Appendix 12 – Fauna Management Plan

Alcoa of Australia Limited

Fauna Management Plan Huntly and Willowdale Mines

Version	Description of Changes	Date
0	EMMP Revision	31 August 2023

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GLOSSARY

ABBREVIATION/ TERM	DESCRIPTION
AER	Annual Environment Report
BC Act	*Biodiversity Conservation Act 2016*
BCs	Black cockatoos
Black Cockatoo nest trees	A tree containing one or more hollows suitable as Black Cockatoo breeding habitat. A suitable hollow is based on hollow size, shape, and entry angle, irrespective of signs of use for breeding. Potential breeding trees that have hollows: • potentially suitable for breeding, being hollows of suitable diameter, height above ground and aspect, and not impacted by feral bees (i.e. potential breeding trees with suitable hollows); or • with evidence of past use, such as a chewed entrance (i.e. actual breeding trees); or • that are currently being used (i.e. actual breeding trees).
Black Cockatoo habitat trees	Trees on a haul road alignment that have the potential to provide nest hollows in the future. These are primarily marri trees with DBH ≥500mm. The tree should already be starting to develop a hollow or have a form that is conducive to hollow formation.
Black Cockatoo significant trees	Jarrah trees with DBH≥2000mm or Marri trees with DBH≥1500mm.
CD	Conservation dependent fauna
Conservation significant	Environmental values which are protected by legislation or are considered to be of ecological importance, which includes: • Threatened Fauna under BC Act and EPBC Act • Priority Fauna
CR	Critically endangered under the EPBC Act or BC Act
CWD	coarse woody debris
Database search area	a 10 km buffer around the Survey Area
DBCA	Department of Biodiversity Conservation and Attractions
DBH	diameter at breast height in millimetres
Direct impact	Impact through direct loss of conservation significant flora and vegetation from vegetation clearing
DWER	Department of Water and Environment Regulation
EN	Endangered under the EPBC Act or BC Act
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FCA	Forest Clearing Advice
FMP	Fauna Management Plan
FPC	Forest Products Commission
FVMP	Flora and Vegetation Management Plan
GDE	Groundwater Dependent Ecosystem
GIS	Geographic Information System
IA	Migratory birds protected under an international agreement

ABBREVIATION/ TERM	DESCRIPTION
Indirect impact	Effects which are considered to potentially impact fauna including: • dust, during construction and mining operations • intensification and spread of dieback • weed infestation during construction and mining operations • Change in fire regimes
IRZ	Intermediate Rainfall Zone
LTFMP	Long Term Fauna Monitoring Program
m	metre
MI, MA	Migratory, Marine
Mining Avoidance Zone	Spatial area which prohibits mine pits and infrastructure, with the exception of monitoring and management activities which have minimal impacts
Mining Exclusion Zone	Spatial area which prohibits mine pits
ML1SA	Mining Lease 1SA
MM	Millimetres
MMP	Mining and Management Program
MMPLG	Mining and Management Program Liaison Group
MOG	Mining Operations Groups
MS	Ministerial Statement
Nest type	Known nesting tree: A tree (live or dead) containing hollow/s suitable for use by Black Cockatoos (based on hollow size, shape and entry angle), which shows evidence of use (chewing/scratching around entrance). Suitable nesting tree: A tree with suitable Black Cockatoo nesting hollow/s present, that show no evidence of use. Potential nesting tree: Trees that have the potential to provide nest hollows in the future, but do not currently have suitable hollows. All trees with DBH ≥500mm or DBH≥300mm for Wandoo. Significant tree: Very large old trees that are significant in the landscape. All Jarrah with DBH≥2000mm or Marri with DBH≥1500mm.
NJF	Northern Jarrah Forest
OS	Other specially protected fauna under the BC Act
P1	Priority 1: Poorly known fauna. 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.
P2	Priority 2: 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,

ABBREVIATION/ TERM	DESCRIPTION
	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.
P3	Priority 3: 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.
P4	Priority 4: 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.
PDWSA	Public Drinking Water Source Area
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
ROM	Run Of Mine
Significant	Impact which is important, notable, or of consequence, having regard to its context or intensity. Adverse impacts to a species' local population or conservation significance rating
SRE	short range endemic
Survey Area	the area subject to the current survey
VFMP	Vegetation and Flora Management Plan
VU	Vulnerable under the EPBC Act or BC Act
WA	Western Australia
Weeds	Flora species that are non-native to the bioregion
Woylie active breeding site	Woylie nest with evidence of use and associated supporting habitat
WRMP	Water Resources Management Plan

Executive Summary

This Fauna Management Plan (FMP) has been prepared by Alcoa of Australia Limited (Alcoa) for the Huntly and Willowdale bauxite mines located within Alcoa's Mining Lease 1SA (ML1SA).

This FMP includes management of the risks and potential impact of bauxite mining on the following Conservation Significant fauna species:

- Three Black Cockatoo species:
  - Baudin's Cockatoo (*Zanda baudinii*) – Endangered
  - Carnaby's Cockatoo (*Zanda latirostris*) – Endangered
  - Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable.
- Woylie (Bettongia penicillata ogilbyi) – Endangered
- Carters Freshwater Mussel (*Westralunio carteri*) – Vulnerable
- Quokka (Setonix brachyurus) – Vulnerable
- Chuditch (*Dasyurus geoffroii*) – Vulnerable
- Brush Tailed Phascogale (*Phascogale tapoatafa*) – Vulnerable
- Masked Owl (southwest) (*Tyto novaehollandiae novaehollandiae*) – Priority 3
- Southern Death Adder (Acanthophis antarcticus) – Priority 3
- Western False Pipistrelle (*Falsistrellus mackenziei*) – Priority 4
- Rakali, Water-rat (Hydromys chrysogaster) – Priority 4
- Quenda (Southern Brown Bandicoot) (Isoodon fusciventer) – Priority 4
- Western Brush Wallaby (Notamacropus Irma) – Priority 4
- Dell's Skink (Ctenotus delli) – Priority 4
- Peregrine Falcon (*Falco peregrinus*) – Other Specially Protected

Table ES0-1 below presents the environmental objectives for the environmental factor to be met through implementation of this FMP, as well as the environmental criteria and management targets to measure achievement of the associated environmental objectives.

Table ES0-1: Environmental criteria to measure achievement of environmental objectives

EMP Name	Fauna Management Plan – Huntly and Willowdale Mines
Proponent Name	Alcoa of Australia Limited
Ministerial Statement Number	Willowdale Mine (Wagerup Refinery): • Ministerial Statement 1157 (preceding statements: 728, 897, 1069)

	Huntly Mine (Kwinana and Pinjarra Refinery): • Ministerial Statement 646
State Agreements	• Alumina Refinery (Kwinana) Agreement Act 1961 • Alumina Refinery (Wagerup) Agreement Act and Acts Amendment Act 1978 • Alumina Refinery (Pinjarra) Agreement Act 1969 • Alumina Refinery (Alcoa) Amendment Act 1987
Purpose of this EMP	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
Key Environmental Factor/s, outcome/s and/or objectives	Terrestrial Fauna EPA Objective: *To protect terrestrial fauna so that biological diversity and ecological integrity are maintained*
Management based provisions	**Environmental Objectives** – Minimise direct loss of fauna individuals from active mining and associated activities – Minimise direct and indirect loss of suitable breeding habitat for conservation significant fauna – Minimise indirect impacts of active mining and other associated activies on fauna habitats – Minimise the fragmentation of fauna habitats – Minimise the disruption to breeding cycles of conservation significant fauna
Proposed construction date	Not applicable
EMP required pre-construction	Not applicable

1 Context, Scope and Rationale

This FMP has been developed to address the environmental management of Terrestrial Fauna, in accordance with:

- Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016 (EPA 2016)
- Environmental Protection Authority's (EPA) Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans (EPA 2021)
- EPA's Environmental Factor Guideline for Terrestrial Fauna (EPA 2016)

1.1 Huntly and Willowdale Mine Regions

Alcoa of Australia Limited's (Alcoa) Western Australian (WA) mining operations comprise the Huntly and Willowdale bauxite mines, which are located in Alcoa's Mining Lease 1SA (ML1SA) within the Northern Jarrah Forest (NJF) IBRA subregion.

The Huntly Mine supplies bauxite to the Kwinana and Pinjarra alumina refineries. The Huntly Mine has operated since 1972, initially as the Del Park Mine, over six mine regions with a further two regions proposed (Table 1-1). This FMP addresses all eight regions including current and future operations and past and future rehabilitation.

Table 1-1: Huntly Mine regions

Mine region	Region area (ha)	Status	Years of operation
Del Park	3,507	Historic	1972-1987
Huntly 1&2	4,570	Historic	1986-1997
White	12,349	Historic	1989-2006
McCoy	15,512	Historic	2003-2015
O'Neil	12,838	Current	2010-2015 2023-2025
Myara	20,829	Current	2014-present 2023-2025
Myara North	18,172	Proposed	~ 2025-2030
Holyoake	9,157	Proposed	~ 2030-2035

The Huntly Mine is predominantly located within the Shire of Serpentine Jarrahdale and Shire of Murray and extends from Dwellingup in the south to Jarrahdale in the north. The Huntly Mine lies within Dwellingup and Jarrahdale State Forest and is broadly bordered by Serpentine National Park and the Darling Scarp to the west, the Monadnocks Conservation Park and Albany Highway to the east, Dwellingup and Pinjarra-Williams Road to the south and the former Jarrahdale Mine to the north.

To the north of the Huntly Mine (Myara North region) lies the former Jarrahdale Mine, which was operated from 1963 and 1998 and is now closed and rehabilitated. This FMP does not address the former Jarrahdale Mine.

The Willowdale Mine supplies bauxite to the Wagerup alumina refinery. The Willowdale Mine has operated since 1984 over three regions (Table 1-2). This FMP addresses all three regions including current and future operations and past and future rehabilitation.

Table 1-2: Willowdale Mine regions

Mine region	Region area (ha)	Status	Years of operation
Arundel	6,102	Historic	1984-2000
Orion	23,149	Historic	2000-2021
Larego	23,422	Current	2021-current 2023-2045 proposed

The Willowdale Mine is located within the Shire of Waroona and Shire of Harvey and is broadly bordered by Lane Poole Reserve in the east and north-east, the Darling Scarp to the west, and Harvey Dam and surrounding rural land to the south-east. The Willowdale Mine lies predominantly within Dwellingup State Forest and Lane Poole Reserve.

Implementation and operation of the mines may impact conservation significant fauna species. This FMP has been prepared to outline Alcoa's approach to managing potential environmental impacts on conservation significant fauna.

This FMP addresses all operation phases of the WA Mining Operations including:

- Exploration
- Construction
- Mining
- Rehabilitation

1.2 Key Environmental Factors

This FMP has been developed to meet the EPA's terrestrial fauna key environmental factor including the factor objective and relevant policy and guidance.

The EPA's objective for terrestrial fauna is:

- "To protect terrestrial fauna so that biological diversity and ecological integrity are maintained."

In the context of this objective, ecological integrity is the composition, structure, function and processes of ecosystems, and the natural range of variation of these elements (EPA 2016).

presents the region-specific environmental values for terrestrial fauna at the Huntly and Willowdale mines and the potential impacts to these values from Alcoa's activities.

Table 1-3: Site specific environmental values and potential impacts

Region specific terrestrial fauna values	Impacts to region specific environmental values
• Three species of black cockatoo and associated habitat • Chuditch and associated habitat • Quokka and associated habitat • Woylie and associated habitat • Carters' freshwater mussel and associated habitat • Priority listed and other conservation significant fauna and associated habitat	• Direct loss of conservation significant fauna individuals • Direct loss of habitat • Behavioural changes in individuals to avoid areas previously used for foraging or breeding. • Decline in health and/or change in habitat composition • Habitat fragmentation • Disruption to breeding cycles

1.3 Condition Requirements

The following environmental management commitments, outlined in Schedule 2 of MS728 (as amended by MS897, MS1069 and MS1157) relate to terrestrial fauna management within ML1SA:

- (3): Alcoa will plan and manage its mining operations to minimise disturbance to biologically diverse areas fringing major rock outcrops and stream zones. Appropriate buffers will be maintained between these areas and mine pit boundaries. Stream crossings will be constructed in a manner which facilitates their removal and rehabilitation after use, unless required for ongoing forest management or other purposes agreed with the State's Mining and Management Program Liaison Group (MMPLG).
- (4): Alcoa will continue its program of biological surveys and support of activities contributing to the conservation of rare, endangered and priority species existing within the vicinity of its mining operations.
- (6): Alcoa will monitor the success of all its rehabilitated mined areas in consultation with the Department of Environment and Conservation

- (7): Alcoa will forego the bauxite resources in the jarrah forest conservation areas agreed in consultation with the State's Reserves Review Committee and specified in the Alumina Refinery Agreement Amendment Act, No 99 or 1986, for as long as their conservation values remain. Mining adjacent to the conservation areas will utilise site-specific environmental management procedures agreed in consultation with the MMPLG. These will include particular consideration of dieback management and mine rehabilitation requirements.
- (8): Alcoa will defer mining indefinitely the bauxite resources in the facilities section of the recreation zone of the Lane Poole Reserve as defined in Figure 10 of the 1994 Consultative Environmental Review. Ore extraction in the remaining areas of the recreation zone will exclude the steep slopes of the Murray River valley and will be undertaken in accordance with site-specific environmental management procedures agreed with the State's MMPLG after consultation with the Department of Environment and Conservation and the Lane Poole Reserve Advisory Committee.
- (9): Alcoa will implementation a comprehensive dieback management Program designed specifically for its mine operations in the jarrah forest. This will include the rehabilitation of dieback-affected areas adjacent to its mine operating areas, in accordance with procedures agreed with State agencies, and irrespective of the cause of introduction of the disease.
- (10): Alcoa is committed to an ongoing research Program into all aspects of its operation that have the potential to adversely affect the environment, and into those environmental characteristics that could be adversely affected by its operations.
- (11): Alcoa will submit a brief review of its research and management Program to the Department of Industry and Resources on an annual basis. Copies will be made available to relevant State agencies and the Shire of Waroona. A more detailed review will be prepared on a triennial basis.

1.4 Rationale and Approach

This FMP provides provisions for potential impacts to terrestrial fauna values specific to Alcoa operational activities.

1.4.1 Environmental management objective/s

This FMP adopts management-based provisions, to achieve the environmental objectives as outlined in

. The objectives are based on the following:

- Site specific environmental values and potential impacts (see Table 1-3)
- Study findings and uncertainties (see Table 1-4 and Section 1.4.3)
- Risk assessment (see Appendix B).

The risk assessment has been used to prioritise management targets, which have been applied to very high- and high-risk ratings.

Management based provisions are applied where a level of uncertainty exists that prevents setting objective and measurable criteria. In this case, management targets are established to measure success of management actions in achieving the environmental objective.

Complementary management-based provisions may be applied to address values where a degree of uncertainty and complexity exists.

1.4.2 Survey and study findings

Table 1-4 outlines the terrestrial fauna studies that have been undertaken across the Huntly and Willowdale mine regions, with a summary of findings of each.

Table 1-4: Terrestrial fauna studies and research

Year	Author	Project / Study region	Summary of findings
1992, 1995, 1998, 2001, 2003, 2006, 2007	Environmental Management and Research Consultants (EMRC)	Long term fauna monitoring program (LTFMP) - Jarrahdale, Huntly, Karnet	The Alcoa LTFMP was designed in 1991. The program is designed to monitor fauna every three years at twenty plots located in rehabilitation and nearby forest at Jarrahdale, Huntly and Karnet (remote from mining). A variety of different survey methods were used including trapping (five successive trap nights in July, August and September), avifauna (quantitative and inventory surveys in summer and winter), reptile survey (trapping over five consecutive nights in Summer with toenail clippings to indicate recapture) opportunistic survey, nocturnal surveys and active searches. The LTFMP recorded: – Huntly site: 18 mammal, 49 bird and 16 reptile species; six conservation significant species – Jarrahdale site: 15 mammal, 56 bird and 21 reptile species; five conservation significant species – Karnet site: total of 9 mammal, 44 bird and 14 reptile species; three conservation significant species. – Frog and ant species were also recorded.
2003, 2007, 2013	EMRC	Long Term Fauna Monitoring Program (LTFMP) - McCoy	The monitoring program involved survey of terrestrial vertebrates (including mammals, birds and reptiles) and ground invertebrates. Mammals, birds, reptiles, and frogs were surveyed in both winter (July-August) and summer (December-January). Mammal and reptile trapping were undertaken. Birds were surveyed using quantitative methods (transects) and inventory methods (opportunistic recordings). In the 2013 survey additional methods were implemented including a single large trapping transect to sample highly mobile species, remote sensor cameras and all invertebrates collected in pitfall traps were identified to taxonomic order. The LTFMP recorded 16 mammal, 51 bird and 10 reptile species, including four conservation significant species. Frog and ant species were also recorded.
2012	Stokes	Vertebrate fauna survey of planned mining areas at Alcoa's Keats Mining	Fauna were surveyed between November 2011 and February 2012 using a range of techniques, including trapping (Elliot), remote sensor cameras, tracking tunnels, observational surveys and spotlighting across a diversity of forest types. Five areas were trapped: two dieback free Jarrah forest areas and three stream zones. Pitfall traps were not used due to time constraints. Black Cockatoo habitat, feeding and occurrence was surveyed during January 2012 covering approximately 840 ha. Recorded conservation significant fauna comprise:

Year	Author	Project / Study region	Summary of findings
		Region 2011/12	– Forest Red-tailed Black Cockatoo - foraging evidence, flock of 11 sighted – Baudin's Cockatoo - foraging evidence, two individuals sighted – Chuditch - one young male trapped – Western Brush Wallaby - opportunistic sighting and recorded on cameras – Carpet Python (delisted) (sighting).
1999, 2004, 2011, 2015	EMRC Stokes / EMRC	Orion (Willowdale Mine) related studies: A fauna survey of planned mining areas at Alcoa's Orion Mining region Long Term Fauna Monitoring Program (LTFMP) - Orion	Fauna survey conducted between February and November 1999. The habitats monitored were surveyed in current mining areas, extensive dieback affected areas, small dieback free areas and on sites where mining operations are planned. A total of 46 bird species, nine mammals (6 native, 3 introduced) and 13 reptiles. Frog species were also recorded. These included three rare species (the Chuditch, Baudin's Cockatoo and possibly the Quokka) and one Specially Protected species (the Carpet Python). As well as these, the Noisy Scrub-bird was recorded in the area and the uncommon Brush-tailed Phascogale was recorded, albeit in low densities. The fauna of the Orion area was largely comparable to that of existing Willowdale mining areas. Results emphasise the need for ongoing fox control. Rehabilitation using Jarrah and other indigenous species offers the best prospects of successfully recreating suitable habitat for the species. The LTMFP was reviewed in 2003 which included a recommendation for a similar program to be established at Orion so that any differences in faunal successional processes taking place at Willowdale could be detected. Similar techniques to those used at Jarrahdale, Huntly and McCoy. Mammals, birds, reptiles and frogs were surveyed during both summer (March) and winter (July), and ground dwelling invertebrates were sampled in summer only. Survey methods were similar to those used in the original LTFMP. A single large trapping transect designed to specifically target Chuditch was used in the later studies. The LTFMP recorded 15 mammal, 54 bird and 19 reptile species; five conservation significant species.
2000, 2007	EMRC	A Vertebrate Fauna Survey of Rehabilitated Areas at Alcoa's Huntly Minesite	Overview of the vertebrate fauna surveys of Alcoa's rehabilitated bauxite mines at Huntly undertaken in 1994, 2000 and 2007. Mammals, birds and reptiles were surveyed in six rehabilitated pits ranging in age from 8 to 16 years. A total of sixteen mammal species (eleven indigenous, five introduced), 34 birds and eight reptiles were recorded. Rare or specially protected species either recorded in the present survey or recently sighted or trapped in rehabilitation at Huntly include the Brush-tailed Phascogale, Chuditch, Quokka, Baudin's Cockatoo, Forest Red-tailed Black Cockatoo and Carpet Python.

