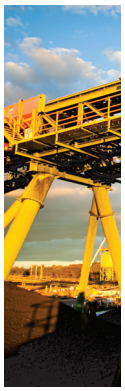

MOOLARBEN COAL COMPLEX
OC3 EXTENSION PROJECT

AMENDMENT REPORT

APPENDIX D

SAII EXPERT REPORTS

YANCOAL
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MOOLARBEN COAL COMPLEX OC3 EXTENSION PROJECT

REVIEW OF THE ASSESSMENT FOR SERIOUS AND IRREVERSIBLE IMPACTS ON THE LARGE-EARED PIED BAT AND EASTERN CAVE BAT

March 2024

1. Introduction

Moolarben Coal Operations (MCO) is proposing an extension to the approved OC3 mining operations, located approximately 40 kilometres (km) north of Mudgee, New South Wales (NSW) (**Figure 1; Figure 2**). Approval for this State Significant Development is being sought under Part 4 of the *Environmental Planning and Assessment Act 1979*. Niche Environment and Heritage (Niche), in collaboration with Premise, prepared a Biodiversity Development Assessment Report (BDAR) for the Project Environmental Impact Statement (EIS) (Niche 2022).

AMBS Ecology and Heritage (AMBS) (2022) undertook targeted bat fauna surveys in 2021 and located Large-eared Pied Bats (*Chalinolobus dwyeri*) at 30 Anabat detector locations around the Study Area. Thirteen individual Large-eared Pied Bats were harp trapped, with another six observed or hand caught while inspecting cave structures. AMBS (2022) also located Eastern Cave Bats (*Vespadelus troughtoni*) at 15 Anabat detector locations around the Study Area. Six Eastern Cave Bat individuals were captured in harp traps, with one roost located during physical inspections of clifflines. Another two confirmed (and one unconfirmed) Large-eared Pied Bat roosts/individuals were located by Andrew Lothian and Glenn Hoye from Biodiversity Monitoring Services during inspections of the habitat in March 2023.

Locations of the AMBS (2022) and Biodiversity Monitoring Services records are presented in **Figure 3**. These were a mix of recordings in foraging habitat around the valley, and along clifflines and escarpments surrounding the valley. The records were found predominantly in Plant Community Type (PCT) 266, PCT1629 and PCT1610 (**Figure 4**). AMBS (2022) describes that breeding habitat[1] of the Large-eared Pied Bat and Eastern Cave Bat is present.

*"Any impacts on **breeding habitat** used by these species could be considered potentially serious and irreversible"* and the decision-maker is required to: "*take likely SAII into consideration and determine if there are any additional and appropriate measures that will minimise the impact if consent or approval is granted"* (Department of Planning, Industry and Environment [DPIE] 2019).

[1] *Potential breeding habitat and breeding individuals (i.e. a female bat of the target species that is pregnant, carrying pups or lactating; or juveniles of the target species).*

LEGEND
- State Forest
- National Park /Nature Reserve
- Local Government Boundary
- Exploration Licence Boundary
- Mining Lease Boundary
- Mining Operation
- Indicative Amended Project Surface Disturbance Extent

Source: NSW Spatial Services (2021)
MCO (2023)

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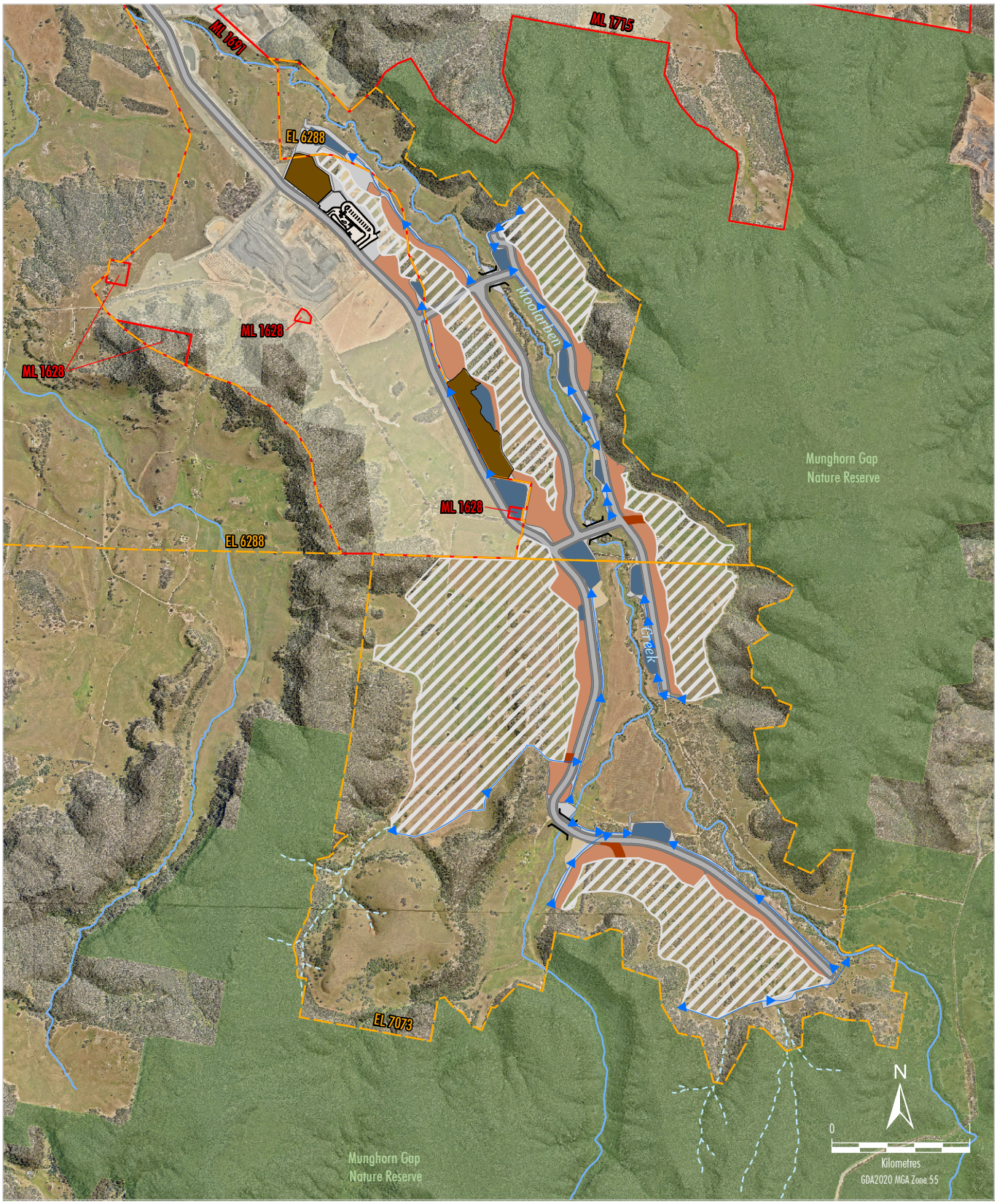
Project Location

Figure 1

MCM-20-18 OC Ext EIS SAII Ass_Bats_2010



MCOA-20-18 OC Ext EIS SAII Ass_ Bats_ 202C

LEGEND

- National Park/Nature Reserve
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- OC3 Extension Project - Amended
- Indicative Open Pit Extent
- Indicative ROM Pad
- Culvert
- Indicative Haul Roads and Infrastructure Corridor
- Indicative Infrastructure Area
- Indicative Construction/Rehabilitation Material Stockpiles
- Conceptual Flood Levee Embankment
- Conceptual Water Management Infrastructure
- Indicative Vehicle Access
- Conceptual Surface Water Drain

Source: MCO (2023); NSW Spatial Services (2021)
Orthophoto: MCO (2021)

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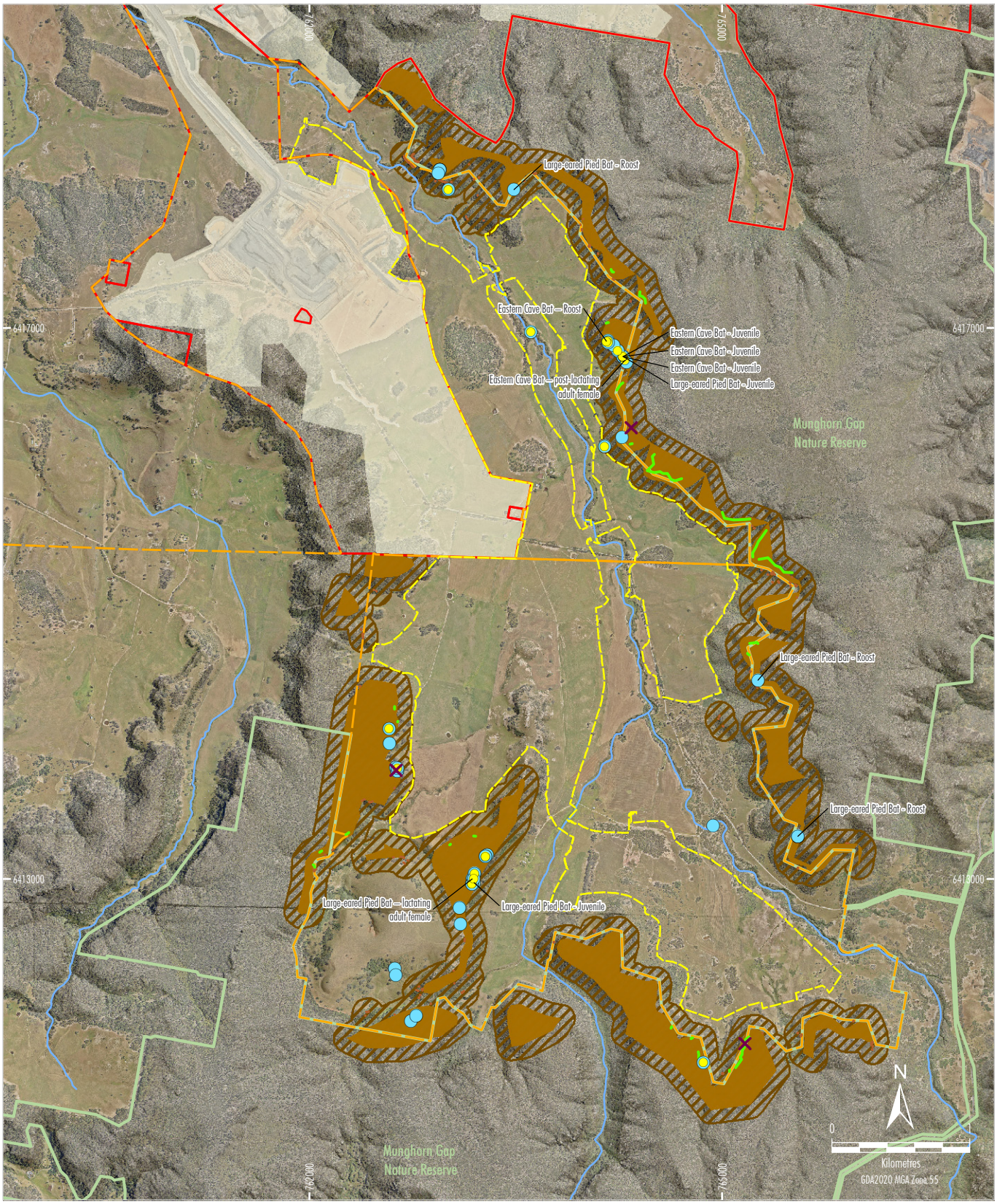
General Arrangement of the Amended Project

Figure 2



LEGEND

- National Park/Nature Reserve
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- Indicative Amended Project Surface Disturbance Extent

Eastern Cave Bat and Large-eared Pied Bat

- Mapped Rocky Habitat
- 100 m Buffer from Mapped Rocky Habitat (Breeding Habitat)
- Most Likely Habitat (Biodiversity Monitoring Services)
- Observed Roost (Biodiversity Monitoring Services)
- Eastern Cave Bat Record
- Large-eared Pied Bat Record

Source: MCO (2023); NSW Spatial Services (2021); AMBS (2023) ; Biodiversity Monitoring Services (2023)
Orthophoto: MCO (2021)

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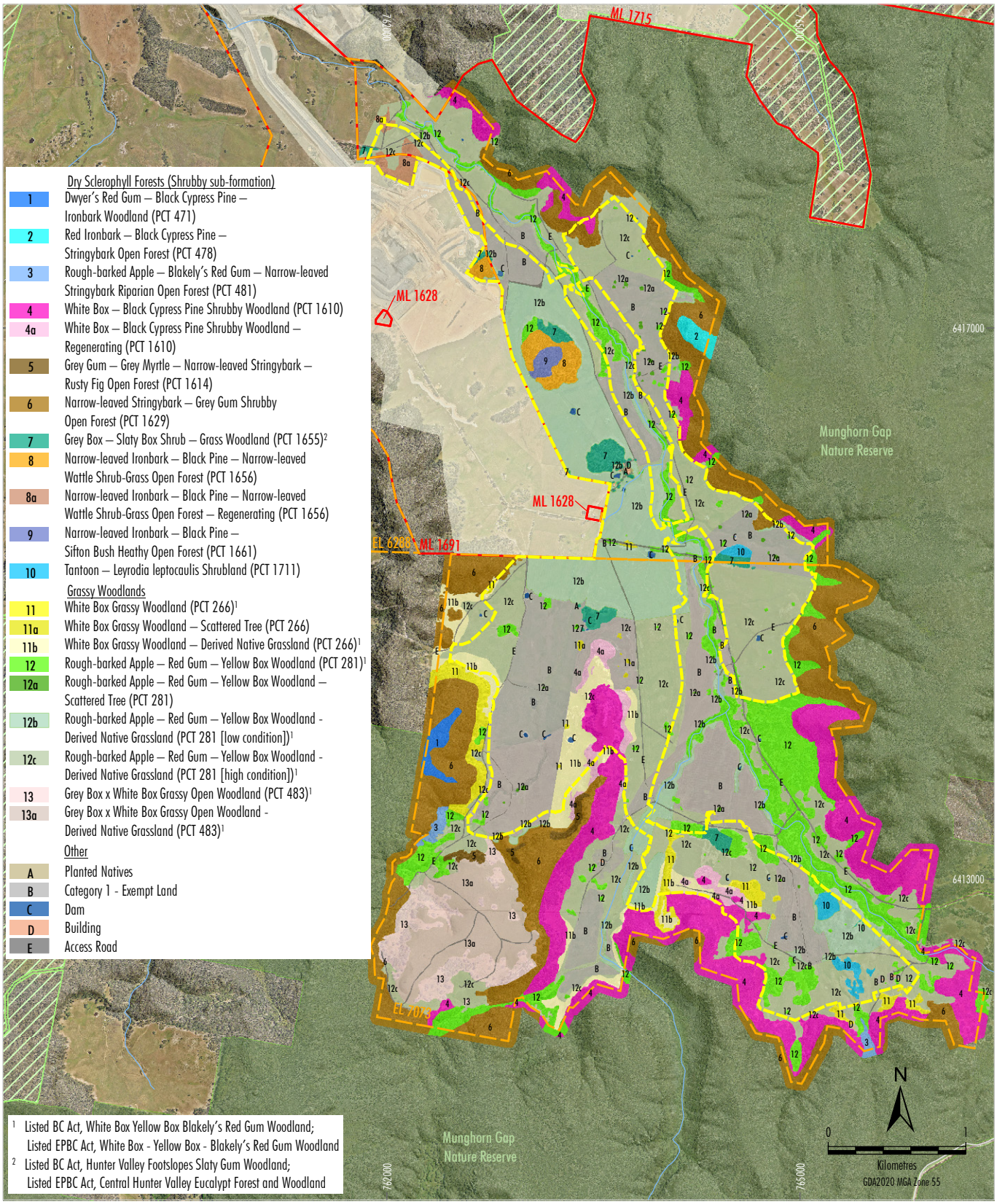
Eastern Cave Bat and Large-eared Pied Bat Habitat

Figure 3



MCM-20-18 OC Ext EIS SAII Ass_ Bats_ 205D

LEGEND

- National Park/Nature Reserve
- Existing Biodiversity Offset Area
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- Indicative Amended Project Surface Disturbance Extent

Source: MCO (2023); NSW Spatial Services (2021); Eco Logical Australia (2023)
Orthophoto Mosaic: MCO (2021)

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Vegetation Mapping

Figure 4

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According to the Biodiversity Assessment Method (BAM) (DPIE 2020) *"the determination of a serious and irreversible impact on biodiversity values is to be made by the decision-maker in accordance with the principles set out in the BC Regulation".* The NSW *Biodiversity Conservation Regulation 2017* states:

> *6.7 Principles applicable to determination of "serious and irreversible impacts on biodiversity values" (section 6.5(1))*
>
> *(1) This clause applies for the purposes of determining whether an impact on diversity values is a serious and irreversible impact for the purposes of the biodiversity offsets scheme.*
>
> *(2) An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because—*
>
> > *(a) it will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or*
> >
> > *(b) it will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or*
> >
> > *(c) it is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or*
> >
> > *(d) the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.*
>
> *(3) For the purpose of this clause, a decline of a species or ecological community is a continuing or projected decline in—*
>
> *(a) an index of abundance appropriate to the taxon, or*
>
> *(b) the geographic distribution and habitat quality of the species or ecological community.*

Breeding habitat for the Large-eared Pied Bat and Eastern Cave Bat ("*PCTs associated with the species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings"* [NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) 2024a]) is listed at risk of a Serious And Irreversible Impact (SAII) due to Principle 4 (NSW DCCEEW 2024b):

> *Principle 4 - the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity, and therefore its members are not replaceable.*

Andrew Lothian and Glenn Hoye from Biodiversity Monitoring Services were approached to review the Niche (2022) assessment of the two bat species against the relevant requirements, and evaluate if any residual impacts (i.e. impacts that would remain after implementation of proposed avoidance/minimisation measures) are serious and irreversible, and whether there are any further measures that would minimise those impacts to avoid an SAII. For the purpose of this assessment, many aspects of the two species' biology and status are similar, so the assessment applies equally to both. In areas where it is relevant, additional information will be presented separately. The 2022 BDAR has been updated by Niche to reflect the Amended Project. The findings of this assessment have also been updated to reflect the Amended Project and reduced impacts.

This review has been undertaken by Andrew Lothian and Glenn Hoye, independent of the BDAR (Niche 2022). This review is not being undertaken in Andrew Lothian's capacity as an accredited assessor.

2. Background information: Large-eared Pied Bat and Eastern Cave Bat

Large-eared Pied Bat

The Large-eared Pied Bat is a cave-roosting bat and belongs to a genus of insectivorous Vespertilionid bats. This species occurs in eastern NSW and Queensland, from the coast to inland slopes, with the bulk of records coming from sandstone country in Sydney-Hunter region (Van Dyck and Strahan 2008) (**Plate 1a** and **Plate 1b**; **Figure 5**). There are records of the Large-eared Pied Bat in 65 National Parks, Nature Reserves and Conservation Areas as well as 13 State Forests in NSW (**Table 1**) (NSW DCCEEW 2024c).

It is highly likely that the species occupation of habitat is much more restricted within its wide distributional range (Department of Environment and Climate Change [DECC] 2007). Colonies are often small (up to 80) (Churchill 2008). They prefer twilight areas of caves, crevices and mines, with Fairy Martin nests and "honeycomb" holes utilised both by individuals and breeding aggregations (Churchill 2008).

The author (Glenn Hoye) has worked extensively with the Large-eared Pied Bat, and we have a local record of a maternity roost near Ulan in a small boulder cave (3 metres [m] high scarp) being utilised year-on-year, with other individuals taking shelter in smaller holes and cracks in isolated boulders at another site across the valley from the maternity roost (Fly By Night Bat Surveys 2018).

The Large-eared Pied Bat is well known from the local area as demonstrated by the records shown on **Figure 6**. Glenn Hoye has been surveying threatened bats in the local area over the past 29 years (Fly By Night Bat Surveys 1998; Fly By Night Bat Surveys 2020), and Andrew Lothian over the last 11 years. Further details on the experience of the authors are provided in **Appendix A**. Most of the survey work for the bat has been for mining companies, either at mine sites or offset areas, which is why the records are concentrated in those areas.

Potential habitat for the species is widespread through the adjacent National Parks and Nature Reserves, as indicated by the cliff mapping on the NSW Topographic Map (**Figure 6**). There has been a lack of bat surveys within the National Parks and Nature Reserves (and Crown Land), where the majority of the local cliff habitat is located. While the Department of Agriculture, Water and the Environment (DAWE) (2021) note that the number of known breeding sites for this bat is limited, there are likely to be many breeding sites throughout the potential habitat given the extensive number of records within the extent of **Figure 6**.

Though sandstone cliffs adjacent fertile valley woodland are important to the species (DECC 2007), rainforest and wet sclerophyll on volcanic substrates may also be important (Gynther 2011 *pers. comm*. and Mathieson 2011 *pers. comm.* cited in Hoye 2005). Box gum woodlands, riparian corridors and rainforest corridors are used for foraging (Pennay 2010 *pers. comm.* cited in Threatened Species Scientific Committee 2012). The species is able to make use of extensive escarpment features through the year, but maternity sites have very specific structural (and presumably microclimatic) requirements. Arched caves with domed roofs and pockets appear to be important features. Required rock features are not limited to large caverns in clifflines (Williams and Thompson 2018; Lothian 2019a), and do not always show up on topographical maps.

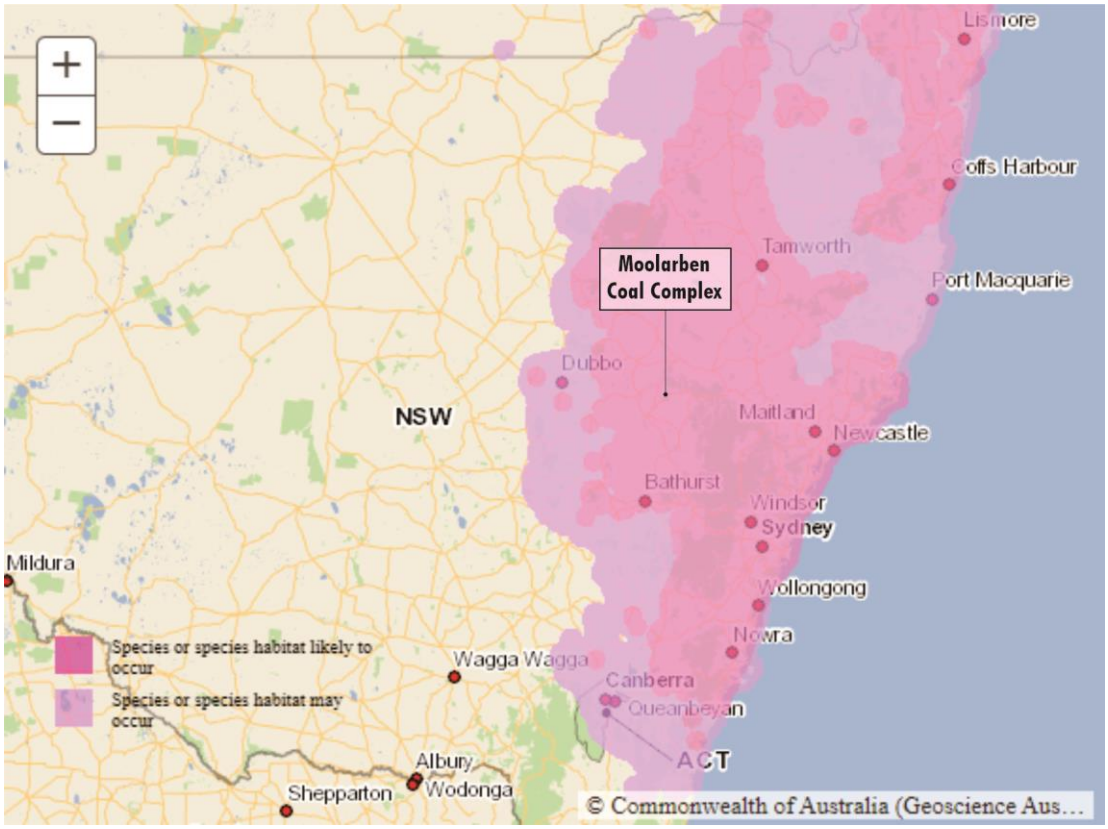


Plate 1a: Large-eared Pied Bat Commonwealth Mapping (Commonwealth Department of Climate Change, Energy, the Environment and Water [Cth DCCEEW] 2023).

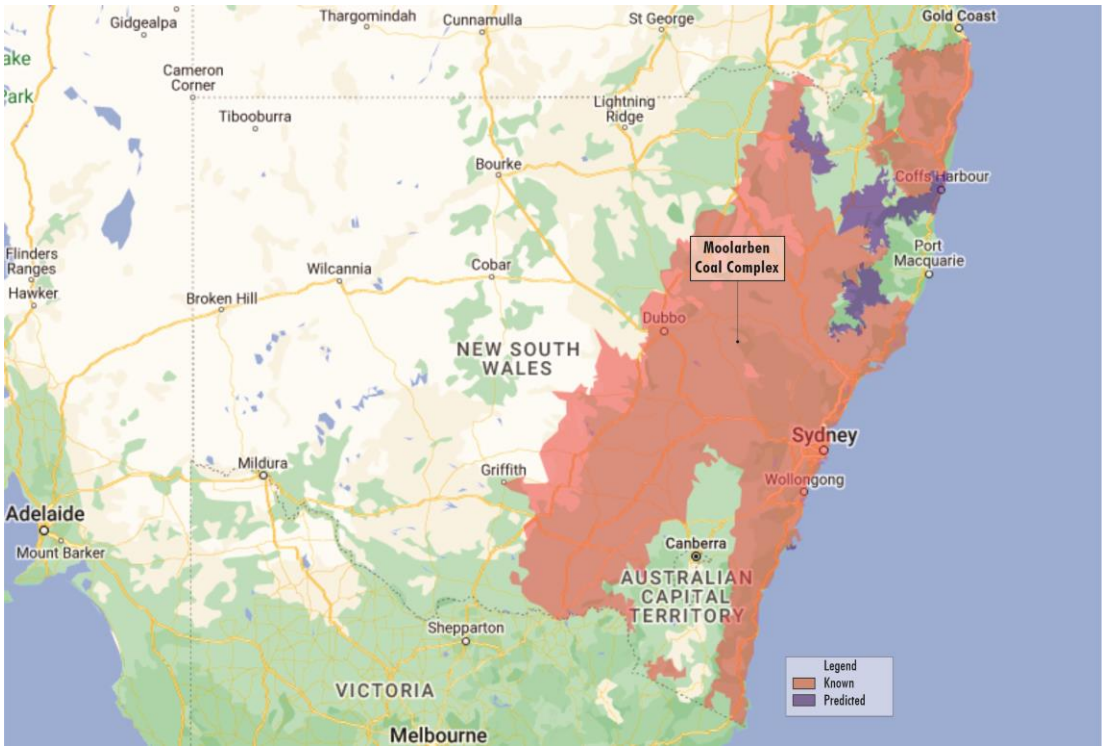
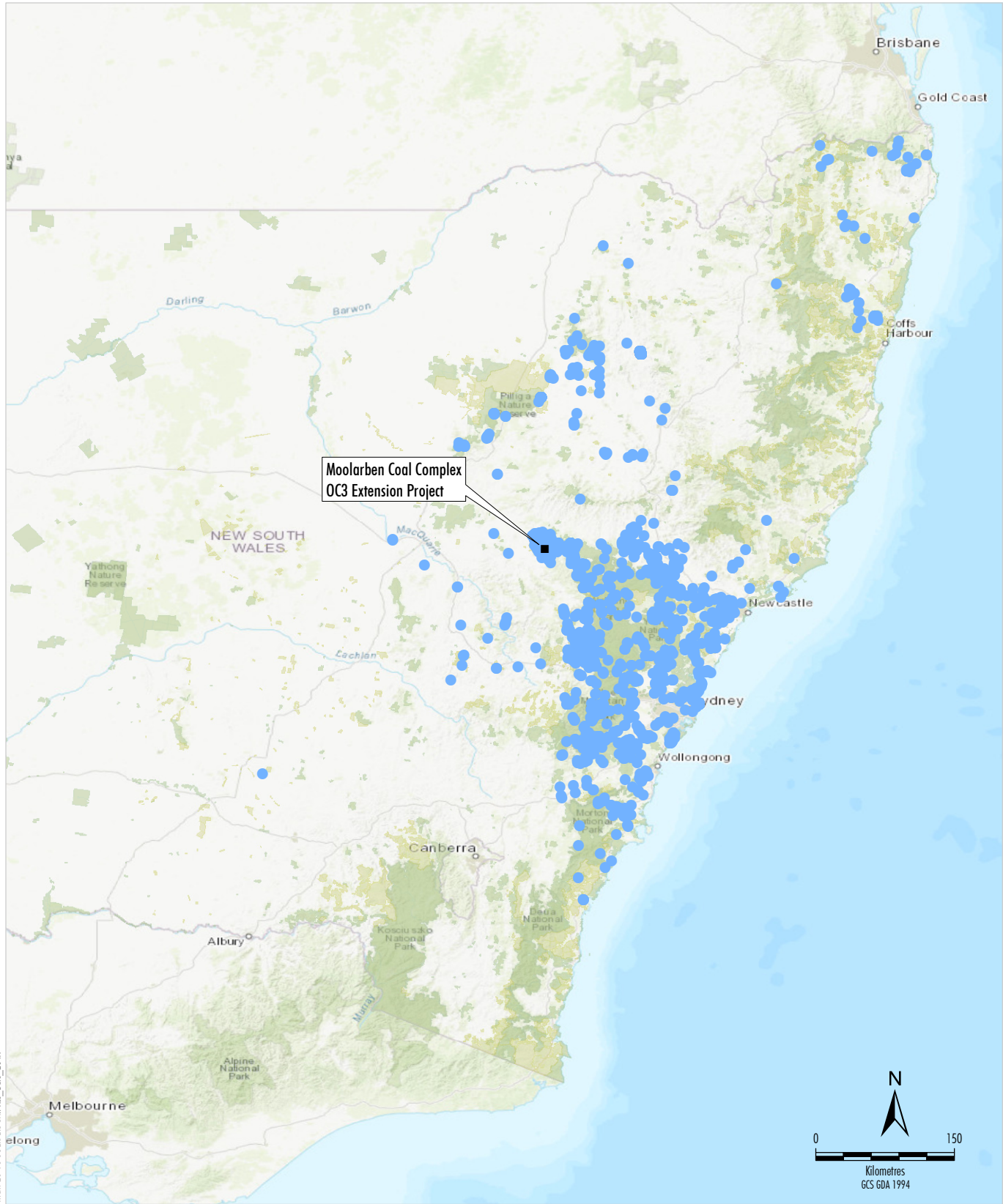


Plate 1b: Large-eared Pied Bat NSW Mapping (NSW DCCEEW 2024d).



MCM-20-18 OC Ext EIS SAII Ass_Bats_204A

LEGEND

- Large-eared Pied Bat - BioNet Atlas Record
- State Forest
- National Park /Nature Reserve

Source: ESRI Base (2023); BioNet Atlas (2023)

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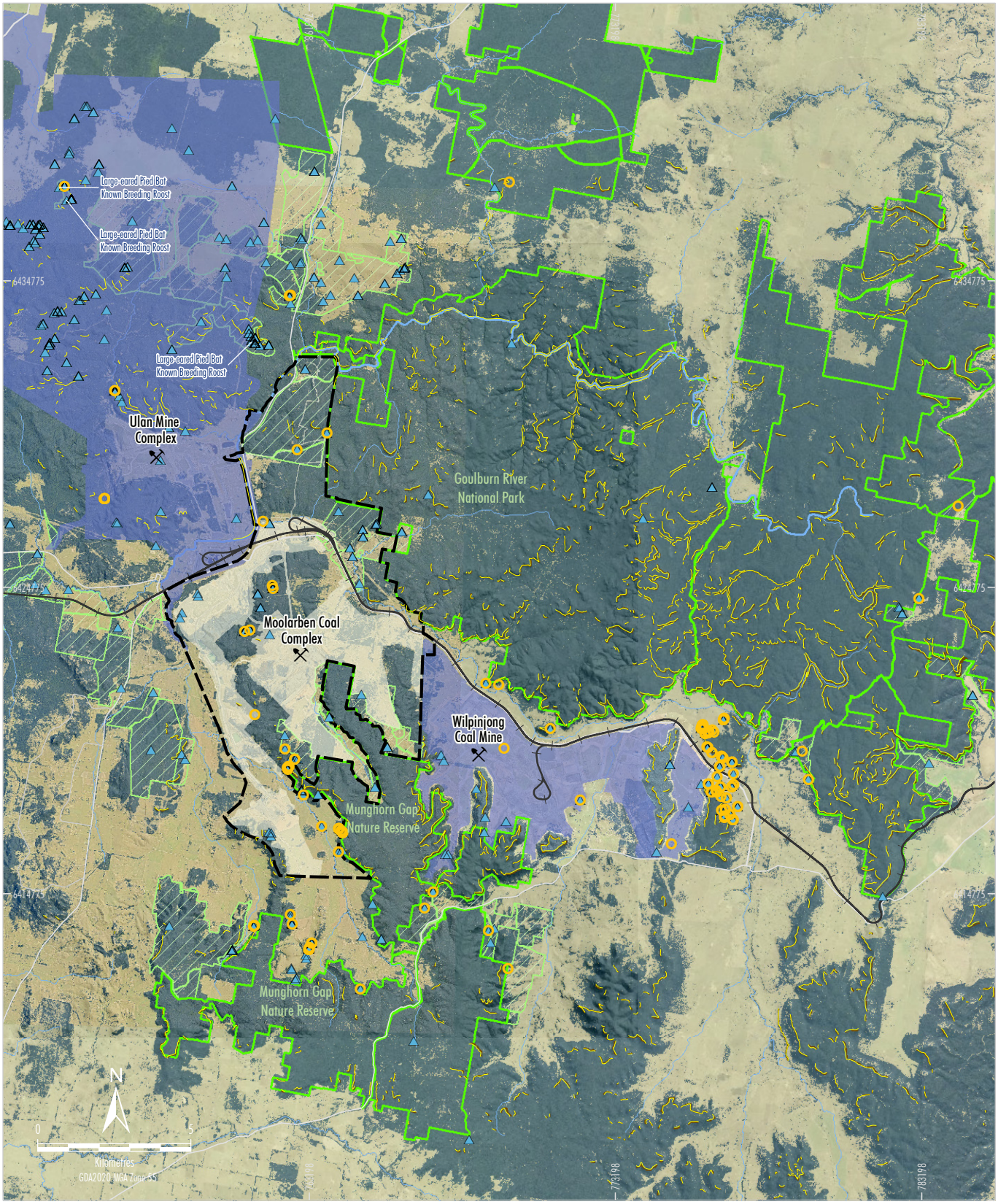
Large-eared Pied Bat BioNet Atlas Records

Figure 5

Table 1: NSW National Parks, Nature Reserves, Conservation Areas and State Forests containing Large-eared Pied Bat Records.

