Technical memorandum

To: Silver Kenny, South32 Worsley Alumina
From: Kerryn Fox
Date: 22 May 2026
Subject: 1652B Zone 4 Interim Memorandum update

Background

South32 Worsley Alumina Pty Ltd (Worsley) are seeking to complete additional environmental studies within the Extended Mining Areas (EMAs; the Project). Under the 2005 Public Environmental Review, Worsley obtained conditional approval to mine the EMAs, comprising areas known as Brookton, Mid-Central, Hotham North Extension, Quindanning East and Morgans (Figure 1). Prior to commencement of operations in these areas, Worsley must first meet a number of conditions including the completion of biodiversity-related investigations (condition 8-1 of MS719, now superseded by condition B4-1 of MS1237) and provide a report to the Minister for the Environment for endorsement on advice from EPA, DBCA and the Conservation and Parks Commission.

In February 2024, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by Worsley to undertake a detailed and targeted vertebrate fauna survey for the Project. A desktop review was undertaken to inform a basic vertebrate fauna survey, as well as site selection and survey requirements for subsequent detailed and targeted surveys.

The study area is approximately 456,544 ha in size, spanning across multiple shires in the South-West, and is situated within the Southern Climatic Region as defined by EPA (2020). Given the large size of the study area, it was split up into 5 smaller targeted zones to ensure adequate survey effort across the entire study area.

This memo report outlines the results of the zone 4 survey program (Figure 1), as well as recommendations for the upcoming surveys in order to complete the scope of works across the entire study area.

Methods

The detailed and targeted terrestrial vertebrate fauna survey was undertaken in accordance with relevant State and Commonwealth guidance, including EPA terrestrial fauna survey guidelines **REF** and DBCA standard operating procedures. Survey methods were selected to adequately sample habitats across the study area and detect conservation significant fauna identified during the desktop assessment.

Survey effort was focused on areas with limited previous survey coverage and was distributed across both the EMAs and surrounding reference areas to support impact and comparative assessment. Field survey dates are provided in Table 1.

Table 1 Survey dates

Survey type	Season	Dates
Detailed and targeted vertebrate fauna survey phase 1	Spring	21 November–2 December 2024
Detailed and targeted vertebrate fauna survey phase 2	Summer	12–22 February 2025
Black cockatoo habitat assessment	Autumn	16–23 May 2025

Habitat Assessment

Habitat assessments were undertaken using a combination of desktop spatial analysis and field verification to identify and characterise fauna habitats across the study area. Site selection considered landform, vegetation type, soil characteristics, proximity to water and habitat condition, with emphasis on habitats known or likely to support conservation significant fauna.

Systematic and Targeted Trapping

Systematic trapping was conducted across representative habitat types to detect ground-dwelling mammals, reptiles and amphibians. Targeted trapping was also undertaken in suitable habitat for conservation significant ground-dwelling mammals, with trapping effort tailored to maximise detection while minimising bias. All trapping and animal handling procedures were undertaken in accordance with relevant DBCA animal welfare and biosecurity requirements.

Morphometric Data and PIT Tagging

Captured conservation significant mammals were scanned for existing microchips, measured and assessed for sex and condition. Unmarked individuals were implanted with PIT tags to enable identification on recapture and support population-level assessments.

Active Searches

Active diurnal and nocturnal searches were undertaken to detect fauna through direct observation and secondary evidence. Searches focused on microhabitats likely to support target species, including logs, hollows, burrows and foraging or feeding signs. Nocturnal searches incorporated spotlighting at sites considered safe to access at night, as well as conducting transects through the study area.

Avifauna Surveys

Standardised timed avifauna surveys were conducted to record bird species, including black cockatoos. Surveys incorporated visual observations, call recognition and secondary evidence, with additional opportunistic records collected during other field activities.