Year	Author	Project / Study region	Summary of findings
2000	EMRC	A survey of the impact of burning on mammals and birds in Alcoa's rehabilitated Bauxite mines at Jarrahdale	To ascertain the impact of burning on birds and mammals, pre burning monitoring took place 1997, and post burn monitoring commenced in 1998 in both burnt and unburnt, rehabilitated and unmined forest sites. Low numbers of mammals were caught making it difficult to conclude with certainty whether burning had an effect on most species. New epicormic growth may have attracted possums into one rehabilitated area, while mice invaded the dense rehabilitated site after the burn. There was a large decline in the numbers of birds and bird species following the burn in the dense rehabilitation. Burning sparse rehabilitation only resulted in a small decline in numbers of birds and bird species while fire had little effect on bird populations of unmined forest. The survey was conducted three years after burning in 1997, and it was concluded that more time was needed to define the longer-term effects of burning on mammals and birds.
2015, 2017	Burgar et al. 2017	Bat related studies: The importance of mature forest as bat roosting habitat within the production landscape Habitat features act as unidirectional and dynamic filters to bat use of production landscapes	Surveys undertaken in forest surrounding Huntly mine site, both unmined and different stages of vegetation succession. *Nyctophilus gouldii* and *Vespadelus regulus* were trapped and tracked during maternity and mating seasons using harp traps and position-sensitive radio transmitters. Few bats were captured in restored forest so traps were relocated to water sources. Study aimed at identifying roost habitat within restored forest versus unmined forest. Findings indicate that habitat restoration in production forest landscapes is unlikely to play a significant role in conserving species that rely on slow developing microhabitats such as tree hollows for decades or centuries and that retaining and managing forest remnants would be a more effective strategy to conserve populations of these species. Ultrasonic detectors (Anabat Titley Electronics) were set at 64 sites four times per year between October and March 2010/2011 and 2011/2012 for a total of 512 survey nights. *Vespadelus regulus* was detected most frequently and *Falsistrellus mackenziei* (P4, BC Act) least frequently.
2013, 2014	Alcoa	Chuditch related studies:	Trapping transects undertaken in 'Myara west' and 'Myara east'. Trapping recorded eight quoll captures at 'Myara west' and one quoll at 'Myara east' between 18-22 March 2013. Total number comprises five males and four females.

Year	Author	Project / Study region	Summary of findings
	McGregor et al. 2014	Chuditch survey raw data Myara. Does forest restoration in fragmented landscapes provide habitat for a wide-ranging carnivore?	Fourteen Chuditch trapping sessions (13 at Huntly, one at Willowdale) across 9 trapping transects (8 at Huntly, one at Willowdale) undertaken between June 2009 and Dec 2010. The study identified 138 den sites from 11 tracked animals: 75 in unmined forest and 63 in restored forest ranging from 2-32 years old. In unmined forest, dens were mostly in hollow logs and ground burrows beneath tree stumps, but these substrates were never used in restored forest where dens were mostly ground burrows, usually associated with rock piles at the surface.
2016, 2019	Doherty et al. 2016 Mastrantonis et al. Craig et al. 2021	Black Cockatoo related studies: Successional changes in feeding activity by threatened cockatoos in revegetated mine sites. Climate change indirectly reduces breeding frequency of a mobile species through changes in	Plots (232) were surveyed in revegetated forest and 480 plots were surveyed in unmined forest to determine whether there were successional patterns in cockatoo feeding activity in revegetation aged between 4 and 23 years. The study concludes that black cockatoos feed in vegetation at all three mine sites, despite variations in vegetation age, structure and floristics. Black cockatoos began feeding on proteaceous and myrtaceous food plants within 4 and 7 years following revegetation, indicating that some food sources are restored quickly after mining disturbance of the Jarrah forest. The results highlight the importance of monitoring fauna recolonization over appropriate time scales to understand how successional processes in revegetation influence fauna persistence in production landscapes. Using a dataset of annual breeding frequency spanning 19 years, in combination with hydrological, climatological, and remotely sensed data, the effects of environmental variation on the annual breeding frequency of Forest Red-tailed Black Cockatoo's (FRTBC) were modelled. Results found several significant relationships between annual breeding frequency of FRTBCs and environmental variation. While the model, which included a proxy for the availability of the cockatoo's primary food source and the previous season's rain, explained 49 per cent of annual breeding frequency, FRTBC breeding was found to appear to be linked to the spatiotemporal availability of its primary food sources, the fruit from the tree species, Marri *Corymbia calophylla* and Jarrah *Eucalyptus marginata*. However, due to climate change experienced and predicted to be experienced in the future in Western Australia it is expected that the food resources during the breeding season for cockatoos will become increasingly limited in time and space, thus threatening their persistence. Nest selection of FRTBC was examined to identify factors influencing nest hollow selection at multiple spatial scales including interactions between functional resources. It was found that nest selection occurred primarily at the hollow scale, with deeper, higher hollows selected, and at the landscape

Year	Author	Project / Study region	Summary of findings
		food availability	scale, with hollows closer to ephemeral and permanent drink sites selected. The preference for specific types of hollows indicated that suitable hollows are likely to be scarce in the landscape and that management prescriptions need to be developed to maintain the supply of suitable hollows. Maintenance of drink sites in an area experiencing significant declines in rainfall will require more novel management prescriptions, which could potentially include the provision of artificial drink sites.
2019-2020	Tony Kirkby	Myara North black cockatoo surveys	Black cockatoo surveys undertaken by Black Cockatoo Specialist as engaged by Alcoa. Surveys undertaken along tracks throughout Myara North and reviewing the trees present 30 m either side of the track. Eighty-two nest trees were recorded.
2011-2022	Alcoa; Tony Kirkby	Pre-clearance black cockatoo hollow surveys - Willowdale and Huntly mines	Black cockatoo surveys undertaken by Black Cockatoo Specialist as engaged by Alcoa. Surveys undertaken within all areas planned for clearing of potential black cockatoo breeding trees.
2021	WRM	Aquatic Fauna Desktop Assessment Myara North and Holyoake Regions	Recent records of Carter's freshwater mussel (EPBC Vulnerable, WA BC Vulnerable) have been collected on Wungong Brook downstream and north of Myara North and in Serpentine Reservoir and on Serpentine River downstream and west of Myara North This species has potential to occur within Myara North and Holyoake and is known to occur in Serpentine Reservoir. Recent records of minute freshwater snail *Glacidorbis occidentalis* (P3) have been collected on Big Brook and Serpentine River upstream and south of Myara North, and on Wungong Brook downstream and north of Myara North. Species is considered likely to occur in Myara North. Hyporheic zone affords seasonal feeding habitat for stygal amphipods (*Uroctena* sp., *Wesniphargus nicholsi*) that are potential short range endemic (SRE) fauna. Rakali (P4) potentially occur in both regions, and pouched lamprey (P1) potentially occur in Murray River tributaries in Holyoake. No conservation significant fish or crayfish species recorded in the Huntly Mine to date, including Myara North and Holyoake regions. Distributions of native fish, crayfish and many endemic macroinvertebrate species are known to overlap the regions.

Year	Author	Project / Study region	Summary of findings
			Potential for populations of macroinvertebrates to occur in streams and headwater swamps, including species of conservation interest, notably stygal amphipods and isopods, and candidate priority dragonflies and damselflies. Holyoake region (southern portion) drains to the Murray River, which is one of the last remaining unregulated (un-dammed) rivers in the NJF subregion, and may provide seasonal connectivity of headwaters for reproductive migration of native fish and habitat for native freshwater crayfish.
2021a	GHD	Myara North – Terrestrial Fauna Survey and Black Cockatoo Assessment	Desktop assessment and two season detailed and targeted (Forest Red-tailed Black Cockatoo, Carnaby's Cockatoo, Baudin's Cockatoo, Chuditch, Quokka, and other priority species) vertebrate fauna survey. Six broad fauna habitat types identified: Jarrah-Marri forest, Bullich forest, Granite outcrop, Blackbutt forest, Flooded Gum woodland, Melaleuca dampland, Mine rehabilitation, and pine plantation. Jarrah-Marri forest predominated at 83 per cent of the survey area. A small portion of the survey area comprises rural cleared land. The survey recorded 132 vertebrate fauna species utilising the Survey Area, including 23 mammals, 76 birds, 26 reptiles and 7 amphibians. Of these, eight introduced species (mammals and birds) were identified. Thirteen conservation significant fauna species were recorded. All species identified are likely to have populations and habitat present within the Survey Area based on fauna habitat mapping. The Survey Area lacks open water such as shallow shorelines or tidal zones for migratory bird foraging habitat. The creek lines and vegetated dampland areas within the Survey Area are not suitable for migratory shorebirds. All three EPBC Act listed Black Cockatoo species were recorded primarily throughout the Marri-Jarrah forest. All habitat types will be utilised for foraging by either one or all of the species. Melaleuca damplands and riparian areas comprising Bullich forest, Blackbutt forest and Marri-Jarrah forest support a Quokka (EPBC and BC Act Vulnerable) population with records scattered throughout the survey area. Chuditch (EPBC and BC Act Vulnerable) are wide ranging and expected to use all habitat types at a relatively low density. Carter's Freshwater Mussel (EPBC and BC Act Vulnerable) was targeted during the survey but no presence was recorded. *Large areas of the survey area had been burnt within the last 2 to 3 years and observed to cause substantial impact to fauna habitats.*

Year	Author	Project / Study region	Summary of findings
2021b	GHD	Holyoake – Terrestrial Fauna Survey and Black Cockatoo Assessment	Desktop assessment and two season detailed and targeted (Forest Red-tailed Black Cockatoo, Carnaby's Cockatoo, Baudin's Cockatoo, Chuditch, Quokka, and other priority species) vertebrate fauna survey. Five broad fauna habitat types identified: Jarrah-Marri forest, Bullich forest, Granite outcrop, Blackbutt forest, Flooded Gum woodland. Jarrah-Marri forest predominated at 88 per cent of the survey area. A small portion of the survey area comprises highly disturbed land, including pine plantation, mine-rehabilitation area, and rural/clearing. The survey recorded 129 vertebrate fauna species utilising the Survey Area, including 22 mammals, 77 birds, 23 reptiles and 7 amphibians. Of these, 8 introduced species (mammals and birds) were identified. Ten conservation significant fauna species were recorded. All species identified are likely to have significant populations and habitat present within the Survey Area. The Survey Area lacks open water such as shallow shorelines or tidal zones for migratory bird foraging habitat. The creek lines and vegetated dampland areas within the Survey Area are not suitable for migratory shorebirds All three EPBC Act listed Black Cockatoo species were recorded primarily throughout the Marri-Jarrah forest. All habitat types will be utilised for foraging by either one or all of the species. Flooded Gum woodland and riparian areas comprising Bullich forest, Blackbutt forest and Marri-Jarrah forest support a Quokka (EPBC and BC Act Vulnerable) population with records scattered throughout the Survey Area. Chuditch (EPBC and BC Act Vulnerable) are wide ranging and expected to use all habitat types at a relatively low density. The Survey Area is unlikely to support a population of Carter's Fresh Water Mussel (EPBC and BC Act Vulnerable) due to the lack of permanent surface water.
2021a	Phoenix	Short-range endemic invertebrate fauna survey for the Huntly Mine Extension	Desktop assessment and two season short-range endemic (SRE) invertebrate fauna survey of Myara North, Holyoake and Huntly Mine rehabilitation sites. SRE habitat mapping was undertaken based on vegetation mapping prepared for the Proposal (Mattiske 2021) and taking into account habitat attributes relevant to SRE invertebrates. Each habitat was rated for its potential to support SREs (potential habitat rating; PHR) as High, Low or None. Ten habitats were present within the Myara North Study Areas and seven SRE habitats were present in the Holyoake Study Area (further details are supplied in Appendix D Section 6.4.1).

Year	Author	Project / Study region	Summary of findings
			A total of 113 taxa from groups known to include SREs were collected in the field surveys and of these, 83 taxa (73 per cent) from 19 families were classified as SREs. A total of 24 of the SRE taxa, from three SRE groups, are currently known only from sites in the baseline study area, mainly the Myara North Study Area. Twenty-eight taxa from nine groups known to include SREs were collected from the Rehabilitation Study Area during the surveys. This indicates that SRE taxa can re-colonise rehabilitated areas but, as expected, the diversity is overall considerably lower than that of remnant native vegetation. As the numbers of SREs showed a moderate positive correlation with rehabilitation age, it may be concluded that SRE colonisation improves with age of rehabilitation. Some overlap of SRE species was identified between the Myara North and Holyoake Study Areas, and between these study areas and records from a nearby large-scale SRE survey or other desktop sources, indicating wider distributions than the baseline study area. However, the survey results suggest at least some SRE invertebrates have narrow habitat preferences and potentially highly restricted distributions. Overall, Myara North is of higher value for SREs than Holyoake, with greater diversity and abundance of SRE habitat features. Myara North is more likely to harbour SREs with highly restricted distributions than Holyoake.
1997 – 2019	WRM	IRZ Streamzone monitoring	Macroinvertebrates and fish were surveyed in the Camerons Intermediate Rainfall Zone (IRZ) area between 1995 and 2007 as part of streamzone monitoring for the Huntly Mine. Further monitoring for macroinvertebrates was conducted in the Camerons, Jayrup and O'Neill areas in 2009, 2011, 2014 and 2019. Long term aquatic biomonitoring during and post-mining aimed to track changes physical and biological attributes in response to mining, particularly in response to secondary salinisation (Croton & Dalton 2010). No detrimental impact on macroinvertebrate communities in response to mining was found, however communities did respond to consistent downward trends in rainfall over the study period.
2014; 2016; 2022	Alcoa	Culvert Camera Trap Monitoring - Willowdale and Huntly	Monitoring of fauna and creek crossing culverts has been undertaken since 2014 across both the Huntly and Willowdale mines. The monitoring recorded twelve native species used the underpasses, including regular activity by Quenda and Echidna, and intermittent use by Grey Kangaroo, Western Brush Wallaby, Chuditch, Brush Tailed Phascogale and a single Quokka record. This suggests the potential for fauna

Year	Author	Project / Study region	Summary of findings
			underpasses to at least partially mitigate the fragmentation effects of haul roads on Quokka and other fauna using stream zones as corridors. Monitoring also recorded feral animals including Feral Pig, Feral Cat and European Fox. Accordingly, targeted feral animal control may be required at underpasses to prevent habitat damage or increased predation of Quokka and other native fauna.
2021 – 2023	Alcoa	LTFMP – Orion and Myara	A revised LTFMP was conducted within the Orion region over four consecutive nights (five days), in winter of 2021 (June/July) and summer of 2022 (January/February). Two transects were established at each of the four sites, which included rehabilitation of five, ten and 15 year age as well as unmined forest. One stream zone site was also monitored, consisting of targeted monitoring of quokkas and short-range endemics and did not follow the standard transect design. An additional eight transects across four sites, and one stream zone site, were established prior to summer 2021/2022. Two landscape trapping transects were also established; one inside the current mine perimeter and close to operations, and one outside the current mine perimeter largely surrounded by unmined forest. Across all sites during the 2021/22 monitoring program at Orion, a total of 13 mammal species were recorded, of which 11 were native, along with two species of frog, seven species of bird and eight species of reptile. This included 4 conservation significant mammals: Chuditch, Quokka, Western Brush Wallaby and Quenda. Several mygalomorph spiders were recorded, comprising at least eight species, with additional undescribed species likely. Several isopods and scorpions, one opilione and one pseudoscorpion were also collected, with identification ongoing.
Various	Various	Introduced fauna threats to conservation significant fauna – Huntly and Willowdale	The Feral Pig, Feral Cat, European Fox and European Rabbit are considered key threatening processes under the EPBC Act as they are threats to fauna species listed under the EPBC Act. These species are key threats to the EPBC Act listed species recorded or likely to occur in the Huntly and Willowdale mines: three Black Cockatoo species, Chuditch, and Quokka. Habitat disturbance from the Feral Pig (*Sus scrofa*) was notable in fauna habitat types that support conservation significant fauna species during the Myara North and Holyoake terrestrial surveys (GHD 2021a; 2021b), and throughout other regions noted during LTFMP and other environmental activities. Feral Cat is a known threat to the Quokka and Woylie, Numbat and Malleefowl (DEE 2013). Feral cats have been recorded across both Huntly and Willowdale during culvert monitoring and the LTFMP. The fox is a known threat to the Malleefowl, Numbat, Quokka, Woylie and Chuditch (DEE 2013). While no records confirming their presence within the Huntly or Willowdale sites have been collected, foxes are presumed to occur as indicated by their known range.

Year	Author	Project / Study region	Summary of findings
			The European Rabbit is a known threat to the Chuditch (DEE 2016). The European Rabbit has been recorded across both Huntly and Willowdale during the LTFMP. Further details of the threats introduced fauna have on conservation significant fauna is outlined in Appendix C.

1.4.2.1 Fauna habitats

A total of nine broad fauna habitat types have been recorded and mapped across portions of the Huntly and Willowdale Mine areas based on vegetation, hydrology, soil and topography, during baseline fauna surveys, as outlined in Table 1-5 and shown in Figure 1-1 and Figure 1-2. Fauna habitat have been mapped in accordance with EPA guidance for terrestrial fauna surveys (EPA 2020) within the Myara North and Holyoake mine regions. Preliminary fauna habitat mapping has been undertaken in areas of the Huntly and Willowdale mines where baseline fauna surveys have not been undertaken, and extrapolation of habitats was made using available historical site vegetation type mapping, undertaken by Mattiske Consulting. These areas have not been subject to ground truthing in accordance with EPA guidance for terrestrial fauna surveys (EPA 2020).

Based on the surveyed and preliminary fauna habitat mapping, approximately 35 per cent of the Huntly and Willowdale Mine areas comprises Jarrah-Marri forest, which is associated with uplands and slopes, and is widespread across the NJF subregion. A further 17 per cent comprise mine site rehabilitation, which is predominantly a restoration of the Jarrah-Marri forest habitat type.

Approximately eight per cent of the mapped Huntly and Willowdale Mine areas comprises Blackbutt and Bullich Forest, associated with the lower slopes and creek lines, and less widespread across the NJF subregion. These habitat types may also be associated with potential Groundwater Dependent Ecosystems (GDEs), and seasonal aquatic fauna habitat along creek lines.

Approximately three per cent of the mapped Huntly and Willowdale Mine areas comprises Flooded Gum Woodland and Melaleuca Dampland, associated with swamps and drainage floors, which is relatively restricted in distribution in the NJF subregion. These habitat types may also be associated with potential GDEs, and seasonal aquatic fauna habitat.

