brush Wallaby (*Notamacropus irma*) – listed as Priority 4.

Reptiles:

- Dell's skink (*Ctenotus delli*) – listed as Priority 4.

Birds:

- Blue-billed Duck (*Oxyura australis*) – listed as Priority 4; and
- Masked Owl (southwest) (*Tyto novaehollandiae novaehollandiae*) – listed as Priority 3.

A total of 29 conservation significant species were identified during the desktop assessment, comprising 12 mammals, one reptile and 16 bird species.

Based on the known distributions and habitat preferences of the species and comparison with the habitats identified and mapped within the study area, five species were determined as being “likely” to occur within the study area (Table 4). Eight species was determined as “possible” to occur in the study area (Table 4). The remaining species identified as “unlikely” to occur (Table 4).

Table 4 Conservation significant fauna species identified during the desktop assessment.

Common Name	Scientific Name	Cons. Code				Habitat Preference	Suitable Habitat Present	Likelihood in the Study Area
		EPBC Act	WC Act	IUCN	DBCA			
Mammals								
Woylie	*Bettongia penicillata ogilbyi*	EN	S1	CE		Woodlands and adjacent heaths with a dense understory of shrubs (Woinarski *et al*. 2014).	Yes	Possible
Chuditch	*Dasyurus geoffroii*	VU	S3	NT		Jarrah forest, in moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest particularly in riparian vegetation (Orell & Morris 1994).	Yes (only limited areas)	Possible
Numbat	*Myrmecobius fasciatus*	EN	S2	EN		Eucalypts forests and woodland, notably wandoo and jarrah woodland (Van Dyck & Strahan 2008).	Yes (only limited areas)	Unlikely[2]
Western Ringtail Possum	*Pseudocheirus occidentalis*	CE	S1	CE		Coastal *Agonis flexuosa* forest or eucalypt woodland or forest with a mid-story of *Agonis flexuosa* (DPaW 2017, Jones *et al.* 1994).	No	Unlikely
Quokka	*Setonix brachyurus*	VU	S3	VU		Habitat varies, but prefer *Acacia* and *Melaleuca* thickets. Associated with *Taxandria linearifolia* in Jarrah Forest (de Tores 2008).	No	Unlikely
Bilby	*Macrotis lagotis*	VU	S3	VU		Mixture of woodland including Jarrah, Marri and Wandoo in the south-west (Abbott 2001).	Yes	Unlikely[1]

[2] Due to no known recent recordings of this species from the local area.

Common Name	Scientific Name	Cons. Code				Habitat Preference	Suitable Habitat Present	Likelihood in the Study Area
		EPBC Act	WC Act	IUCN	DBCA			
Red-tailed Phascogale	*Phascogale calura*	VU	S6	NT		Wandoo-rock sheoak uplands, and lowland habitat with riverine fringing vegetation of swamp sheoak, York Gum and Wandoo (Short *et al.* 2011).	Yes (only limited areas)	Possible
South-western Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*		S6	NT		Dry sclerophyll forests and open woodlands that contain hollow-bearing trees with a sparse ground cover (Woinarski *et al.* 2014).	Yes	Likely
Western False Pipistrelle	*Falsistrellus mackenziei*			NT	P4	Tall forests and woodlands in higher rainfall parts of the south-west, particularly Karri forests but also Tuart and Jarrah forests (Woinarski *et al.* 2014).	Yes (only limited areas)	Possible
Water-rat	*Hydromys chrysogaster*				P4	Permanent bodies of fresh or brackish water, subalpine streams to lakes and farm dams (Van Dyck & Strahan 2008).	No	Unlikely
Southern Brown Bandicoot	*Isoodon obesulus fusciventer*				P4	Jarrah forest and swamp habitats, preferring dense vegetation around wetland fringes and heathland (Cooper 1998, Woinarski *et al*. 2014).	Yes (only limited areas)	Possible
Western Brush Wallaby	*Notamacropus irma*				P4	Wide-range of habitats including low *Banksia* woodlands, Jarrah/Marri woodlands and moist *Melaleuca* lowlands, favours open, grassy areas (Wann & Bell 1997, Woinarski *et al.* 2014).	Yes	Likely