Bat Echolocation Monitoring

Ultrasonic recorders were deployed at targeted sites to detect echolocating bats, with site selection based on habitat suitability for foraging, roosting or movement. Recorders operated over multiple nights, and recordings were analysed by a specialist bat ecologist.

Camera Trapping

Motion-sensitive camera traps were deployed across suitable habitat to detect medium- to large-bodied mammals. Camera traps were deployed throughout the study area to maximise spatial coverage and detection rates. Camera imagery was processed to identify species and, where possible, individual animals.

Black Cockatoo Habitat Assessment

A targeted black cockatoo habitat assessment was undertaken to identify and assess breeding, foraging and roosting habitat. Habitat tree surveys quantified hollow availability and evidence of use, while foraging and roosting habitat quality was assessed using current Commonwealth guidance and established assessment frameworks. Results were extrapolated to mapped habitat units to inform habitat value assessments.

Results

The total survey effort within zone 4 is presented in Table 2.

Table 2 Survey effort

Method	Number of sites	Total effort
Habitat assessment (#)	58	58
Foraging–vertebrates (hrs)	9	14.8
Foraging–nocturnal (hrs)	4	7.9
Birding (hrs)	10	24.6
Black cockatoo habitat assessment quadrat (#)	39	39
Cage (nights)	65	640
Elliott trap (nights)	65	640
Dry pitfall trap (nights)	6	840
Funnel (nights)	6	1,680
Camera (nights)	73	5,794
Ultrasonic recording (nights)	6	51
Opportunistic sighting (#)	57	72

Fauna recorded

A total of 145 terrestrial vertebrate species representing 59 families and 116 genera were recorded in zone 4 during the field surveys (Table 3). The assemblage included 138 native species and 7 introduced species.

Table 3 Summary of vertebrate fauna recorded

Class	Native	Introduced	Total
Amphibians	9	0	9
Aves	80	1	81
Reptilia	29	0	29
Mammalia	20	6	26
Total	**138**	**7**	**145**

Conservation significant fauna recorded

Four Threatened and 3 Priority vertebrate fauna were recorded in zone 4 (Table 4, Figure 2). Evidence of white-tailed black cockatoos that was unable to be attributed to either Baudin's or Carnaby's cockatoo was recorded as *Zanda* sp.

Forest red-tailed black cockatoo was the most common significant fauna species recorded, with the highest number of site detections and overall abundance. Woylie foraging evidence was recorded at 2 sites, while evidence of quenda was only recorded at a single site. Dell's skink was captured at 3 systematic trapping sites. Chuditch was captured in cage traps at 6 sites, with an opportunistic direct sighting and tracks recorded at an additional 2 sites (Table 4).

Table 4 Significant vertebrate fauna identified in zone 4

Species	Status	# of sites	Abundance	Evidence
Calyptorhynchus banksii naso Forest red-tailed black cockatoo	VU (EPBC & BC Acts)	43	241	Calling, Foraging evidence, Direct sighting, Feathers, Flying over
Zanda latirostris Carnaby's cockatoo	EN (EPBC & BC Acts)	9	128	Calling, Direct sighting, Foraging evidence
Zanda sp. White-tailed black cockatoo species	EN (EPBC & BC Acts)	12	71	Calling, Direct sighting, Foraging evidence
Ctenotus delli Dell's skink	P4 (DBCA list)	3	9	Direct sighting
Dasyurus geoffroii Chuditch	VU (EPBC & BC Acts)	8	9	Direct sighting, Scat
Isoodon fusciventer Quenda	P4 (DBCA list)	1	≥1	Foraging evidence
Notamacropus irma Western brush wallaby	P4 (DBCA list)	8	11	Direct sighting, Scat
Bettongia penicillata ogilbyi Woylie	EN/CR (EPBC Act; BC Act)	2	≥1	Foraging evidence

Habitats

The dominant remnant habitat type present is JM Uplands (Table 5, Figure 3). The least common habitat type is Valley Floor Woodland and occurs only along river systems in the eastern half of zone 4. The remnant woodland/forest habitat across the western half of the zone is dominated by jarrah and marri, whereas the eastern portion includes habitats characterised by the presence of wandoo in addition to jarrah/marri (Figure 3).

