APPENDIX D BDAR - Part 2

4.3 Threatened ecological communities

Two threatened ecological communities (TEC) were confirmed to occur within and immediately adjacent to the development footprint. These are identified in Table 23, with their occurrence shown in Figure 9.

Table 23 Threatened ecological communities mapped within the development footprint and their conservation status

TEC	PCT	Conservation status[1]		Area (ha)
		EPBC Act	BC Act	
Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion	540 - Silvertop Stringybark - Ribbon Gum - Rough-barked Apple open forest on basalt hills of southern Nandewar Bioregion, southern New England Tableland Bioregion and NSW North Coast Bioregion PCT 1194 - Snow Gum – Mountain Gum – Mountain Ribbon Gum open forest on ranges of the NSW North Coast Bioregion and eastern New England Tableland Bioregion	Not listed	E	23.36
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	433 - White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region, BBS Bioregion PCT434 - White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion PCT 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 PCT 599- Blakely's Red Gum – Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion	CE	CE	6.07

[1] Conservation status – CE: critically endangered; E: endangered

4.3.1 Ribbon Gum-Mountain Gum-Snow Gum Grassy Forest/Woodland

Ribbon Gum-Mountain Gum-Snow Gum Grassy Forest/Woodland is listed as an TEC under the BC Act and its occurrence the subject land is strongly influenced by topography and location within the landscape. This TEC occurs at elevations of between approximately 700 metres and 1,500 metres on deep basalt or loam soils.

Within the development footprint the EEC consists of the following PCTs, where they occur within, or as prat of a contiguous patch within, the New England Tablelands IBRA bioregion:

- 540 - Silvertop Stringybark - Ribbon Gum - Rough-barked Apple open forest on basalt hills of southern Nandewar Bioregion, southern New England Tableland Bioregion and NSW North Coast Bioregion

- PCT 1194 – Snow Gum – Mountain Gum – Mountain Ribbon Gum open forest on ranges of the NSW North Coast Bioregion and eastern New England Tableland Bioregion.

As outlined in the *Guidelines for interpreting listing criteria for species, populations and ecological communities under the NSW Biodiversity Conservation Act 2016 Version 2* (NSW TSSC 2018), an ecological community as defined by the BC Act (section 1.6) is 'an assemblage of species occupying a particular area'. For Ribbon Gum-Mountain Gum-Snow Gum Grassy Forest/Woodland this includes the list of species provided in Part 2 of the community's Final Determination for listing under the BC Act, and the occurrence of those species in the ew England Tableland Bioregion.

As outlined in the EEC's final determination for listing under the BC Act, the listed community can occurred in degraded states including areas that persist as native grassland where the woody component of the community has been eliminated by clearing. As such the above PCTs occurring in all condition states were considered to conform to the listed EEC.

The location of this EEC within the development footprint is predominantly associated with the upper ridgelines and more shallow slopes at the top of the escarpment (Figure 9). Where it does occur away from the ridgelines the EEC generally exists in in a low or moderate condition and fragmented spatial distribution due to the history of land clearing and grazing.

Due to these topography and soil constraints, the majority of the EEC within the development footprint is impacted by the wind farm and internal road infrastructure type, with the internal roads contributing to the majority of these impacts (Table 24). As much as possible the placement of wind farm infrastructure avoided these areas of TEC, however engineering constraints with steeper slopes and ridgelines require internal access roads to have a concept earthworks design that increases the footprint.

Field surveys also confirmed substantial areas of high quality Ribbon Gum-Mountain Gum-Snow Gum TEC within the adjacent Ben Halls Gap Nature Reserve. These areas were in much higher condition than the patches of this TEC within the development footprint, largely due to the exclusion of cattle grazing pressure and weed management along fence lines. These areas also contained a much higher density of larger eucalypt trees supporting various sized hollows, containing improved habitat resources for native fauna.

Table 24: Distribution of Ribbon Gum-Mountain Gum-Snow Gum EEC within each infrastructure type in the development footprint.

Vegetation condition class	Ribbon Gum-Mountain Gum-Snow Gum EEC area in each infrastructure type (ha)						
	Wind turbine infrastructure	Internal roads	Temporary construction footprint	Ancillary infrastructure	Transmission line	Transmission line access tracks	Transport route road upgrades
High condition	2.56	0.99	4.23	-	1.61	-	0.07
Moderate condition	2.24	1.83	3.90	0.72		-	0.24
Low condition	1.18	0.60	1.28			-	0.05
DNG	0.68	0.22	0.45			-	0.50
Total (ha)	**6.67**	**3.64**	**9.86**	**0.72**	**1.61**	-	**0.86**

4.3.2 White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (Box Gum Woodland) is a CEEC listed under both the EPBC Act and the BC Act. Its distribution is strongly associated with more fertile soils on lower elevations across the known range in Queensland, New South Wales and Victoria. Over much of its range, this CEEC has been subject to extensive clearing and modification for agriculture and grazing, so it often occurs as derived native grasslands with no overstorey.

Within the development footprint, the CEEC consists of the following PCTs:

- PCT 433 - White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region, Brigalow Belt South Bioregion.
- PCT434 - White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion
- PCT 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.
- PCT 599- Blakely's Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion.

It has been conservatively assumed that all condition states of the above listed PCTs support the required floristic diversity to represent the CEEC. Based on this conservative assumption, within the revised development footprint, there is a total of 6.07 hectares of Box Gum Woodland, which meets the listing requirements of both the EPBC Act TEC and the BC Act.

The CEEC was found to occur along the transmission line corridor, mainly to the west of the wind farm, with a small area in the central portion of the development site downslope (and north) of the wind farm itself. Furthermore the CEEC was found to occur at the far northern end of the access track servicing the central portion of the transmission line, and within two areas requiring upgrades for the transport route including just east of Nundle, and at Devils Elbow (Figure 9).

Consistent with the topographic, geological and soils requirements of this CEEC, it was not recorded across the ridgelines where the wind turbines and internal roads are located (Table 25), however the occurrence of the CEEC at Devils Elbow would not be considered its typical grassy woodland form. PCT492 vegetation in this area occurs on thinner rockier soils, with a relatively high shrubby understorey cover, however floristically it matches both BC Act and EPBC Act requirements well, based on plot data, and the PCT is noted as 'Equivalent' to the TEC in the BioNet Vegetation Classification Database, and as such the vegetation in this area has been conservative assessed as representing Box Gum Woodland CEEC.

Table 25 provides a summary of the condition states which the CEEC was recorded in within the footprint. As it can be seen over 40% of the CEEC occurs in Low of DNG condition, with the majority of the areas mapped as occurring in moderate condition occurring as small fragmented and isolated patches within a generally highly disturbed landscape (Figure 9).

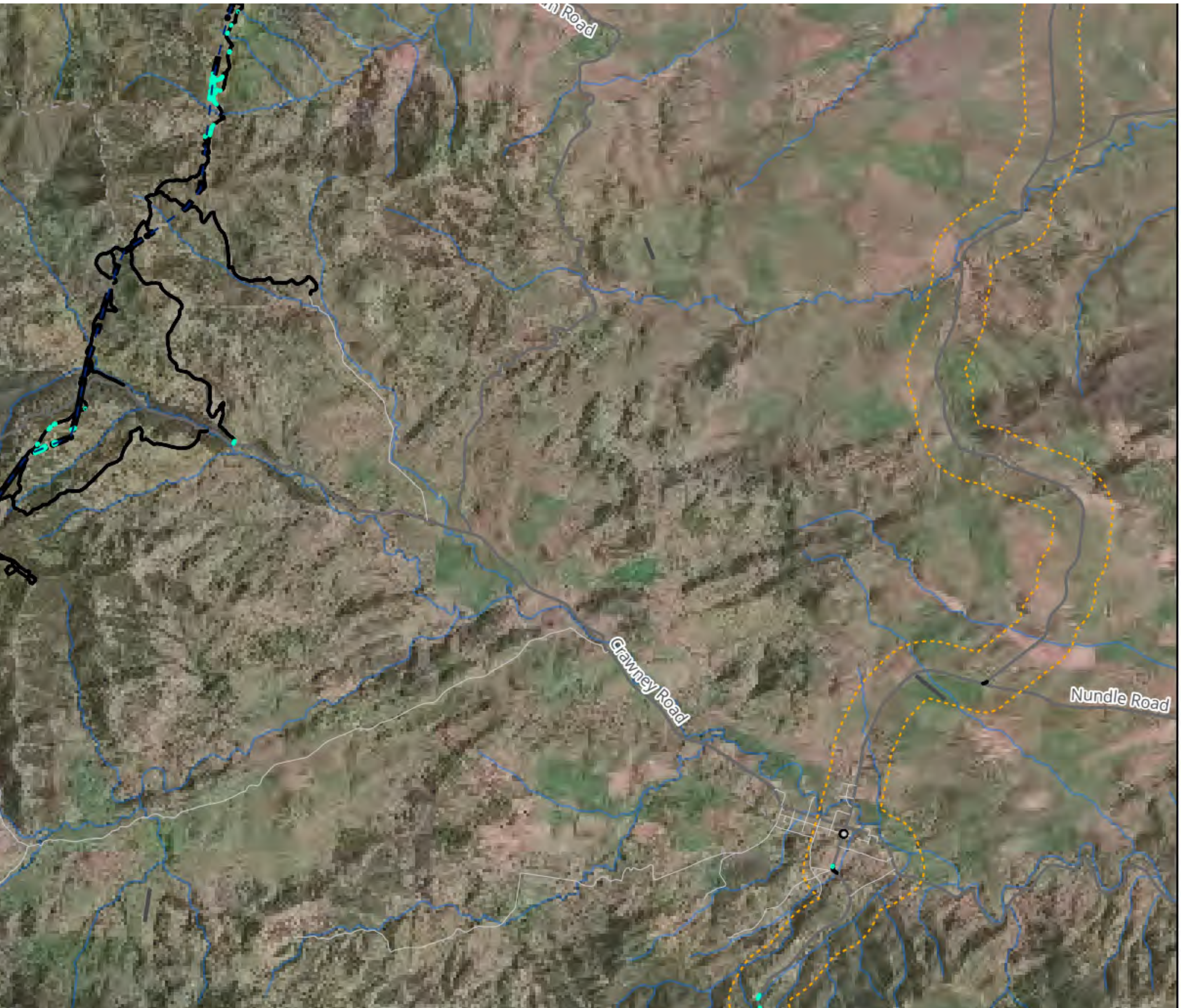
Table 25 Distribution of Box Gum Woodland CEEC within each infrastructure type in the development footprint

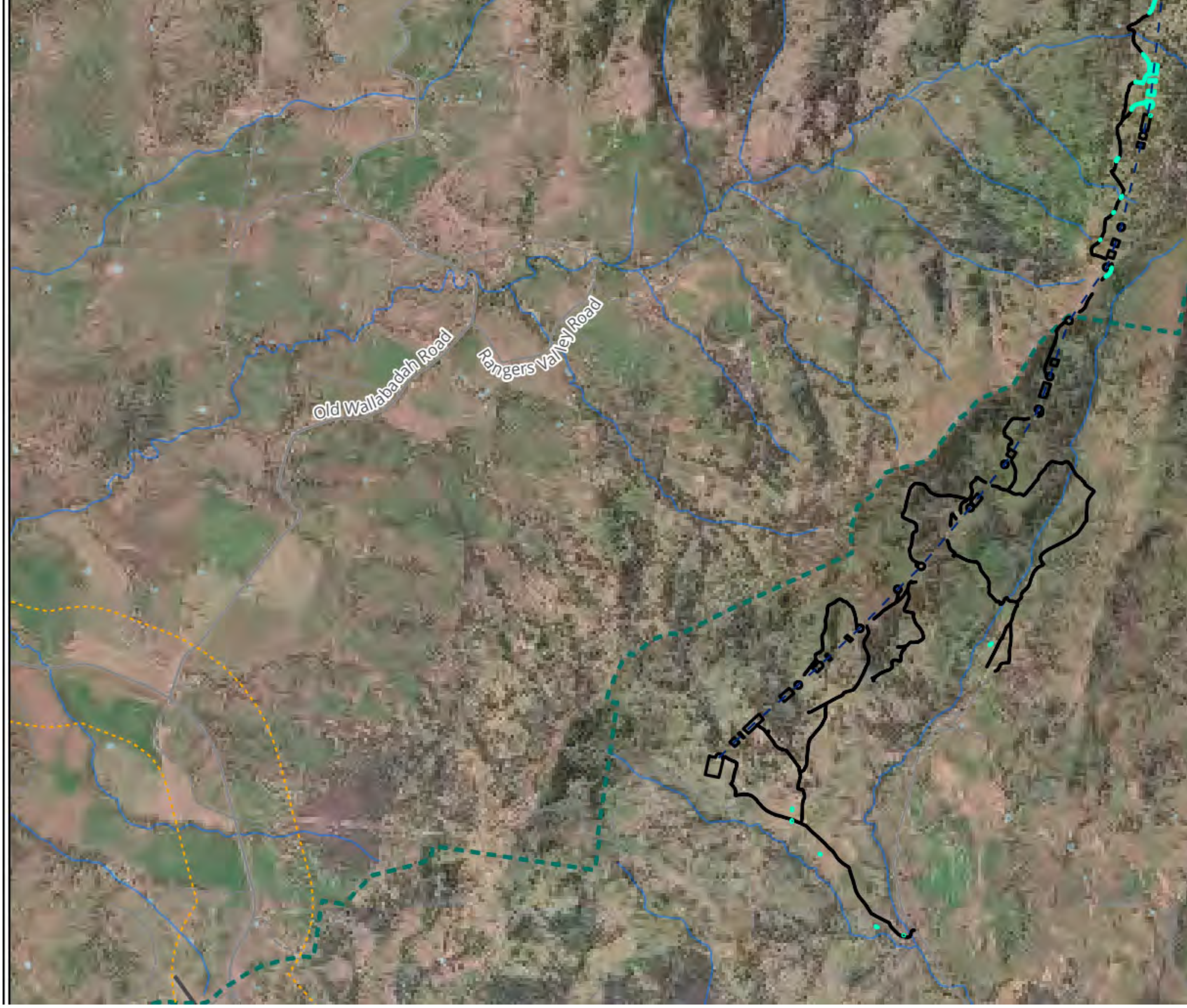
Vegetation condition class	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland TEC area in each infrastructure type (ha)						
	Wind turbine infrastructure	Internal roads	Temporary construction footprint	Ancillary infrastructure	Transmission line	Transmission line access tracks	Transport route road upgrades
High condition	-	-	-	-	0.06	-	2.90
Moderate condition	-	-	-	-	0.48	0.13	0.04
Low condition	-	-	-	-	1.29	0.21	0.08
DNG	-	-	-	-	0.71	0.17	-
Total (ha)	-	-	-	-	**2.54**	**0.51**	**3.02**

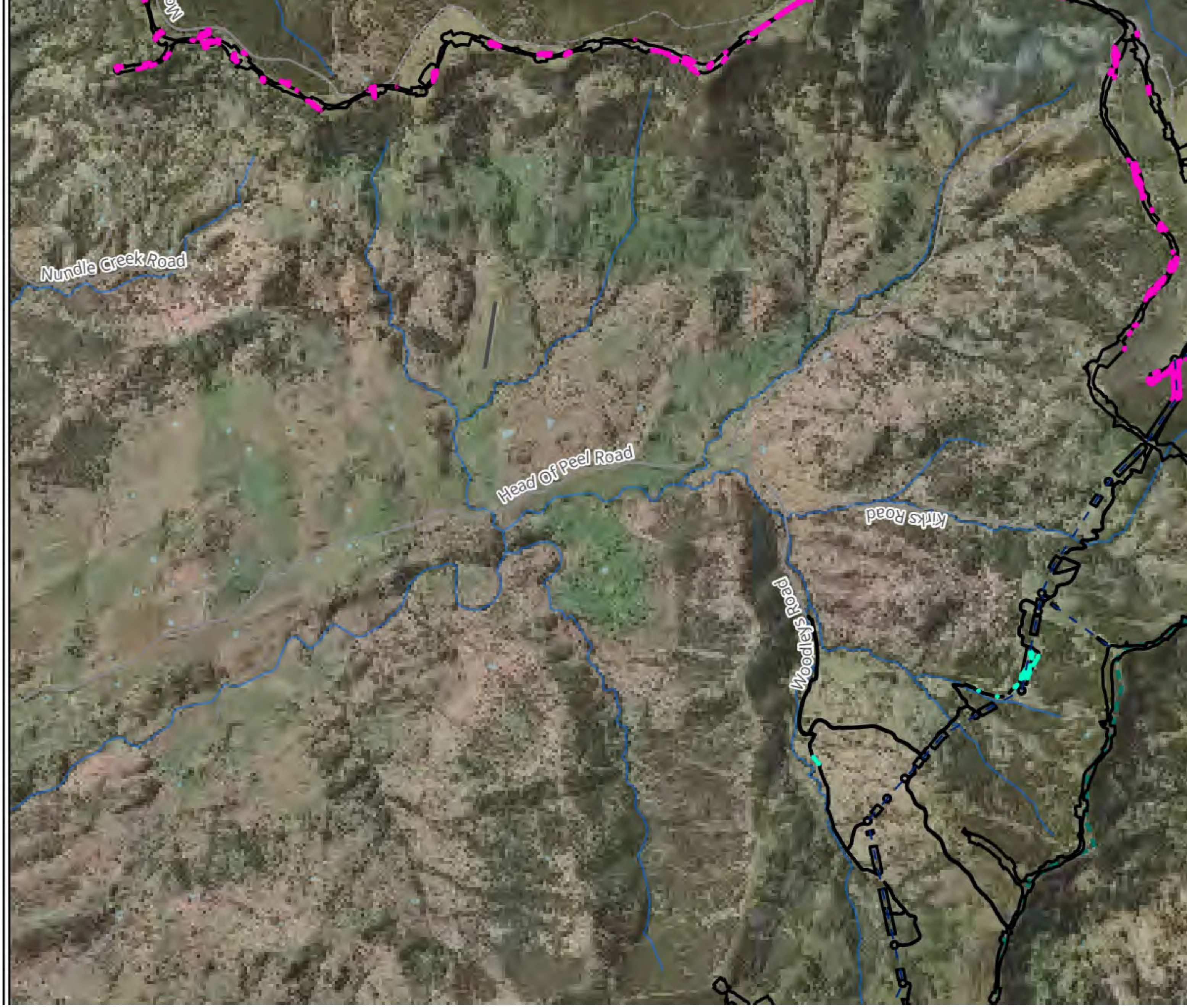
4.3.3 Sphagnum Moss Cool Temperate Rainforest

In addition to the TECs that have been mapped within the development footprint and subject land, desktop investigations have also mapped patches of the endangered Ben Halls Gap Nature Reserve Sphagnum Moss Cool Temperate Rainforest. This TEC is listed as endangered under the BC Act only, and is mapped within Ben Halls Gap Nature Reserve, over 135 metres outside the closest extent of the development footprint. The project will not result in any direct impacts to this TEC and indirect impacts associated with the construction and operation of the Project are highly unlikely, but will be considered in the Erosion and Sediment Control Plan which will include specific actions to identify and protect sensitive receptors associated with the National Park estate, including waterways and the adjacent Sphagnum Moss TEC.

An updated assessment of site gradients and risk to this TEC is provided in the updated Soil and Water report including project commitments to avoid impact in the Amendment Report.


Crawney Road
Nundle Road


Old Wallabadah Road
Rangers Valley Road



Nundle Creek Road
Head Of Peel Road
Kirks Road
Woodleys Road


River Road
Oakenville Creek Road
Nundle Creek Road
Hall Street
Nundle Road

4.4 Groundwater dependent ecosystems

Review of the Groundwater Dependent Ecosystem (GDE) Atlas (BOM, 2020) indicates the presence of low, moderate and high potential GDEs within and immediately adjacent to the development footprint. High potential GDEs identified for the development footprint are detailed in Table 26.

Table 26 Groundwater dependent ecosystems with a high potential of occurring within the development footprint

Groundwater dependent ecosystem name	Extent within the development footprint (ha)
Blakely's Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion	1.89
Blakely's Red Gum - Yellow Box grassy woodland of the New England Tablelands Bioregion	2.00
Forest Ribbon Gum - Silvertop Stringybark - Mountain Gum tall open forest on basalt on the Liverpool	1.84
Messmate - Mountain Gum tall moist forest of the far southern New England Tableland Bioregion	1.06
Messmate open forest of the tableland edge of the NSW North Coast Bioregion and New England Tableland	0.24
Mountain Gum/ Messmate/ Snow Gum grassy open forest of the New England Tablelands	3.82
Narrow-leaved Peppermint/ Forest Ribbon Gum grassy open forest of the New England Tablelands	2.80
Ribbon Gum - Mountain Gum - Snow Gum grassy open forest or woodland of the New England Tablelands Bioregion	0.59
River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt	0.78
River Oak moist riparian tall open forest of the upper Hunter Valley, including Liverpool Range	14.94
Silvertop Stringybark - Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liver	6.47
Silvertop Stringybark - Ribbon Gum - Rough-barked Apple open forest on basalt hills of southern land	67.90
Silvertop Stringybark - Rough-barked Apple grassy open forest of southern Nandewar Bioregion, south	0.27
Silvertop Stringybark - Yellow Box - Apple Box - Rough-barked Apple shrub grass open forest mainly	5.48
Silvertop Stringybark/ Tussock Grass grassy open forest of the Northern Tablelands escarpment	3.29
Snow Gum - Mountain Gum - Mountain Ribbon Gum open forest on ranges of	0.01

Groundwater dependent ecosystem name	Extent within the development footprint (ha)
the NSW North Coast Bioregion	
Snow Gum - Mountain Gum - Silver Wattle tall open forest of the Liverpool Range, Brigalow Belt South	3.90
Tea-tree riparian shrubland / heathland wetland on drainage areas of Nandewar Bioregion and New England	0.06
White Box - Silvertop Stringybark +/- White Cypress Pine grass shrub open forest of the southern Nan	3.13
White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills	0.01
White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region	0.47

Further assessment of the potential for the vegetation within the assessment area to be a GDE reliant on the subsurface presence of groundwater was undertaken based on the information provided in the GDE Atlas and the rulesets detailed Atlas of Groundwater Dependent Ecosystems (GDE Atlas), Phase 2 Task 5 Report: Identifying and mapping GDEs (SKM 2012).

From the results of the field surveys and observation made of the location and topography, it is considered unlikely that any of these ecosystems are actually dependent on the subsurface or surface expression of groundwater. These PCTs occur on the top of ridgelines or steep slopes. A single spring was observed during the field investigations on top of the ridge, however, it had been historically cleared, modified and utilised for agricultural purposes.

Review of groundwater wells carried out as part of the EIS investigations identified that the groundwater aquifer occurs at depths significantly greater than would be intercepted by earthworks associated with the Project construction. The project has been assessed to not have any material impact on groundwater flows, so impacts to GDEs are considered unlikely to occur.

5 Threatened species and habitat

This section outlines the field survey methods and results for identifying threatened flora and fauna, and their habitats within the development footprint, in accordance with Section 5 of the BAM. Prior to the detailed assessment, some preliminary descriptions of the broad habitat types and their conditions is provided.

5.1 General habitat types and features

5.1.1 Exotic pasture

The most common habitat type across the development footprint is exotic grasslands, which also has the lowest value to threatened flora and fauna (Photo 1). These areas are prevalent due to the current and historical use of the development footprint and surrounding landscape for grazing and agriculture. Habitat features for native fauna are limited in these areas; however, they may be utilised by common species adapted to disturbance.

Areas of open, exotic pasture can also provide foraging opportunities for large, diurnal raptors who predate on small mammals and birds. Exotic pastures within the development footprint are also used by common, large-bodied birds that do not require forest cover for shelter and foraging. These birds will forage in more open areas, however, will require adjacent forests for breeding.

Other fauna species observed utilising these areas of exotic pasture include bare-nosed wombat *Vombatus ursinus* and red-bellied black snake *Pseudechis porphyriacus*. Wombat burrows are common throughout these cleared areas, as well as areas of derived native grasslands.

Habitat for threatened flora is very limited in areas of exotic grassland due to altered plant community dynamics, with exotic pasture grasses being more completive. Changed light, water and nutrient dynamics in this habitat type will also limit the suitability of this habitat to support threatened flora species.

5.1.2 Derived native grasslands

Derived native grasslands occur where the canopy and shrub layer has been historically cleared and native grasses and forbs have been retained or regenerated within the ground layer (Photo 2).

Photo 1 Exotic pasture located within the internal road infrastructure footprint

Photo 2 Derived native grassland with Poa spp. dominant with exotic grasses and forbs sub-dominant. Retained eucalypt trees form extremely sparse canopy

5.1.3 Open eucalypt forest and woodland

Open eucalypt forests and woodlands are the most common, intact habitat type within the development footprint and assessment area (Photo 3). These habitat types represent the dominant important habitat type for threatened native fauna within the development footprint and have a strong influence on the flora and fauna composition observed. Eucalypt forest vegetation types within the development footprint include:

- Grassy woodlands.
- Open eucalypt forest.
- Tall moist eucalypt forest.
- Riparian open forest and woodland with co-dominant river oak *Casuarina cunninghamiana*.

These eucalypt woodlands provide foraging, shelter, movement and breeding resources for native fauna. Within the development footprint, patches of eucalypt forest in a high or moderate condition contained mature eucalypt trees that contained hollows of varying size. These hollows provide roosting and breeding resources for threatened mammals observed on the development footprint, including Greater Glider *Petauroides volans*, Squirrel Glider *Petaurus norfolcensis* and microbat species.

5.1.4 Steep cliffs and rocky outcrops

Adjacent to the development footprint and on the edges of the ridgeline associated with the wind farm infrastructure and internal roads, there are a number of steep sections with exposed rock outcroppings (Photo 4). These areas provide habitat resources, including shelter and roosting opportunities, for native fauna. In particular two areas have been identified as potential diurnal roost sites for threatened cave-dwelling bat species recorded on the site during field surveys. These areas were identified and have been avoided by the development footprint during the project concept design and are not located within the development footprint.

Photo 3 Grassy open eucalypt forest in the development footprint, showing Mountain Gum and stringybark eucalypts over a grassy ground layer

Photo 4 Example of rocky outcrops, with rounded boulders in the foreground and steep, incised cliffs in the background

5.1.5 Waterways

The waterways which intersect with the development footprint are dominated by first order streams due to the steep topography of the location and location on a ridgeline at the top of catchments. On top of the ridgeline and upper slopes, waterways are highly ephemeral and are likely to experience flows only immediately following rainfall. These waterways are unlikely to provide habitat for any threatened frogs or fish.

Further down the catchment in areas of the development footprint covered by the transmission line and haul route, there several 3rd and 4th order waterways. These waterways are characterised by shallow banks, with rocky substrates. A very thin zone of riparian vegetation is usually present, with substantial evidence of impacts from cattle grazing and incursion of exotic pasture grasses (Photo 5).

Photo 5 4th order waterway located along Head of Peel road transport haul route

5.2 Identifying habitat suitability for threatened species

A preliminary assessment was undertaken using the BAM Calculator to identify threatened flora and fauna species with potential to occur within the assessment area. Ground-truthed PCTs were entered into the BAM calculator including maximum values for native vegetation cover, patch size and vegetation integrity. Ecosystem credit species and species credit species predicted for the assessment area are provided in Appendix C.

A search of relevant government databases, including the Bionet database and the EPBC Act Protection Matters Search Tool (PMST) was also carried out for a 10km radius to the development footprint to identify any additional threatened species not identified by the BAM calculator. Desktop sources for the review are detailed in Section 1.8.