Approximately one per cent of the mapped Huntly and Willowdale Mine areas comprises Granite Outcrops, which is relatively restricted in distribution in the NJF subregion.

Approximately 4.6 per cent of the mapped Huntly and Willowdale Mine areas comprises cleared land while 0.1 per cent comprises pine plantations.

To date, 81,382 ha (85.3%) of the Huntly Mine and 28,139 ha (47.4%) of the Willowdale Mine has been mapped for fauna habitat types and site vegetation types as identified within Table 1-5.

Table 1-5: Extent of fauna habitat within the Huntly and Willowdale Mines

Description	Extent within Huntly Mine (ha)	Proportion of Extent within Huntly Mine (%)	Extent within Willowdale Mine (ha)	Proportion of Extent within Willowdale Mine (%)
Blackbutt Forest Blackbutt open forest with occasional Bullich, and Marri over sparse *Banksia littoralis* over *Trymalium, Macrozamia, Xanthorrhoea preissii*, over *Lepidosperma tetraquetrum*, *Astartea scoparia* and areas of dense Swamp peppermint (*Taxandria linearifolia*). This habitat is limited to localised patches often associated with creeks and drainage lines. Disturbance factors include frequent fire, feral pigs, dieback, trail bike and 4WD. **Habitat for conservation significant species:** Core habitat for Western Brush Wallaby, Quenda, Quokka, Woylie, Chuditch and Western False Pipistrelle. Breeding and roosting habitat for all three Black Cockatoo species with moderate foraging to Forest Red-tailed Black Cockatoo.	2,790.6	2.8%	923.6	1.6%
Bullich forest Valleys and drainage areas dominated by Bullich (*Eucalyptus megacarpa*) and with some Blackbutt (*E. patens*), occasional Marri (*Corymbia calophylla*), over Sheoak (*Allocasuarina fraseriana*), *Banksia littoralis* over Grass trees (*Xanthorrhoea preissii*), Bracken fern, patches of dense *Gahnia trifida* shrubland over *Lasiopetalum floribundum*, sedges and herbs. Substrate is dark clayloam soil. These areas are associated with seasonal creeks and drainage areas. Disturbance factors include frequent fire, feral pigs, dieback. **Habitat for conservation significant species:** Core habitat for Black Cockatoos (all three, breeding and roosting with limited foraging), Chuditch, Quokka, Woylie, Quenda, Western Brush Wallaby, Masked Owl, Brush-tailed Phascogale and Western False Pipistrelle.	3,317.2	3.4%	1,249.7	2.2%
Flooded Gum woodland Flooded Gum (*E. rudis*) open woodland with occasional Blackbutt, over open to open to sparse *Banksia littoralis* over Prickly Moses (*Acacia pulchella*), myrtaceous species such as Swamp peppermint (*Taxandria linearifolia*), *Astartea scoparia Trymalium odoratissimum*, low shrub/sedgeland. Substrate varies from dark grey to grey brown sandy clays. Associated with	2,969.9	3.0%	446.3	0.8%

Description	Extent within Huntly Mine (ha)	Proportion of Extent within Huntly Mine (%)	Extent within Willowdale Mine (ha)	Proportion of Extent within Willowdale Mine (%)
poorly drained broad valleys forming seasonal swamps and occasionally tall open forest along drainage lines. Disturbance factors include frequent fire, feral pigs. **Habitat for conservation significant species:** Core habitat for Chuditch, Western Brush Wallaby, Quokka, Woylie and Quenda for which it will also provide refuge and movement corridors. Foraging and roosting habitat for all Black Cockatoos. Breeding habitat for Carnaby's Cockatoo limited for others.				
Granite outcrop Granite outcrops with associated lithic vegetation complexes and adjacent associated fringing open Jarrah and Marri areas with scattered Sheoak, Melaleuca, *Banksia ilicifolia* over occasional Grass trees over mixed open heath communities of Myrtaceous and Proteaceous low shrubs. Soils are pale grey to yellowish fine sand or sandy clay. Granite outcrops often associated with seasonal watercourse and seasonally damp areas. This habitat found as localised patches throughout the Survey Area. Disturbance factors include frequent fire, feral pigs, dieback, damage caused by rock removal, trail bike and 4WD on granite. **Habitat for conservation significant species:** Foraging and denning habitat for Chuditch. Habitat for Western Brush Wallaby, Southern Death Adder, and Dell's Ctenotus. Fringing open forest provides foraging and potential breeding habitat for Black Cockatoo species.	1,513.5	1.5%	87.0	0.2%
Jarrah – Marri forest *E. marginata* and *C. calophylla* open forest over Grass trees (*Xanthorrhoea preissi*), *Lasiopetalum floribundum*, Macrozamia mid shrubland. Patches have dominance of understory *Allocasuarina fraseriana* and *Banksia grandis*. Often with complex mosaic of low shrubs such as Fabaceae, *Hibbertia*, *Leucopogon*, *Adenanthos*, and *Pteridium*. This is the most extensive habitat identified and comprises a number of vegetation types dominated by Jarrah on upper, mid and low slopes and broad valleys. Soils range from well drained gravely sand to sandy clay loam. Historical logging is a significant disturbance factor: extensive areas of forest are at varying ages of regeneration. Other disturbances include frequent fire (significant), feral pigs, dieback, trail bike, 4WD and dumped rubbish including weed plants.	52,974.1	53.6%	11,926.0	20.9%

Description	Extent within Huntly Mine (ha)	Proportion of Extent within Huntly Mine (%)	Extent within Willowdale Mine (ha)	Proportion of Extent within Willowdale Mine (%)
Habitat for conservation significant species: Core habitat for Chuditch, Brush-tailed Phascogale, Western Brush Wallaby, Peregrine Falcon, Masked Owl, Western False Pipistrelle, Dell's Skink, Southern Death Adder. Foraging and potential roosting habitat for all three locally occurring Black Cockatoo (Calyptorhynchus) species. Breeding habitat for all three Black Cockatoo species. Quokka may use dense area of Jarrah Marri Forest for foraging and dispersal.				
Melaleuca dampland Paperbark (*Melaleuca preissiana*) over sparse isolated *Banksia littoralis* over open *Hakea*, occasional Woody Pear (*Xylomelum*), Grass trees and over mixed shrub layer of Cyperaceae, Restionaceae, *Babingtonia*, *Jacksonia* and *Acacia*, over low shrubs, sedges and herbs. There are areas of sparse to occasional stunted Jarrah and Marri however these are limited to lowland transitional zones adjacent to slightly higher elevation and drainage open forest areas. Generally limited to areas of poor drainage and subject to winter inundation such as broad valleys and swamps. Substrate is grey gravely clay and clay loam. Disturbance factors include frequent fire and feral pigs. **Habitat for conservation significant species:** Western Brush Wallaby, Western False Pipistrelle. Foraging habitat for all three locally occurring Black Cockatoo (*Calyptorhynchus*) species although Jarrah and Marri are generally stunted and sub-optimal for potential breeding habitat. Where creek lines or dense vegetation is present Quokka and Quenda reside.	931.8	0.9%	41.8	0.1%
Mine rehabilitation Mine rehabilitation of the Huntly and Willowdale Mines of varying ages. Areas of age greater than 8 years provide foraging habitat for Black Cockatoo species but lack trees of suitable age (trunk diameter) to have developed hollows of sufficient diameter and depth to be considered potentially suitable breeding trees for Black Cockatoos. These areas also provide continuity of forest or woodland connectivity allowing fauna movement and foraging habitat for a range of species ground such as terrestrial reptiles, birds, small mammals. **Habitat for conservation significant species**	13,767.3	13.9%	5,082.9	8.9%

Description	Extent within Huntly Mine (ha)	Proportion of Extent within Huntly Mine (%)	Extent within Willowdale Mine (ha)	Proportion of Extent within Willowdale Mine (%)
Research indicates use of mine rehabilitation within 2 years of establishment for Chuditch and Quenda, 4-5 years for Western Brush Wallaby, by Quokka (varying ages) and within 4-7 years for foraging by Black Cockatoos				
Cleared areas	329.0	0.3%	-	0.0%
Sub-Total	4,784.7	4.8%	1,657.2	2.9%
Unsurveyed	83,378.3	84.4%	21,414.5	37.6%
Total Area	15,400.7	15.6%	35,597.6	62.4%

1.4.2.2 SRE fauna habitats

Phoenix (2021) undertook a SRE survey across the Holyoake and Myara North regions. This survey was undertaken across two seasons, over an area of approximately 28,000 ha. During this survey, 83 SRE taxa were recorded, comprising 19 families classified as SREs, broken down as follows:

- 10 confirmed SREs, represented by nine millipedes and one scorpion;
- five likely SREs, all represented by isopods; and
- 68 potential SREs, represented by:
    - 35 taxa of mygalomorphs (trap-door spiders);
    - 11 species of isopods (slaters);
    - seven species of diplopods (millipedes);
    - seven species of opiliones (harvestmen spiders);
    - five species of land snail;
    - one species of scorpion; and
    - two species of pseudoscorpions.

SRE habitats have been mapped using available historical site vegetation type mapping, undertaken by Mattiske Consulting.

Based on site vegetation (Mattiske & Havel 1998), five broad SRE habitats may occur across the Huntly and Willowdale mines, comprising a mix of High and Low SRE Potential Habitat Rating (PHR) (Figure 1-3 and Figure 1-4). For areas outside the Holyoake and Myara North regions, these associations are preliminary and require additional desktop survey assessment for confirmation. The Low potential SRE habitat, Open forest to woodland of Jarrah/Marri on slopes and less undulating hills, is the most widespread, comprising 52% and 55% of the Huntly and Willowdale mine areas respectively. The remaining is primarily comprised of High potential SRE habitats; Open Jarrah/Marri or Blackbutt woodlands on sands, clay-loam or sandy-gravel on lower slopes and valley floors (Huntly: 32%, Willowdale: 20%), Open woodlands of Wandoo and Flooded Gum on seasonally wet or water-logged clays and clay loams on valley floors (Huntly: 9%, Willowdale: 21%), with minor occurrences of Melaleuca woodlands/shrublands on seasonally wet or water-logged clays and clay loams on valley floors (Huntly: 4%, Willowdale: 1%), and Heath/shrubland/woodland on shallow soils on granite or outcrops (Huntly: 4%, Willowdale: 3%). Collectively, High potential SRE habitats may occupy just less than half of each Mine area. It should be noted that high potential SRE habitats are not considered conservation significant habitats.

Additionally, Phoenix (2021) investigated the relationship between rehabilitation age and SRE occurrence. Results were able to show a moderate positive correlation with rehabilitation age. It may be concluded that SRE colonisation improves with age of rehabilitation. Other factors, such as rehabilitation method, flora species diversity, abundance of coarse woody debris or large trees, distance to/from mine and disturbances are also likely to have influenced recolonisation of SREs.

Towns
Myara North
Monadnocks East
Monadnocks
Myara
Beryl
Darling Scarp
Oneil
Willard
Mccoy
Duncan
White
Huntly
Del Park
Holyoake
Teesdale

Legend

- 24 Month Clearing Schedule
- Conceptual clearing buffer
- Mining Regions
- National Parks
- Major Dams
- Rehabilitation
- Cleared Areas

Fauna Habitats

- Blackbutt Forest
- Bullich Forest
- Flooded Gum Woodland
- Granite Outcrop Association
- Jarrah Marri Forest
- Melaleuca Dampland

Alcoa

N

0 2 4 km

2023 – 2027 Mining and Management Plan

Figure 1-1: Indicative fauna habitats - Huntly

Scale: 1:117,413

Date Printed: 4/09/2023

Darling Scarp

Orion

Arundel

Laregó

Cornwall

Legend

- 24 Month Clearing Schedule
- Conceptual Clearing Buffer
- Rehabilitation
- Cleared Areas
- Mining Regions
- Major Dams

Fauna Habitats

- Blackbutt Forest
- Bullich Forest
- Flooded Gum Woodland
- Granite Outcrop Association
- Jarrah Marri Forest
- Melaleuca Dampland

Alcoa

N

0 1 2 km

2023 – 2027 Mining and Management Plan

Figure 1-2: Indicative fauna habitats - Willowdale

Scale: 1:50,175

Date Printed: 5/09/2023

Towns
Myara North
Monadnocks East
Monadnocks
Myara
Beryl
Darling Scarp
Oneil
Willard
Mccoy
White
Duncan
Huntly
Del Park
Holyoake
Teesdale

Legend

- 24 Month Clearing Schedule
- Conceptual clearing buffer
- Mining Regions
- Rehabilitation
- Cleared Areas
- National Parks
- Major Dams
- SRE Habitats
- Low
- High

Alcoa

N

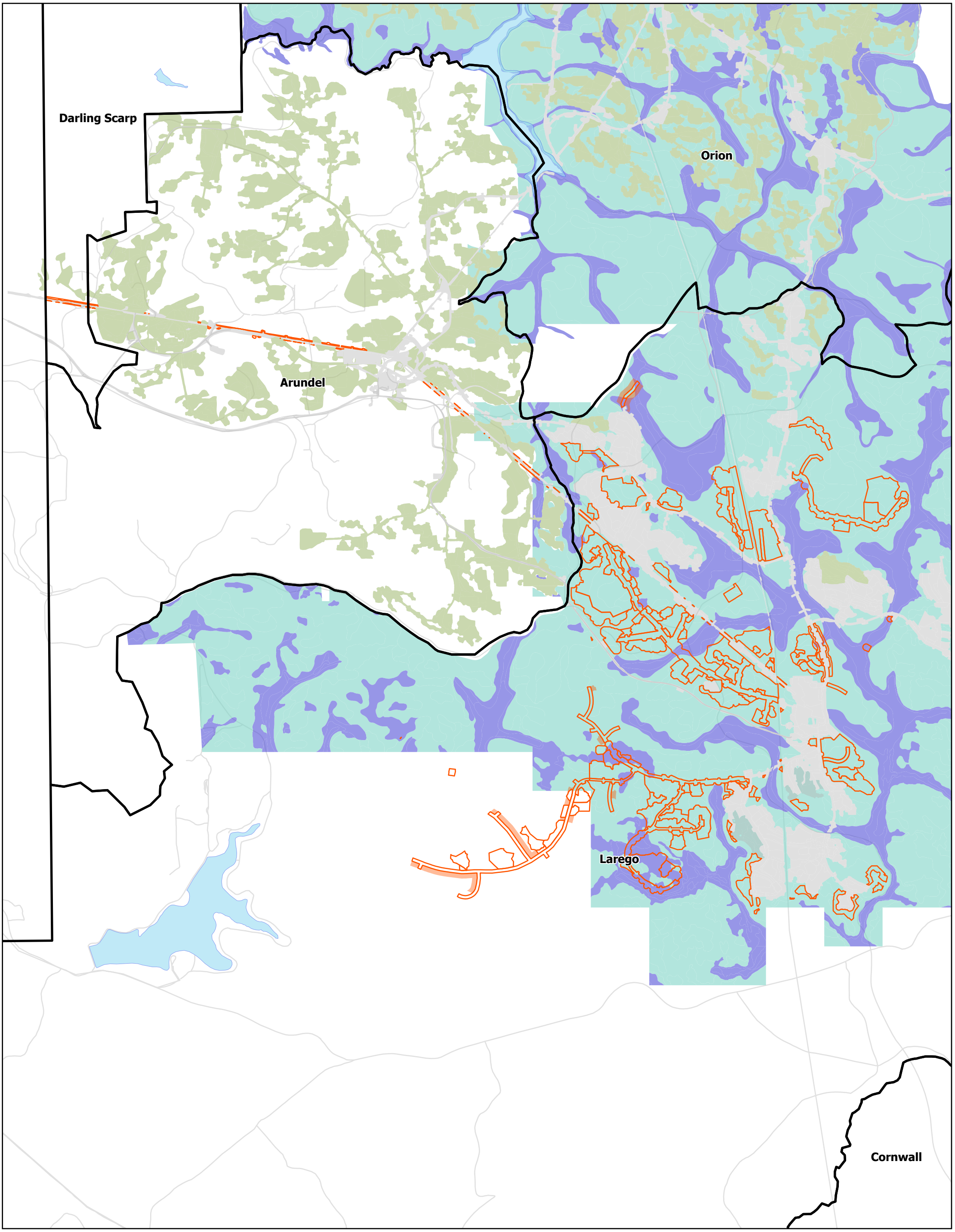
0 2 4 km

2023 – 2027 Mining and Management Plan

Figure 1-3: Indicative SRE habitat - Huntly

Scale: 1:117,413

Date Printed: 4/09/2023



Legend

- 24 Month Clearing Schedule
- Conceptual Clearing Buffer
- Rehabilitation
- Cleared Areas
- Mining Regions
- Major Dams

SRE Habitats

- Low
- High

Alcoa

N

0 1 2 km

2023 – 2027 Mining and Management Plan

Figure 1-4: Indicative SRE habitat - Willowdale

Scale: 1:50,175

Date Printed: 5/09/2023

1.4.2.3 Research into mine rehabilitation

Alcoa's rehabilitation and its effectiveness in restoring terrestrial fauna habitats and assemblages demonstrates:

- Alcoa's mine rehabilitation restores most terrestrial vertebrate fauna biodiversity in the short to medium term (within about 10 years), as it restores foraging habitat through establishment of a native vegetation understorey then overstorey. Current rehabilitation prescriptions are expected to improve foraging habitat values for Black Cockatoos.
- The relatively dense vegetation of past rehabilitation prescriptions, that aligned with past completion criteria affected the restoration of reptile biodiversity; however, the current rehabilitation prescription aligned with current (2016) completion criteria, aims to restore a lower density of trees which may increase the restoration of reptile biodiversity.
- Rehabilitation restores minor densities of coarse woody debris (CWD) and does not immediately restore potential hollow bearing trees, both will take over a century to accumulate to levels comparable to un-mined forest. CWD and trees hollows provide shelter, breeding habitat and invertebrate microhabitats and are key elements of fauna habitat quality and ecological integrity.
- Whilst rehabilitation will take over a century to get to an age where the trees will start to develop hollows, all trees with current hollows suitable for use by Black Cockatoos are retained, so large mature trees are interspersed throughout the rehabilitation, providing habitat to birds and arboreal mammals immediately.

A summary of the research is provided in Table 1-6.