Table 5 Summary of zone 4 habitats

Habitat	Code	Area (ha)	%
Cleared	Cleared	39,903.5	38.6
Jarrah/marri forest on lateritic uplands	JM Uplands	23,060.9	22.3
Jarrah/marri woodland on valley floors	JM Valleys	14,788.0	14.3
Woodland/shrubland on shallow soils	Woodland Shallow	12,971.9	12.6
Jarrah/marri/wandoo woodland on lateritic uplands	JMW Uplands	5,139.1	5.0
Melaleuca shrubland in valley depressions	Mel. Shrublands	3,591.6	3.5
Wandoo woodland on valley slopes	Wandoo Woodlands	2,571.5	2.5
Woodland/shrubland on valley floors	Valley Floor Woodland	1,287.3	1.2
Total		**103,313.8**	**100**

JM Valleys and Woodland Shallow recorded the greatest number of significant species (7; Table 6). JMW Uplands recorded the lowest number of significant fauna species, with only a single record of forest red-tailed black cockatoo. However, much of the JMW Uplands habitat occurs in small, isolated patches in the east of zone 4, often on private land and was not subject to intense survey effort.

Forest red-tailed black cockatoo was recorded within all habitat types, including Cleared. The single record of quenda was located within JM Valleys habitat, while woylie was detected in JM Uplands and Woodland Shallow (Table 6). Chuditch was detected within all habitat types except JMW Uplands and Valley Floor Woodland. Dell's Skink was most common in JM Valleys but was also recorded in Woodland Shallow habitat.

Table 6 Significant vertebrate fauna habitat records

Species	Habitat (number of records)							
	Cleared	JM Uplands	JM Valleys	Woodland Shallow	JMW Uplands	Mel. Shrublands	Wandoo Woodlands	Valley Floor Woodland
Forest red-tailed black cockatoo	8	26	59	16	1	33	96	2
Carnaby's cockatoo	100	3	2	18			4	1
White-tailed black cockatoo	1	6	29	6		11	18	
Dell's skink			7	2				
Chuditch		2	4	1		1	1	
Quenda			1					
Western brush wallaby	1	1	4	2		2	1	
Woylie		1		1				
Total	**110**	**39**	**106**	**46**	**1**	**47**	**120**	**3**
Number of species	**4**	**6**	**7**	**7**	**1**	**4**	**5**	**2**

Black cockatoo results

Black cockatoo habitat assessments identified 780 potential nesting trees (Table 7) across 39 quadrats (Figure 4; Table 2). Of these, hollows were present in 95 trees, with 76 trees containing hollows considered possibly suitable for black cockatoo nesting. Two hollows were confirmed to be suitable for nesting following pole camera inspection. A total of 685 trees were of suitable diameter at breast height (DBH) but did not currently have hollows. Jarrah was the most common tree species recorded with a DBH over 500 mm.

Table 7 Black cockatoo potential nest tree summary

Tree species	Hollows present				Total
	No	Yes			
		Unsuitable	Possibly suitable	Suitable	
Corymbia calophylla (marri)	134	2	15		151
Eucalyptus marginata (jarrah)	516	14	57	2	589
Eucalyptus rudis (flooded gum)	3				3
Eucalyptus sp.	10	1	2		13
Eucalyptus todtiana (coastal blackbutt)	7				7
Eucalyptus wandoo (wandoo)	15		2		17
Total	**685**	**17**	**76**	**2**	**780**

Limitations

Survey effort was mostly restricted to the large continuous section of remnant habitat in the west of zone 4. Many of the vegetation types that were restricted to the east section of zone 4, such as Valley Floor Woodland and JMW Uplands, have not been well surveyed. This is primarily because most of the native vegetation in this area occurs in small, isolated patches, often on private land.