Common Name	Scientific Name	Cons. Code				Habitat Preference	Suitable Habitat Present	Likelihood in the Study Area
		EPBC Act	WC Act	IUCN	DBCA			
Reptiles								
Dell's skink	*Ctenotus delli*				P4	Dry sclerophyll forest on stony hills and ranges (Cogger 2014).	Yes (only limited areas)	Possible
Birds								
Australasian Bittern	*Botaurus poiciloptilus*	EN	S2	EN		Tall dense *Typha* and sedges in freshwater swamps (Johnstone & Storr 1998).	No	Unlikely
Curlew Sandpiper	*Calidris ferruginea*	CE, MG	S3	NT		Intertidal mudflats in sheltered coastal areas (Geering *et al.* 2007).	No	Unlikely
Forest Red-tailed Black-Cockatoo	*Calyptorhynchus banksii naso*	VU	S3			Eucalypt forests, areas of seeding Marri, Jarrah, Blackbutt, Karri and Sheoak (Johnstone & Storr 1998).	Yes	Likely
Baudin's Cockatoo	*Calyptorhynchus baudinii*	EN	S2	EN		Eucalypt forest, areas of Marri, Karri and Wandoo (Johnstone & Storr, 1998, Johnstone & Kirkby 2008).	Yes	Likely
Carnaby's Cockatoo	*Calyptorhynchus latirostris*	EN	S2	EN		Eucalypt woodlands and forests and adjacent area of *Proteaceous* scrubs and heaths (Johnstone & Storr 1998).	Yes	Likely
Eastern Curlew	*Numenius madagascariensis*	CE, MG	S3	EN		Tidal mudflats, also reef flats, sandy beaches (Johnstone & Storr 1998).	No	Unlikely
Fork-tailed Swift	*Apus pacificus*	MG	S5			Entirely aerial species (Johnstone & Storr 1998).	N/A	Possible
Grey Wagtail	*Motacilla cinerea*	MG	S5			Various habitats with open waterbodies (Johnstone & Storr 2004).	No	Unlikely

Common Name	Scientific Name	Cons. Code				Habitat Preference	Suitable Habitat Present	Likelihood in the Study Area
		EPBC Act	WC Act	IUCN	DBCA			
Common Sandpiper	*Actitis hypoleucos*	MG	S5			Edge of sheltered waters, salt or fresh, estuaries, river pools, claypans, drying swamps (Johnstone & Storr 1998).	No	Unlikely
Sharp-tailed Sandpiper	*Calidris acuminata*	MG	S5			Coastal and inland areas saline and fresh or brackish wetlands (Geering *et al.* 2007).	No	Unlikely
Pectoral Sandpiper	*Calidris melanotos*	MG	S5			Fresh waterbodies including swamps, lagoons and river pools (Johnstone & Storr 1998).	No	Unlikely
Osprey	*Pandion haliaetus*	MG	S5			Sheltered seas around islands, tidal creeks, estuaries and saltwork ponds, and large river pools (Johnstone *et al.* 2013).	No	Unlikely
Peregrine Falcon	*Falco peregrinus*		S7			Coastal cliffs, rivers and ranges, wooded watercourses and lakes (Johnstone & Storr 1998).	No	Unlikely
Wood Sandpiper	*Tringa glareola*		S5			Freshwater wetlands and occasional brackish intertidal mudflats (Geering *et al.* 2007).	No	Unlikely
Blue-billed Duck	*Oxyura australis*			NT	P4	Mainly deep freshwater swamps and lakes, occasionally salt lakes and estuaries freshened by flood waters (Johnstone & Storr 1998).	No	Unlikely
Masked Owl	*Tyto novaehollandiae*				P3	Forested areas and occasionally dry woodland areas (Johnstone & Storr 1998).	Yes	Possible

3.1.3 Ecological Communities

TECs listed under State and Federal Legislation

A search of the EPBC Act Protected Matters database (DoEE 2018b) and the DBCA ecological communities database (DBCA 2018b) identified no Federal listed TECs previously recorded within, or adjacent to, the study area.