Table 1-6: Summary of Alcoa research into mine rehabilitation

Species	Research findings
Mammals	– Nichols and Grant (2007) reviewed mammal recolonisation of mine rehabilitation based on a range of studies commencing as early as 1978. It was noted that monitoring of native mammals was problematic until fox baiting in the 1990s, following which there was increased trapping success. The studies collectively indicated all mammal species recolonize rehabilitation within 10 years of completion, however the timeframe for recolonisation varies between species. – Rapid colonizers (e.g. Chuditch, Quenda) were recorded within 2 years of completion. Other species (e.g. Brush Wallaby) recolonize within 4-5 years while Echidna, Brush-tailed Phascogale and Common Brushtail Possum recolonized in 8-10 years. Nichols and Grant (2007) note this is partly due to foraging requirements, with rapid colonizers grazing on newly established plants or invertebrates while arboreal species require trees of a certain age for foraging. – Studies collectively indicated that for most species females were recorded carrying young in rehabilitated areas, however breeding records varied between species (Nichols and Grant 2007). Kangaroos and Western Pygmy Possum were recorded breeding in rehabilitation; however no breeding had been recorded for Chuditch or Quenda, and Brushtail Possums require hollows for nesting so will rely on older trees in un-mined forest or those retained within rehabilitation. – Nichols and Grant (2007) concluded that studies indicate that all mammal species use Alcoa's rehabilitation, though in differing rates and extent which appears to be due to differing foraging and shelter requirements and possibly abundance in the surrounding forest. – Craig et al. (2012) investigated successional patterns of six small mammal species in Alcoa's rehabilitation at ages of 4 to 17 years and concluded that mammal communities converged to that of un-mined forest as rehabilitation matured. All

Species	Research findings
	species surveyed recolonized rapidly, indicating that there were no habitat features that acted as 'filters' to slow or prevent small mammal recolonisation.
Woylie	– Recolonisation of Woylie into mine rehabilitation has not been recorded to date nor have specific studies been conducted on the species. The species primarily feeds on fruiting bodies of ectomycorrhizal fungi, however they also consume a broad diet including invertebrates, seeds and other plant material (Zosky et al 2018). – Glen et al (2008) found that Alcoa's mine rehabilitation contained a species richness of ectomycorrhizal fungi similar to that un-mined forest within a period of 15 years, with species composition tracking towards that of un-mined forest as the rehabilitation increased in age, suggesting the gradual restoration of ectomycorrhizal communities. – The findings by Glen et al (2008), the restoration of floristic diversity (>80 per cent) and recolonisation by invertebrates suggest that mine rehabilitation has potential to support Woylie foraging as rehabilitation matures, provided that ongoing integrated predator control is maintained.
Chuditch	– McGregor et al (2014) studied macro and micro habitat use by Chuditch within the mosaic of mine rehabilitation and un-mined forest at the Huntly and Willowdale Mines. The study indicated that Chuditch used rehabilitation of varying ages for denning and were adaptable in use of den substrates, selecting burrows associated with surface rocks in rehabilitation where preferred substrates used in unmined forest (hollow logs and stumps) were less available. Logs were an important microhabitat used by Chuditch to traverse un-mined forest and were relatively sparse in rehabilitation, at three per cent of the density of un-mined forest. – McGregor et al (2014) suggested that rehabilitation provides a permeable matrix for Chuditch that is rapidly recolonized and utilized for denning, however the relative sparsity of microhabitats in rehabilitation required further study to determine whether this affected breeding success and long-term survival.
Quokka	– Craig et al (2017) studied occupation of Quokka in mine rehabilitation aged 16-21 years to identify whether the vegetation structure provides suitable habitat. Quokka prefers riparian and swamp habitats with dense understorey vegetation that provides shelter from predators. Mining does not occur within riparian and swamp areas and accordingly rehabilitation predominantly restores the structure of upland Jarrah forest that is not the species preferred habitat. – Craig et al (2017) recorded Quokka in riparian forest and mine rehabilitation but not in un-mined mid-slope Jarrah forest, with findings indicating that Quokka favoured mine rehabilitation with dense understory in proximity to riparian habitat. It is noted that the rehabilitation surveyed by Craig et al (2017) developed under prescriptions of the 1990s. Contemporary rehabilitation prescriptions are expected to reduce the density of understorey, which may potentially reduce the shelter from predators and so habitat value for Quokka.
Birds	– Nichols and Grant (2007) reviewed bird recolonisation of Alcoa's mine rehabilitation based on a range of studies commencing as early as the mid-1970s. The studies collectively indicated that birds rapidly recolonized rehabilitation, recording 95 per cent of 70 bird species that inhabit upland Jarrah forest. – Analysis of Alcoa's LTFMP data indicated that contemporary rehabilitation had similar community structure to that of un-mined forest at about 10 years from establishment, including comparable numbers of species, diversity (i.e. relative abundance) and composition (Nichols and Grant 2007). The most notable species not yet present was the Rufous Treecreeper (*Climacteris rufa*), which forages for insects on the trunks of tall eucalypts and among log piles. The remainder were uncommon species that may have returned but have not yet been observed. Nichols and Grant (2007) noted that while species that built nests in a variety of sites bred successfully in rehabilitation, those that nest in hollows will not breed for an extended period until hollows reform, but will use rehabilitation for foraging.
Black Cockatoos	– Doherty et al (2016) studied foraging by Black Cockatoos in Huntly Mine rehabilitation over ages 4 to 20 years. The study indicated that Black Cockatoos commenced foraging on proteaceous and myrtaceous food plants within 4 and 7

Species	Research findings
	years of rehabilitation establishment, respectively. Foraging transitioned from proteaceous plants to myrtaceous plants as the vegetation structure transitioned from a dominant understorey to a closed overstorey. Foraging densities in rehabilitation were relatively low, being recorded in ten per cent of rehabilitation plots, with zero per cent foraging of Jarrah, ten per cent foraging of Marri and 50 per cent of some Hakea species (where present). By comparison, un-mined forest plots recorded foraging in 25 per cent of Jarrah, 65 per cent of Marri and 25 per cent of Persoonia and Sheoak. Logistic regression analysis indicated a lower likelihood of foraging with rehabilitation age. – Survey undertaken in 2020 of Jarrahdale and Huntly Mine rehabilitation at 20 and 30 years indicated predominantly low foraging by Black Cockatoos compared to higher foraging in adjacent un-mined forest (T. Kirkby, pers. comm., 2020). Doherty et al (2016) speculated that the lower foraging in rehabilitation may be due to the younger tree age; a higher stem density affecting growth, flowering and fruiting; or a higher stem density impeding access for canopy feeding. – It is noted that the rehabilitation studied by Doherty et al (2016) and surveyed by Kirkby (2020) reflects prescriptions in the 1990s with an average tree establishment of 3000 stems/ha, whereas contemporary prescriptions from 2016 onwards target 1000 stems/ha. Contemporary rehabilitation is therefore expected to have a substantially lower overstorey density, which may improve foraging habitat quality from that indicated by Doherty et al (2016) and Kirkby (2020).
Reptiles	– Nichols and Grant (2007) reviewed reptile recolonisation of Alcoa's mine rehabilitation based on a range of studies commencing as early as the mid-1970s. The combined studies have indicated recolonisation by 87 per cent of 24 reptile species that inhabit upland Jarrah forest. These include species from all upland reptile families, indicating that to some extent rehabilitation caters for a wide range of reptile habitat requirements. – Reptile recolonisation appears to follow a pattern of succession, with rapid return of general foragers and active predators that feed on feral mice that are temporary, early disturbance colonisers. These are followed by small, mobile insectivores. Late colonists include those species that require particular habitats such as exfoliating bark and deep leaf litter that may take more than 10 years to develop (Nichols and Grant 2007). – Three species not yet recorded feed on small vertebrates and so may be affected by low densities of small reptiles and potentially scarcity of shelter such as coarse woody debris (CWD e.g., logs, stumps). However, it is also noted that the three species are rarely recorded in un-mined forest and so may be present but not noticed in rehabilitation. The studies indicate that abundance of reptiles is lower in rehabilitation than in un-mined forest, which is likely to be due to the scarcity of shelter rather than food availability. – Craig et al (2012) investigated successional patterns of 20 reptile species in Alcoa's rehabilitation at ages of 4 to 17 years and concluded that reptile communities did not converge to that of un-mined forest, indicating that there were 'filters' that slowed or prevented recolonisation. Craig et al (2012) identified lower CWD volumes and higher overstorey stem densities as likely filters, with CWD a filter that will decrease gradually over the long term (possibly centuries) as CWD naturally deposits, while overstorey density is dynamic and fluctuates in intensity over shorter timeframes. Craig et al (2018) further reported overstorey fluctuation over a period of two to seven years in response to thinning and fire treatments, with the recovery of overstorey density precluding persistence of some reptile species. – It is important to note that the rehabilitation studied by Craig et al (2012, 2018) comprised distinct cohorts with a substantial variation in prescriptions. Contemporary rehabilitation from 2016 onwards comprises a lower overstorey seeding (1000 stems/ha) than that of the 2000s (1400 stems/ha) or 1990s (3000 stems/ha), a lower legume seeding and a lower fertilizer application (20 kg P/ha) than in the 2000s (40 kg P/ha) or 1990s (80 kg P/ha). The combined effect of the contemporary prescription is a reduced density of overstorey and understorey, a reduced dominance of leguminous (e.g. Acacia) shrubs and increased floristic

Species	Research findings
	diversity. Accordingly, contemporary rehabilitation is expected to reduce the effect of the dynamic filter and improve reptile recolonisation to that documented by Craig et al (2012). **Coarse woody debris habitat value for reptiles** – The importance of CWD as habitat for some reptiles was further studied by Christie et al (2012, 2013) with respect to Napoleon's skink (*Egernia napoleonis*). This species relies on logs for habitat and is largely absent from rehabilitation. Christie et al (2012) concluded that CWD fauna habitats were required at densities of 60 per hectare to enable the species to recolonize. Given that such habitat construction is unfeasible, Christie et al (2012) recommended targeted CWD placement in large piles or corridors near un-mined forest. Christie et al (2013) trialled CWD placement within rehabilitation close to un-mined forest, reporting initial success in recolonisation by Napoleon's skink. – Triska et al (2016) assessed the relative influence of landscape and site factors on reptile recolonization of rehabilitation at the Huntly Mine. The study indicated that most reptiles that were commonly found in rehabilitation were present by 3-4 years from completion, however assemblages did not converge to that of un-mined forest. Species composition and abundance was primarily influenced by site factors such as canopy height, litter cover and CWD volume and not by landscape factors (e.g. availability of source populations). Triska et al (2016) recommended continued focus on restoring microhabitats and vegetation structure to that of un-mined forest to promote recolonisation by reptiles. – The studies have demonstrated that mine rehabilitation provides suitable habitat for recolonisation by some reptile species however the lower density of CWD and higher overstorey stem density may prevent recolonisation and persistence of some reptile species over the long term. This suggests a partial loss of biodiversity and ecological integrity until CWD habitat and overstorey density matures over the long term and approaches that of un-mined forest.

1.4.2.4 Conservation significant fauna

The likelihood of occurrence of conservation significant fauna within the Huntly and Willowdale mine areas has been assessed, based on the species identified during desktop assessments and surveys, and search results from the EPBC Act PMST database, DBCA Threatened and Priority Fauna database. The likelihood of occurrence assessment was based on species' biology, habitat requirements, the preliminary habitat types interpreted from vegetation mapping, and records of the species in the regions and locality.

In total 15 conservation significant species are known or likely to occur in the Huntly and Willowdale mine areas based on the Fauna LOO assessment (Table 1-7; Appendix A). Based on this assessment, the species in Table 1-7 were either known or likely to occur within the mines. Nine are priority species, or other conservation significant species, listed by DBCA under the BC Act. Seven of the conservation significant species are listed as threatened under the EPBC Act or BC Act and comprise matters of national environmental significance (MNES). These include the following:

- Three Black Cockatoo species:
  - Baudin's Cockatoo (Zanda baudinii) – Endangered
  - Carnaby's Cockatoo (Zanda latirostris) – Endangered
  - Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) – Vulnerable
- Woylie (*Bettongia ogilbyi*) – Endangered
- Quokka (*Setonix brachyurus*) – Vulnerable

- Chuditch (*Dasyurus geoffroii*) – Vulnerable
- Carter's Freshwater Mussel (*Westralunio carteri*) - Vulnerable

Table 1-7: Fauna species of conservation significance identified as known or likely to occur within the Huntly and Willowdale mine regions

Species Name	Common Name	Status	
		State	Federal
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	VU
Zanda baudinii (Zanda baudinii)	Baudin's Black Cockatoo	EN	EN
Zanda latirostris	Carnaby's Black Cockatoo	EN	EN
Falco peregrinus	Peregrine Falcon	OS	
Tyto novaehollandiae subsp. novaehollandiae	Masked Owl (southern subsp)	P3	
Falsistrellus mackenziei	Western False Pipistrelle	P4	
Dasyurus geoffroii	Chuditch	VU	VU
Bettongia penicillata ogilbyi	Woylie	EN	EN
Hydromys chrysogaster	Rakali, Water-rat	P4	
Phascogale tapoatafa	Brush Tailed Phascogale	CD	
Isoodon fusciventer	Quenda (Southern Brown Bandicoot)	P4	
Notamacropus irma	Western Brush Wallaby	P4	
Setonix brachyurus	Quokka	VU	VU
Acanthophis antarcticus	Southern Death Adder	P3	
Ctenotus delli	Dell's Skink	P4	
Westralunio carteri	Carter's Freshwater Mussel	VU	VU

Threatened species that were assessed as unlikely to occur in the Huntly and Willowdale mine areas include the Numbat (*Myrmecobius fasciatus*), Noisy Scrub Bird (*Atrichornis clamosus*) and Malleefowl (*Leipoa ocellata*). The Huntly and Willowdale mine areas may include suitable habitat for these species and, Numbat and Malleefowl have previously been recorded within the Huntly and Willowdale mine areas and the Noisy Scrub Bird previously recorded south of Dwellingup. The Noisy Scrub Bird was translocated into sites in the NJF from 1997-2003, however monitoring indicates that establishment of permanent populations was unsuccessful. The four species have not been in the regions nor recorded in the vicinity of the Huntly and

Willowdale mine areas in recent decades and are considered locally extinct or very low densities likely to be below the level of survey detection.

No migratory bird species were considered likely to occur due to the lack of wetland habitats favoured by the species. The Flooded Gum Woodland and Melaleuca Dampland habitats are seasonally waterlogged and may have areas that are seasonally inundated, however they do not contain large areas of wading habitat with mudflat, grasses, sedges, rushes or reeds. The Huntly and Willowdale regions are unlikely to support populations of threatened birds that use such wetland habitats, such as the Australasian Bittern (*Botaurus poiciloptilus*) and Australian Painted Snipe (*Rostratula australis*).

The threatened aquatic invertebrate Carters Freshwater Mussel (*Westralunio carteri*) is known or likely to occur in the artificial perennial waterbodies (reservoirs) adjacent and downstream of the Huntly mine region. The species may disperse from water supply reservoirs into the Huntly mine area in the form of glochidia cysts attached to fish that swim upstream during periods of seasonal stream flow. Any juveniles that detach from their fish hosts and settle into sediments of seasonal streams or swamps are expected to die off during the subsequent sustained dry period (> 6 months) each year.

1.4.2.5 Black Cockatoo Habitat

Black cockatoo foraging habitat was mapped over the Huntly and Willowdale mine areas, based on the fauna habitat derived from the vegetation type mapping completed by Mattiske (2008-2022). The Huntly and Willowdale mine areas contain predominantly high-quality foraging habitat due to the prevalence of Jarrah Forest, which contains key foraging species including Marri, Jarrah and proteaceous species (Table 1-8). The mine areas comprise approximately 77% high quality foraging habitat for Forest Red-tailed Black Cockatoo (FRTBC) and approximately 78% high quality foraging habitat for Baudin's and Carnaby's Cockatoos. Other fauna habitats provide low to medium quality foraging habitat.

The Huntly and Willowdale mine areas are highly likely to support breeding by FRTBC and Baudin's Cockatoo (T. Kirkby, pers. Comm; GHD [2021a]).

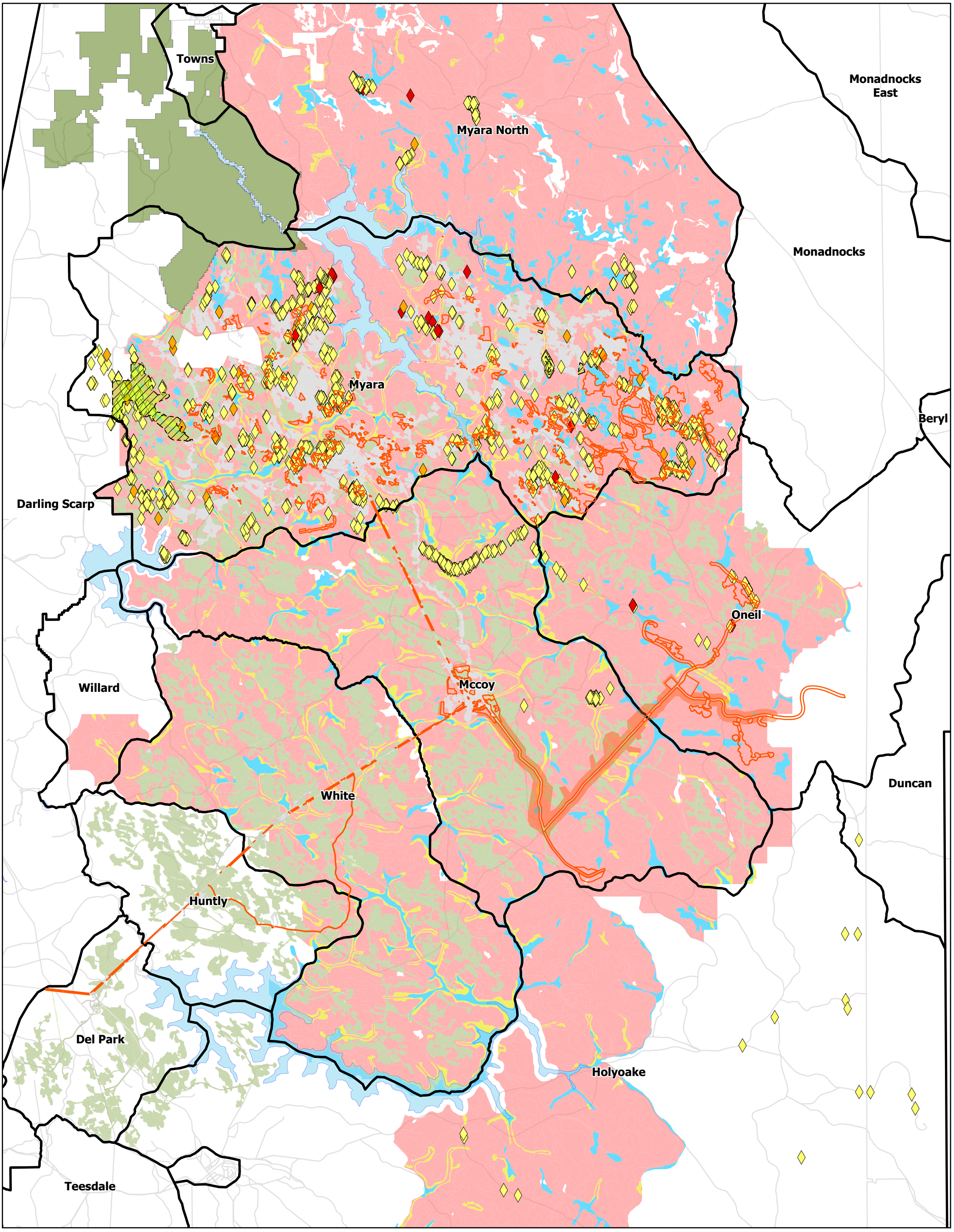
No confirmed roosting sites are located within the Huntly and Willowdale mine areas based on surveys data. However, it is highly likely that roosting occurs within these areas given the presence of high-quality foraging habitat, water sources, and large number of bird records.