Surveys in zone 4 have mostly been conducted during summer months. Surveys may not have detected species that are more active during the wet winter months, or when there is greater connectivity between water sources such as wetlands and inundated ephemeral waterways.

Inspections of potential black cockatoo hollows were limited to hollows that were able to be reached with the pole camera. Black cockatoo foraging evidence cannot always be attributed to a species and therefore are recorded as black cockatoo species.

There were no other limitations in completing the scope of work.

Recommendations

It is recommended that the isolated remnant habitat that occurs mostly in the farmland to the east of zone 4 receive additional survey effort. This can be achieved through deployment of cameras, active searches, avifauna surveys and habitat assessments in these fragmented patches, particularly those that are managed by DBCA.

Targeted post-winter surveys along the Hotham River and within seasonally inundated areas are recommended to target wetland species that may not have been captured during the detailed surveys (such as waterbirds, frogs and rakali). These targeted wetland surveys will also inform the selection of sites for long term monitoring of bio-indicator species and the effects of climate change.

Drones represent a potential alternative to pole cameras, allowing hollows at any height to be effectively inspected and verified for black cockatoo nesting suitability. Follow-up surveys of hollows that could not be checked will provide a more accurate assessment of hollow suitability and the number of suitable hollows.

Additional survey effort for conservation significant species that appeared in the desktop but have not yet been sufficiently targeted is also recommended. For example, targeted effort for barking owl and masked owl using play-back methods. To address the outstanding items and data gaps identified above, Phoenix proposes to undertake a supplemental field program scheduled for August- September 2026.