A wider desktop assessment area was developed for reviewing potential bat roost sites, including possible maternity roosts to understand more detail on cave systems where known threatened bats may have important roosts. This resulted in an additional three sites in known cave networks, in the landscape surrounding the development footprint, being assessed for microbat activity.

The suitability of habitat in the assessment area was assessed according to the steps outlined in BAM Section 6.4- *Steps for identifying habitat suitability for threatened species* (Appendix C). The results of the assessment are presented in the following sections and form the basis for the removal of species from the assessment where relevant.

5.2.1 Ecosystem credit species

Under the BAM, threatened species with a likelihood of occurrence that can be predicted by vegetation surrogates and landscape features or for which targeted survey has a low probability of detection are identified as ecosystem credits species. These species are not required to be subject to targeted surveys, and their habitat within the development footprint is linked directly to the PCTs present. Habitat for these ecosystem credit species is assumed to be present and their impacts are addressed as part of impacts and loss of habitat. Despite no requirement under the BAM to carry out targeted surveys for these species, the survey design employed for species credit species was sufficient to detect these.

Table 27 identifies ecosystem credit species predicted for the development footprint and an assessment of habitat suitability. The assessment indicates one identified ecosystem species that is unlikely to occur within the development footprint and can be removed from the assessment.

One predicted ecosystem species can be discounted from the assessment due to a lack for both foraging and breeding habitat is the white-bellied sea eagle. The development footprint does not occur within 1km of coastal rivers, lakes, large dams or creeks, wetlands and coastlines, with the exception of the minor road upgrade works in the Hunter Bioregion. These small impacts do not contain suitable breeding habitat for white-bellied sea-eagle. Where Peel River occurs within 1km of the development footprint it is considered a minor watercourse for the purpose of white-bellied sea-eagle habitat.

Table 27 Ecosystem credit species relevant to the assessment

Scientific name	Common name	EPBC Act status	BC Act status	Bionet records within 10km of site	Habitat suitability	Species relevant to the assessment
Anthochaera phrygia	Regent Honeyeater (Foraging)	CE	CE	No	Potential forage habitat present	Yes
Artamus	Dusky Woodswallow	-	V	Yes - 2 records	Potential forage	Yes

Scientific name	Common name	EPBC Act status	BC Act status	Bionet records within 10km of site	Habitat suitability	Species relevant to the assessment
cyanopterus					habitat present	
Callocephalon fimbriatum	Gang-gang Cockatoo	-	V	Yes – 1 record	Potential forage habitat present	Yes
Calyptorhynchus lathami	Glossy Black Cockatoo (Foraging)	-	V	No	Potential forage habitat present	Yes
Chthonicola sagittata	Speckled Warbler	-	V	No	Potential forage habitat present	Yes
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies	-	V	No	Potential forage habitat present	Yes
Daphoenositta chrysoptera	Varied Sittella	-	V	No	Potential forage habitat present	Yes
Glossopsitta pusilla	Little Lorikeet	-	V	Yes - 3 records	Potential forage and breeding habitat present	Yes
Grantiella picta	Painted Honeyeater	V	V	No	Potential forage habitat present	Yes
Haliaeetus leucogaster	White-bellied Sea-Eagle (Foraging)	-	V	No	No habitat present	No
Hieraaetus morphnoides	Little Eagle (Foraging)	-	V	No	Potential forage habitat present	Yes
Lathamus discolor	Swift Parrot (Foraging)	CE	E1	No	Potential forage habitat present, but vagrant species	Yes
Lophoictinia isura	Square-tailed Kite (Foraging)	-	V	No	Potential forage habitat present	Yes
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	-	V	No	Potential forage and breeding habitat present	Yes
Melithreptus gularis	Black-chinned Honeyeater	-	V	No	Potential forage habitat present	Yes
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	-	V	No	Potential forage habitat present	Yes
Neophema pulchella	Turquoise Parrot	-	V	No	Potential forage habitat present	Yes
Ninox connivens	Barking Owl	-	V	No	Potential forage and habitat	Yes

Scientific name	Common name	EPBC Act status	BC Act status	Bionet records within 10km of site	Habitat suitability	Species relevant to the assessment
					present	
Ninox strenua	Powerful Owl (Foraging)	-	V	Yes - 4 records	Potential forage habitat present	Yes
Pachycephala olivacea	Olive Whistler	-	V	No	Potential forage habitat present	Yes
Petroica boodang	Scarlet Robin	-	V	Yes - 3 records	Potential forage and breeding habitat present	Yes
Pomatostomus temporalis	Grey-crowned Babbler (eastern species)	-	V	No	Potential forage habitat present	Yes
Petroica phoenicea	Flame Robin	-	V	Yes - 1 record	Potential forage and breeding habitat present	Yes
Stagonopleura guttata	Diamond Firetail	-		No	Potential forage and breeding habitat present	Yes
Tyto novaehollandiae	Masked Owl (Foraging)	-		No	Potential forage habitat present	Yes
Tyto tenebricosa	Sooty Owl (Foraging)	-		No	Potential forage habitat present	Yes
Dasyurus maculatus	Spotted-tailed Quoll	E	V	Yes - 2 records Also recorded by survey within assessment area	Potential forage and breeding habitat present	Yes
Falsistrellus tasmaniensis	Eastern False Pipistrelle	-	V	Yes - 11 records	Potential forage habitat present	Yes
Kerivoula papuensis	Golden-tipped Bat	-	V	No	Potential forage habitat present	Yes
Miniopterus australis	Little Bentwing-bat (Foraging and Breeding)	-	V	No Recorded by survey within assessment area	Potential forage habitat present	Yes
Miniopterus orianae oceanensis	Large Bentwing-bat (Foraging)	-	V	No Recorded by survey within	Potential forage habitat present	Yes

Scientific name	Common name	EPBC Act status	BC Act status	Bionet records within 10km of site	Habitat suitability	Species relevant to the assessment
				assessment area		
Mormopterus norfolkensis	Eastern Freetail Bat	-	V	No Recorded by survey within assessment area	Potential forage habitat present	Yes
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	No	Potential forage habitat present	Yes
Petaurus australis	Yellow-bellied Glider	-	V	No	Potential forage and breeding habitat present	Yes
Phascolarctos cinereus	Koala (Foraging)	V	V	No Recorded by survey within assessment area (3 individuals)	Potential forage and breeding habitat present	Yes
Pteropus poliocephalus	Grey-headed Flying-fox (Foraging)	V	V	No Recorded by survey within assessment area	Potential forage habitat present	Yes
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	-	V	No Recorded by survey within assessment area	Potential forage habitat present	Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	-	V	Yes - 2 records. Recorded by survey within assessment area	Potential forage habitat present	Yes
Thylogale stigmatica	Red-legged Pademelon	-	V	No	Potential forage habitat present	Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	-	V	No Recorded by survey within assessment area	Potential forage habitat present	Yes

Table codes: E- Endangered, V- Vulnerable, C– Critical, CE- Critically Endangered, M- Marine/ Migratory.

5.2.2 Species credit species

Under the BAM, threatened species with a likelihood of occurrence that cannot be confidently predicted by vegetation surrogates and landscape features but can be reliably detected by targeted survey are identified as species credit species.

Table 28 identifies species credit species predicted for the development footprint and an assessment of habitat suitability.

Table 28 Potential species credit species assignment of candidate status

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
Adelotus brevis	Tusked Frog	3.00	Marginal habitat supported by a number of minor waterbodies within the wind farm infrastructure and internal access roads sections of the subject land. Habitats degraded on transmission line sections of the subject land.	Yes
Litoria booroolongensis	Booroolong Frog	2.00	Marginal habitat supported by a number of minor waterbodies within the wind farm subject land. Low quality potential habitat present where transmission line and access tracks crosses Wombramurra Creek	Yes
Litoria daviesae	Davies' Tree Frog	2.00	Marginal habitat supported by a number of minor waterbodies within the wind farm infrastructure and internal access roads sections of the subject land. Habitats degraded on transmission line sections of the subject land.	Yes
Litoria subglandulosa	Glandular Frog	3.00	Marginal habitat supported by a number of minor waterbodies within the wind farm subject land. Habitats degraded on transmission line and access tracks sections of the subject land. Species records associated with large areas on intact vegetation to the east of the subject land, with no records within 100kms of the project site.	No (however species targeted during frog survey)
Mixophyes balbus	Stuttering Frog	3.00	Marginal habitat supported by a number of minor waterbodies within the wind farm sections of the subject land. Habitats degraded on transmission line corridor. Species records associated with large areas on intact vegetation to the east of the project site, with no records within 100kms of the subject land for the wind farm and transmission line.	No (however species targeted during frog survey)
Anthochaera phrygia	Regent Honeyeater	3.00	Potential forage habitat supported across the subject land and addressed through ecosystem credits. Subject land does not occur within mapped Important Areas for the species.	No
Burhinus grallarius	Bush Stone-curlew	2.00	Species occurs at altitudes much lower than the subject land with the highest elevation record of the species within over 120kms of the wind farm site at an altitude of 500 metres (approx.). The lowest point of the wind farm and transmission line subject land occurs along the transmission line at an altitude	No

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
			of 750 metres (approx.) and as such the subject land does not support habitat for the species. Two records of the species occur at an elevation of approximately 1,000 metres, one hear Armidale over 120kms from the subject land, and the other in Washpool NP, over 270kms from the project site. When these records are compared to the remainder of the 1,350 species' records in BioNet, these occurrences are considered to be vagrants.	
Callocephalon fimbriatum	Gang-gang Cockatoo	2.00	Of the 16,000 records of the species in ebird (and >600 in BioNet), none occur north of Muswellbrook NSW, except occasional records along coast just south of Coffs Harbour. As such the subject land does not support habitat for the species.	No
Calyptorhynchus lathami	Glossy Black-Cockatoo	2.00	Marginal potential forage habitat supported across the subject land, very few *Casuarina* spp or *Allocasuarina* spp. have been recorded during floristic surveys and fauna habitat assessments, with the exception of some very small (less than 1ha) patches of River Oak riparian forest. Breeding habitat potentially present in the form of hollow-bearing trees.	Yes
Haliaeetus leucogaster	White-bellied Sea-Eagle	2.00	The subject land associated with the wind farm, transmission line, access tracks and internal roads does not occur within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines. Where Peel River occurs within 1km of the subject land it is a minor watercourse. Some areas of the transport haul route subject land are within 1km of the coastline, however, habitat suitability in these areas of minor impact are not considered to support foraging or breeding functions for White-bellied Sea-eagle.	No
Hamirostra melanosternon	Black-breasted Buzzard	1.50	Riparian habitats are degraded within the subject land.	No
Hieraaetus morphnoides	Little Eagle	1.50	Potential forage and breeding habitat supported across the subject land.	Yes
Lathamus discolor	Swift Parrot	3.00	Potential forage habitat supported across the subject land. Project site does not occur within mapped Important Areas for the species.	No

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
Lophoictinia isura	Square-tailed Kite	1.50	Potential forage and breeding habitat supported across the subject land.	Yes
Ninox connivens	Barking Owl	2.00	Potential forage and breeding habitat supported across the subject land.	Yes
Ninox strenua	Powerful Owl	2.00	Potential forage and breeding habitat supported across the subject land.	Yes
Tyto novaehollandiae	Masked Owl	3.00	Potential forage and breeding habitat supported across the subject land.	Yes
Tyto tenebricosa	Sooty Owl	3.00	Potential forage and breeding habitat supported across the subject land.	Yes
Aepyprymnus rufescens	Rufous Bettong	2.00	Marginal and degraded potential habitat occurs within areas of the subject land associated with the wind farm and transmission corridor.	Yes
Cercartetus nanus	Eastern Pygmy-possum	2.00	Potential habitat is present within the subject land.	Yes
Chalinolobus dwyeri	Large-eared Pied Bat	3.00	Habitat occurs within and adjacent to the subject land.	Yes
Macropus parma	Parma Wallaby	2.00	Potential habitat occurs in higher condition areas connected to Ben Halls Gap Nature Reserve. Potential habitats within the transmission line corridor are degraded.	Yes
Miniopterus australis	Little Bent-winged Bat	3.00	Habitat occurs within and adjacent to the subject land.	Yes
Miniopterus orianae oceanensis	Large Bent-winged Bat	3.00	Habitat occurs within and adjacent to the subject land.	Yes
Myotis macropus	Southern Myotis	2.00	Habitat occurs within and adjacent to the subject land.	Yes
Petaurus norfolcensis	Squirrel Glider	2.00	Potential habitat is present within the subject land.	Yes
Petrogale penicillata	Brush-tailed Rock-wallaby	3.00	Potential habitat is present within the subject land.	Yes
Phascogale tapoatafa	Brush-tailed Phascogale	2.00	Potential habitat is present within the subject land. However, BioNet notes the species occurrences in the following IBRA subregions relevant to the project site. Walcha Plateau IBRA - Known to occur, but a geographic restriction exists stating "East of the Tia River". This river's headwaters occur >50kms north-east	No

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
			of the assessment area. Nearest record of the species is 56kms east. Tomala IBRA - species known, with no geographic restrictions listed. However, only records of the species comprise an inaccurate record (10kms) noted as Mount Royal SF (or NP) from 1991, one more low accuracy (10kms) in similar location (but in Barrington Tops IBRA), one further single record in the IBRA from 1974, and >66kms from the assessment area. Peel IBRA - Species predicted to occur (i.e. not known), no geographic restrictions listed. Species never recorded in IBRA.	
Phascolarctos cinereus	Koala	2.00	Breeding and foraging habitat occurs within and adjacent to the subject land.	Yes
Pteropus poliocephalus	Grey-headed Flying-fox	2.00	Potential forage habitat supported across the subject land.	Yes
Vespadelus troughtoni	Eastern Cave Bat	3.00	Habitat occurs within and adjacent to the subject land.	Yes
Hoplocephalus bitorquatus	Pale-headed Snake	2.00	Species known only to occur at altitudes much lower than the subject land, within highest elevation BioNet records including 550m elevation (approx.) north of Bindarri NP (>200kms from the project site), 390m elevation (approx.) west of Kwiambal NP (>150km from the project site) and 375m elevation (approx.) west of Gunnedah (>100kms from the project site). The lowest point of the project site occurs along the transmission line at an altitude of 750m (approx.) and as such the subject land does not support habitat for the species.	No
Uvidicolus sphyrurus	Border Thick-tailed Gecko	2.00	Species distribution is north of the subject land associated with the wind farm and transmission line corridor and has never been recorded (or predicted to occur in) Tomala or Walcha Plateau IBRA subregions. Peel IBRA has records 20-25kms north of the site across cleared land, which are at the southern extent of the species' occurrence. Peel IBRA abuts parts of the wind farm subject land and includes the western 60% of the transmission line section of the subject land.	Yes

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
Acacia atrox	Myall Creek Wattle	3.00	Known populations more than 200km north/ northwest of the assessment area. No records within proximity to the site. Potential habitat in PCT599 is marginal and unlikely to support the species.	No
Eucalyptus nicholii	Narrow-leaved Black Peppermint	2.00	Potential habitat within grassy woodland and dry sclerophyll forests within the subject land.	Yes
Eucalyptus oresbia	Small-fruited Mountain Gum		Habitat suitability within subject land for *Eucalyptus oresbia* was assessed by Arup. It was concluded that the subject land is not suitable to support this species due to the lack of 'very steep valleys and deeply incised creek lines with primarily south to southwest exposure' (NSW BioNet, DPIE 2021). Due to this habitat limitation, the species was excluded from assessment under the BAM	No
Chiloglottis platyptera	Barrington Tops Ant Orchid	2.00	Potential habitat within grassy woodland and open forests within the wind farm infrastructure section of the subject land.	Yes
Dichanthium setosum	Bluegrass	2.00	Potential habitat within dry sclerophyll forests, derived native grassland and forested wetlands within the subject land.	Yes
Digitaria porrecta	Finger Panic Grass	2.00	Habitat within box woodland marginal for the species. No other suitable habitat within the site.	No
Homoranthus prolixus	Granite Homoranthus	2.00	No suitable habitat within the subject land.	No
Monotaxis macrophylla	Large-leafed Monotaxis	2.00	No suitable habitat within the subject land.	No
Picris evae	Hawkweed	2.00	Open Eucalypt woodland within site does not support *Dichanthium* spp. dominated ground layer and is marginal for the species.	No
Polygala linariifolia	Native Milkwort	2.00	Potential habitat within PCT 1194 in the wind farm sections of the subject land.	Yes
Commersonia procumbens	Commersonia procumbens	2.00	No PCTs known to be associated with the species occur within the subject land.	No
Tasmannia glaucifolia	Fragrant Pepperbush	3.00	Eucalypt forest within PCT 934, 931 and 927 offers marginal habitat for the	Yes

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
			species.	
Tasmannia purpurascens	Broad-leaved Pepperbush	2.00	Suitable habitat within open woodland and forest within the site (PCT 934, 931, 927 and 1194).	Yes
Thesium australe	Austral Toadflax	1.50	Suitable habitat within the assessment area.	Yes
Tylophora linearis	Tylophora linearis	2.00	Associated PCTs within the development site occur at higher altitudes than recorded for the species.	No
***Asterolasia* sp. 'Dungowan Creek'**	Dungowan Starbush	3.00	Marginal habitat within PCT 934.	Yes
Homopholis belsonii	Belson's Panic	2.00	Site lacks suitable habitat.	No
Euphrasia arguta	Euphrasia arguta	3.00	Suitable habitat within the assessment area.	Yes

5.3 Candidate threatened species and targeted survey methods

Candidate species credit species requiring targeted survey include 33 threatened fauna species and 10 threatened flora species. Table 29 presents a summary of field survey methods for candidate species credit species relative to BAM survey requirements, with additional detail on the survey methods in the following section.

Table 29 Candidate species credit species and survey design employed

Scientific name	Common name	BAM survey period	Survey guidelines	Survey design employed	Survey effort
Frogs					
Adelotus brevis	Tusked Frog	Oct – Feb	Field survey methods for amphibians (DECC 2009).	Spotlighting, call playback surveys and active searches.	Frog surveys were undertaken in spring 2019 and autumn 2020. 12 sites were surveyed between 18 and 21 November 2019. Six sites were surveyed between 24 and 27 March 2020.
Litoria booroolongensis	Booroolong Frog	Nov - Dec	Field survey methods for amphibians (DECC 2009).	Spotlighting, call playback surveys and active searches.	
Litoria daviesae	Davies Tree Frog	Sep – Jan	Field survey methods for amphibians (DECC 2009).	Spotlighting, call playback surveys and active searches.	
Litoria subglandulosa	Glandular Frog	Oct - Dec	Field survey methods for amphibians (DECC 2009).	Spotlighting, call playback surveys and active searches.	
Mixophyes balbus	Stuttering Frog	Sep - Mar	Field survey methods for amphibians (DECC 2009).	Spotlighting, call playback surveys and active searches.	
Birds					
Anthochaera phrygia	Regent Honeyeater	Sep – Dec	Commonwealth Survey Guidelines for threatened birds (DEWHA 2010).	Diurnal bird surveys during the migration period/survey timing and habitat mapping.	Bird surveys undertaken at 17 sites in August 2019, 21 sites in November 2019 and 21 sites in February 2020.
Calyptorhynchus lathami	Glossy Black Cockatoo	Mar - Aug	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Habitat mapping, hollow-bearing tree mapping and diurnal bird surveys.	Bird surveys undertaken at 17 sites in August 2019, 21 sites in November 2019 and 21 sites in February 2020.
Hamirostra melanosternon	Black-breasted Buzzard	Sep - Nov	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Stick-nest surveys.	Bird surveys undertaken at 17 sites in August 2019, 21 sites in November 2019 and 21 sites in February 2020.
Hieraaetus morphnoides	Little Eagle	Aug - Oct	Draft Threatened Species Survey and Assessment	Stick-nest surveys.	Bird surveys undertaken at 17 sites in August 2019, 21 sites in

Scientific name	Common name	BAM survey period	Survey guidelines	Survey design employed	Survey effort
			Guidelines (DECC 2004).		November 2019 and 21 sites in February 2020.
Lathamus discolour	Swift Parrot	May - Aug	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Winter diurnal bird survey targeting flower eucalypts.	Bird surveys undertaken at 17 sites in August 2019.
Lophoictinia isura	Square-tailed Kite	Sep - Jan	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Stick-nest surveys.	Bird surveys undertaken at 17 sites in August 2019, 21 sites in November 2019 and 21 sites in February 2020.
Ninox connivens	Barking Owl	May - Aug	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Call Playback and spotlighting.	Nocturnal bird surveys undertaken between 26 and 30 August 2019.
Ninox strenua	Powerful Owl	May - Aug	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Call Playback and spotlighting.	
Tyto novaehollandiae	Masked Owl	May – Aug	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Call Playback and spotlighting.	
Tyto tenebricosa	Sooty Owl	May – Aug	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Call Playback and spotlighting.	
Mammals					
Aepyprymnus rufescens	Rufous Bettong	Year round	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Deployment of baited terrestrial camera traps and spotlighting.	Total of 1362 trap nights using ground deployed infrared motion sensing cameras.
Cercartetus nanus	Eastern Pygmy Possum	Oct - Mar	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Deployment of baited arboreal camera traps and spotlighting.	Total of 1014 trap nights using arboreal deployed infrared motion sensing cameras.

Scientific name	Common name	BAM survey period	Survey guidelines	Survey design employed	Survey effort
Chalinolobus dwyeri	Large-eared Pied Bat	Sep - Mar	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Ultrasonic detection and habitat mapping.	24 Ultrasonic bat detectors were deployed for a total of 1042 trap nights.
Dasyurus maculatus	Spotted-tailed Quoll	Year round	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Deployment of baited terrestrial camera traps and spotlighting.	Total of 1362 trap nights using ground deployed infrared motion sensing cameras.
Macropus parma	Parma Wallaby	Year round	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Deployment of baited terrestrial camera traps and spotlighting.	Total of 1362 trap nights using ground deployed infrared motion sensing cameras.
Miniopterus australis	Little Bentwing-bat	Dec - Feb	''Species credit' threatened bats and their habitats (EES 2018).	Ultrasonic detection and habitat mapping.	24 Ultrasonic bat detectors were deployed for a total of 1042 trap nights.
Miniopterus orianae oceanensis	Large Bentwing-bat	Nov - Feb	'Species credit' threatened bats and their habitats (EES 2018).	Ultrasonic detection and habitat mapping.	24 Ultrasonic bat detectors were deployed for a total of 1042 trap nights.
Myotis macropus	Southern Myotis	Nov - Mar	'Species credit' threatened bats and their habitats (EES 2018).	Ultrasonic detection and habitat mapping.	24 Ultrasonic bat detectors were deployed for a total of 1042 trap nights.
Petauroides volans	Greater Glider	Year round	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Spotlighting.	Total of 1014 trap nights using arboreal deployed infrared motion sensing cameras.
Petaurus norfolcensis	Squirrel Glider	Year round	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Deployment of baited arboreal camera traps and spotlighting.	Total of 1014 trap nights using arboreal deployed infrared motion sensing cameras.
Petrogale penicillata	Brush-tailed Rock-wallaby	Year round	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Deployment of baited terrestrial camera traps and spotlighting.	Total of 1362 trap nights using ground deployed infrared motion sensing cameras.
Phascolarctos cinereus	Koala	Year round	EPBC Act referral	SAT surveys in high quality	Total of 1014 trap nights using

Scientific name	Common name	BAM survey period	Survey guidelines	Survey design employed	Survey effort
			guidelines for the vulnerable koala (DoE 2014).	habitat (high abundance of feed trees), and spotlighting.	arboreal deployed infrared motion sensing cameras.
Pteropus poliocephalus	Grey-headed Flying-fox	Year round	Survey-guidelines-bats (DEWHA 2010).	Habitat mapping and active searches for camps.	No suitable camp habitat within the assessment area.
Vespadelus troughtoni	Eastern Cave Bat	Nov - Jan	'Species credit' threatened bats and their habitats (EES 2018).	Ultrasonic detection and habitat mapping.	24 Ultrasonic bat detectors were deployed for a total of 1042 trap nights.
Reptiles					
Uvidicolus sphyrurus	Border Thick-tailed Gecko	Nov - Mar	Survey guidelines for Australia's threatened reptiles (DSeWPaC 2011)	Targeted searches and habitat mapping.	A total of 3 nights spotlighting and active searches in marginal habitat present on site.
Plants					
Asterolasia sp. 'Dungowan Creek'	Dungowan Star Bush	Year round	NSW Guide to Surveying Threatened Plants (OEH, 2016) as far as practicable	Seasonal surveys involving transects and targeted random meanders, depending on the density of vegetation. All surveys were carried out within the suitable seasonal window for candidate flora except: • Barrington Tops Ant Orchid: surveys were completed from 18-22 November. Conditions were exceptionally dry for much of spring 2019 due to drought. Review of BOM (2020) indicates there was little change in local	A reasonable survey effort was employed including: • A spring survey over 5 days from 18-22 November 2019- limited to suitable habitat within the subject land. • Summer survey over 5 days in February 2020- including suitable habitat within the subject land and transmission line corridor (where accessible). • Autumn 2021 surveys over 5 days in March by two Biosis senior botanist during supplementary BAM plot surveys.
Chiloglottis platyptera	Barrington Tops Ant Orchid	Sep - Oct			
Dichanthium setosum	Bluegrass	Dec - May			
Digitaria porrecta	Finger Panic Grass	Dec - Jan			
Eucalyptus nicholii	Narrow-leaved Peppermint	Year round			
Polygala linariifolia	Native Milkwort	Year round			
Pterostylis elegans	Elegant Greenhood	Dec - May			
Tasmannia glaucifolia	Fragrant Pepperbush	Year round			
Tasmannia purpurascens	Broad-leaved Pepperbush	Year round			

Scientific name	Common name	BAM survey period	Survey guidelines	Survey design employed	Survey effort
Thesium australe	Austral Toadflax	Sep - Feb		conditions from September to October. • Finger Panic Grass: Surveys were completed in February.	

5.3.1 Terrestrial flora survey methods

Surveys for candidate threatened flora were carried out over two seasons by Arup and Biosis botanists and under the direction of accredited assessor Matt Davies, as follows:

- Survey of the wind farm development footprint over 5 days from 18-22 November 2019.
- Survey of the wind farm development footprint and accessible parts of the transmission line corridor over 5 days in February 2020.
- Supplementary vegetation community survey to verify PCTs, with incidental searches for threatened species conducted of the internal access roads, Ben Halls Gap Nature Reserve buffer and transport haul route portions of the development footprint over 5 days in August 2020.

Targeted surveys involved searches for target species and random meanders, depending on the density of vegetation. A summary of survey requirements and deployed field methods is provided for all candidate threatened flora in Table 29 above. The extent of targeted surveys for threatened flora is shown in Figure 10.

Following identification of the candidate threatened flora species list, a field survey plan was devised by Arup ecologists in accordance with the *NSW Guide to Surveying Threatened Plants* (OEH 2016). This plan included identification of potential habitat for each of the candidate threatened flora species based on known vegetation associations, review of threatened species profiles, PlantNet profiles, Recovery Plans Conservation Advices and other available literature to determine the presence of suitable areas of potential habitat for species within the assessment area, as well as BioNet records available for each species.

Optimum timeframes for surveys, and which species would be targeted when, were also determined based on the recommended survey times for the candidate species provided by the BAM calculator, literature review, as well as prevailing weather conditions on site. Estimation of the survey effort required to adequately assess the species was undertaken in accordance with Table 3 of the *NSW Guide to Surveying Threatened Plants* (OEH 2016) and was based on the distance required between the minimum separation of parallel traverses (20 metres), and the hectares of potential habitat calculated for each of the candidate species. A field guide of identification information was prepared, taken into the field and used as required.