PECs recognised by DBCA

A search of the State database (DBCA 2018b) identified no PECs previously recorded within, or adjacent to, the study area.

Environmentally Sensitive Areas

There is one Environmentally Sensitive Area (ESA) identified to the south-west of the study area approximately 560 m from the intersection of Huitson Road and Maranup Ford Road. The ESA incorporates the winter-wet dampland supporting the *Caladenia harringtoniae* population.

3.2 Level 1 Fauna Survey

3.2.1 Vertebrate Fauna Species

Threatened Fauna listed under the WC Act and EPBC Act

No vertebrate fauna species listed as Scheduled species under the WC Act or listed as Threatened fauna under the EPBC Act were recorded from the study area.

Priority Fauna recognised by the DBCA

No Priority fauna species, as recognised by the DBCA, were recorded from the study area.

Introduced Fauna species

No introduced fauna species (feral animals) were observed within the study area during the survey.

3.2.2 Fauna Habitat

Habitat Types

Seven fauna habitats were identified and mapped within the study area during the field survey (Figure 4; Table 5).

The Northern Bypass corridor of the study area was dominated by the Hill Slope habitat type as well as areas of historical mine rehabilitation. The Southern Bypass corridor was also dominated by the Hill Slope habitat type and included areas of cleared annual pasture. The Powerline corridor of the study area largely consisted of areas of cleared annual pasture, and Blue Gum and Pine plantation. There was also a section of the Hill Slope habitat type intersecting the powerline corridor (Figure 4).

Table 5 Fauna habitat mapped within the study area.

Habitat Type	Description
Hill Crest & Upper Hill Slope	Jarrah, Marri and Sheoak forest with open scrubs on loamy sands with laterite outcropping.
Hill Slope	Jarrah, Marri and mixed woodland to forest over scrubs on grey/brown sandy loam.
Drainage Flat	Marri and Yarri (with pine trees) forest over scrubs with scattered sedges on sandy clay loam.
Minor Drainage Line	Flooded gum (*Eucalyptus rudis*) forest over scrubs and tall sedges on sandy clay loam.
Pasture	Areas of cleared annual pasture on farmland.
Plantation	Areas of Blue Gum (*Eucalyptus globulus*) or Pine plantation.
Rehabilitation	Areas of historical mine rehabilitation.

TALISON LITHIUM

Northern Bypass

Habitat Types

Figure 4

Legend

- Mine Development Area
- Study

Habitat Types

- Hill Crest & Upper Hill Slope (HCUH)
- Hill Slope (HS)
- Drainage Flat (DF)
- Minor Drainage Line (MDL)
- Cleared (CL)
- Cleared Pasture (CP)
- Rehab (RH)
- Road (RD)

N

0 100 200 300

Meters

1:12,500

Datum: GDA94

Projection: MGA Zone 50

Date:	13/09/2018
Status:	Draft
Figure:	4
Sheet Size:	A3
Internal Reference:	TL_Nth_bp_HT
Drawn by:	GSM
Requested by:	DB

411000
412000
413000
414000
6250000
6249000

MARANUP FORD RD
PERRYS RD
WOLJENUP CREEK
FOREST PARK AV
DANIELS RD

HS
RD
RH
CP

TALISON LITHIUM

Southern Bypass

Habitat Types

Figure 4

Legend

- Mine Development
- Study

Habitat Types

- Hill Slope (HS)
- Cleared Pasture (CP)
- Rehab (RH)
- Road (RD)