Yours Sincerely,

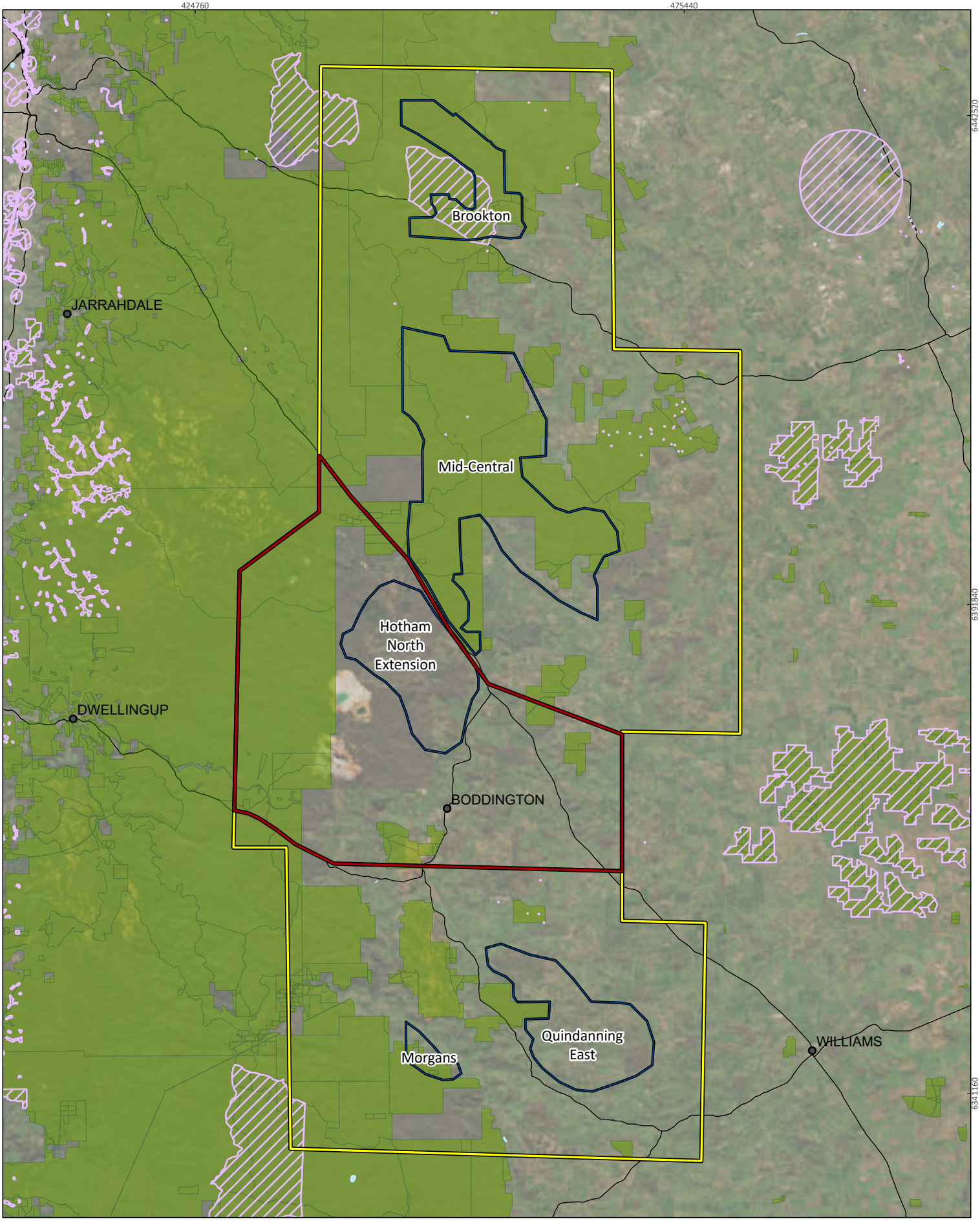
Kerryn Fox

Senior Zoologist

Kerryn.fox@phoenixenv.com.au

08 6323 5410

5 Pitino Court Osborne Park WA 6017





South32 Worsley Alumina Pty Ltd
Extended Mining Areas

Project No	1652b
Date	31/03/2026
Drawn by	JL
Map author	KF

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Kilometers

1:506,800 (at A4) GDA 1994 MGA Zone 50

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- Study area
- EMAs
- Zone 4
- Lakes
- DBCA managed land
- Environmentally sensitive areas
- Road