Additional searches for threatened flora were undertaken during PCT verification and habitat assessments completed in Ben Halls Gap Nature Reserve and additional infrastructure elements in August 2020.


Barry Road
Nundle
Nundle Road
Crawney Road
Old Wallabadah Road

5.3.2 Terrestrial fauna survey methods

A range of targeted terrestrial fauna survey methods were planned and implemented by Biosis ecologists over all four seasons between November 2018 and May 2020 to detect the candidate threatened species assessed as likely to occur on the site. Field surveys were carried out during optimal seasonal conditions and weather conditions, with rainfall and temperature (BOM, 2020) during all survey events provided in Table 30.

Weather and observations for the deployment of camera traps and passive acoustic detectors which remained in the field for several months have been presented as monthly averages for temperature and total monthly rainfall (Table 31). Note, temperature measurements on the wind farm development footprint are likely to be several degrees lower due to higher elevation; however, the BOM station presented below is the closest station with temperature data. The monthly observations during the fauna survey period show the drought conditions from November and December 2019, with substantially lower than average total monthly rainfall recorded in these months. These conditions were alleviated from January 2020, with an opposite trend of substantially higher falls than monthly means experience from January 2020 – May 2020, covering a large portion of the field survey campaign.

Also linked to the weather conditions during the field survey was the severe bushfire conditions that were experienced across south-eastern Australia in the 2019/20 summer (refer Section 3.2). During the field survey campaign, the area experienced bushfires within the transmission line and access track footprints. Habitat mapping has taken into consideration these fire events, with the vegetation and condition assessments assuming pre-fire condition for the purpose of PCT mapping, condition assessment and likelihood of occurrence for threatened fauna.

The following sections describe the fauna field methods in detail, with locations of all targeted fauna surveys shown on Figure 12,.

Table 30 Weather conditions during targeted fauna surveys[1]

Survey date	Temperature (°C)		Rainfall to 0900 hrs (mm)
	Minimum	Maximum	
12 November 2018	10.1	30.6	0.0
13 November 2018	12.8	32.2	0.0
14 November 2018	12.8	26.1	0.0
15 November 2018	9.3	32.2	0.0
26 August 2019	1.4	24.5	0.0
27 August 2019	3.4	23.5	0.0
28 August 2019	1.2	22.5	0.0
29 August 2019	0.6	20.9	0.0
30 August 2019	0.5	18.4	0.0
31 August 2019	5.0	19.8	0.0
18 November 2019	11.2	30.4	0.0
19 November 2019	10.8	36.4	0.0
20 November 2019	14.6	35.4	0.0
21 November 2019	13.6	37.0	0.0

Survey date	Temperature (°C)		Rainfall to 0900 hrs (mm)
	Minimum	Maximum	
22 November 2019	20.8	31.0	0.0
24 February 2020	22.4	25.8	3.4
25 February 2020	16.2	30.3	11.4
26 February 2020	19.0	31.0	1.2
27 February 2020	16.6	30.5	15.2
28 February 2020	13.6	30.4	0.2
29 February 2020	15.2	No recorded	0.0
23 March 2020	15.4	27.5	0.0
24 March 2020	15.9	29.1	0.0
25 March 2020	16.6	23.6	0.0
26 March 2020	14.4	22.9	24.4
11 May 2020	-0.4	Not recorded	0.0
12 May 2020	0.3	20.5	0.0
13 May 2020	4.4	19.5	0.0
14 May 2020	2.4	19.5	0.0
15 May 2020	5.1	19.4	0.0
17 August 2020	4.2	16.0	1.0
18 August 2020	4.4	19.0	0.0
19 August 2020	3.8	20.0	0.0
20 August 2020	7.8	15.8	0.0
21 August 2020	3.0	15.6	0.0

[1] Recorded at Murrurundi Gap AWS, BOM station 061392

Table 31 Monthly weather observations during camera and acoustic detector deployment

Month deployed	Temperature (°C)[1]		Total rainfall[2,3]
	Mean daily minimum[3]	Maximum	
November 2019	13.1 (12.1)	31.5 (28.7)	42.4 (89.6)
December 2019	16.8 (14.8)	36.0 (31.3)	19.8 (131.8)
January 2020	20.8 (16.6)	36.8 (32.4)	137.6 (81.4)
February 2020	18.4 (16.2)	29.8 (31.5)	203.0 (66.7)
March 2020	13.9 (13.6)	27.2 (29.3)	71.8 (56.5)
April 2020	9.9 (9.0)	24.8 (25.0)	95.2 (40.6)

Month deployed	Temperature (°C)[1]		Total rainfall[2,3]
	Mean daily minimum[3]	Maximum	
May 2020	4.7 (5.1)	19.0 (20.5)	112.0 (57.5)

[1] Recorded at Quirindi Post Office, BOM station 055049.

[2] Recorded at Head of Peel station, BOM station 55336.

[3] Numbers in brackets represent summary mean for all years recorded.

Bird strike collision risk survey and diurnal bird survey

This method provides a standardised measure of bird activity. It is important that a sufficient quantum of utilisation data for a fully representative annual cycle is obtained, for collision risk modelling. A representative sample of point counts were taken across the assessment area.

Surveys were conducted over three seasons:

- 17 survey points between 27-30 August 2019.
- 21 survey points between 18-22 November 2019.
- 21 number survey points between 25-29 February 2020.

All survey locations were near proposed turbines as this provided the best access and visual for surveys. The majority of the utilisation survey points were located in open areas between stands of native vegetation.

Method for the bird utilisation surveys is as follows:

- Observers walk to each transect and to move between fixed points on transects. When reaching an observation point on the transect observers stop and allow time for birds to habituate to their presence (approximately 10 minutes). The area is then scanned for 5 minutes, during which all birds present are recorded. Scanning involves observing at a steady rate in a circle while remaining on the spot (over 360 degrees).
- Observers record all birds as far as the eye can see over 20 minutes at each observation point (which does bias large birds over smaller ones, as the former are more conspicuous, however this can be accounted for in the analyses). Observations are to be made using the naked eye only. Binoculars can only be used to assist with the identification of a bird.
- As it is the number of movements of birds that is the important variable for modelling, all movements were noted even if it is the same individual. Only birds that were seen are to be recorded, although bird calls can be used to alert the observer to the presence of a bird and its location.
- The order in which transects were sampled was randomised to ensure that transects are equally sampled over the various times of day.

The information collected included:

- Time of the observation
- Point and transect number
- Species
- Number
- Direction of flight
- Height above ground

- Distance from observer
- Behaviour

The location of all bird surveys is shown on Figure 12.

Nocturnal bird surveys and spotlighting

Spotlighting was aimed to detect small macropods, owls and arboreal mammals.

General and targeted spotlighting and call-broadcast surveys for candidate (and potential candidate) threatened mammal, reptile and bird fauna species over nine nights total between:

- 26-30 August 2019 (2 nights)
- 18-21 November 2019 (2 nights)
- 24-26 March 2020 (3 nights)
- 11-12 May 2020 (2 nights)

During the August 2019 winter survey event, call playback was conducted at six locations, near areas identified as supporting some potential suitable owl roosting/breeding habitat, to detect the presence of owls in the area. Species targeted which included Barking Owl *Ninox connivens*, Powerful Owl *Ninox strenua*, Masked Owl *Tyto novaehollandiae* and Sooty Owl *Tyto tenebricosa*.

Further nocturnal bird surveys undertaken to assess areas of identified better quality habitat for threatened owls, and additional to the two nights at six locations within the windfarm corridor between 26-30 August 2019, were two additional nights between 11-12 May 2020. These call-broadcast surveys included 1 location near area of highest potential habitat.

During the Stage 2 spring survey, spotlighting survey was conducted in the subject land along the edge of Ben Halls Gap Nature Reserve to gain additional information on the presence of potential nocturnal birds. The intent of this survey was to provide additional data about the specie present within the interface between the development footprint and the Nature Reserve.

The location of nocturnal bird surveys and spotlighting transects shown on Figure 12.

Surveys for hollow-dependant birds and raptors in breeding season

A total of 41 days targeted fauna surveys and habitat assessment between August 2019 and August 2020 by teams of between 1 and 4 ecologists/zoologists where the presence of stick nests, tree hollows and evidence of nesting / breeding was captured.

The aim of this survey was to determine whether the assessment area supports breeding habitat for the target species of birds, and whether that habitat is being used for breeding, tree hollows and stick nests were assessed for their suitability in providing breeding habitat, and evidence of use was recorded.

Camera trapping

A total of 19 Reconyx Hyperfire camera trap units were deployed within the subject land. Of these, 12 were targeted to terrestrial fauna and 7 were targeted for arboreal fauna. Three cameras were also deployed along the transmission line corridor; however, two arboreal cameras and one terrestrial camera were destroyed during the bushfires in the summer 2019 fire season.

Deployment methods included:

- Units with strong-odour meat bait for Spotted-tailed Quoll and Brush-tailed Phascogale.

- Units passively deployed (without bait) for Parma Wallaby and Brush-tailed Rock Wallaby, Eastern Pygmy-possum, Greater Glider, Koala and Rufous Bettong.

Total of 12 baited ground deployed infrared motion sensing cameras set 20-21 November 2019 and collected on 9 April 2020 (1 camera) and 11-15 May 2020 (8 cameras), with 3 cameras destroyed in January 2020 bushfires affecting the assessment area. Camera batters and memory cards were checked in February 2020, allowing for up to 1,539 trap nights (burnt camera traps excluded).

Total of 7 baited arboreal deployed infrared motion sensing cameras set 20-22 November 2019 and collected on 9 April 2020 (1 camera) and 11-15 May 2020 (5 cameras), with 1 camera destroyed in January 2020 bushfires affecting the assessment area. Camera batters and memory cards were checked in February 2020, allowing for up to 1,009 trap nights (burnt camera traps excluded). An example of the arboreal camera trap set up is provided in Photo 6.

Camera trap deployment locations are shown on Figure 12.

Photo 6 Arboreal camera trap set up

Nocturnal frog surveys

During the 2019 spring survey event, a total of 26 creeks were characterised for habitat considered potentially to support threatened frogs. Of these, eight were suitable for targeted frog survey. This is largely due to the prevalence of first order streams within the development footprint, providing a lack of permanent water even during optimal rainfall conditions.

Spotlighting and call playback surveys were conducted at sites identified as frog habitat and were damp or containing water at the time of survey.

Frog surveys were undertaken in spring 2019 and autumn 2020 and included:

- 18-21 November 2019 - Areas of potential habitat in the within the windfarm corridor were surveyed as follows:
  - 6 nights watercourse spotlight / call-playback / active search transect, including 300m, 250m, 500m transects.
  - 4 nights spotlight / call-playback / active search dam surveys.
  - 6 nights spotlight / call-playback / active search pool surveys.
- 23-25 March 2020 - Wombramura Creek (transmission line corridor) was surveyed over 3 x 2 nights watercourse spotlight / call-playback / active search transect over approx. 200m of creekline.

All frog survey and habitat assessment locations are shown on Figure 12.

Koala Spot Assessment Technique (SAT) surveys

SAT surveys are the Commonwealth recommended survey method used to determine the presence/absence of Koalas across the assessment area, the activity levels to determine resident aggregation and/or transient sites, the population density and size, and habitat availability. Searches are undertaken to identify direct/indirect evidence of activity of Koala including evidence of scats or characteristic, scratches on the trunks of trees. Preferred Koala feed trees will be recorded during flora surveys (i.e. Ribbon Gum Eucalyptus viminalis) and during the habitat feature surveys.

All SAT surveys were undertaken between the 24-28 February 2020 within the subject land and 11-15 May 2020 within the transmission line corridor. SAT surveys are recommended by the Commonwealth DAWE to assess Koala activity levels within the project area. Additional targeted surveys for Koala were also carried out through the deployment of terrestrial and arboreal camera traps, with confirmed photos of the species obtained in March 2020 (Photo 18).

The location of Koala SAT surveys is provided on Figure 12.

Microbat surveys and monitoring

Ultrasonic bat detectors were deployed at a total of 24 locations across the windfarm corridor for a total of up to 1,268 trap nights. Detectors were deployed between 26-29 February 2020 and collected between late March and early May 2020. Five units were relocated within the site in April 2020, when batteries and memory cards were also checked and replaced. An example of a ground-deployed detector used on the site is shown in Photo 7 to Photo 9 and all microbat detectors are shown on Figure 12.

Photo 7 Ground-deployed acoustic detectors

Photo 8 Met mast deployed acoustic detector at head height

Photo 9 Met mast deployed acoustic detector at aerial height

During the 2019 spring survey, an acoustic/ultrasonic transect assessment for threatened microbats was conducted between 19 – 21 November 2019 (three nights), targeting a variety of habitats such as open-space areas, open waterbodies, riparian corridors, vegetated edges, hollow-bearing trees and areas with rocky outcrops and overhangs that are suitable for foraging and roosting. These habitat types were characterised throughout the day and then subsequently surveyed during the evening.

The transects were approx. 1 hour each and on average 1 kilometre long with a range of 100 metres either side. This rapid assessment method was a preliminary survey to provide a perception of species richness and abundance throughout the assessment area and refine areas to primarily target during the summer survey event, where acoustic detectors were deployed.

The handheld acoustic equipment (Echo Meter 2 with a directional microphone – Wildlife Acoustics) using live mode and Real Time Expansion (RTE) function, allowed the observer to simultaneously view the spectrogram and identify bat species in audible (transformed data) and ultrasonic frequencies. Species were identified using the app compatible with the recording device (Echo meter) and in most cases; the species was identified via spotlight. The acoustic data was reviewed and cross-referenced using Kaleidoscope analysis software, the observers personal call library and Bat Calls of New South Wales (Pennay et al. 2004).

Further microbat survey was undertaken to assess for impacts relating to the likelihood of bat species being impacted by turbine strike and possibly barotrauma, the rate of impact per turbine per year, and the impacts to the bioregional populations. This relates not only to bats resident within (or adjacent to) the assessment area, but those that may fly through the site from surrounding habitats, such as local cave/karst systems.

Additional surveys consisted of deployment of acoustic devices on three meteorological masts within the assessment area to determine the activity level of bats at different elevations. Consultation was undertaken with BCD in order to confirm the suitability of the location of the masts, height and number of data points suggested.

Three acoustic detectors were deployed per meteorological mast at heights of 10 metres, 30 metres and 60 metres (Figure 11). These detectors were fitted with an omni-directional microphone capable of detecting and recording calls within a 100m radius in all directions. This capability allowed the detection of calls from ground level to a total height of 160m, capturing a large area within the potential rotor swept path of the wind turbines.

Additional acoustic devices were deployed within three separate karst cave systems identified within or nearby the assessment area. All acoustic devices on the met masts and within the karst systems in wider landscape were deployed between the 8-9 April 2020 and were collected on the 11-15 of May 2020.

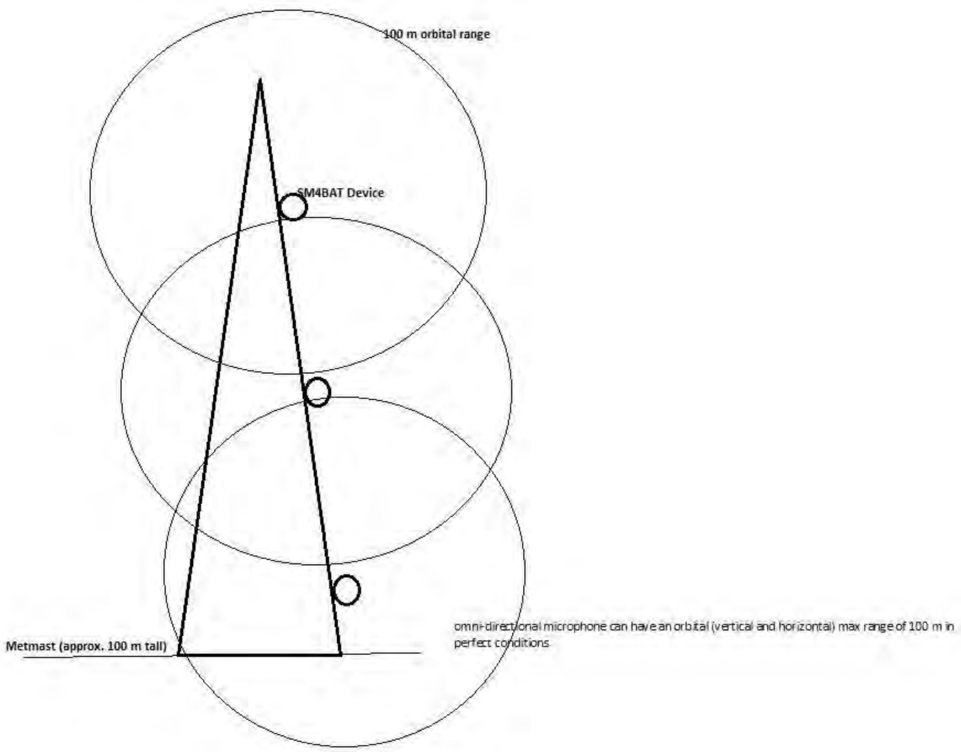


Figure 11 Schematic diagram of installation of acoustic bat detectors on meteorological masts

Additional on ground assessment of areas identified as potential microbat roost habitat was then undertaken between 29 March and 1 April 2021, by two zoologist staff over 80 person hours. High priority areas were able to be visually inspected from the nearest accessible point. Due to the large size of the subject land, not all areas previously mapped as potential habitat were able to be ground-truthed, and a sampling approach was undertaken. However, suitable conclusions were able to be reached for all areas not visited on ground based on the results of the desktop assessment and extrapolation of ground observations across other areas of the development footprint. Further detail is provided in Section 5.4.2.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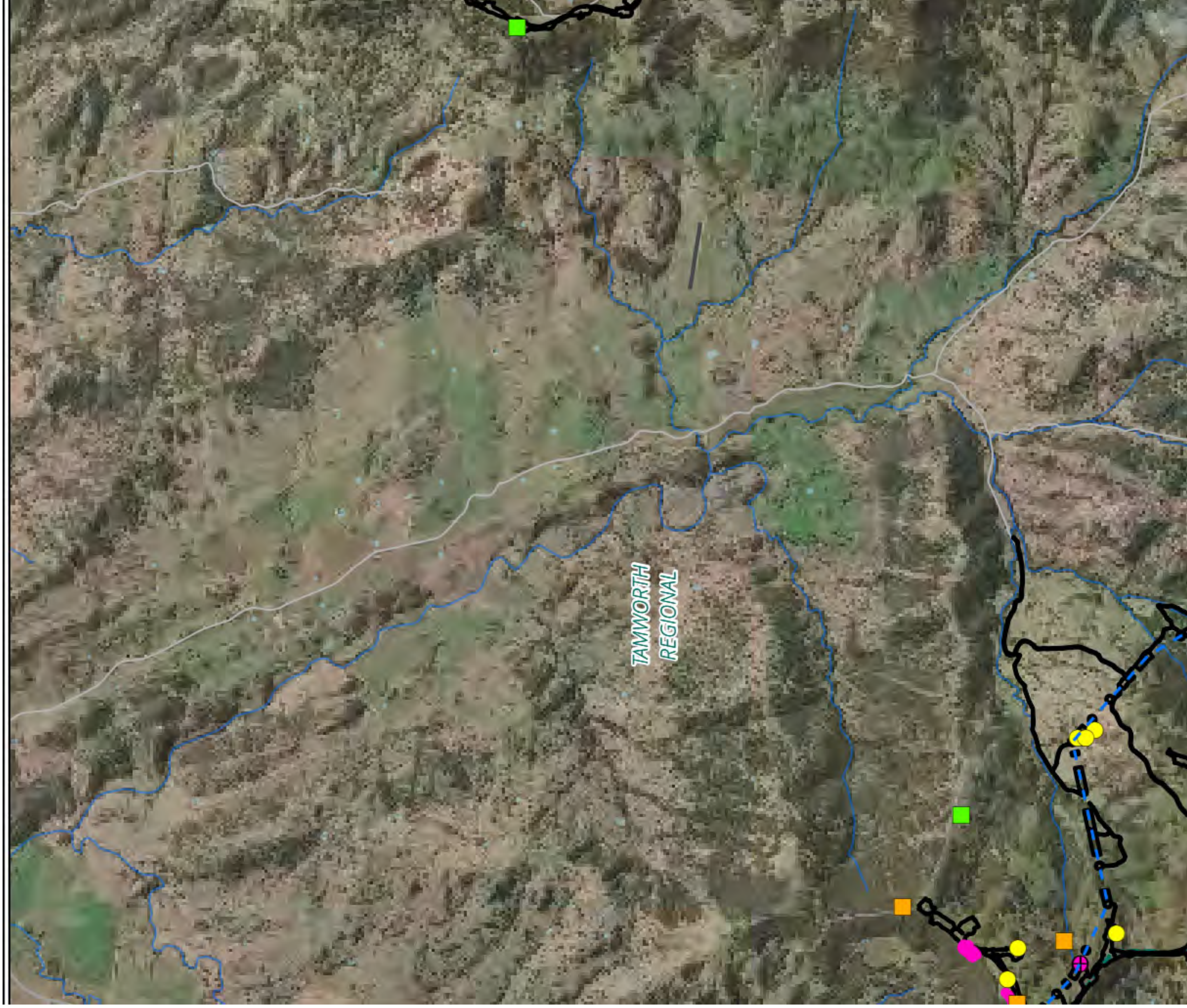
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5.4 Threatened species results

5.4.1 Threatened flora

One threatened flora species, Broad-leaved Pepperbush *Tasmannia purpurascens*, was identified within the project area, as detailed in Table 32. The species was recorded in two locations adjacent to the north-eastern section of the wind farm infrastructure section of the development footprint, as shown in Figure 13. They were not recorded within the development footprint.

The northern-most record of this species was located in an area of PCT 934, with Messmate *Eucalyptus obliqua* as the dominant canopy tree and an open shrub cover with Broad-leaved Pepperbush being locally abundant in areas. The second, more southerly record for Broad-leaved Pepperbush was within an area of good quality PCT 1194 dominated by Snow Gum *Eucalyptus pauciflora* with a grassy understory and an open shrub layer. The development footprint avoids direct impacts to both of these recorded locations of Broad-leaved Pepperbush.

Table 32 Threatened flora identified in the assessment area

Scientific name	Common name	EPBC Act Status	BC Act Status	Count
Tasmannia purpurascens	Broad-leaved Pepperbush	-	V	10


Hanging Rock
Morrisons Gap Road

5.4.2 Threatened fauna

Survey results - bird utilisation survey and diurnal bird survey

The raw data from all bird utilisation surveys, including survey location, species names, abundance, vertical and horizontal distances and flying directions are provided in the Collision Risk Model Report in Appendix D.

During the bird utilisation surveys, 51 bird species were recorded with 18 of these species recorded flying at the maximum rotor swept height of 230m (Table 33). During the bird utilisation surveys, 224 bird movements (flights) were recorded comprising 33 different bird species. Of the 224 flights recorded, 190 (or 85%) were recorded at between 5 and 20 metres vertical distance (height), indicating that the majority of bird activity within the development footprint will not be at risk of blade strike.

Table 33 Bird species recorded flying at rotor swept height

Common name	Species name
Brown Goshawk	*Accipiter fasciatus*
Galah	*Cacatua roseicapilla*
Nankeen Kestrel	*Falco cenchroides*
White-browed Treecreeper	*Climacteris affinis*
Australian Magpie	*Gymnorhina tibicen*
Yellow-tailed Black- Cockatoo	*Calyptorhynchus funereus*
Laughing Kookaburra	*Dacelo novaeguineae*
Red Wattlebird	*Anthochaera carunculata*
Spotted Pardalote	*Pardalotus punctatus*
Common Starling	*Sturnus vulgaris*
Rainbow Lorikeet	*Trichoglossus haematodus*
Crimson Rosella	*Platycercus elegans*
Little Wattlebird	*Anthochaera chrysoptera*
Pied Currawong	*Strepera graculina*
White-breasted Woodswallow	*Artamus leucorynchus*
Australian Raven	*Corvus coronoides*
Sulphur-crested Cockatoo	*Cacatua galerita*
Wedge-tailed Eagle	*Aquila audax*

In the interests of ensuring a conservative assessment, the impact assessment for bird collision risk assumes that all bird species that were recorded flying within the rotor swept height, even if only a single flight was recorded at this height. When the average flight heights are assessed, the majority of these 18 species were flying below the rotor swept height in most recorded flights (Figure 14).

The average flight heights shows that only four species have an average recorded flight height that is within the rotor swept height, including Australian Raven, Brown Goshawk, Wedge-tailed Eagle and White-breasted

Woodswallow. This indicates that for most flights, there are only a small number of native birds that are considered at risk of collision with turbines.

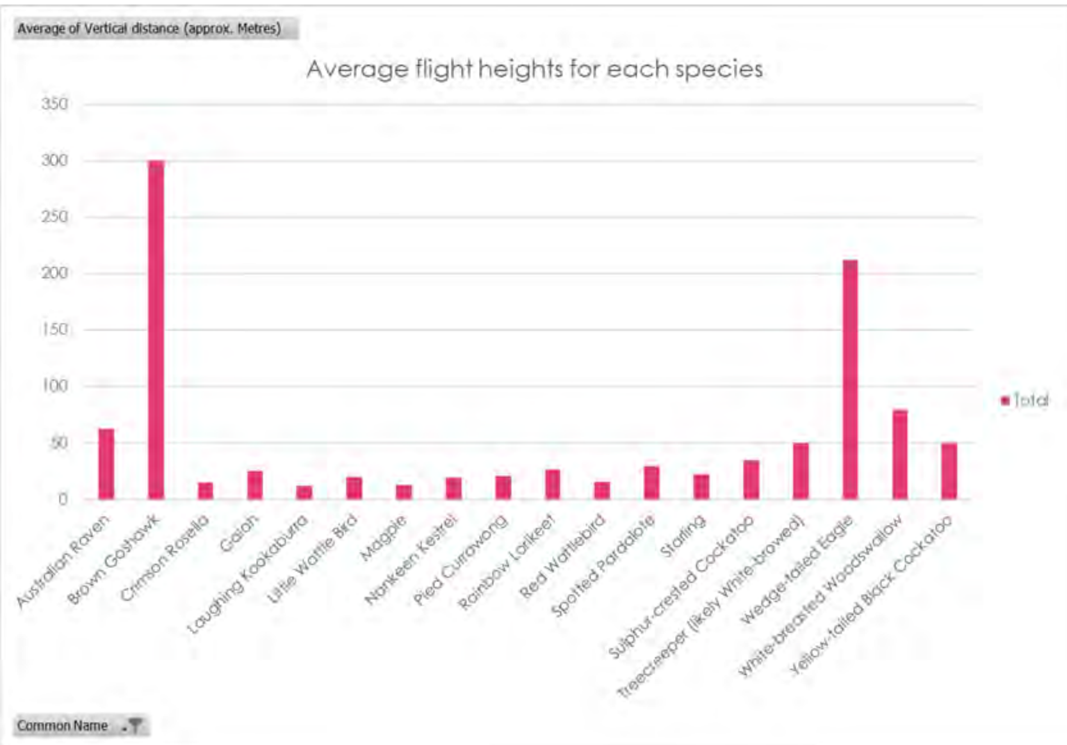


Figure 14 Average flight height for bird species recorded flying within rotor swept height

This list of at risk species is based on flight height and number of observed movements. All of the birds considered most at risk of collision with turbines are listed as least concern under the NSW BC Act and are not listed as listed threatened species or migratory species under the EPBC Act.