Prior to the development of clearing plans, black cockatoo surveys are undertaken for all proposed disturbance areas to identify Black Cockatoo trees. All nest trees with a suitable hollow (size, entry angle, position), regardless of evidence of use, are protected irrespective of where they are located. Significant trees, which include marri with DBH>1500mm and Jarrah with DBH>2000mm, are also protected everywhere in the landscape. Ten metre radius buffers are applied to all these tree types. Habitat trees, which include marri trees with DBH>500mm are avoided for haul road clearing.

Black Cockatoo trees recorded to date and indicative foraging habitat values are shown in Figure 1-5 to Figure 1-8.

Table 1-8: Black Cockatoo foraging habitat in the Huntly and Willowdale mine areas

Fauna habitat type	Huntly				Willowdale			
	Area (ha)	Foraging habitat quality			Area (ha)	Foraging habitat quality		
		Forest Red-tailed Black Cockatoo	Baudin's Cockatoo	Carnaby's Cockatoo		Forest Red-tailed Black Cockatoo	Baudin's Cockatoo	Carnaby's Cockatoo
Blackbutt forest	2,791	High	Medium	Medium	924	High	Medium	Medium
Bullich forest	3,317	Medium	Medium	Medium	1,250	Medium	Medium	Medium
Flooded Gum woodland	2,970	Low	Medium	Medium	446	Low	Medium	Medium
Granite outcrop	1,513	Low	Low	Low	87	Low	Low	Low
Jarrah-Marri forest	52,974	High	High	High	11,926	High	High	High
Melaleuca dampland	932	None	Low	Low	42	None	Low	Low
Mine rehabilitation	13,767	Medium	Medium	Medium	5,083	Medium	Medium	Medium
Cleared and other land	4,785	None	None	None	1,657	None	None	None
Unsurveyed	15,401	n/a	n/a	n/a	35,598	n/a	n/a	n/a
Foraging habitat quality summary								
High		55,765	52,974	52,974		12,850	11,926	11,926
Medium		17,085	22,845	22,845		6,333	7,703	7,703
Low		4,483	2,445	2,445		533	129	129
None		5,717	4,785	4,785		1,699	1,657	1,657
Unsurveyed		15,401	n/a	n/a		35,598	n/a	n/a
Total		98,450	48,107	48,107		57,012	57,292	57,292



Legend

- 24 Month Clearing Schedule
- Conceptual clearing buffer
- Mining Regions
- National Parks
- Major Dams
- Rehabilitation
- Cleared Areas

Forest Red-tailed Black Cockatoo

- High
- Medium
- Low
- Black Cockatoo Protection Zones

Black Cockatoo Nests

- Habitat tree
- Nest tree
- Significant tree

Alcoa

N

0 2 4 km

2023 – 2027 Mining and Management Plan

Figure 1-5: Black Cockatoo records and Forest Red-Tailed Black Cockatoo indicative habitat - Huntly

Scale: 1:117,413

Date Printed: 4/09/2023

Towns
Myara North
Monadnocks East
Monadnocks
Myara
Beryl
Darling Scarp
Oneil
Willard
Mccoy
White
Duncan
Huntly
Del Park
Holyoake
Teesdale

Legend

- 24 Month Clearing Schedule
- Conceptual clearing buffer
- Mining Regions
- National Parks
- Major Dams
- Rehabilitation
- Cleared Areas

Baudin's & Carnaby's Cockatoo (Foraging Habitat Quality)

- High
- Medium
- Low
- Black Cockatoo Protection Zones

Black Cockatoo Nests

- Habitat tree
- Nest tree
- Significant tree

Alcoa

N

0 2 4 km

2023 – 2027 Mining and Management Plan

Figure 1-6: Black Cockatoo records and Baudin's & Carnaby's Black Cockatoo indicative habitat - Huntly

Scale: 1:117,413

Date Printed: 4/09/2023

Darling Scarp

Orion

Arundel

Laregó

Cornwall

Legend

- 24 Month Clearing Schedule
- Conceptual Clearing Buffer
- Mining Regions
- Major Dams
- Rehabilitation
- Cleared Areas

Forest Red-tailed Black Cockatoo

- High
- Medium
- Low
- Black Cockatoo Protection Zones

Black Cockatoo Nests

- Habitat tree
- Nest tree
- Significant tree

Alcoa

N

0 1 2 km

2023 – 2027 Mining and Management Plan

Figure 1-7: Black Cockatoo records and Forest Red-Tailed Black Cockatoo indicative habitat - Willowdale

Scale: 1:50,175

Date Printed: 5/09/2023

Darling Scarp

Orion

Arundel

Laregо

Cornwall

Legend

- 24 Month Clearing Schedule
- Conceptual Clearing Buffer
- Mining Regions
- Major Dams
- Rehabilitation
- Cleared Areas

Baudin's & Carnaby's Cockatoo (Foraging Habitat Quality)

- High
- Medium
- Low
- Black Cockatoo Protection Zones

Black Cockatoo Nests

- Habitat tree
- Nest tree
- Significant tree

Alcoa

N

0 1 2 km

2023 – 2027 Mining and Management Plan

Figure 1-8: Black Cockatoo records and Baudin's & Carnaby's Black Cockatoo indicative habitat - Willowdale

Scale: 1:50,175

Date Printed: 5/09/2023

1.4.2.6 Current fauna management

Alcoa's current operations use numerous internal documents and processes to manage impacts to terrestrial fauna. Table 1-9 below outlines these documents along with their scope and purpose.

Table 1-9: Alcoa internal fauna management documents

Document	Scope
Rescue Injured or Orphaned Fauna (Doc no. AUACDS-2056-546)	Describes the procedure that is followed should injured or orphaned animals are found within the mining operations.
Survey and Management of Black Cockatoo Habitats (Doc no. AUACDS-2053-3273)	Describes the procedures for identifying, mapping, retention and managing information related to critical habitat for Black Cockatoos prior to timber harvesting and mining.
Fauna Management Plan (MIN) (Doc no. AUACDS-2053-5518)	Describes the monitoring actions and operating controls undertaken by WA Mining
Threatened Fauna Species Management (Doc no. AUACDS-2056-765)	Describes management of threatened fauna species during Alcoa's WA mining operations.

Alcoa has contributed funding to feral animal control in the NJF subregion from 1994 onwards, commencing with Operation Foxglove which was the first broadscale baiting program in the NJF subregion. Operation Foxglove involved baiting over 550,000 ha of Jarrah forest and demonstrated that baiting was effective at controlling European Fox but did not impact the native carnivore Chuditch.

The success of Operation Foxglove in the NJF subregion led to the implementation of Western Shield, DBCA's flagship wildlife recovery program. Western Shield expanded baiting and feral animal control to cover large areas of DBCA managed lands in Western Australia and resulted in the recovery of several critical weight range mammals including Woylie, Chuditch and Quokka. Due to the program's success the species Quenda and Tammar Wallaby (*Macropus eugenii*) were de-listed as endangered species and the Chuditch re-listed from Endangered to Vulnerable. Woylie was also de-listed, however its population subsequently declined, primarily due to Feral Cat predation with the removal of European Fox as the top predator, and the species has been re-listed as Endangered.

Recognition of the increase in Feral Cat predation led to the development and deployment of Eradicat baits as part of Western Shield. During 2020-2021 approximately 3.8 million ha of DBCA managed and adjoining lands were baited using approximately 410,000 fox baits and 648,000 Eradicat baits. Integrated baiting has been demonstrated to reduce the abundance of European Fox by 80 per cent and Feral Cat by 70 per cent.

1.4.3 Uncertainties / Limitations

The key assumptions and uncertainties are considered to include:

- Portions of Huntly and Willowdale remain unmapped from a fauna habitat perspective and therefore the extent and presence of significant fauna habitats is incomplete with varying survey gaps and compliance with EPA guidance.
- Comprehensive targeted fauna assessments have not been undertaken across all regions prior to mining operations and therefore the total extent and location of populations is unknown.
- Comprehensive SRE invertebrate assessments have only been undertaken across two regions (Myara North and Holyoake) and therefore potential for significant populations and habitat across the entire Huntly and Willowdale mines is unknown.
- Effectiveness of fauna underpasses with respect to conservation significant fauna (e.g., Quokka). Additional monitoring required to determine regular use of underpasses by conservation significant fauna.
- Effectiveness of contemporary rehabilitation in improving foraging density by Black Cockatoos and recolonisation by reptiles.
- Severity and duration of indirect impact of noise, light and blasting on breeding individuals and fauna populations. The tolerance of fauna to these impacts is uncertain.
- Impact of prescribed burning and wildfires on fauna habitat values of rehabilitation.
- Occurrence and impact of varying cat population with suppressed fox population (e.g., collapse of Woylie population in the Southern Jarrah Forest) and timeframes and effectiveness of cat population control in the NJF subregion.
- Potential changes in State Forest use and management objectives under the 2024 Forest Management Plan and WA Government announcement to end native forest logging.

1.4.4 Objective-based EMP – risk-based approach

The FMP has been developed using a risk-based approach that outlines management-based provisions. It encompasses both broad fauna management techniques and species-specific management measures where appropriate. As many fauna are mobile and can relocate to follow resource availability, the protection of significant habitat features (including streams, rocky outcrops and nesting trees) forms the basis of much of the species management. Appendix B presents a risk assessment of the potential impacts to conservation significant fauna values identified within the Huntly and Willowdale mine regions.

As presented in Appendix B, the risk assessment indicated the following Moderate and High risks, in which mitigations/actions need to be applied. There are no Extreme risks identified for the Huntly and Willowdale mines in relation to terrestrial fauna.

High Risks:

1. Clearing activities.
2. Fragmentation.
3. Increased light spill, noise or vibration.
4. Restoration of fauna habitat quality.

Moderate Risks:

5. Dust deposition.
6. Alteration of surface water flows.
7. Introduction and spread of weeds.

8. Fauna entrapment in sumps/ open trenches.
9. Altered fire regimes.
10. Increased introduced predator activity.
11. Physical presence of mine pits and haul roads.

The management approach in this FMP is consultative and conservative, with the view of managing impacts during all phases of mining. The FMP adopts an environmental management hierarchy in the prioritisation of management provisions:

- Avoidance: measures taken to avoid impact
- Minimisation: measures taken to reduce the duration, intensity and/or extent of impact
- Rehabilitation: measures taken to restore previously existing conditions.

This FMP establishes a staged approach to data gathering for terrestrial fauna, reflecting the progressive nature of mine planning and development, as outlined in Table 1-10.

Avoidance mitigation measures include the establishment of Mining Avoidance and Exclusion Zones, based on the outcomes of fauna surveys. In addition, Black Cockatoo Protection Zones may be established, specifically to protect Black Cockatoo habitat. These Protection Zones are considered similar to Mining Avoidance Zones, whereby no mining clearing activities will occur. Protection Zones are determined by various factors, including presence of high quality foraging habitat, high density of nest and/or habitat trees or permanent water sources.

Currently, two Black Cockatoo Protection Zones have been established:

- Huntly contains an approximately 277 ha Protection Zone in the Yamba area, which contains a high density of nest trees. In 2022 there were 30 recorded breeding events, with the majority being Forest Red-tailed Black Cockatoos, however two Carnaby's Black Cockatoo pairs were recorded.
- Willowdale contains an approximately 206 ha Protection Zone in the Giles area. This Protection Zone contains a high density of nest tree, particularly in comparison to the surrounding area. In 2021 there were three Baudin's Black Cockatoo breeding events recorded. The Protection Zone includes a large number of trees of habitat and significant trees (864 Marri trees with a DBH>500mm, excluding nest trees). High quality foraging habitat and permanent water sources are also contained within the Protection Zone.

Table 1-10: Fauna data gathering and survey approach

Survey	Relevant Species	Application	Approval Process	Methodology	Timing	Frequency	Fauna Management Response Actions
Baseline survey – existing mine regions	All species (vertebrate, aquatic and SRE invertebrate)	Conceptual Clearing Areas	Report submitted with the MMP to the MMPLG	Fauna habitat mapping based on Havel vegetation mapping	Prior to inclusion in MMP.	As required	Development of Mining Exclusion Zones for the following: ○ Swamp and stream zone fauna habitats and associated buffers, where practicable
Baseline survey – new mine regions	All species (vertebrate, aquatic and SRE invertebrate)	Conceptual Clearing Areas and a 500m buffer	Report submitted with the MMP to the MMPLG or as part of Part IV EP Act assessment.	As per EPA Guidance – detailed survey to determine potential breeding and foraging habitat for conservation significant fauna. Surveys will be guided by: • Referral Guideline for three WA threatened Black Cockatoo species (DAWE 2022) (and their updates) • Survey guidelines for Australia's threatened birds (DEWHA 2010) (and their updates) • Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020) (and their updates)	Prior to clearing seasonal surveys will be undertaken. Prior to inclusion in MMP.	As required	Development of Mining Avoidance Zones for the following: • Black Cockatoo nest trees, significant trees and associated 10m buffer as per 'Survey and Management of Black Cockatoo Habitats' (Alcoa internal procedure - Doc no. AUACDS-2053-3273). Trees will be clearly marked on construction drawings and documentation. Trees will be marked up and buffers marked with flagging tape. Development of Mining Exclusion Zones for the following: • Carter's Freshwater Mussel populations, where practicable • Swamp and stream zone fauna habitats and associated buffers, where practicable. Trees will be clearly marked on construction drawings and documentation. Trees will be marked up and buffers marked with flagging tape. Black Cockatoo habitat trees and associated 10m buffer within haul road alignments are avoided where practicable, as per 'Survey and Management of Black Cockatoo Habitats' (Alcoa internal procedure - Doc no. AUACDS-2053-3273)
Targeted Survey (Pre-clearance surveys)	Black Cockatoo	Conceptual Clearing Areas – All proposed haul roads, conveyors, mine pits and other infrastructure	Report submitted with FCA to MOG or as part of Part IV EP Act assessment	Prior to clearing, a qualified/experienced terrestrial fauna spotter will be utilised to identify all potential, suitable and actual breeding black cockatoo trees. Targeted surveys will be guided by: • Referral Guideline for three WA threatened Black Cockatoo species (DAWE 2022) • Survey guidelines for Australia's threatened birds (DEWHA 2010) • Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)	Prior to clearing, 1 phase of seasonal surveys will be undertaken.	As required	Development of Mining Avoidance Zones for the following: • Black Cockatoo nest trees, significant trees and associated 10m buffer as per 'Survey and Management of Black Cockatoo Habitats' (Alcoa internal procedure – Doc no. AUACDS-2053-3273). Trees will be clearly marked on construction drawings and documentation. Trees will be marked up and buffers marked with flagging tape. Development of Mining Exclusion Zones for the following: • Carter's Freshwater Mussel populations, where practicable • Swamp and stream zone fauna habitats and associated buffers, where practicable Black Cockatoo habitat trees and associated 10m buffer within haul road alignments are avoided where practicable, as per 'Survey and Management of Black Cockatoo Habitats' (Alcoa internal procedure – Doc no. AUACDS-2053-3273). Trees will be clearly marked on construction drawings and documentation. Trees will be marked up and buffers marked with flagging tape. Black Cockatoo Protection Zones may be established, whereby no mining activities will occur. Protection Zones may include high quality foraging habitat, high density of nest and/or habitat trees or permanent water sources
	Carter's Freshwater Mussel	Conceptual Clearing – Haul Road crossing over streams	Report submitted with FCA to MOG or as part of Part IV EP Act assessment	Targeted surveys as per EPA Guidance	Prior to clearing	As required	Re-alignment of proposed waterway crossings to avoid recorded Carter's Freshwater Mussel populations, where practicable. If disturbance to a recorded Carter's Freshwater Mussel population/s cannot be avoided, undertake permanent translocation of population/s, in accordance with a Translocation Management Plan approved under the *Biodiversity Conservation Act 2016 and in consultation with the DBCA*.
	Chuditch, Quokka, Woylie	Conceptual Clearing Areas –	Report submitted with FCA to MOG or as part of Part	Targeted surveys as per EPA Guidance and DBCA methodology	Prior to clearing.	As required	Development of mining avoidance areas for: • Chuditch, Woylie or Quokka breeding sites (particularly if active) will be avoided, where possible

Survey	Relevant Species	Application	Approval Process	Methodology	Timing	Frequency	Fauna Management Response Actions
		with potential habitat	IV EP Act assessment	Chuditch & Woylie – Landscape scale trapping transects and camera traps with targeted searches. Habitat assessments to be completed. Quokka – targeted surveys in stream vegetation, with cameras. Habitat assessments to be completed. Report to include discussion on population size and identify any breeding sites.			• If clearing of a breeding site is required, a relocation plan will be developed in consultation with DBCA with appropriate approval obtained under the *Biodiversity Conservation Act 2016*. It is expected relocations will be undertaken by a suitably qualified biologist with breeding site destruction to occur once confirmed inactive to prevent re-entry.
Pre-clearing displacement	Chuditch	Within Final Clearing Areas if suitable breeding / nesting habitat identified; and Within Final Clearing Areas if clearing occurs less than three months after FPC logging	Not applicable	No further surveys required, as low likelihood of species interactions, however a fauna displacement process will be followed during clearing operations.			
Pre-clearing monitoring	Chuditch	Within Final Clearing Areas if suitable breeding / nesting habitat identified; and Within Final Clearing Areas if clearing occurs greater than three months after FPC logging	Section 40 approval to take Threatened fauna, including Animal Ethics Committee approval.	Baited cameras to be installed to identify fauna individuals	At least one weeks recording (7 nights) prior to clearing occurring. Recordings to occur a maximum of 2 weeks prior.	A trial of this methodology will be undertaken for a period of six months to assess the number of occurrences	If Chuditch individuals are identified on cameras: A targeted search of the clearing area will occur to identify any potential active dens. Clearing will only occur if actives dens do not occur within clearing area.
Pre-clearing trapping	Chuditch	Within Final Clearing Areas if suitable breeding / nesting habitat identified; and If FPC logging does not occur	Section 40 approval to take Threatened fauna, including Animal Ethics Committee approval. A fauna handling procedure will be developed in consultation with DBCA.	Pre-clearing walk throughs to be undertaken the morning before clearing / disturbance to displace individuals and will include searching and checking refugia sites. Chuditch specific controls: Clearing be undertaken during August to November (denning months) requires pre-clearance survey procedure to be modified (to include trapping) to further mitigate the risk to denning females and young. A Chuditch Handling Procedure will be developed by a suitably qualified zoologist in consultation with DBCA to ensure the appropriate capture and release methods are adopted.			– If walk throughs identify any individuals or active dens, clearing equipment will be requested to stand down until individuals have displaced from the area. – Chuditch denning season specific response actions: • Any captured individuals will have the following recorded; sex, weight, hind foot length (between base of toe to end of heel), head length, pouch status for females will all be recorded and obvious wounds or injuries. Individuals will be temporarily marked to account for recapture. • In the event a lactating female is captured, she will be held during the day and released during the evening with a radio collar or a targeted search of the Final Clearing Area. • The radio-collared lactating female will be tracked to identify the location of the den. Tracking will occur for two days to establish breeding denning site location (due to the relatively flat terrain there is high confidence radio collars will be effective). • Once den identified, trail cameras will be installed to monitor breeding den activity and an exclusion radius of 100 m applied for clearing activity. The exclusion radius area will not be cleared until such time as it appears the female and young have left the den.