Figure 1

Project location and study area

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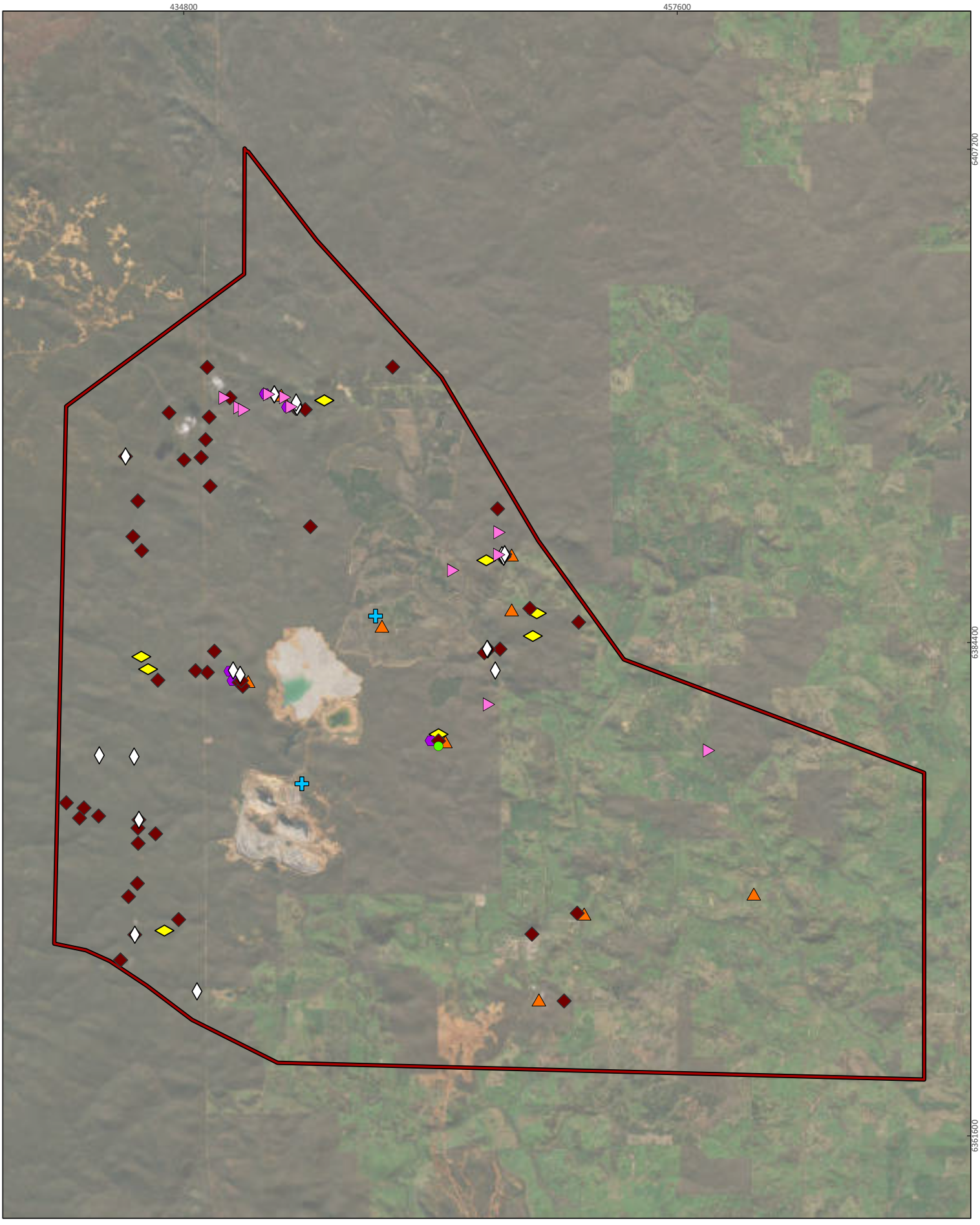



South32 Worsley Alumina Pty Ltd
Extended Mining Areas

Project No	1652b
Date	11/05/2026
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Kilometers

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Zone 4

Species, status

- carnaby's cockatoo, EN (EPBC & BC Acts)
- chuditch, VU (EPBC & BC Acts)
- Dell's skink, P4 (DBCA list)
- forest red-tailed black cockatoo, (EPBC & BC Acts)
- quenda, P4 (DBCA list)
- white-tailed black cockatoo, EN (EPBC & BC Acts)
- western brush wallaby, P4 (DBCA list)
- woylie, EN/CR (EPBC Act; BC Act)