Regarding other diurnal, winter-specific threatened bird species that were assessed as having the potential to occur in the subject land with Glossy Black Cockatoo *Calyptorhynchus lathami*, listed as vulnerable under the BC Act, were considered unlikely to utilise the site for breeding, but suitable locations for breeding and foraging were observed down slope of the western section of the wind farm transmission line development footprint. Despite survey during suitable seasons and climatic condition, no Glossy Black Cockatoos were observed.

There were no records of Little Eagle *Hieraaetus morphnoides* during the diurnal bird surveys and no stick nests were recorded, suggesting areas of suitable habitat were not currently being utilised for breeding. There were also no records of Swift Parrot *Lathamus discolour* during the diurnal surveys and there is also a lack of preferred foraging trees within the subject land. Swift Parrot breed in Tasmania from September to January, meaning breeding habitat for this species is not a consideration for this project and field surveys are sufficient to rule out presence as a foraging species.

Nocturnal bird surveys and spotlighting

During all targeted surveys for threatened owls no response was detected for the species targeted, despite targeted call playback searches in areas considered to be good habitat. Habitat for these threatened owls was focused on areas within and adjacent to the development footprint.

The subject land is only considered likely to support potential large forest owl breeding habitat in the wetter forested gullies/drainage lines on the three "fingers" and with only low-moderate potential. The majority of the site is not suitable for owl breeding due to a lack of sheltered gullies, existing disturbances associated with clearing and agricultural land use and highly edge-effected patches of vegetation.

It is noted that in undertaking a total of four nights of targeted call-playback surveys for forest owls, the assessment was unable to meet the 90% probability requirement outlined in the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004 (DEC 2004) to exclude the species presence. As such determination of suitable areas of owl breeding habitat within and immediately surrounding the development site has been undertaken and the presence of Barking Owl, Powerful Owl, Masked Owl and Sooty Owl has been assumed in these areas (where applicable). Details on the parameters used to model potential owl breeding habitat impacted by the project (in accordance with the BAM) are provided in Section 5.5.

Notwithstanding the lack of owls detected during the nocturnal surveys, Table 34 below shows the threatened fauna that were detected during spotlighting surveys. A total of three threatened mammals were detected over all survey periods.

Table 34 Threatened fauna detected during spotlighting

Scientific name	Common name	EPBC Act status	BC Act status	Survey period identified
Phascolarctos cinereus	Koala	V	V	Stage 2 winter survey
Petauroides volans	Greater Glider	V	V	Stage 2 winter survey, Stage 2 spring survey
Dasyurus maculatus	Spotted-tailed Quoll	V	V	Stage 2 winter survey (road kill individual)

Hollow-dependent birds and raptors

Areas of high densities of hollows, fallen timber large trees and an intact understorey were mapped as part of the PCT condition classification, with areas in high condition providing fauna habitat to be targeted for threatened birds.

These areas are not large in the context of the whole site, although these areas are high priority for avoidance of impacts. These areas are also most intact in terms of vegetation structure, and as such likely represent the highest condition vegetation present.

These areas were targeted in the spring and summer survey events, due to the potential importance of these areas. During the field surveys no stick nests or threatened diurnal birds were observed within the development footprint.

Nocturnal frog surveys

During the field surveys no threatened frogs were recorded (Table 35).

Table 35 Frogs identified during nocturnal frog surveys

Creek/Dam	Survey Methods	Results
HoGCP06	One 200m transect within windfarm development area, surveyed on two separate nights by two ecologists, call play back conducted along transect	No frogs found

Creek/Dam	Survey Methods	Results
	for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*.	
HoGCP07	One 200m transect within windfarm development area, surveyed on two separate nights by two ecologists, call play back conducted along transect for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*.	Night 1: 1x *Litoria verreauxii* (observed) Night 2: 1x *Litoria verreauxii* (observed)
HoGCP07g	Survey conducted around the perimeter of the dam on two separate nights by two ecologists, call play back conducted during survey for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*.	Night 1: 2x *Litoria peronii* (heard) Night 2: 1x *Litoria peronii* (heard & observed)
HoGCP07h	Survey conducted around the perimeter of the dam on two separate nights by two ecologists, call play back conducted during survey for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*. Tadpoles captured with non-abrasive net and photos taken for identification.	Night 1: 1x *Litoria verreauxii* (heard), several L. *verreauxii* tadpoles identified Night 2: 1x *Litoria verreauxii* (heard), several *L. verreauxii* tadpoles identified
HoGCP22 (Woodleys Ck)	One 200m transect within and immediately downstream of windfarm development area, surveyed on two separate nights by two ecologists, call play back conducted along transect for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*. --------- Survey conducted around the perimeter of large dam located upstream of transect on two separate nights by two ecologists, call play back conducted during survey for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*.	Night 1: 1x *Litoria peronii* (heard & observed) Night 2: 1x *Litoria peronii* (heard), 1x *Crinia signifera* (observed) -------- Night 1: 3x *Litoria peronii* (heard & observed) Night 2: Multiple Litoria peronii (heard), 4x *Litoria peronii* (observed), Multiple *Crinia signifera* (heard), 3x *Crinia signifera* (observed)
HoGCP24	Survey conducted around the perimeter of the pool on two separate	No frogs found

Creek/Dam	Survey Methods	Results
	nights by two ecologists, call play back conducted during survey for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*. Tadpoles captured with non-abrasive net and photos taken for identification.	
HoGCP26	Survey conducted around the perimeter of the pool on one night two ecologists, call play back conducted during survey for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*. Tadpoles captured with non-abrasive net and photos taken for identification.	No frogs found

Microbats

Bat call analysis was completed from the data collected on the 25 separate detector units over a total of 257 'trap nights', ranging from between 2 nights to 38 nights per detector, with nearly 25,000 calls identified containing over 32,000 passes. Data analysis was undertaken across the temporal range of the survey period, with total 'trap nights' analysed per month including:

- November 2019 – 2 nights
- February 2020 – 49 nights
- March 2020 – 94 nights
- April 2020 – 87 nights
- May 2020 – 25 nights

Bat calls recorded were analysed using a combination of two separate call identification software programs, AnaScheme and Anabat Insight, due to the software requirements of the different detector units used in the survey.

Bat calls were identified to genus or species level using automated call identification software, AnaScheme (Adams et al. 2010) and a key developed for North-western NSW (unpublished data – K. Asplet and M. Gibson). Calls with fewer than three valid pulses (i.e. minimum of six data points and model quality of >0.8) are not analysed by AnaScheme due to a paucity in data and are assigned as 'unknown'. Because multiple bat species may call simultaneously, calls were assigned to a single species only if > 50% of pulses within a sequence are assigned to that species, and only passes with a minimum of three pulses classified to the same species were identified. Lower frequency calls, such as those produced by Southern Myotis and Freetail bats, cannot be distinguished using AnaScheme, and lower frequency calls were manually identified. Long-eared bat calls are only able to be identified to genus, due to the linear nature of the calls produced.

Additional call analysis was undertaken using Anabat Insight software and relevant published reference call guides (Pennay, Law, & Reinhold 2004). Analysis was run through a custom decision tree created for the project, to remove noise (frequencies below 7kHz) and files/passes with less than three pulses (as above). The decision tree was then run using characteristic frequency and duration to identify calls to genus, or species level where possible. Calls identified by the system as significant or uncommon species were checked manually against visual comparison of sonograms with published reference calls by an experienced bat expert (Pennay, Law, & Reinhold (2004)), to ensure accurate results. In addition, a subset calls were chosen for manual vetting from each species/genus grouping for quality assurance of data.

Microbat acoustic survey results

Bat call activity was found to occur throughout the project area, with 28 species identified to species level from data recorded across 25 acoustic detectors deployed during field surveys (Table 36). The majority of the species recorded were not threatened species listed under the BC Act or the EPBC Act, with 20 least concern species detected.

A total of 28 species is considered to represent a high level of species diversity within the local microbat population. The species with the highest mean calls per night recorded across the site as a whole is the White-striped Freetail Bat *Austronomus australis*, a common bat found throughout most of Australia, with an average of 46.3 calls recorded per night of data analysed. Next most common species include Inland Free-tailed Bat *Ozimops petersi* at 14.3 calls per night and then the BC Act listed threatened species Large Bent-wing Bat *Miniopterus orianae oceanensis* with 10.3 calls detected per night of data analysed. These are considered to be relatively high levels of call activity for each species.

Generally, microbat species known to be dependent (or at least partially dependent) on caves for roosting were less commonly recorded than non-cave dwelling species with just three cave dependent/utilising species, Large Bent-wing Bat, Eastern False Pipistrelle *Falsistrellus tasmaniensis* and Little Pied Bat *Chalinolobus picatus* among the 14 most commonly recorded species. With the remaining five cave dependent/utilising species recorded, occurring at levels among the 14 least commonly recorded bats.

Table 37 provides details of the mean number of calls recorded per night, per species, per detector deployed across the project area. Mean calls per night provides an indication of microbat activity within project area and provides insight into the nature and make-up of the local bat population. Call data can be used to infer how microbats are utilising a site based on analysis of variables such as the time a call has been recorded, the presence of calls on detectors deployed at various elevations, and the presence and relative abundance of species' calls across a temporal scale. Analysis of call data does not allow for the size of a bat population to be determined as a single recorded call does not equate to an individual bat, as a single individual can be responsible for multiple calls recorded on a detector (or multiple detectors). This is a known limitation of acoustic surveys for microbats.

Additional analysis of a number of previous un-analysed nights of data has been able to be undertaken following agency responses. This has been done to provide further detail on the extent and nature of the microbat populations within project area. Furthermore, it should be noted that in re-analysing the microbat call data a small number of mathematical errors were realised and have been corrected. These relate largely to the calculation of mean number of calls per night / detector for the most commonly recorded bat species (White-striped Freetail Bat) during call data analysis, and the total number of nights' data analysed for the November 2019 Echometer transect survey.

Table 36 Detailed summary of bat detector data listing mean number of calls per night per detector. Detectors were placed in a range of habitats around the P
the area

Species	Detector Number																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	MM1 – 2m	MM1- 30m	MM1 - 60m
White-striped free-tailed bat *Austronomus australis*	25.73	173.00	48.43	116.00	1.00	14.33	27.00	25.10	13.50	20.50	5.67	3.00	31.50	56.50	141.25	88.25	38.50	20.72
Large-eared Pied Bat *Chalinolobus dwyeri #**	0.36	0.00	0.04	0.50	0.00	0.67	1.33	0.40	0.00	0.10	0.17	2.00	0.75	5.33	0.00	7.25	1.50	0.06
Gould's Wattled Bat *Chalinolobus gouldii*	14.36	14.75	9.14	6.50	0.75	6.33	9.67	13.80	17.20	3.80	15.17	7.00	9.00	27.00	5.50	15.50	4.00	2.25
Chocolate Wattled Bat *Chalinolobus morio*	0.09	10.00	0.32	8.00	0.00	3.50	6.50	0.10	0.40	0.60	0.33	2.00	6.25	24.00	5.75	7.00	0.17	0.00
Little Pied Bat *Chalinolobus picatus +**	1.00	4.00	0.11	12.50	0.25	5.67	14.50	1.10	0.00	0.00	0.00	8.00	3.75	5.17	5.00	15.50	5.00	0.16
Eastern False Pipistrelle *Falsistrellus tasmaniensis* +*	9.64	0.50	1.07	0.00	0.00	0.50	0.00	9.00	7.70	4.20	0.50	0.00	0.00	2.17	1.25	0.00	0.17	1.06
Eastern Coastal Free-tailed Bat	30.91	0.00	0.00	0.00	0.00	0.00	0.00	32.10	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38

Species	Detector Number																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	MM1 – 2m	MM1-30m	MM1 - 60m
Myotis ***Myotis macropus #****																		
Lesser Long-eared Bat ***Nyctophilus geoffroyi***	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nyctophilus **sp.**	5.45	2.00	1.75	3.00	0.00	0.67	0.50	5.00	2.60	2.30	0.33	0.00	2.50	4.17	0.75	0.25	0.33	0.19
Northern Free-Tailed Bat ***Ozimops lumsdenae***	0.00	0.75	0.46	0.00	0.00	0.00	0.00	0.00	2.80	0.10	0.00	0.00	0.00	0.00	0.25	0.50	0.00	0.25
Inland Free-tailed Bat ***Ozimops petersi***	0.00	50.50	0.00	15.50	0.00	7.00	51.67	0.00	0.00	0.00	1.50	0.00	64.50	22.00	67.50	26.50	14.00	0.00
South-eastern Free-tailed Bat ***Ozimops planiceps***	0.00	8.00	0.00	2.00	1.75	10.50	4.33	0.00	0.00	0.00	1.33	0.00	11.50	16.00	1.25	3.75	1.67	0.00
Ride's Free-Tailed Bat ***Ozimops ridei***	0.09	0.00	3.82	0.00	0.00	0.00	0.00	0.10	0.80	1.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.59
Golden-tipped Bat ***Phoniscus papuensis***	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Species	Detector Number																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	MM1 – 2m	MM1- 30m	MM1 - 60m
Bat *Scoteanax rueppellii*																		
Scotorepens balstoni	0.00	0.25	0.00	0.00	0.25	0.00	0.17	0.00	0.00	0.00	0.83	0.00	0.00	0.83	0.00	0.00	0.17	0.00
Scotorepens greyii	3.09	13.00	5.25	6.00	0.00	2.83	15.67	3.20	0.20	0.30	0.17	0.00	4.00	9.67	5.25	3.50	0.67	6.00
Scotorepens orion	0.00	0.00	5.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vespadelus darlingtoni	5.18	9.25	8.00	0.00	0.00	0.83	10.67	5.20	7.80	4.10	0.67	0.00	9.50	8.50	7.50	0.00	0.50	0.03
Vespadelus regulus	0.00	4.75	0.04	32.00	0.00	7.17	12.67	0.00	0.00	0.00	1.17	0.00	0.25	1.83	0.50	0.00	0.33	0.00
***Vespadelus* sp.**	0.00	0.00	0.00	0.50	0.00	0.00	2.50	0.00	0.00	0.00	0.50	0.00	0.00	0.50	0.00	4.50	0.17	0.00
Eastern Cave Bat *Vespadelus troughtoni #**	0.00	0.25	0.00	0.00	0.00	0.83	7.83	0.00	0.00	0.00	0.00	0.00	0.50	2.17	0.25	1.00	0.33	0.00
Vespadelus vulturnus	0.55	0.00	0.93	40.00	0.00	11.17	20.83	0.50	0.70	0.10	0.83	0.00	2.00	7.33	9.25	4.00	7.33	0.00

Assessment of microbat activity at different elevations

Acoustic detectors were deployed at varying elevations on meteorological masts (met masts) across the project area to allow for the relative abundance of microbat species flying at different heights to be determined. This analysis is critical to determine the potential impacts of the project with regards to blade strike and possibly barotrauma.

Acoustic detectors deployed at ground level were most common and comprise 19 of the 25 detectors deployed. Ground level detectors were found to have recorded similar results to the project area as whole, with the top three species recorded (based on mean calls per night) including White-striped Freetail Bat, Inland Free-tailed and Large Bent-winged Bat, with non-cave dependent species again more frequently recorded. For detectors mounted on met masts at canopy height (three detectors at approximately 30 metres above the ground) White-striped Freetail Bat and Inland Free-tailed Bat were again the most common, with *Scotorepens greyii* the third most commonly recorded, and Large Bent-winged Bat fourth ranked. Most commonly recorded species flying above canopy (three detectors deployed approximately 60 metres above the ground) again include White-striped Freetail Bat and *Scotorepens greyii*, with Ride's Free-Tailed Bat *Ozimops ridei*, Gould's Wattled Bat *Chalinolobus gouldii* and the BC Act listed Greater Broad-nosed Bat *Scoteanax rueppellii* among the top five most commonly recorded species. It should be noted that the mean number of calls for White-striped Freetail Bat at 60 meters elevation is far greater than the next most common species with a mean of 39 calls recorded per night of data analysed, compared to the next most common species with a mean of 2.8 calls per night.

Other BC Act and or EPBC Act listed threatened species recorded by the detectors deployed at above canopy height (60 metres), and thus within the expected rotor swept area include:

- Little Bent-winged Bat *Miniopterus australis* – Mean of 1.5 calls recorded per night.
- Eastern False Pipistrelle– Mean of 1.1 calls recorded per night.
- Large Bent-winged– Mean of 1.1 calls recorded per night.
- Eastern Coastal Free-tailed Bat *Micronomus norfolkensis* – Mean of 0.6 calls recorded per night.
- Yellow-bellied Sheathtail-bat Saccolaimus flaviventris – Mean of 0.4 calls recorded per night.
- Little Pied Bat – Mean of 0.2 calls recorded per night.
- Large-eared Pied Bat *Chalinolobus dwyeri* – Mean of 0.1 calls recorded per night.

Of the 28 species recorded across the site, 23 were recorded by detectors mounted on meteorological masts at canopy height (30 metres), and 19 recorded at the above canopy level (60 metres). A total of eight species recorded at the above canopy level were recorded with a mean of more than one call per night of analysed data, seven species were recorded with a mean of between 0.7 calls per night and 0.2 calls per night, and the remaining four species were recorded as having a mean of 0.1 calls per night.

There is a general trend for reduced activity levels with increased elevation with ground detectors averaging a total of 130.3 mean calls per night, detectors deployed at 30 metres averaging a total of 107.5 mean calls per night, and detectors deployed at 60 metres averaging a total of 56.0 mean calls per night. Table 37 and Table 38 provide a comparison of total mean activity across the paired detectors deployed at each of the three met masts and illustrates the decrease in activity at higher elevations.

Table 37 Mean calls per night on met mast deployed detectors

Met mast location	2m height	30m height	60m height
MM1	193.8	85.7	37.6

Met mast location	2m height	30m height	60m height
MM2	61.0	185.0	75.2
MM3	98.5	87.5	55.2
Averages	117.8	119.4	56.0

Table 38 Mean calls per night on met mast deployed detectors White-striped Freetail Bat removed

Met mast location	2m height	30m height	60m height
MM1	109.5	47.2	16.9
MM2	18.3	73.4	13.0
MM3	38.5	49.8	21.2
Averages	55.4	56.8	17.0

The above tables also illustrate that with White-striped Freetail Bat included in the analysis, the activity at 60 metres elevation is approximately half that recorded below canopy and at canopy height, whereas with the species removed the relative activity level at 60 metres falls to approximately one third of that closer to the ground. This illustrates that not only is White-striped Freetail Bat the most commonly recorded species across the project area, it is also contributing to a higher proportional representation of the species abundance higher in the air column. Furthermore, it should be noted that White-striped Freetail Bat has a loud, low frequency call that is likely to be recorded from further away, so the detectors are likely to be recording this species from a larger volume of air than for other species.

When the results of the bat detectors installed on met masts are reviewed for the threatened microbats, there is also a similar trend for the majority of species having decreased activity at rotor swept height (Table 39). Generally, activity of the threatened bats at the 60m height was found to be low, with the highest number of mean calls per night recorded being 3.3 for Little Bent-winged Bat. The majority of threatened bats detected recorded less than 1 mean calls per night at each detector installed at 60 metres, with Southern Myotis and Eastern Cave Bat absent from the data at this elevation. The highest activity at met mast sites, based on mean calls of 17.3 (Large Bent-winged Bat) and 15.3 (Little Pied Bat) per night, were recorded at the ground level (2 metre height).

The BC Act and EPBC Act listed Large-eared Pied Bat showed a marked reduction in the mean number of calls per night with increasing height. The species mean nightly activity across all ground deployed detectors was found to be 0.7 calls per night, 0.6 calls per night across detectors deployed at canopy height and less than 0.1 calls per night at 60 metres elevation. A very similar trend was observed for the Little Pied Bat. This suggests that bats of this genus (*Chalinolobus* spp.) prefer to forage below canopy height.

The two bent-wing bat species belonging to the genus *Miniopterus*, Greater Broad-nosed Bat and Eastern False Pipistrelle recorded the highest nightly mean calls at the 60 metres height. These species are known to forage above the canopy and for most of the met mast sites there was a greater number of mean calls per night detected at the 30 metres detector height.

Large Bent-winged Bat was the most commonly recorded threatened species with a mean of 10.3 call per night across all detectors. The highest mean nightly calls were recorded at Site 4 with 49 calls per night, this is however only based on data captured for two nights, in late February / early March, with the majority of other detectors recording between 6 and 27.5 calls per night. The species was recorded at all but two sites, with sites representing highest activity spread throughout the development footprint. The species was recorded with highest levels of activity on detectors deployed at ground level, with a mean of 12.39 calls per night, activity was seen to decrease at canopy level by approximately half with a mean of 6.66 calls per night recorded, and activity fell further again at the above canopy (60 meter) elevation where the species was recorded on average at 1.09 calls per night.

Table 39 provides details of all threatened species of microbats and the relative activity at different elevations based on data from paired detectors deployed on met masts. As is the case with Large-eared Pied Bat and Large Bent-winged Bat, activity can be seen to generally decrease with increasing elevation for the majority of species.

Notable exceptions to this, based solely on met mast data are Little Bent-winged Bat, Greater Broad-nosed Bat and Eastern Coastal Free-tailed Bat.

When data collected across the site as a whole is considered Little Bent-winged Bat, it is found to be more active at ground level with 1.15 mean nightly calls, and at above canopy height with 1.53 mean nightly calls recorded, and least active at the canopy level with only 0.25 mean nightly calls recorded. Greater Broad-nosed Bat and Eastern Coastal Free-tailed Bat show the more common trend of decreasing levels of activity with increasing elevation, with calls most commonly recorded at ground level and to a lesser degree at canopy and above canopy levels.

Table 39 Mean calls per night for threatened microbats detected at paired met mast locations

Threatened species	MM1			MM2			MM3		
	2m	30m	60m	2m	30m	60m	2m	30m	60m
Chalinolobus dwyeri #*	7.25	1.50	0.06	0.71	0.26	0.14	1.75	0.50	0.03
Chalinolobus picatus +*	15.50	5.00	0.16	1.00	0.00	0.33	2.50	2.50	0.18
Falsistrellus tasmaniensis +*	0.00	0.17	1.06	0.57	5.03	0.38	0.00	0.00	1.85
Micronomus norfolkensis +	0.00	0.00	0.38	0.00	0.39	1.29	0.00	0.00	0.15
Miniopterus australis #*	0.00	0.00	0.25	0.29	0.74	3.29	0.00	0.00	1.06
Miniopterus orianae oceanensis #*	18.00	3.83	1.63	3.14	13.89	0.24	1.25	2.25	1.39
Myotis macropus #*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Saccolaimus flaviventris+	1.75	7.00	0.13	2.71	0.55	0.33	0.25	0.00	0.76
Scoteanax rueppellii+	0.00	0.00	1.91	0.43	6.53	1.71	0.00	0.00	1.85

Threatened species	MM1			MM2			MM3		
	2m	30m	60m	2m	30m	60m	2m	30m	60m
Vespadelus troughtoni* #	1.00	0.33	0.00	0.00	0.00	0.00	1.75	0.00	0.00

This above data suggests that whilst the majority of species present within the subject land will occur most frequently below canopy or at canopy height, there is also a high number of species, both threatened and non-threatened, that will on occasion fly higher and may be at risk of collision with turbine blades during the operational phase of the wind farm.

Assessment of potential roosting or foraging activity

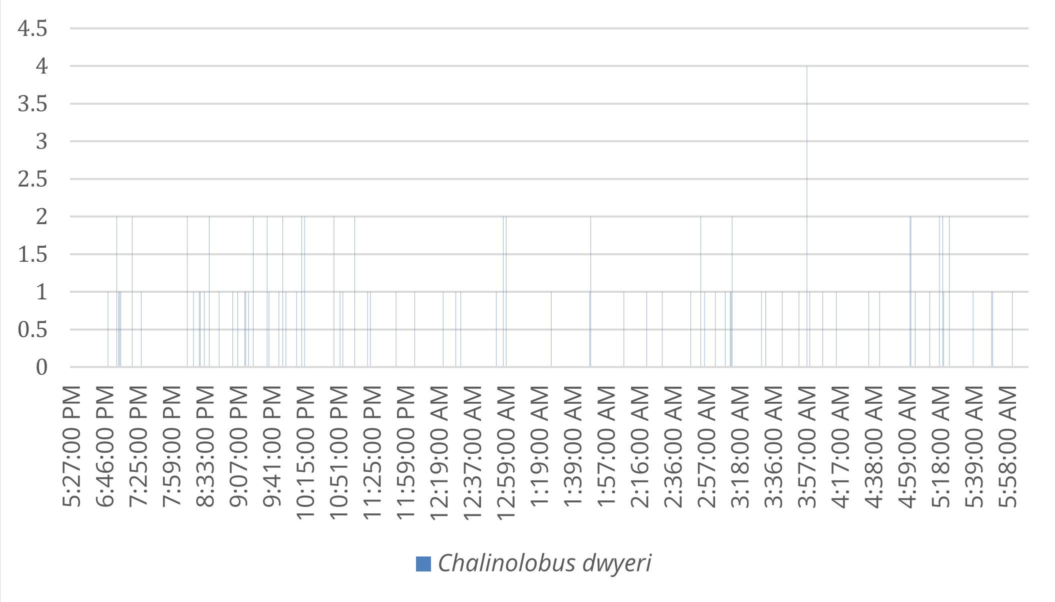
To further determine the nature of the microbat population recorded within the development footprint, analysis of the times calls were recorded has been undertaken. The aim of this analysis is to provide insight into the likelihood of the development footprint and the immediately surrounding landscape to support bat roosts, or whether the microbats recorded on site are travelling form roosts located away from the development to forage. It could be expected that if bats were roosting in close proximity to the development footprint, calls would be consistently clustered towards sunset and sunrise times, when bats are entering/exiting the roost for nocturnal forage activity. Furthermore, if the microbats present within the project area are roosting further from the site, and traveling some distance through the landscape to forage, calls would generally be clustered later into the night.

Table 40 provides times for sunset, end of twilight and sunrise as provided by https://www.timeanddate.com/ for Nundle in 2020.