Survey	Relevant Species	Application	Approval Process	Methodology	Timing	Frequency	Fauna Management Response Actions
							• If den site is outside of clearing area, clearing will proceed following one night of trapping. • If the den is located inside the clearing area, potential dens will have trail cameras deployed to confirm chuditch presence and if confirmed, an exclusion zone of 100 m radius will be employed. Clearing will not commence in this area, until the trail cameras or the radio collar confirms the den has been abandoned. • In the event the radio collared chuditch and potential den is not located within 48 hours, a further one night of trapping will be implemented at the same sites. If no captures, then clearing will proceed as planned. • Suitable records of pre-clearance survey results will be created and held by the fauna specialist.
Pre-clearing displacement	Quokka and Woylie	Within Final Clearing Areas if suitable breeding/nesting habitat (stream zones) identified	Regulation 28 to take fauna (relocation) licence	Pre-clearing walk throughs to be undertaken the morning before clearing / disturbance to displace individuals and will include searching and checking refugia sites	Within one day of clearing occurring	As required	– If walk throughs identify any individuals clearing equipment will be requested to stand down until individuals have displaced from the area

1.4.5 Rationale for choice of interim management actions

Table 1-11 below lists the internal and external inputs and drivers that informed the development of the environmental management components and provisions detailed in section 3.

Table 1-11: Rationale and choice for provisions

Inputs	Drivers
Changes in intensity, duration, magnitude and geographic footprint of the impact	• Changes in mine plans • Change in impacts as mining progresses
Environmental changes and rate of change	• Progressive restoration of fauna habitat quality as rehabilitation matures • Timeframe to demonstrate performance of contemporary rehabilitation • Requirements to vary rehabilitation with 2024-2033 Forest Management Plan
External issues	• Feral animals presence • Fire regimes • Climate change • Forest Management Plan 2024-2033

2 EMP Components

This section of the FMP identifies the management based provisions Alcoa will implement to ensure the defined environmental objectives are met during the implementation of this FMP. Monitoring has been designed to inform, through the environmental criteria and management targets if the corresponding environmental objectives are being achieved.

Objectives, management based interim provisions and monitoring provisions are detailed in Table 2-1 and Table 2-2.

This FMP will be updated to align with the adaptive management approach (refer to Section 4).

Table 2-1: Management Objectives and Targets

Region specific terrestrial fauna values	Impacts to region specific environmental values	#	Environmental objectives	Management Targets
• Three species of black cockatoo and associated habitat • Chuditch and associated habitat • Quokka and associated habitat • Priority listed and other conservation significant fauna and associated habitat • Carters' freshwater mussel and associated habitat	• Direct loss of conservation significant fauna individuals • Direct loss of habitat	1	Minimise direct loss of conservation significant fauna individuals from active mining and construction activities	• Minimise mortality and injury to conservation significant fauna individuals as a result of clearing activities
				• Minimise mortality and injury to listed threatened fauna species as a result of vehicle movements (light vehicle and heavy vehicle fauna strikes)
				• Minimise feral predator populations as a result of exploration, construction and mining activities
		2	Minimise direct loss of suitable high quality habitat for conservation significant fauna	• Minimise direct loss to suitable breeding habitat for threatened fauna
	• Behavioural changes in individuals to avoid areas previously used for foraging or breeding. • Decline in health and/or change in habitat composition • Habitat fragmentation • Disruption to breeding cycles	3	Minimise indirect impacts on conservation significant fauna species	• No reduction in extent of conservation significant fauna habitat resulting from dust deposition
				• No significant indirect loss of suitable breeding habitat for conservation significant fauna resulting from dust deposition
				• No reduction in quality of conservation significant flora or communities resulting from introduction or spread of weeds, Phytophthora dieback or other forest diseases or fire
				• No significant impact to surface water values from mining activities
				• No reduction in the extent or quality of fauna habitat resulting from changes to fire regimes caused by mining operations

Region specific terrestrial fauna values	Impacts to region specific environmental values	#	Environmental objectives	Management Targets
		4	Minimise the fragmentation of fauna habitats	• No significant impacts to populations of conservation significant fauna as a result of fragmentation of habitats
		5	Minimise the disruption to breeding cycles of conservation significant fauna	• No significant disruption to breeding cycles of conservation significant fauna resulting from increased light spill, noise or vibration

Table 2-2: Objective based EMP

	EPA factor/s and objective/s: Terrestrial Fauna **Key environmental values:** Key Native Fauna **Key impacts and risks:** Clearing				
	Objective-based				
Management Objective	**Management targets**	**Management actions**	**Monitoring**	**Timing / frequency of actions**	**Reporting**
Objective 1: Minimise direct loss of conservation significant fauna individuals from active mining and construction activities	1.1 Minimise mortality and injury to conservation significant fauna individuals as a result of clearing activities	– Conduct baseline fauna surveys (vertebrate, aquatic and SRE invertebrate) in accordance with relevant technical guidance (as per Table 1-10) – Conduct pre-clearance surveys in suitable habitat as determined by baseline fauna surveys in accordance with relevant technical guidance and/or conservation/listing advice (as per Table 1-10) – Conduct pre-clearance surveys for Black Cockatoo and implement 10 m radius avoidance as per 'Survey and Management of Black Cockatoo Habitats' (Doc no. AUACDS-2053-3273) (as per Table 1-10) – Conduct pre-clearance surveys within all proposed waterway crossings (100 m downstream and 50 m upstream) (as per Table 1-10). • Where disturbance to a recorded Carter's Freshwater Mussel population/s cannot be avoided, consult with DBCA to determine if permanent translocation of population/s, in accordance with a Translocation Management Plan approved under the *Biodiversity Conservation Act 2016* can be undertaken. – Conduct clearing activities in consistent direction towards native vegetation to avoid fauna becoming trapped against multiple clearing fronts or 'dead ends'. – Injured fauna to be cared in accordance with DBCA guidance and advice provided via the Wildcare Helpline – Avoid construction during night-time hours as far as practicable, to avoid peak nocturnal animal activity. – Provision of Mining Avoidance and Exclusion Zones as per Table 1-10 for threatened fauna species: • Mining Avoidance and Exclusion Zones to be determined at mine planning stage • Mining Avoidance and Exclusion Zones will be demarcated in construction spatial data to guide mine planning personnel – Inductions for construction personnel in native fauna presence, risks and management/reporting requirements	**Indicator**: Native fauna interactions / deaths **Method**: Review of fauna register and incidents **Indicator**: Conservation Significant Fauna presence/absence **Method**: Fauna monitoring Program **Indicator**: Conservation Significant Fauna relocations **Method**: Review of fauna register **Indicator**: Fauna movement through Fauna Underpass **Method**: Camera monitoring **Indicator**: Feral predator populations **Method**: Fauna monitoring Program **Indicator**: Rehabilitation status and use by conservation significant fauna species **Method**: Fauna monitoring Program	Annual review of monitoring and reporting program	– Outcomes and results to be reported in AER – If management target is exceeded, reporting as per internal Incident Reporting and Investigation Procedure
	1.2 Minimise mortality and injury to listed threatened fauna species as a result of vehicle movements (light vehicle and heavy vehicle fauna strikes)	– Construct fauna underpasses where conservation significant fauna populations may become isolated by haul roads – Establish speed limits appropriate for location and commensurate with fauna strike risk – Forest track usage is restricted at night, unless authorised, with a restricted speed limit implemented – Inductions for vehicle users in native fauna presence, risks and avoidance – Injured conservation significant fauna to be cared in accordance with DBCA guidance and advice provided via the Wildcare Helpline – Report all fauna deaths	**Indicator**: Fauna movement through Fauna underpass **Method**: Camera monitoring **Indicator**: Fauna deaths from vehicle strike **Method:** Review of fauna register	– Annual review of monitoring and reporting program – Reporting as required	– Outcomes and results to be reported in AER – If management target is exceeded, reporting as per internal Incident Reporting and Investigation Procedure
	1.3 No increase in feral predator populations as a result of exploration, construction and mining activities	– Maintain current contributions to Western Shield program and other feral control programs – Implement feral monitoring program to measure changes in feral predator populations in active mining and rehabilitated areas – All exploration phase food wastes bagged and disposed off site – No domestic animals are to be brought onsite by mining personnel or contractors – All construction and operational food wastes stored in containers with secured lids and disposed off-site at a licensed waste facility – Develop and implement additional feral control measures in response to feral monitoring program outcomes as required – Exploration, construction and operations personnel inducted in feral animal presence, risk and management/reporting requirements	**Indicator**: Feral fauna populations **Method**: Fauna monitoring Program	– Annual review of monitoring and reporting program	Outcomes and results to be reported in AER – If management target is exceeded, reporting as per internal Incident Reporting and Investigation Procedure

	EPA factor/s and objective/s: Terrestrial Fauna **Key environmental values:** Key Native Fauna **Key impacts and risks:** Clearing				
	Objective-based				
Management Objective	**Management targets**	**Management actions**	**Monitoring**	**Timing / frequency of actions**	**Reporting**
Objective 2: Minimise direct loss of suitable high quality habitat for conservation significant fauna	2.1 Minimise direct loss to suitable breeding habitat for threatened fauna	– Conduct pre-clearance surveys for Black Cockatoo and implement avoidance as per 'Survey and Management of Black Cockatoo Habitats' (Doc no. AUACDS-2053-3273) – Conduct pre-clearance survey to identify breeding habitat for other conservation significant fauna. – Avoid all nest trees and significant trees as per 'Survey and Management of Black Cockatoo Habitats' (Doc no. AUACDS-2053-3273) – Provision of Mining Avoidance and Exclusion Zones as per Table 1-10 for known breeding habitat for threatened fauna species – Black Cockatoo Protection Zones may be established, whereby no mining activities will occur. Protection Zones may include high quality foraging habitat, high density of nest and/or habitat trees or permanent water sources. – Installation of constructed fauna habitat as per 'Build Fauna Habitat' (Doc no. AUSCDS02053-223) to supplement potential breeding habitat for Chuditch.	**Indicator**: Clearing conducted post-pre-clearance surveys **Method**: Internal Clearing register **Indicator**: Avoidance of suitable nest trees **Methods**: Recording of all suitable nest trees to be retained as per 'Survey and Management of Black Cockatoo Habitats' (Doc no. AUACDS-2053-3273)	– Annual review of monitoring and reporting program	– Outcomes and results to be reported in AER – If management target is exceeded, reporting as per internal Incident Reporting and Investigation Procedure
Objective 3: Minimise indirect impacts on conservation significant fauna species	3.1 No reduction in extent of conservation significant fauna habitat resulting from dust deposition	– Investigate the magnitude of impacts caused from mining related dust deposition on fauna habitat – Implement a vegetation dust monitoring program to determine the level of impact of dust deposition on fauna habitat condition – Undertake dust suppression activities during high level use of haul roads as per internal dust management procedure.	**Indicator**: Vegetation health **Method**: Vegetation dust monitoring program	– Annual monitoring and reporting program	– Outcomes and results to be reported in AER – If management target is exceeded, reporting as per internal Incident Reporting and Investigation Procedure
	3.2 No significant indirect loss of suitable breeding habitat for conservation significant fauna resulting from dust deposition	– Investigate the magnitude of impacts caused from mining related dust deposition on fauna habitat – Develop and implement a vegetation dust monitoring program to determine the level of impact of dust deposition on fauna habitat condition – Undertake dust suppression activities during high level use of haul roads as per internal dust management procedure.	**Indicator**: Vegetation health **Method**: Vegetation dust monitoring program	– Annual monitoring and reporting program	– Outcomes and results to be reported in AER – If management target is exceeded, reporting as per internal Incident Reporting and Investigation Procedure
	3.3 No reduction in quality of conservation significant flora or communities resulting from introduction or spread of weeds, Phytophthora dieback or other forest diseases or fire	– Refer to Flora and Vegetation Management Plan (FVMP)	As per FVMP	– As per FVMP	– As per FVMP
	3.4 No significant impact to surface water values from mining activities	– Refer to Water Resources Management Plan (WRMP)	As per WRMP	– As per WRMP	– As per WRMP
	3.5 No reduction in the extent or quality of fauna habitat resulting from changes to fire regimes caused by mining operations	– Develop and undertake studies to determine the short, medium and long-term impacts of fire on fauna habitat in rehabilitated areas – Amend current rehabilitation treatments where required to develop greater resilience to changes in climate in rehabilitation areas.	**Indicator**: Rehabilitation status and use by conservation significant fauna species **Method**: Fauna monitoring assessment	– Annual monitoring and reporting program	– Outcomes and results to be reported in AER

	EPA factor/s and objective/s: Terrestrial Fauna **Key environmental values:** Key Native Fauna **Key impacts and risks:** Clearing				
	Objective-based				
Management Objective	**Management targets**	**Management actions**	**Monitoring**	**Timing / frequency of actions**	**Reporting**
Objective 4: Minimise the fragmentation of fauna habitats	No significant impacts to populations of conservation significant fauna as a result of fragmentation of habitats	– Consider construction of fauna underpasses where conservation significant fauna populations may become isolated by haul roads, to maintain connectivity between areas of significant habitat – Undertake study to determine effectiveness of fauna underpasses for each species of conservation significant fauna – Implement changes to fauna underpass construction based on study outcomes – Where possible, all captured fauna moved into nearby suitable habitat within likely home range.	**Indicator**: Native fauna use of underpasses **Method**: Camera monitoring **Indicator**: Native fauna **Method**: Reporting of all relocated fauna	– Annual review of monitoring and reporting program	– Outcomes and results to be reported in AER – If management target is exceeded, reporting as per internal Incident Reporting and Investigation Procedure
Objective 5: Minimise the disruption to breeding cycles of conservation significant fauna	No significant disruption to breeding seasons of selected conservation significant fauna resulting from increased light spill, noise or vibration	– Avoid construction during night-time hours as far as practicable, to avoid peak nocturnal animal activity – New facilities to have lighting designed to point away from uncleared areas and in-pit lighting towers to be directed away from uncleared areas – Forest track usage is restricted at night, unless authorised, with a restricted speed limit implemented	**Indicator**: Conservation Significant Fauna presence/absence **Method**: Fauna monitoring assessment	– Annual monitoring and reporting program	– Outcomes and results to be reported in AER – If management target is exceeded, reporting as per internal Incident Reporting and Investigation Procedure

3 Adaptive Management and Review of the EMP

The adaptive management approach will include evaluation of:

- Monitoring data and comparison to baseline, historic, reference, local and regional data on a regular basis to verify responses to potential impacts.
- The effectiveness and relevance of management actions against the objectives, will be reviewed on an annual basis to determine if any changes to actions, targets or monitoring are required.
- New or additional monitoring methodologies, including those stemming from complimentary provisions.

Table 3-1 outlines the monitoring programs that will assist in measuring success of proposed management objectives. Within each objective, management actions are proposed that directly relate to each of the monitoring programs proposed (see Table 1-10 for detailed actions).

Table 3-1: Summary of monitoring programs

Monitoring	Relevant management objectives	Details	Timing	Frequency
LTFMP Fauna monitoring Program	Objective 1: Minimise direct loss of fauna individuals from active mining and construction activities as far as practicable Objective 2: Minimise direct and indirect loss of suitable breeding habitat for conservation significant fauna Objective 3: Minimise indirect impacts of construction and mining operations on fauna habitats Objective 5: Minimise the disruption to breeding cycles of conservation significant fauna	LTFMP monitors fauna presence within rehabilitated areas. Fauna monitoring Program to be designed as a result of Targeted fauna surveys planned in 2023. Intent is to increase knowledge about conservation significant fauna populations and any impact from Alcoa's operational activities. Monitoring of feral predators will be included. Consultation with key stakeholders (DBCA) will be undertaken to ensure alignment with any regional monitoring Programs. Methods to be designed as required as per the adaptive management approach.	TBD	LTFMP – 5 years Fauna monitoring Program – initially annually then every three years once sufficient data obtained.
Feral monitoring program	Objective 1: Minimise direct loss of fauna individuals from active mining and construction activities as far as practicable			

Monitoring	Relevant management objectives	Details	Timing	Frequency
Fauna underpass monitoring program	Objective 3: Minimise indirect impacts of construction and mining operations on fauna habitats Objective 4: Minimise the fragmentation of fauna habitats	Currently in development – methods to be redesigned as required	TBD	TBD
Vegetation dust monitoring program	Objective 3: Minimise indirect impacts of construction and mining operations on fauna habitats	Currently under development – will consider fauna habitat outcomes	TBD	TBD

3.1 Changes to an EMP

Based on result of the review process Alcoa will update and adjust the measures and strategies as per Table 3-2 below.

This FMP will be audited one year post implementation and then subject to detailed review every three years thereafter. Additional reviews will be undertaken following:

- Release of final approved 2024-2033 Forest Management Plan
- New or changes to relevant legislative requirements
- Identification of additional species-specific knowledge or change in impacts as a result of Alcoa's research Program
- Identification of additional moderate or high risks to fauna impacts
- Identification, listing or change in listing of additional conservation significant fauna species
- Changes to mining operational procedures.

Table 3-2: Proposed changed to the FMP

Complexity of changes			**Minor revisions** ☐	**Moderate revisions** ☐	**Major revisions** ☐
Number of Key Environmental Factors			**One** ☐	**2-3** ☐	**> 3** ☐
Date revision submitted to EPA: DD/MM/YYYY					
Proponent's operational requirement timeframe for approval of revision Reason for Timeframe:				**< One Month** ☐ **< Six Months** ☐	**> Six Months** ☐ **None** ☐
Item no.	**EMP section no.**	**EMP page no.**	**Summary of change**	**Reason for change**	
1.					
2.					
3.					

4 References

Christie K., Craig M., Stokes V. and Hobbs R. 2012, Home range size and micro-habitat density requirements of Egernia napoleonis: implications for restored Jarrah forest of south-western Australia. Restoration Ecology Vol 20, pp 740–746.

Christie K., Stokes V., Craig M., and Hobbs R. 2014, Microhabitat Preference of Egernia napoleonis in Undisturbed Jarrah Forest, and Availability and Introduction of Microhabitats to Encourage Colonization of Restored Forest, Restoration Ecology Vol. 21, pp. 722–728.

Craig, Michael D., Tony Kirkby, Vicki L. Stokes, Michael Renton, and Richard J. Hobbs. 2022. "Does the Need to Drink Influence Nest Site Selection in a Wide-Ranging Threatened Cockatoo?" *Forest Ecology and Management* 505 (February): 119928. https://doi.org/10.1016/j.foreco.2021.119928.

Craig M. D., Smith M.E., Stokes V.L., Hardy G. E. and Hobbs R.J. 2018, Temporal longevity of unidirectional and dynamic filters to faunal recolonization in post-mining forest restoration, Australian Ecology Vol 43, pp 973-988.

Craig M.D., White D.A., Stokes V.L. and Prince J. 2017, Can postmining revegetation create habitat for a threatened mammal? Ecological Management and Restoration Vol 18, pp 149-155.

Department of Environment and Conservation (DEC) 2012a, *National Recovery Plan for the Woylie (Bettongia penicillata ogilbyi): Wildlife Management Program No. 51*, Government of Western Australia, Australian Government.

Department of Environment and Conservation (DEC) 2012b, *Chuditch (Dasyurus geoffroii) National Recovery Plan: Wildlife Management Program No. 5*, Government of Western Australia, Australian Government.