Figure 2

Significant vertebrate fauna recorded in the study area

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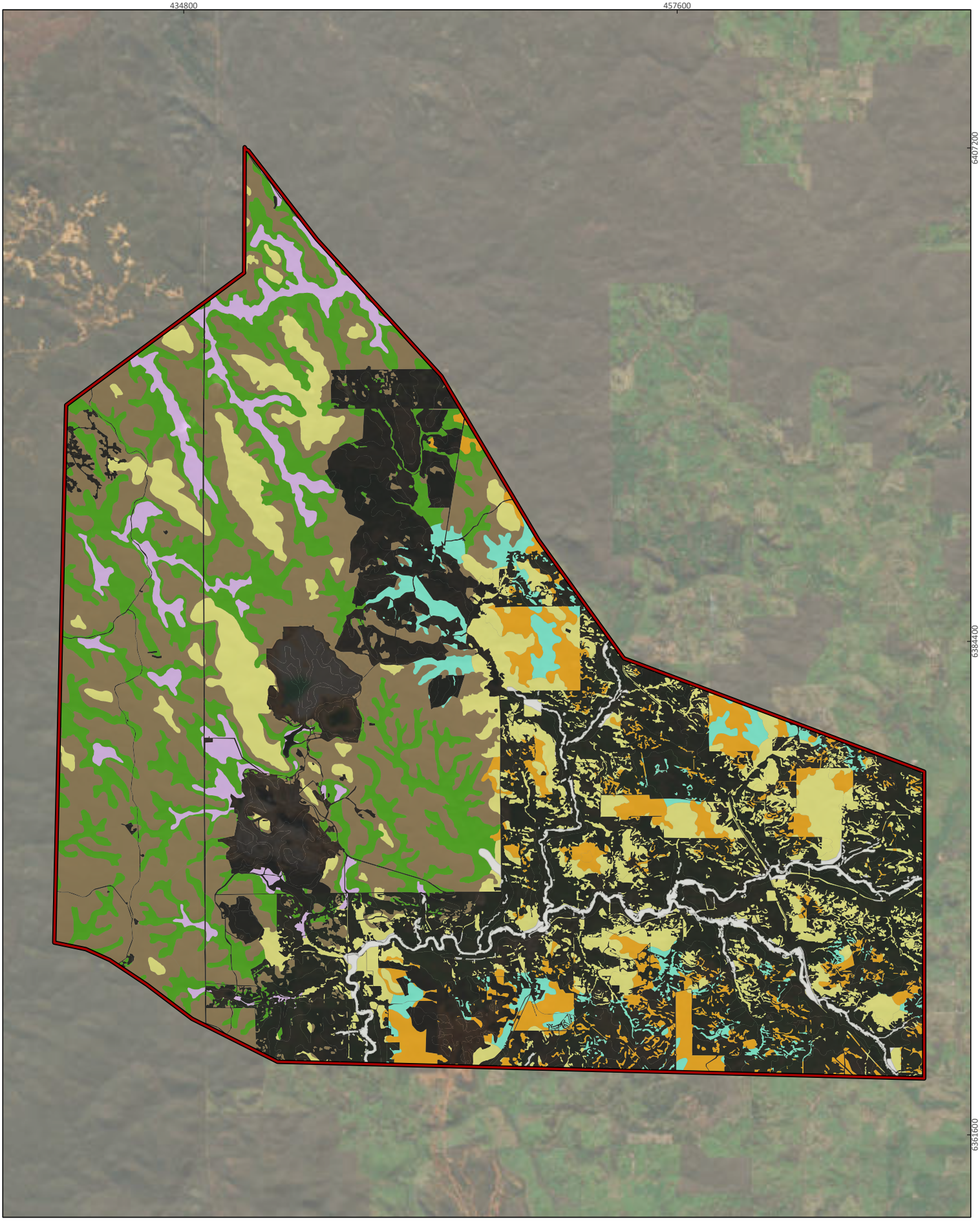



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Zone 4

Habitat

- Cleared
- Jarrah/Marri forest on lateritic uplands
- Jarrah/Marri woodland on valley floors
- Jarrah/Marri/Wandoo woodland on lateritic uplands
- *Melaleuca* shrubland in valley depressions
- Wandoo woodland on valley slopes
- Woodland/shrubland on shallow soils
- Woodland/shrubland on valley floors