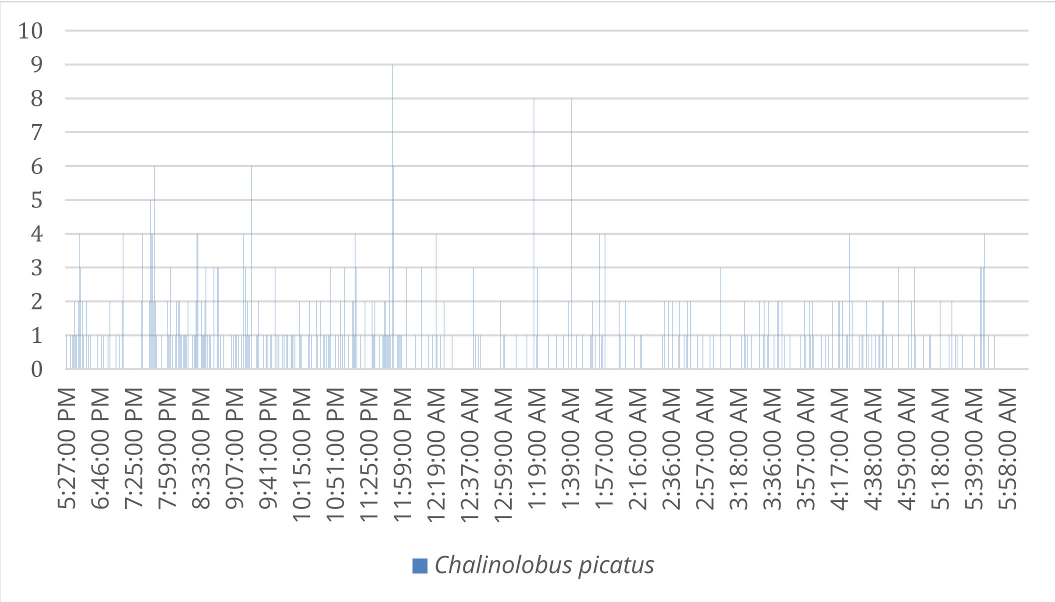
Table 40 Sunset, twilight and sunrise times for February to May 2020

Month	Sunset	End of twilight	Sunrise
February	7:55pm – 7:30pm	8:23pm – 7:55pm	6:20am – 6:44am
March	7:29pm – 6:52pm	7:54pm – 7:17pm	6:45am – 7:06am
April	6:51pm – 5:19pm	7:15pm – 5:44pm	7:06am – 6:25am
May	5:18pm – 5:00pm	5:43pm – 5:26pm	6:26am – 6:45am

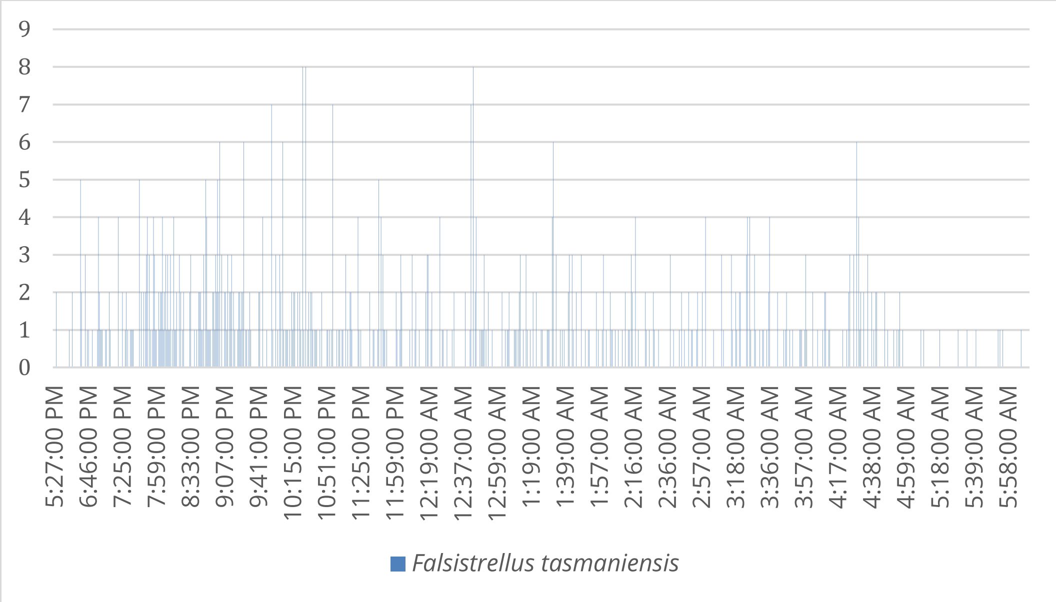
The following graphs have been prepared using the time-stamped call data collected between February and May 2020 and are provided to illustrate the time of night various species of microbats were found to be active within the project area. The first set of graphs relates to cave dependent/utilising species.



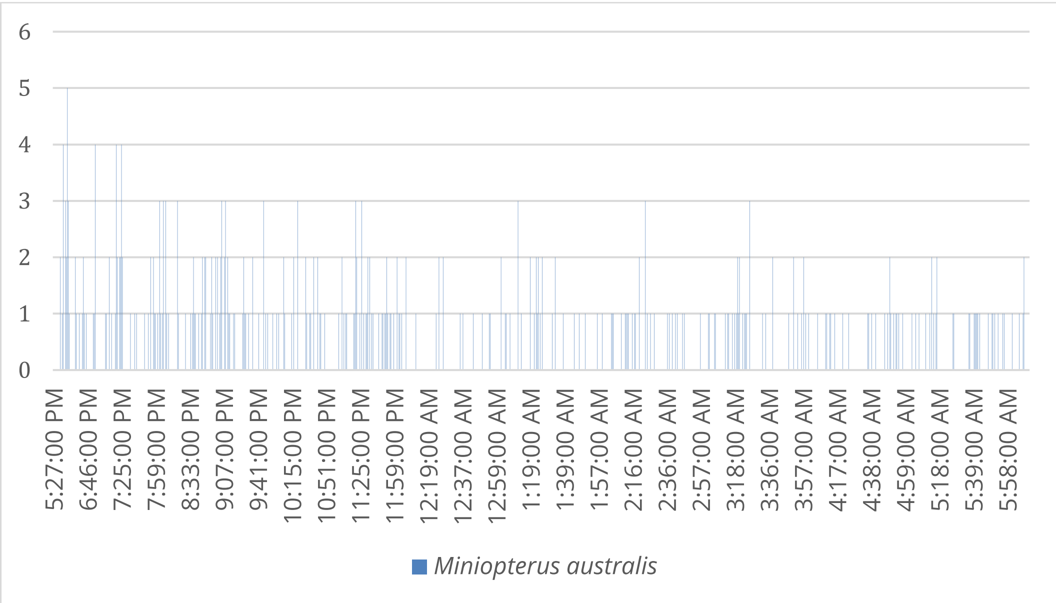
Graph 1 Time range and total number of calls recorded for Large-eared Pied Bat



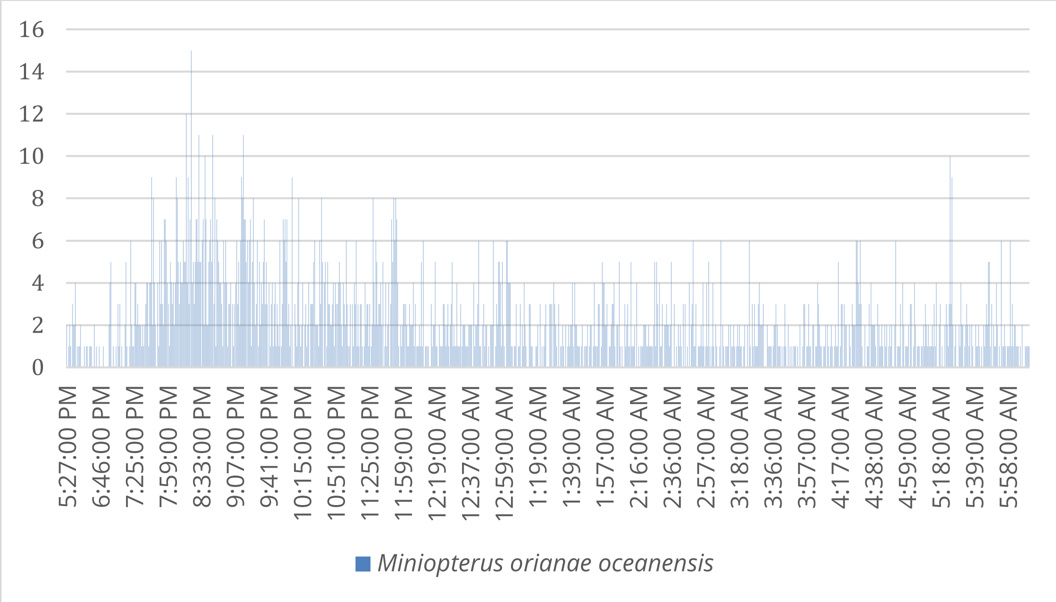
Graph 2 Time range and total number of calls recorded for Little Pied Bat



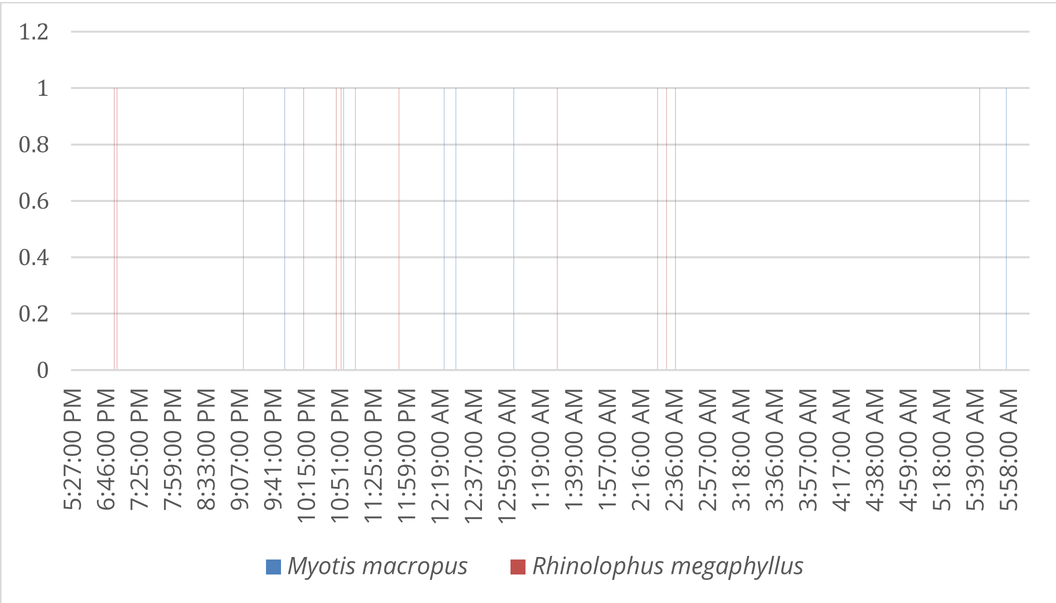
Graph 3 Time range and total number of calls recorded for Eastern False Pipistrelle



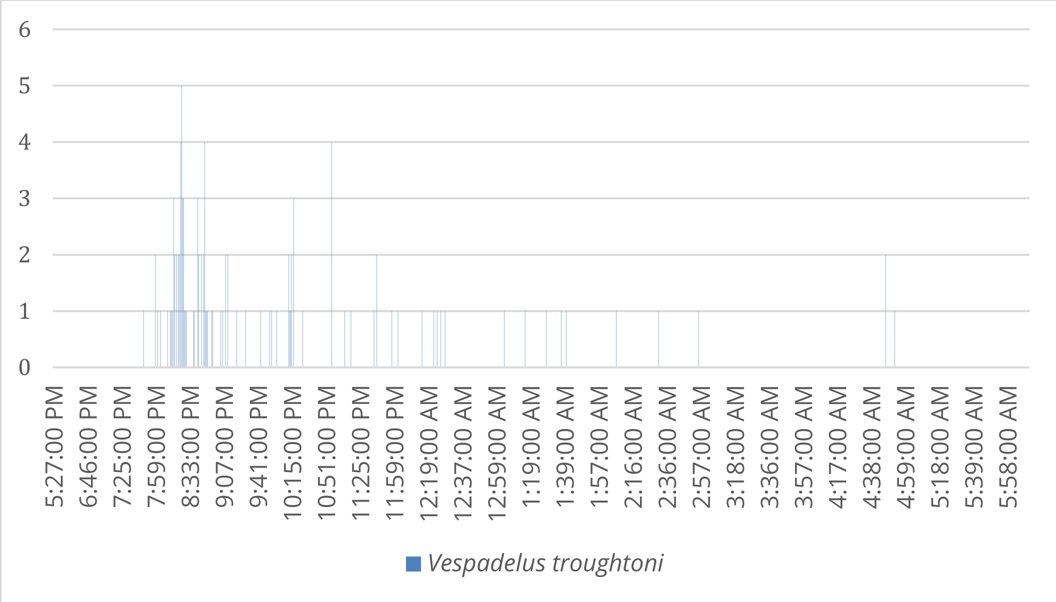
Graph 4 Time range and total number of calls recorded for Little Bent-winged Bat



Graph 5 Time range and total number of calls recorded for Large Bent-winged Bat



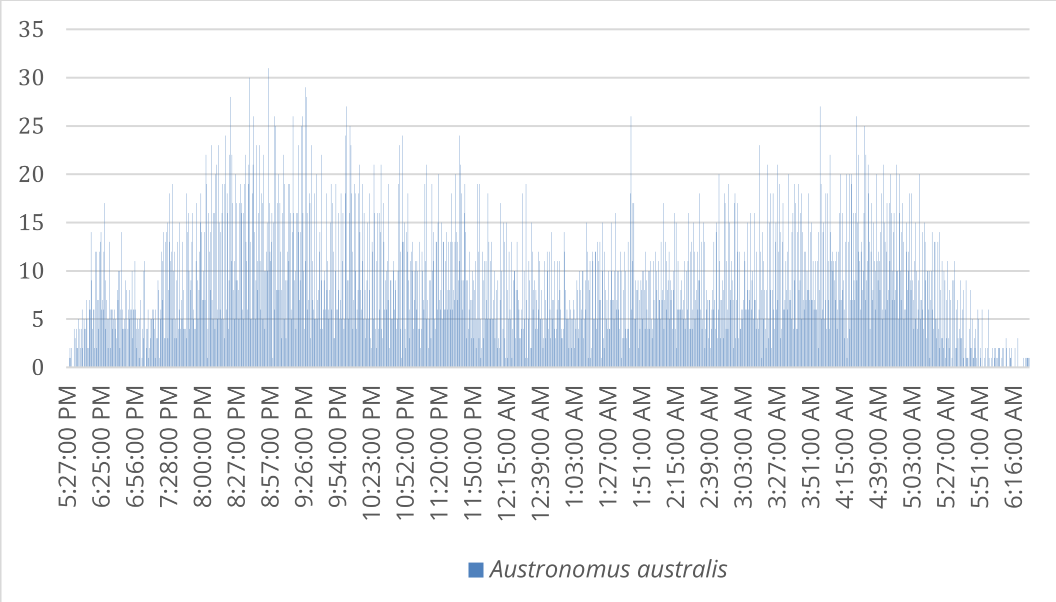
Graph 6 Time range and total number of calls recorded for Southern Myotis and Smaller Horseshoe Bat



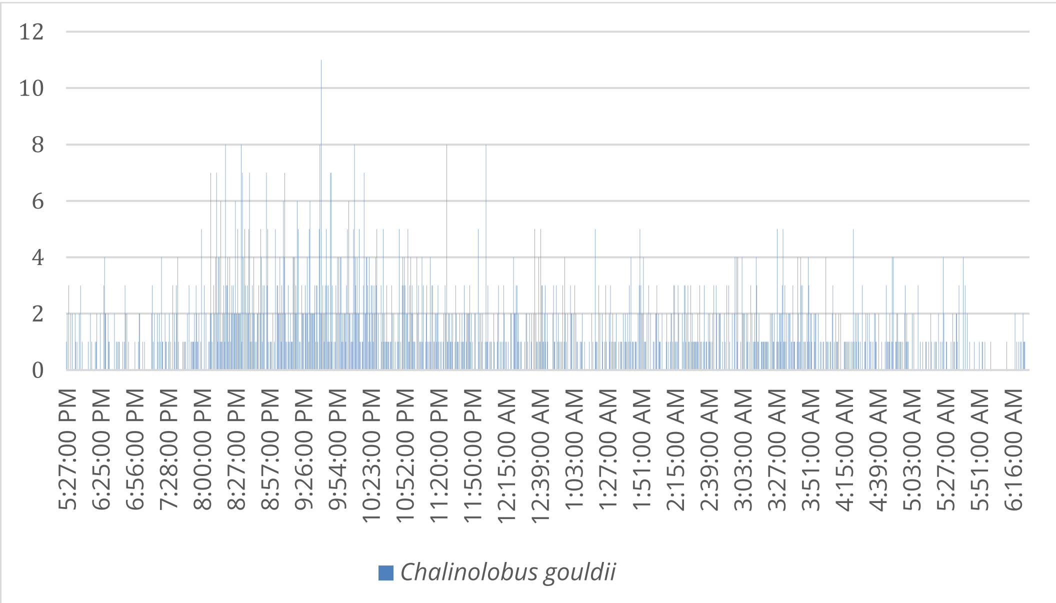
Graph 7 Time range and total number of calls recorded for Eastern Cave Bat

Based on the above graphs of time and number of calls recorded within the project area for cave dependent species, there appears to be a correlation for both Little Bent-winged Bat and Large Bent-winged Bat being commonly recorded on site between 5:30pm and 7:15pm for Little Bent-winged Bat, and 7:15pm and 9:25pm for Large Bent-winged Bat. Whilst this data suggests bats are arriving on site around sunset and end of twilight, the highest number of calls for Large Bent-winged Bat can be seen to be after 8:00pm, well after the end of twilight for the majority of the survey period. Furthermore, other than a total of five additional calls occurring before 7:30pm, call activity for Little Bent-winged Bat is relatively consistent through until 12:00am. Both species' high proportion of calls earlier in the night suggest they may be roosting close by, and only traveling a short distance to the site. This is supported by the presence of the known non-maternity roost for the species at Timor Caves, approximately 5 kilometres to the south of the project area. Both species are commonly recorded throughout the rest of the night, with Large Bent-winged Bat calls showing another minor increase closer to sunrise. Little Pied Bat, Eastern False Pipistrelle and Eastern Cave Bat calls also show some correlation towards the sunset / end of twilight time range however the trends are less apparent.

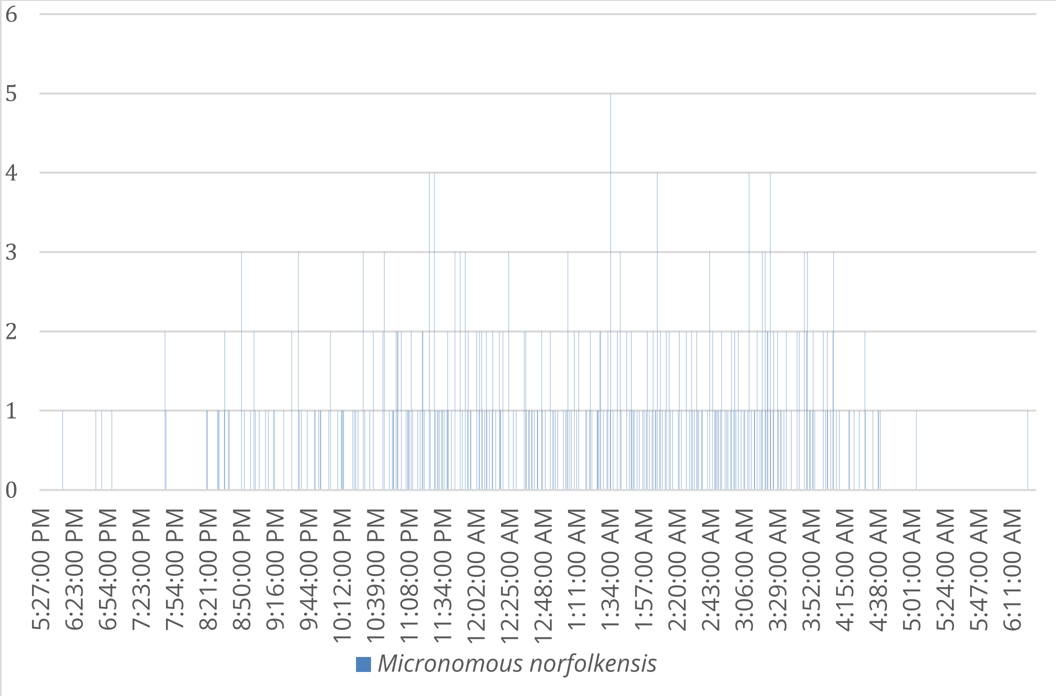
The following graphs provide comparable data for the three most common non-cave dependent microbat species and the remaining three threatened species (non-cave dependents) recorded within the project area.



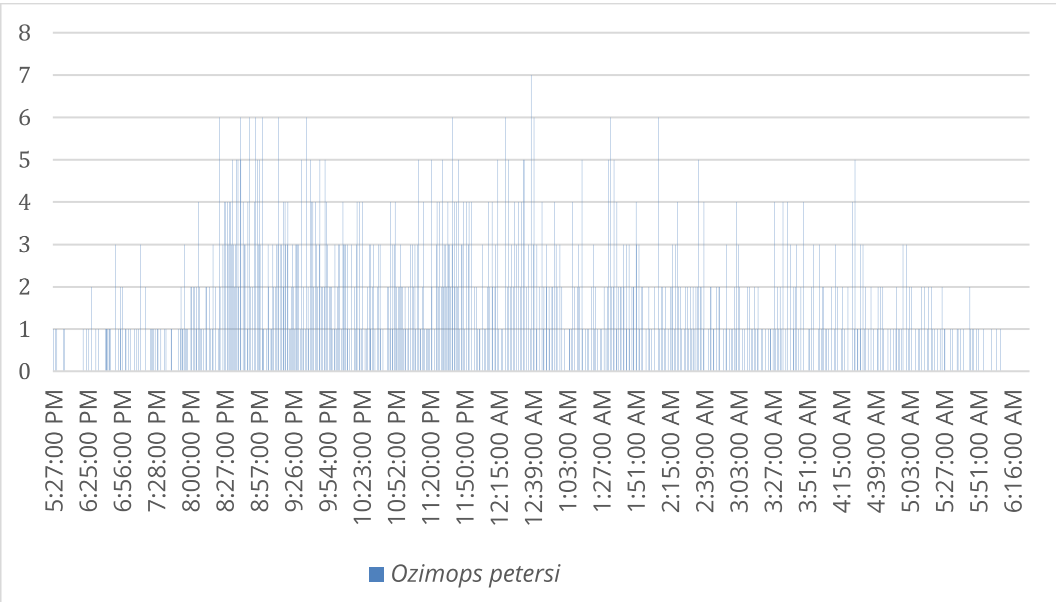
Graph 8 Time range and total number of calls recorded for White-striped free-tailed bat



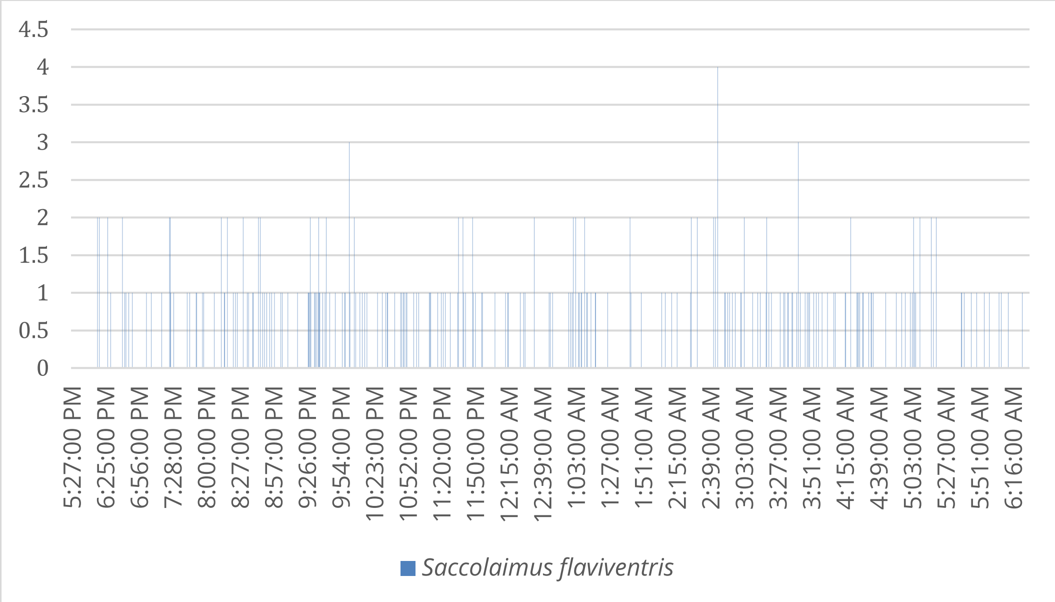
Graph 9 Time range and total number of calls recorded for Gould's Wattled Bat



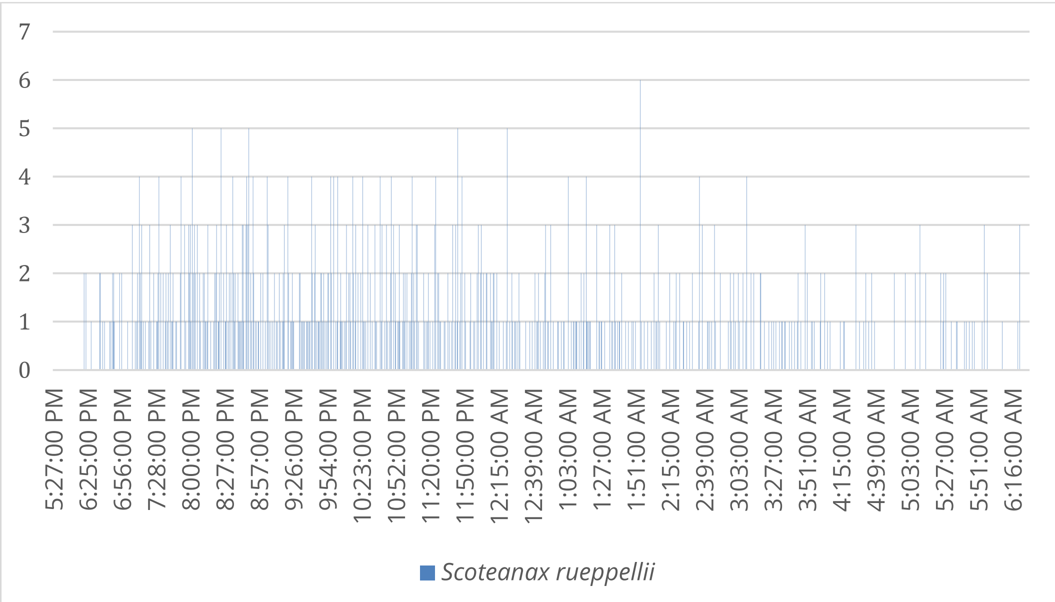
Graph 10 Time range and total number of calls recorded for Eastern Coastal Free-tailed Bat



Graph 11 Time range and total number of calls recorded for Inland Free-tailed Bat



Graph 12 Time range and total number of calls recorded for Yellow-bellied Sheath-tailed Bat



Graph 13 Time range and total number of calls recorded for Greater Broad-nosed Bat

Two of the non-cave dependent bats, the threatened Eastern Coastal Free-tailed Bat and non-threatened Inland Free-tailed Bat, are clearly more active within the project area during the later stages of the night suggesting roosting is occurring elsewhere. Timing of calls recorded for Gould's Wattled Bat and the threatened Great Broad-nosed Bat are somewhat clustered towards the start of the night with most activity found to be occurring between 8:00pm and 9:00pm, however there are also calls reasonably consistently recorded across the remainder of the night. Yellow-bellied Sheath-tailed Bat show no real trend in time of call, with numbers of calls recorded remaining consistent across the night.

The most common bat species recorded during the survey, White-striped Free-tailed Bat, shows a correlation for being recorded on site most commonly between 7:00pm and 10:30pm and again between 3:00am and 5:30am, which suggests roosting may be occurring in the vicinity of the site. However, calls are skewed somewhat away from both sunset / end of twilight and sunrise suggesting roosting may not be within the immediate surrounds. The species is known to roost in tree hollows and an abundance of this habitat type is present within the development footprint and the landscape immediately surrounding, and further afield from, the project area.

Based on the analysis of the time ranges that species' calls were recorded, it is concluded that whilst some species, including Large Bent-winged Bat, Little Bent-winged Bat and White-striped Free-tailed Bat, are arriving on site during the early parts of the night, there is no clear evidence to suggest that regularly utilised roosts are present within the development footprint or immediate surrounds. The presence of potential cave roosts is discussed further below, and as outlined above the potential for tree roosts supporting White-striped Free-tailed Bat exists, however there is an abundance of potential tree roosting habitat throughout the broader landscape.