National Parks and Conservation Areas	Nature Reserves	State Forests
Bimberamala National Park	Barren Grounds Nature Reserve	Mogo State Forest
Meroo National Park	Joadja Nature Reserve	Ben Bullen State Forest
Morton National Park	Gulguer Nature Reserve	Olney State Forest
Bugong National Park	Mulgoa Nature Reserve	Kandos State Forest
Budderoo National Park	Cockle Bay Nature Reserve	Putty State Forest
Guula Ngurra National Park	Pambalong Nature Reserve	Coricudgy State Forest
Nattai National Park	Munghorn Gap Nature Reserve	Doona State Forest
Blue Mountains National Park	Pilliga Nature Reserve	Leard State Forest
Royal National Park	Manobalai Nature Reserve	Kangaroo River State Forest
Kanangra-Boyd National Park	Sherwood Nature Reserve	Conglomerate State Forest
Sydney Harbour National Park	Chambigne Nature Reserve	Camira State Forest
Scheyville National Park	Mann River Nature Reserve	Mount Belmore State Forest
Bouddi National Park	Mount Neville Nature Reserve	Yabbra State Forest
Wollemi National Park		
Upper Nepean State Conservation Area		
Wombeyan Karst Conservation Reserve		
Yerranderie State Conservation Area		
Nattai State Conservation Area		
Burragorang State Conservation Area		
Bents Basin State Conservation Area		
Gardens of Stone State Conservation Area		
Parr State Conservation Area		
Brisbane Water National Park		
Mount Canobolas State Conservation Area		
Yengo National Park		
Jilliby State Conservation Area		
Gardens of Stone National Park		
Mugii Murum-ban State Conservation Area		
Hill End Historic Site		
Capertee National Park		
Watagans National Park		
Sugarloaf State Conservation Area		
Goulburn River National Park		
Durridgere CCA Zone 3 State Conservation Area		
Coolah Tops National Park		
Warrumbungle National Park		
Mount Kaputar National Park		
Woodsreef CCA Zone 3 State Conservation Area		
Horton Falls CCA Zone 1 National Park		
Chambigne State Conservation Area		
Bullala CCA Zone 1 National Park		
Mount Pikapene National Park		
Whian Whian State Conservation Area		
Nightcap National Park		
Mount Jerusalem National Park		
Mebbin National Park		
Wollumbin National Park		
Jenolan Karst Conservation Reserve		
Ukerbarley Aboriginal Area		
Willala CCA Zone 2 Aboriginal Area		
Boonalla CCA Zone 2 Aboriginal Area		
Deriah CCA Zone 2 Aboriginal Area		



LEGEND

National Park/Nature Reserve
Existing Biodiversity Offset Area
Cliffs (Cliff Top and Area)
OC3 Extension
Indicative Amended Project Surface Disturbance Extent

NSW Woody Vegetation Extent
Not Woody
Woody

Threatened Bat Species Records
Eastern Cave Bat
Large-eared Pied Bat

Existing/Approved Development
Moolarben Coal Complex
Project Approval Boundary
Moolarben Coal Complex Disturbance Footprint
Other Mining Operations

Source: MCO (2023); NSW Spatial Services (2021)); ALA (2023); AMBS (2021, 2022); Biodiversity Monitoring Services (2013, 2015b); DPE (2023); ELA (2011, 2012, 2019, 2021, 2022a, 2022b); Fly By Night Bat Surveys (2017, 2018a, 2018b, 2019a, 2019b, 2020a, 2020b); Greg Richards and Associates Pty Ltd (2005); Lesryk Environmental Consultants (2013); Umwelt (2022);
Orthophoto Mosaic: MCO (2021)

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Threatened Bat Species Recorded in Moolarben Region

Figure 6

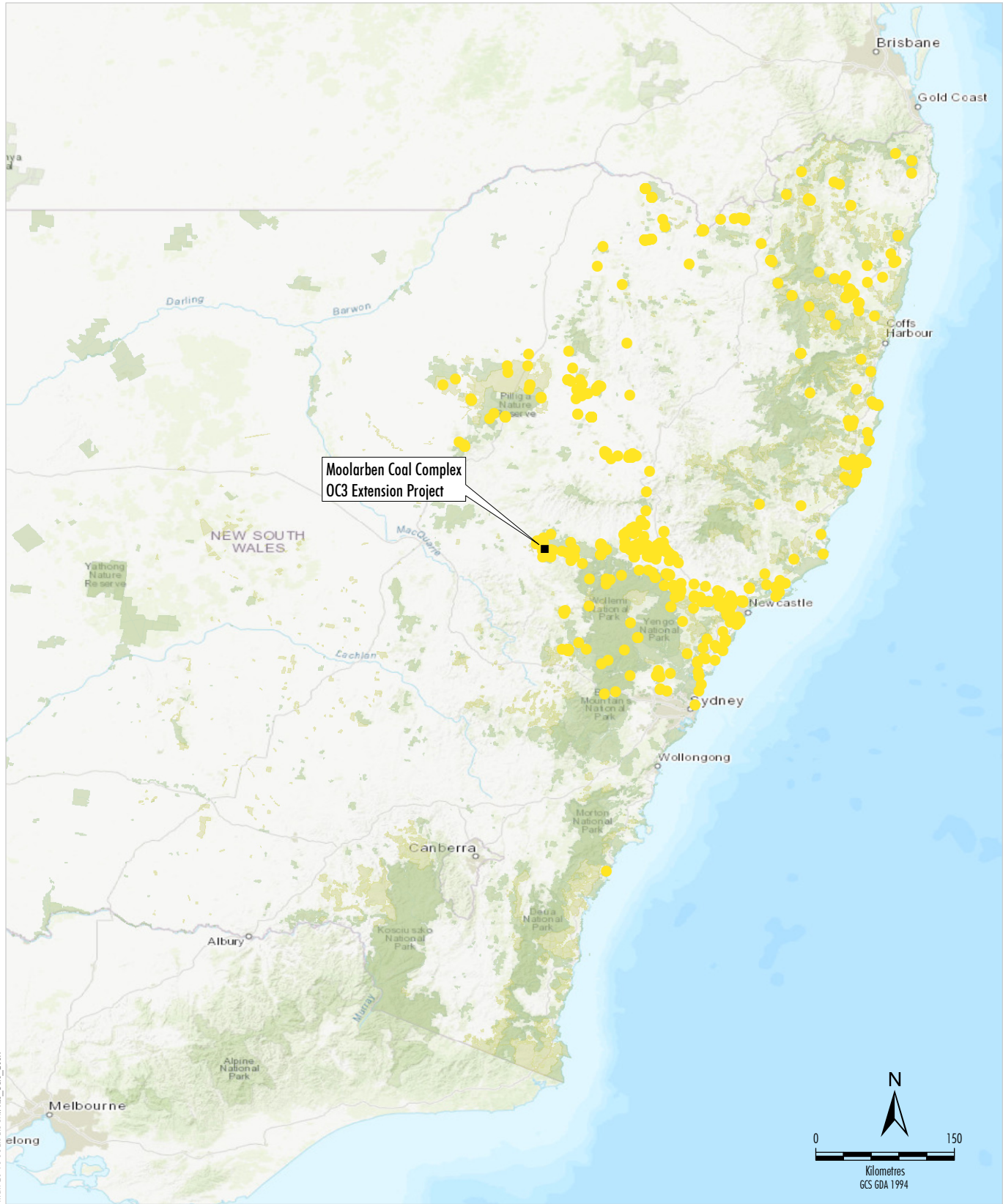
The species is considered sensitive to clearing (DECC 2007), with vegetated buffers around roosting habitat (within 100 m) then an important consideration when looking at direct impacts on a maternity roost within breeding habitat. The wing profile is short and broad, consistent with bat species that forage within the canopy rather than over open country (Hoye 2005). Williams and Thompson (2018) undertook radio tracking in the western Blue Mountains and found Large-eared Pied Bats foraging within 700 m of day roost habitat (no breeding roosts were observed). The bats foraged along the forest/pasture boundary and in adjacent forest/riparian areas. The species has been located however using areas that were 2.7 km along a riparian corridor from the nearest escarpment, or 2.2 km across open ground from the nearest escarpment (Lothian 2019b).

Reproduction occurs in autumn or spring, with young raised in maternity roosts from November through February (Churchill 2008). Fecundity is low, with only one to two young per year (Hoye and Dwyer 1995). The maternity roost at Copeton NSW cited in Hoye and Dwyer (1995) was utilised over at least two consecutive summers. The maternity roost the authors' located near Ulan noted breeding over at least three consecutive summers (Fly By Night Bat Surveys 2018; Fly By Night Bat Surveys 2020), with additional monitoring by other consultants extending that timeframe to seven consecutive years (Eco Logical Australia 2021). Pennay (2008) also observed a maternity roost near Coonabarabran being used over three consecutive summers. All this suggests site fidelity is high for maternity roosts (individuals return to the same breeding site), even in extreme seasons (like the Black Summer of 2019). Williams and Thompson (2018) observed Large-eared Pied bats showing fidelity to localised day roost areas or a cluster of roosts (rather than to an individual roost), however only two females were radio tracked during the breeding season (December) and both were identified as non-parous (never having given birth).

Eastern Cave Bat

The Eastern Cave Bat is a cave-roosting bat and belongs to another genus of insectivorous Vespertilionid bats. This species occurs predominantly in the coast and western slopes of eastern Australia, from Sydney north to Cape York (**Plate 2**; **Figure 7**). There are records of the Eastern Cave Bat in 35 National Parks, Nature Reserves and Conservation Areas as well as 12 State Forests in NSW (**Table 2**) (NSW DCCEEW 2024c).

Plate 2: Eastern Cave Bat NSW Mapping (NSW DCCEEW 2024d).



MCM-20-18 OC Ext EIS SAII Ass_Bats_203A

LEGEND

- Eastern Cave Bat - BioNet Atlas Record
- State Forest
- National Park /Nature Reserve

Source: ESRI Base (2023); BioNet Atlas (2023)

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Eastern Cave Bat BioNet Atlas Records

Figure 7

It sometimes shares habitat requirements with the Large-eared Pied Bat, utilising the same overhangs and caves, though also making use of limestone, volcanic and man-made structures (mines, bridges and buildings) on top of sandstone (Van Dyck and Strahan 2008; Churchill 2008). Often found roosting in smaller groups, the species can also form larger maternity colonies (up to 500) in summer when it seeks much hotter roosts. Though reported to use well lit areas, recent local work by the author (Andrew Lothian) has discovered them using cracks and pockets in the dark zones of domed roofs in low wide caves that slope upwards towards the back, as well as Fairy Martin (bottle) nests near the entrance.

Table 2: NSW National Parks, Nature Reserves, Conservation Areas and State Forests containing Eastern Cave Bat Records.

National Parks and Conservation Areas	Nature Reserves	State Forests
Sydney Harbour National Park	Pambalong Nature Reserve	Kandos State Forest
Brisbane Water National Park	Manobalai Nature Reserve	Doona State Forest
Blue Mountains National Park	Pilliga Nature Reserve	Baradine State Forest
Gardens of Stone State Conservation Area	Sherwood Nature Reserve	Cumbil State Forest
Wollemi National Park	Chambigne Nature Reserve	Pilliga East State Forest
Gardens of Stone National Park	Mann River Nature Reserve	Pilliga West State Forest
Yengo National Park	Arakoola Nature Reserve	Clouds Creek State Forest
Goulburn River National Park	Gibraltar Nature Reserve	Sheas Nob State Forest
Durridgere CCA Zone 3 State Conservation Area		Chaelundi State Forest
Towarri National Park		Ramornie State Forest
Wallabadah CCA Zone 1 National Park		Devils Pulpit State Forest
Sea Acres National Park		Girard State Forest
Warrumbungle National Park		
Goolawah National Park		
Willala CCA Zone 2 Aboriginal Area		
Pilliga CCA Zone 3 State Conservation Area		
Deriah CCA Zone 2 Aboriginal Area		
Guy Fawkes River National Park		
Chambigne State Conservation Area		
Ramornie National Park		
Gibraltar Range National Park		
Butterleaf National Park		
Bullala CCA Zone 1 National Park		
Kwiambal National Park		
Dthinna Dthinnawan CCA Zone 1 National Park		
Boonoo Boonoo National Park		
Mount Jerusalem National Park		

The Eastern Cave Bat is known from the local area as demonstrated by the records shown on **Figure 6**. It appears to be near the western extent of its range in the local area at Moolarben, with few records west of the Ulan Road despite substantial survey over several decades. Glenn Hoye has been surveying threatened bats in the local area over the past 29 years (Fly By Night Bat Surveys 1998; Fly By Night Bat Surveys 2020). Most of the survey work for the bat has been for mining companies, either at mine sites or offset areas, which is why the records are concentrated in those areas.

Potential habitat for the species is widespread through adjacent National Parks and Nature Reserves, as indicated by the cliff mapping (**Figure 6**). There has been a lack of bat surveys within the National Parks and Nature Reserves, where the majority of the local cliff habitat is located. There are likely to be a number of breeding sites throughout this potential habitat given the distribution of records found thus far (**Figure 6**).

As with Large-eared Pied Bat, cliffs adjacent fertile valley woodland are likely important to the species, with a mix of sandstone and volcanic substrates used. Box gum woodlands, riparian corridors and rainforest corridors would be used for foraging. Eastern Cave Bats are able to make use of extensive escarpment features through the year, but maternity sites have very specific structural (and climatic) requirements, making them rarer in the landscape. Low and wide entranced caves that slope up towards the back appear to be important features for maternity sites from recent observations in the local area by the authors. Similar cave attributes were found to house maternity roosts in northern NSW, with a tin-roofed shed also containing a maternity roost (Law and Chidel 2007). Thermal and humidity profiles differed between cave and shed roosts, but all were characterised by higher than ambient temperatures (though higher temperatures were present at different times of day for each type of roost). Higher temperature roosts are thought to be important for the growth of young individuals (Law and Chidel 2007). Caves with differing aspects were occupied, even though microclimate variables differed (Law and Chidel 2007). The Eastern Cave Bat exhibits low roost fidelity (Law *et al*. 2005), switching roosts (even when nursing) every few days (Churchill 2008).

The species uses vegetation and riparian corridors for foraging, but has been recorded travelling 500 m across open ground (Law *et al*. 2005). Due to frequent movement between roosts on a nightly basis (Law *et al*. 2005), vegetated buffers around roosting habitat are an important consideration when looking at direct impacts on breeding habitat. Furthermore, these vegetative links provide access for lactating mothers to source drinking water during rearing of young.

Similar to the Large-eared Pied Bat, births of young occur around mid-late November (Churchill 2008).

3. Relevance of Large-eared Pied Bat and Eastern Cave Bat to the Project

The Large-eared Pied Bat and Eastern Cave Bat are species credit species under the NSW Biodiversity Offset Scheme. The *BioNet Threatened Biodiversity Data Collection* (TBDC) (NSW DCCEEW 2024a) states the following for the Eastern Cave Bat:

> *Species polygon boundary should align with PCTs on the subject land to which the species is associated that are within 2 km of identified potential roost habitat features.*
> …
> *Any impacts on **breeding habitat** used by this species could be considered potentially serious and irreversible. Potential breeding habitat is PCTs associated with the species within 100m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the potential habitat.*

The same statements are made in the for the TBDC (NSW DCCEEW 2024a) for the Large-eared Pied Bat, noting that the list of breeding habitat contains "culverts, derelict concrete buildings" instead of "old buildings and sheds".

Breeding habitat is defined in the *Species credit threatened bats and their habitats, NSW survey guide for the Biodiversity Assessment Method* (Office of Environment and Heritage [OEH] 2018):

> *breeding habitat is considered present on the subject land if there is 1) potential breeding habitat … AND 2) breeding individuals of the target species.*
> …
> *Any bats of the target species observed (or previously recorded) that are pregnant, carrying pups, lactating, juveniles (i.e. less than six months old) should be considered positive confirmation of breeding habitat.*

A total of 110 harp trap nights and 98 Anabat detection nights were conducted by AMBS in January 2021 within the Study Area around the Project (Niche 2022). Locations of these surveys are presented in Figure 10 of the BDAR (Niche 2022), but are more clearly presented in Figure 2.2 of the fauna report (AMBS 2022). This is in line with requirements under the survey guidelines for threatened bats (OEH 2018).

Additionally, three days of cliffline inspections (27-30 March 2023, outside breeding period) were carried out by authors Andrew Lothian and Glenn Hoye, to ascertain the relative value of mapped rocky habitats in the areas where the proposed original footprint encroached on downslope buffer vegetation, or came close to mapped rocky features. The most likely Large-eared Pied Bat and Eastern Cave Bat habitat along the clifflines was mapped and is shown on **Figure 3**. As Eastern Cave Bats often move around from night to night, and utilise a matrix of roost structures through the year depending on seasonal requirements, the location of threatened bats in one location does not preclude them from being present or utilising other locations. Important roost caves could be found unoccupied on any given night owing to the movement of the bats (Law and Chidel 2007). Even if you surveyed all mapped cracks and caves, there would be no guarantee you had found every crevice available for use by the species', as cave structures are often seen high up on clifflines. One roost in Law *et al*. (2005) was located up a cliffline and required abseiling to inspect. As such, "unknown unknowns" make ruling out these species problematic if they have been found anywhere on/near site.

Thirteen Large-eared Pied Bats were captured in harp traps by AMBS in January 2021, with an additional six individuals observed/hand caught from habitat inspections (Niche 2022). One adult female was reported as lactating, with another two immature males indicating breeding has taken place locally. Locations of physically captured/observed individuals are mapped in **Figure 3,** with the records indicative of breeding identified independently. Three roosts were identified by AMBS (**Figure 3**), with another two-three identified by Andrew Lothian and Glenn Hoye during inspections in March 2023 (**Figure 3**).

Six Eastern Cave Bats were captured in harp traps by AMBS in January 2021 (**Figure 3**), with none recorded from physical habitat inspections. One post-lactating adult female and three immature males suggest breeding has taken place locally. Locations of trapped individuals are mapped in **Figure 3**, with those records suggesting breeding identified independently.

Additional PCTs have been considered associated with the species due to location of the two target bats in these PCTs on site. This approach is supported by the authors.

Direct impacts on mapped rocky habitat for the Large-eared Pied Bat and Eastern Cave Bat would be avoided by the Project (i.e. no clearance of mapped rocky habitat)[2]. Since the BDAR (Niche 2022) was submitted, MCO undertook a detailed review of the Development Footprint as presented in the Project EIS and has committed to avoiding further direct impacts on the 100 m buffer around suitable rocky habitat. Therefore, the only potential pathway for breeding habitat to be impacted is through indirect impacts. If there are no impacts on the bat breeding habitat, then the SAII considerations are not triggered.

Indirect impacts most relevant to these species and the Project include disturbance by light, and noise and vibration associated with blasting. These impacts are currently hard to quantify, but are temporary in nature. Once mining activity ceases, as long as the caves are not collapsed, bats that found the sites unsuitable for occupation during mining would be able to return to the caves post impact.

Disturbance by pest animals is listed in the BDAR (Niche 2022), and is already having potential impacts on site. A number of large caves with suitable attributes were identified by Andrew Lothian along the south-western cliffline section. These are currently subject to high disturbance from sheep sheltering in the caves, and could be having the same impact as feral goats.

The Eastern Cave Bat is not listed in the BDAR (Niche 2022) under prescribed impact for "features that provide for movement of threatened species that maintains their lifecycle". This would refer to the buffer of vegetation around the clifflines that would be used to support movement of this species between nightly roosts through the breeding seasons. Additional caves would be utilised by females throughout the night to digest prey in between foraging bouts. Linkage to these will be important when bats will be foraging bigger distances from maternity roosts after the Project removes valley vegetation.

Vehicle strike is not listed as a threat in TBDC, but is listed under prescribed impacts on the two bats in the BDAR (Niche 2022). Haul roads around the edge of the footprint could cause issues, but as haul roads are outside the forest canopy, this is considered less of an issue by the authors. Water bodies and water quality are identified as prescribed impacts for the bat species. Again, as the riparian corridor through the proposed mine is to be avoided, this is considered less of an issue here.

Backing up conclusions made in the BDAR, no suitable breeding habitat for Large Bent-winged Bat (*Miniopterus orianae oceanensis*) or Little Bent-winged Bat (*Miniopterus australis*) was identified by the authors while on site in March 2023.

[2] Note there is a typo error in the BDAR (Niche 2022) - The Eastern Cave Bat SAII component of the BDAR incorrectly states that "only foraging habitat within 2 km of rocky areas is considered at risk of an SAII". This statement is incorrect, as it is the breeding habitat component of this species polygon that the SAII applies to.

4. SAII Assessment

Information towards assessing the risk of SAII for Large-eared Pied Bat and Eastern Cave Bat is provided in Appendix F of the BDAR (Niche 2022). This information has been used to guide the following independent assessment relating to BAM Section 9.1.2 (DPIE 2020).

1. Action and measures taken to avoid the direct and indirect impact on the species at risk of an SAII

The Project considers alternative locations unsuitable due to proximity to existing infrastructure/operations, and visual amenity. Underground operations are not feasible with shallow coal seams. Project design has generally avoided areas of higher quality vegetation and habitat, and riparian zones around major creeklines. Progressive rehabilitation has been proposed to minimise the time habitat is absent from site.

The Project has been designed to avoid any direct and prescribed impacts on mapped rocky habitat for the two bat species, which breed in caves, crevices and overhangs along cliffs and scarps.

Since the BDAR (Niche 2022) was submitted, MCO undertook a detailed review of the Development Footprint presented in the Project EIS and has committed to avoiding further direct impacts on the 100 m buffer around suitable rocky habitat. If there are no impacts on the 100 m buffer around suitable rocky habitat, then the SAII considerations are not triggered. Avoidance of the buffering vegetation will retain connectivity between roost sites and foraging sites, and facilitate movement of breeding females and their young between changing roost sites in the case of Eastern Cave Bat (Churchill 2008).

There would be a direct impact on foraging habitat (woodland within 2 km of the rocky habitat), but this is not relevant to the SAII trigger.

MCO has revised the mine design to incorporate a 100 m setback of all Project disturbance (including open cut pit extents) from mapped rocky habitat associated with threatened bat species. As a result, the Project would not cause direct physical impacts to mapped rocky habitat features, and blast vibration at mapped rocky habitat features would be reduced, as they are now further from the proposed open cut pit extents when compared to the Project EIS. Therefore, the only significant remaining potential pathway for impact to mapped rocky habitat would be indirectly through blasting vibration.

In order to minimise the potential for indirect blast vibration impacts, MCO would adjust blast designs during Project operations to comply with a conservative vibration limit of 50 millimetres per second (mm/s) at the nearest mapped rocky habitat (safe design 5% exceedance level peak particle velocity [PPV] limit), unless further geotechnical investigation supports a higher value. Accordingly, sensitive geological features located further from blasting than the mapped rocky habitat (e.g. deeper into the Munghorn Gap Nature Reserve) would experience lower vibration as a result of this limit. Blast adjustment measures to achieve the vibration limit would include moderation of Maximum Instantaneous Charge (MIC) and/or implementation of pre-split blasts where appropriate, in accordance with the Moolarben Coal Complex Blast Management Plan (MCO 2020).

The proposed blast vibration limit was determined by specialist geotechnical engineers (PSM 2024) through a comprehensive analysis of historical blast monitoring data, inspection of other sensitive geological features subject to historical blasting (geotechnical characteristics, analysis of mining related impacts on proximal rocky outcrops and assessment of likely cause of suspected blast interactions), ground truthing of mapped rocky habitat surrounding the Project, and review of site-specific modelling predictions of vibration effects.

It is noted that higher vibration limits (250 mm/s) than proposed for the Project (50 mm/s) have been adopted at Moolarben based on recommendations from SLR (2018) to protect rock features associated with Aboriginal heritage shelter sites (this is the current design criterion under the Blast Management Plan [MCO 2020]). Analysis from geotechnical engineers (PSM 2024) suggests that vibration from blasting has caused no distinguishable impacts from natural processes or other anthropogenic sources (e.g. visitors moving rocks).

MCO would implement the following monitoring and mitigation measures to manage potential blast vibration impacts to mapped rocky habitat:

- pre-blast desktop assessment to identify the proximity of mapped rocky habitat to planned blast areas, in order to inform vibration modelling and therefore blast design;
- site-specific vibration modelling per blast to calculate MIC required to meet PPV limit for nearest mapped rocky habitat;
- continuation of existing vibration monitoring as described in the Blast Management Plan (MCO 2020), and implementation of additional vibration monitoring at one or more new representative sites of mapped rocky habitat adjacent to the Project;
- ongoing review of monitoring data to confirm and update site-specific vibration modelling where necessary; and
- visual inspections of key representative mapped rocky habitat on a 6-monthly basis to confirm that the target outcome of no physical impact to mapped rocky habitat (and therefore no physical impact to the Munghorn Gap Nature Reserve) as a result of blasting vibrations continues to be achieved.

These measures would be related to bat disturbance via a concurrent bat monitoring programme.

Other indirect impacts are being mitigated by management plans to monitor/control pest species, limit vehicle speeds at night in the vicinity of the bat habitat, and managing light spill outside the Project boundary. Vehicle strike would be minimised by all traffic using internal speed limited roads from existing infrastructure areas to the north. During clearing operations, the boundary of clearing at the buffer is to be clearly delineated.

2. <u>Current Population of the species</u>

a. Evidence of Rapid Decline presented by an estimate of the:

i. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or

ii. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites

No evidence of rapid decline of the Large-eared Pied Bat and Eastern Cave Bat is presented in the TBDC (NSW DCCEEW 2024a). Eastern Cave Bat is listed as “stable” under International Union for Conservation of Nature (IUCN) Red List Assessment (Pennay 2020a). Large-eared Pied Bat is listed as “decreasing” under IUCN Red List Assessment (Pennay 2020b). The IUCN Assessment (Pennay 2020b) for Large-eared Pied Bat states:

> *The population of* Chalinolobus dwyeri *is inferred to have experienced a 30% past decline in population size and number of mature individuals over the past three (3) generations (GL = 5.6 years; Pacifici* et al*. 2013) due to historic and ongoing high-level of loss and degradation of its habitat (Woinarski* et al*. 2014). At least 30% of the species area of occupancy burnt during wildfires in 2019-2020 alone and the decline is projected to be continuing. Expert estimations of the species total population have ranged between 10,000 (Pennay & Thompson 2008) and 20,000 individuals (Woinarski* et al*. 2014) and the number of mature individuals would be significantly lower. The total number of individuals in any of the scattered subpopulations is*

> *estimated to be less than 1,000 (Woinarski* et al*. 2014). Numerical analysis of reporting rates in NSW support previous assessments that it is naturally rare as the species accounts for less than 1% (9.9:1000) of all bats reported within its range on average (Pennay 2011).*

This is consistent with data presented in the BDAR (Niche 2022), which notes that the species are both data deficient with regards to accurately estimating population sizes and declines. Total population size (historical or current) for both species is difficult to establish, considering the species are typically surveyed by ultrasonic detection which only gives activity not abundance.

b. evidence of small population size presented by:

- ***i. an estimate of the species' current population size in NSW, and***
- ***ii. an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and***
- ***iii. where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations***

No evidence of a small population size of the Large-eared Pied Bat and Eastern Cave Bat is presented in the TBDC (NSW DCCEEW 2024a). Much of the species' habitat is in reserved land which is not systematically surveyed. Total population size (historical or current) for both species is unknown. Woinarski *et al*. (2014) estimated a total population size for the Large-eared Pied Bat across NSW and Queensland as <20,000 individuals.

This is consistent with data presented in Tables 53 and 56 in the BDAR (Niche 2022).

c. evidence of limited geographic range for the threatened species presented by:

- ***i. extent of occurrence***
- ***ii. area of occupancy***
- ***iii. number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and***
- ***iv. whether the species' population is likely to undergo extreme fluctuations***

<u>*Large-eared Pied Bat*</u>

The Large-eared Pied Bat uses various types of cliffline habitat across its range, with most records coming from sandstone geology. This does not construe "limited geographic range" for the purposes of this principle. Extent of Occurrence (EOO) and Area of Occupancy (AOO) are not available in TBDC (NSW DCCEEW 2024a).

Data presented in the BDAR (Niche 2022) suggest EOO is 280,000 square kilometres (km^2) and AOO is 1,500 km^2, based on calculations by Woinarski *et al*. (2014). This same data was presented in the Conservation Advice (DAWE 2021). The IUCN Red List Assessment (Pennay 2020b) states that the EOO for the Large-eared Pied Bat is 609,747 km^2 and the AOO is 1,508 km^2. The reason for the difference is not clear.

No threat defined locations are noted for the Large-eared Pied Bat, bearing in mind the Black Summer bushfires of 2019 covered a large proportion of their known geographic distribution. Due to its preference for rocky habitat, the species would appear to be somewhat protected by bushfires, though the preceding drought and loss of foraging habitat would have obvious effects on individual survival.

IUCN Red List Assessment (Pennay 2020b) states that there are no extreme fluctuations in the AOO of the Large-eared Pied Bat, but the species has shown a continued decline in AOO. Estimates for AOO for Large-eared Pied Bat have gone from 9,120 km^2 in Hoye and Dwyer (1995), to 1,500 km^2 in Woinarski *et al*. (2014), to 1,508 km^2 in IUCN (Pennay 2020b). EOO fluctuated to a greater extent, going from 570,000 km^2 to 280,000 km^2 to 609,747 km^2 respectively.

Eastern Cave Bat

The Eastern Cave Bat uses various types of cliffline habitat across its range. This does not construe "limited geographic range" for the purposes of this principle. EOO and AOO are not available in TBDC (NSW DCCEEW 2024a). Data presented in the BDAR (Niche 2022) suggest EOO is 285,609 km^2 and AOO is 41,946 km^2, based on calculations from Atlas of Living Australia (ALA 2022).

No threat defined locations are noted for the Eastern Cave Bat, bearing in mind the Black Summer bushfires of 2019 covered a large proportion of their known geographic distribution. Due to its preference for rocky habitat, the species would appear to be somewhat protected by bushfires, though the preceding drought and loss of foraging habitat would have obvious effects on individual survival.

IUCN Red List Assessment (Pennay 2020a) states that there are no extreme fluctuations in the Eastern Cave Bat populations, and no estimates for AOO and EOO are presented.

d. evidence that the species is unlikely to respond to management because:

- ***i. known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g. species is clonal) on, a biodiversity stewardship site***
- ***ii. the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site, or***
- ***iii. life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g. frogs severely impacted by chytrid fungus).***

Large-eared Pied Bat

This species is listed as an SAII entity on account of this principle, yet no data has been populated in the TBDC for the Large-eared Pied Bat (NSW DCCEEW 2024a). Large-eared Pied Bats have high site fidelity, and very selective microclimatic requirements during the breeding season. They are reliant on abiotic habitats (caves, scarps, cliffs, rocky overhangs and disused mines) for breeding and sheltering. It is currently unknown if these rocky habitats can be created or restored on biodiversity stewardship sites. Not enough data on microclimatic requirements of breeding roosts have been collected, though the authors have had some initial success with having bats occupy constructed rock habitat (one individual occupying one of two structures on one night).

Eastern Cave Bat

This species is listed as an SAII entity on account of this principle, yet no data has been populated in the TBDC for the Eastern Cave Bat (NSW DCCEEW 2024a). Eastern Cave Bats exhibit low site fidelity, and very selective microclimatic requirements during the breeding season. They are reliant on abiotic habitats (caves, scarps, cliffs, rocky overhangs and disused mines) for breeding and sheltering. It is currently unknown if these rocky habitats can be created or restored on biodiversity stewardship sites.

3. Record any unknown or data deficient information in the TBDC

No data for SAII has been populated in the TBDC for Large-eared Pied Bat or Eastern Cave Bat (NSW DCCEEW 2024a).

4. Impacts on the species at risk of an SAII from the proposal

a. the impact on the species' population (Principles 1 and 2) presented by:

i. an estimate of the number of individuals (mature and immature) present in the subpopulation on the subject land (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and

ii. an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or

iii. if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal

Large-eared Pied Bat

As described above, this species is not listed as an SAII entity on account of Principles 1 and 2. Regardless, this question is addressed below.

This species unit of measure is 'area' rather than 'individual' according to the TBDC (NSW DCCEEW 2024a) therefore the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted is provide below.

Information presented on Large-eared Pied Bat in the BDAR (Niche 2022) can be summarised as follows:

- Total NSW population is unknown, as is the size of the local population. This is due to scarcity of records/historical searches for the species. Woinarski *et al*. (2014) estimated a total population size for the species across NSW and Queensland as <20,000 individuals.
- Data deficiency prevents estimation of subpopulation or NSW population.

The subject land is defined as the Development Footprint. The Project would result in the direct clearance of approximately 113.02 ha of foraging habitat in the Development Footprint for the Amended Project. No habitat within 100 m of the rocky habitat would be directly impacted by the Project.

The number of Large-eared Pied Bat individuals that use the subject land (i.e. forage in the habitat in the Development Footprint) is unknown but is estimated to be potentially in the order of 100s of individuals based on experience in surveying bats in the local area. Foraging habitat is not limited in the local area so the number of individuals likely to be impacted is estimated to be less.

Total NSW population is unknown, but given that approximately 113.02 ha of the Development Footprint is foraging habitat for the Large-eared Pied Bat, or 0.075% of the species occurrence (AOO 1,500 km^2 [Woinarski et al. 2014]), it is not unreasonable that the number of individuals present in the subpopulation on the subject land as a percentage of the total NSW population could be similar.

Eastern Cave Bat

As described above, this species is not listed as an SAII entity on account of Principles 1 and 2. Regardless, this question is addressed below.

This species unit of measure is 'area' rather than 'individual' according to the TBDC (NSW DCCEEW 2024a) therefore the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted is provide below.

The Project would result in the direct clearance of approximately 113.02 ha of foraging habitat in the Development Footprint for the Amended Project. No habitat within 100 m of the rocky habitat would be directly impacted by the Project.

The number of Eastern Cave Bat individuals that use the subject land (i.e. forage in the habitat in the Development Footprint) and would be impacted is unknown but is estimated to be potentially in the order of 100s of individuals based on experience in surveying bats in the local area. Foraging habitat is not limited in the local area so the number of individuals likely to be impacted is estimated to be less.

Total NSW population is unknown, but given that approximately 113.02 ha of the Development Footprint is foraging habitat for the Eastern Cave Bat, or 0.003% of the species occurrence (AOO 41,946 km^2 [ALA 2022]), it is not unreasonable that the number of individuals present in the subpopulation on the subject land as a percentage of the total NSW population could be similar.

b. impact on geographic range (Principles 1 and 3) presented by:

i. the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW

As described above, the Large-eared Pied Bat and Eastern Cave Bat are not listed as an SAII entity on account of Principles 1 and 3. Regardless, this question is addressed below.

Large-eared Pied Bat

The EOO for the Large-eared Pied Bat is estimated to be 280,000 km^2 and AOO is 1,500 km^2 (Woinarski *et al*. 2014). The Project would not impact the EOO of the species, as the Project is not at a limit of the species extent. The Project may impact 0.075% of the AOO.

Eastern Cave Bat

The EOO for the Eastern Cave Bat is estimated to be 285,609 km^2 and AOO is 41,946 km^2 (ALA 2022). The Project would not impact the EOO of the species, as the Project is not at a limit of the species extent. The Project may impact 0.003% of the AOO.

ii. the impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted

The Project would affect some Large-eared Pied Bat and Eastern Cave Bat individuals and habitat by removing approximately 113.02 ha of foraging habitat shared by the species). No habitat within 100 m of the rocky habitat would be directly impacted by the Project. MCO would implement monitoring and mitigation measures to manage potential blast vibration impacts to mapped rocky habitat.

iii. to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g. seed dispersal) and pollination distance for the species

The Large-eared Pied Bat and Eastern Cave Bat habitat occurs around the edge of the Project footprint and would not be fragmented. Connectivity remains through surrounding forest/escarpment and Nature Reserve. Progressive rehabilitation will minimise the time foraging habitat is absent around breeding areas in the east.

Direct clearance of breeding habitat is being avoided, and extensive areas of potential breeding habitat exist in the local area, with the neighbouring Munghorn Gap Nature Reserve likely being an important reservoir for the local population. A great proportion of records from BioNet (NSW DCCEEW 2024c) are from reserved areas (National Parks and Nature Reserves; **Figures 5** and **7**) which obviously contain a lot of the required rocky habitat.
Having a 100 m vegetated buffer around rocky breeding habitat in surrounding areas avoided means genetic exchange should be able to continue for both species, and populations of both should remain connected and viable with the Project proceeding.

iv. to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections of the BDAR or BCAR.

The Project would not change fire regimes, hydrology, increase fragmentation, increase edge effects, or increase predation. The habitat already exists at the edge of modified agricultural land, though in some places the edge would be moved closer to the rocky habitat (**Figure 4**). Exotic predators already exist in the landscape and having a site plan to monitor and trigger control of them would be implemented. Vehicle strike is considered to be a very low risk as haul roads are positioned outside of forested vegetation.

5. New information to demonstrate that the principle identifying the species as at risk of an SAII, is inaccurate.

No new information relating to the listing of the two species as SAII entities has been produced.

5. Is there likely to be an SAII?

Breeding habitat for the Large-eared Pied Bat and Eastern Cave Bat (*PCTs associated with the species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings* [NSW DCCEEW 2024a]) is listed at risk of a SAII due to Principle 4 (NSW DCCEEW 2024b):

> *Principle 4 - the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.*

There is "*evidence that the species is unlikely to respond to management"* (DPIE 2020) because, based on current knowledge, "*the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site"* (DPIE 2020).

The Project was designed to avoid any direct impacts on "*abiotic habitats"* (mapped rocky habitat) for the two bat species. Since the BDAR (Niche 2022) was submitted, MCO undertook a detailed review of the Development Footprint presented in the Project EIS and has committed to avoid further direct impacts on the 100 m buffer around suitable rocky habitat. If there are no impacts on the 100 m buffer around suitable rocky habitat, then the SAII considerations are not triggered.

The only potential pathway for the breeding habitat to be impacted is through indirect impacts. Indirect impacts are minimal and relate mostly to edge effects and exposure to noise, vibration, light spill and dust. Most of these would be somewhat mitigated by avoiding the loss of the 100 m vegetation buffer around suitable rocky habitat. It is possible for blasting vibration to lead to the reduced use of the roosts, however if the roost structures are retained it is likely that any reduction would be temporary (i.e. the life of the active mine).

The Project would not contribute significantly to the risk of the Large-eared Pied Bat and Eastern Cave Bat becoming extinct as the direct impacts on the area 100 m from mapped rocky habitat are now avoided, and some indirect impacts (blasting vibrations) are likely to be short-term. MCO would implement monitoring and mitigation measures to manage potential blast vibration impacts to mapped rocky habitat, and assess bat disturbance from such impacts.

6. Further Measures to Mitigate/Manage Residual Impacts

As explained in Section 4, in order to minimise the potential for indirect blast vibration impacts, MCO would adjust blast designs during Project operations to comply with a conservative vibration limit of 50 mm/s at the nearest mapped rocky habitat (safe design 5% exceedance level PPV limit) as determined by specialist geotechnical engineers (PSM 2024), unless further geotechnical investigation supports a higher value.