Figure 3

Habitats in the study area

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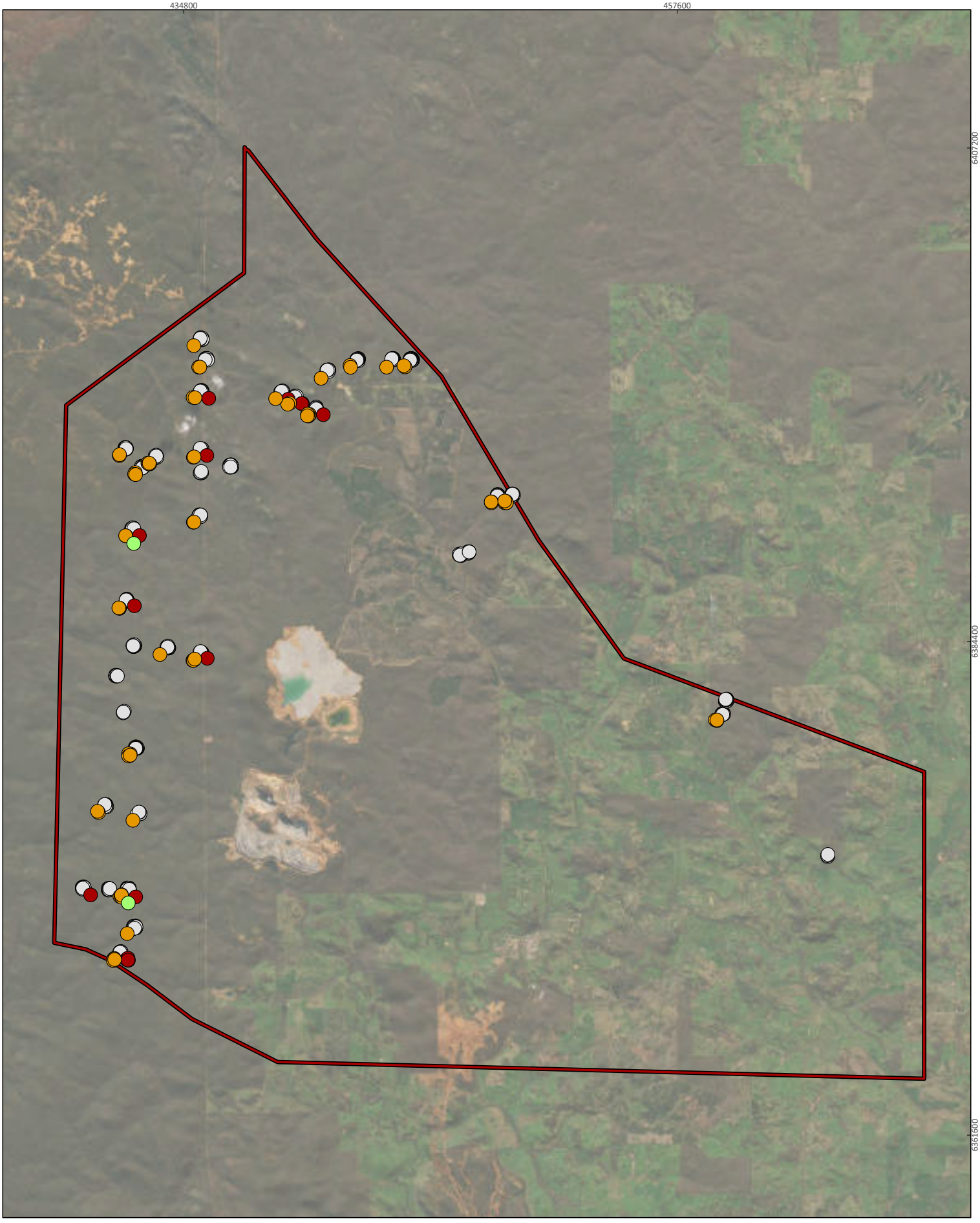



South32 Worsley Alumina Pty Ltd
Extended Mining Areas

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Zone 4

Potential nest trees

- Suitable hollow/s
- Possibly suitable hollow/s
- Unsuitable hollow/s
- No hollows

Figure 4

Black cockatoo potential nesting trees

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References

EPA. 2020. *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment*. Environmental Protection Authority, Perth, WA. Available at: https://epa.wa.gov.au/sites/default/files/Policies_and_Guidance/EPA-Technical-Guidance-Vertebrate-Fauna-Surveys.pdf