Assessment of potential breeding activity

Another limitation of acoustic surveys for microbats is the lack of ability to confirm the presence of breeding status of the bats present within the project area. To confirm the presence of breeding activity bats must be trapped and checked for signs of breeding such as attached juvenile bats or lactation. Largely due to the size and inaccessible nature of the development footprint, as well as the wide-spread potential for possible roost habitat, trapping surveys were not able to be undertaken as part of the current assessment.

To provide insight into the likelihood of habitats potentially present within and immediately surrounding the development footprint being used as maternity roosts, call data has been analysed based on mean nightly activity across the survey period on a temporal scale. Many bats are known to migrate to colonial maternity roots and as such, activity levels can be expected to change over time based largely on the presence of breeding females. Survey data was collected in November 2019 and March to May 2020, allowing for temporal comparison of activity around the known breeding periods of a number of bats.

Due to the high species diversity in microbat activity within the project area, the focus of this analysis has been on those bats considered at highest risk of substantial or significant impacts if breeding was found to occur and was impacted upon. Those species being the BAM species credit listed bats; Large-eared Pied Bat, Eastern Cave Bat, Large Bent-winged Bat and Little Bent-winged Bat.

Movement patterns relating to the reproductive strategies of these bats are outlined below, with information based on that provided in Churchill (2008), Parnabt et al. (2008), Hoye & Hall (2008), and Hoye & Schulz (2008).

Large-eared Pied Bat

- Births occur at maternity roosts in late November to early December, with juveniles suckled until late January.
- Young leave the roost in February, followed by females in late March.

Eastern Cave Bat

- Females congregate at maternity roosts in November, with births occurring in mid to late November.

Large Bent-winged Bat

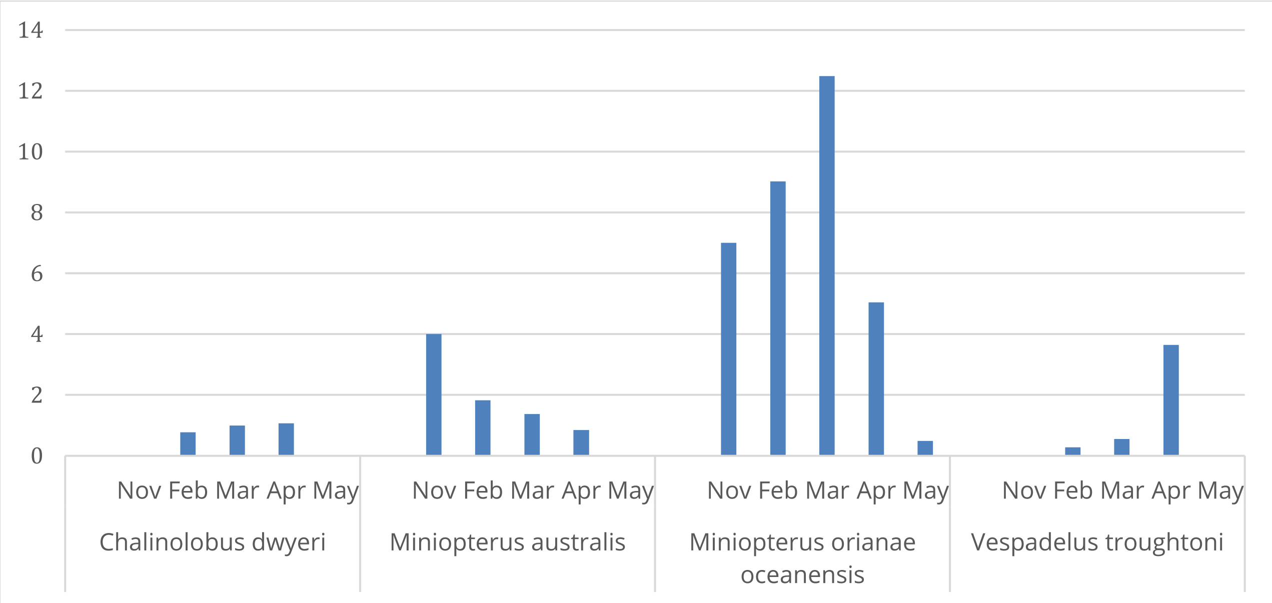
- Females congregate at maternity roosts in spring (from October), with births in December to January.
- Females leave maternity roost in February, with juveniles leaving around a month later. The colonies are deserted by April.

Little Bent-winged Bat

- Females congregate at maternity roosts in spring (recorded as early as August), males are also present but disperse from December.

- Young are born in December.

The graph below illustrates the mean nightly activity recorded for the four BAM species credit microbat species across the survey period to provide an indication of relative abundance within the project area over a temporal scale.



Graph 14 Mean nightly activity for Large-eared Pied Bat, Eastern Cave Bat, Large Bent-winged Bat and Little Bent-winged Bat during the microbat acoustic survey period

Relative abundance of Large-eared Pied Bat can be seen to be stable across late summer and into early autumn, with no activity recorded in either November or May. This indicates that breeding roosts are unlikely to be present within or immediately surrounding the development footprint as higher levels of activity would be expected in November, with activity levels dropping in late March.

Eastern Cave Bat can be seen to be most active within the project area in April, with low levels of activity recorded in February and March. Little is known about the breeding biology of this species; however, it could be expected that some activity would have been recorded in November if maternity roosts were present.

Large Bent-winged Bat activity peaks in March with higher activity levels also recorded in November and February. This suggests that individuals occurring within the project area are unlikely to be breeding females, who are known to leave maternity roosts in February, which would lead to a reduction in activity through March. Furthermore, as noted above, the species' maternity roosts are generally deserted by April and activity was recorded within the development footprint in both April and May, though at lower levels to those recorded in the warmer months. This could be expected for a species known to decrease activity during colder weather.

Little Bent-winged Bat activity was highest within the project area in November and reduces from February through to April although the reduction relates to a mean of less than one call per night fewer being recorded between these months. Higher levels of activity in November are based on only two nights' data and as such higher activity may be more related to outlier nights than truly higher activity. There is little evidence from activity levels to suggest breeding behaviour in the immediately vicinity of the development footprint, and that overall activity for the species is comparatively low. Furthermore, Little Bent-winged Bat is known to co-occur in maternity roosts with Large Bent-winged Bat, especially in colder environment, and based on activity data for Large Bent-winged Bat, there is again little evidence to suggest either species is breeding in the area.

Whilst it is acknowledged that without trapping microbat breeding activity cannot be conclusively ruled out from occurring within and surrounding the project area, temporal activity patterns do not suggest that this is occurring.

Microbat cave roost assessments and results

To further define the nature and extent of the local mircobat population within the project area, investigation of potential microbat roost and possible breeding habitat within and surrounding the development footprint was undertaken during the course of the development of the BDAR. Initial desktop investigation using GIS were undertaken to locate areas of potential for field investigation, the results of which were fed back into the project design to allow for avoidance of direct and indirect impacts. Follow-up desktop assessment and additional detailed field validation was then undertaken to further refine these areas of potential habitat.

The locations of steep topography with the potential to represent cliff-lines (and therefore potential bat roosts) on the edge of the escarpments in the project area were mapped. The GIS desktop analysis was undertaken as follows:

- A 5 m Digital Elevation Model (DEM) was created from a LiDAR point cloud.
- Focal statistics were run on the DEM to create a surface representing the range of elevation in a 2x2m cell neighbourhood around each input cell (roughly a 10m buffer).
- Focal range surface was reclassified to remove areas with a range less than 3m between highest and lowest points in the neighbourhood. This was undertaken to remove small topographic features less likely to provide suitable root habitat.
- The resulting 'clifflines' layer was symbolised to show areas of potential clifflines based on where the range was 4, 5, 6, 7 or >7 metres within the 2x2 neighbourhood.

These areas of steepest topography were used to identify potential areas where cave-dwelling microbats could establish roosts, and potentially breeding habitat.

Initial ground-truthing of these areas of potential habitat was undertaken in late-February 2020; however, rain and fog over the duration of the field event meant accessing down or near these areas of potential habitat, which comprise the steepest areas of the upper slopes surrounding the development footprint, was unable to undertaken, and views from the top were highly restricted. As illustrated in Photo 10 below.

The result of the inclement weather meant areas of potential habitat were mapped in a highly conservative manner and encompassed all areas of steep terrain potentially supporting cliff-lines, overhangs and any other such potential bat roost habitat. Ultrasonic recording devices were installed at many of the locations assessed as potential bat roost habitat to record the level of microbat activity at each location (with results as discussed above).

Photo 10 Wet and foggy weather conditions during February 2020 attempted ground-truthing survey

Follow-up assessment of the areas mapped as potential microbat roosting habitat was able to be undertaken in March 2021, and the two-staged process of desktop analysis followed by on-ground confirmation was repeated.

During the second round of desktop analysis of, the LiDAR data used to create the potential 'clifflines' layer was re-analysed using a slope analysis, with slope face classified into ranges, with the areas of steepest slope classified into between 65 to 75 degrees and 75 to 90 degrees. It was determined that whilst the potential clifflines layer provided information of the areas of greatest change in elevation, the approximately 10 metre buffer (created by the 2x2 pixel neighbourhood) meant that a change of 7 meters in elevation could occur over a 10 metre area, representing only a 35 degree slope. As the potential cliffline habitat being targeted by the desktop assessment is considered to comprise slopes of 75 degrees or greater, the aim of this second round of desktop analysis was to located areas supporting a combination of a large change in elevation (>3 metres) within a 10 metre neighbourhood, and a steep slope (>65 degrees).

In undertaking the desktop assessment in this manner, combined with a detailed review of high definition aerial imagery captured for the purposes of project design, a number of the areas previously assessed as potential microbat habitat could be discounted. It was found that in a number of locations the large change in elevation occurred either over a wide area, therefore representing steep slopes rather than cliffs or overhangs, or that where such changes occurred over more discrete areas they were often associated with breaks in canopy, rather than sharp changes in ground topography. All areas previously mapped as potential bat roost habitat were re-assessed and prioritised for follow-up ground confirmation.

On ground assessment of areas identified as potential microbat habitat was then undertaken between 29 March and 1 April 2021. All high priority areas that were identified as having a sudden decrease in elevation were able to be visually inspected from the nearest accessible point. The terrain within the project area was notably steep and rugged, and as a result some sections could only be accessed 50 to 100 metres away. This was not considered a significant limitation as the slopes or clifflines were visible from these distances when the location could not be directly accessed. Due to the large size of the site, not all areas previously mapped as potential habitat were able to be ground-truthed, and a sampling approach was undertaken. However, suitable conclusions were able to be reached for all areas not visited on ground based on the results of the desktop assessment and extrapolation of ground observations across other areas of the development footprint.

Photographs were taken at each location and information regarding the type of slope, presence of outcropping, presence of clifflines, overhangs and fissures etc. was recorded. A significant portion of the sites identified during the desktop assessment as having sharp decreases in elevation were confirmed as very steep slopes and comprised of loose soils and unconsolidated material (Photo 11 to Photo 17) and were not considered to provide suitable habitat for microbats. This was in some cases observed to be the result of relatively recent landslides, less than 50 years old, as evident by the immature vegetation structure (images included) and eroded slopes. Two sites were identified as containing microbat habitat suitable to provide roosting and possibly breeding opportunities (Table 41 and Figure 15), one a small cliff line and another forming a large pillar like rocky outcrop. The majority of the rock forming these two habitats was deeply fissured, however the rock forming them was highly friable.

Table 41 provides details of the results of the desktop and/or ground assessment of all areas previously mapped as potential microbat roosts surrounding the development footprint. Area numbers are illustrated on Figure 15, and photos of a number of locations assessed on ground are provided below.

Table 41 Microbat habitat investigation results

Area No. (refer Figure 13)	Microbat habitat presence	Desktop assessment conclusions	Rationale and field observations
01	No	Steepness >65 degrees correlates to edges of canopy only. Larger areas of change associated with canopy breaks only	Moderate to steep slope with well vegetated grassy forest. No outcropping present.
02 & 03	No	Area of significant change, and linear steep slopes adjacent and continuing to the north	Steep slope, no cliff lines or notable outcropping.
04	No	Steepness >65 degrees correlates to edges of canopy only. No larger areas where change in elevation occur over a wider area (Ie lower potential cliffline values only)	Desktop assessment only.
05	No	Areas of significant change and steepness appear to relate to patchy canopy, however previous notes say rocky habitat abundant	Loose older landslip, no caves, crevices or fissures, unconsolidated and unstable.
06	No	Areas of significant change and steepness appear to relate to broken canopy edges, understory disturbed and cleared, lacks steep changes away from canopy	Desktop assessment only.
07	No	Areas of significant change and steepness appear to relate to patchy canopy, however previous notes say potential cave. Significant erosion in gully. Roost potential seems low	Loose older landslip, no depth to cavities, approx. 20 cm deep.
08	No	Areas of significant change and steepness mainly appear to relate to patchy canopy, however area of large change >7m should be targeted for ground-truthing	Very steep, almost vertical slope, well vegetated and boulders present, however no cliffines or fissures suitable for microbats were present.
09	No	Area appears steep from aerial, larger areas of change and steep slopes not well correlated (slope patchy not linear). will be able to extrapolate from other areas	Desktop assessment only.
10	No	Steepness >65 degrees correlates to edges of canopy only. No larger areas where change in elevation happens over a wider area (Ie lower potential cliffline values only)	Moderate to steep well vegetated slope. No cliffines or rock outcropping observed.
11	No	Large area of significant change, with more linear areas of steep slope	Moderate to steep well vegetated slope. No cliffines or rock outcropping observed.
12	No	Large area of significant change, with patchy areas of steep slope, sample approach	Moderate to steep well vegetated slope. Loose

Area No. (refer Figure 13)	Microbat habitat presence	Desktop assessment conclusions	Rationale and field observations
			boulders present and no outcropping observed.
13	No	Area of large change and steep decent at western extent appears to be consistent slope	Desktop assessment only.
14	No	Area appears steep from aerial, larger areas of change and steep slopes generally appear to be canopy edges, western end could be targeted for ground-truthing	Desktop assessment only.
15	No	Areas of significant change and steepness appear to relate to patchy canopy	Desktop assessment only.
16	No	Areas of significant change and steepness appear to relate to patchy canopy	Desktop assessment only.
17	No	Areas of significant change and steepness appear to relate to patchy canopy, understory less disturbed may represent breaks in slope, targeted ground-truthing likely to provide good clarity	Steep grassy slope, with very loose soils and no outcropping.
18	Yes	Large change steep descent, high priority for ground-truth	Cliffline extending for 70 metres, with both ends buried by landslide.
19	No	Areas of significant change and steepness appear to relate to patchy canopy	Steep and highly unstable slope. Many small cliffines and outcropping observed, however these contained only shallow cavities and depressions. Exposed material considered a result of relatively recent landslide.
20	No	Areas of significant change and steepness appear to relate to patchy canopy	Desktop assessment only.
21-23	No	Areas of significant change and steepness appear to relate to patchy canopy, data can be extrapolated form other areas	Loose steep slope, no large boulders mostly unconsolidated material.
24	No	Areas of significant change and steepness appear to relate to patchy canopy, data can be extrapolated form other areas	Densely vegetated steep slope, with no rock outcrops observed.
25	No	Areas of significant change and steepness appear to relate to patchy canopy, data can be extrapolated form other areas	Desktop assessment only.
26 (south)	No	Potential gully in centre of polygon high priority for ground-truth, remaining area is	Steep and loose slope with some grassy

Area No. (refer Figure 13)	Microbat habitat presence	Desktop assessment conclusions	Rationale and field observations
		similar to other areas and data can be extrapolated	groundcovers and unconsolidated rocks.
26 (north)	No	Potential gully in centre of polygon high priority for ground-truth, remaining area is similar to other areas and data can be extrapolated	Steep slope formed of unconsolidated cobble and boulders.
27	Yes	Potential gully in centre of polygon high priority for ground-truth, remaining area is similar to other areas and data can be extrapolated	Pillar like outcrop with many deep and vertical fissures. No guano or odours identified.
28	No	Areas of significant change and steepness appear to relate to patchy canopy, but breaks in slope also possible, data can be extrapolated to/from other areas	Desktop assessment only.
29	No	Areas of significant change and steepness appear to relate to patchy canopy, data can be extrapolated form other areas	Heavily incised drainage line. No fissures observed and rock highly friable.
30	No	Areas of significant change and steepness appear to relate to patchy canopy, but breaks in slope also possible, data can be extrapolated to/from other areas	Desktop assessment only.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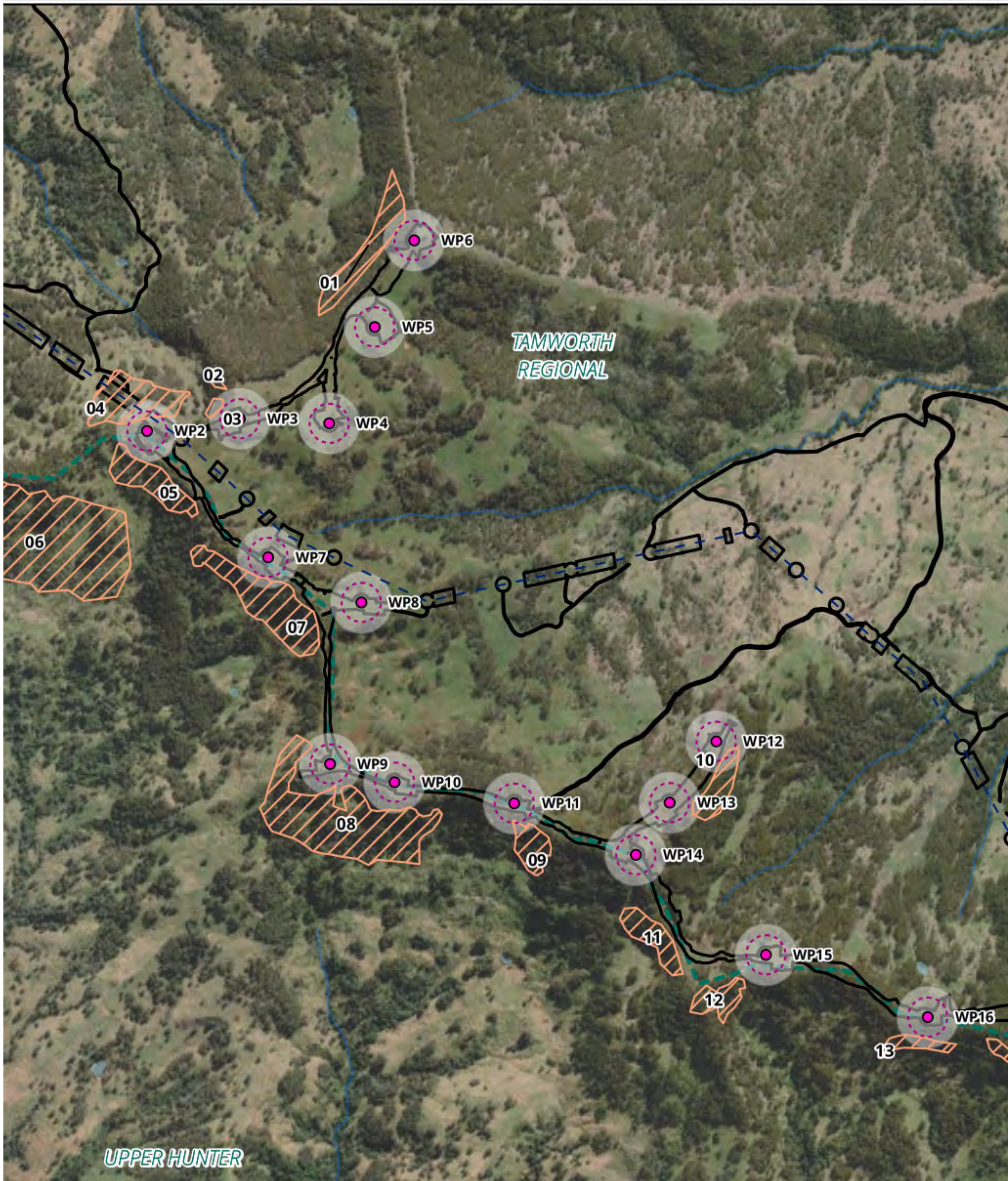

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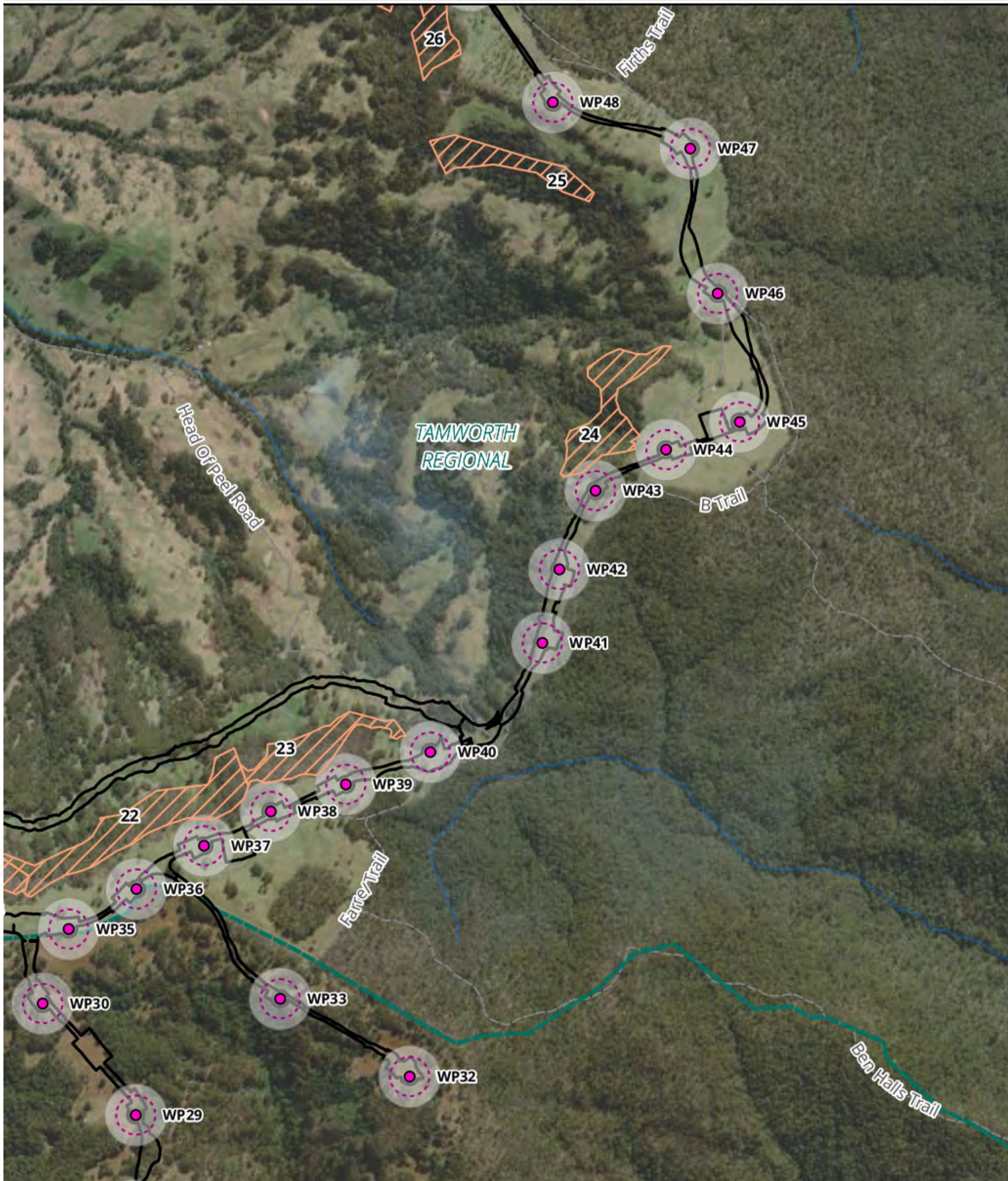

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B Trail
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Ben Halls Trail
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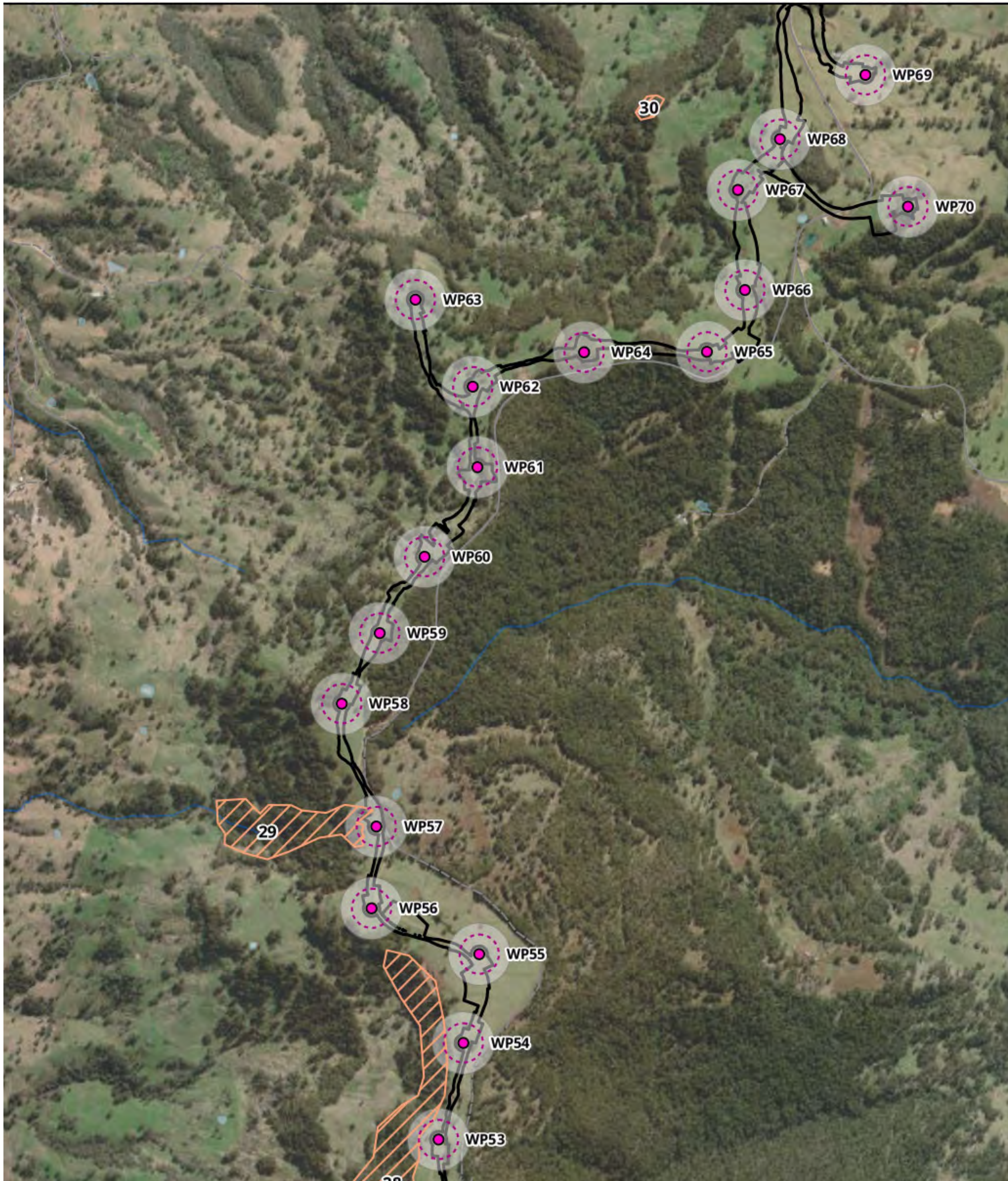
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Photo 11 Area 27 potential microbat roost habitat

Photo 12 Area 18 potential microbat roost habitat (over crest of slope)

Photo 13 Area 19 steep rocky slope not supporting microbat habitat

Photo 14 Area 01 steep slope not supporting microbat habitat

Photo 15 Example of recent landslide east slope, not supporting microbat habitat

Photo 16 Example of recent landslide west slope, not supporting microbat habitat

Photo 17 Area 26 (north) steep rocky slope not supporting microbat habitat

Geomorphology and Geology and Potential Microbat Roosting Habitat

To provide additional scientific advice on the likelihood of the project area and surrounding landscape to provide roosting and potential breeding habitat opportunities for microbats, a desktop geomorphological assessment was undertaken by Environmental Geosurveys Pty Ltd (Neville Rosengren, Geomorphologist and Honorary Associate La Trobe University). The full report (Environmental Geosurveys 2021) is attached as Appendix F of the BDAR.