Department of Environment and Conservation (DEC) 2013, *Quokka Setonix brachyurus Recovery Plan: Wildlife Management Program No. 56*, Government of Western Australia, Australian Government.

Department of Environment and Energy (DEE) 2017c, *Revised draft referral guidelines for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) Calyptorhynchus latirostris, Baudin's Cockatoo (Vulnerable) Calyptorhynchus baudinii Forest Red-tailed*

Department of the Environment and Energy (DEE) 2016, Threat abatement plan for competition and land degradation by rabbits. Canberra, ACT: Commonwealth of Australia.

Doherty T.S., Wingfield B.N., Stokes V.L., Craig M.D., Lee J.G.H., Finn H.C. and Calver M.C. 2016, Successional changes in feeding activity by threatened cockatoos in revegetated mine sites, Wildlife Research Vol 43, 93–104

Environmental Protection Authority (EPA) 2020, Technical Guidance - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment, EPA, Western Australia.

Environmental Protection Authority (EPA) 2021, Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans, EPA, Western Australia.

EPA (2016) Environmental Factor Guideline - Terrestrial Fauna, EPA, Western Australia.

GHD 2021a, *Terrestrial Fauna Survey and Black Cockatoo Habitat Assessment for Huntly Mine - Myara North,* prepared for Alcoa of Australia Ltd.

GHD 2021b, *Terrestrial Fauna Survey and Black Cockatoo Assessment – Holyoake*, prepared for Alcoa of Australia Ltd.

Glen M., Bougher N.L., Colquhoun I.J., Vlahos S., Loneragan W.A., O'Brien P.A., Hardy G.E. 2008, Ectomycorrhizal fungal communities of rehabilitated bauxite mines and adjacent, natural jarrah forest in Western Australia, Forest Ecology and Management 255 (2008) 214–225.

McGregor R.A., Stokes V.L. and Craig M.D. 2014, Does forest restoration in fragmented landscapes provide habitat for a wide-ranging carnivore? Animal Conservation Vol 17, pp 467–475.

Nichols O.G. and Grant C.D. 2007, Vertebrate Fauna Recolonization of Restored Bauxite Mines—Key Findings from Almost 30 Years of Monitoring and Research, Restoration Ecology Vol. 15, No. 4 (Supplement), pp. S116–S126.

Triska M. D., Craig M. D., Stokes V. L., Pech R. P. and Hobbs R. J. 2016, The relative influence of in situ and neighborhood factors on reptile recolonization in post-mining restoration sites. Restoration Ecology Vol 24, pp 517–527.

Water Research and Management (WRM) 2021, *Aquatic Fauna Desktop Assessment Myara North and Holyoake Regions,* prepared for Alcoa of Australia Ltd.

Zolsky K.L., Wayne A.F., Bryant K.A. and Calver M.C. 2018, Diet of the critically endangered woylie (*Bettongia penicillata ogilbyi*) in south-Western Australia. Australian Journal of Zoology Vol 65.

5 Appendices

APPENDIX A: Likelihood of Occurrence assessment

Species recorded from studies and database searches

The table presents all vertebrate fauna species recorded in previous studies within or in proximity to the Survey Area, and database searches within a 20-kilometre radius of the Survey Area.

Fauna likelihood of occurrence assessment guidelines

Table 5-1: Vertebrate Fauna Species

Assessment outcome	Description
Known	Species recorded during the field survey or from recent, reliable records from within or close proximity to the Survey Area.
Likely	Species are **likely** to occur in the Survey Area where there is suitable habitat within the Survey Area and there are recent records of occurrence of the species in close proximity to the Survey Area. OR Species known distribution overlaps with the Survey Area and there is suitable habitat within the Survey Area.
Unlikely	Species assessed as **unlikely** include those species previously recorded within 40 km of the Survey Area however: There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the Survey Area. The suitable habitat within the Survey Area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the Survey Area. OR Those species that have a known distribution overlapping with the Survey Area however: There is limited habitat in the Survey Area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). The suitable habitat within the Survey Area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the Survey Area.
Highly unlikely	Species that are considered **highly unlikely** to occur in the Survey Area include: Those species that have no suitable habitat within the Survey Area. Those species that have become locally extinct, or are not known to have ever been present in the region of the Survey Area.

Source information - desktop searches
NM – DBCA *NatureMap* (accessed May 2020)
PMST – DEE Protected Matters Search Tool (PMST) to identify fauna listed under the EPBC Act potentially occurring within the Survey Area (accessed June 2020)

Table 5-2: Fauna likelihood of occurrence assessment of conservation significant species identified in the desktop assessment as potentially occurring within the Survey Area.

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
Birds										
Actitis hypoleucos	Common Sandpiper	MI	MI		X				Habitat for the Common Sandpiper is varied: coastal and interior wetlands – narrow muddy edges of billabongs, river pools, mangroves, among rocks and snags, reefs or rocky beaches. Avoids wide open mudflats. This species is widespread and scattered, common on the north and west coasts and uncommon in the south-east and interior (Morcombe 2004).	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species.
Apus pacificus	Fork-tailed Swift	MI	MI		X				In Western Australia, there are sparsely scattered records of the Fork-tailed Swift along the south coast, ranging from near the Eyre Bird Observatory and west to Denmark. They are widespread in coastal and subcoastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands. They are scattered along the coast from south-west Pilbara to the north and east Kimberley region, near Wyndham. There are sparsely scattered inland records, especially in the Wheatbelt, from Lake Annean and Wittenoom. They are found in the north and north-west Gascoyne Region, north through much of the Pilbara Region, and the south and east Kimberley. They are also recorded in the Timor Sea, both at sea and around islands such as the Ashmore Reef. Isolated records occur at Neale Junction in the Great Victoria Desert and on the Nullarbor Plain (Higgins 1999).	**Unlikely** Suitable habitat is not available to support this species however the species may occasionally occur as a vagrant.
Atrichornis clamosus	Noisy Scrub-bird	EN	EN	X					The Noisy Scrub-bird inhabits areas with dense understorey or lower stratum of sedges and shrubs, dense leaf litter and abundant litter-	**Unlikely**

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
									dwelling invertebrates. It mainly occurs in low closed forests 5–15 m in height that are dominated by *Eucalyptus* or *Agonis* and *Banksia littoralis*, and occur in the steep and wetter gullies, and drainage lines of hills and granite mountains (Eucalyptus), and on the margins of freshwater lakes (*Agonis* and *B. littoralis*). It is also common in low closed forests up to 5 m in height that are dominated by *Hakea elliptica*, *Eucalyptus* or *Agonis* and *B. littoralis* and occur around granite outcrops, in shallower and drier gullies and on the margins of freshwater lakes. It mostly occurs at sites that have not been burnt for 10 or more years. It occurs at two locations in the south west; on the mainland in coastal areas from Two Peoples Bay Nature Reserve to Cheyne Beach, and on Bald Island (DEE 2017).	Previously known from small populations in the Jarrah Forest however this population is now considered locally extinct.
Botaurus poiciloptilus	Australasian Bittern	EN	EN		X				The Australasian Bittern occurs mainly in densely vegetated freshwater wetlands and, rarely, in estuaries or tidal wetlands. The species favours foraging in tall, dense vegetation in shallow permanent or seasonal fresh water. In the southwest of Western Australia the Bittern is now largely confined to coastal areas especially along the south coast where it is found in beds of tall rush mixed with or near short fine sedge or open pools (Burbridge 2004). It also occurs around swamps, lakes, pools, rivers and channels fringed with lignum Muehlenbeckia, canegrass Eragrostis or other dense vegetation (Marchant & Higgins 1990). It occasionally ventures into areas of open water or onto banks.	**Unlikely** Suitable habitat such as expansive wetland with emergent native reeds is not available to support this species.
Cacatua pastinator pastinator	Muir's Corella	CD		X		X			Muir's Corella lives in woodland on the drier, eastern side of the main forest block in the south	**Highly unlikely**

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
									west, in woodlands that are dominated by Wandoo (E. wandoo), Marri, (*Corymbia calophylla*), or Jarrah, (*Eucalyptus marginata*). Most suitable habitat for this species now consists of remnant patches that occur in or adjacent to farmland, or along roadsides, paddock boundaries or watercourses, and sometimes as a few, isolated shade trees in otherwise cleared paddocks (Garnett & Crowley 2000). The bird nests in large hollows in trees at least 160 years old. Its now has a restricted distribution in the Tone Bridge, Rocky Gully, Frankland River and Lake Muir area (TSSC).	This species is not known from the region.
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI		X				In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. Sometimes they occur on rocky shores (DotE 2016). They are found throughout many wetlands on the Swan Coastal Plain, in Perth lakes with wet grassed margins and receding waters, Vasse and Harvey Estuaries, and the Busselton wetlands, but are less common on the south coast until the Esperance region (Nevill 2013).	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species.

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
Calidris canutus	Red Knot	EN, MI	EN, MI		X				In Australasia the Red Knot mainly inhabits intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps (DEE 2017). They are found near mudflats and estuaries from Murchison to Bunbury but are then uncommon from Wilson Inlet to Esperance. In the Perth region they are mainly found in Alfred Cove and Peel Inlet (Nevill 2013).	**Unlikely**. Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species.
Calidris ferruginea	Curlew Sandpiper	MI	MI		X				Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (DSEWPaC 2013).	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species.
Calidris melanotos	Pectoral Sandpiper	MI	MI		X				In Australia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
									coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum (DotE 2016). The bird can be seen on the Swan Coastal Plain but is rare to scarce on Lake Thompson, and as well on any freshwater wetland in the southwest with shallow, well-grassed margins. They are seen at Lake Warden, Esperance, and at Lake McLarty (Nevill 2013).	is not present to support this species.
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	VU	X	X	X	X	X	The Forest Red-tailed Black Cockatoo inhabits the dense Jarrah, karri, and Marri forests receiving more than 600 mm annual average rainfall but also occurs in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt (*E. staeri*), Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (DEE 2017). Habitats tend to have an understorey of balga (Xanthorrhoea spp.), kingia (*Kingia australis*), snottygobble (*Persoonia* spp.), parrot bush (*Banksia sessilis*), holly-leaved mirbelia (*Mirbelia dilatata*), bull banksia (*B. grandis*), bullich (*Taxandria* spp.) and sheoak (*Allocasuarina fraseriana*). They are most common in the Jarrah forest region of the northern Darling Range from Collie north to Mundaring and are very local throughout the lower south-west. They can be found on the Swan Coastal Plain, mainly in search of food the exotic white cedar (*Melia azedarach*). There are also several small isolated populations in the eastern parts of its range (DEE 2017).	**Known** Recorded within the Mining area and suitable habitat is available.

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
Calyptorhynchus baudinii *(Zanda baudinii)*	Baudin's Black Cockatoo	EN	EN	X	X	X	X	X	Baudin's Black Cockatoo mainly occurs in eucalypt forests, especially Jarrah, Marri and karri forest that receives 750 mm of annual rainfall. The species is less frequently in woodlands of wandoo (*Eucalyptus wandoo*), blackbutt (*E. patens*), flooded gum (*E. rudis*), yate (*E. cornuta*), partly cleared farmlands and urban areas. The range of the species extends from Albany northward to Gidgegannup and Mundaring (east of Perth), and inland to the Stirling Ranges and near Kojonup. Preferred roosts are in areas with a dense canopy close to permanent sources of water (DEE 2017).	**Known** Recorded within the Mining area and suitable habitat is available.
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	EN	EN	X	X	X	X	X	Carnaby's Cockatoo occurs in uncleared or remnant native eucalypt woodlands, especially those that contain salmon gum, wandoo, Marri, Jarrah and karri, and in shrubland or kwongan heathland dominated by Hakea, Dryandra, Banksia and Grevillea species. Breeding activity is restricted to eucalypt woodlands mainly in the semiarid and subhumid interior, from Kalbarri in the north, Three Springs District south to the Stirling Range, west to Cockleshell Gully and east to Manmanning. The species has expanded its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp and into the tuart forests of the Swan Coastal Plain, including the Yanchep area, Lake Clifton and near Bunbury. It ness in trees older than 120-150 years (DEE 2017).	**Known** Recorded within the Mining area and suitable habitat is available.
Falco peregrinus	Peregrine Falcon	OS		X		X	X		The Peregrine Falcon is found on and near cliffs, gorges, timbered watercourses, riverine environments, wetlands, plains, open woodlands, and pylons and spires of buildings, though less frequently in desert regions (Morcombe 2004;	**Known** Recorded within the Mining area and

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
									Pizzey & Knight 2012). They are not common but can be found almost anywhere throughout WA and in the southwest, including particularly at Fitzgerald River, Stirling Range, Porongurup National Parks, Kondinin, and Peak Charles, with many more locations north of Perth (Nevill 2013).	suitable habitat is available.
Leipoa ocellata	Malleefowl	VU	VU & MI	X	X	X			The Malleefowl generally occurs in semi-arid areas of Western Australia, in shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine Callitris woodlands, Acacia shrublands, paperbark, sheoak, Broombush *Melaleuca uncinata* vegetation, eucalypt woodlands, or coastal heathlands. Mostly they are found where there are sandy or gravel soils. The nest is a large mound of sand or soil and organic matter (Jones & Goth 2008; Morcombe 2004; Nevill 2013). In WA they are found from the southwest Nullarbor to Albany, north, and then west from Moore River up to Shark Bay, past Cue, across to Wiluna and east to the northern Victoria Desert south of the Blackstone Ranges (Nevill 2013; Pizzey & Knight 2012).	**Highly unlikely** There is an absence of suitable habitat to support this species.
Motacilla cinerea	Grey Wagtail	MI	MI		X				The Grey Wagtail is strongly associated with water, particularly rocky substrates along water courses but also lakes and marshes. It breeds from Western Europe to Asia, migrates to Africa, Malaysia, Indonesia and New Guinea. In the nonbreeding season the species may visit northern Australia and Christmas Island (Pizzey & Knight 2012)	**Highly Unlikely** This species does not frequent southern Australia and is not considered likely to be vagrant within the Mining region.
Numenius madagascariensis	Eastern Curlew	CR	CR & MI	X	X				The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of	**Unlikely** Suitable habitat such as open shallow flood

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
									seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, sometimes within the mangroves, and in coastal saltworks and sewage farms. In the south west, Eastern Curlews are recorded from Eyre, and there are scattered records from Stokes Inlet to Peel Inlet (Marchant & Higgins 1993). They are uncommon further south of Geraldton, but can be spotted in Alfred Cove, Peel Inlet and the Albany region (Nevill 2013).	plain or tidal mud flat is not present to support this species.
Pandion haliaetus	Osprey	MI	MI		X				Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging. They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes. They exhibit a preference for coastal cliffs and elevated islands in some parts of their range but may also occur on low sandy, muddy or rocky shores and over coral cays. They may occur over atypical habitats such as heath, woodland or forest when travelling to and from foraging (DSEWPaC 2016)	**Unlikely** Suitable habitat is not available to support this species however the species may occur in the Survey Area as a vagrant.
Rostratula australis	Australian Painted Snipe	EN	EN		X				The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and	**Unlikely** Suitable habitat is not available to support

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
									permanent lakes, swamps and claypans. Australian Painted Snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. The species rarely occurs in south-western Australia, where it was once more common (Marchant & Higgins 1993; Garnett & Crowley 2000).	this species however the species may occur in the Survey Area as a vagrant.
Tyto novaehollandiae subsp. novaehollandiae	Masked Owl (southern subsp)	P3		X		X	X		The Masked Owl is found in forests (wet and dry sclerophyll, non-eucalypt dominated), open woodlands, farmlands or scrub with large trees (12-20 m) and adjacent cleared country, timbered watercourses, paperbark woodlands, and caves (Pizzey & Knight 2012). It requires large hollows in old growth eucalypts or bare sand or the earth of a cave for nesting, and often favours areas with dense understorey or ecotones comprising dense and sparse ground cover. It is often recorded foraging within 100-300 m of the boundary of two vegetation types (Bell & Mooney 2002). The bird is restricted to the thicker humid forests of the south west region, particularly in the Pemberton and Manjimup area and along the Murray River in the Lane Poole area. It nests in hollows in large Karri (*Eucalyptus diversicolor*), Marri (*Corymbia calophylla*) and Jarrah (*E. marginata*) trees (Nevill 2013).	**Known** This species has been previously recorded. There is suitable breeding and foraging habitat to support this species.
Mammals										
Falsistrellus mackenziei	Western False Pipistrelle	P4		X		X	X		The Western False Pipistrelle occurs in wet sclerophyll forest dominated by Karri (*Eucalyptus diversicolor*), and in the high rainfall zones of the Jarrah (*E. marginata*) and Tuart (*E. gomphocephala*) dry sclerophyll forests. The species is restricted to areas in or adjacent to	**Known** This species has been previously recorded. There is suitable breeding and

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
									stands of old growth forest. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri (*Corymbia calophylla*), Sheoak (*Casuarina heugeliana*) and Peppermint (*Agonis flexuosa*) trees are often co-dominant at its collection localities (Churchill 2008; McKenzie & Start 1999).	foraging habitat to support this species.
Bettongia penicillata ogilbyi	Woylie	CR	EN	X	X	X			Preferred habitat for the Woylie includes dense undergrowth, logs and rock-cavities and occasionally in burrows (Burbidge 2004). Scattered Woylie populations may be found throughout the Jarrah forest in the south-west corner of WA. Extant naturally occurring populations of the species are restricted to three small wheatbelt reserves – Dryandra Woodland, Tutanning Nature Reserve and Perup Forest. All are characterised by the presence of thickets of the plant *Gastrolobium* (Van Dyck and Strahan 2008). The species is now restricted to forests and areas where predation has been controlled (or excluded). It rests during the day in a well-concealed nest, built over a shallow depression. The nest is most commonly built using long strands, of grasses, but other material such as strips of bark are also used (in the forest) or dried seagrass and/or triodia (in arid coastal areas) (Freegard 2007).	**Known** This species has been previously recorded. There is suitable breeding and foraging habitat to support this species.
Dasyurus geoffroii	Chuditch	VU	VU	X	X	X	X	X	The Chuditch inhabits eucalypt forest (especially Jarrah, *Eucalyptus marginata*), dry woodland, mallee shrublands, heaths, and desert, particularly in the south coast of WA. They also occur at lower densities in drier woodland and mallee shrubland in the goldfields and wheatbelt, as well as in Kalbarri National Park (translocated). Chuditch	**Known** This species has been previously recorded. There is suitable breeding and foraging habitat to support this species.

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
									require adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) to survive (DEC 2011b). In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest (Van Dyck & Strahan 2008). The species can travel large distances, and for this reason requires habitats that are of a suitable size and not excessively fragmented.	
Hydromys chrysogaster	Rakali, Water-rat	P4		X		X	X		The Water Rat lives in the vicinity of permanent bodies of fresh, brackish, or marine water, lakes and farm dams, and on sheltered coastal beaches, mangroves and offshore islands. In the south-west of WA they have been shown to prefer areas with riparian vegetation, better water quality and a degree of habitat complexity. Woody debris, rock ledges and wetland islands are likely to be important areas for feeding and refuge (DEC 2012). It is an occasional vagrant to temporary waters. Water Rat's dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck & Strahan 2008).	**Known** This species has been previously recorded. There is suitable breeding and foraging habitat to support this species.
Phascogale calura	Red-tailed Phascogale	CD	VU		X				The Red-tailed Phascogale inhabits Wandoo (Eucalyptus wandoo) and dense Sheoak (*Allocasuarina huegeliana*) woodland associations, with populations being most dense in the latter vegetation type. The species prefers vegetation that is unburnt for a long time, which provides continuous canopy cover to assist their arboreal habits. Trees need to be of a sufficient age to provide hollows for nesting in limbs or logs, and grass trees need to have ample skirts to provide cover. Small, scattered populations still	**Unlikely**. Not recorded during the survey. The Mining regions are beyond the known range of this species.