MCO would implement the following monitoring and mitigation measures to manage potential blast vibration impacts to mapped rocky habitat:

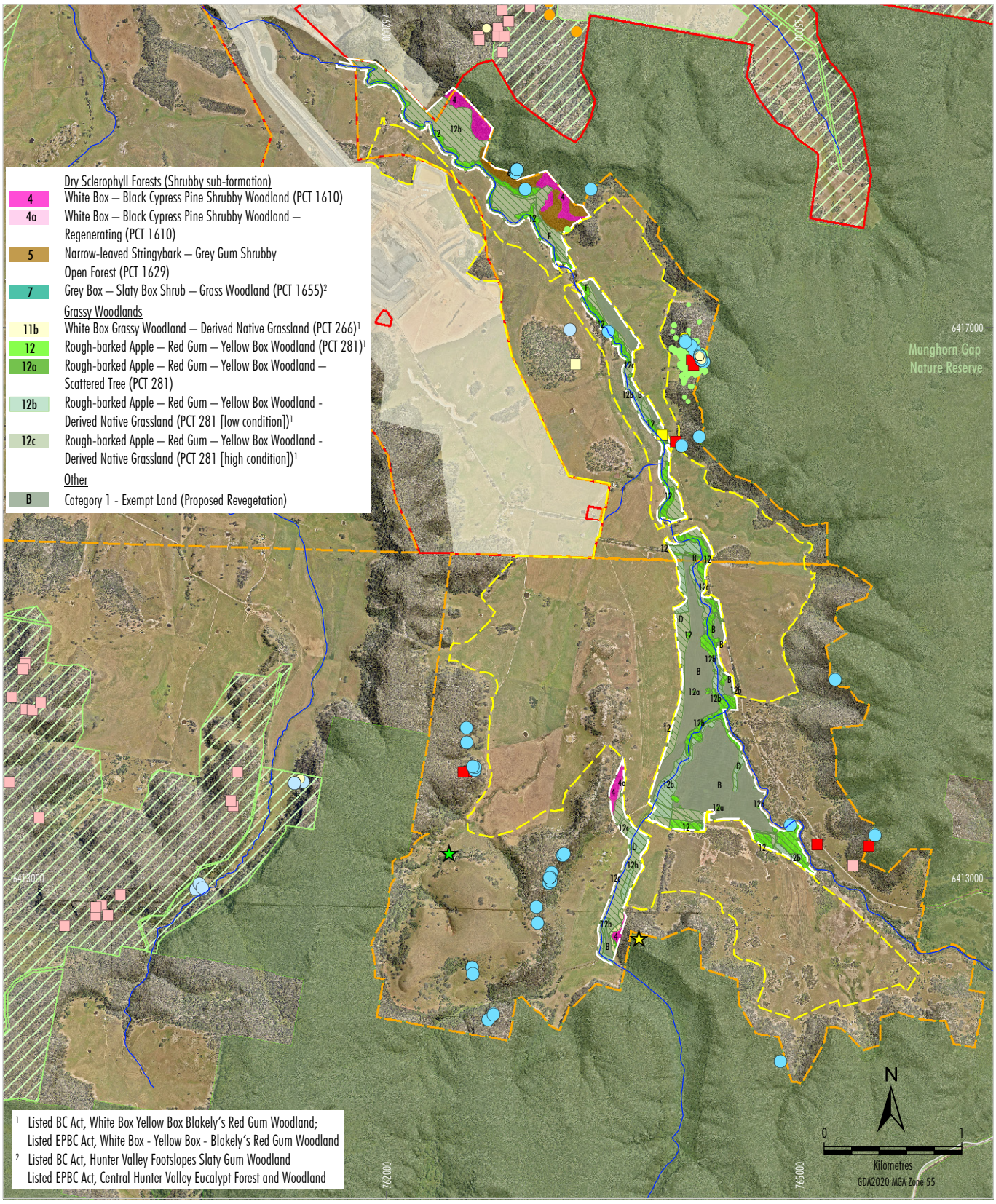
- pre-blast desktop assessment to identify the proximity of mapped rocky habitat to planned areas, in order to inform vibration modelling and therefore blast design;
- site-specific vibration modelling per blast to calculate MIC required to meet PPV limit for nearest mapped rocky habitat;
- continuation of existing vibration monitoring as described in the Blast Management Plan (MCO 2020), and implementation of additional vibration monitoring at one or more new representative sites of mapped rocky habitat adjacent to the Project;
- ongoing review of monitoring data to confirm and update site-specific vibration modelling where necessary; and
- visual inspections of key representative mapped rocky habitat on a 6-monthly basis to confirm that the target outcome of no physical impact to mapped rocky habitat (and therefore no physical impact to the Munghorn Gap Nature Reserve) as a result of blasting vibrations continues to be achieved.

A monitoring program for Large-eared Pied Bat and Eastern Cave Bat would be implemented. This would involve targeted surveys and monitoring of select caves, such as the roosts that have been identified by AMBS (2022) and Biodiversity Monitoring Services. An automated process may be able to be setup, whereby vibration sensors, noise sensors, cameras and bat detectors are all used to record data.

To mitigate and offset the loss of foraging habitat, MCO would:

- implement a Habitat Enhancement Area surrounding the Project (including 20.4 ha of the 100 m buffer and rocky habitat), involving revegetation, fencing to exclude grazing livestock (as required), weed management, animal pest management, and fire management (**Figure 8**);
- undertake progressive rehabilitation of disturbed areas following completion of active mining operations (**Figure 9**); and
- provide species credits for the Large-eared Pied Bat and Eastern Cave Bat under the NSW Biodiversity Offset Scheme.

Dr Paul Frazier (2rog 2024) undertook a review of the potential of the proposed woodland mine site rehabilitation areas to provide habitat for the Eastern Cave Bat and Large-eared Pied Bat considering the performance of existing rehabilitation areas within Moolarben Coal Complex and at the nearby Ulan Coal Mine. It was concluded that mine site rehabilitation could provide for the re-establishment of habitat for threatened species in the long-term, as evidenced by the existing rehabilitation at Moolarben Coal Complex which currently provides or has potential to provide foraging habitat for a range of microbat species, including the Eastern Cave Bat and Large-eared Pied Bat (2rog 2024). Long-term monitoring by the author (Glenn Hoye) of open cut mine rehabilitation areas at Ulan Coal Mine indicates that a range of insectivorous bat species use rehabilitated areas within 10 years of planting and by 18 years, activity levels are equivalent to that in surrounding forested areas (Hoye 2012; Fly By Night 2004). Of particular note, Large-eared Pied Bats have been recorded on Anabat detectors within rehabilitation areas.



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LEGEND

- National Park/Nature Reserve
- Existing Biodiversity Offset Area
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- Indicative Amended Project Surface Disturbance Extent

Habitat Enhancement Area

- Indicative Habitat Enhancement Area Extent
- Box-Gum Woodland CEEC

	Survey	Database
Threatened Flora Records		
Cotoneaster Pomaderris		
Threatened Fauna Records		
Pink-tailed Legless Lizard		
Broad-headed Snake		
Koala		
Squirrel Glider		
Large-eared Pied Bat		
Eastern Cave Bat		
Swift Parrot		

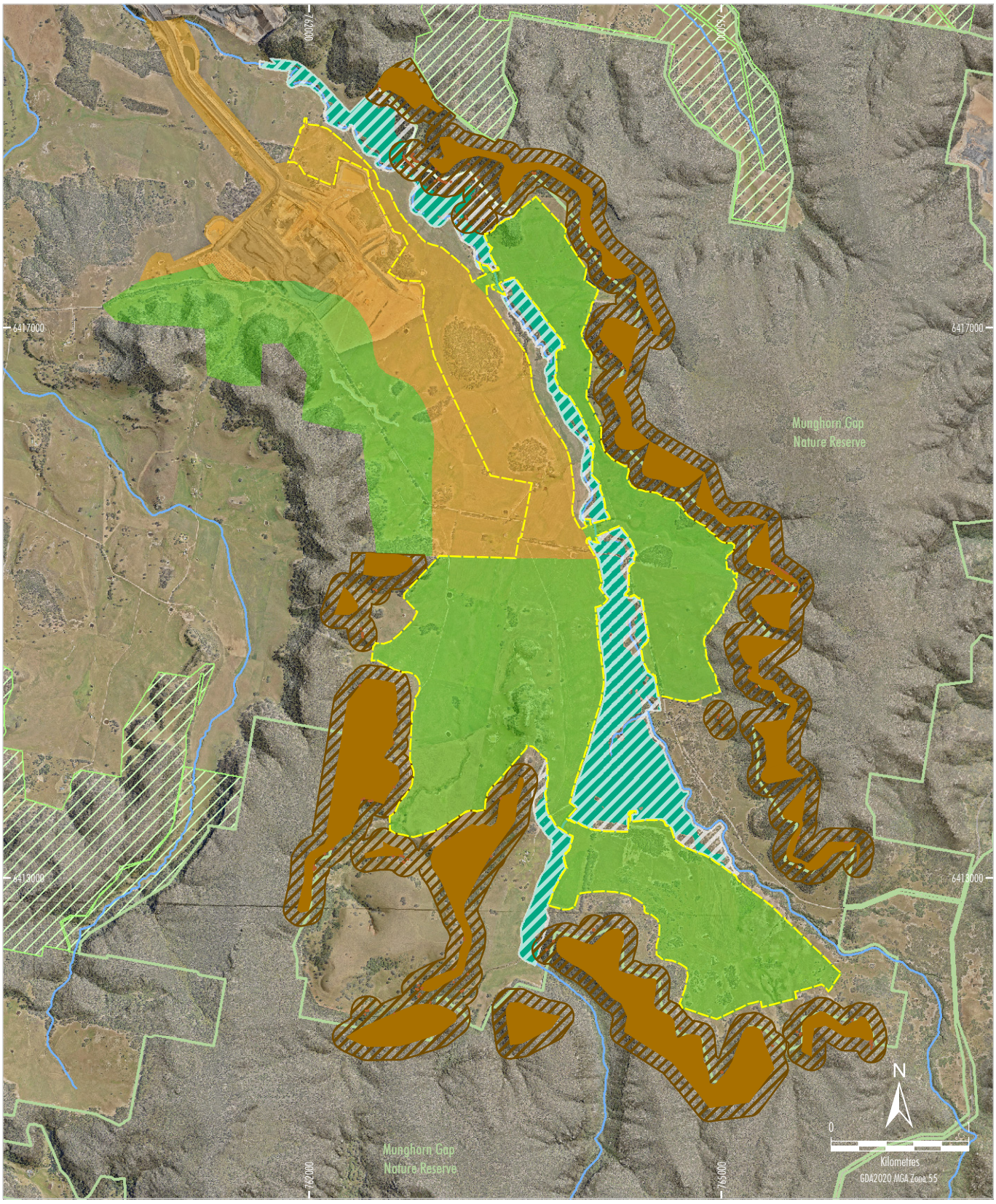
Source: MCO (2023); NSW Spatial Services (2021); Eco Logical Australia (2023); AMBS (2023). Orthophoto Mosaic: MCO (2021)

YANCOAL 克煤澳大利亚有限公司 MOOLARBEN COAL

MOOLARBEN COAL COMPLEX

Habitat Enhancement Area Values

Figure 8



MCIA-20-18 OC Ext EIS SAII Ass_ Bats_ 210C

LEGEND

- National Park/Nature Reserve
- Indicative Amended Project Surface Disturbance Extent
- Existing Biodiversity Offset Area
- Threatened Bat Mapped Rocky Habitat
- 100 m Buffer from Mapped Rocky Habitat (Breeding Habitat)

Conceptual Post-mining Land Use Areas

- Agricultural Pasture/Scattered Trees
- Native Woodland

Habitat Enhancement Area

- Indicative Habitat Enhancement Area Extent
- Indicative Revegetation Area Extent

Source: MCO (2023); NSW Spatial Services (2021); AMBS (2023)
Orthophoto: MCO (2021)

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Revised Conceptual Post-mining Land Use

Figure 9

7. Conclusion

The Large-eared Pied Bat and Eastern Cave Bat are listed as threatened entities at risk of an SAII under principle 4 of the NSW *Biodiversity Conservation Regulation 2017*. Both species are unlikely to respond to measures to improve their habitat and vegetation integrity and therefore their members are not replaceable. The trigger for considering SAII is disturbance within 100 m of the rocky habitat (particularly breeding roosts).

The Project would not contribute significantly to the risk of the Large-eared Pied Bat and Eastern Cave Bat becoming extinct (i.e. no SAII) as the Project has been re-designed to avoid any direct clearance within 100 m of the mapped rocky habitat that is likely to contain breeding roosts. Mitigation strategies will be put in place to assess the occupation of man-made structures within the footprint, and remove bats from/prevent them from occupying structures in the lead up to removal.

Potential indirect impacts on the rocky bat habitat would be managed by:

- adjusting the blast designs during Project operations to comply with a conservative vibration limit of 50 mm/s at the nearest mapped rocky habitat (safe design 5% exceedance level PPV limit) as determined by specialist geotechnical engineers (PSM 2024), unless further geotechnical investigation supports a higher value;
- implementing monitoring and mitigation measures to manage potential blast vibration impacts to mapped rocky habitat; and
- implementing a monitoring program for Large-eared Pied Bat and Eastern Cave Bat.

To mitigate and offset the loss of foraging habitat outside of the 100 m buffer of mapped rocky habitat, MCO would:

- implement a Habitat Enhancement Area surrounding the Project (including 20.4 ha of the 100 m buffer and rocky habitat), involving revegetation, strategic removal of fencing (as required), weed management, animal pest management, and fire management;
- undertake progressive rehabilitation of disturbed areas following completion of active mining operations; and
- provide species credits for the Large-eared Pied Bat and Eastern Cave Bat under the NSW Biodiversity Offset Scheme.

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9. Appendix A: Author Experience

Glenn Hoye has been working as a specialist bat consultant (Fly By Night Bat Surveys) for 31 years (since 1992). He has worked on a variety of projects assessing the impact of development proposals on bats and formulating plans to minimise potential impacts of these proposals on resident bat communities. Glenn has contributed species information and comments to the Federal survey guidelines for threatened bats (DEWHA, 2010), and disseminated much information on bats at various conferences (see list of related publications below). Currently, Glenn is working on preparing a number of scientific papers for various cave-roosting species for the NSW DCCEEW Saving Our Species program.

Andrew Lothian has been working alongside Glenn Hoye since 2009, bringing Glenn in house to BMS in 2020. Both Andrew and Glenn worked on developing and conducting underground mining impact monitoring surveys for cave roosting bats at Ulan, Moolarben and Wilpinjong. Ongoing work at Wilpinjong has recently been published in a scientific journal (Lothian and Hoye, 2023). Andrew has also been involved with impact assessment and roost relocation of cave roosting bats in other areas of the central west, as well as conducting long term monitoring work (including bat survey) at Newnes Plateau for the last 15 years. Part of the work at Ulan involved conducting a similar monitoring program to what is proposed here. Also, Glenn identified a number of Large-eared Pied Bat maternity roosts at Ulan that are among the longest continuously monitored maternity roosts for the species. Combine this with identification of a number of Large-eared Pied Bat and Eastern Cave Bat roosts across Moolarben and Wilpinjong leases, you can see the authors have extensive experience with these species (and other cave-roosting bats) in the local area.

Both authors have also helped guide work conducted by Elizabeth Williams on Large-eared Pied Bat in the western Blue Mountains (Williams, 2018).

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MOOLARBEN COAL COMPLEX OC3 EXTENSION PROJECT

REVIEW OF THE ASSESSMENT FOR SERIOUS AND IRREVERSIBLE IMPACTS ON THE BROAD-HEADED SNAKE

February 2024

1. Introduction

Moolarben Coal Operations (MCO) is proposing an extension to the approved OC3 mining operations, located approximately 40 kilometres (km) north of Mudgee, New South Wales (NSW) (**Figure 1; Figure 2**). Approval for this State Significant Development is being sought under Part 4 of the *Environmental Planning and Assessment Act 1979*. Niche Environment and Heritage (Niche), in collaboration with Premise, prepared a Biodiversity Development Assessment Report (BDAR) for the Project Environmental Impact Statement (EIS) (Niche 2022).

AMBS Ecology and Heritage (AMBS) (2022) undertook targeted fauna surveys for the Project in 2021 and located one Broad-headed Snake (*Hoplocephalus bungaroides*) individual. It was recorded *"approximately 30 m outside the Study Area boundary, at the edge of the escarpment under a large sandstone rock"* (**Figure 3**). According to AMBS (2022), *"the habitat in which the individual was recorded is contiguous with potential habitat that occurs within the Study Area"*, i.e., the exfoliating rocky ridgetops and escarpments surrounding the Development Footprint. The record was found in Plant Community Type (PCT) 1629 (**Figure 3**).

The Broad-headed Snake is listed as a threatened entity at risk of a Serious And Irreversible Impact (SAII). According to the Biodiversity Assessment Method (BAM) (DPIE 2020): "*The determination of a serious and irreversible impact on biodiversity values is to be made by the decision-maker in accordance with the principles set out in the BC Regulation"*.

The NSW *Biodiversity Conservation Regulation 2017* states:

6.7 Principles applicable to determination of "serious and irreversible impacts on biodiversity values" (section 6.5(1))

(1) This clause applies for the purposes of determining whether an impact on diversity values is a serious and irreversible impact for the purposes of the biodiversity offsets scheme.

(2) An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because—

(a) it will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or

(b) it will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or

(c) it is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or

(d) the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.

(3) For the purpose of this clause, a decline of a species or ecological community is a continuing or projected decline in—

(a) an index of abundance appropriate to the taxon, or

(b) the geographic distribution and habitat quality of the species or ecological community.

LEGEND
- State Forest
- National Park /Nature Reserve
- Local Government Boundary
- Exploration Licence Boundary
- Mining Lease Boundary
- Mining Operation
- Indicative Amended Project Surface Disturbance Extent

Source: NSW Spatial Services (2021)
MCO (2023)

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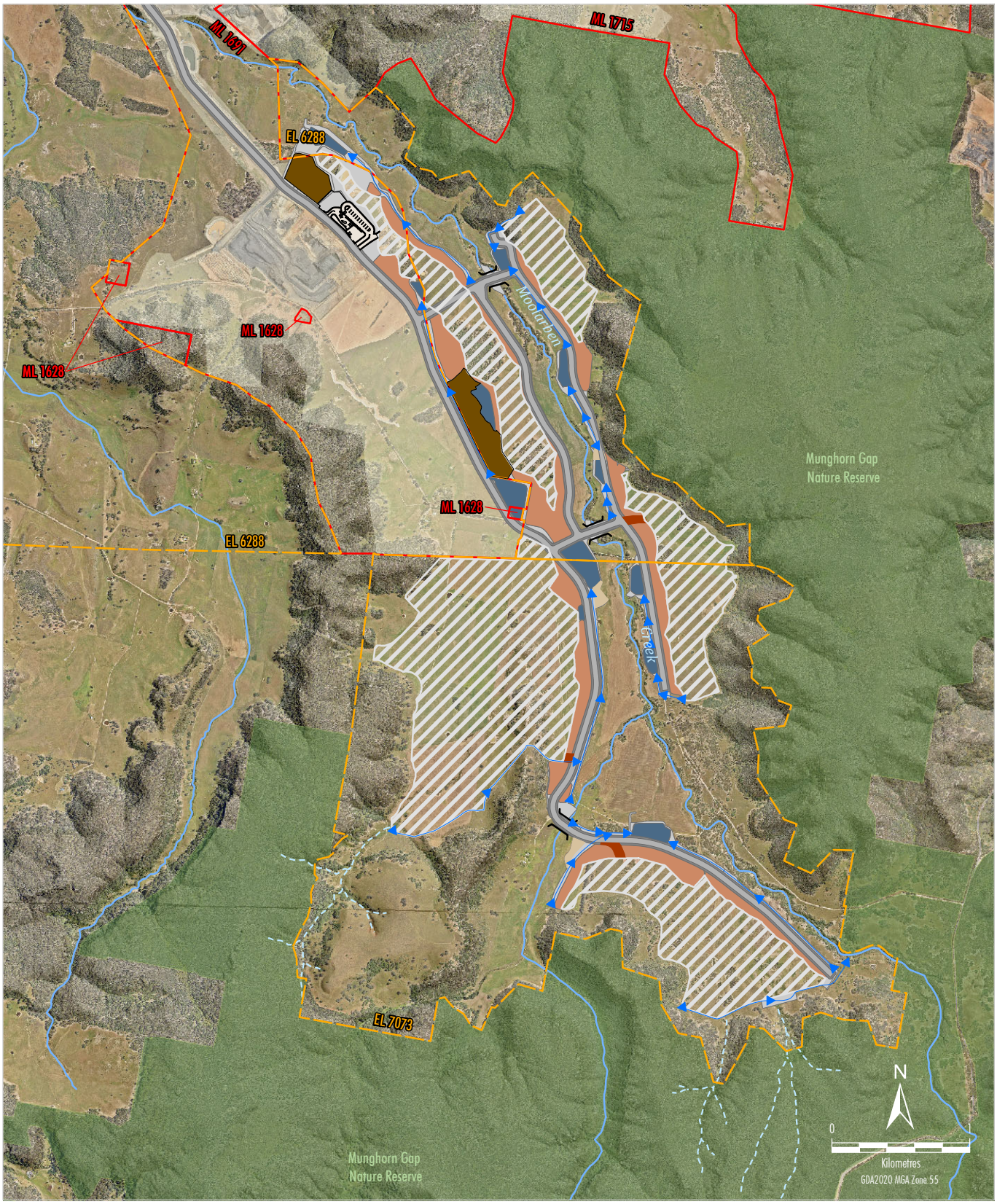
Project Location

MCM-20-18 OC Ext EIS AP SAII Ass_BS_201B

Figure 1



MCM-20-18 OC Ext EIS AP SAII Ass_ BS_202C

LEGEND

- National Park/Nature Reserve
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- OC3 Extension Project - Amended
- Indicative Open Pit Extent
- Indicative ROM Pad
- Culvert
- Indicative Haul Roads and Infrastructure Corridor
- Indicative Infrastructure Area
- Indicative Construction/Rehabilitation Material Stockpiles
- Conceptual Flood Levee Embankment
- Conceptual Water Management Infrastructure
- Indicative Vehicle Access
- Conceptual Surface Water Drain

Source: MCO (2023); NSW Spatial Services (2021)
Orthophoto: MCO (2021)

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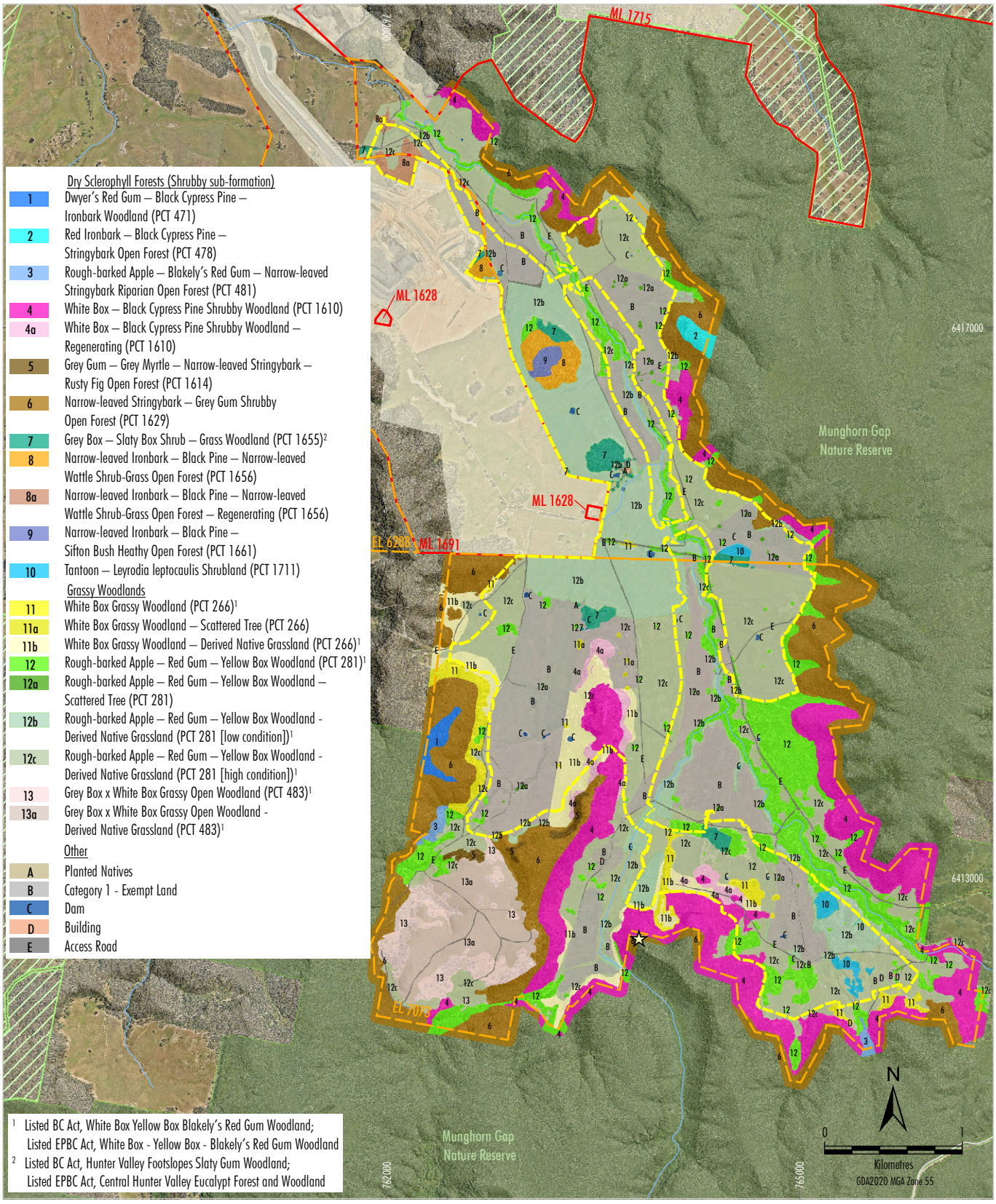
General Arrangement of the Amended Project

Figure 2



Dry Sclerophyll Forests (Shrubby sub-formation)

1 Dwyer's Red Gum – Black Cypress Pine – Ironbark Woodland (PCT 471)

2 Red Ironbark – Black Cypress Pine – Stringybark Open Forest (PCT 478)

3 Rough-barked Apple – Blakely's Red Gum – Narrow-leaved Stringybark Riparian Open Forest (PCT 481)

4 White Box – Black Cypress Pine Shrubby Woodland (PCT 1610)

4a White Box – Black Cypress Pine Shrubby Woodland – Regenerating (PCT 1610)

5 Grey Gum – Grey Myrtle – Narrow-leaved Stringybark – Rusty Fig Open Forest (PCT 1614)

6 Narrow-leaved Stringybark – Grey Gum Shrubby Open Forest (PCT 1629)

7 Grey Box – Slaty Box Shrub – Grass Woodland (PCT 1655)[2]

8 Narrow-leaved Ironbark – Black Pine – Narrow-leaved Wattle Shrub-Grass Open Forest (PCT 1656)

8a Narrow-leaved Ironbark – Black Pine – Narrow-leaved Wattle Shrub-Grass Open Forest – Regenerating (PCT 1656)

9 Narrow-leaved Ironbark – Black Pine – Sifton Bush Heathy Open Forest (PCT 1661)

10 Tantoon – Leyrodia leptocaulis Shrubland (PCT 1711)

Grassy Woodlands

11 White Box Grassy Woodland (PCT 266)[1]

11a White Box Grassy Woodland – Scattered Tree (PCT 266)

11b White Box Grassy Woodland – Derived Native Grassland (PCT 266)[1]

12 Rough-barked Apple – Red Gum – Yellow Box Woodland (PCT 281)[1]

12a Rough-barked Apple – Red Gum – Yellow Box Woodland – Scattered Tree (PCT 281)

12b Rough-barked Apple – Red Gum – Yellow Box Woodland - Derived Native Grassland (PCT 281 [low condition])[1]

12c Rough-barked Apple – Red Gum – Yellow Box Woodland - Derived Native Grassland (PCT 281 [high condition])[1]

13 Grey Box x White Box Grassy Open Woodland (PCT 483)[1]

13a Grey Box x White Box Grassy Open Woodland - Derived Native Grassland (PCT 483)[1]

Other

A Planted Natives

B Category 1 - Exempt Land

C Dam

D Building

E Access Road

[1] Listed BC Act, White Box Yellow Box Blakely's Red Gum Woodland; Listed EPBC Act, White Box - Yellow Box - Blakely's Red Gum Woodland

[2] Listed BC Act, Hunter Valley Footslopes Slaty Gum Woodland; Listed EPBC Act, Central Hunter Valley Eucalypt Forest and Woodland

LEGEND

National Park/Nature Reserve

Existing Biodiversity Offset Area

Exploration Licence Boundary

Mining Lease Boundary

Moolarben Coal Complex Disturbance Footprint

Indicative Amended Project Surface Disturbance Extent

Broad-headed Snake Record

Source: MCO (2023); NSW Spatial Services (2021); Eco Logical Australia (2023)
Orthophoto Mosaic: MCO (2021)

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Vegetation Mapping

Figure 3

The Broad-headed Snake is listed as a threatened entity at risk of an SAII due to Principle 4 (NSW Department of Climate Change, Energy, the Environment and Water [NSW DCCEEW] 2024a):

> *Principle 4 - the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity, and therefore its members are not replaceable.*

Andrew Lothian from Biodiversity Monitoring Services was approached to review the Niche (2022) assessment of Broad-headed Snake against the relevant requirements, and evaluate if any residual impacts (i.e. impacts that would remain after implementation of proposed avoidance/minimisation measures) are serious and irreversible, and whether there are any further measures that would minimise those impacts to avoid an SAII. The 2022 BDAR has been updated by Niche to reflect the Amended Project. The findings of this assessment have also been updated to reflect the Amended Project and reduced impacts.

This review has been undertaken by Andrew Lothian, independent of the BDAR (Niche 2022). This review is not being undertaken in Andrew Lothian's capacity as an accredited assessor.

2. Background information: Broad-headed Snake

The Broad-headed Snake is an Elapid snake belonging to a genus of agile climbers with keeled ventral scales (Cogger 2014). This species occurs in the Triassic and Permian sandstones of the Sydney Basin, including Hawkesbury, Narrabeen and Shoalhaven groups.

The BDAR notes that the snake is known from the Munghorn Gap Nature Reserve (NSW National Parks and Wildlife Service [NPWS] 2003), yet of the 494 records in the NSW BioNet Atlas (NSW DCCEEW 2024b), no records are known to exist in Munghorn Gap Nature Reserve confirming this detail. Note that this species is categorised as a 'sensitive species' and therefore geographic coordinates of species records have been withheld from this report based on the NSW BioNet Atlas (NSW DCCEEW 2024b) licencing conditions. The Commonwealth *Species Profile and Threats Database* (SPRAT) profile (Commonwealth Department of Climate Change, Energy, the Environment and Water [Cth DCCEEW] 2024) (**Plate 1**) shows a similar distribution to BioNet records, not including the extension out to Munghorn Gap Nature Reserve. The NSW *Threatened Biodiversity Profile Search* (NSW DCCEEW 2024c) (**Plate 2**) also shows predicted species distribution further north around Port Macquarie.

Plate 1: Broad-headed Snake Commonwealth Mapping (Cth DCCEEW 2024).

The Broad-headed Snake is aggressive and nocturnal, often found under slabs of exfoliating rock on ridgetops, or in rocky crevices. Suitable habitat is defined as *"rocky areas, including escarpments, outcrops and pagodas within the Sydney Sandstone geologies within PCTs associated with the species in the TBDC"* (Department of Planning and Environment [DPE] 2022). The species polygon is then mapped out as the full extent of all suitable habitat on the subject land including a 100 metre (m) buffer from the edge of suitable habitat.

A large proportion of its time is spent in tree hollows downslope of the rocky habitat. Conflicting evidence from the literature suggest it either spends winter in tree hollows (Cogger 2014) or summer in tree hollows and autumn-winter-spring under rocks (NSW DCCEEW 2024d; Croak *et al*. 2013; Wilson and Swan 2013). Older research suggests rocks and crevices are occupied by adults from autumn through spring (Webb and Shine 1994), with juveniles remaining in rocky habitat year-round (Downes 1999).

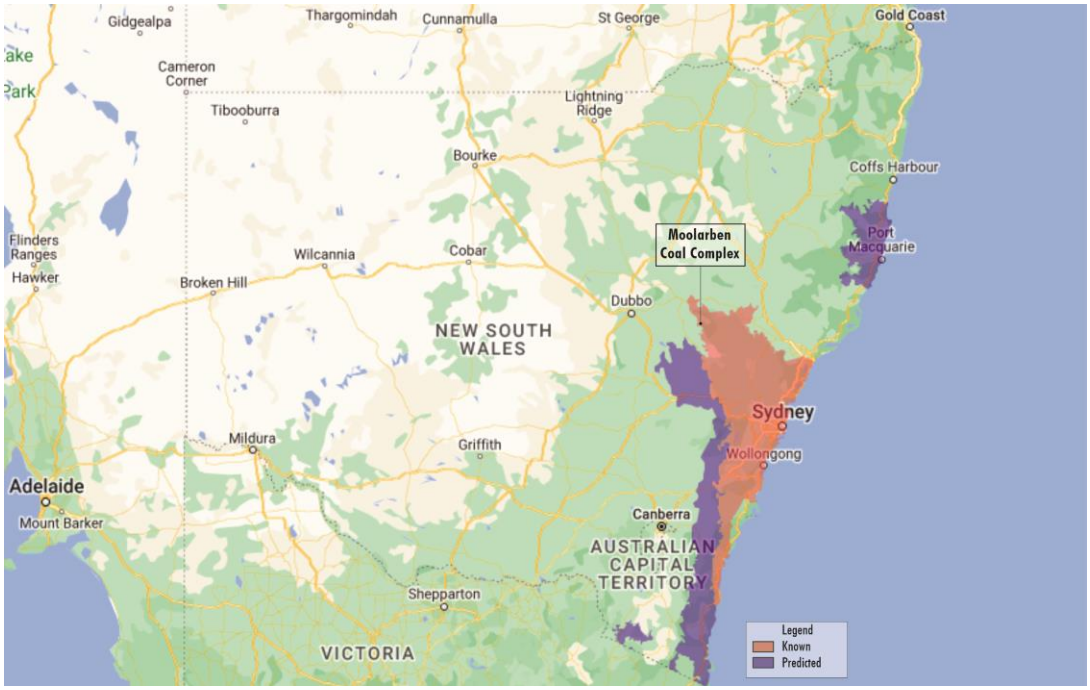


Plate 2: Broad-headed Snake NSW Mapping (NSW DCCEEW 2024c).

Thin shelter sites less than 20 centimetres (cm) thick are used in exposed locations on rocky substrate (Webb and Shine 1994; Webb and Shine 1998a). Sunny aspect and radiant energy from the sun appear to be important (Webb and Shine 1998a; Pringle *et al*. 2003), with west to north-west aspects being preferred (NPWS 2001) as they provide maximum body temperature at dusk (Webb and Shine 1998b). Late spring to summer can increase heat under rocks to a point where adult male and non-breeding female snakes move to tree hollow habitat (Webb and Shine 1997a; Croak *et al*. 2013). Breeding females and juveniles stay in cooler shaded rocks and crevices over this period (Webb and Shine 1998b). Noted shelter trees include Red Bloodwood (*Corymbia gummifera*), Yellow Bloodwood (*C. exima*), Grey Gum (*Eucalyptus punctata*), Scribbly Gum (*E. haemastoma*), Sydney Peppermint (*E. piperita*), Narrow-leaved Stringybark (*E. sparsifolia*) and Blue-leaved Stringybark (*E. agglomerata*), with larger trees, dead trees and trees with multiple hollows being preferred. Recent studies suggest tree species are less important than a preference for shorter dead trees with larger diameter and multiple hollows close to the ground (Croak *et al*. 2013). Hollow branches are preferred to hollow trunks, with site fidelity being high in both rock and tree habitats (Webb and Shine 1997a; Webb and Shine 1998a). Re-use of specific trees by multiple individuals suggest hollow-bearing trees that present the right characteristics are a limiting resource for the species (Croak *et al*. 2013).

Growth of juveniles is slow, with long time to maturation and breeding every two to four years (Webb *et al*. 2003; Webb *et al*. 2002a; Croak *et al*. 2013). Mating occurs from autumn through spring (Webb and Shine 1998c), which would coincide with occupation of rocky habitat. Site fidelity is high, with discrete home ranges reported to be 3.0 - 3.4 hectares (ha) on average (Webb and Shine 1997b; Croak *et al*. 2013). Maximum recorded movements of 375 m for dispersing juveniles were previously reported (Webb and Shine 1997b), but more recent genetic studies suggest juvenile dispersal averages 2.9 km (Dubey *et al*. 2011). Adult movement in rocky habitat averaged 37 m, while movement in woodland habitat averaged 134-159 m (Croak *et al*. 2013; Webb and Shine 1997b). Threatened Biodiversity Data Collection (TBDC) (NSW DCCEEW 2024d) reports movement of 500 m from escarpments, but this is not referenced.

Threats are well understood, with removal of key rocky habitat obviously impacting shelter sites for adults and juveniles, as well as their breeding habitat. Removal of large hollow bearing trees near sandstone escarpments would impact adult males and non-breeding females. Though other threats exist, impacts within 100 m of rocky (breeding) habitat is the main consideration for the determination of SAII.

3. Relevance of Broad-headed Snake to the Project

Four person-hours of rock turning (habitat inspection) at three locations were undertaken to survey for Broad-headed Snake across associated PCTs 1629 and 1711 (as shown on Figure 10 of Niche 2022). This was in line with requirements under the TBDC (NSW DCCEEW 2024d), as the survey guidelines for threatened reptiles had not been released at the time of surveys (DPE 2022). It is noted in the BDAR that PCT1711 areas did not contain suitable rocky habitat, so surveys were restricted to PCT1629 patches (Niche 2022). Additionally, seven person-hours of spotlighting across four sites were conducted, with only some of these fitting into the recommended survey timing listed in the new guidelines (DPE 2022). Spotlighting conducted in March 2022 does not fit the survey time restrictions for this species. Survey locations are restricted to the southern boundary of the Project area (some in eastern facing escarpments), so presumably further surveys were not undertaken as the species was already recorded.