The geomorphological assessment found the project area and surrounding landscape to comprise a diverse geological landscape formed in part by a range of volcanic activity resulting in the basalt lithology present at the development footprint. The occurrence of suitable microbat habitat was considered based on the potential presence and persistence of spaces in a coherent rock mass, or in accumulations of detached rock clasts. The extent to which either of these niches is present and suitable is a function initially of lithology and rock structure modified over time by geological and environmental processes that can increase or decrease the available space (Environmental Geosurveys 2021), with a diverse range of both inherent structures and secondary processes likely to occur in the broader landscape.

It was assessed that the likelihood for unreported caves within the vicinity of the development footprint, and specifically relating to previously mapped potential bat roost polygons, was low given the areas were not remote and there was generally good surface visibility, and that the potential roost sites in the wider area of basalt and other lithologies should be considered (Environmental Geosurveys 2021).

Within the surrounding basalt lithology, it was considered unlikely that large caverns such as those formed by dissolution of limestone at Timor and amygdaloidal basalt as at Coolah Tops have remained undetected. However, the extent of basalt exposure in valleys and at the margins of the several lava fields within flight range of microbats (conservative estimated as around 50-75 kilometres) means smaller cavities formed in this way may occur. Similarly, outcrop of fractured and weathered rock and downslope accumulations of blocky scree as potential habitat sites are also possibly widespread (Environmental Geosurveys 2021). This latter form of potential habitat is considered of lower likelihood to support microbat roots due to it being low to the ground and unlikely to provide bats with opportunities to fly into the habitat. Furthermore, the wide range of lithology within the estimated microbat flight range, including carbonate and close-bedded sandstone-mudstone units, have the inherent and secondary (weathering) properties to develop potential habitat opportunities (Environmental Geosurveys 2021).

It was found that the diverse terrain and lithology across the broader landscape, combined with dynamic geomorphology result in a high potential for microbat roosting sites to occur at all elevations within the expected flight range of mircobats potentially present within the project area. However, the undulating plateau and ridge terrain of the project area has no extended rock escarpments and limited outcropping of fractured basalt as vertical or inclined columnar structures. Detailed ground survey would be needed to define the extent of such outcropping, but the evidence from the available data lead to the conclusion that there is discontinuous and limited bat roost habitat in the immediate vicinity. Furthermore, no data was found to suggest that the development footprint and immediate surrounds geomorphologically standout from the surrounding landscape in any way. (Environmental Geosurveys 2021).

The assessment found that in the immediate vicinity of the project area, outcrops of fractured basalt may provide localised habitat, However, the terrain and geology of this precinct provide limited opportunity for extensive habitat. While several large solution caverns in limestone and basalt occur in surrounding terrain, these are localised and there is a low probability that similar unreported large roost habitat sites occur. It is extremely unlikely there are basalt caverns of the dimension to accommodate a large bat colony. There is also a low possibility that unknown caves occur in the Devonian crystalline limestone, as these outcrops have been searched on several occasions (Allen et al. 1986, Environmental Geosurveys 2021).

The geomorphological assessment is considered to support the findings of the re-assessment of potential microbat roosting habitat within and immediately surrounding the development footprint. A diverse range of rocky outcropping was recorded during on-ground assessments, however few sites were of a size and structure suitable to support roosting bats. The broader landscape is considered highly likely to support a large range of bat roosting opportunities for the local bat populations, hence the high levels of microbat activity recorded as part of the current assessment. Due to this expected high availability of habitat in the landscape, there is no reason to suggest that bats are favouring the project area for roosting, and/or doing so in large numbers, and may well be present foraging over the higher ground, and intact vegetation on the slopes surrounding the project area.

Further supporting the assessment of high levels of available habitat in the broader landscape surrounding the project area, is in Table 42 provided by Environmental Geosurveys from local speleological groups (specifically academic and expert speleologist—Dr Susan White of La Trobe University), illustrating 14 known caves with microbats known to be present, in the Tamworth area.

Table 42 Known bat caves in the Tamworth area

Cave Area	District	Cave Number	Cave Name	Significant number of bats	Occasional roosting
Kunderang Brook	East of Kempsey	2KB-1	Youdales Cave, Hut Cave	Yes	
-	-	2KB2	-		Yes
Timor (Incl Isaacs Ck; Isis R;Allston)	Timor	2TR-2	Belfry Cave		Yes
-	-	2TR-4	Helictite Cave		Yes

Cave Area	District	Cave Number	Cave Name	Significant number of bats	Occasional roosting
Stockyard Creek	West of Kempsey	2SC-5	Carrai Bat Cave	Yes	
-	-	2SC-7		Yes	
-	-	2SC-9			Yes
Moparabah	West of Kempsey	2MP-1	Moparabah Cave; Main Cave	Yes	
Yessabah	WSW of Kempsey	2YE-1	Yessabah Bat Cave	Yes	
Willi Willi	West of Kempsey	2WW-1	Willi Willi Bat Cave	Yes	
-	-	2WW-4	Possum Cave	Yes	
Moore Creek	North of Tamworth	2MC-1	Moore Creek		Yes
Sulcor	North of Tamworth	2S-4	Bullock Hole		Yes

Note. Many of the locations of the above caves were not provided due to the regarded sensitivity of caves to the speleological groups who provided the information.

Based on the above, the occurrence of high potential cave dependent microbat habitat within and/or immediately surrounding the development footprint, additional to that confirmed as present during the recent field investigation, is considered low, and that this habitat is likely to be present throughout the broader landscape.

Greater Glider

The Greater Glider is listed as Vulnerable under the EPBC Act and is not a listed species under the BC Act. It is the largest gliding possum in Australia, with a head and body length of 35 – 46 centimetres, and a tail measuring 45 – 60 centimetres (Menkhorst & Knight 2011). The species is arboreal and nocturnal and is mostly restricted to eucalypt forests and woodlands. It is typically found in highest abundance in tall, montane and moist eucalypt forests with old trees and abundant hollows. The species favours forests with a diversity of eucalypt species, due to the seasonal variation in its preferred tree species. During the day Greater Glider shelters in tree hollows, particularly those that are in large, old trees (McKay 2008).

The Greater Glider occurs in eastern Australia, from the Windsor Tableland in north Queensland through to central Victoria. The broad extent of occurrence is unlikely to have changed substantially since European settlement, however the area of occupancy has decreased substantially, mostly due to land clearing (Threatened Species Scientific Committee 2016). This decline is most likely continuing due to further land clearing, fragmentation, fire and forestry activities. The species is considered to be particularly sensitive to forest clearance, logging and fire, and is slow to recover following major disturbance. The species is also considered to be sensitive to fragmentation due to a low dispersal ability, previously showing low persistence in small forest fragments (Threatened Species Scientific Committee 2016).

Twenty-five Greater Gliders were recorded within the development footprint during targeted surveys in the current assessment (Biosis 2019). Previous records of the species are also scattered throughout the adjacent Ben Halls Gap Nature Reserve (EES 2020). As Greater Glider tend to have relatively small home ranges (1 – 4 ha), for the purposes of this assessment, these records throughout the development footprint and adjacent reserve make up the 'local population'. Nationally, there are no officially recognised 'important populations' of

Greater Glider. However, in NSW there are three specific populations listed as Endangered under the BC Act (EES 2020). These are the populations of the Eurobodalla LGA, Mount Gibraltar Reserve, and Seven Mile Beach National Park which are remote from the Project. It is not considered that the local population addressed in this assessment makes up an important population of the species. Further assessment of impacts to Greater Glider are provided in Section 8.8.5.

Approximately 35.48 hectares of Greater Glider habitat is proposed to be removed from the development footprint as a part of the current project. This encompasses eucalypt woodland, and the associated hollow-bearing trees throughout. The impacts to Greater Glider habitat are also predominantly to smaller patches of fragmented suitable habitat on the wind farm infrastructure sections of the development footprint, and no large contiguous patches of habitat will be impacted.

Koala

Koala is listed as Vulnerable under the Commonwealth EPBC Act and the NSW BC Act. It occurs from north-east Queensland to South Australia, including parts of NSW. A rapid decline in the number of individuals has been seen since European settlement, primarily due to a reduction in available good quality vegetation with appropriate canopy species suitable for supporting the species (DECC 2008).

The development footprint is located within the Northern Tablelands Koala Management Area (KMA), and the proposed works include the removal of a total of 132.4 hectares of native vegetation, composed of various forms of eucalypt forest. Of this, approximately 36.4 hectares is considered to be Koala habitat as defined using the BAM method for mapping species polygons, encompassing multiple PCTs.

Within 10 kilometres of the development footprint, the species has been recorded seven times (EES 2020), with an additional three individuals recorded within the development footprint during the current field assessment (consisting of a mother and joey during spotlighting surveys, and a mature individual on camera trap). The closest previous records of Koala occur within Ben Halls Gap Nature Reserve, which is east of, and contiguous with, the development footprint. Hanging Rock State Forest, Nundle State Forest, and Tomalla State Forest and Nature Reserve all lie within 20 kilometres of the development footprint and contain scattered Koala records throughout (EES 2020). For the purposes of this assessment the definition of “the population” encapsulates all contiguous areas of Koala habitat into a singular spatial unit.

Photo 18 Koala recorded on arboreal camera trap

The results of the Koala SAT survey indicate that there is a low level of Koala activity across the site. Eight of the eleven SAT surveys had no scats recorded around the 30 surveyed trees, two SATs recorded scats around two trees and one SAT recorded 6 scats. This level of koala activity is consistent with the known population dynamics of Koalas in central NSW, with lower levels in drier areas. The escarpment where the wind farm is located is likely to support higher koala numbers than the transmission line corridor due to the higher soil nutrients and preferred koala food trees.

Phillips and Callaghan (2011) note that low levels of Koala activity assessed using the SAT method can also indicate that Koala use of the site may be transitory or a result of a naturally low density population.

As Koala is listed under the EPBC Act and, as the proposed works include potential impacts to this species, an assessment against the Significant Impact Criteria detailed in the Matters of National Environmental Significance: Significant impact guidelines version 1.1 (Commonwealth of Australia 2013) has been undertaken in this BDAR.

Spotted-tailed Quoll

Spotted-tailed Quoll is listed as Endangered under the Commonwealth EPBC Act and Vulnerable under the NSW BC Act. It occurs across south-east Queensland, eastern NSW, Victoria, south-east South Australia and Tasmania (Jones 2001). The subspecies' mainland range is now considered to have reduced by 50–90% (Jones 2001). However, detailed distribution records and abundance estimates are generally lacking due to the scale and intensity of surveying that is required to detect the species across its entire range (DAWE 2016).

The Spotted-tailed Quoll has previously been recorded within and adjacent to the development footprint. In 2019 a roadkill individual was located within the Ben Halls Gap State Forest adjacent the development footprint, and another individual was recorded on a camera trap within the development footprint. Hanging Rock State Forest, Nundle State Forest, and Tomalla State Forest and Nature Reserve all lie within 20 kilometres of the development footprint and contain scattered previous Spotted-tailed Quoll records throughout (EES 2020).

Potential Spotted-tailed Quoll habitat occurs throughout the development footprint in the form of eucalypt woodland, rocky outcrops, caves, logs and tree hollows. Spotted-tailed Quoll was recorded twice during targeted remote camera surveys as part of the current assessment. As such approximately 40.67 hectares of Spotted-tailed Quoll habitat has been identified within the development footprint which will be removed as part of the proposed works. This habitat is comprised of the PCTs identified in BioNet, assessed as having high and moderate condition levels.

As Spotted-tailed Quoll is listed as Endangered under the EPBC Act and, as the proposed works include potential impacts to this species, an assessment against the Significant Impact Criteria detailed in the Matters of National Environmental Significance: Significant impact guidelines version 1.1 (Commonwealth of Australia 2013) has been undertaken in this BDAR.


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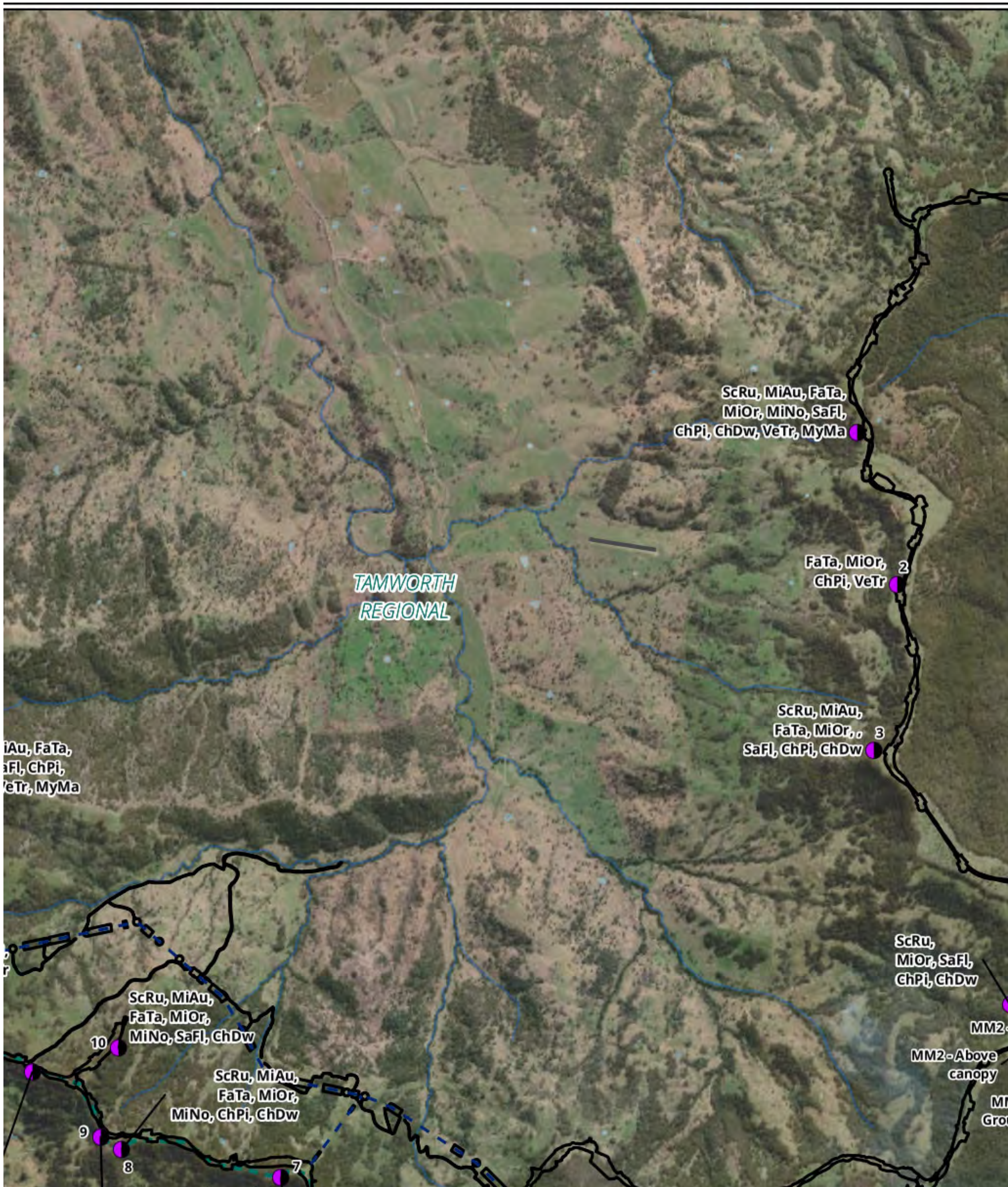
ScRu, MiAu, FaTa, MiOr, MiNo, SaFl, ChPi, ChDw, VeTr, MyMa
FaTa, MiOr, ChPi, VeTr
2
ScRu, MiAu, FaTa, MiOr, , SaFl, ChPi, ChDw
3
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ScRu, MiOr, SaFl, ChPi, ChDw
MM2 - Above canopy
ScRu, MiAu, FaTa, MiOr, MiNo, SaFl, ChDw
10
ScRu, MiAu, FaTa, MiOr, MiNo, ChPi, ChDw
9
8
7

5.5 Threatened fauna habitat polygons

According to the BAM, impacts to threatened fauna species must be calculated according to the area of suitable habitat identified by the species polygon. For dual credit species, only the breeding habitat for the species is to be mapped. For full credit species, both foraging and breeding habitats need to be included in any species polygons.

A detailed assessment of the mapped fauna habitat for threatened species listed under the BC Act is provided in Table 43 and mapped in Figure 17 to Figure 21.

Table 43 Approach to estimating impacts for species credit species

Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent	Approach to assessment of impacts
Large-eared Pied Bat	Recorded	The species is a full species credit because it cannot be reliably predicted to occur on a site based on vegetation and other landscape features (either foraging or breeding). Potential breeding habitat is 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. Surveys must be undertaken as per the Threatened Bat Survey Guide to confirm breeding habitat. Species mapping polygon for breeding habitat must use high resolution aerial imagery and topographic maps to identify features on the subject land (caves, scarps, cliffs etc.). Polygon must be at least 100m wide (or 50m radius for point locations such as caves) with the breeding habitat features (may be multiple) as the centroid (see Threatened Bat Survey Guide). All breeding habitat on or within 100m of the subject land and the area immediately surrounding the feature must be identified. All habitat on the subject land should also be mapped if present. Use high resolution aerial imagery and topographic maps to identify potential roost habitat features on the subject land within 2km caves, scarps, cliffs etc. Species polygon boundary should align with PCTs on the subject land to which the species is associated that are within 2km of identified potential roost habitat features.	Species polygons for 'Forage habitat' include PCTs associated with the species in the BioNet database, in moderate and high condition states, where they occur within 2km of confirmed potential microbat breeding habitat, and/or within 2km of Mount Royal Tops soil landscape (Mitchell 2002). All impacted native vegetation in the development footprint within the buffer areas is captured. Cave bat habitat polygons are mapped in Figure 17.
Eastern Cave Bat	Recorded	The species is a full species credit because it cannot be reliably predicted to occur on a site based on vegetation and other landscape features (breeding or foraging). 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. Surveys must be undertaken as per	Species polygons for 'Forage habitat' include PCTs associated with the species in the BioNet database, in moderate and high condition states, where they occur within 2km of confirmed potential microbat breeding habitat, and/or within 2km of Mount Royal Tops soil landscape (Mitchell 2002). All impacted native vegetation in the development

Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent	Approach to assessment of impacts
		the Threatened Bat Survey Guide to confirm breeding habitat. All breeding habitat on or within 100m of the subject land and the area immediately surrounding the feature must be mapped. Artificial structures should be inspected and included on the map if the species is using these features for breeding. All habitat for this species should also be mapped if present. Species mapping polygon for breeding habitat must use high resolution aerial imagery and topographic maps to identify features on the subject land (caves, scarps, cliffs etc). Polygon boundaries must be at least 100m wide (or 50m radius for point locations such as caves) with the breeding habitat features (may be multiple) as the centroid (see Threatened Bat Survey Guide). When the species is present on the subject land and the proposed impact is not a potential SAII, standard species credits will be generated. All habitat on the subject land where the subject land is within 2km of caves, scarps, cliffs, rock overhangs and disused mines must be mapped. Use high resolution aerial imagery and topographic maps to identify potential roost habitat features on the subject land within 2km caves, scarps, cliffs etc. Species polygon boundary should align with PCTs on the subject land to which the species is associated that are within 2km of identified potential roost habitat features.	footprint within the buffer areas is captured. Cave bat habitat polygons are mapped in Figure 17.
Southern Myotis	Recorded	The species was allocated to species credit because it is dependent on waterways with pools of 3m wide or greater for foraging (which will be protected under legislation), habitat surrounding waterways is used for breeding and roosting. All habitat on the subject land where the subject land is within 200m of a waterbody with pools/ stretches 3m or wider including rivers, creeks, billabongs, lagoons, dams and other waterbodies on the subject land must be mapped. Use aerial imagery to map	Dams more than 3m wide were mapped and a 200m buffer applied. All PCTs within the development footprint forming habitat associations for the species, as listed in the BioNet database, were included within the habitat polygons where they were located with 200m of the dams. No waterways >3m wide were identified. Habitat polygons for Southern Myotis are mapped in Figure 18.

Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent	Approach to assessment of impacts
		waterbodies with pools/ stretches 3m or wider on or within 200m of the subject land. Species polygon boundaries should align with PCTs on the subject land to which the species is associated that are within 200m of waterbodies mapped.	
Koala	Recorded	No specific guidance is provided on how to derive habitat polygons for the species.	Habitat polygons include impacted areas of the species' associated PCTs within the development footprint, as listed in BioNet, and mapped in moderate and high condition states. Field captured habitat assessments were used to refine the polygons, with the following characteristics excluded: Areas supporting >50% rock outcropping Areas mapped as being subject to high severity clearing of the tree canopy Habitat polygons for Koala are mapped in Figure 19.
Eastern Pygmy-possum	Assumed present	Based on BioNet, there are no habitat constraints for these species other known PCT habitat associations.	Habitat polygons include impacted areas of the species' associated PCTs within the development footprint as listed in BioNet and mapped as in 'High" condition. Field captured habitat assessments were used to refine the polygons, with the following characteristics excluded: Areas supporting <5% characteristic understorey feed species Areas mapped as not supporting any tree hollows Areas mapped as being subject to high severity clearing of the tree canopy Areas mapped as being subject to highly or moderately severe agriculture impacts such as cropping, grazing, exotic pasture, soil disturbance. Habitat polygons for Eastern Pygmy Possum are mapped in Figure 19.

Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent	Approach to assessment of impacts
Squirrel Glider	Assumed present	No specific guidance is provided on how to derive habitat polygons for the species.	Habitat polygons include impacted areas of the species' associated PCTs, as listed in BioNet, and mapped in Moderate and High condition within the development footprint. Field captured habitat assessments were used to refine the polygons, with the following characteristics excluded: Areas supporting <5% characteristic understorey feed species Areas mapped as not supporting any tree hollows Areas mapped as being subject to high severity clearing of the tree canopy Areas mapped as being subject to high severity agriculture impacts such as cropping, grazing, exotic pasture, soil disturbance. Furthermore, areas where sufficient survey in the form of arboreal camera trapping has been undertaken for the species have been removed from the habitat polygons (as the species was not recorded). Areas retained are considered to have undergone less intensive survey and include the central-southern portion of the wind farm corridor, due to camera traps being burnt in bushfire in this area, and along the transmission line corridor, where nocturnal surveys did not occur. Habitat polygons for Squirrel Glider are mapped in Figure 19.
Border Thick-tailed Gecko	Assumed present	Based on BioNet, there are no habitat constraints for this species other known PCT habitat associations.	Habitat polygons include impacted areas of the species' associated PCTs as listed in BioNet, and mapped in Moderate and High condition states, where they are associated rocky areas mapped in the development footprint as potentially suitable to support the species,

Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent	Approach to assessment of impacts
			and within the species' known elevation range of 500 - 1000m altitude. Habitat polygons for Border Thick-tailed Gecko are mapped in Figure 20.
Booroolong Frog	Assumed present	No specific guidance is provided on how to derive habitat polygons for the species.	Habitat polygons include areas within the development footprint of native vegetation in High and Moderate condition where they occurred within a 40m riparian buffer from Wombramurra Creek (centreline/hydroline). PCTs not listed in the BioNet database as associated with the species were also included in the habitat polygons due to the presence of a high density of records in the area and the known SOS population along the creekline. A 40m buffer was selected as it represents the BAM riparian buffer for a 5th order watercourse, which Wombramurra exists as in this location. Habitat polygons for Booroolong Frog are mapped in Figure 20.
Barking Owl	Assumed present	Where any known nest trees occur on site (e.g. known from existing data, studies or other documented evidence), a species polygon providing a circular buffer with a 100 m radius should be drawn around the known nest trees. As nest trees have not been recorded, and the species is assumed as present, the following guidance has been used in determining the location and extent of species polygons. The species typically breeds in hollows of large eucalypts or paperbarks, usually near watercourses or wetlands (NPWS 2006). The species seems most abundant in the largest remnants but also occurs at low density in fragmented habitat, where it uses healthy riparian woodland or gallery forest amid extensive, diverse woodland supporting a diversity of native prey. (Debus 2001). Sometimes able to successfully breed along timbered	Timbered watercourses in deep gullies within and surrounding (within 100m) the development footprint was manually reviewed using high-definition aerial imagery, LiDAR data, and topographical contour lines, to selected potential locations for breeding habitat. Mapped hydroline features present within potential gully habitat were used to create a 100m buffer, within which all native vegetation was selected, and included within the species polygon. Habitat polygons for Barking Owl are mapped in Figure 21.

Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent	Approach to assessment of impacts
		watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils. (BioNet 2021b). It was also noted that Barking Owl habitat has a strong spatial association with hydrological features such as rivers and wetlands (Taylor & Kirsten 1999).	
Powerful Owl	Assumed present	Where any known nest trees occur on site (e.g. known from existing data, studies or other documented evidence), a species polygon providing a circular buffer with a 100 m radius should be drawn around the known nest trees. Species known to breed in old hollow eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines (DEC 2006).	Timbered watercourses in deep gullies within and surrounding (within 100m) the development footprint was manually reviewed using high-definition aerial imagery, LiDAR data, and topographical contour lines, to selected potential locations for breeding habitat. Mapped hydroline features present within potential gully habitat were used to create a 100m buffer, within which all native vegetation was selected, and included within the species polygon. Habitat polygons for Powerful Owl are mapped in Figure 21.
Masked Owl	Assumed present	Where a breeding site has been identified in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. Species known to breed in old hollow eucalypts, live or dead but commonly live, in a variety of topographic positions from gully to upper slope, with hollows greater than 40 cm wide and greater than 100 cm deep; there is no relationship with distance to streams. (DEC 2006). Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. (BioNet 2021a).	Deep gullies within and surrounding (within 100m) the development footprint was manually reviewed using high-definition aerial imagery, LiDAR data, and topographical contour lines, to selected potential locations for breeding habitat. Mapped hydroline features present within potential gully habitat were used as the centreline of the gully to create a 100m buffer, within which all native vegetation was selected, and included within the species polygon. Sections of the habitat polygons above an elevation of 1100m were removed. Habitat polygons for Masked Owl are mapped in Figure 21.

Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent	Approach to assessment of impacts
Sooty Owl	Assumed present	Where a hollow bearing tree has been identified as a breeding site in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. Old hollow trees, eucalypt or rainforest species usually live but stags are occasionally used, in unlogged, unburnt gullies and lower slopes within 100 m of streams, with hollows greater than 40 cm wide and greater than 100 cm deep; surrounded by canopy trees. (DEC 2006) Also nests in caves.	Timbered watercourses in deep gullies within and surrounding (within 100m) the development footprint was manually reviewed using high-definition aerial imagery, LiDAR data, and topographical contour lines, to selected potential locations for breeding habitat. Mapped hydroline features present within potential gully habitat were used to create a 100m buffer, within which all native vegetation was selected, and included within the species polygon. Habitat polygons for Sooty Owl are mapped in Figure 21.