N

0 100 200 300

Meters

1:10,000

Datum: GDA94

Projection: MGA Zone 50

Date:	13/09/2018
Status:	Draft
Figure:	4
Sheet Size:	A3
Internal Reference:	TL_Sth_bypass
Drawn by:	GSM
Requested by:	DB

412000 413000 414000 415000 416000 417000 418000 419000 420000

6252000 6251000 6250000 6249000 6248000 6247000 6246000

HESTER BROOK

WOLJENUP CREEK

MC HS RD RD RH MC RH WT HS RH RH

HS CP HS RD CP RD CP HS Plant (Blue Gum)

Plant (Blue Gum) MDL Plant (Pine) CP CL Plant (Blue Gum) MDL HS CP CP Plant (Pine) HS RD HS HS HS CP CP Plant (Pine)

TALISON LITHIUM

Powerline

Habitat Types

Figure 4

Legend

- Mine Development Area
- Study Area

Habitat Types

- Hill Slope (HS)
- Minor Drainage Line (MDL)
- Cleared (CL)
- Cleared Pasture (CP)
- Rehab (RH)
- Plantation (Plant)
- Road (RD)
- Water (WT)
- Mine Clearing (MC)

N

0 250 500 750

Meters

1:25,000

Datum: GDA94

Projection: MGA Zone 50

Date:	15/11/2018
Status:	Draft
Figure:	4
Sheet Size:	A3
Internal Reference:	TL_Powerline
Drawn by:	GSM
Requested by:	DB

3.2.3 Fauna Habitats and Species of Significance

Black Cockatoos

Habitats within the study area were assessed for the use by, and suitability for, Black Cockatoos. There was no evidence of foraging by Black Cockatoos observed from within the study area. However, the majority of habitats within the study area are deemed to be suitable foraging habitat for the cockatoos, with the exception of areas of cleared annual pasture and historical mine rehabilitation (Figure 4). Although it is not a native habitat, Black Cockatoos are considered likely to use the areas of plantation. They may forage within the pine plantation areas, and may use large introduced *Eucalyptus* species (i.e. the Blue Gum plantation) for night roosting but not for nesting or foraging (Figure 4).

To assess the potential for breeding habitat within the study area, suitable tree species (i.e. *Corymbia/Eucalyptus* species) that had a DBH of equal to or greater than 50 cm were evaluated. Of the trees identified, four were observed to have hollows present and were assessed by Onshore Environmental (Table 6). An additional four trees with hollows that were previously assessed are also located within the study area (Table 6) (Harewood 2018a). Four of these trees are located within the Northern Bypass Corridor and four within the Powerline Corridor of the study area (Figure 5). Details of each tree hollow is presented in Table 6, with photographs presented in Appendix 5. Of the assessed tree hollows, only one (ON-01) was deemed suitable for use by Black Cockatoos (Table 6). Although the hollow was considered suitable there was no evidence of use by Black Cockatoos. No evidence of roosting from Black Cockatoos was observed during the field survey.

Table 6 Tree hollows recorded within the study area (by Onshore Environmental or reported by Harewood 2018a).

Hollow ID	Description of Usage	Classification
ON-01	Potential hollow, however no usage observed	Potential
ON-03	Hollow very shallow	Unsuitable
ON-04	Hollow very shallow	Unsuitable
ON-32	Hollow shallow and diameter less than 10cm	Unsuitable
1055	Hollow shallow	Unsuitable
65	Unused relatively small hollow	Unused / likely unsuitable
115	Hollow shallow with a small diameter	Unsuitable
331	Unused hollow with hindered access	Unused / likely unsuitable

Western Ringtail Possum

Dreys were actively searched for within the study area to provide evidence of the presence of Western Ringtail Possums. No evidence of Western Ringtail Possums were recorded during the survey. No scats or dreys were observed during the active searches undertaken within the study area, and no individuals were observed during nocturnal searches.