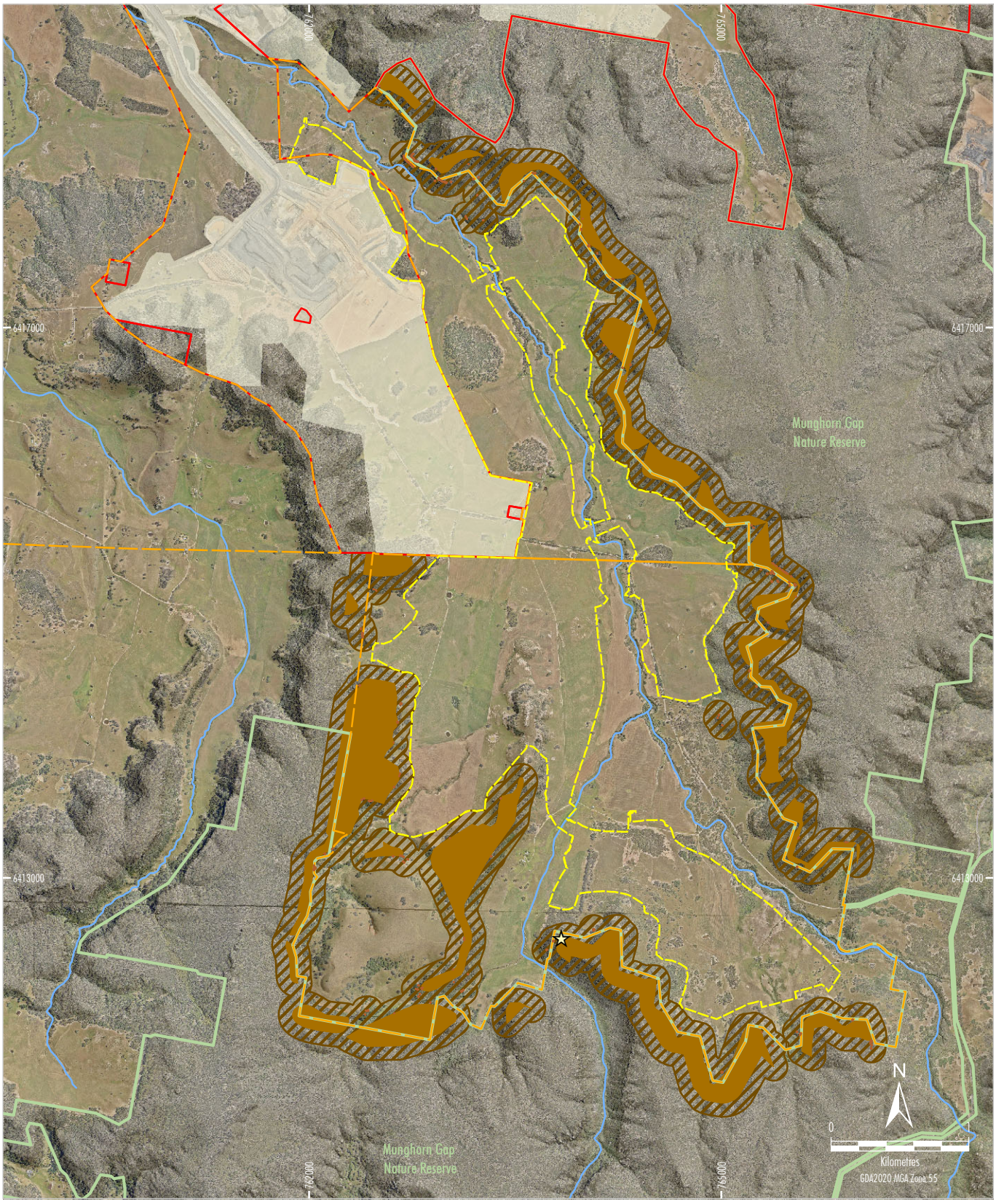
As a dual credit species, the offsetting of associated PCTs (ecosystem credits) covers foraging habitat (and woodland habitat with tree hollows). Rocky areas are breeding habitat for this species, and are covered under species credit habitat constraints, prescribed impacts and SAII under the BAM (DPIE 2020).

One individual was recorded approximately 200 m outside the Development Footprint associated with the Amended Project on a north facing escarpment (**Figure 4**). The one positive record means all rocky habitat in the study area has been assumed suitable for occupation and breeding by the Broad-headed Snake. The new *Threatened Reptiles Biodiversity Assessment Method Survey Guide* (DPE 2022) specifies mapping of the species polygon as suitable rocky habitat in associated PCTs on the subject land, including a 100 m buffer from the edge of mapped suitable habitat, and this is consistent with the approach by AMBS (2022) and Niche (2022).

Direct impacts on mapped rocky habitat (i.e. caves, crevices, cliffs, rocks) for the Broad-headed Snake would be avoided by the Project (i.e. no clearance of mapped rocky habitat). Since the BDAR (Niche 2022) was submitted, MCO undertook a detailed review of the Development Footprint as presented in the Project EIS and has committed to avoiding further direct impacts on the 100 m buffer around suitable rocky habitat. If there are no impacts on the 100 m buffer around suitable rocky habitat, then the SAII considerations are not triggered.

Not all downslope areas are treed, with cleared paddocks making up some of the 100 m buffer zones. From the authors inspection of site on 27-30 March 2023, some timbered buffer areas consist only of smaller trees with no hollows. Some large hollow bearing trees exist within the mapped rocky slope just below clifflines and would be retained by the rocky habitat protection. Most timbered downslope areas contain two of the associated tree species (Grey Gum and Stringybark).

Indirect impacts relevant to Broad-headed Snake are listed by Niche (2022) as "*reduced viability of adjacent habitat due to edge effects*" and "*reduced viability of adjacent habitat due to noise and blasting*". Though the species is not specifically mentioned in this section, and this habitat is already on the edge of a modified agricultural landscape, the buffer zone encroachment would bring the edge habitat closer to the breeding habitat than it is currently. Noise and blasting would be heard/felt in the breeding habitat, but there is little evidence in the literature as to whether this would have an adverse impact on this species of snake. A recent study tested five captive bred Australian snake species responses to various sound frequencies, one of which produced ground vibrations. Responses were genus dependent, but some demonstrated potential avoidance behaviour (Zdenek *et al*. 2023). Related *Hoplocephalus bitorquatus* (Pale-headed Snake) was one of the species tested, but results were excluded from the model without clear explanation of why. It may have been a result of an absence of differences in display of defensive/cautious behaviours between control and treatment trials.



MCM-20-18 OC Ext EIS AP SAII Ass_BS_2050

LEGEND

- National Park/Nature Reserve
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- Indicative Amended Project Surface Disturbance Extent

Broad-headed Snake

- Mapped Rocky Habitat
- 100 m Buffer from Mapped Rocky Habitat (Breeding Habitat)
- Broad-headed Snake Record

Source: MCO (2023); NSW Spatial Services (2021); AMBS (2023)
Orthophoto: MCO (2021)

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Broad-headed Snake Habitat

Figure 4

Blasts are short duration, so are unlikely to disturb the snake to a point it feels the need to leave its shelter. Blasts could indirectly impact cliffline stability, but would not have an impact on shelter rocks on the top of rocky ridges. Dust and light spill are not likely to impact this well camouflaged ambush predator. No removal or disturbance of rock, or collection of firewood would be allowed outside of the Development Footprint in the mining lease. Bush rock collection is another listed threat to the species. Though predation by foxes and cats are listed as threats, these species already exist in the landscape and are unlikely to increase as a result of the Project.

Cumulative impacts in the local area involve a number of other mines, who would likely be geographically constrained to the same extent as this Project (i.e. rocky ridges and clifflines relevant to the snake would likely be avoided in project planning due to consideration of threatened/SAII species habitat).

Vehicle strike is listed as a threat to Broad-headed Snake, and the associated prescribed impact has been identified in the BDAR (Niche 2022). Due to the location of this rocky habitat being at the top of the escarpment, it is likely that this prescribed impact would be less applicable to this species on site. Vehicle strike would be minimised by all traffic using internal speed limited roads from existing infrastructure to the north.

4. SAII Assessment

Information towards assessing the risk of SAII for Broad-headed Snake is provided in Appendix F of the BDAR (Niche 2022). This information has been used to guide the following independent assessment addressing BAM Section 9.1.2 (DPIE 2020).

1. Action and measures taken to avoid the direct and indirect impact on the species at risk of an SAII

The Project considers alternative locations unsuitable due to proximity to existing infrastructure/operations, and visual amenity. Underground operations are not feasible with shallow coal seams. Project design has generally avoided areas of higher quality vegetation and habitat, and riparian zones around major creek-lines. Progressive rehabilitation has been proposed to minimise the time habitat is absent from the site.

The Project has been designed to avoid any direct and prescribed impacts on rocky habitat for the Broad-headed Snake, which breeds in exfoliating rock on rocky ridges and escarpments. Since the BDAR (Niche 2022) was submitted, MCO undertook a detailed review of the Development Footprint as presented in the Project EIS and has committed to avoiding further direct impacts on the 100 m buffer around suitable rocky habitat. If there are no impacts on the 100 m buffer around suitable rocky habitat, then the SAII considerations are not triggered.

MCO propose clear delineation of the areas to be disturbed prior to clearing activities being undertaken. Disturbance boundaries would be digitally captured and displayed within the site survey and Geographic Information System (GIS) databases.

Indirect impacts are being minimised by commitments to monitor/control pest species, limit vehicle speeds, managing light spill outside the Project boundary, and monitoring limits for noise/vibration associated with blasting.

In order to minimise the potential for indirect blast vibration impacts, MCO would adjust blast designs during Project operations to comply with a conservative vibration limit of 50 millimetres per second (mm/s) at the nearest mapped rocky habitat (safe design 5% exceedance level peak particle velocity [PPV] limit), unless further geotechnical investigation supports a higher value. Accordingly, sensitive geological features located further from blasting than the mapped rocky habitat (e.g. deeper into the Munghorn Gap Nature Reserve) would experience lower vibration as a result of this limit. Blast adjustment measures to achieve the vibration limit would include moderation of Maximum Instantaneous Charge (MIC) and/or implementation of pre-split blasts where appropriate, in accordance with the Moolarben Coal Complex Blast Management Plan (MCO 2020).

The proposed blast vibration limit was determined by specialist geotechnical engineers (PSM 2024) through a comprehensive analysis of historical blast monitoring data, inspection of other sensitive geological features subject to historical blasting (geotechnical characteristics, analysis of mining related impacts on proximal rocky outcrops and assessment of likely cause of suspected blast interactions), ground truthing of mapped rocky habitat surrounding the Project, and review of site-specific modelling predictions of vibration effects.

It is noted that higher vibration limits (250 mm/s) than proposed for the Project (50 mm/s) have been adopted at Moolarben based on recommendations from SLR (2018) to protect rock features associated with Aboriginal heritage shelter sites (this is the current design criterion under the Blast Management Plan [MCO 2020]). Analysis from geotechnical engineers (PSM 2024) suggests that vibration from blasting has caused no distinguishable impacts from natural processes or other anthropogenic sources (e.g. visitors moving rocks).

MCO would implement the following monitoring and mitigation measures to manage potential blast vibration impacts to mapped rocky habitat:

- pre-blast desktop assessment to identify the proximity of mapped rocky habitat to planned blast areas, in order to inform vibration modelling and therefore blast design;
- site-specific vibration modelling per blast to calculate MIC required to meet PPV limit for nearest mapped rocky habitat;
- continuation of existing vibration monitoring as described in the Blast Management Plan (MCO 2020), and implementation of additional vibration monitoring at one or more new representative sites of mapped rocky habitat adjacent to the Project;
- ongoing review of monitoring data to confirm and update site-specific vibration modelling where necessary; and
- visual inspections of key representative mapped rocky habitat on a 6-monthly basis to confirm that the target outcome of no physical impact to mapped rocky habitat (and therefore no physical impact to the Munghorn Gap Nature Reserve) as a result of blasting vibrations continues to be achieved.

2. Current Population of the species

a. Evidence of Rapid Decline presented by an estimate of the:

i. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or

ii. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites

No evidence of rapid decline is presented in the TBDC (NSW DCCEEW 2024d). Its preferred rocky habitat tends to be avoided by development, where flatter ground provides fewer engineering constraints. Total population size (historical or current) is unknown. This species was listed as 'Endangered' under the Threatened Species Conservation Act in 1995 and its listing has not changed since.

This is consistent with data presented in Table 54 in the BDAR.

b. evidence of small population size presented by:

i. an estimate of the species' current population size in NSW, and

ii. an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and

iii. where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations

No evidence of the Broad-headed Snake having a small population size is presented in the TBDC (NSW DCCEEW 2024d). Much of the species' habitat is in reserved land which is not systematically surveyed. Total population size (historical or current) is unknown. One study modelling occupancy over a 16-year period in Royal National Park found no evidence of decline (Goldingay 2017). The broader applicability of this to other areas is unknown. Suffice to say, impacts from human disturbance are likely to be higher in the Royal National Park due to the National Park's proximity to Sydney.

This is consistent with data presented in Table 54 in the BDAR (Niche 2022).

c. evidence of limited geographic range for the threatened species presented by:

- ***i. extent of occurrence***
- ***ii. area of occupancy***
- ***iii. number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and***
- ***iv. whether the species' population is likely to undergo extreme fluctuations***

The Broad-headed Snake's range is restricted to Sydney Sandstone geologies of the Sydney Basin, but this does not construe "limited geographic range" for the purposes of this principle. Extent of Occurrence (EOO) and Area of Occupancy (AOO) are not available in TBDC (NSW DCCEEW 2024d) or the Conservation Listing Advice (Department of the Environment 2014). The International Union for Conservation of Nature (IUCN) Red List Assessment (Webb *et al.* 2018) states that the EOO for the Broad-headed Snake is 30,756 square kilometres (km^2) and the AOO is 688 km^2.

IUCN Red List Assessment (Webb et al. 2018) states that there are seven distinct locations. How these seven locations are defined is unknown, but it may relate to the number of Reserved Land parcels (i.e. National Parks and Nature Reserves). There are no threat-defined locations for the Broad-headed Snake.

Due to the low fecundity, and large proportion of the species habitat located in protected reserves, they are unlikely to exhibit extreme population fluctuations (outside of widespread wildfire causing large population declines).

d. evidence that the species is unlikely to respond to management because:

- ***i. known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g. species is clonal) on, a biodiversity stewardship site***
- ***ii. the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site, or***
- ***iii. life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g. frogs severely impacted by chytrid fungus).***

Suitable breeding habitat for the Broad-headed Snake is listed at risk of an SAII because the species is reliant on abiotic habitats which cannot be restored or replaced on a biodiversity stewardship site. These rocky habitats generally cannot be created or restored on biodiversity stewardship sites with certainty.

Recent work by Goldingay and Newell (2016) has shown that habitat restoration for Broad-headed Snakes may be possible. They created artificial habitat by harvesting suitably sized rocks from the local area and placing them in groups of 10 or 50 on exposed rock platforms. An increase in the number of prey (lizard and gecko) species was noted, with Broad-headed Snakes occupying constructed and natural habitat with the same probability. Distance to nearest access point had a large effect on the probability of occupation, meaning human disturbance (via poaching and rock removal/disturbance) was a significant factor in whether an outcrop supported the species. Suitability of artificial rock habitat reduced over time, with less than 50% of artificial habitat remaining suitable after 14 years (Goldingay and Newell 2016). Though there may be some success in generating artificial habitat for the species, it must be done in a way that does not remove habitat for this and other species in the area. Furthermore, there would need to be constant additions to this habitat to maintain the increase in habitat value over the longer term. This process of habitat restoration would require rock substrate to already be present. So, although it is possible to generate new shelter and foraging habitat, it is generally not possible to install extensive rocky substrate that underlies the artificial habitat. This would need to be present already, meaning the methods described in Goldingay and Newell (2016) would only be suitable for improving

degraded habitat that already exists in the species range, rather than creating new habitat from a previously cleared site.

While the known reproductive characteristics do not severely limit the ability of the Broad-headed Snake to increase its existing population on, or occupy new habitat on, a biodiversity stewardship site, the characteristics and known demographic parameters suggest the species exhibits extremely low population growth capacity. With low fecundity (small clutch sizes, frequent egg failure, infrequency of breeding), late age to sexual maturity, and high site fidelity, the species would be very slow to colonise new areas or expand following a translocation. Rates of population growth of just over one have been reported by multiple studies (Goldingay 2017; Webb *et al*. 2002b). However, the life history traits and/or ecology is known, and threatening processes can be controlled on a biodiversity stewardship site.

3. Record any unknown or data deficient information in the TBDC

No data for SAII has been populated in the TBDC for Broad-headed Snake (NSW DCCEEW 2024d).

4. Impacts on the species at risk of an SAII from the proposal

a. the impact on the species' population (Principles 1 and 2) presented by:

i. an estimate of the number of individuals (mature and immature) present in the subpopulation on the subject land (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and

ii. an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or

iii. if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal

As described above, this species is not listed as an SAII entity on account of Principles 1 and 2. Regardless, this question is addressed below.

This species unit of measure is 'area' rather than 'individual' according to the TBDC (NSW DCCEEW 2024d). In regard to data on the number of individuals on the site, one individual Broad-headed Snake is known from outside the Development Footprint (approximately 200 m outside the Development Footprint associated with the Amended Project).

Since the BDAR (Niche 2022) was submitted, MCO undertook a detailed review of the Development Footprint as presented in the Project EIS and has committed to avoiding further direct impacts on the 100 m buffer around suitable rocky habitat. Given this, it is estimated that close to no individuals would be impacted directly by the Project (close to 0% of the total NSW population), acknowledging that it is always possible that individuals move further than 100 m from rocks into foraging/shelter habitat (as per movements derived in Croak *et al*. 2013).

It is difficult to estimate the number that will be impacted due to scarcity of records on site, the lack of NSW-wide data, and the cost and difficulty in locating the species in what is typically remote areas. However, if we take the number of snakes found by Goldingay (2017) in 143 km^2 Royal National Park, this gives a density of 0.003-0.004 snakes/ha (assuming no snakes were missed which is highly unlikely). The above must be interpreted with extreme caution, as mapping supposedly suitable habitat is a poor proxy for estimation of density/numbers, as large areas of seemingly suitable habitat have been found unoccupied (Newell and Goldingay 2005).

No Broad-headed Snake habitat within 100 m of the rocky escarpment habitat would be impacted by the Project.

b. impact on geographic range (Principles 1 and 3) presented by:

i. the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW

As described above, this species is not listed as an SAII entity on account of Principles 1 and 3. Regardless, this question is addressed below.

The IUCN Red List Assessment (Webb *et al.* 2018) states that the EOO for the Broad-headed Snake is 30,756 km^2 and the AOO is 688 km^2. The Project area is outside of the EOO and AOO so would not reduce the EOO and AOO as presented by IUCN Red List (Webb *et al.* 2018), instead the new record of the Broad-headed Snake by AMBS (2022) increases the EOO and AOO.

ii. the impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted

The Project may affect some individuals if individuals are using hollow-bearing trees for summer shelter sites further than 100 m from the rocky habitat. Breeding occurs in rocky habitat which has been avoided. Breeding females and juveniles use rocky habitat year-round.

iii. to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g. seed dispersal) and pollination distance for the species

Species habitat occurs around the edge of the Project footprint and would not be fragmented. Connectivity remains through surrounding forest/escarpment and the Nature Reserve.

Extensive areas of suitable habitat exist in the local area, with the neighbouring Munghorn Gap Nature Reserve likely being an important reservoir for the local population (**Figure 1**; **Plate 1** and **Plate 2**).

This species exhibits high site fidelity (low dispersal) so having rocky habitat in surrounding areas avoided means genetic exchange is likely to continue as normal with the Project proceeding. However, it must be noted that Croak *et al*. (2013) report the importance of downslope valley forested vegetation in a northern population of the species. The importance of downslope vegetation likely depends on the type of vegetation present. At this site, cleared paddocks would not form important downslope vegetation for the species, but areas with suitable large hollow-bearing trees would.

iv. to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections of the BDAR or BCAR.

The Project would not change fire regimes, increase fragmentation, increase edge effects, or increase predation. The habitat already exists at the edge of modified agricultural land, though in some places, the edge would be moved closer to the rocky habitat. Exotic predators

already exist in the landscape and having a site plan to monitor and trigger control of them would be implemented. The risk of vehicle strike is not likely to increase as mitigation measures would be put in place.

The record lends weight to the assumption that the species exists in nearby Munghorn Gap Nature Reserve, and is a 30 km range extension for the species from previously known records in Wollemi National Park. This is the westernmost record for the Broad-headed Snake, and suggests that the species may also exist through nearby Goulburn River National Park and out towards Ulan.

5. New information to demonstrate that the principle identifying the species as at risk of an SAII, is inaccurate.

No new information relating to the listing of the species as an SAII entity has been produced. Having said this, Goldingay and Newell (2016) demonstrated that degraded habitat can be improved by movement of suitable shelter rocks onto exposed rock outcrops. In this way, existing habitat can be improved, but new habitat cannot be created without certain underlying geological formations already being present. Ongoing work is also required to maintain suitability of restored habitat over the longer term.

5. Is there likely to be an SAII?

Suitable habitat for the Broad-headed Snake (i.e. PCTs associated with the species within 100 m of rocky areas including escarpments, outcrops and pagodas within the Sydney Sandstone geologies [DPE 2022]) is listed at risk of a SAII due to Principle 4 (NSW DCCEEW 2024a):

> *Principle 4 - the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.*

There is "*evidence that the species is unlikely to respond to management*" (DPIE 2020) because, based on current knowledge, "*the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site*" (DPIE 2020).

The Project has been designed to avoid any direct impacts on abiotic habitats (mapped rocky habitat) for the snake species. Since the BDAR (Niche 2022) was submitted, MCO undertook a detailed review of the Development Footprint as presented in the Project EIS and has committed to avoiding further direct impacts on the 100 m buffer around suitable rocky habitat. If there are no impacts on the 100 m buffer around suitable rocky habitat, then the SAII considerations are not triggered.

The only potential pathway for the breeding habitat to be impacted is through indirect impacts. Indirect impacts on abiotic habitats include fracturing of rock outcrops and potential collapse of caves as a result of blasting vibrations. While collapse of escarpments could result in the loss of some habitat, it is likely that this collapse may also result in the creation of new crevices. Cave collapse could have small, isolated impacts on exfoliated rock on exposed outcrops at the top of the ridge where snakes are generally sheltering during winter (and summer for breeding females and juveniles). Collapses could also knock down summer shelter trees below the escarpment. The impacts of physical blast vibrations on the species is unknown. It is known that they are sensitive to disturbance of their exfoliated rock shelters (when disturbance involves fracturing of the larger shelter rocks into smaller pieces, or dislodges them to a point they are no longer suitable for sheltering under). Uncertain indirect impacts from blasting would likely be short term in any given area (due to the movement of workings through the footprint). However, fracturing of shelter rocks cannot be undone once mining has moved past. There is potential for loss of habitat for the local populations, but the likelihood is low, area is small, and the impact is unlikely to pose significant extinction risk to the species in the local area. The project is situated adjacent the Munghorn Gap Nature Reserve which contains a more extensive area of similar potential habitat.

Indirect impacts on mapped rocky habitat from clearing of trees is unlikely, as shading of rocks on ridges by vegetation is known to reduce habitat quality. The development is not likely to increase shading of any Broad-headed Snake rocky habitat due to the modified 100 m setback from constraint habitat.

The Project would not contribute significantly to the risk of the Broad-headed Snake becoming extinct as the direct impacts on the area 100 m from rocky habitat are now avoided, and indirect impacts (blasting vibrations) are likely to be short-term. There is a small risk of reduction in foraging and shelter habitat area outside the 100 m buffer, but this is would not lead to extinction of the local population. Although no rocky habitat would be directly disturbed, studies from disturbed populations in Morton National Park suggest populations of the snake can recover after episodic or spatially limited disturbance to rock habitat (Webb *et al*. 2002b; Webb and Shine 2008; Goldingay 2017) and this is likely to also apply to the portion of foraging habitat area in and around the 100 m buffer zone around rocky habitat.

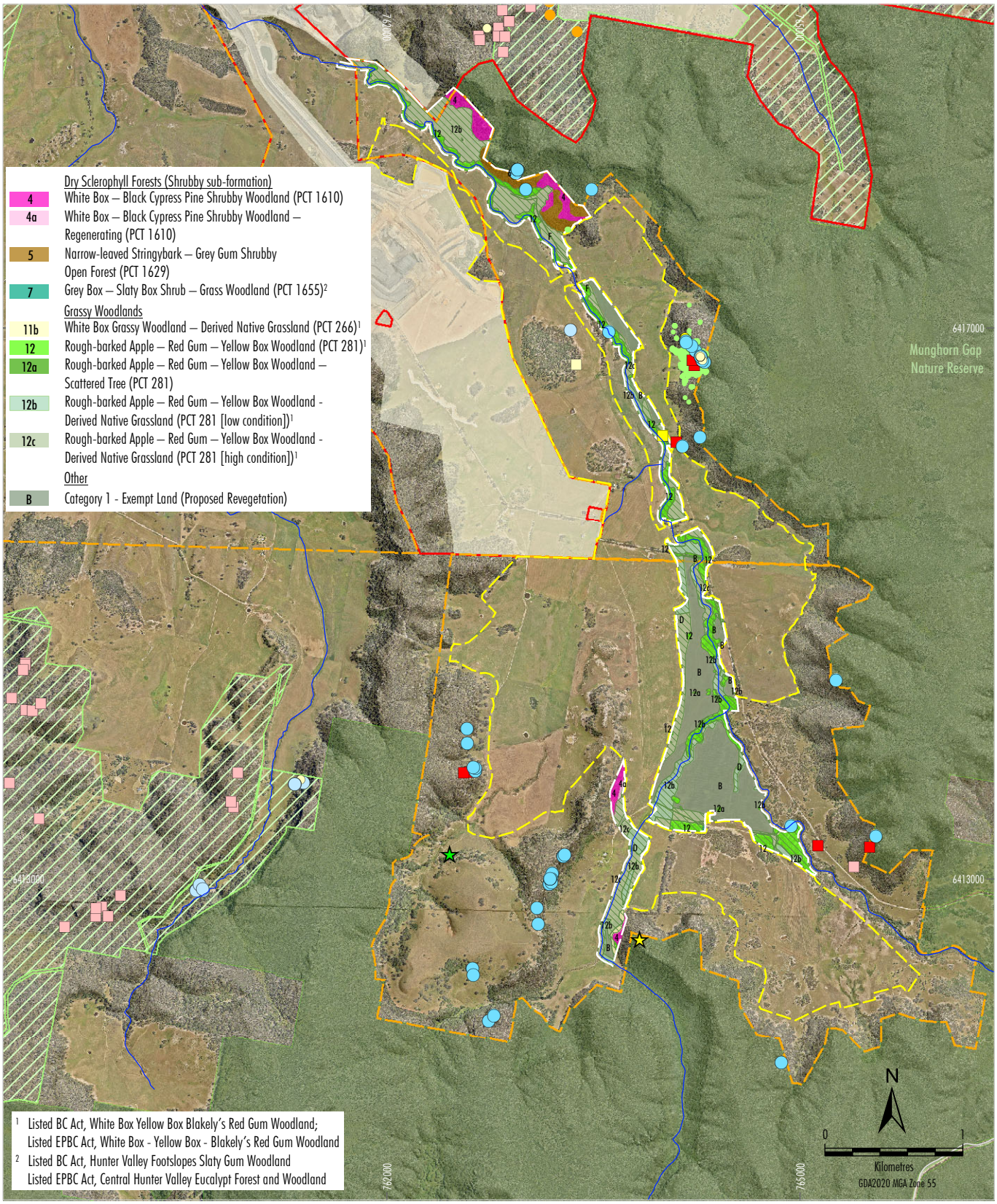
6. Further Measures to Mitigate/Manage Residual Impacts

MCO has revised the mine design to incorporate a 100 m setback of all Project disturbance (including open cut pit extents) from mapped rocky habitat associated with threatened bat species and the Broad-headed Snake. As a result, the Project would not cause direct physical impacts to mapped rocky habitat features, and blast vibration at mapped rocky habitat features would be reduced, as they are now further from the proposed open cut pit extents when compared to the Project EIS. Therefore, the only significant remaining potential pathway for impact to mapped rocky habitat would be indirectly through blasting vibration. Noting, however, that MCO would adjust its blast designs in order to further minimise the potential for blast vibrations to impact on rocky habitat (Section 4.1).

During the operations, MCO would implement a Habitat Enhancement Area surrounding the Project, involving revegetation, fencing to exclude livestock (as required), weed management, animal pest management, and fire management (**Figure 5**). Since the BDAR (Niche 2022) was submitted, MCO is committing to increase the Habitat Enhancement Area, resulting in an overall total of 4.9 ha of Broad-headed Snake habitat in the Habitat Enhancement Area.

Progressive rehabilitation of disturbed areas following completion of active mining operations, including the reuse of salvaged large hollow-bearing trees/stags, will be conducted. Since the BDAR (Niche 2022) was submitted, MCO is committing to increase the rehabilitation of mined areas to woodland from 325 ha to 535 ha (**Figure 6**).

As a dual credit species, ecosystem credits for woodland habitat with tree hollows are required to be retired under the NSW Biodiversity Offset Scheme. Modification of the footprint has been conducted, which now demonstrates avoidance of Broad-headed Snake species credit habitat within 100 m of rocky habitat. After avoiding direct and prescribed impacts on the species, and providing measures to minimise and mitigate indirect impacts, residual impacts are limited to ecosystem credits.



LEGEND

- National Park/Nature Reserve
- Existing Biodiversity Offset Area
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- Indicative Amended Project Surface Disturbance Extent

Habitat Enhancement Area

- Indicative Habitat Enhancement Area Extent
- Box-Gum Woodland CEEC

	Survey	Database
Threatened Flora Records		
Cotoneaster Pomaderris	●	
Threatened Fauna Records		
Pink-tailed Legless Lizard	★	
Broad-headed Snake	★	
Koala	■	■
Squirrel Glider	■	■
Large-eared Pied Bat	●	●
Eastern Cave Bat	●	●
Swift Parrot		●

Source: MCO (2023); NSW Spatial Services (2021); Eco Logical Australia (2023); AMBS (2023). Orthophoto Mosaic: MCO (2021)

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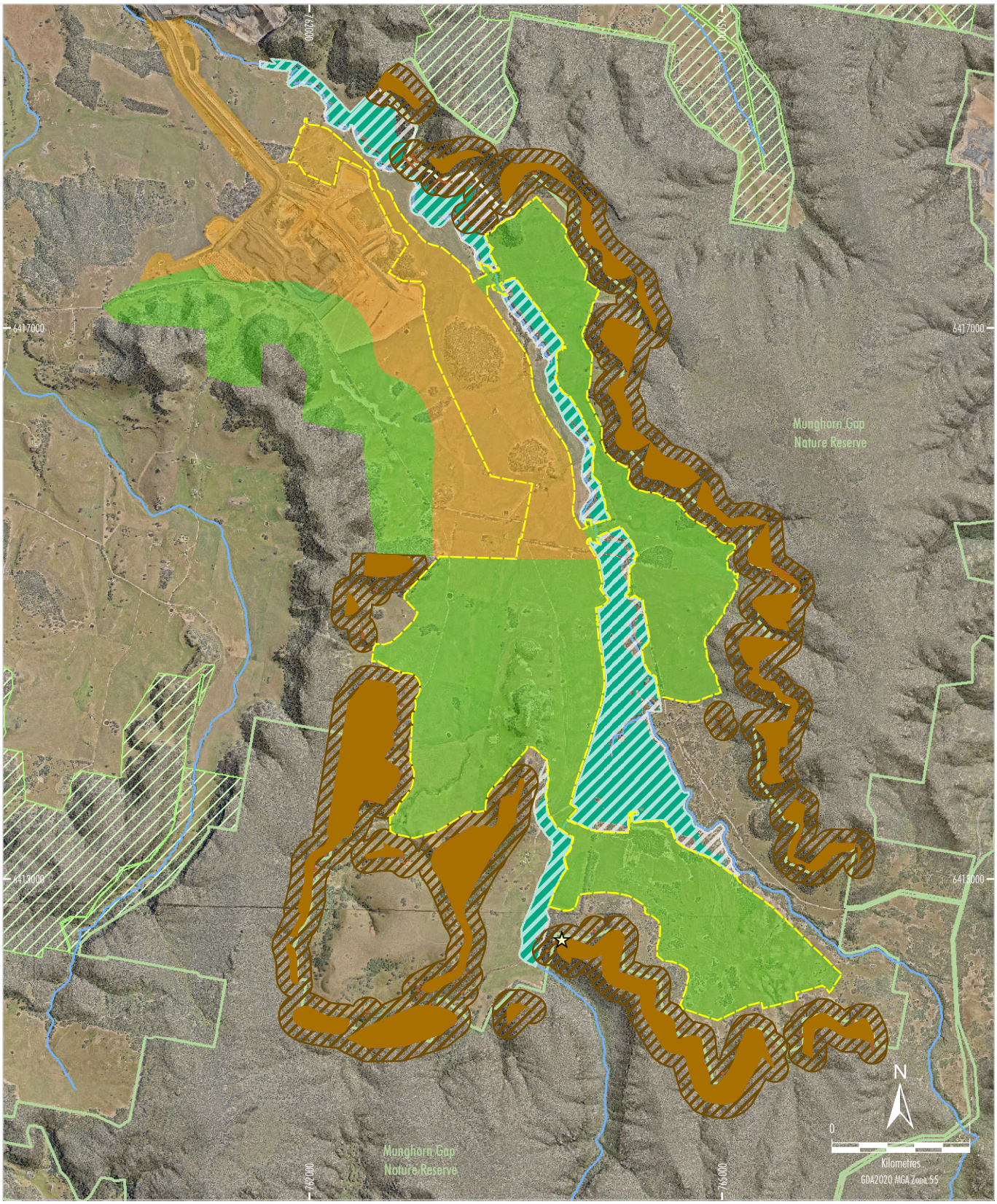
Habitat Enhancement Area Values

Figure 5



MCA-20-18 OC Ext EIS AP SAII Ass_BS_206E

LEGEND

- National Park/Nature Reserve
- Indicative Amended Project Surface Disturbance Extent
- Existing Biodiversity Offset Area
- Broad-headed Snake Mapped Rocky Habitat
- 100 m Buffer from Mapped Rocky Habitat (Breeding Habitat)
- Broad-headed Snake Record

Conceptual Post-mining Land Use Area

- Agricultural Pasture/Scattered Trees
- Native Woodland

Habitat Enhancement Areas

- Indicative Habitat Enhancement Area Extent
- Indicative Revegetation Area Extent

Source: MCO (2023); NSW Spatial Services (2021); AMBS (2023)
Orthophoto: MCO (2021)

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Revised Conceptual Post-mining Land Use

Figure 6

7. Conclusion

Broad-headed Snake are listed as a threatened entity at risk of an SAII under Principle 4 of the NSW *Biodiversity Conservation Regulation 2017*. The species is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable. The trigger for considering SAII is disturbance within 100 m of their rocky shelter/breeding habitat.

The Project will not contribute significantly to the risk of the Broad-headed Snake becoming extinct (i.e. no SAII) as the Project has been re-designed to avoid any direct clearance within 100 m of the rocky constraint habitat, and indirect impacts (including offsite impacts) are unlikely to lead to extinction of the local population. This is not to say there will be no risk to loss of occupancy, just that the potential reductions will not significantly impact the local population's persistence. Low densities also mean the potential loss of discrete cliffline areas due to collapse are unlikely to impact the population overall.

In order to further minimise the potential for blast vibrations to impact on rocky habitat, MCO will adjust its blast designs (as detailed above). During the operations, MCO would implement a Habitat Enhancement Area surrounding the Project, involving revegetation, fencing to exclude livestock (as required), weed management, animal pest management, and fire management. Since the BDAR (Niche 2022) was submitted, MCO is committing to increase the Habitat Enhancement Area, resulting in an overall total of 4.9 ha of Broad-headed Snake shelter/foraging habitat in the Habitat Enhancement Area.

Progressive rehabilitation of disturbed areas following completion of active mining operations, including the reuse of salvaged large hollow-bearing trees/stags, will be conducted. Since the BDAR (Niche 2022) was submitted, MCO is committing to increase the rehabilitation of mined areas to woodland from 325 ha to 535 ha.

As a dual credit species, ecosystem credits for woodland habitat with tree hollows are required to be retired under the NSW Biodiversity Offset Scheme. Modification of the footprint has been conducted, which now demonstrates avoidance of Broad-headed Snake species credit habitat within 100 m of rocky habitat. After avoiding direct and prescribed impacts on the species, and providing measures to minimise and mitigate indirect impacts, residual impacts are limited to ecosystem credits.

Following the above avoid, minimise, mitigate and offset hierarchy should not result in any increased risk of extinction for the species at a local, Interim Biogeographic Regionalisation for Australia (IBRA) subregional/regional, State or Commonwealth scale. Nor should it trigger a Serious And Irreversible Impact on the Broad-headed Snake for this project.

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2023 PRACTISING MEMBER

ECOLOGICAL CONSULTANTS ASSOCIATION OF NSW — CERTIFIED PRACTISING ECOLOGICAL CONSULTANT — REGISTERED NUMBER: 10

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- Fauna surveys
- Ecology of birds
- Impact assessment
- Review & editorial
- Bibliographical

MOOLARBEN COAL COMPLEX OC3 EXTENSION PROJECT REVIEW OF THE ASSESSMENT FOR SERIOUS AND IRREVERSIBLE IMPACTS ON THE REGENT HONEYEATER

March 2024

1. Introduction

Moolarben Coal Operations (MCO) is proposing an extension to the approved OC3 mining operations to allow for extraction of additional coal within existing mining and exploration tenements adjacent to approved operations at the Moolarben Coal Complex (the Project) (Figures 1 and 2). Approval for the Project is being sought under Part 4 of the *Environmental Planning and Assessment Act 1979*.

Niche Environment and Heritage Pty Ltd (Niche), in collaboration with Premise, was commissioned by MCO to prepare a Biodiversity Development Assessment Report (BDAR) for the Project (Niche 2022). The BDAR includes information on the Regent Honeyeater (*Anthochaera phrygia*), a threatened species under the New South Wales (NSW) *Biodiversity Conservation Act 2016* (BC Act) and listed on the Department of Planning and Environment (DPE) list of Serious and Irreversible Impact (SAII) Entities.

The Biodiversity Assessment Method (BAM) (Department of Planning, Industry and Environment [DPIE 2020]) states that the determination of a serious and irreversible impact on biodiversity values is to be made by the decision-maker in accordance with the principles set out in the NSW *Biodiversity Conservation Regulation 2017*. The NSW *Biodiversity Conservation Regulation 2017* states:

> *6.7 Principles applicable to determination of "serious and irreversible impacts on biodiversity values" (section 6.5(1))*
>
> *(1) This clause applies for the purposes of determining whether an impact on diversity values is a serious and irreversible impact for the purposes of the biodiversity offsets scheme.*
>
> *(2) An impact is to be regarded as serious and irreversible if it is <u>likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct</u> because—*
>
> > *(a) it will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a <u>rapid rate of decline</u>, or*

> *(b) it will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or*
>
> *(c) it is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or*
>
> *(d) the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.*
>
> *(3) For the purpose of this clause, a decline of a species or ecological community is a continuing or projected decline in—*
>
> *(a) an index of abundance appropriate to the taxon, or*
>
> *(b) the geographic distribution and habitat quality of the species or ecological community.*

The Regent Honeyeater is listed as threatened entity at risk of a SAII due to Principles 1 and 2:

> *Principle 1 – An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because it will cause a further decline of the species or ecological community.*
>
> *Principle 2 – An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because it will further reduce the population size of a species or ecological community.*

The purpose of this report is to review Niche's (2022) assessment on the Regent Honeyeater and evaluate if any residual impacts (i.e. impacts that would remain after implementation of proposed avoidance/minimisation measures) are serious and irreversible, and whether there are any further measures that will minimise those impacts. An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of the threatened species becoming extinct.