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
									occur in remnant vegetation in the Wheatbelt (DEC 2007).	
Phascogale tapoatafa	Brush Tailed Phascogale	CD				X	X	X	The Brush-tailed Phascogale is sparsely distributed outside the semi-arid zone in dry sclerophyll forest and monsoonal forest and woodland. The species is generally rare and threatened by habitat fragmentation in the south west of Western Australia.	**Known** This species has been previously recorded. There is suitable breeding and foraging habitat to support this species.
Pseudocheirus occidentalis	Western Ringtail Possum	CR	CR	X	X				The Western Ringtail Possum occurs in coastal and near coastal and Peppermint Tree (*Agonis flexuosa*) forest and Tuart (*Eucalyptus gomphocephala*) dominated forest with a Peppermint Tree understorey from Bunbury to Albany. Also occurs in Jarrah (*E. marginata*) forest and Jarrah-Marri *(Corymbia calophylla*) forest associated with Peppermint Tree (Van Dyck & Strahan 2008).	**Unlikely** Suitable habitat Tuart over peppermint understory is not present to support this species.
Isoodon fusciventer	Quenda (Southern Brown Bandicoot)	P 4		X		X	X	X	The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Van Dyck & Strahan 2008).	**Known** This species has been previously recorded. There is suitable breeding and foraging habitat to support this species.
Myrmecobius fasciatus	Numbat	EN	EN	X		X			Current Numbat populations occupy several different habitat types: upland Jarrah forest, open eucalypt woodland, banksia woodland and tall closed shrubland. The only remaining original	**Unlikely** Suitable habitat is available to support this species;

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
									subpopulations are at Dryandra Woodland and the Upper Warren area (including Tone Perup Nature Reserve, Greater Kingston National Park and adjoining State Forest). In WA there are nine translocation sites, including Boyagin Nature Reserve, Tutanning Nature Reserve, Batalling block and Karroun Hill Nature Reserve (see DPaW 2015 for complete list and details). At Dryandra, numbats inhabit brown mallet (*Eucalyptus astringens*) plantations. Habitats usually have an abundance of termites in the soil, and hollow logs, tree hollows, burrows and branches for shelter (DEE 2017; Van Dyck & Strahan 2008).	however, the Mining regions are outside the current known range of the Numbat.
Notamacropus irma	Western Brush Wallaby	P4		X		X	X	X	The Western Brush Wallaby is found primarily in open forest or woodland, particularly favouring open, seasonally- wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland and is uncommon in karri forest (DEC 2011b; Van Dyck & Strahan 2008).	**Known** This species has been previously recorded. There is suitable breeding and foraging habitat to support this species.
Setonix brachyurus	Quokka	Vu	Vu	X	X	X	X	X	The current distribution of the Quokka includes Rottnest and Bald Islands, and at least 25 sites on the mainland, including Two Peoples Bay Nature Reserve and Torndirrup, Mt Manypeaks and Walpole-Nornalup National Parks, and swamp areas through the south-west forests from Jarrahdale to Walpole. The last known population on the Swan Coastal Plain occurs in Muddy Lakes near Bunbury. Quokkas have also been reintroduced to Karakamia Sanctuary (DEC 2013). They occupy dense forests and thickets, streamside vegetation, heaths, shrublands, *Agonis linearifolia*-dominated swamps in the Jarrah (*Eucalyptus marginata*) forest, and	**Known** This species was recorded on remote cameras. There is suitable breeding and foraging habitat to support this species.

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
									sometimes tea-tree thickets on sandy soils along creek systems. The northern extent on the mainland is in the Jarrah forest immediately south-east of the Perth metropolitan area, from where it extends southward through the southern Jarrah, Marri and Karri forests to the south coast, but largely confined throughout to areas receiving an annual rainfall of 1,000 mm or more (DEC 2013; Van Dyck & Strahan 2008).	
Reptiles										
Acanthophis antarcticus	Southern Death Adder	P3		X		X	X		The Southern Death Adder habitat ranges from rainforest to shrublands and heaths. This species is declining in many areas, probably due to habitat destruction and altered fire regimes (Wilson & Swan 2013).	**Known** Two individuals were recorded within the Myara North region during the Mattiske vegetation and flora survey (2020).
Ctenotus delli	Dell's Skink	P4		X		X			Dell's Skink is associated with Jarrah-Marri woodland that has a shrub-dominated understorey, on laterite, sandy or clay soils. It is found in the north Darling Range and inhabits dry sclerophyll forest on granite outcrops, stony hills and ranges. It is absent from the Swan Coastal Plain (Cogger 2014; Wilson & Swan 2013).	**Likely** The Survey Area contains suitable breeding and foraging habitat to support this species.
Geotria australis	Pouched Lamprey	P3		X					This species utilises freshwater streams in the south west (Perth to Albany) to breed and grow before migrating to the ocean to mature (Allen *et al*. 2002). Dams and weirs are the main obstacles for the species. Sporadic records exist throughout the South West Coast Drainage Division between Perth and Albany including the Swan, Canning,	**Highly Unlikely** Permanent suitable habitat with coastal linkages not recorded.

Species name	Common name	Status		Source					Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna	Baseline Fauna surveys	LTFMP		
									Serpentine, Margaret, Donnelly, Warren and Goodga rivers.	
Westralunio carteri	Carter's Freshwater Mussel	Vu	Vu		X		X		Carter's Freshwater Mussel is usually found in freshwater river pools. They are most common in areas with muddy, silty and sandy bottoms and flowing permanent water. Environmental tolerances of W. carteri are not precisely known but they can be found where water temperatures range from 4° C to over 30° C. Formerly this species occurred widely through the southwest including interior rivers of southwest such as Avon, Murray and Blackwood, however Salination of many waterways has severely reduced this species distribution.	**Known** Occurs in the adjacent Serpentine Reservoir. Permanent streams to provide suitable aquatic habitat are likely present within the Mining regions.

APPENDIX B: Risk Assessment Tables

Risk Outcome Matrix

Consequence	Likelihood				
	Rare	Unlikely	Possible	Likely	Almost Certain
Critical	Medium	Medium	High	Very High	Very High
Major	Low	Medium	High	High	Very High
Moderate	Low	Medium	Medium	High	High
Minor	Low	Low	Medium	Medium	Medium
Insignificant	Low	Low	Low	Low	Medium

Likelihood Descriptors (likelihood of consequence occurring)

Likelihood Descriptor	Description	Guidance
Almost certain or Frequent	Expected to occur	A similar outcome has arisen several times per year in local operations
Likely or Probable	More likely to occur than not occur.	A similar outcome has arisen several times per year in Alcoa operations worldwide or broader industry
Possible or Occasional	As likely to occur as not to occur.	A similar outcome has arisen at some time previously in local operations
Unlikely or Remote	Not impossible, more likely not to occur than to occur.	A similar outcome has arisen at some time previously in Alcoa operations worldwide or broader industry
Rare or Improbable	Very unlikely to occur.	No experience of this happening in the broader worldwide industry but is theoretically possible

Consequence Descriptors

Aspect	Insignificant	Minor	Moderate	Major	Critical
Vegetation	Minor temporary and localised change to vegetation extent and quality	Localised short term, minor change to vegetation extent and quality	Localised medium to long term or local scale change to vegetation extent and quality	Regional or long-term change to vegetation extent and quality	Irreversible change to vegetation extent and quality; or Results in changes in conservation status of significant species or ecosystems
Fauna death or injury	No animal mortality or loss of conservation significant species.	Minor impact on fauna species populations. Limited mortality of conservation significant species with only minor impact to local populations.	Localised effect on fauna species populations. Moderate impact to local populations of conservation significant species.	Major long-term effect on fauna species populations. Impacts conservation significant species over an extended area or with major impact to local populations	Mortality causes local extinction of wildlife species. Death of multiple conservation significant fauna individuals leading to localised extinction.
Habitat	Minor temporary and localised change to fauna habitat extent and quality, which does not support its ability to support conservation significant flora or fauna	Localised short term, minor change to fauna habitat extent and quality	Localised medium to long term or local scale change to fauna habitat extent and quality	Regional or long-term change to fauna habitat extent and quality	Irreversible change to fauna habitat extent and quality; or Results in changes in conservation status of significant species or ecosystems
Contamination of Soils	Minimal land contamination within localised area, easily treatable in short term and does not result in adverse impacts on associated environmental values.	Minimal land contamination which is localised and treatable in medium term. Does not result in adverse impacts on associated environmental values.	Low level land contamination within localised area resulting in short to medium term impacts to environmental values.	Low level land contamination on a regional scale resulting in medium to long term impacts on associated environmental values.	Mid-level land contamination on a regional scale resulting in permanent impacts on environmental values.
Erosion	Project activities cause negligible erosion in isolated area.	Project activities lead to limited, localised erosion which does not impact on any environmental values	Project activities lead to substantial erosion which can be rectified in short term.	Project activities lead to substantial erosion which will require long-term remedial works.	Project activities lead to substantial erosion resulting in long term residual effects.

Aspect	Insignificant	Minor	Moderate	Major	Critical
		and can be rectified in short term.			

Risk assessment for the FMP

Risk	Description of Impact	Risk Controls			Residual Risk Rating
		Avoid	Minimise	Rehabilitate	
Direct loss to fauna habitat	Decrease in fauna population sizes and extent	• Provision of Mining Avoidance and Exclusion Zones as per the Fauna Management Plan • Black Cockatoo Protection Zones may be established, whereby no mining activities will occur. Protection Zones may include high quality foraging habitat, high density of nest and/or habitat trees or permanent water sources	• Conduct baseline and pre-clearance fauna surveys (vertebrate, aquatic and SRE invertebrate) as per Fauna Management Plan. • Detailed infrastructure and mine plans minimise clearing where possible and are designed to minimise impacts to breeding habitat. • Forests Products Commission undertakes harvesting activities prior to Alcoa clearing. • Clearing procedures/process (clearing boundary for approved clearing areas).	• Rehabilitation to meet Completion Criteria. • Rehabilitation to re-instate potential fauna habitat. • Installation of constructed fauna habitat as per 'Build Fauna Habitat' (Doc no. AUSCDS02053-223).	Medium

Risk	Description of Impact	Risk Controls			Residual Risk Rating
		Avoid	Minimise	Rehabilitate	
			• Clearing lines in work pack and GIS (tablet within dozer, procedures to ensure clearing in approved areas). • Regulatory approval process (MMP/FCA) stipulates approved clearing areas. • Native fauna interactions reported in register.		
Direct loss to suitable breeding habitat for threatened fauna	Loss of breeding habitat for threatened fauna	• No mining pits are located within stream zones (Mining Exclusion Zones) • Avoid all nest trees, significant trees and associated 10m buffer as per 'Survey and Management of Black Cockatoo Habitats' (Doc no. AUACDS-2053-3273) (Mining Avoidance Zones) • Provision of Mining Avoidance Zones as per the Fauna Management Plan • Black Cockatoo Protection Zones may be established,	• Infrastructure crossings over stream zones are minimised. • Conduct pre-clearance surveys for Black Cockatoo and implement avoidance as per 'Survey and Management of Black Cockatoo Habitats' (Doc no. AUACDS-2053-3273). • Conduct pre-clearance survey for to identify breeding habitat for other conservation significant fauna. • Detailed infrastructure and mine plans minimise clearing	• Rehabilitation to meet Completion Criteria. • Installation of constructed fauna habitat as per 'Build Fauna Habitat' (Doc no. AUSCDS02053-223) to supplement potential breeding habitat for Chuditch.	Medium

Risk	Description of Impact	Risk Controls			Residual Risk Rating
		Avoid	Minimise	Rehabilitate	
		whereby no mining activities will occur. Protection Zones may include high quality foraging habitat, high density of nest and/or habitat trees or permanent water sources	where possible and are designed to minimise impacts to breeding habitat. • Forests Products Commission undertakes harvesting activities prior to Alcoa clearing.		
Mortality and injury to conservation significant fauna individuals as a result of clearing activities	Loss of conservation significant fauna individual	• Avoid construction during night-time hours as far as practicable, to avoid peak nocturnal animal activity. • Provision of Mining Avoidance and Exclusion Zones as per Fauna Management Plan, which will be demarcated in construction spatial data to guide mine planning personnel. • Mining Avoidance Zones for: ○ high value habitat for black cockatoos habitat. ○ Black Cockatoo nest trees and significant trees with 10m buffer.	• Conduct baseline fauna surveys (vertebrate, aquatic and SRE invertebrate) as per Fauna Management Plan. • Conduct pre-clearance surveys in suitable habitat as determined by baseline fauna surveys in accordance with relevant technical guidance and/or conservation/listing advice as per Fauna Management Plan. • Conduct pre-clearance surveys within all proposed waterway crossings (100 m downstream and 50 m upstream) as per Fauna Management Plan.	• Injured Animal Procedure includes agreements with organisations to undertake care for injured animals. • Injured conservation significant fauna to be cared in accordance with DBCA guidance and advice provided via the Wildcare Helpline.	Medium

Risk	Description of Impact	Risk Controls			Residual Risk Rating
		Avoid	Minimise	Rehabilitate	
			• Forests Products Commission undertakes harvesting activities prior to Alcoa clearing. • Haul road construction to only occur during the day. • Where disturbance to a recorded Carter's Freshwater Mussel population/s cannot be avoided, consult with DBCA to determine if permanent translocation of population/s, in accordance with a Translocation Management Plan approved under the *Biodiversity Conservation Act 2016* can be undertaken. • Pre-clearing displacement, monitoring and trapping for Chuditch and Quokka to be undertaken as per Fauna Management Plan. • Conduct clearing activities in consistent		

Risk	Description of Impact	Risk Controls			Residual Risk Rating
		Avoid	Minimise	Rehabilitate	
			direction towards native vegetation to avoid fauna becoming trapped against multiple clearing fronts or 'dead ends'. • Inductions for construction personnel in native fauna presence, risks and management/reporting requirements. • Clearing procedures/process (clearing boundary for approved clearing areas). • Clearing lines in work pack and GIS (tablet within dozer, procedures to ensure clearing in approved areas). • Regulatory approval process (MMP/FCA) stipulates approved clearing areas. • Native fauna interactions reported in register. • Training for all personnel around requirements for		

Risk	Description of Impact	Risk Controls			Residual Risk Rating
		Avoid	Minimise	Rehabilitate	
			licences to handle/remove flora/fauna.		
Mortality and injury to listed threatened fauna species as a result of vehicle movements (light vehicle and heavy vehicle fauna strikes)	Mortality and injury to listed threatened fauna	• High value habitat for conservation significant fauna are identified and Mining Avoidance Zones implemented as applicable.	• Construct fauna underpasses where conservation significant fauna populations may become isolated by haul roads. • Establish speed limits appropriate for location and commensurate with fauna strike risk, with Speed limit audits/checks. • Inductions for vehicle users in native fauna presence, risks and avoidance, including fatigue management. • Roadside vegetation is controlled to minimise fauna interactions. • Fauna sightings reported in register, providing information on fauna hotspots. • Training for all personnel around requirements for licences to handle/remove flora/fauna.	•	Medium

Risk	Description of Impact	Risk Controls			Residual Risk Rating
		Avoid	Minimise	Rehabilitate	
			• Injured animal and handling training undertaken for key personnel. • Injured Animal Procedure includes agreements with organisations to undertake care for injured animals. • Injured conservation significant fauna to be cared in accordance with DBCA guidance and advice provided via the Wildcare Helpline.		
Increase in feral predator populations as a result of exploration, construction and mining activities	Direct loss of, or injury to, individual fauna Competition of food resources Destruction of habitat/s	•	• Maintain current contributions to Western Shield program and other feral control programs. • All exploration phase food wastes bagged and disposed off site. • No domestic animals are to be brought onsite by mining personnel or contractors. • All construction and operational food wastes stored in containers with secured lids and	•	Medium

Risk	Description of Impact	Risk Controls			Residual Risk Rating
		Avoid	Minimise	Rehabilitate	
			disposed off-site at a licensed waste facility. • Exploration, construction and operations personnel trained in feral animal presence, risk and management/reporting requirements. • Feral animal sightings recorded to improve understanding and improve monitoring Programs. • Potential water sources that may attract feral animals are minimised or interactions limited.		
Fragmentation of habitat (multi) [disruption of geneflow, movement though disruption of transport] (however able to transverse the forest) Decline in health and/or change in habitat composition	Disruption to geneflow Reduced habitat size Reduced connectivity between habitat and populations	• No mining pits are located within stream zones (Mining Exclusion Zones) • High value habitat for conservation significant fauna are identified and Mining Avoidance Zones implemented as applicable.	• Construct fauna underpasses or reduce isolation and to maintain connectivity between areas of significant habitat. • Infrastructure crossings over stream zones are minimised. • Undertake study to determine effectiveness of fauna underpasses for each species of conservation significant fauna.	• Rehabilitation to meet Completion Criteria. • Rehabilitation Plan to minimise the timeframe of areas open.	Medium

Risk	Description of Impact	Risk Controls			Residual Risk Rating
		Avoid	Minimise	Rehabilitate	
			• Underta.ke targeted feral animal control and monitoring at fauna underpasses to verify or guide management effectiveness. • Undertake trapping program in vegetated islands less than 90 ha in size to prevent isolation of female Chuditch in areas that will not sustain the individual. • All captured fauna moved into nearby suitable habitat within likely home range.		
Loss of individual from entrapment	Loss of fauna individual	•	• Drill holes are capped when not in use and rehabilitated (including plugging) when no longer required. • Open holes, sumps and trenches are to be minimised. If required, egress options (ramps or egress netting) will be installed or inspections undertaken. • Lined sumps will have fencing or egress options installed.	• Injured Animal Procedure includes agreements with organisations to undertake care for injured animals. • Injured conservation significant fauna to be cared in accordance with DBCA guidance and advice provided via the Wildcare Helpline. • Drill holes are rehabilitated when no longer required.	Low

Risk	Description of Impact	Risk Controls			Residual Risk Rating
		Avoid	Minimise	Rehabilitate	
			• Training for all personnel around requirements for licences to handle/remove flora/fauna.		
Increased light spill, noise or vibration resulting in disruption to breeding cycles of conservation significant fauna or displacement	Disruption to breeding cycles of conservation significant fauna. Behavioural changes in individuals to avoid areas previously used for foraging and/or breeding.	•	• Avoid construction during night-time hours as far as practicable, to avoid peak nocturnal animal activity. • Restricted use of forest tracks at night to avoid peak nocturnal animal activity. • In-pit lighting towers to be directed away from uncleared areas. (Tow and Set up Lighting Plant procedure includes details on where/how to set up lighting with minimal forest disturbance.) • Undertake studies to determine the medium and long-term impacts of mining operations on the breeding cycles of conservation significant fauna.	•	Low