The majority of habitats within the study area are considered to be unsuitable for Western Ringtail Possums. Areas comprised of cleared annual pasture farmlands, plantation and historical mine rehabilitation do not provide habitat for this species (Figure 4). Areas with open scrubs that are lacking a well-connected mid-story and upper-story (i.e. the Hill Crest and Upper Hill Slope habitat type) are also considered unsuitable habitat for the Western Ringtail Possum.

The remaining three habitat types of the study area (Hill Slope, Drainage Flat and Minor Drainage Line) (Figure 4) provided poor or marginal habitat for Western Ringtail Possums. The habitats lack structured mid-story and upper-story strata and canopy connectivity that Western Ringtail Possums require. It is considered unlikely that a population of Western Ringtail Possums would inhabit the study area, and if individuals are occasionally present within the study area, they are not considered to be dependent on the habitats of the study area.

South-western Brush-tailed Phascogale

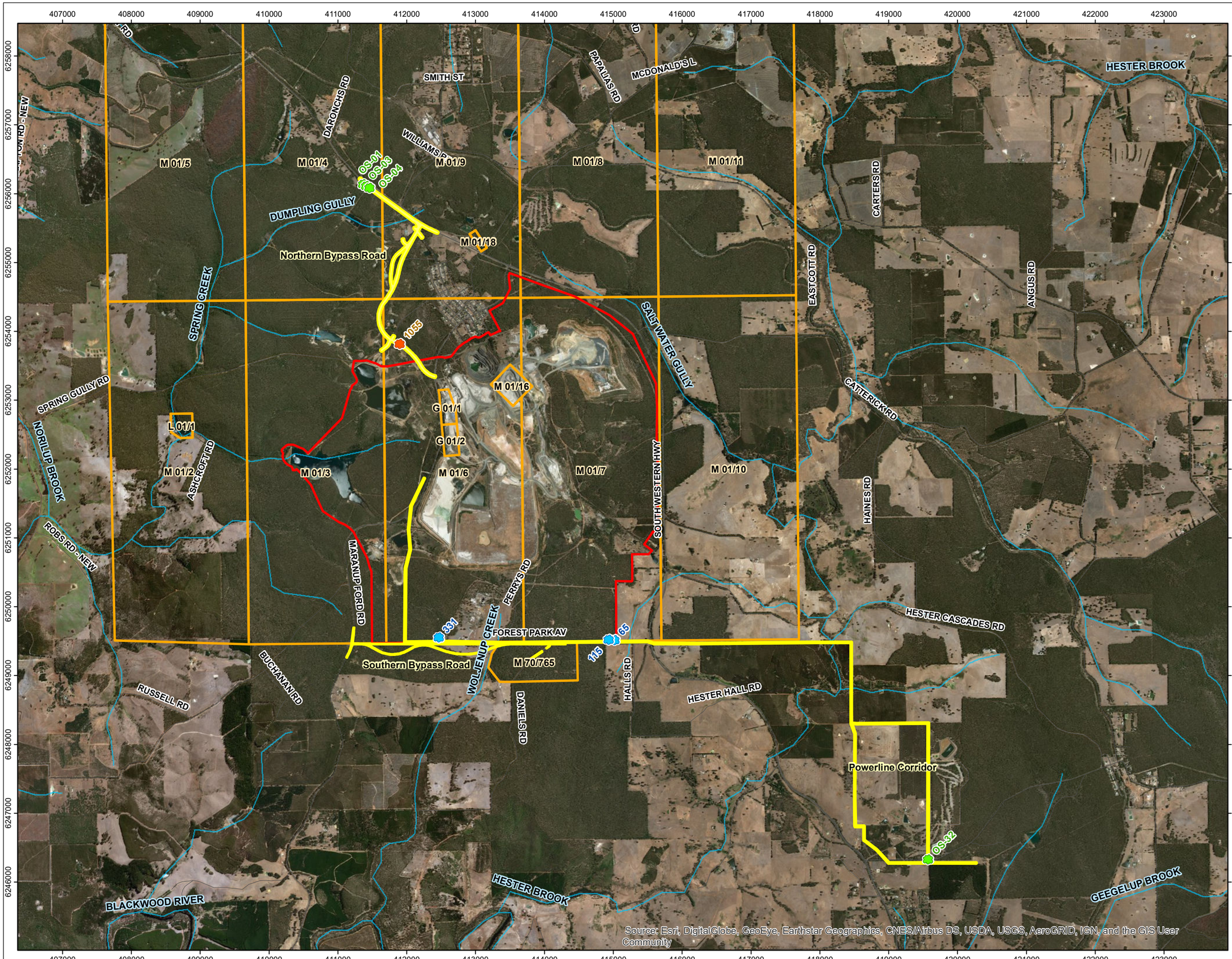
The South-western Brush-tailed Phascogale was assessed during the desktop assessment as likely to occur within the study area. No evidence of this species was recorded during the survey of the study area, with no individuals observed during nocturnal searches. The species has previously been recorded from habitat situated adjacent to the study area, specifically from within remnant regrowth Marri-Jarrah forest in close vicinity to the Powerline corridor (Biologic Environmental Survey 2011), approximately 1.5 km south-west of the Northern Bypass corridor (Harewood 2018b) and from numerous locations within the Mine Development Envelope (Biologic Environmental Survey 2018b).