It is noted that the BDAR (Niche 2022) has been updated to reflect amendments made by MCO to the Project after submission of the Environmental Impact Statement. The findings of this report remain relevant. They are based on Niche's (2022) assessment and have been adapted to reflect the amended Development Footprint and the further reduced impacts to potential habitat for the Regent Honeyeater (reduced from 184.41 hectares [ha] to 80.5 ha). The findings of this assessment have also been updated to reflect the Amended Project.

This review has been undertaken by Dr Stephen Debus, independent of the BDAR.

LEGEND
- State Forest
- National Park /Nature Reserve
- Local Government Boundary
- Exploration Licence Boundary
- Mining Lease Boundary
- Mining Operation
- Indicative Amended Project Surface Disturbance Extent

Source: NSW Spatial Services (2021)
MCO (2023)

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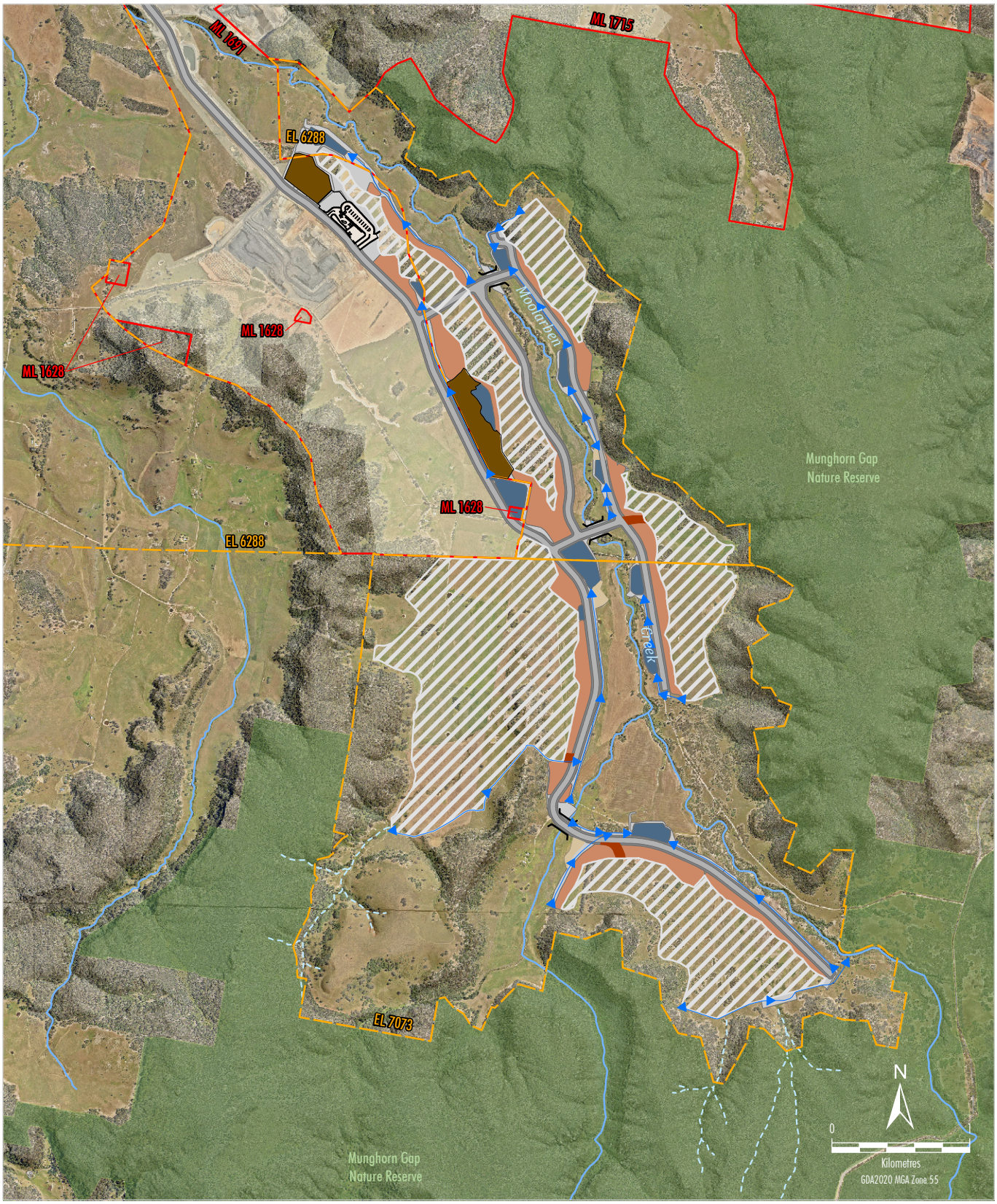
Project Location

Figure 1

MCM-20-18 OC Ext EIS AP SAII Ass_REH_2010



MCOA-20-18 OC Ext EIS AP SAII Ass_REH_202C

LEGEND

- National Park/Nature Reserve
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- OC3 Extension Project - Amended
- Indicative Open Pit Extent
- Indicative ROM Pad
- Culvert
- Indicative Haul Roads and Infrastructure Corridor
- Indicative Infrastructure Area
- Indicative Construction/Rehabilitation Material Stockpiles
- Conceptual Flood Levee Embankment
- Conceptual Water Management Infrastructure
- Indicative Vehicle Access
- Conceptual Surface Water Drain

Source: MCO (2023); NSW Spatial Services (2021)
Orthophoto: MCO (2021)

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General Arrangement of the Amended Project

Figure 2

2. Background information: Regent Honeyeater

Distribution

The BDAR (Niche 2022) accurately represents the Regent Honeyeater's distribution. The Regent Honeyeater occurred historically, within 300 kilometres (km) of the coast, from 100 km north of Brisbane (Queensland [QLD]) to Adelaide (South Australia), but following drastic range and population reduction now occurs from just over the QLD border to north-eastern Victoria, with key remaining populations distributed patchily in NSW: Bundarra-Barraba, Capertee Valley, the Upper and Lower Hunter Valley, and the Burragorang Valley (Crates *et al.* 2021).

The most significant breeding population appears now to be in the Lower Hunter, in the Tomalpin woodlands (Cessnock-Kurri Kurri), with recent breeding also recorded in Goulburn River National Park, and in the Murrumbo, Merriwa, Widden, Putty, Wolgan and Hawkesbury Valleys in 2019–2020 (Ingwersen *et al.* 2020, 2021; Roderick *et al.* 2022). Mudgee-Wollar formerly featured as a significant breeding population centre (Department of the Environment [DotE] 2016) (Figure 3), but is currently not specifically mentioned (Crates *et al.* 2021). Although birds are occasionally sighted throughout their contemporary range, known breeding activity is now restricted to north-eastern Victoria (estimated population 30 individuals) and two regions of NSW: the Northern Tablelands (estimated population 50) and the greater Blue Mountains (estimated population 150) (Heinsohn *et al.* 2022). Note this species is categorised as a 'sensitive species' and therefore geographic coordinates of species records have been withheld in the NSW BioNet Atlas (NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) 2024a).

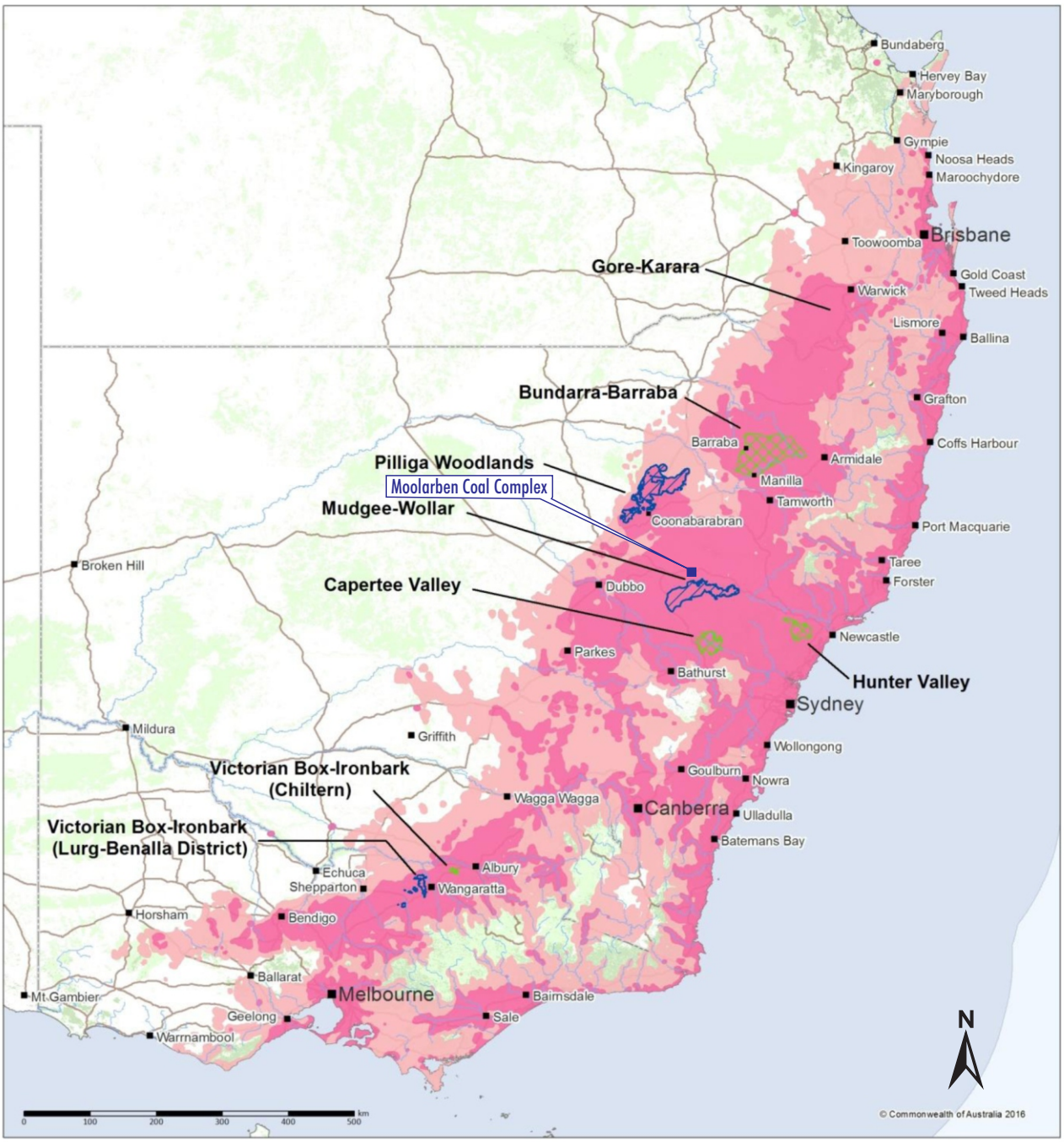
Habitat

The BDAR (Niche 2022) accurately represents the Regent Honeyeater's habitat preferences for foraging, breeding and movement. The Regent Honeyeater forages and breeds in a range of flowering eucalypt species from the coast to the inland slopes, on the more fertile soils of lower slopes and flats near water in valleys. Important flowering resources include box and ironbark species (notably Yellow Box *Eucalyptus melliodora*, White Box *E. albens*, Mugga Ironbark *E. sideroxylon*, Swamp Mahogany *E. robusta*, Spotted Gum *Corymbia maculata*, and mistletoes *Amyema* spp. and *Dendrophthoe* sp. growing on eucalypts and River She-oak *Casuarina cunninghamiana*) (DotE 2016; Crates *et al.* 2021). Nest sites include forks among foliage and branchlets in eucalypts, *Angophora* species, mistletoes and River She-oaks.

Important Habitat Mapping for the Regent Honeyeater (NSW DCCEEW 2024b), in the form of breeding areas, is shown on Figure 4. A total of approximately 556,841 ha of Important Habitat is mapped by NSW DCCEEW (2024b). Within the species' distribution there are four known key breeding areas where the species is regularly recorded (DotE 2016). This figure shows the Bundarra-Barraba, Capertee Valley and Hunter Valley key breeding areas in NSW where breeding has been regularly recorded. The Mudgee-Wollar breeding area is also shown on Figure 4 as the patch surrounding the Project (DotE 2016).

Current population

The BDAR (Niche 2022) accurately represents the Regent Honeyeater's current population and trend. The current global population is estimated at approximately 250 individuals (Crates *et al.* 2021). The decline is continuing, albeit apparently slowing, despite a captive-breeding and release program and other intensive management at several sites (Crates *et al.* 2021).



Map description: The presence categories in the indicative species distribution mapping capture: the specific habitat type or geographic feature that represents the recent observed locations of the species, as well as, suitable or preferred habitat occurring in close proximity to these locations (Likely to Occur); and, the broad environmental envelope or geographic region that encompasses all areas that could provide habitat for the species (May Occur). These presence categories are created using an extensive database of species observation records, national and regional-scale environmental data, environmental modelling techniques, documented scientific research, and, where possible, expert review. Breeding areas within the likely distribution are indicated as per Garnett, S., J. Szabo and G. Dutson (2011). The Action Plan for Australian Birds 2010 and the Birds Australia (2009) Important Bird Areas of Australia dataset.

Produced by: Environmental Resources Information Network (2016)
Contextual data source: Geoscience Australia (2006), Geodata Topo 250K Topographic Data
Indicative Map Only: This map has been compiled from datasets with a range of geographic scales and quality. Species distributions are indicative only and not to be used for local assessment. Local knowledge and information should be sought to confirm the presence of the species, or it's habitat, at the location of interest.

Caveat: The information presented in this map has been provided by a range of groups and agencies. While every effort has been made to ensure accuracy and completeness, no guarantee is given, nor responsibility taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect of any information or advice given in relation to, or as a consequence of, anything containing herein.

Important Bird Areas for the Species
- Key breeding areas
- Other breeding areas

Presence Category
- Species may occur
- Species likely to occur
- Major rivers
- Major Roads
- Closed Forest
- Open Woodland

11/03/2016

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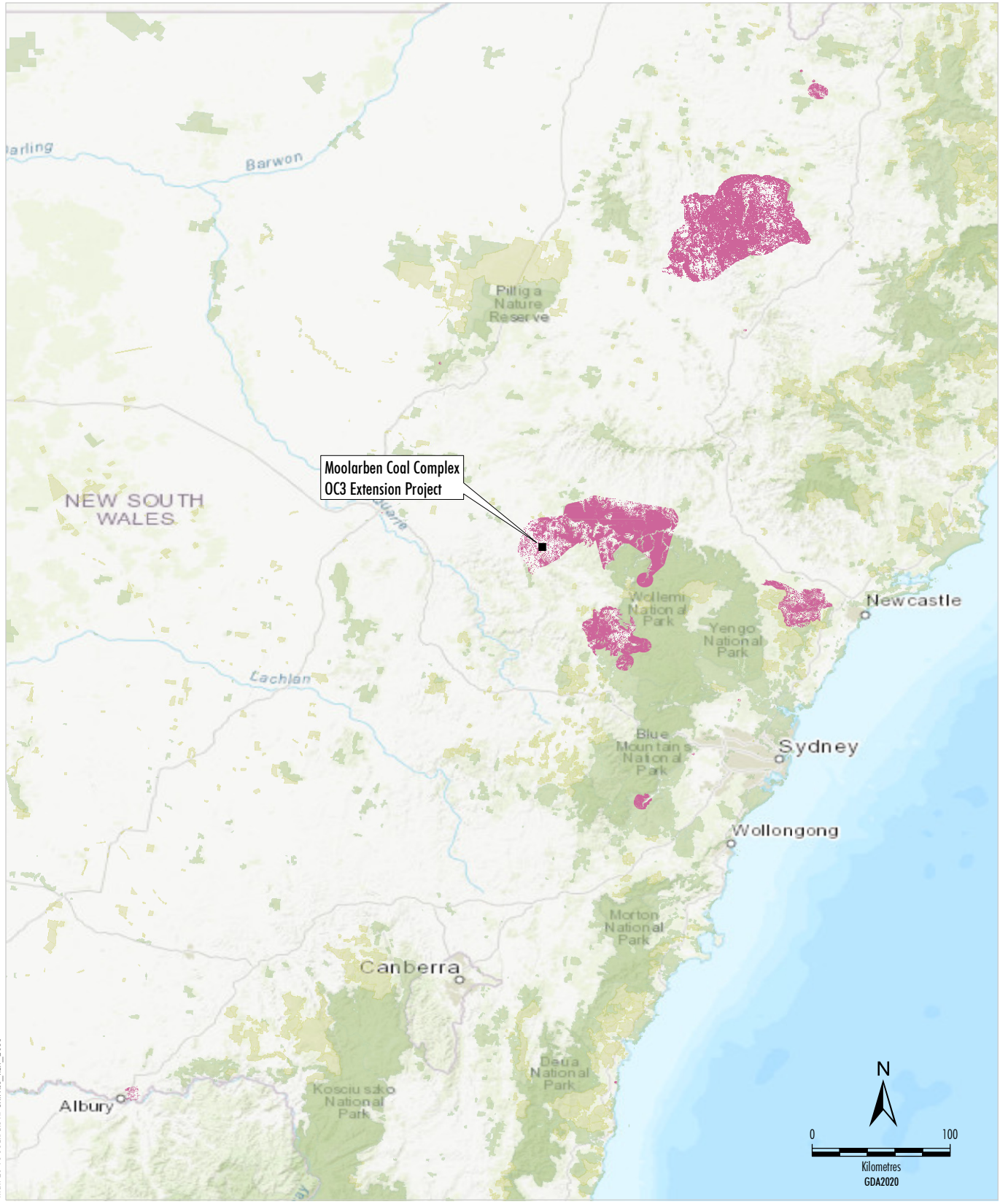
Regent Honeyeater Distribution

MCM-20-18 OC Ext EIS AP SAII Ass_REH_001A

Figure 3



MCM-20-18 OC Ext EIS AP SAII Ass_REH_203C

LEGEND
State Forest
National Park /Nature Reserve
NSW Government Regent Honeyeater Important Habitat Mapping

Source: ESRI Base (2023); NSW Government (2023)

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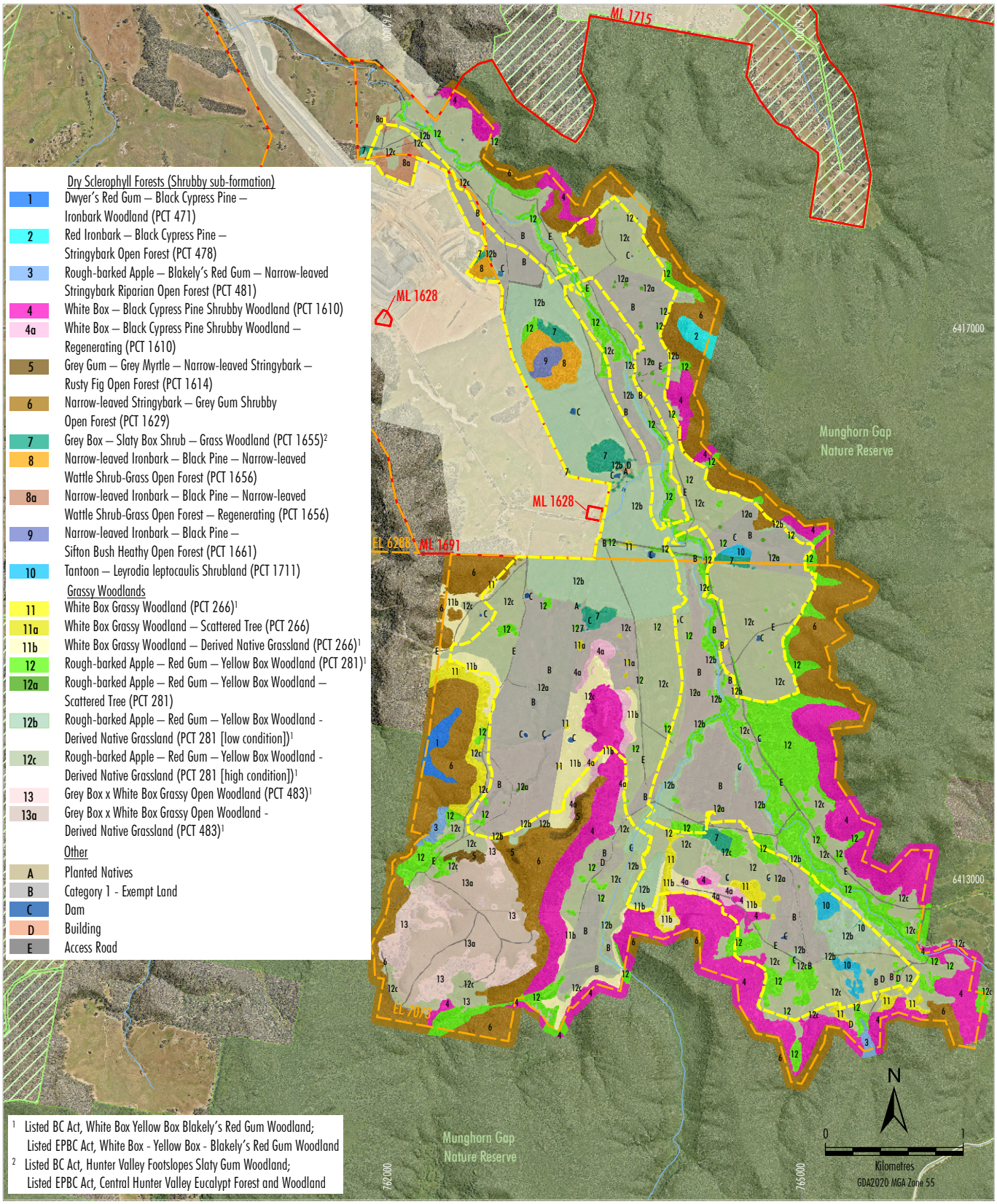
NSW Government Regent Honeyeater Important Habiat Mapping - NSW

Figure 4

3. Relevance of Regent Honeyeater to the Project

The BDAR (Niche 2022) accurately reviews all pertinent information. Important Habitat Mapping for the Regent Honeyeater (NSW DCCEEW 2024b) occurs in the Project area (Figure 4) as remnant woodland, albeit of variable quality (Figure 5). There are no specific Regent Honeyeater records within the Development Footprint, but the species has been recorded in close proximity in the past (Figure 17f of the BDAR [Niche 2022]). The Plant Community Types present within the Project area support a number of known forage tree species, including White Box, Yellow Box, Blakely's Red Gum, Red (Mugga) Ironbark, mistletoes, and a known nest-tree species, Rough-barked Apple *Angophora floribunda* (Figure 5). It is noted that diurnal bird surveys were conducted by AMBS (2022) in the Project area in April-May 2021, with no relevant findings, but these surveys were not conducted during the Regent Honeyeater breeding season (July–January) when the species is likely to be more detectable if present. This approach is consistent with the requirements of the BAM (DPIE 2020) (i.e. no surveys are required for this species). I personally recorded several Regent Honeyeaters in Munghorn Gap Nature Reserve in autumn 2006, but have not visited Mudgee-Wollar since then.



MCA-20-18 OC Ext EIS AP SAII Ass_ REH_204D

LEGEND

- National Park/Nature Reserve
- Existing Biodiversity Offset Area
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- Indicative Amended Project Surface Disturbance Extent

Source: MCO (2023); NSW Spatial Services (2021); Eco Logical Australia (2023)
Orthophoto Mosaic: MCO (2021)

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Vegetation Mapping

Figure 5

4. SAII assessment

As stated earlier, an impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of the threatened species becoming extinct. The BDAR (Niche 2022) lists questions relating to the risk of SAII on the Regent Honeyeater arising from the Project.

The following facts are pertinent to the risk of SAII for the Regent Honeyeater arising from the Project, including:

- the Regent Honeyeater has not been recorded in the Development Footprint (Niche 2022);
- the clearing of 80.5 ha represents 0.01% of the approximately 556,841 ha of total Mapped Important Habitat (NSW DCCEEW 2024b); and
- the Habitat Enhancement Area is likely to result in a net gain of habitat extent and quality over time.

Given that the 80.5 ha to be cleared is unlikely to be necessary to the Regent Honeyeater's survival as a species, it is unlikely that the Project would contribute significantly to the risk of the threatened species becoming extinct. The main point of concern is Noisy Miners (*Manorina melanocephala*), because the Project would increase the edge effect along the boundary with Munghorn Gap Nature Reserve and thus facilitate invasion by Noisy Miners. However, MCO has committed to implementing a Noisy Miner management program to minimise impacts to the Regent Honeyeater.

The BAM (DPIE 2020), Section 9.1.2: Additional impact assessment provisions for threatened species at risk of an SAII, is addressed here.

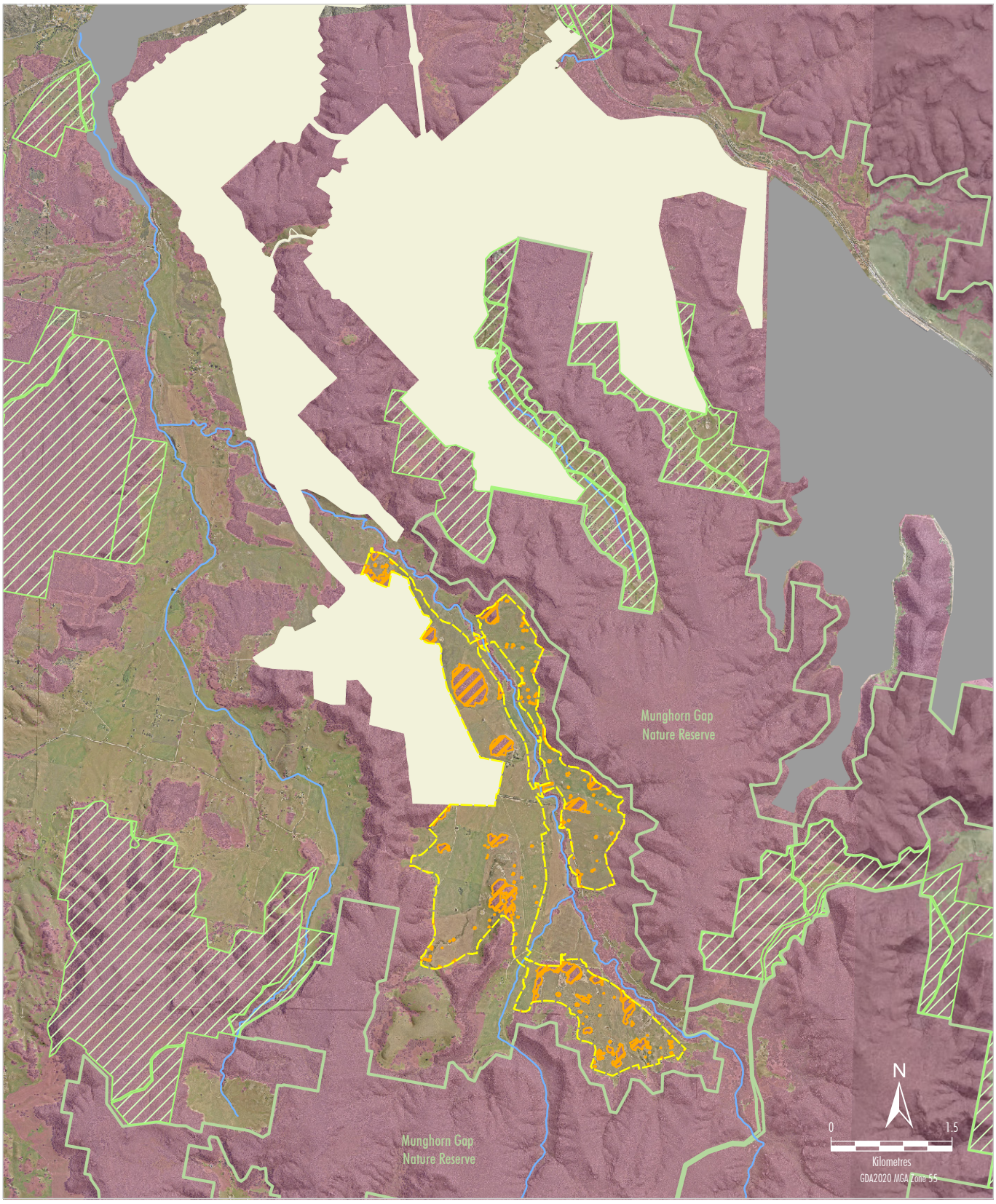
1. Action and measures taken to avoid the direct and indirect impact on the species at risk of an SAII

Actions and measures taken to avoid direct and indirect impacts on the Regent Honeyeater are detailed in Section 4.2 and Table 33 of the BDAR (Niche 2022).

Since the BDAR (Niche 2022) was submitted, MCO undertook a detailed review of the Development Footprint and has committed to further avoiding approximately 103.91 ha of Important Habitat (NSW DCCEEW 2024b) than originally proposed in the BDAR (Niche 2022). In other words, 184.41 ha of potential habitat was proposed to be cleared, but this has been reduced to 80.5 ha of potential habitat.

Inclusive of the further avoidance, the Project has now been designed to avoid 88% (approximately 601.9 ha) of Important Habitat (NSW DCCEEW 2024b) in the extent of the ecology Study Area, including avoidance of most of the Important Habitat mapped along Moolarben and Murdering Creeks.

In summary, the main impact with respect to the Regent Honeyeater is that 80.5 ha of potential habitat is to be cleared (Figure 6). The habitat to be cleared is made up of fragmented patches within grazing paddocks and edges of extensive areas of habitat within Munghorn Gap Nature Reserve.



MCM-20-18 OC Ext EIS AP SAII Ass_ REH_206C

LEGEND

- National Park/Nature Reserve
- Existing Biodiversity Offset Area
- Other Mining Operation
- Moolarben Coal Complex Disturbance Footprint
- Indicative Amended Project Surface Disturbance Extent
- NSW Government Regent Honeyeater Important Habitat Mapping
- NSW Government Regent Honeyeater Important Habitat Mapping Requiring Offset

Source: MCO (2023); NSW Government (2023)
Orthophoto: MCO (2021)

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Regent Honeyeater Impacts

Figure 6

2. Current Population of the species

The current status of the Regent Honeyeater is detailed in Table 51 (Appendix F) of the BDAR (Niche 2022).

There is a single population of Regent Honeyeater in NSW (Kvistad 2015). The NSW Scientific Committee (2011) states '*it is estimated that the NSW population of Regent Honeyeaters may now be fewer than 250 mature individuals'*. The current population is estimated at 250 individuals, an estimate supported by Crates *et al.* (2021).

A captive breeding program has been established for this species at the Taronga Zoo, with the reintroduction of 285 captive-bred Regent Honeyeaters in Victoria between 2008 and 2017 (27 birds in 2008; 44 birds in 2010; 37 birds in 2013; 77 birds in 2015; and 100 birds in 2017) (Tripovich *et al.* 2021). A total of 78 birds were released in NSW between 2020 and 2021 (27 birds in 2020 in the Lower Hunter Valley and 58 birds in 2021 in the Cessnock-Kurri Kurri woodlands NSW) (State Wide Integrated Flora and Fauna Teams [SWIFFT] 2023). This location is over 100 km from the Project.

a. evidence of rapid decline presented by an estimate of the:

- ***i. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or***
- ***ii. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites***

The BDAR (Niche 2022) presents information from the NSW *BioNet Threatened Biodiversity Database Collection* (NSW DCCEEW 2024c) and DotE (2015).

The population is estimated to have declined by >80% in three generations (~15 years), based on both population estimates at intervals over recent decades, and observed decline in geographic distribution and habitat quality (Crates *et al.* 2021). Therefore, a(i) and a(ii) apply for the Regent Honeyeater.

Over the past 10 years the population has been estimated to be in the order of 250 individuals (NSW Scientific Committee 2011; Crates *et al.* 2021). Population modelling by Heinsohn *et al.* (2022) predicts a worsening trajectory for the population.

To stabilise the population trajectory, the breeding rate of birds in the wild needs to be increased (Heinsohn *et al* 2022), which is the aim of the captive breeding program, and which has documented some breeding successes in Victoria (Tripovich *et al.* 2021) and NSW (Roderick *et al.* 2022; SWIFFT 2023).

b. evidence of small population size presented by:

- ***i. an estimate of the species' current population size in NSW, and***
- ***ii. an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and***
- ***iii. where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations***

The BDAR (Niche 2022) presents information from the NSW Scientific Committee (2010) and DotE (2015).

There is evidence that the Regent Honeyeater has a small population size. As most of the current population occurs in NSW, the estimated 250 individuals (see above) mostly exist in NSW.

Therefore b(i) applies; whilst b(ii) and b(iii) do not apply to the Regent Honeyeater.

c. evidence of limited geographic range for the threatened species presented by:

- ***i. extent of occurrence***
- ***ii. area of occupancy***
- ***iii. number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and***
- ***iv. whether the species' population is likely to undergo extreme fluctuations***

Niche (2022) considers that Principle 3 (species with very limited geographic distribution) is not to be applicable to the Regent Honeyeater as the species' extent of occurrence (EOO) and area of occupancy (AOO) are not geographically limited and the species does not experience fluctuations. Threat-defined locations have also not been identified and no extreme fluctuations in the population have been recorded (Niche 2022). The BDAR (Niche 2022) references the EOO of approximately 600,000 square kilometres (km^2) and AOO of approximately 300 km^2 as presented in the Conservation Advice (DOE 2015c).

The species still has a distribution from the NSW/QLD border to north-east Victoria; and the current EOO and AOO are estimated at 340,000 km^2 and 300 km^2, respectively; no threat-defined locations are identified, and there are no extreme fluctuations (Crates *et al.* 2021). Therefore, c(i) to c(iv) do not apply to the Regent Honeyeater.

d. evidence that the species is unlikely to respond to management because:

- ***i. known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g. species is clonal) on, a biodiversity stewardship site***
- ***ii. the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site, or***
- ***iii. life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g. frogs severely impacted by chytrid fungus).***

Niche (2022) considers that Principle 4 (species unlikely to respond to management and is therefore irreplaceable) is also not applicable to the Regent Honeyeater, as known reproductive characteristics do not severely limit the ability to increase the existing population on a biodiversity stewardship site, the species is not reliant on abiotic habitat that cannot be restored or replaced on a biodiversity stewardship site, and life history traits and/or ecology are known and threatening processes can be controlled on a biodiversity stewardship site.

Additionally, the species does respond to habitat restoration, and the active captive-breeding and release program has been particularly successful in the Lower Hunter (Roderick *et al.* 2022). Therefore, the Niche (2022) assessment is correct in that Principle 4 does not apply to the Regent Honeyeater.

A review of the potential of the proposed woodland mine site rehabilitation areas to provide habitat for the Regent Honeyeater was undertaken by Dr Paul Frazier (2rog 2024), considering the performance of existing rehabilitation areas within Moolarben Coal Mine and at the nearby Ulan Coal Mine. Dr Paul Frazier (2rog 2024) concluded that mine site rehabilitation could provide for the re-establishment of foraging habitat for the Regent Honeyeater, on the basis that several other bird species that forage either on the nectar or within the canopy of eucalyptus species have been recorded in the existing rehabilitation areas, and this provides a good indication of a developing eucalypt-dominated canopy and associated provision of habitat for birds that utilise eucalypt canopies.

3. Record any unknown or data deficient information in the TBDC

Not applicable.

4. Impacts on the species at risk of an SAII from the proposal

a. the impact on the species' population (Principles 1 and 2) presented by:

- ***i. an estimate of the number of individuals (mature and immature) present in the subpopulation on the subject land (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and***
- ***ii. an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or***

iii. if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal

It is not known if the potential habitat in the Development Footprint is used by the species. No subpopulation has been recorded on the Project area. It is noted that diurnal bird surveys were conducted in the Project area in April–May 2021 (AMBS 2022), with no relevant findings, but these surveys were not conducted during the Regent Honeyeater breeding season (July–January) when the species is likely to be more detectable if present. In any case, the nearest records to the Project in the past 5 years are no closer than Goulburn River National Park (i.e. several kilometres).

As described earlier, the most significant breeding population of the Regent Honeyeater appears now to be in the Lower Hunter, in the Tomalpin woodlands (Cessnock-Kurri Kurri), with recent breeding also recorded in Goulburn River National Park, and in the Murrumbo, Merriwa, Widden, Putty, Wolgan and Hawkesbury Valleys in 2019–20 (Ingwersen *et al.* 2020, 2021; Roderick *et al.* 2022). Mudgee-Wollar formerly featured as a significant breeding population centre (DotE 2016) (Figure 3), but is currently not specifically mentioned (Crates *et al.* 2021).

Regent Honeyeaters are occasionally sighted throughout their contemporary range (in which the Project is located), but known breeding activity is now restricted to sites not near the Project (after Heinsohn *et al.* 2022; Crates *et al.* 2021). Based on this current understanding of the population size and location in NSW, it appears there is a high likelihood of close to 0% of the total NSW population using the Project area, and a low likelihood of greater than 0%. This is particularly the case if the population is further declining, as its extent in NSW would likely become more restricted to the key breeding areas, rather than return to areas that were once more often used. However, if the population improves, then it is more likely that Regent Honeyeater individuals would once again visit the locality. There is currently a low likelihood that any of the total NSW population would be lost as a result of the Project.

The Regent Honeyeater's unit of measure under the NSW *BioNet Threatened Biodiversity Database Collection* (NSW DCCEEW 2024c) is 'Area'. The Project would result in the clearance of 80.5 ha potential habitat for the species (not known to be used), representing 0.01% of the approximately 556,841 ha of total Mapped Important Habitat (NSW DCCEEW 2024b). The potential habitat is fragmented and along edges, which is sub-optimal for the species, and can lead to proliferation of Noisy Miners which can disadvantage species such as the Regent Honeyeater (NSW Scientific Committee 2011).

b. impact on geographic range (Principles 1 and 3) presented by:

i. the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW

The BDAR (Niche 2022) discusses that key areas of Regent Honeyeater potential habitat, as identified by the Important Habitat Map for the species (NSW DCCEEW 2024b), are present within the Development Footprint within the intact areas of woodland. The Project would result in impacts to 80.5 ha of Regent Honeyeater potential habitat within the Mudgee-Wollar breeding area as per the Important Habitat Mapping (NSW DCCEEW 2024b).

Guidelines for interpreting listing criteria for species, populations and ecological communities under the NSW Biodiversity Conservation Act 2016 (NSW Threatened Species Scientific Committee 2020) states:

> *Extent of occurrence (EOO) is defined in Clause 4.18(2a) as the area of the total geographic range that includes all extant populations of the species.*
>
> *Area of occupancy (AOO) is defined in Clause 4.18(2b) as the area within the total range (and hence within EOO) that is currently occupied by the species. It excludes unsuitable and unoccupied habitat.*

The NSW Scientific Committee (2011) states '*The species EOO in NSW would therefore be less than 210 000 km^2, and AOO less than 200 km^2*.' The current EOO is approximately 340,000 km^2 and AOO is approximately 300 km^2 (Crates *et al.* 2021).

The Project area is within the EOO. However, the Project would not impact the EOO, because it would not reduce the total geographic range of the species.

The AOO was calculated by Crates *et al.* (2021) based on the total area of 1 km × 1 km grids containing a verified Regent Honeyeater sighting since 1990 sourced from BirdLife Australia. If the AOO is assumed to include the Project area, the Project would affect approximately 0.3% of the AOO. However, due to the decline of the Regent Honeyeater since 1990, the current AOO may not be as extensive as estimated by Crates *et al.* (2021).

ii. the impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted

As described above, the Project would impact potential habitat but is unlikely to impact Regent Honeyeater individuals, based on the current understanding of the population size and location in NSW.

iii. to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g. seed dispersal) and pollination distance for the species

The population would not become fragmented as a result of the Project.

iv. to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites.

The main point of concern is Noisy Miners, because the Project would increase the edge effect along the boundary with Munghorn Gap Nature Reserve and thus facilitate invasion by Noisy Miners. However, a Noisy Miner management program will be implemented.

5. New information to demonstrate that the principle identifying the species as at risk of an SAII, is inaccurate.

N/A

5. Is there likely an SAII on the Regent Honeyeater?

The Regent Honeyeater is listed as a threatened entity at risk of a SAII due to Principles 1 and 2. These are discussed below considering the information presented above.

Principle 1

Principle 1 states:

> *An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because it will cause a further* ***decline of the species*** *or ecological community.*
>
> *A* ***decline of a species*** *or ecological community is a* ***continuing or projected decline*** *in—*
>
> *(a) an* ***index of abundance*** *appropriate to the taxon, or*
>
> *(b) the* ***geographic distribution*** *and habitat quality of the species or ecological community.*

Guidelines for interpreting listing criteria for species, populations and ecological communities under the NSW Biodiversity Conservation Act 2016 (NSW Threatened Species Scientific Committee 2020) states:

> *A* ***continuing decline*** *is a recent, current or projected future decline (which may be smooth, irregular or sporadic) which is liable to continue unless remedial measures are taken.*
>
> *An* ***index of abundance*** *appropriate to the taxon may include a range of direct or indirect measures including direct counts or estimates of all types of individuals, or direct counts of individuals belonging to particular life stages (e.g. mature individuals).*
>
> ***Habitat quality*** *(also known as habitat suitability) refers to the environmental conditions that govern a species' rates of survival, growth and reproduction, and hence the ability of its populations to persist. A reduction in habitat quality will therefore usually be associated with an increase in extinction risks due to a decline in survival, growth and/or reproduction. Where knowledge of the relationship between these demographic rates and the environment is limited, habitat quality may be inferred from variation in the abundance of the species across different environments.*

Geographic distribution is defined under Clause 4.18 of the *Biodiversity Conservation Regulation 2017*:

> *(1) Geographic distribution is the area or areas in which a species or ecological community occurs, excluding cases of vagrancy in species.*
>
> *(2) This may be assessed by estimating—*
>
> *(a) the extent of occurrence (the area of the total geographic range that includes all extant populations of the species or all extant occurrences of the ecological community), or*
>
> *(b) the area of occupancy (the area within the total range that is currently occupied by the species or ecological community, that is it excludes unsuitable and unoccupied habitat), or*
>
> *(c) the* ***area of suitable habitat*** *(the area within the total range that includes occupied and unoccupied suitable habitat, but excludes unsuitable habitat).*
>
> *(3) The scale at which a geographic distribution is assessed should be appropriate to the biology of the species (or component species in ecological communities), the nature of threats and available data.*

Area of suitable habitat is defined in Clause 4.18(2c) as

> *'the area within the total range that includes occupied and unoccupied suitable habitat, but excludes unsuitable habitat.'*

Population modelling by Heinsohn *et al.* (2022) predicts a continuing decline for the Regent Honeyeater mainly due to low breeding rates. As described above, Regent Honeyeaters are occasionally sighted throughout their contemporary range (in which the Project is located), but known breeding activity is now restricted to sites not near the Project (after Heinsohn *et al.* 2022; Crates *et al.* 2021).

The Project is unlikely to impact Regent Honeyeater individuals or cause a further reduction in breeding rates. The Project would not result in a decline in the EOO and would result in a reduction in suitable habitat, not known to be occupied and equal to 0.01% of the approximately 556,841 ha of total Mapped Important Habitat (NSW DCCEEW 2024b).

Principle 2

Principle 2 states:

> *Principle 2 – An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because it will further reduce the population size of a species or ecological community*.

The Project is unlikely to further reduce the population size, as it is unlikely to impact Regent Honeyeater individuals or cause a further reduction in breeding rates.

6. Mitigation/management of residual impacts

The *Guidance to assist a Decision-maker to Determine a Serious and Irreversible Impact* (DPIE 2019) states:

> *For proposals that are state significant development/state significant infrastructure, Part 5 activities or biodiversity certification applications that are approved and considered likely to result in a serious and irreversible impact, the consent authority can include conditions in the approval that further minimise the impact. The consent authority should use information in the BAR that addresses section 10.2 or section 10.3 of the BAM to identify additional measures that will minimise impacts.*

The BDAR (Niche 2022) includes the following proposed impact mitigation measures of the Regent Honeyeater:

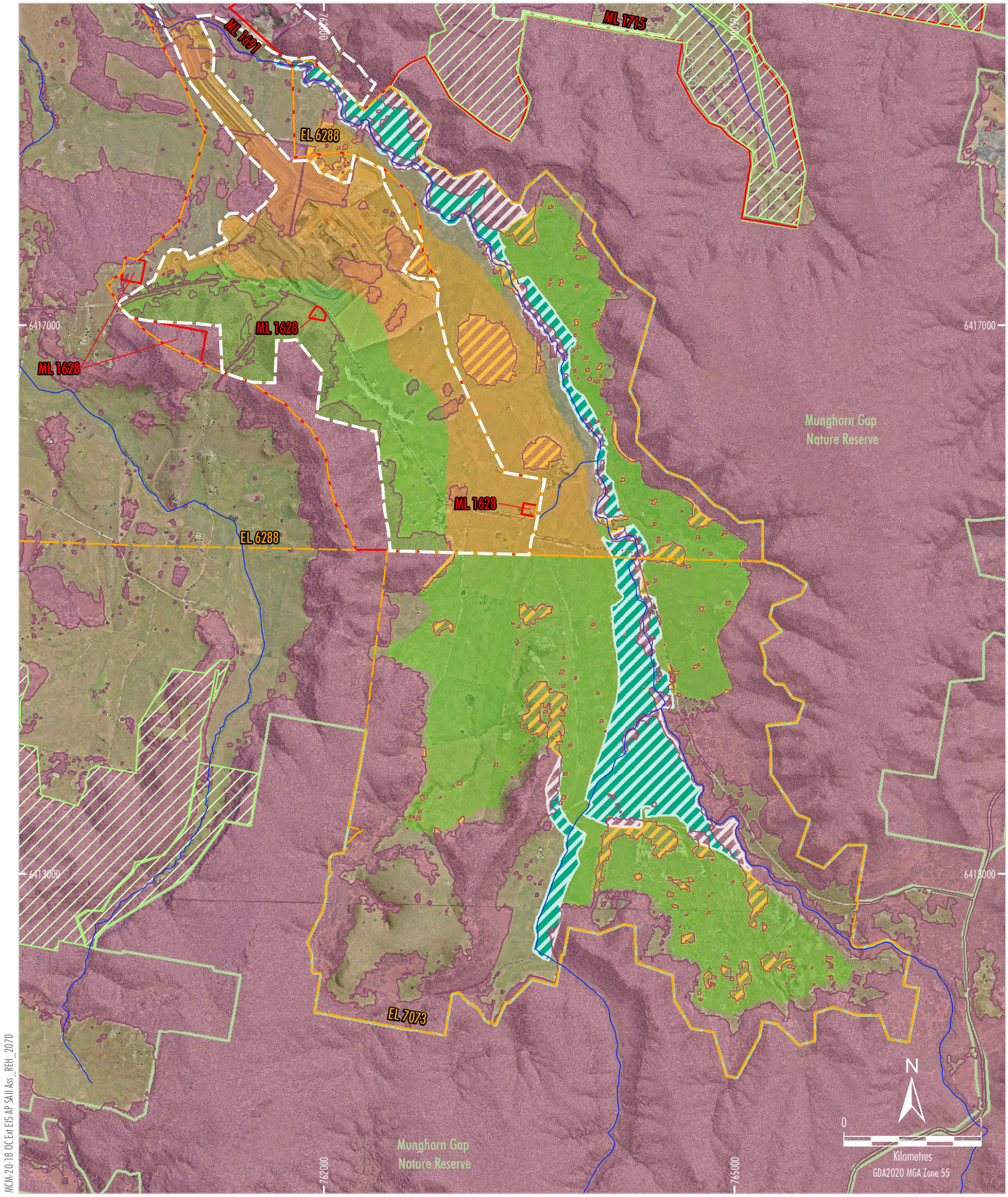
- targeted searches for the Regent Honeyeater in the Project area in the breeding season, July–January, within 1 km of the nearest record;
- minimising of blasting impacts on any Regent Honeyeater nests identified;
- monitoring of the Regent Honeyeater;
- evaluation of methods to increase breeding success if Regent Honeyeaters are found to be breeding in the Project area;
- management of Noisy Miners (which competitively exclude Regent Honeyeaters and interfere with nests);
- implementation of a Habitat Enhancement Area along the riparian zones of Moolarben and Murdering Creeks, through revegetation, fencing (as required), weed management, animal pest management, and fire management; and
- rehabilitation of mined areas to woodland.

Since the BDAR (Niche 2022) was submitted, MCO undertook a detailed review of the mitigation measures relevant to the Regent Honeyeater and the following changes were made to result in a net increase in habitat in the future:

- an increase in the Habitat Enhancement Area from 160 ha to 188 ha, resulting in an overall total of 52 ha of Mapped Important Habitat (NSW DCCEEW 2024b) under management.
- an increase in the rehabilitation of mined areas to woodland from 325 ha to 535 ha (Figure 7).

As described above, a review by Dr Paul Frazier (2rog 2024) concluded that mine site rehabilitation could provide for the re-establishment of foraging habitat for the Regent Honeyeater.

These proposed mitigation measures are appropriate and comprehensive, although some will depend on detection of the Regent Honeyeater and nest trees within the Project area.



MCM-20-18 OC Ext EIS AP SAII Ass_ REH_207D

LEGEND

- National Park/Nature Reserve
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- Existing Biodiversity Offset Area
- Regent Honeyeater Important Areas
- Regent Honeyeater Impacts Requiring Offset

Conceptual Post-mining Land Use Areas

- Agricultural Pasture/Scattered Trees
- Native Woodland

Habitat Enhancement Area

- Indicative Habitat Enhancement Area Extent
- Indicative Revegetation Area Extent

Source: MCO (2023); NSW Government (2023)
Orthophoto: MCO (Jan 2021)

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Revised Conceptual Post-mining Land Use

Figure 7

Offsets

In addition to the above measures, proposed mitigation/management measures to minimise residual impacts (i.e. loss of 80.5 ha of mapped Regent Honeyeater Important Habitat) include offsets from species and ecosystem credits generated by the Regent Honeyeater's Important Habitat polygon outside of the Development Footprint.

Under the BC Act, the offset for the Regent Honeyeater would be a land-based offset area multiple times the area to be cleared. The Biodiversity Conservation Trust (BCT) has confirmed that MCO could pay into the Biodiversity Offset Fund at a cost of approximately $17 million for the Regent Honeyeater credits. Alternatively, there is approximately 1,172 ha of Important Habitat Mapping on Moolarben-owned land being investigated by MCO as potential offset areas.

7. Conclusion

It is not known if the potential habitat in the Development Footprint is used by the species.

The most significant breeding population of the Regent Honeyeater appears now to be in the Lower Hunter, in the Tomalpin woodlands (Cessnock-Kurri Kurri), with recent breeding also recorded in Goulburn River National Park, and in the Murrumbo, Merriwa, Widden, Putty, Wolgan and Hawkesbury Valleys in 2019–20 (Ingwersen *et al.* 2020, 2021; Roderick *et al.* 2022).

Regent Honeyeaters are occasionally sighted throughout their contemporary range (in which the Project is located), but known breeding activity is now restricted to sites not near the Project (after Heinsohn *et al.* 2022; Crates *et al.* 2021). There is currently a low likelihood that any of the total NSW population would be lost as a result of the Project.

The Project would not result in a decline in the EOO and would result in a reduction in suitable habitat, not known to be occupied and equal to 0.01% of the approximately 556,841 ha of total Mapped Important Habitat (NSW DCCEEW 2024b). The Project is unlikely to further reduce the population size, as it is unlikely to impact Regent Honeyeater individuals or cause a further reduction in breeding rates.

Given the above considerations, the residual impact of the Project will not contribute significantly to the risk of the Regent Honeyeater becoming extinct).

The habitat to be cleared is made up of fragmented patches within grazing paddocks and edges of extensive areas of habitat within Munghorn Gap Nature Reserve. The habitat is not currently under active management for the Regent Honeyeater.

However, MCO is proposing a net increase in potential habitat. In areas that would not be cleared for the Project, MCO is proposing to manage and restore the habitat, through revegetation, fencing (as required), weed management, animal pest management, and fire management in the Habitat Enhancement Area (Figure 7). In areas that would be cleared for the Project, MCO is proposing to rehabilitate 535 ha of the post-mine landforms with woodland (Figure 7).

Under the BC Act, the offset for the Regent Honeyeater would be a land-based offset area multiple times the area to be cleared. The BCT has confirmed that MCO could pay into the Biodiversity Offset Fund at a cost of approximately $17 million for the Regent Honeyeater credits. Alternatively, there is approximately 1,172 ha of Important Habitat Mapping on Moolarben-owned land being investigated by MCO as potential offset areas.

Based on the above information, the Project's impacts to the Regent Honeyeater should not be regarded as SAII.

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6 March 2024

Mark Jacobs
Executive General Manager Environment and Communities
Yancoal Australia Ltd
c/- Resource Strategies

Attention: Mark Jacobs

Re: Potential for Moolarben Coal Complex OC3 Extension Project rehabilitated areas to support threatened species

An extension to the Moolarben Coal Complex (MCC) open cut 3 mine (OC3) (the Project) is proposed by Moolarben Coal Operations Pty Ltd (MCO) near Mudgee, New South Wales (NSW). The Project would result in the clearing of native woodland, open forest and derived native grasslands (DNG), known or with the potential to be habitat for threatened fauna species. A rehabilitation strategy, *MCC OC3 Environmental Impact Statement (EIS) Attachment 8 Rehabilitation and Mine Closure Addendum* (EIS Addendum) (Yancoal 2022a), has been prepared which details the proposed final landform design, post -mining land uses and rehabilitation objectives and completion criteria to achieve the nominated land-uses.

This review provides an assessment of the potential of the proposed native and open woodland rehabilitation areas to provide habitat for threatened species. In undertaking the assessment, consideration is given to:

- Native vegetation communities within the Project disturbance area
- Threatened species habitat values in the Project disturbance area
- Project rehabilitation strategy (EIS Addendum)
- Attributes of a rehabilitation area with potential to provide habitat for threatened species
- Biodiversity outcomes of existing rehabilitation areas within MCC and outcomes of on-going monitoring of rehabilitation at nearby Ulan Coal Mine (UC).

In summary, from the outcomes of existing rehabilitation of open cut mining areas at MCC and UC, there is potential for the re-establishment of habitat for threatened species in rehabilitation for the Project in the long-term. In particular, existing rehabilitation at MCC:

- Recorded presence of several birds which forage either on the nectar or within the canopy of eucalyptus species, which provides a good indication of a developing eucalypt dominated canopy and associated provision of habitat for birds that utilise eucalypt canopies. This includes potential habitat for regent honey eaters (*Anthochaera phrygia*) and swift parrot (*Lathamus discolor*). As the canopy continues to mature, it is expected foraging opportunities for these threatened species will increase.
- Currently provides or has potential to provide foraging habitat for a range of microbat species (including eastern cave bat (*Vespadelus troughtoni*) and large-eared pied bat (*Chalinolobus dwyeri*).

The presence of two threatened ecological communities (TECs), has also been confirmed within the Project disturbance area - *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland;* and *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion*. The potential for the re- establishment of the TECs has not been directly addressed within this review as there are specific criteria for species composition, vegetation structure and location in the landscape to be recognised as a TEC. However, where a rehabilitation area has potential to provide habitat for threatened species, there is also good potential for the rehabilitation area to be managed and steered towards meeting the TEC criteria in the long-term. As such, the review indirectly evaluates the capacity for the rehabilitation of open cut mining to re-establish the TECs.

01 Woodland and open forest habitat in the Project disturbance area

Threatened species that utilise woodland and open forest habitat and are known or have potential to be present in the Project disturbance area (AMBS 2023) include swift parrot, regent honeyeater, large-eared pied bat (foraging), and eastern cave bat (foraging). The woodland and open forest habitat is dominated by eucalyptus canopy species, a mid-storey that varies from sparse to absent, and a ground layer that varied in cover though, where dense, was dominated by perennial native grasses. As outlined in the Project *Biodiversity Development Assessment Report* (Niche 2024) a total of 93.64 hectares (ha) of remnant woodland/forest/shrubland and 17.2 ha regenerating woodland/forest is proposed to be cleared. DNGs are also being cleared, however are not the focus of this review.

A large portion of this vegetation is open woodland dominated by *Eucalyptus melliodora*, *Angophora floribunda*, *E. blakelyi* (Plant Community Type [PCT] 281) and open woodland to forest dominated by *E. albens* and *Callitris endlicheri* (PCT 1610) (Table 01-1). These two vegetation associations are located along the valley floors and drainage lines (PCT 281), and footslopes and shaley ridges (PCT 1610). The majority of the balance of woody vegetation to be cleared is open forest dominated by *E. sparsifolia* and *E. punctata* (PCT 1629) (Table 01-1).

Table 01-1 provides an overview of the vegetation associations (excluding the DNG components) that comprise the greatest extent of woody vegetation to be removed and their value to threatened species[1].

Table 01-1 Major vegetation associations within Project disturbance footprint and habitat values

PCT	Position in landscape	Short description in Study Area[2]	Habitat for threatened species/communities[3]	Hectares (ha) of woodland/ forest/ shrubland within disturbance area[4]
266	Footslopes	Woodland to open woodland, with trees to 25 m – *E. albens.* Mid-storey sparse, ground layer dominated by perennial grasses, high herb diversity.	• Swift parrot • Regent honeyeater • Large-eared pied bat (foraging) • Eastern cave bat (foraging)	6.7
281	Valley floor and drainage lines	Open woodland - *E. melliodora*, *A. floribunda*, *E. blakelyi*. Mid-storey sparse, ground layer dominated by perennial grasses.		25.3
483	Hillslopes, hillcrests and gullies associated with basalt intrusion in South West section of the Study Area.	Open woodland – Dominated by *A. floribunda and E. albens.* Ground layer high throughout, dominated by high native herb diversity.		0.04
1610	Footslopes and shaley ridges	Open woodland to forest – Dominated by *E. albens* and *Callitris endlicheri*. The mid-storey cover was variable, ground layer variable, perennial grasses common.		28.2
1629	Sandstone ranges and escarpments	Open forest - Dominated by *E. sparsifolia* and *E. punctata*. Mid-storey sparse and ground layer.		5.5
1655	Footslopes and small rises proximal to Moolarben Creek	Woodland - Dominated by *E. moluccana* (Grey Box). *E. dawsonii*, *E. melliodora*, *E. blakelyi*, *E. crebra* and *A. floribunda*. Mid-storey sparse, ground layer variable, perennial grasses common.		16.1
1656	Slight sandstone rises	Open forest – Dominated by *A. floribunda* and *E. crebra.* Mid-storey sparse.		17.8

[1] Swift parrot, regent honeyeater, large-eared pied bat (foraging), and eastern cave bat (foraging)
[2] Adapted from ELA (2023, in Niche 2024). Refer ELA (2023). Section 3.1.2 for full floristic description and assessment
[3] Sourced from Niche 2024, Table 32
[4] Sourced from Niche (2024). Refer Table 6.

PCT	Position in landscape	Short description in Study Area[2]	Habitat for threatened species/communities[3]	Hectares (ha) of woodland/ forest/ shrubland within disturbance area[4]
		Relatively high ground layer, native grasses dominating.		
1661	Low sandstone/shale rises	Open forest – Dominated by *Callitris endlicheri* and *Eucalyptus crebra* (Narrow-leaved Ironbark). Mid-storey sparse. Ground layer high, dominated by *Microlaena stipoides.*		3.7
1711	Ephemeral to semi-permanent drainage lines and alluvial fans with impeded drainage	Shrubland to open woodlands – Dominated by *Callistemon pinifolius* (Pine-leaved Bottlebrush), *Leptospermum arachnoides* and *Melaleuca thymifolia* (Thyme Honey-myrtle).	• Regent honeyeater • Large-eared pied bat (foraging) • Eastern cave bat (foraging)	7.5
Total				110.84

02 Overview of the proposed Project rehabilitation strategy

Proposed post-mining land uses for the Project area include agricultural land, permanent water infrastructure and native and open woodland areas.

As detailed in the *EIS Addendum* (Yancoal 2022), one of the principal post-mining land use visions for the Project is 'to enhance biodiversity by providing a net increase in native vegetation and improving connectivity with adjacent woodland communities in the Munghorn Gap Nature Reserve'. The overall objective for the final rehabilitated landform is to establish a safe, stable and non-polluting landform that is compatible with the surrounding landscape and fit for sustaining the intended post-mining land use. Proposed rehabilitation objectives developed for the Project are consistent with the existing approved rehabilitation strategy for MCC.

Table 6 of the EIS Addendum provides a summary of the proposed rehabilitation objectives and completion criteria to achieve the post-mining land uses, including the Native Ecosystem rehabilitation domain which would include native and open woodland areas. The Native Ecosystem rehabilitation domain objectives (Yancoal 2022) are summarised as follows:

- Soil profile development is occurring and growth medium suitable for the establishment and maintenance of land use
- Weeds are controlled
- Habitat is re-established for native fauna species
- Floristics and vegetation structure is characteristic of vegetation communities prior to OC3 clearing and/or historical clearing for agriculture
- Rehabilitation areas are resilient and self-sustaining.

Rehabilitation practices and measures to achieve these outcomes will be undertaken over a series of rehabilitation phases, including during active mining. These phases are consistent with the NSW Resources Regulator (NSW RR) RMP guidelines *Form and Way – Rehabilitation Management Plan for Large Mines* (2021). Table 02-1 provides a synopsis of the key aspects of each phase, refer to Section 7 of the EIS Addendum for a full description.

Table 02-1: Rehabilitation phases and key aspects

Phase	Key aspects of Phase (relevant to re-establishment of native ecosystems)
Active Mining	• Suitable soil and organic matter stored for reuse in rehabilitation areas • Seed collection • Pest (weeds and feral animals) management • Stockpile (from clearing) habitat features for enhancement of rehabilitation areas • Progressive rehabilitation (implementing the phases below) over life of the mine
Decommissioning	• Removal of infrastructure associated with mining activities

Phase	Key aspects of Phase (relevant to re-establishment of native ecosystems)
Landform Establishment	• Profiling the surface of rehabilitation areas for o Long-term stability o Natural looking landscape o Variability to promote biodiversity
Growth Medium Establishment	• Establish the physical, chemical and biological components of the substrate • To support the desired vegetation community
Ecosystem And Land Use Establishment	• Establishing the target vegetation community and fauna habitat (seeding or tube stock) • Maximise connectivity with existing habitat (e.g. Munghorn Gap Nature Reserve') • Habitat enhancement (e.g. salvaged habitat features, nest boxes)
Ecosystem And Land Use Development	• Manage maturing rehabilitation towards objectives (including weed and pest control) • Monitoring o Measure progress against performance indicators and completion criteria o Inform improvement to and refinement of methodologies and completion criteria o Adaptive management
Rehabilitation Completion	• Achievement of completion criteria • Rehabilitation outcomes and learnings used to: o Refine rehabilitation methodologies o Validate rehabilitation performance indicators and completion criteria

03 Habitat requirements of threatened species

The Baseline Fauna Report prepared by AMBS (2023), identifies the PCTs in the Project area that provide habitat for threatened species, as summarised in Table 01-1. Habitat features important to the threatened species and the habitats in which they were found during Project field surveys are also discussed and evaluated in AMBS (2023). A summary of these values is provided below in Table 03-1.

Table 03-1: Habitat features of threatened species

Species/Community	Habitat attributes within disturbance area[5] (AMBS 2023)
Swift parrot	• Autumn and winter flowering eucalyptus species (foraging habitat) – *E. albens E. sideroxylon. E. fibrosa, E. sparsifolia, E. punctata, E. crebra, E. melliodora*
Regent honeyeater	• All remnant woodland areas are within *Important Habitat Map*. • Species known to occur where there are large numbers of mature trees, high canopy cover and an abundance of mistletoes. • In the disturbance area: o Mistletoes (scattered to absent) o Key tree species (sources of nectar) – *E. albens E. sideroxylon, E. melliodora, E. fibrosa, E. crebra* present
Large-eared pied bat	• Foraging (all PCTs in disturbance area close to roosting features) o Dry open forest and woodland o Well-timbered areas containing gullies
Eastern cave bat	• Dry open forest or woodland (all PCTs in disturbance area)

04 Characteristics of successful habitat rehabilitation for threatened species

In evaluating the potential of mature woodland and open forest rehabilitation of an open cut mining area to provide resources for threatened fauna species, the expected habitat attributes of successful rehabilitation have been identified. These attributes, listed below in

Table 04-1, have been extrapolated from the habitat information provided in AMBS (2023), in consideration of species composition, vegetation structure, and micro-habitat in a rehabilitated landscape.

[5] AMBS report 2024, in Niche 2023. NB. Escarpment/rocky habitat important for large-eared pied bat, eastern cave bat, broad-headed snake, is located outside the disturbance area.

Table 04-1: Habitat attributes of successful rehabilitation

Habitat attributes of successful rehabilitation		Species
1	Woodland or open forest areas with overstorey dominated by *E. albens E. sideroxylon. E. fibrosa, E. sparsifolia, E. punctata, E. crebra, E. melliodora*	Swift parrot, regent honeyeater
2	Dry open forest and woodland	Large-eared pied bat, eastern cave bat

In summary, successful rehabilitation of open cut mining areas to provide habitat for threatened species should resemble regenerating woodland and open forest with the following habitat features:

- Key overstorey tree species - *E. albens E. sideroxylon. E. fibrosa, E. sparsifolia, E. punctata, E. crebra, E. melliodora*
    - Dominant in overstorey
    - Minimum of 8 m in height
    - Flowering and producing seed/naturally regenerating
- Sparse mid-storey.

Successful rehabilitation that includes these habitat features would be founded on a high standard of site preparation, revegetation techniques, management and monitoring. As highlighted in Section 02, standard industry rehabilitation best-practice for decommissioning, landform and plant establishment, monitoring and maintenance would be implemented for the Project. These practices have been successfully implemented in existing rehabilitated open cut mining areas within MCC. Outcomes include rehabilitation areas with a stable substrate suitable for plant growth, managed for threats (including weeds), with revegetation using local provenance seed to maximise plant stock resilience to local climatic conditions. Further detail on these outcomes is provided the MCC Annual Review reports (available on the MCC website).

05 Rehabilitation case studies

05.1 – Moolarben Coal Complex

The flora and fauna rehabilitation monitoring reports and annual reviews for MCC open cut mining areas OC1, OC2, OC3 and OC4 (ELA 2021a, 2021b, 2022a, 2022b, 2022c) have been examined with particular focus on habitat attributes identified in Section 04 and noting the following:

- Confirmed presence of Project threatened fauna species
- Confirmed presence of fauna species that occupy a similar ecological niche or utilise the same resources as Project threatened species.

Rehabilitation monitoring includes surveying of analogue sites for a comparison of results at the same point in time, which have also been assessed. The key findings of the evaluation of the MCC monitoring reports are summarised in Table 05-1.

With regards to species that utilise similar resources as threatened species for the Project, the presence of the birds listed in Table 05-1 show potential for the rehabilitation area to provide future habitat for the regent honeyeater and swift parrot. While the species in Table 05-1 utilise a greater range of food resources and are not as reliant on nectar of eucalypts/mistletoes as the regent honeyeater and swift parrot, the yellow-faced honeyeater, fuscous honeyeater and noisy friarbird all forage on nectar from eucalypt flowers (BB 2023a, BB 2023b, BB 2023c) and the striated pardalote and spotted pardalote mainly forage for insects in the tops of eucalypt canopies (AM 2023, BB 2022d). As such, their presence provides a good indication of a developing eucalypt dominated canopy and associated provision of habitat for birds that utilise eucalypt canopies.

The 2019 Annual Review (MCC 2020) provides a comparison of years of fauna monitoring data, which illustrates an increasing trend in species richness in birds from 2013 to 2019, while the species richness of microbats was generally stable. The MCC OC1 survey plot results included eight species at R5 and nine species at R14 (ELA 2021b), suggesting microbat species are at a minimum able to make flights across the rehabilitation area, and may also be

feeding. One of the threatened microbat species, large-eared pied bat, was recorded in the OC1 rehabilitation area in 2020. It cannot be determined if the species was feeding within the rehabilitation area or only traversing through. However, it establishes that the rehabilitation area does not present a barrier to the species movement.

Further, ELA 2022b recorded an average overstorey percent foliage cover (PFC) cover of 13% at Secondary Domain A – Box Gum Shrubby Woodland, lower than that recorded at analogue sites (average 47%); however the density of overstorey species present at Secondary Domain A sites indicates that overstorey PFC should continue to increase as the vegetation community matures and provides an existing or potential future foraging resource.

The PCTs in the Study Area noted as habitat for threatened species have a sparse mid-storey. The recorded mid-storey cover in the rehabilitation areas was higher than analogue sites (ELA 2022b), however this can be expected to decrease as the canopy matures.

Table 05-1: MCC existing rehabilitation habitat attributes and observations

Attributes/observations	Present	Monitoring Report	Rehabilitation Area Details	
			Box Gum Shrubby Woodland (10 – 12 years old at time of monitoring)	**Sedimentary Ironbark Forest (3 – 10 years old at time of monitoring)**
E. sideroxylon > 8 m in height	No	Spring 2022 floristics raw data (ELA 2022c)	Not recorded	
E. albens, E. fibrosa, *E. sparsifolia*, *E. punctata, E. crebra, E. melliodora* > 8 m in height	Present in 'canopy stratum'		It is assumed canopy stratum recorded in ELA 2022c is a minimum of 8 m. It is noted within ELA 2021a overstorey was ~12 m tall at OC1 R1, R5, R7, R14 (in relation to locations of microbat detector placement). No confirmation of heights of individual species.	
Evidence of reproduction of key overstorey species	Yes	Autumn 2022 (ELA 2022b)	*E. punctata* (buds)	None recorded[6]
Sparse mid-storey	No		• PFC 0.5 – 11.4% (> than 0% at analogue)	• PFC 0 – 22% (> than 0% at analogue)
Project threatened species	Yes	Annual Report 2021 (ELA 2021b)	• Large-eared pied bat (noted as recorded 2020)	
Species that utilise similar resources as key threatened species	Yes		• Yellow-faced honeyeater *(Lichenostomus chrysops)* • Numerous microbats including chocolate wattled bat (*Chalinolobus morio*) and eastern horseshoe bat (*Rhinolophus megaphyllus*)	• Numerous microbats including chocolate wattled bat
		2021 fauna raw data (ELA 2022c)	• Yellow-faced honey eater • Fuscous honeyeater (*Lichenostomus fuscus*) • Noisy friarbird (*Philemon corniculatus*) • Striated pardalote (*Pardalotus punctatus*) • Spotted pardalote (*Pardalotus punctatus*)	N/A Monitoring did not encompass these survey plots

[6] *E. dawsonii* buds, flowers and fruit recorded in 2021, a component of the BC Act listed TEC Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion subject to clearing.

Table 7 of the Autumn 2022 monitoring report (ELA 2022b) recorded the following aspects of the rehabilitation, relevant to the overall rehabilitation objective[7], during visual transects (VTs):

- High annual weed cover, but not or rarely over 50%cover.cover
- Overstorey included >3 canopy species at most VTs
- Mid-storey and groundcover species richness was generally high
- Stable surface
- Few soil compaction issues
- Only one area of minor sheet erosion.

While the potential for the rehabilitation area to provide habitat for TECs is not specifically addressed in this review, it is noted that key tree and ground layer species for the relevant TECs have been recorded in the survey plots in existing rehabilitation areas at MCC.

05.2 Ulan Coal Mine

A review of reporting for the UC Mine including *Ulan Coal Mine Floristic Annual Monitoring Report 2021* (ELA 2021c), *Ulan Coal Mine 2021 Annual Review* (GCAA 2021), and *Rehabilitation Information Release* (NSW RR 2020), has been undertaken. Access to detailed data on individual tree species and heights, and fauna monitoring results was not available for review, however the findings relevant to rehabilitation potential to provide habitat resources for a high species richness of fauna, including threatened fauna, are as follows:

- Evidence of canopy species flowering woodland/open forest UC rehabilitation area Domain B and second-generation juvenile trees in most rehabilitation areas established in 1997 – 2014 (ELA 2021c)
- Two areas (26 ha and 57 ha) rehabilitated 2005 – 2008 have stands of dense *Eucalyptus sp.* 4 - 8 m in height (GCAA 2021)
- A 50 ha area of rehabilitation commenced in the early 1980's, and signed-off by the NSW RR as meeting all completion criteria, has achieved the following outcomes (NSW RR 2020):
    - Surrounding landscape features and vegetation communities present in rehabilitation area – faunal composition, habitat features and general biodiversity
    - Mixed woodland/open forest, Spotted gum woodland/open forest
    - Self-sustaining native ecosystem which has reached a state of high resilience and requires minimal maintenance
    - Satisfies all the required ecological, soil and landform rehabilitation completion criteria with no significant weed infestations
    - The monitoring program recorded five amphibians, 100 birds, 23 mammals and six reptiles species.

06 Conclusion

In consideration of the habitat requirements of threatened species and the outcomes of existing rehabilitation undertaken at open cut mining areas at the MCC, it appears there is good potential for high standard, well designed and managed rehabilitation to provide habitat for threatened species.

A MCC rehabilitation monitoring report (ELA 2021a) observed the overstorey at several survey plots was ~12 m tall, and at least one key overstorey species has been recorded with flower buds (*E. punctata*). While species recorded in the ~12m tall canopy are not specified in the report (ELA 2021a), it is assumed the canopy includes key eucalypt foraging species for swift parrot and regent honeyeater. These species have not been observed to date in the MCC rehabilitation areas, however the vegetation has matured sufficiently to provide habitat for several birds which forage either on the nectar or within the canopy of eucalyptus species. Their presence provides a good indication of a developing eucalypt dominated canopy and associated provision of habitat for birds that utilise eucalypt canopies. As the canopy continues to mature, it is expected foraging opportunities for these threatened species will increase.

Additionally, the microbat species richness within MCC rehabilitation areas is generally consistent with that recorded within the Project area (during baseline surveys), including the large-eared pied bat. This established that the microbat species populations have not been displaced in the long-term and the rehabilitation either currently provides or has potential to provide foraging habitat for a range of microbat species.

The MCC rehabilitation monitoring reports reviewed do not list the eastern cave bat as being observed in the rehabilitation areas, however it is unclear what fauna was recorded prior to clearing at OC 1 – 4, and the results of

[7] Overall objective for the final rehabilitated landform is to establish a safe, stable and non-polluting landform that is compatible with the surrounding landscape and fit for sustaining the intended post-mining land use

past fauna monitoring campaign were not all available (e.g. prior to 2021). Relevant to consider in determining the likelihood the rehabilitation area has potential to provide habitat for this species, a study of the eastern cave bat in northern NSW (Law et al. 2005) frequently observed the species along a stream, lined with trees, but surrounded by cleared paddocks. Occasional rapid flights across paddocks (> 500 m) were also observed. Law et al. (2005) suggest that a key requirement for the eastern cave bat in the rural landscape 'is the presence of native vegetation in close proximity to roosts, although extensive forested areas may not be required'. While there is not extensive knowledge on the foraging requirements of the eastern cave bat, based on these observations of the species and the microbat species richness recorded in OC1, there is good potential for the Project rehabilitation to provide habitat suitable for the species.

The mid-storey PFC recorded at MCC rehabilitation areas is higher than habitat typical of a number of threatened species habitat, however this is expected to thin out over time, or be managed to be reflective of open woodland and woodland.

The UC mine rehabilitation established in the mid 1980's has achieved a mature state, able to support a wide suite of fauna species, shows resilience, and is a self-supporting woodland/open forest community.

In summary, from the outcomes of existing rehabilitation of open cut mining areas at MCC and UC, there is potential for the re-establishment of habitat for threatened species in rehabilitation for the Project in the long-term.