This species is known to inhabit dry sclerophyll forests and open woodlands that contain hollow-bearing trees with a sparse ground cover (Woinarski *et al.* 2014). South-western Brush-tailed Phascogales rely on tree hollows for nesting. Although not observed, individuals may utilise the Hill Slope, Hill Crest and Upper Hill Slope, and Drainage Flat habitat types of the study area for foraging (Figure 4). None of the hollows assessed within the study area are considered to provide suitable nesting habitat for this species as they are too shallow.

Western Brush Wallaby

The Western Brush Wallaby was assessed during the desktop assessment as likely to occur within the study area. No evidence of this species was recorded during the survey of the study area. The species has previously been recorded from within the Mine Development Envelope from Jarrah-Marri forest habitat type (Biologic Environmental Survey 2018b).

This species is known to inhabit a wide-range of habitats including low Banksia woodlands, Jarrah/Marri woodlands and moist Melaleuca lowlands, and it favours open, grassy areas (Wann & Bell 1997, Woinarski et al. 2014). Due to the nearby records and present of suitable habitat, the Western Brush Wallaby may utilise habitats within the study area on occasion.



ONSHORE ENVIRONMENTAL

TALISON LITHIUM

Figure 5

Tree hollows recorded inside and within 50m of the study area

Legend

- Mine Development
- Talison
- Study

Tree Hollow Locations - within 50m

- Biologic
- Kirkby
- Onshore

N

0 500 1,000 1,500

Meters

1:50,000

Datum: GDA94

Projection: MGA Zone 50

Date:	14/11/2018
Status:	Draft
Figure:	5
Sheet Size:	A3
Internal Reference:	TL_Hab_tree
Drawn by:	GSM
Requested by:	DB

GRIFFIN SPATIAL & MAPPING

4.0 SUMMARY

Talison currently operates a lithium mine at Greenbushes, situated approximately 250 km south of Perth in south-west Western Australia. As part of the current expansion of mining operations at the Greenbushes Mine, Onshore Environmental was commissioned to undertake a vertebrate fauna survey of three proposed infrastructure corridors surrounding the mine site.

The field survey was completed by a Senior Zoologist from Onshore Environmental working over a three-day period between the 4th and 7th October 2018.

No conservation significant fauna species were recorded from the study area during the survey. No introduced fauna species (feral animals) were observed during the survey.