Regards

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Moolarben Coal Complex OC3 Extension Project
Review of the Assessment for Serious and Irreversible Impacts on the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland

March 2024

1 *Introduction*

The Moolarben Coal Complex is located approximately 40 kilometres (km) north of Mudgee, New South Wales (NSW) (Figure 1). Moolarben Coal Operations (MCO) is proposing an extension to the approved OC3 mining operations to allow for extraction of additional coal within existing mining and exploration tenements adjacent to approved operations at the Moolarben Coal Complex (the Project) (Figure 2). Approval for the Project is being sought under Part 4 of the *Environmental Planning and Assessment Act 1979*.

Niche Environment and Heritage (Niche), in collaboration with Premise, was commissioned by MCO to prepare the Biodiversity Development Assessment Report (BDAR) for the Project Environmental Impact Statement (EIS) (Niche 2022). The BDAR includes information on the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland, a threatened ecological community (TEC) under the NSW *Biodiversity Conservation Act 2016* (BC Act) and listed on the Department of Planning and Environment (DPE) list of Serious and Irreversible Impact (SAII) Entities. Eco Logical Australia (ELA 2022) undertook the vegetation (TEC) mapping and flora sampling for the Project.

The Biodiversity Assessment Method (BAM) (Department of Planning, Industry and Environment [DPIE] 2020a) states that the determination of a SAII on biodiversity values is to be made by the decision-maker in accordance with the principles set out in the NSW *Biodiversity Conservation Regulation 2017*. The NSW *Biodiversity Conservation Regulation 2017* states:

> *6.7 Principles applicable to determination of "serious and irreversible impacts on biodiversity values" (section 6.5(1))*
>
> *(1) This clause applies for the purposes of determining whether an impact on diversity values is a serious and irreversible impact for the purposes of the biodiversity offsets scheme.*
>
> *(2) An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because—*
>
> *(a) it will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or*
>
> *(b) it will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or*
>
> *(c) it is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or*
>
> *(d) the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.*
>
> *(3) For the purpose of this clause, a decline of a species or ecological community is a continuing or projected decline in—*
>
> *(a) an index of abundance appropriate to the taxon, or*
>
> *(b) the geographic distribution and habitat quality of the species or ecological community.*

LEGEND
- State Forest
- National Park /Nature Reserve
- Local Government Boundary
- Exploration Licence Boundary
- Mining Lease Boundary
- Mining Operation
- Indicative Amended Project Surface Disturbance Extent

Source: NSW Spatial Services (2021)
MCO (2023)

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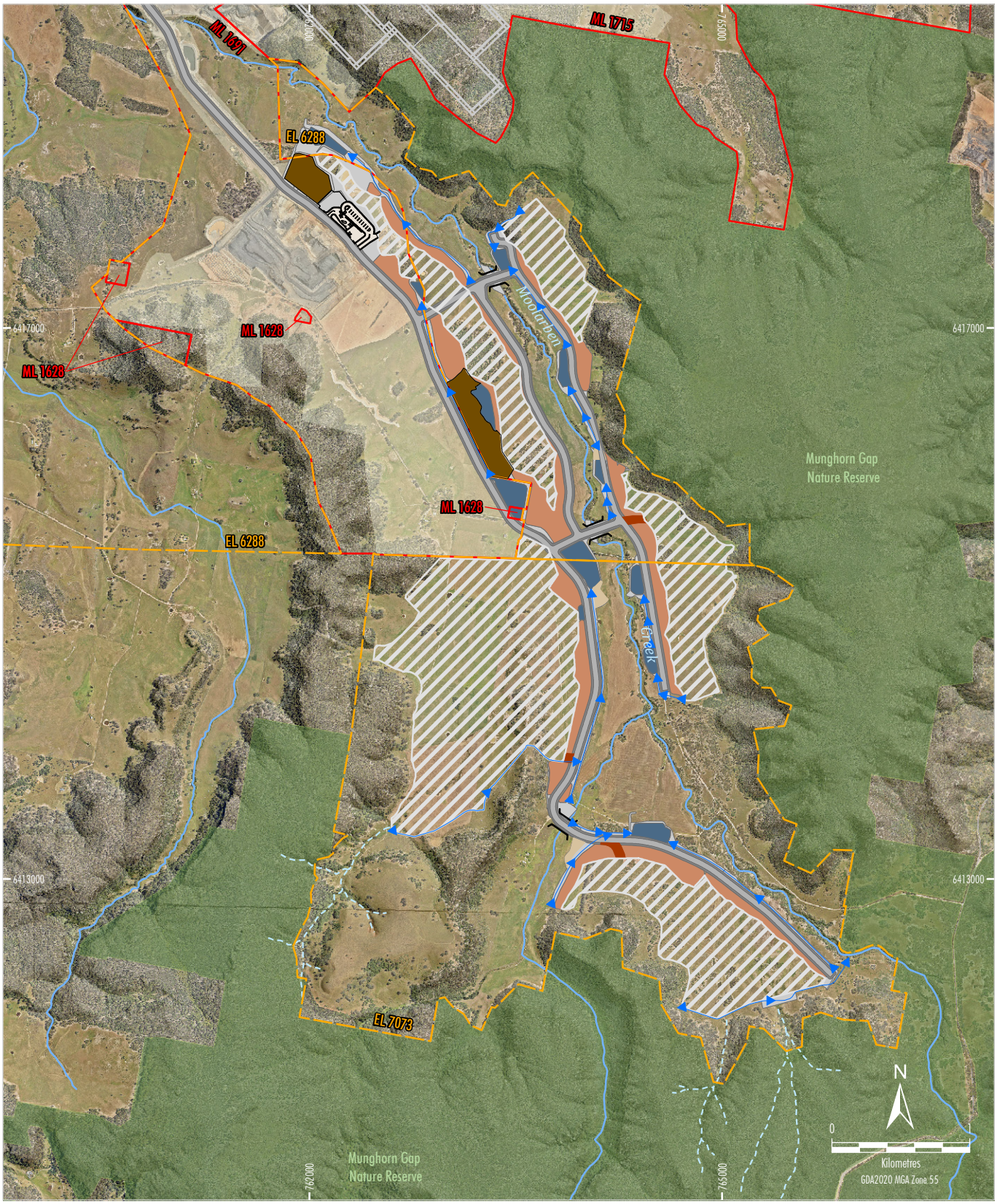
Project Location

Figure 1

MCM-20-18 OC Ext EIS AP SAII Ass_BG_201E



MCM-20-18 OC Ext EIS AP SAII Ass_ B6 _202C

LEGEND

- National Park/Nature Reserve
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- Underground Longwall Layout
- OC3 Extension Project - Amended
- Indicative Open Pit Extent
- Indicative ROM Pad
- Culvert
- Indicative Haul Roads
- Indicative Infrastructure Corridor
- Indicative Infrastructure Area
- Indicative Construction/Rehabilitation Material Stockpiles
- Conceptual Flood Levee Embankment
- Conceptual Water Management Infrastructure
- Indicative Vehicle Access
- Conceptual Surface Water Drain

Source: MCO (2023); NSW Spatial Services (2021)
Orthophoto: MCO (2021)

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General Arrangement of the Amended Project

Figure 2

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is listed as an entity at risk of a SAII due to Principles 1 and 2:

> *Principle 1 – An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because it will cause a further decline of the species or ecological community.*
>
> *Principle 2 – An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because it will further reduce the population size of a species or ecological community.*

The purpose of this report is to review Niche's (2022) assessment on the *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions* (White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland) and evaluate if any residual impacts (i.e. impacts that would remain after implementation of proposed avoidance/minimisation measures) are serious and irreversible and whether there are any further measures that would minimise those impacts. An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of the ecological community becoming extinct.

Since the initial BDAR (Niche 2022) was submitted, MCO undertook a detailed review of the Project Development Footprint as presented in the Project EIS, which resulted in an Amended Project and in turn, further minimised impact to the existing White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland. The 2022 BDAR has been updated by Niche to reflect the Amended Project. The findings of this assessment have also been updated to reflect the Amended Project.

This review has been undertaken by Dr Colin Driscoll (Hunter Eco), independent of the BDAR. This review is not being undertaken in Dr Driscoll's capacity as an accredited assessor.

2 *Background Information on the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland*

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is comprised of Grassy Woodlands occurring on the tablelands and western slopes of the Great Dividing Range from the Darling Downs in southern Queensland, through NSW and into central Victoria (Threatened Species Scientific Committee [TSSC] 2020). This community occurs in hilly to undulating landscapes in soils of moderate fertility derived from a range of lithologies (Prober and Thiele 2004). Figure 3 below shows the NSW regions where the ecological community is known or predicted to occur (NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) 2024a).

This community can occur as either woodland or derived native grassland with a scattered shrub layer and a ground layer of native tussock grasses. Where a tree layer occurs, trees are typically widely spaced with projected foliage cover generally less than 30% and a canopy characteristically dominated by one or more of the species *Eucalyptus albens* (White box), *E. melliodora* (Yellow Box) and *E. blakelyi* (Blakely's Red Gum) (TSSC 2020). Understorey shrubs are typically sparse or absent with a groundcover dominated by perennial tussock grasses (*Themeda triandra* and *Poa sieberiana*) and a range of other forbs and grasses (TSSC 2020). Alternately, the canopy may be completely absent in areas of derived native grassland where tree removal has occurred.

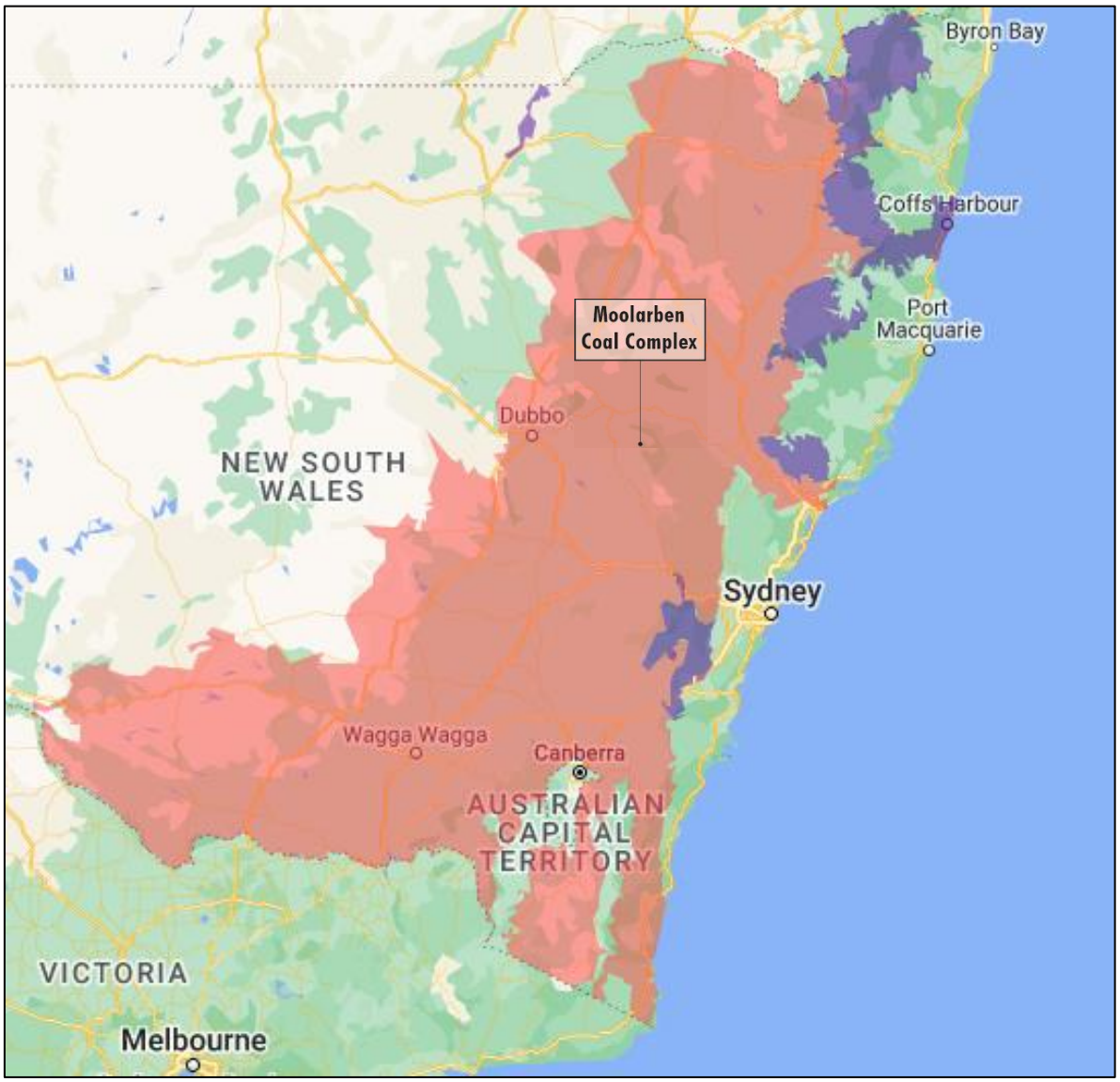


Figure 3. Geographic distribution of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Pink represents sub-regions the ecological community is known to occur. Purple represents sub-regions the ecological community is predicted to occur (NSW DCCEEW 2024a).

3 *Relevance of the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland to the Project*

The BDAR (Niche 2022) recognises three plant community types (PCTs) comprising the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Figure 4):

- PCT 266 White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion;
- PCT 281 Rough-Barked Apple – red gum – Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion; and
- PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley.

A total of 401.12 hectares (ha) of the TEC would be cleared by the Amended Project, consisting of 34.22 ha (8.5 %) of woodland and 366.9 ha of derived native grassland (91.5 %) (Niche 2024) (Figure 5). The derived native grassland has been created through the clearance of the tree and shrub layers, some of which has also been previously cultivated for crops (and the native plants have regrown from the seedbank).

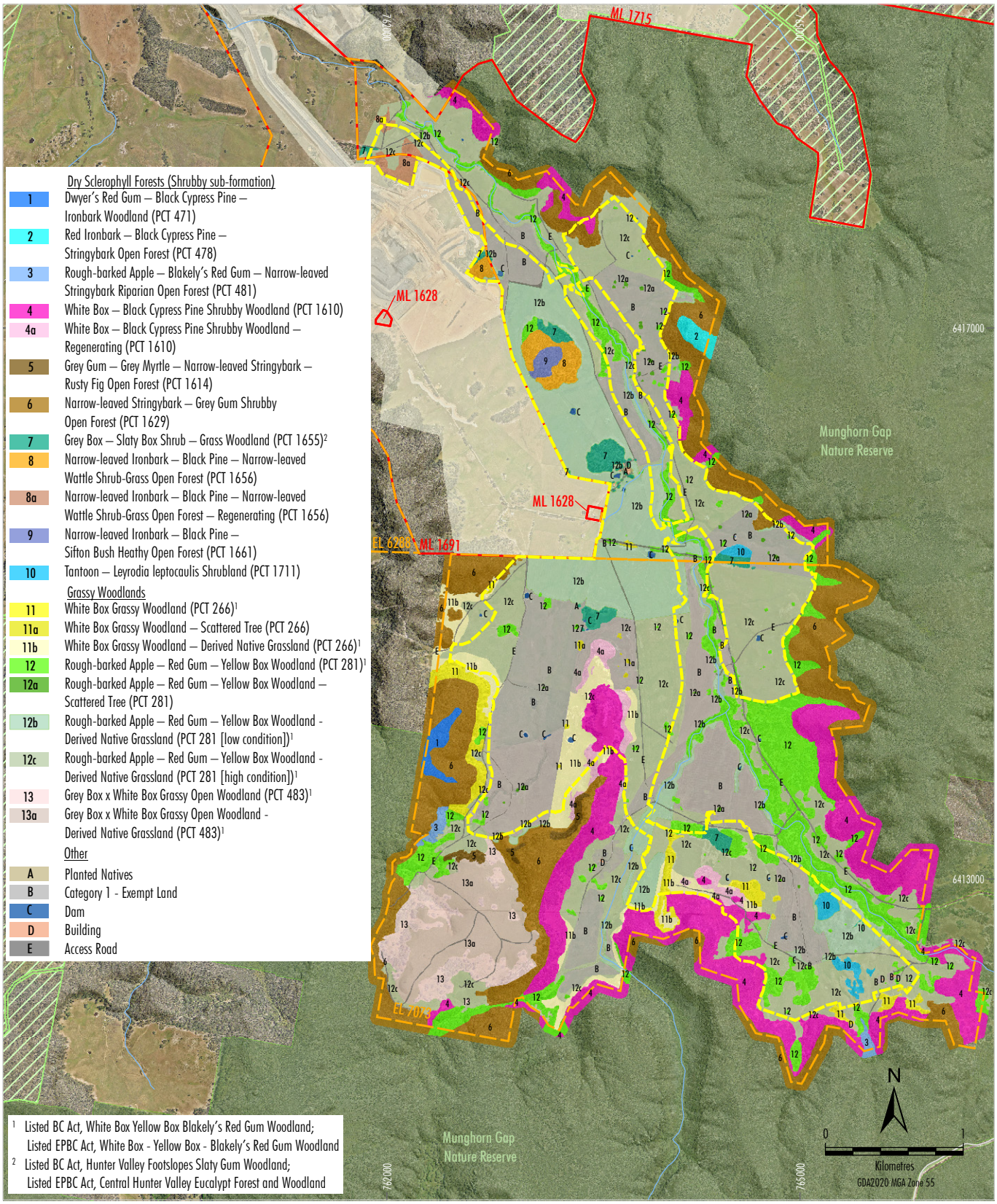
There is a negligible amount of PCT 483 to be cleared with PCT 281 being 90% and PCT 266 being 10% of the approximate portions of total TEC clearance. Most of the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland within the Project Development Footprint occurs on grazing land (comprising native vegetation, modified pastures) and cropping land as per the NSW 2017 Landuse mapping (DPIE 2020b) (Figure 6).

There is infrastructure through-out the occurrence of the TEC, including paddock fences, sheds, houses, dirt tracks and dams. The condition of the TEC has been measured through vegetation integrity data and consistent with the BAM (DPIE 2020a). The vegetation integrity (VI) scores for the vegetation zones (VZ) associated with the TEC are summarised in Table 1. The derived native grassland is highly disturbed with a VI score of less than 40% (out of 100%). The woodland areas have a higher VI score (80-90%).

Table 1
Vegetation Integrity Data for the TEC

Vegetation Zone Name	Composition Condition Score	Structure Condition Score	Function Condition Score	VI Score*	Area (ha)*
281 Derived Native Grassland (High) – VZ4 (Plate 1)	60.1	58.6	10.5	33.3	203.3
281 Derived Native Grassland (Low) – VZ5 (Plate 2)	57.6	64.8	9.4	32.7	135.6
266 Derived Native Grassland – VZ2 (Plate 3)	71	60.2	14.8	39.8	28
281 Remnant Woodland – VZ3 (Plate 4)	83.5	89	99.4	90.4	25.3
266 Remnant Woodland – VZ1 (Plate 5)	82.1	86	96.8	88.1	6.7
483 Remnant Woodland – VZ9 (Plate 6)	84.1	99.4	69.5	83.4	0.04
281 Scattered Trees – VZ21	78.5	76.7	100	84.4	1.58
266 Scattered Trees – VZ20	83.5	38.4	94.8	67.2	0.6
				Total	**401.12**

* The BDAR (Niche 2022) has been revised as part of the Response to Submissions on the Project EIS. The vegetation integrity scores and areas presented are consistent with the Revised BDAR (Niche 2024).



MCA-20-18 OC Ext EIS AP SAII Ass_ B6 _2030

LEGEND

- National Park/Nature Reserve
- Existing Biodiversity Offset Area
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- Indicative Amended Project Surface Disturbance Extent

Source: MCO (2023); NSW Spatial Services (2021); Eco Logical Australia (2023)
Orthophoto Mosaic: MCO (2021)

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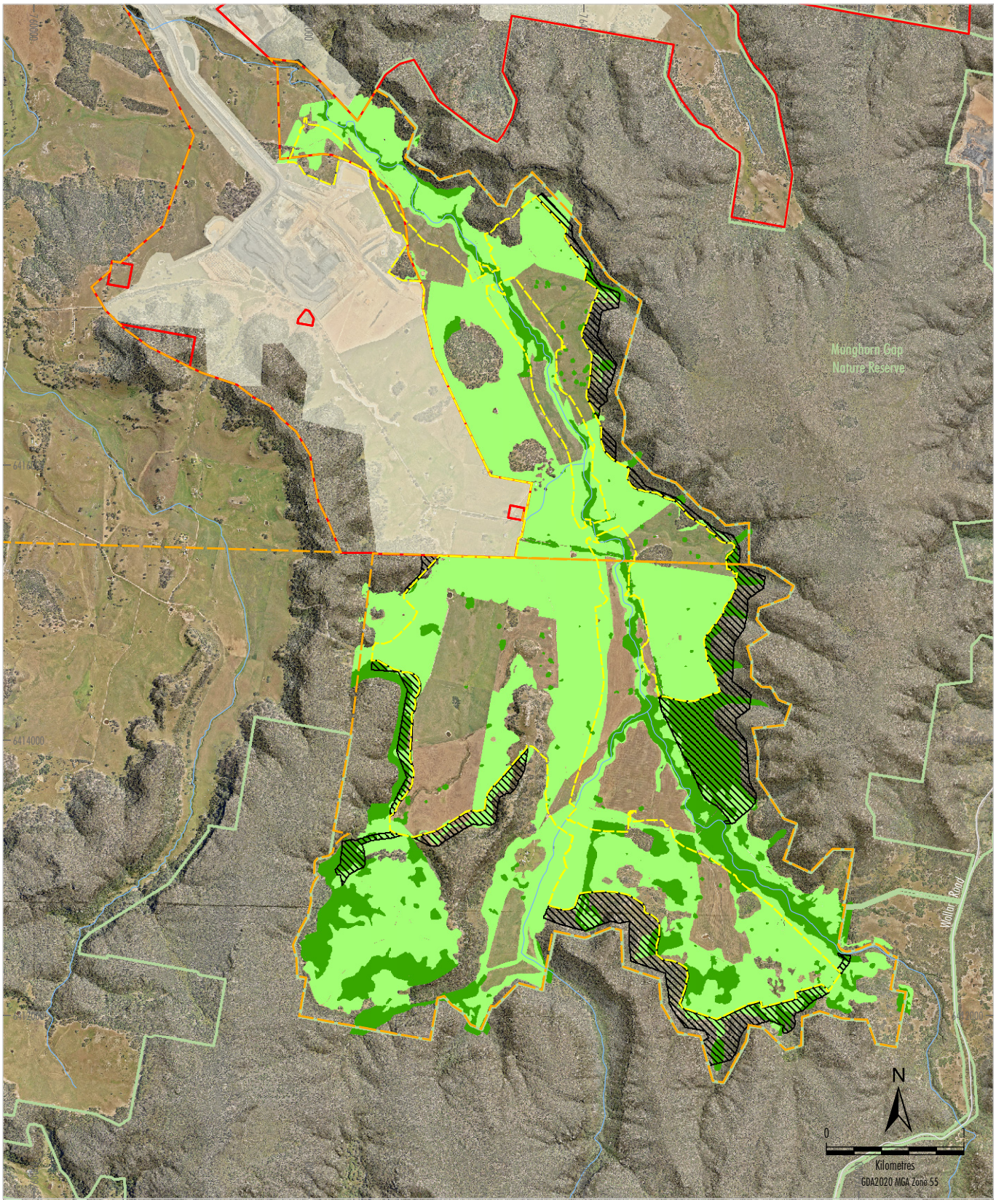
Vegetation Mapping

Figure 4



NCIA-20-18 OC Ext EIS AP SAII Ass_ BG_2040

LEGEND

- National Park/Nature Reserve
- Exploration Licence Boundary
- Mining Lease Boundary
- Moolarben Coal Complex Disturbance Footprint
- Indicative Amended Project Surface Disturbance Extent
- Additional Avoidance/Minimisation for Amended Project

Box-Gum Woodland CEEC

- Woodland
- Derived Native Grassland

Source: MCO (2023); NSW Spatial Services (2021); Eco Logical Australia (2023)
Orthophoto Mosaic: MCO (2021)

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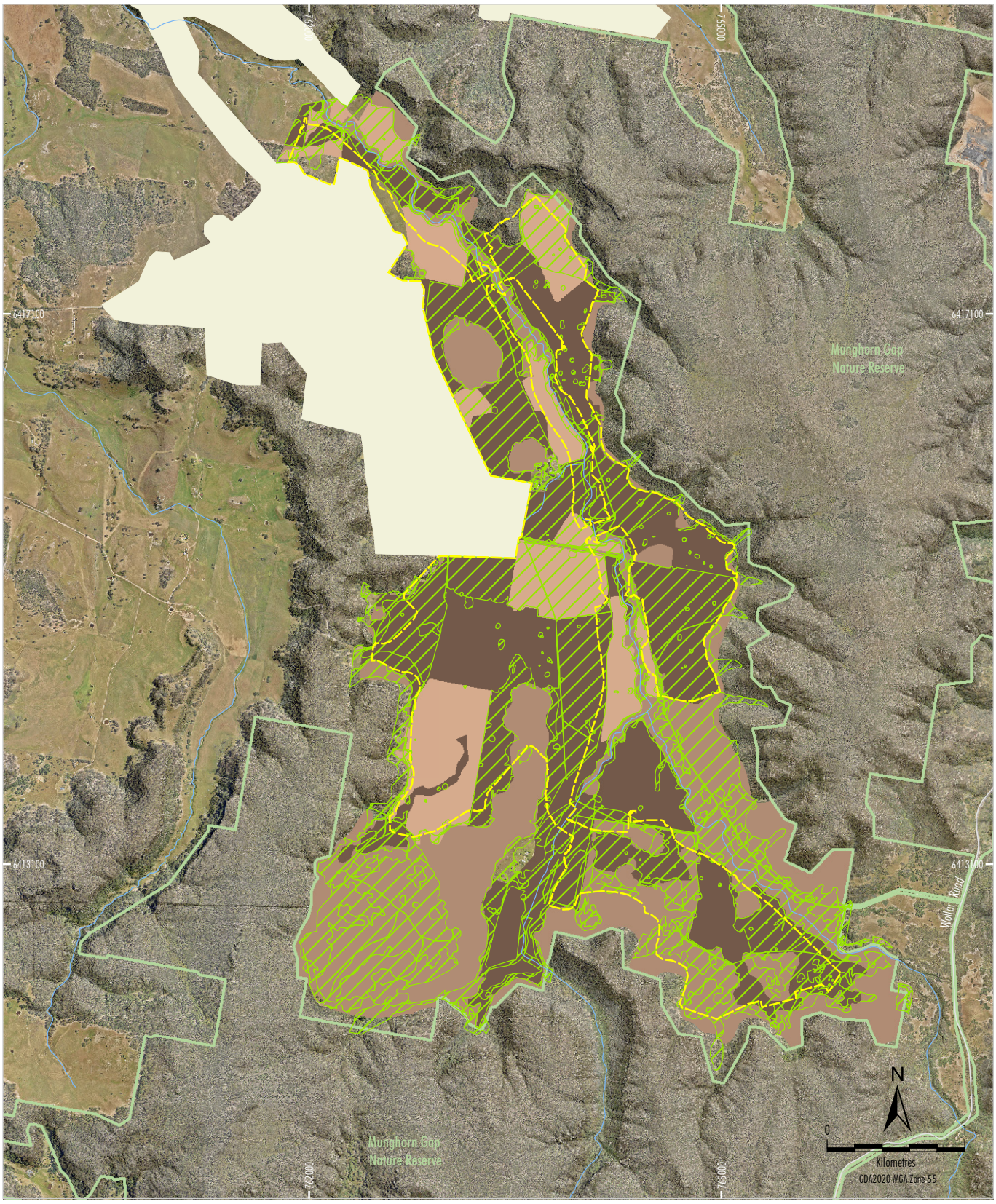
Box-Gum Woodland CEEC
- Woodland and Derived Native Grassland

Figure 5



LEGEND

- National Park/Nature Reserve
- Moolarben Coal Complex Disturbance Footprint
- Indicative Amended Project Surface Disturbance Extent
- Box-Gum Woodland CEEC

NSW Land Use

- 2.1.0 Grazing Native Vegetation
- 3.2.0 Grazing Modified Pastures
- 3.3.0 Cropping

Source: MCO (2023); NSW Spatial Services (2021); Eco Logical Australia (2023)
Orthophoto Mosaic: MCO (2021)

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Box-Gum Woodland CEEC Mapping and NSW Land Use

Figure 6

MCM-20-18 OC Ext EIS AP SAII Ass_ BG_205C

Plate 1 PCT 281 Derived Native Grassland (VZ4)

Plate 2 PCT 281 Derived Native Grassland – Low Condition (VZ5)

Plate 3 PCT 266 Derived Native Grassland (VZ2)

Plate 4 PCT 281 Remnant Woodland (VZ3)

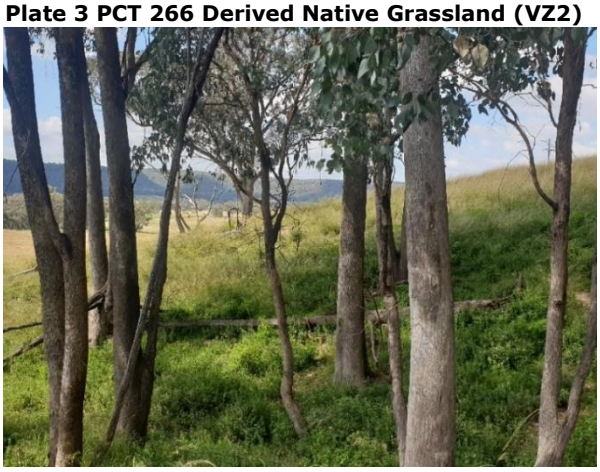


Plate 5 PCT 266 Remnant Woodland (VZ1)

Plate 6 PCT 483 Remnant Woodland (VZ9)

Source: ELA 2022

4 *Assessment of whether the Residual Impact is Serious and Irreversible*

This section addresses BAM (DPIE 2020a) Section 9.1.1 regarding additional impact assessment provisions for threatened ecological communities at risk of an SAII.

1. **Action and measures taken to avoid the direct and indirect impact on the TEC at risk of an SAII**

   As outlined in Section 4.2.2 of the BDAR (Niche 2022), the Project was designed to avoid and/or minimise impacts on native vegetation (including White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland) by:

   - preferentially locating disturbance in areas lacking White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (e.g., Category 1 – exempt land as defined by the NSW Local Land Services Act 2013) or where the vegetation/habitat is in the poorest condition (e.g. low quality Derived Native Grassland) (Figure 4);
   - avoiding open cut mining within 200 metres (m) of Moolarben Creek and Murdering Creek (which have a riparian zone comprising White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland) (Figure 2);
   - minimising infrastructure within the riparian zone of Moolarben Creek and Murdering Creek and locating creek crossings (three haul road creek crossings are proposed) within previously cleared areas, where practicable and feasible (Figure 2);
   - condensing the Project Development Footprint by locating infrastructure areas immediately adjacent to open cut mining areas; and
   - progressively back-filling open cut pits to minimise the required disturbance extent (i.e., reducing the need for large out-of-pit overburden emplacements), as far as practically possible, as well as removing residual pit voids from the final landform.

   Since the BDAR (Niche 2022) was submitted, MCO undertook a detailed review of the Project Development Footprint as presented in the Project EIS and further avoided approximately 76.63 ha of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland than originally proposed in the BDAR (Niche 2022). A total of 477.75 ha of TEC, consisting of 84.22 ha of woodland and 393.53 ha of derived native grassland was proposed to be cleared but this has been reduced to 401.12 ha of TEC, consisting of 34.22 ha of woodland and 366.9 ha of derived native grassland for the Amended Project.

   Additional measures would also be in implemented including best practice measures associated with a Vegetation Clearance Protocol to minimise impacts to the ecological community which would include:

   - mine staff and contractors involved in vegetation clearance works being made aware of clearing limits via the ground disturbance process; and
   - clear delineation of the areas to be disturbed prior to clearing activities and disturbance boundaries being digitally captured and displayed within the site survey and Geographic Information System (GIS) databases.

   As a result of the above, areas of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland to the north, south-west and south-east would be avoided by the Project (Figure 5).

2. Current Status of the TEC

The BDAR (Niche 2022) presents the current status of the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland as Critically Endangered under the BC Act and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. However, the Commonwealth listing advice does exclude some patches of the ecological community on the basis of condition or structure thresholds (including patch size, ground cover and tree density) (TSSC 2006; 2020).

The BioNet Threatened Biodiversity Database Collection (TBDC) (NSW DCCEEW 2024b) lists the TEC as an SAII entity based on the following:

- Principle 1 Population reduction of >=80% in 10 years or three generations; and
- Principle 2 <50 individuals or <250 individuals where threats are known[1].

The TSSC (2020) lists the TEC as Critically Endangered based on the following clauses from the *Biodiversity Conservation Regulation 2017*:

- Clause 4.9 A very large reduction in geographic distribution; and
- Clause 4.12 A very large disruption of biotic processes or interactions.

a. *Evidence of Reduction in Geographic Distribution as the current total geographic extent of the TEC in NSW AND the estimated reduction in geographic extent of the TEC since 1970 (not including impacts of the proposal).*

The BDAR (Niche 2022) presents information from the TSSC (2020). The TSSC (2020) describes White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland as having undergone at least a 90% reduction in geographic distribution as a consequence of extensive clearing throughout its range. TSSC (2006) estimated that <5% of the original distribution remained at the time of publication.

There is no precise information available on the reduction in geographic extent of the TEC since 1970.

b. *Extent of reduction in ecological function for the TEC using evidence that describes the degree of environmental degradation or disruption to biotic processes indicated by:*
   i. *change in community structure;*
   ii. *change in species composition;*
   iii. *disruption of ecological processes;*
   iv. *invasion and establishment of exotic species;*
   v. *degradation of habitat; and*
   vi. *fragmentation of habitat.*

It is undisputed that since European arrival (*circa* 1750) urban development, agriculture, forestry, mining and changed fire regimes have all resulted in reduction in ecological function as described by the above six points. This is exemplified by several Key Threatening Processes listed under the BC Act:

- alteration of habitat following subsidence due to longwall mining;

[1] DPE noted in response to a query regarding the relevance of species counts with regard to TEC that: The TBDC is incorrect and the application of Principle 2 for TECs should specify '*communities with very high levels of either environmental degradation or disruption of biotic processors, and interactions have an increased risk of failure to sustain their characteristic native species assemblages. The criteria for this is ≥90% extent and severity where the disruption or impacts are measured since 1970 or (ii) ≥80% extent and severity where the disruption or impacts are over a 50-year period, either in the past, future, or any part of the past, present and future (as per Bland et al. 2016)*'

- alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;
- bushrock removal;
- clearing of native vegetation;
- competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus* (L.);
- high frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition;
- invasion of native plant communities by exotic perennial grasses;
- loss of hollow-bearing trees;
- predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa Linnaeus* 1758; and
- removal of dead wood and dead trees.

c. *Evidence of restricted geographic distribution based on the TEC's geographic range in NSW.*

Niche (2022) considers this Principle 3 (*the impact is made on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution*) not to be applicable to White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland as the extent of occurrence (EOO), area of occupancy (AOO) and number of threat-defined locations are unknown in the TBDC (NSW DCCEEW 2024b).

TSSC (2020) notes that the geographic distribution of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is not restricted. Further information is provided below for completeness.

i. extent of occurrence

The EOO for the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is estimated in TSSC (2020) to be 702,800 square kilometres (km^2) based on a minimum convex polygon enclosing likely occurrences. This appears to be a considerable over-estimate when the land-based area of NSW[2] is 801,137 km^2; perhaps the TSSC (2020) value covers the national distribution including Victoria and Queensland.

Since the TSSC (2020) listing, the NSW State Vegetation Type mapping has been published (DPE 2023b) in the form of current extant and pre-clearing (pre-1750) maps. Analysis provided in Attachment 1 indicates an EOO of 327,174 km^2.

ii. area of occupancy

The AOO for the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is estimated in TSSC (2020) to be 151,100 km^2 based on occupancy of 10 x 10 km grid cells excluding grid cells with less than 1% occupancy by the TEC (as per Bland *et al* 2017). Analysis provided in Attachment 1 indicates an AOO of approximately 160,900 km^2.

iii. number of threat-defined locations

Data deficient.

[2] https://www.ga.gov.au/scientific-topics/national-location-information/dimensions/area-of-australia-states-and-territories

d. Evidence that the TEC is unlikely to respond to management.

Niche (2022) did not address Principle 4 (*the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity, and therefore its members are not replaceable*).

The *National Recovery Plan for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (Department of Environment, Climate Change and Water [DECCW] 2011) does not infer that the TEC is unlikely to respond to management. The plan notes several measures that individually or in combination can improve the quality of TEC remnants including:

- active regeneration involving planting or seeding;
- exclusion of herbivores;
- grazing management;
- fencing of remnants to facilitate natural regeneration;
- mosaic burning; and
- regrowth thinning.

Key tree and ground layer species for the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland have been recorded in the existing rehabilitation areas at Moolarben Coal Complex, including White Box and Yellow Box (2rog 2024). Dr Paul Frazier (2rog 2024) notes that there is good potential for mine site rehabilitation to be managed and steered towards characteristics of the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

A project under the NSW Saving our Species program (DPIE 2021) increased the resilience of approximately 2,600 ha of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland achieved through application of several of the actions listed in the recovery plan. This project clearly indicates that the TEC will respond to management with members replaceable.

3. Record any unknown or data deficient information in the TBDC

- Principle 1 Current total Geographic Extent;
- Principle 1 Reduction in Geographic Extent;
- Principle 2 Extent of Reduction in Ecological Function;
- Principle 3 AOO;
- Principle 3 EOO; and
- Principle 3 Number of Threat-defined Locations.
- Principle 4 Justification

4. Impacts on the TEC from the proposal

a) impact on geographic extent based on total area to be impacted:

i. in hectares.