A total of seven fauna habitat types were described and mapped from the study area, with a majority of the study area consisting of the Hill Slope habitat type, as well as areas of historical mine rehabilitation, cleared annual pasture, and Blue Gum and Pine plantation. The fauna habitats mapped within the study area are well represented in adjacent local areas, as well as regionally.

Habitats within the study area were assessed for the use by, and suitability for, Black Cockatoos. There was no evidence of foraging, roosting or breeding by Black Cockatoos observed from within the study area. Within the study area eight (8) trees with hollows were recorded and assessed, of which one was deemed suitable for use by Black Cockatoos; there were no signs of this hollow being utilised.

Dreys were actively searched for within the study area to provide evidence of the presence of Western Ringtail Possums. No evidence of Western Ringtail Possums were recorded during the survey (i.e. no scats or dreys were observed during the active searches, and no individuals were observed). The majority of habitats within the study area are considered to be unsuitable for Western Ringtail Possums.

The South-western Brush-tailed Phascogale and Western Brush Wallaby were assessed during the desktop assessment as being likely to occur within the study area, having previously been recorded during surveys of adjacent areas. The South-western Brush-tailed Phascogale may utilise the Hill Slope, Hill Crest and Upper Hill Slope, and Drainage Flat habitat types within the study area for foraging. No tree hollows within the study area were considered suitable for nesting by this species. Due to nearby records and present of suitable habitat, the Western Brush Wallaby may utilise habitats within the study area on occasion. No evidence of these species occurring within the study area were recorded during the survey.

5.0 STUDY TEAM

The Level 1 vertebrate fauna survey was planned, co-ordinated and executed by the following personnel:

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APPENDIX 1

Status codes for species listed on the IUCN 'Red List'

Category	Description
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (CR)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
Not Evaluated (NE)	A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

APPENDIX 2

Conservation categories for species listed under the EPBC Act

Category	Description
Extinct	A species is extinct if there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A species is categorised as extinct in the wild if it is only known to survive in cultivations, in captivity, or as a naturalised population well outside its past range; or if it has not been recorded in its known/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	The species is facing an extremely high risk of extinction in the wild and in the immediate future.
Endangered	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival, or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Conservation Dependent	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 within a period of 5 years.

APPENDIX 3

Conservation categories for species listed under the WC Act

Fauna Species - Wildlife Conservation (Specially Protected Fauna) Notice 2017

Category	Description
Schedule 1	Fauna that is rare or is likely to become extinct as critically endangered fauna.
Schedule 2	Fauna that is rare or is likely to become extinct as endangered fauna.
Schedule 3	Fauna that is rare or is likely to become extinct as vulnerable fauna.
Schedule 4	Fauna presumed to be extinct.
Schedule 5	Migratory birds protected under an international agreement.
Schedule 6	Fauna that is of special conservation need as conservation dependent fauna.
Schedule 7	Other specially protected fauna.

APPENDIX 4

Conservation codes for Western Australian species

Threatened Species

Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice* for Threatened Fauna and *Wildlife Conservation (Rare Flora) Notice* for Threatened Flora (which may also be referred to as Declared Rare Flora).

Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the *Wildlife Conservation Act*.

Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the *Wildlife Conservation Act*.

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.

Priority One: Poorly-known species

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. 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.

Priority Two: Poorly-known species

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.

Priority Three: Poorly-known species

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.

Priority Four: Rare, Near Threatened and other species in need of monitoring

(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.

(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.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

APPENDIX 5

Photographs of tree hollow recorded within the study area

Hollow ID	Classification
ON-01	Potential

ON-03	Unsuitable

Hollow ID	Classification
ON-04	Unsuitable

ON-32	Unsuitable

Hollow ID	Classification
1055	Unsuitable
No photo available	
65	Unused / likely unsuitable

115	Unsuitable

Hollow ID	Classification
331	Unused / likely unsuitable