Following a review by MCO (Section 6.1) a reduced total of 401.12 ha of TEC would be cleared, consisting of 34.22 ha (8.5 %) of woodland and 366.9 ha of derived native grassland (91.5 %) for the Amended Project (Figure 5). The derived native grassland has been created through the clearance of the tree and shrub layers, some of which has also been previously cultivated for crops (and the native plants have regrown from the seedbank).

There is a negligible amount of PCT 483 to be cleared with PCT 281 being 90% and PCT 266 being 10% of the approximate portions of total TEC clearance.

ii. as a percentage of the current geographic extent of the TEC in NSW.

As described above, the EOO for the TEC is estimated to be 327,174 km^2 meaning that the total TEC lost to the project is 0.0012 % of the current geographic extent of the TEC in NSW (note: this would be 0.0006 % based on the EOO reported in TSSC [2020]). Noting, however, that the EOO (overall extent of the TEC) will be unaffected by the Project as the Project is not at the limit of the range of the TEC.

As described above, the AOO for the TEC is reported to be 151,100 km^2 (TSSC 2020) meaning that the total TEC lost to the project is 0.0027 % of the AOO of the TEC in NSW. Analysis provided in Attachment 1 indicates an AOO of approximately 160,900 km^2, which would slightly reduce this percentage. However, the AOO for the TEC reported in TSSC (2020) has been conservatively adopted.

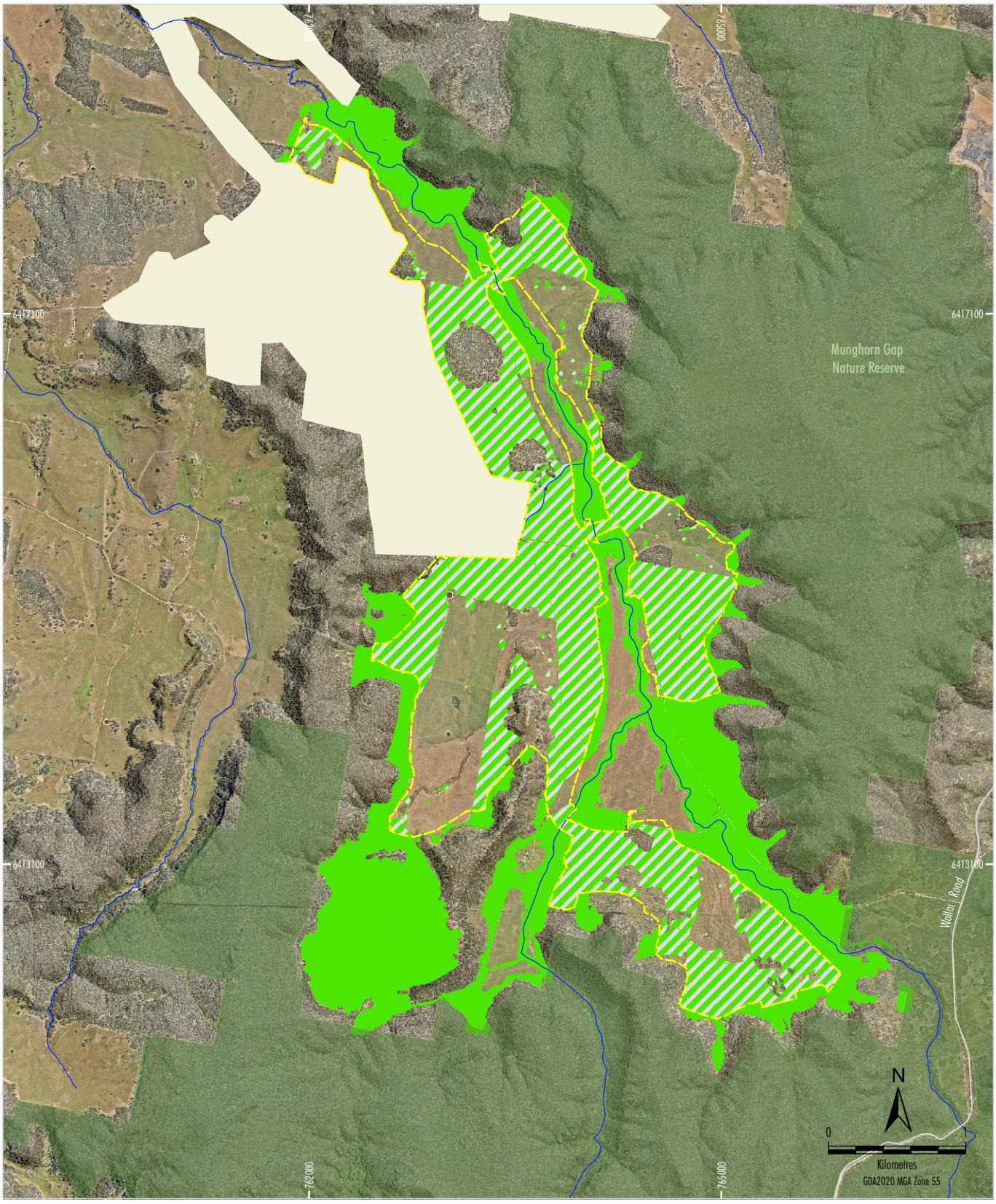
b. extent that impacts could contribute to further degradation/disruption of biotic processes on of the TEC by:

i. estimating the size of any remaining, but now isolated, areas of the TEC; including areas of the TEC within 500 m of the development footprint or equivalent area for other types of proposals.

There is approximately 339.1 ha of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland mapped within 500 m of the Development Footprint, consisting of approximately 139.4 ha of woodland and 199.7 ha of derived native grassland. No White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland would be isolated by the Project. At the outer boundaries of the Project, remnants retain connectivity with natural forest, adjacent offsets and the Munghorn Gap Nature Reserve (Figure 7).

A corridor of connectivity approximately 7.5 km long and a median width of 272 m would be retained along Moolarben and Murdering Creeks down the centre of the Project, directly connected with natural forest and Munghorn Gap Nature Reserve at the northern and southern ends (Figure 7). In relation to the surface water flow in Moolarben and Murdering Creeks, WRM (2022) concludes that the loss of catchment flows would be indiscernible and, the potential impact on flows due to the excision of catchment from Project is considered negligible. At the completion of mining, the open cut pits would be backfilled and rehabilitated to a free-draining landform. Accordingly, there would be no loss of catchment post-mining (WRM 2022).

The BDAR (Niche 2022) describes indirect impacts to White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland within the surrounds are likely to be minimal due to proposed mitigation measures, such as drainage structures, erosion control dust suppression and weed control.



MCM-20-18 OC Ext EIS AP SAII Ass_ BG_207B

LEGEND

- National Park/Nature Reserve
- Moolarben Coal Complex Disturbance Footprint
- Indicative Amended Project Surface Disturbance Extent
- Box-Gum Woodland CEEC
- Box-Gum Woodland CEEC within Indicative Surface Disturbance Extent

Source: MCO (2023); NSW Spatial Services (2021); Eco Logical Australia (2023)
Orthophoto Mosaic: MCO (2021)

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Box-Gum Woodland CEEC Connectivity

Figure 7

ii. describing the impacts on connectivity and fragmentation of the remaining areas of TEC measured by:

- *distance between isolated areas of the TEC, presented as the average distance if the remnant is retained AND the average distance if the remnant is removed as proposed;*
- *estimated maximum dispersal distance for native flora species characteristic of the TEC; and*
- *other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the TEC as a result of the development.*

Most of the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland within the Project Development Footprint occurs on grazing land (comprising native vegetation, modified pastures) and cropping land as per the NSW 2017 Landuse mapping (DPIE 2020b) (Figure 6). There is infrastructure through-out the occurrence of the TEC, including paddock fences, sheds, houses, dirt tracks and dams.

As noted above, no White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland would be isolated by the Project.

The average pre-mining distance between TEC fragments is 48 m and post-mining would be 71 m. Genetic dispersal through pollen transfer for the characteristic canopy Eucalypts would be by birds, flying foxes and insects which would amount to kilometres distant. The seed of ground species would be dispersed by wind or mammals which would be in the hundreds of metres distant.

The pre-mining TEC consists of 68 fragments comprised of a single large area and 67 small isolated fragments resulting in an average pre-mining area to perimeter ratio of 7.8. Coincidentally, there would also be 68 fragments post-mining but with an area to perimeter ratio of 19.7.

MCO is proposing to manage 108.1 ha of the surrounding TEC within the Habitat Enhancement Areas, including active revegetation along Moolarben and Murdering Creeks. The active revegetation would aim to increase the connectivity of the woodland components of the TEC.

iii. describing the condition of the TEC according to the vegetation integrity score for the relevant vegetation zone(s) (Section 4.3). The assessor must also include the relevant composition, structure and function condition scores for each vegetation zone.

Table 9 of the BDAR provides VI scores along with composition, structure and function scores for each vegetation zone (Niche 2024). The VI scores for the VZs associated with the TEC are summarised in Table 1. The derived native grassland is highly disturbed with a VI score of less than 40%. The woodland areas have a higher VI score (80-90%).

5. New information to demonstrate that the principle identifying the species as at risk of an SAII, is inaccurate.

No new information relating to the listing of the TEC as an SAII entity.

5 *Is there likely an SAII on the TEC?*

It is not a specific incremental loss in the extent of a TEC which is considered to determine an SAII but rather the decision-maker considers the impact the proposal will have on the viability of the entity. The *Guidance to Assist a Decision-maker to Determine a Serious and Irreversible Impact* (DPIE 2019) states:

> *Where a proposed impact has been identified as potentially serious and irreversible, based on the application of Steps 1–3, the decision-maker must review the additional information provided for all entities at risk of a SAII by the assessor in the BAR.*
> *The assessment criteria in the BAM under Subsection 10.2.2 for TECs and 10.2.3 for species[3], are designed to estimate the impact the proposal will have on the viability of the entity at the local, Interim Biogeographic Regionalisation of Australia (IBRA) subregional/regional and state scales (see Appendix B).*
> *The decision-maker can use the impact assessment information to decide if the proposal is likely to increase the extinction risk of any of the relevant entities and whether impacts/losses/declines are likely to be serious and irreversible.*

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is listed as a threatened entity at risk of a SAII due to Principles 1 and 2. These are discussed below considering the information presented above.

Principle 1

Principle 1 states:

> *An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because it will cause a further* ***decline of the*** *species or* ***ecological community****.*
> *A* ***decline of a*** *species or* ***ecological community*** *is a* ***continuing or projected decline*** *in—*
> *(a) an* ***index of abundance*** *appropriate to the taxon, or*
> *(b) the* ***geographic distribution*** *and habitat quality of the species or ecological community.*

The *Guidelines for Interpreting Listing Criteria for Species, Populations and Ecological Communities under the NSW Biodiversity Conservation Act 2016* (TSSC 2018) state:

> *A* ***continuing decline*** *is a recent, current or projected future decline (which may be smooth, irregular or sporadic) which is liable to continue unless remedial measures are taken.*
>
> *An* ***index of abundance*** *appropriate to the taxon may include a range of direct or indirect measures including direct counts or estimates of all types of individuals, or direct counts of individuals belonging to particular life stages (e.g., mature individuals).*
>
> ***Habitat quality*** *(also known as habitat suitability) refers to the environmental conditions that govern a species' rates of survival, growth and reproduction, and hence the ability of its populations to persist. A reduction in habitat quality will therefore usually be associated with an increase in extinction risks due to a decline in survival, growth and/or reproduction. Where knowledge of the relationship between these demographic rates and the environment is limited, habitat quality may be inferred from variation in the abundance of the species across different environments.*

Geographic distribution is defined under Clause 4.18 of the BC Regulation 2017:

> *(1) Geographic distribution is the area or areas in which a species or ecological community occurs, excluding cases of vagrancy in species.*
> *(2) This may be assessed by estimating—*

[3] Note these section references were revised from BAM (OEH 2017) to BAM (DPIE 2020a).

(a) the extent of occurrence (the area of the total geographic range that includes all extant populations of the species or all extant occurrences of the ecological community), or

(b) the area of occupancy (the area within the total range that is currently occupied by the species or ecological community, that is it excludes unsuitable and unoccupied habitat), or

*(c) the **area of suitable habitat** (the area within the total range that includes occupied and unoccupied suitable habitat, but excludes unsuitable habitat).*

(3) The scale at which a geographic distribution is assessed should be appropriate to the biology of the species (or component species in ecological communities), the nature of threats and available data.

Area of suitable habitat is defined in Clause 4.18(2c) as

'the area within the total range that includes occupied and unoccupied suitable habitat, but excludes unsuitable habitat.'

An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct. As described above, the loss of 401.12 ha (34.22 ha [8.5 %] of woodland and 366.9 ha of derived native grassland [91.5 %]) of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland represents 0.0012% of its EOO (note: this would be 0.0006 % based on the EOO reported in TSSC [2020]). Noting, however, that the EOO (overall geographic extent) would be unaffected by the Project as the Project is not at the limit of the range of the TEC. As described above, the AOO for the TEC is reported to be 151,100 km^2 (TSSC 2020) meaning that the total TEC lost to the project is 0.0027 % of the AOO of the TEC in NSW. Further, the remaining White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland areas would not be isolated being connected to natural forest.

The impact of the Project on the ecological community as a whole would be extremely low, to the degree that it would be unlikely to change the trajectory of the ecological community by causing a further decline (i.e., a further continuing or projected decline).

In regard to this principle, the impacts of the Project would not likely contribute significantly to the risk of the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland becoming extinct.

Additionally, it is noted that the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is likely to respond to measures to improve its habitat and vegetation integrity and therefore it is possible to mitigate and offset the impacts on the TEC such that the Project could result in no net loss and may even result in a net gain over time.

Principle 2

Principle 2 states:

Principle 2 – An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because it will further reduce the population size of a species or ecological community.

There is in the order of 15,110,000 ha of TEC in NSW (TSSC 2020) meaning that the total TEC lost to the project is 0.0027 % of the total occurrence, which would not place the TEC as a whole at risk of extinction.

6 *Further Measures to Mitigate/Manage Residual Impacts*

As outlined in Section 5.7 and Table 24 of the BDAR (Niche 2022), mitigation and management measures would be implemented to mitigate/manage residual direct, indirect and prescribed impacts on White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland following Project impact avoidance and minimisation.

Terrestrial biodiversity monitoring programs would be developed for the Project with consideration of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland to include:

- weed monitoring;
- mine site rehabilitation monitoring; and
- monitoring of revegetation in the Habitat Enhancement Area (Figure 8).

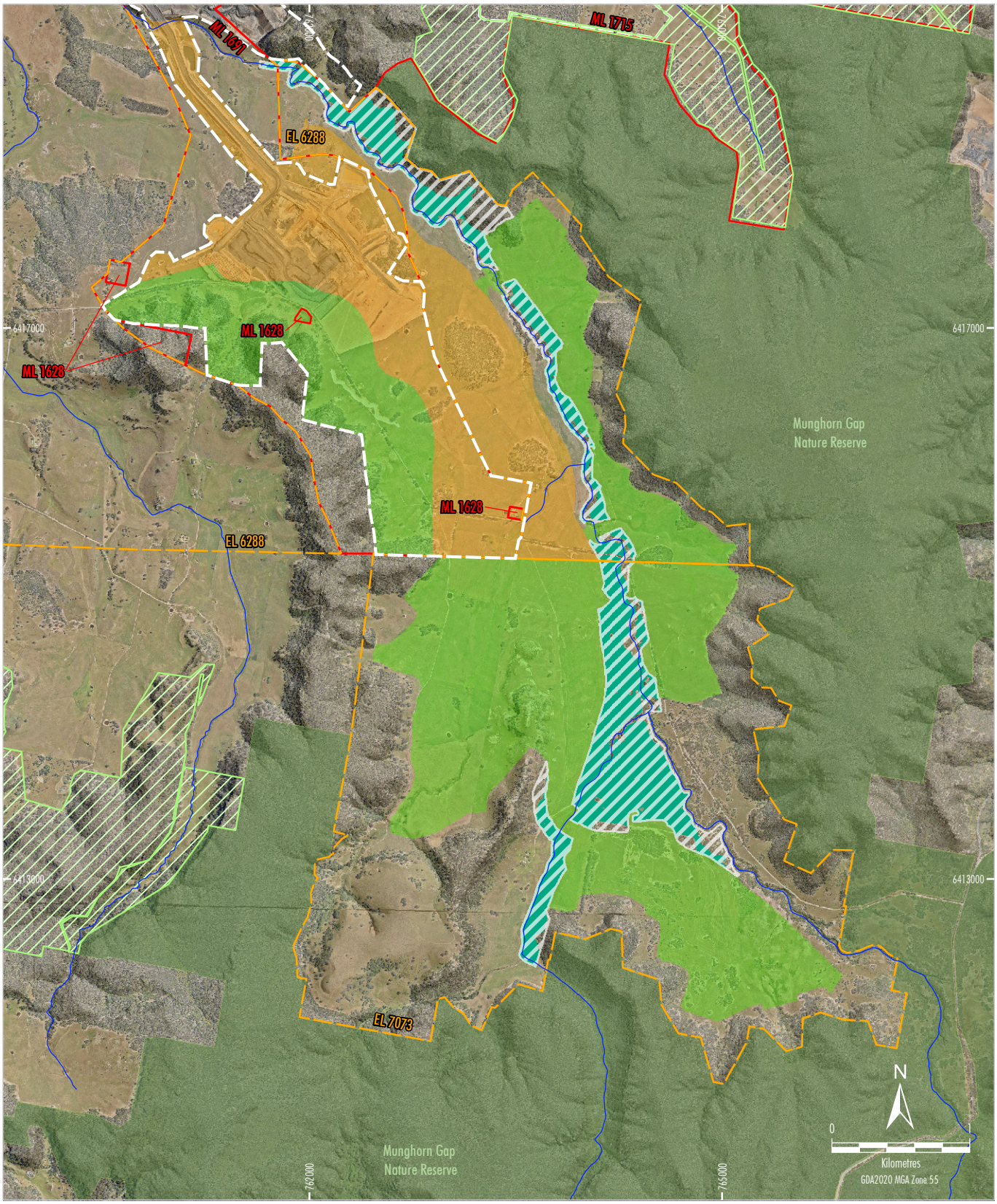
Proposed mitigation and management measures relevant for residual impacts to White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Niche 2022) include:

- Progressive rehabilitation of backfilled areas with species consistent with White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland;
- Management of a Habitat Enhancement Area (Figure 8) along the riparian zone of Moolarben and Murdering Creek (outside of the Development Footprint). Management measures would include revegetation, fencing (as required), weed management, animal pest management, and fire management;
- Bushfire management to reduce bushfire risk, education and training, and revising existing responses and evacuation strategies to include the Project area; and
- Weed and pathogen management with a focus on vehicle/machinery hygiene control and physical and/or chemical weed removal/control; Where herbicides may be required, they would be used in a manner that would not adversely impact on nearby White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Since the BDAR (Niche 2022) was submitted, MCO is proposing:

- an increase in the Habitat Enhancement Area from 160 ha to 188 ha, resulting in:
    - approximately 108.1 ha of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland under management; and
    - approximately 135 ha of land subject to active revegetation.
- an increase in the rehabilitation of mined areas to woodland from 325 ha to 535 ha (Figure 7).

Dr Paul Frazier (2rog 2024) notes there is good potential for rehabilitation at the Moolarben Coal Complex to be managed and steered towards characteristics of the Box-Gum Woodland CEEC.



MCM-20-18 OC Ext EIS AP SAII Ass_ B6_2066

LEGEND

National Park/Nature Reserve
Exploration Licence Boundary
Mining Lease Boundary
Moolarben Coal Complex Disturbance Footprint
Existing Biodiversity Offset Area

Conceptual Post-mining Land Use Areas
Agricultural Pasture/Scattered Trees
Native Woodland

Habitat Enhancement Area
Indicative Habitat Enhancement Area Extent
Indicative Revegetation Area Extent

Source: MCO (2023); NSW Spatial Services (2021)
Orthophoto: MCO (2021)

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Revised Conceptual Post-mining Land Use

Figure 8

7 *Conclusion*

This assessment has presented evidence to indicate that the impacts of the Project will not contribute significantly to the risk of the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland becoming extinct either locally or State-wide on the grounds that:

- The ecological community does not have a very limited distribution.
- The ecological community has been shown to respond to measures to improve its habitat and vegetation integrity.
- The TEC to be cleared is mostly derived native grassland (366.9 ha, 91.5 %), with a smaller portion of woodland (34.22 ha, 8.5 %).
- There is in the order of 15,110,000 ha of TEC in NSW (TSSC 2020) meaning that the total TEC lost to the project is 0.0027 % of the total occurrence which would not place the TEC as a whole at risk of extinction.
- The Project would not result in isolation of any TEC remnants.

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ATTACHMENT 1
Determination of the Area of Occupancy and Extent of Occurrence in NSW of *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland*

Determination of the Area of Occupancy and Extent of Occurrence in NSW of *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland*

February 2024

Dr Colin Driscoll

Introduction

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions is a Threatened Ecological Community (TEC) under the New South Wales (NSW) *Biodiversity Conservation Act 2016* (herein referred to as the Box-Gum Woodland Critically Endangered Ecological Community [CEEC]).

The Extent of Occurrence (EOO) is the minimum convex polygon enclosing likely occurrences of the community (Bland *et al* 2017). The Area of Occupancy (AOO) is the area within its EOO which is occupied by Box-Gum Woodland CEEC. The EOO is estimated in Threatened Species Scientific Committee (TSSC) (2020) to be 702,800 km^2. Based on occupancy of 10 x 10 km grid cells excluding grid cells with less than 1% occupancy, (as per Bland *et al* 2017) TSSC (2020) estimates the AOO of Box-Gum Woodland CEEC to be 151,100 km^2.

The purpose of this report is to review the current EOO and AOO of the Box-Gum Woodland CEEC using the NSW State Vegetation Type Map (SVTM) Current Release C2.0M2.0 (December 2023) (Department of Planning and Environment [DPE] 2023).

Method

Plant Community Types (PCTs) associated with Box-Gum Woodland CEEC were extracted from the BioNet vegetation classification data table (NSW Department of Climate Change, Energy, the Environment and Water [NSW DCCEEW] 2024). In a GIS (Manifold 2024), those associated PCTs were extracted from the NSW SVTM Current Release C2.0M2.0 (December 2023) (DPE 2023). The PCT to TEC assignment was in two categories: complete i.e., all of the PCT occurrences were assigned to Box-Gum Woodland CEEC; and part i.e., only those parts of the PCT that meet the floristic composition in the Box-Gum Woodland CEEC determination (TSSC 2020).

The extracted SVTM polygons were intersected with a 10 km square grid and the area of Box-Gum Woodland CEEC occupying each grid cell was determined. All grid cells having <1 km^2 of Box-Gum Woodland CEEC were deleted. The determination (TSSC 2020) specifies particular bioregions which the TEC is restricted to and the occupied grid cells were overlaid on the NSW bioregions map. Any grid cells lying outside of the determination bioregions were deleted. The total AOO was then calculated as the resulting number of occupied grid cells multiplied by 100 km^2. The EOO was the area of the convex polygon bounding the occurrences of Box-Gum Woodland CEEC within the determination bioregions.

The SVTM only provides mapping of woodland PCTs with no mapping of the derived native grassland element of the Box-Gum Woodland CEEC. The derived native grassland distribution could be determined by deducting the current extant woodland distribution from the pre-1750 distribution of PCT assigned to Box-Gum Woodland CEEC; unfortunately a pre-1750 SVTM map is incomplete.

Results

The Box-Gum Woodland EOO was determined to be 327,174 km^2. The AOO of the Box-Gum Woodland CEEC in NSW is estimated to be approximately 160,900 km^2. Table 1 shows the breakdown of the grid cells containing PCT assigned to Box-Gum Woodland CEEC.

Table 1 Area of Occupancy Determination

Item	Number of Grid Cells	Square Kilometres
Total grid cells occupied by PCT assigned to Box-Gum Woodland CEEC	2,265	226,500
Less cells with <1km^2 of Box-Gum Woodland CEEC	546	54,600
Less cells outside of the determination IBRA bioregions	110	11,000
Total AOO cells	**1,609**	**160,900**

IBRA: Interim Biogeographic Regionalisation for Australia

There were 106 (10,600 km^2) grid cells having >1 km^2 Box-Gum Woodland CEEC containing PCTs assigned by NSW DCCEEW (2024) as part meeting the Box-Gum Woodland CEEC criteria. If it were possible to remove these parts it would reduce the total AOO by an unknown amount, but by less than 10,600 km^2. However, as noted in the methods section, this analysis also could not include the derived native grassland element of the Box-Gum Woodland CEEC, and if it were possible to add these it may add to the AOO.

Figure 1 shows the grid and PCTs assigned to Box-Gum Woodland CEEC over a map of the NSW IBRA Bioregions and Appendix 1 provides a key to the PCT.

Conclusion

This analysis has determined that the AOO of the Box-Gum Woodland CEEC in NSW is 160,900 km^2 less an unknowable portion of 10,600 km^2 of PCTs partially assigned to the TEC plus an unknowable portion of derived native grassland. This is within the range of the AOO of 151,100 km^2 provided in the Box-Gum Woodland CEEC determination (TSSC 2020). This AOO was nested inside an EOO of 327,174 km^2 which is less than half the EOO of 702,800 km^2 estimated in TSSC (2020). Given the area of NSW is 801,150 km^2 an EOO which is almost 90% of the State is not credible given the Box-Gum Woodland CEEC distribution shown in Figure 1. Perhaps the higher figure was for the national distribution of Box-Gum Woodland CEEC.

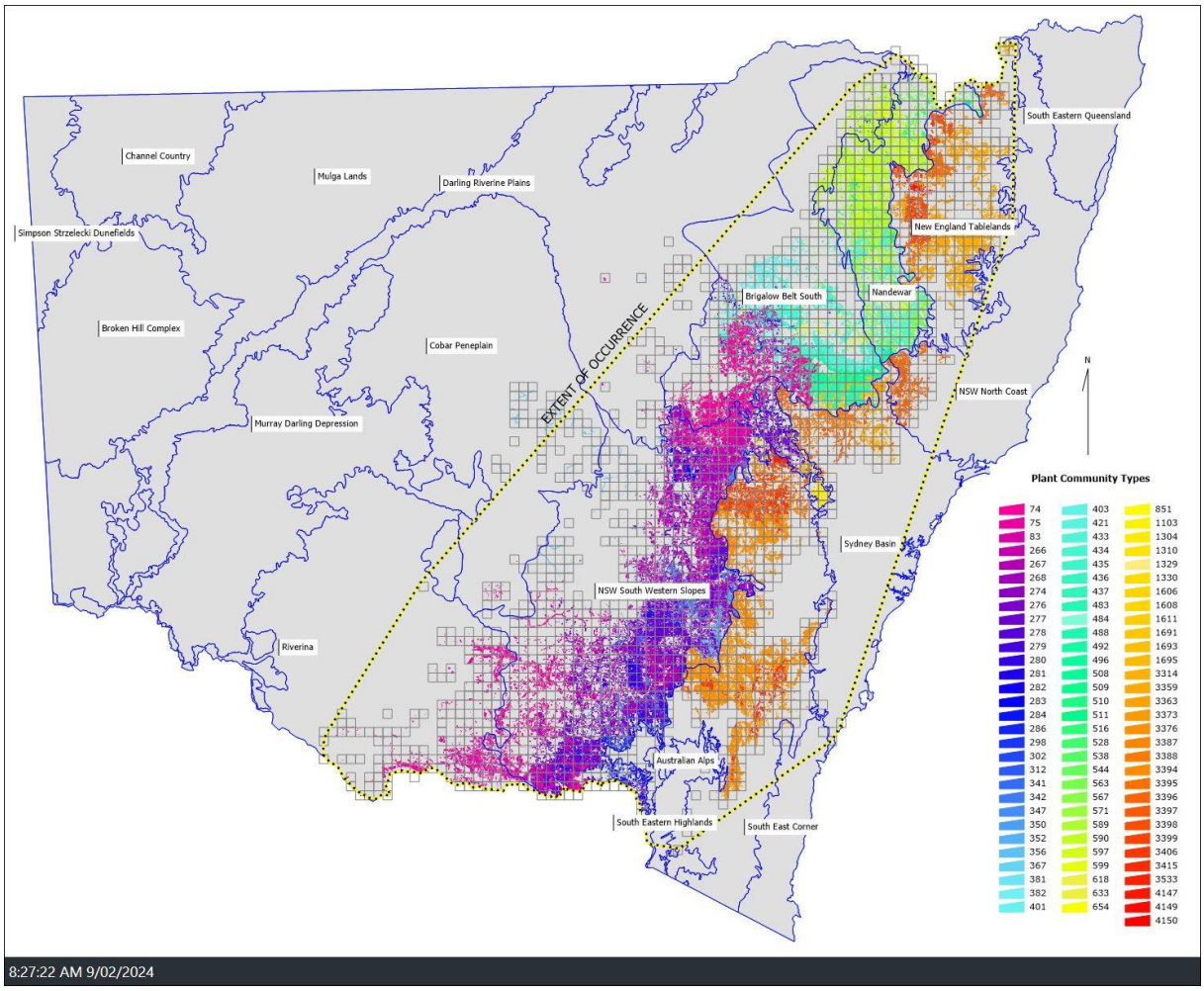

Figure 1 The distribution of PCT assigned to Box-Gum Woodland CEEC overlaid by the 10 km square grid

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Appendix 1 Key to the Plant Community Types

PCT	PCT Name	Assignment Status
74	Yellow Box - River Red Gum tall grassy riverine woodland of NSW South Western Slopes Bioregion and Riverina Bioregion	All
75	Yellow Box - White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and western NSW South Western Slopes Bioregion	Part
83	Yellow Box woodland on sandy loam soils on alluvial plains mainly in the upper Darling Riverine Plain Bioregion	Part
266	White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion	All
267	White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	All
268	White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion	All
274	White Box - Rough-barked Apple alluvial woodland of the NSW central western slopes including in the Mudgee region	All
276	Yellow Box grassy tall woodland on alluvium or parna loams and clays on flats in NSW South Western Slopes Bioregion	All
277	Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	All
278	Riparian Blakelys Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	All
279	Blakelys Red Gum - White Cypress Pine woodland on footslopes of hills in central part of the NSW South Western Slopes Bioregion	All
280	Red Stringybark - Blakelys Red Gum +/- Long-leaved Box shrub/grass hill woodland of the NSW South Western Slopes Bioregion	All
281	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	All
282	Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion	All
283	Apple Box - Blakelys Red Gum moist valley and footslopes grass-forb open forest of the NSW South Western Slopes Bioregion	All
284	Red Stringybark - Blakelys Red Gum - tea tree herbaceous swampy valley open forest of the southern NSW South Western Slopes Bioregion	All
286	Red Box - Blakelys Red Gum sedge woodland on colluvial clay drainage lines in the NSW South Western Slopes Bioregion	All
298	Apple Box - Nortons Box - Blakelys Red Gum valley flat moist grassy tall open forest in the southern NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion	All
302	Riparian Blakelys Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	All
312	Yellow Box grassy tall woodland on valley flats in the upper slopes of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	All
341	Blakelys Red Gum - Red Box - Black Cypress Pine grass/shrub woodland on hills in the Upper Slopes sub-region of the NSW South Western Slopes Bioregion and western South Eastern Highlands Bioregion	All
342	Mugga Ironbark - mixed box woodland on hills in the Cowra - Boorowa - Young region of the NSW South Western Slopes Bioregion	All
347	White Box - Blakelys Red Gum shrub/grass woodland on metamorphic hillslopes in the mid-southern part of the upper slopes sub-region of the NSW South Western Slopes Bioregion	All
350	Candlebark - Blakelys Red Gum - Long-leaved Box grassy woodland in the Rye Park to Yass region of the NSW South Western Slopes Bioregion and South Eastern Highland Bioregion	All
352	Red Stringybark - Blakelys Red Gum hillslope open forest on meta-sediments in the Yass - Boorowa - Crookwell region of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	All

PCT	PCT Name	Assignment Status
356	Blakelys Red Gum x Dirty Gum - White Cypress Pine tall riparian woodland, NSW South Western Slopes Bioregion	All
367	Forest Red Gum x Blakelys Red Gum - box woodland of the Yetman region, Brigalow Belt South Bioregion	All
381	Rough-barked Apple - Yellow Box grass/shrub footslope open forest, Brigalow Belt South Bioregion	All
382	Warrumbungle mountains Nandewar Box - Yellow Box shrub grass open forest, Brigalow Belt South Bioregion	All
401	Rough-barked Apple - Blakelys Red Gum - Black Cypress Pine woodland on sandy flats, mainly in the Pilliga Scrub region	All
403	Dapper Mugga Ironbark - Western Grey Box - Blakelys Red Gum - Black Cypress Pine grass shrub hill woodland (southern Brigalow Belt South Bioregion)	All
421	Yellow Box - White Cypress Pine alluvial terrace flats grassy woodland in the Pilliga forests and surrounds, Brigalow Belt South Bioregion	All
433	White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region, BBS Bioregion	All
434	White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion	All
435	White Box - White Cypress Pine shrub grass hills woodland in the Brigalow Belt South Bioregion and Nandewar Bioregion	All
436	Derived Kurrajong grassy open woodland / isolated trees in the Brigalow Belt South Bioregion and Nandewar Bioregion	All
437	Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	All
483	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	All
484	Derived tall spear grass grassland on mainly basalt hills of the Liverpool Plains, Liverpool Range and in the upper Hunter Valley (Merriwa district), south-eastern Brigalow Belt South Bioregion	All
488	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	All
492	Silvertop Stringybark - Yellow Box - Apple Box - Rough-barked Apple shrub grass open forest mainly on southern slopes of the Liverpool Range, Brigalow Belt South Bioregion	All
496	Yellow Box - White Box - Silvertop Stringybark - Blakelys Red Gum grass shrub woodland mainly on the Liverpool Range, Brigalow Belt South Bioregion	All
508	Blakelys Red Gum - Stringybark - Rough-barked Apple open forest of the Nandewar Bioregion and western New England Tableland Bioregion	All
509	Blakelys Red Gum - White Cypress Pine - Rough-barked Apple grassy open forest of drainage lines of the northern Nandewar Bioregion and New England Tableland Bioregion	All
510	Blakelys Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion	All
511	Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion	All
516	Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	All
528	Mugga Ironbark - Blakelys Red Gum open forest of the Nandewar Bioregion and New England Tableland Bioregion	All
538	Rough-barked Apple - Blakely's Red Gum open forest of the Nandewar Bioregion and western New England Tableland Bioregion	All
544	Rough-barked Apple - White Cypress Pine - Blakelys Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion	All
563	White Box - Silvertop Stringybark +/- White Cypress Pine grass shrub open forest of the southern Nandewar Bioregion and New England Tableland Bioregion	All

PCT	PCT Name	Assignment Status
567	Broad-leaved Stringybark - Yellow Box shrub/grass open forest of the New England Tableland Bioregion	All
571	Ribbon Gum - Rough-barked Apple - Yellow Box grassy woodland of the New England Tableland Bioregion and NSW North Coast Bioregion	All
589	White Box - White Cypress Pine - Silver-leaved Ironbark grassy woodland on mainly clay loam soils on hills mainly in the Nandewar Bioregion	All
590	White Box grassy woodland on the Inverell basalts mainly in the Nandewar Bioregion	All
597	White Box - cypress pine - Silver-leaved Ironbark shrub grass open forest / woodland of the northern Brigalow Belt South Bioregion and Nandewar Bioregion	All
599	Blakelys Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion	All
618	White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	All
633	Speargrass - Redleg Grass derived grassland on hills in the Jindera to Holbrook region, southern NSW South Western Slopes Bioregion	All
654	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands Bioregion	All
851	Grey Box - grass tree - spinifex woodland on limestone hills of the western Hunter and Capertee Valleys, Sydney Basin Bioregion	All
1103	Ribbon Gum - Yellow Box grassy woodland on undulating terrain of the eastern tablelands, South Eastern Highlands Bioregion	Part
1304	White Box - Narrow-leaved Ironbark grassy woodland of the Capertee Valley, Sydney Basin Bioregion	All
1310	White Box - Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South Bioregion	All
1329	Yellow Box - Blakelys Red Gum grassy woodland of the Nandewar Bioregion	All
1330	Yellow Box - Blakelys Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion	All
1606	White Box - Narrow-leaved Ironbark - Blakelys Red Gum shrubby open forest of the central and upper Hunter	All
1608	Grey Box - Grey Gum - Rough-barked Apple - Blakelys Red Gum grassy open forest of the central Hunter	All
1611	Narrow-leaved Ironbark - Black Cypress Pine shrub - grass woodland upper Hunter and northern Wollemi	All
1691	Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	Part
1693	Yellow Box - Rough-barked Apple grassy woodland of the upper Hunter and Liverpool Plains	All
1695	Yellow Box grassy woodland on basalt soils of the upper Hunter	All
3314	Central Hunter Slopes Grey Box Forest	Part
3359	New England Hills Stringybark-Box Woodland	All
3363	Western New England Blakelys Red Gum-Box Grassy Forest	All
3373	Goulburn Tableland Box-Gum Grassy Forest	All
3376	Southern Tableland Grassy Box Woodland	All

PCT	PCT Name	Assignment Status
3387	Central West Creekflat Grassy Woodland	All
3388	Central West Valleys White Box Forest	All
3394	Northwest Basalt Grassland-Woodland Complex	Part
3395	Northwest Elevated White Box Woodland	All
3396	Northwest Flats Box-Blakelys Red Gum Forest	All
3397	Northwest Flats Yellow Box Woodland	All
3398	Northwest Slopes Box-Apple Woodland	All
3399	Southwest Hills White Box-Blakelys Red Gum Forest	All
3406	Southwest Ranges White Box Woodland	All
3415	Southern Tableland Red Grass-Spear Grass Grassland	Part
3533	Avisford Sandstone Moist Sheltered Forest	All
4147	Northwest White Box Sparse Grassy Woodland	All
4149	Northwest Red Gum-Apple-White Pine Grassy Woodland	All
4150	Northwest White Box-White Pine Forest	All