TAMWORTH
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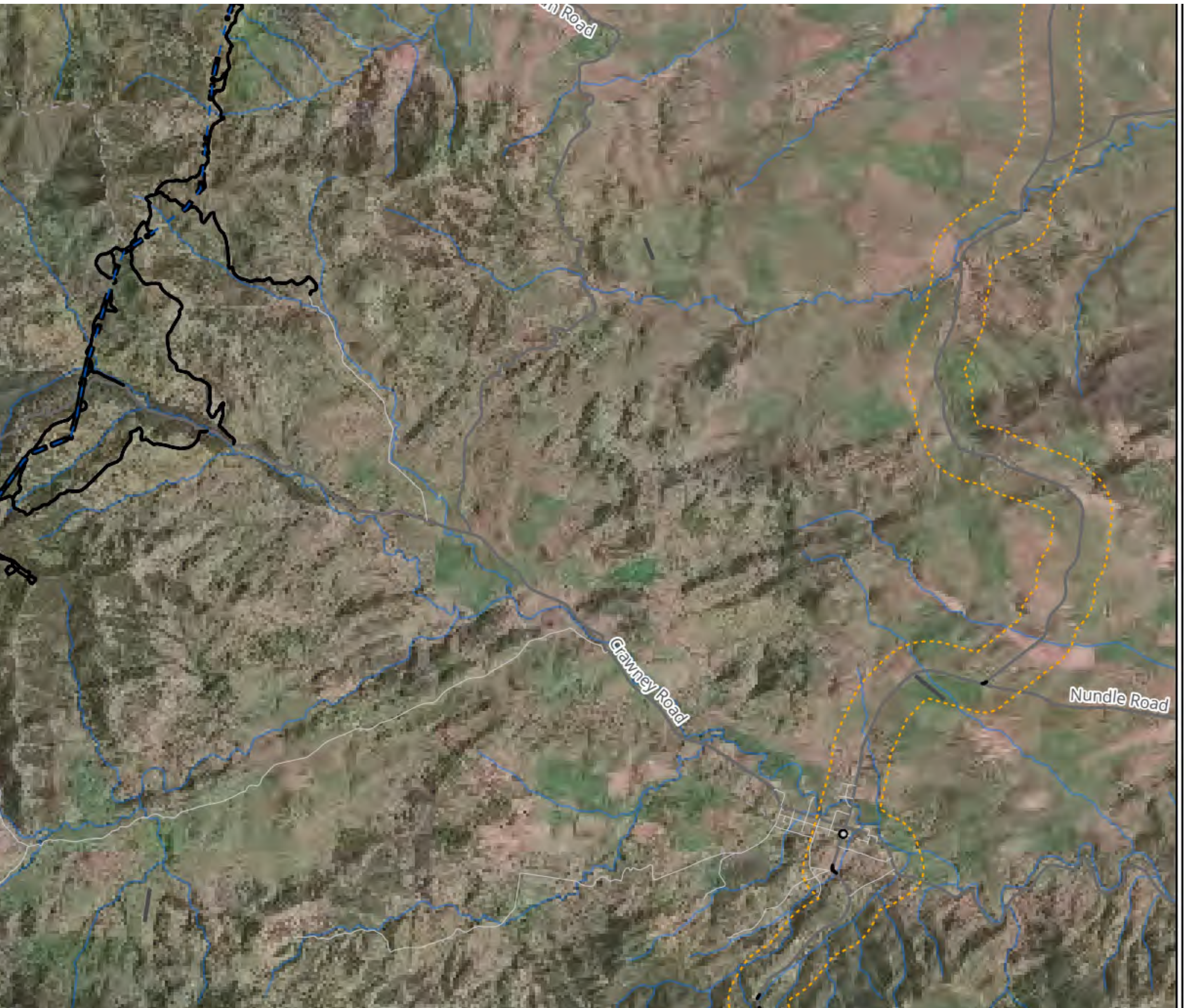
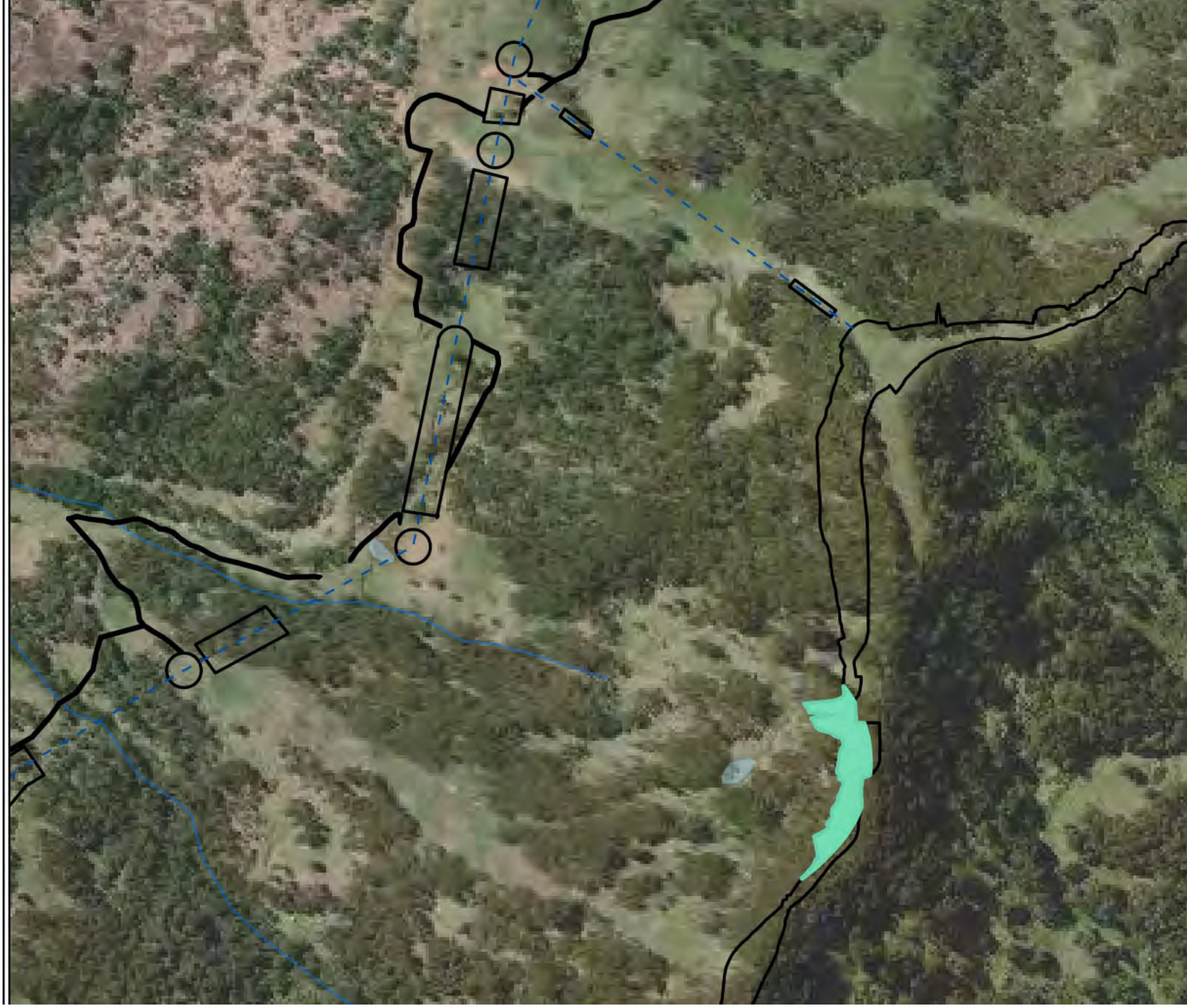
Head Of Peel
Farrel Trail
Morrisons Gap Road


Firths Trail
Morrisons Gap Road


Morrisons Gap Road


Crawney Road
Nundle Road



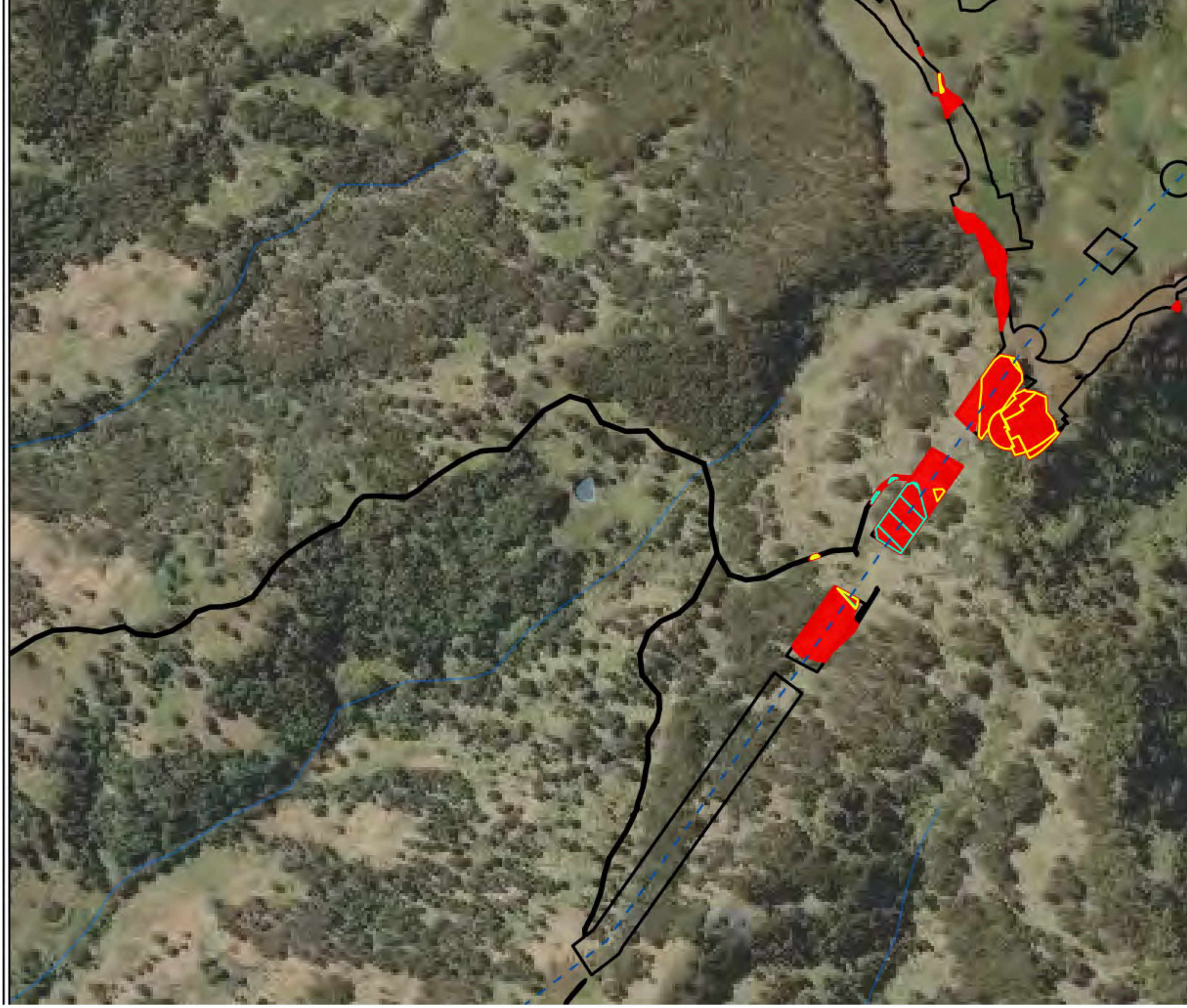

Head Of Peel
Farrel Trail
Morrisons Gap Road


Firths Trail
Road


Morrisons Gap Road

Nundle Road
Crawney Road


Basin Creek Road



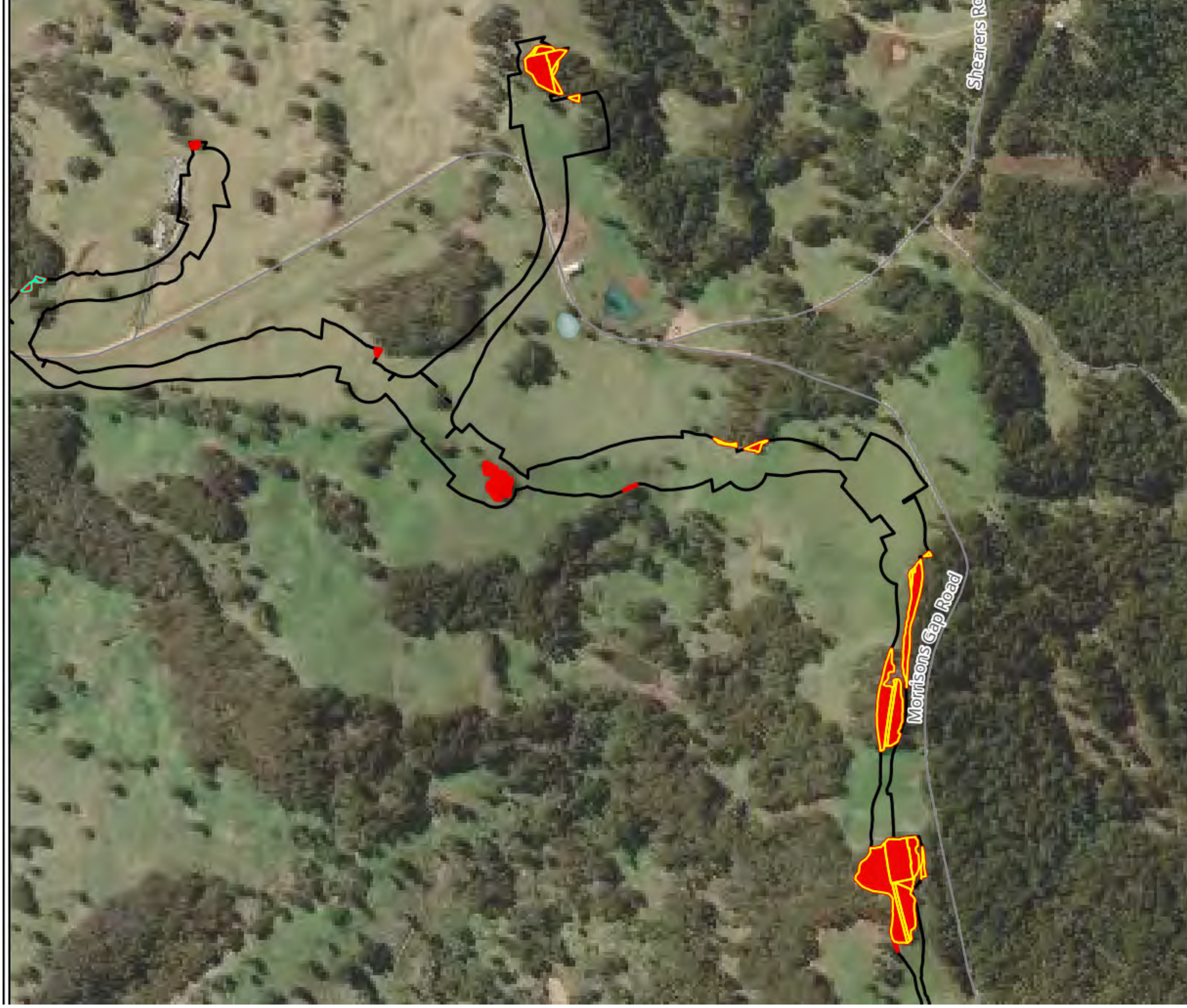

Kirks Road

Farrel Trail
Morrisons Gap Road


Treefern Trail

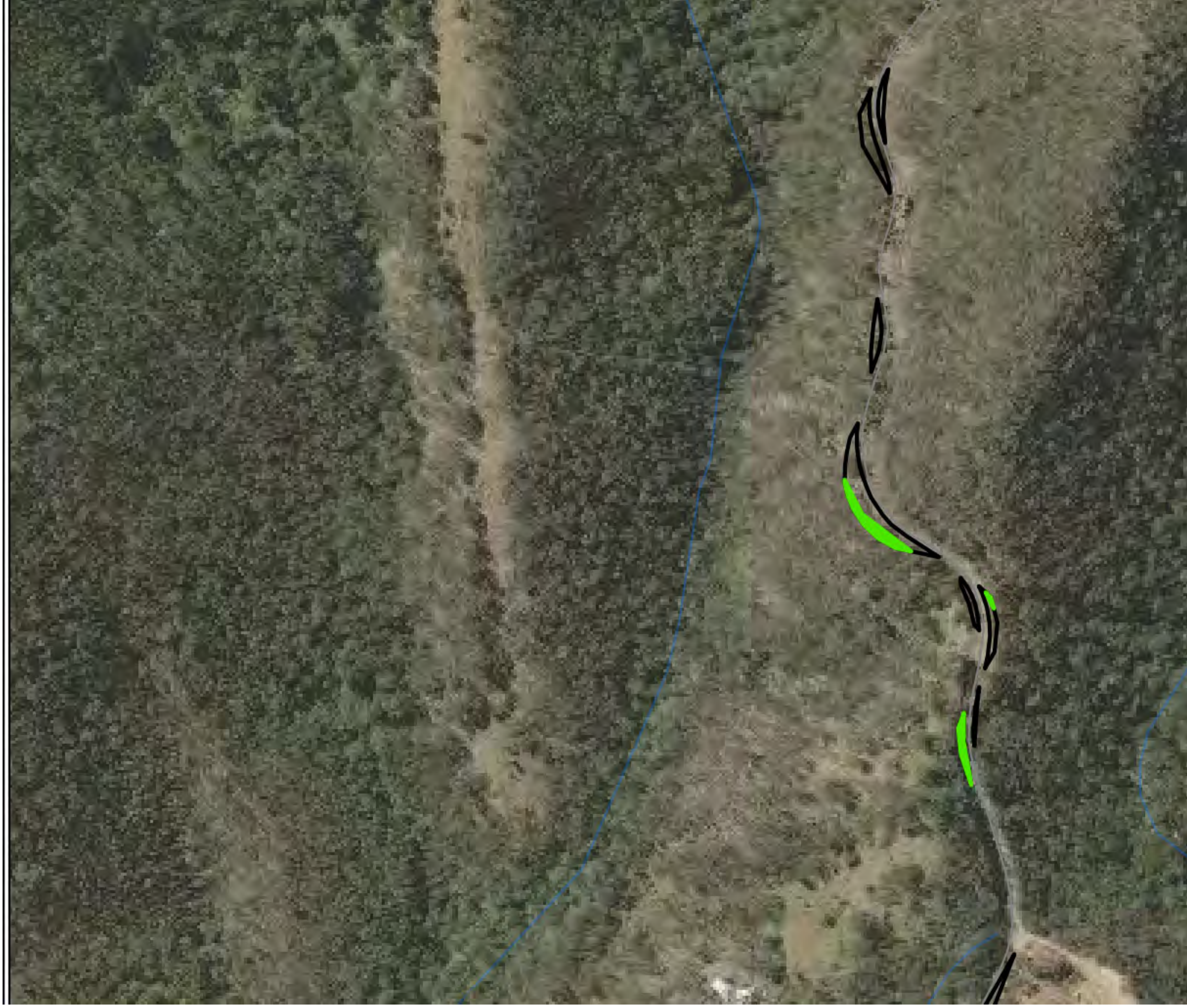

Firths Trail
Road


Morrisons Gap Road


Shearers Ro
Morrisons Gap Road


Nundle
TAMWORTH REGIONAL


Mountain Road




Nundle
TAMWORTH REGIONAL

6 Matters of National Environmental Significance

6.1 Commonwealth determination and controlling provisions

In accordance with the EPBC Act, a referral for the Project was submitted to the Commonwealth Department of Agriculture, Water and Environment (DAWE) (EPBC Ref 2019/8535).

On the 23 December 2019, the Commonwealth determined the Project was a controlled action under section 75 of the EPBC Act. Controlling provisions for the proposed action include listed threatened species and communities (section 18 and 18A) and listed migratory species (section 20 and 20A). Based on the referral documentation (EPBC 2019/8535), the Commonwealth determined there was likely to be significant impacts to the following matters:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC, listed as critically endangered.
- Regent Honeyeater *Anthochaera Phrygia*, listed as critically endangered.
- Swift Parrot *Lathamus discolour*, listed as critically endangered.
- Booroolong Frog *Litoria booroolongensis*, listed as endangered.
- Fork-tailed Swift *Apus pacificus*, which is listed as migratory.

In addition, the Commonwealth identified potential for some risk of significant impacts to the following matters:

- Small Snake Orchid *Diuris pedunculata*, listed as endangered.
- Blackbutt Candlebark *Eucalyptus rubida* subsp*. barbigerorum*, listed as vulnerable.
- Fragrant Pepperbush *Tasmannia glaucifolia*, listed as vulnerable.
- Austral Toadflax *Thesium austral*, listed as vulnerable.
- Spotted-tailed Quoll *Dasyurus maculatus* (SE mainland population), listed as endangered.
- Koala *Phascolarctos cinereus* (combined populations of Qld, NSW and the ACT), listed as vulnerable.
- White-throated Needletail *Hirundapus caudacutus*, listed as vulnerable.
- *Euphrasia arguta*, listed as critically endangered.

Further information was requested by the Commonwealth to determine the extent of potential impacts associated with the transport route road upgrades for the following relevant protected matters:

- New England Peppermint Eucalyptus nova-anglica Grassy Woodlands ecological community, listed as critically endangered.
- Lowland Rainforest of Subtropical Australia TEC, listed as critically endangered.
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC, listed as critically endangered.
- Regent Honeyeater *Anthochaera Phrygia*, listed as critically endangered.
- *Euphrasia arguta*, listed as critically endangered.

- Small Snake Orchid *Diuris pedunculata*, listed as endangered.
- Willi Willi Zieria *Zieria lasiocaulis*, listed as endangered.
- *Diuris eborensis*, listed as endangered.
- White-flowered Wax Plant *Cynanchum elegans*, listed as endangered.
- Milky Silkpod *Parsonsia dorrigoensis*, listed as endangered.
- Guthrie's Grevillea *Grevillea guthrieana*, listed as endangered.
- Craven Grey Box *Eucalyptus largeana*, listed as endangered.
- Manning Yellow Solanum *Solanum sulphureum*, listed as endangered.
- Blackbutt Candlebark *Eucalyptus rubida* subsp*. barbigerorum*, listed as vulnerable.
- Koala *Phascolarctos cinereus* (combined populations of Old, NSW and the ACT), listed as vulnerable.
- Earp's Gum *Eucalyptus parramattensis* subsp*. decadens*, listed as vulnerable.
- Austral Toadflax *Thesium australe*, listed as vulnerable.
- Greater Glider *Petauroides Volans*, listed as vulnerable.
- Leafless Tongue-orchid *Cryptostylis hunteriana*, listed as vulnerable.
- Fragrant Pepperbush *Tasmannia glaucifolia*, listed as vulnerable.
- Narrow-leaved Peppermint *Eucalyptus nicholii*, listed as vulnerable.
- Long-nosed Potoroo (SE Mainland) *Potorous tridactylus*, listed as vulnerable.
- Tall Velvet Sea-berry *Haloragis exalata* subsp*. velutina*, listed as vulnerable.
- Big Nellie Hakea *Hakea archaeoides*, listed as vulnerable.

6.2 Significant impact assessment

Based on the results of the desktop investigations, field surveys and the likelihood of occurrence assessments (contained in the EPBC assessment prepared by Arup), significant impact assessments were found to be required for the EPBC Act listed species and TECs that are known to occur or have a 'high' likelihood of occurrence, as listed below, with a detailed significant impact assessment provided in Section 8.8 of this BDAR.

Threatened Ecological Communities

- White Box-Yellow Box-Blakely's Red Gum Grassy TEC Woodland and Derived Native Grassland (critically endangered).

Listed threatened fauna species

- Booroolong Frog *Litoria booroolongensis* (Endangered).
- Large-eared Pied Bat *Chalinolobus dwyeri* (Vulnerable)
- Spotted-tailed Quoll *Dasyurus maculatus* (Endangered).
- Greater Glider *Petauroides volans* (Vulnerable).
- Koala *Phascolarctos cinereus* (Vulnerable).

The significant impact assessment was completed in accordance with the EPBC Act *Significant Impact Guidelines 1.1 Matters of National Environmental Significance* (Commonwealth of Australia, 2003).

The results of the assessment in this BDAR identified the potential for a significant impact to the following MNES:

- Koala.
- Spotted-tailed Quoll.

As a result targeted field survey and the changes proposed to the project design, significant refinement has been achieved for previously assumed potential roosting / breeding habitat locations for cave dwelling bats including Large-eared Pied Bat within and surrounding the development footprint. The former conclusion of a potential significant impact to Large-eared Pied Bat has been updated based on the revised assessment which confirms that the amended project is unlikely to have a significant impact on the Large-eared Pied Bat.

Following re-design of project components and reassessment of impacts to Box Gum Woodland the former conclusion of a potential significant impact has also been updated based on the revised assessment which confirms that the amended project is unlikely to have a significant impact on Box Gum Woodland.

Impacts to Koala and Spotted-tailed Quoll have been minimised through project design amendments reducing direct impacts to Koala habitat by approximately 14 hectares and to Spotted-tailed Quoll by approximately 40-50 hectares (with the species being associated with all areas of moderate and high condition native vegetation in the development footprint). Impacts will be further minimised through construction and operational mitigation measures targeting these species and through the establishment of local offsets aimed to increase local habitat connectivity between the existing reserve network. Despite the efforts made to reduce impacts, the residual impacts to both species have been conservatively considered significant in accordance with the EPBC Act significant impact guidelines, and as such the species will require direct offsets in accordance with the EPBC Act Offsets Policy (Commonwealth of Australia 2016). Required offsets are expected to be achieved via a combination of establishment of local Biodiversity Stewardship Sites and the securing of biodiversity credits.

Further information is provided in Section 8.8.

7 Avoid and minimise impacts

Measures to avoid and minimise impacts have been included throughout the development of the design for the Project, including the selection of wind farm layouts, access roads and the transmission line route.

The preliminary identification and mapping of biodiversity constraints occurred before the development of the wind farm layout and the selection of the preferred transmission line corridor, with preliminary biodiversity fieldwork completed in the wind farm and transmission line area in November 2018 before concept engineering design commenced. By collecting ecological data early, this allowed for consideration of biodiversity constraints during the concept design development.

Measures to minimise impacts associated with construction and operation have also been considered, with further detail on these provided in Section 8.9 and Section 8.10 of this BDAR.

The efforts made by the project to avoidance and minimise impacts to biodiversity are illustrated on Figure 1 and Figure 23.

7.1 Wind farm layout

A first pass technically feasible layout for the Project was produced based on the wind resource and required turbine spacing and resulted in a layout of up to 97 turbines. This layout was made publicly available during in the Preliminary Environmental Assessment to request the SEARs. Subsequent iterations of this layout reduced the layout to 78 turbines, then to up to 70 turbines for the project as assessed in the EIS and original BDAR, and now finally reduced to up to 65 turbines based on further design changes made in response to submissions. These updated layouts were derived based on updated turbine technology, the most up to date environmental survey information available, and additional biodiversity impact assessments. Various design rounds were held with civil, wind and biodiversity expertise and also incorporated community feedback into the project design process to minimise biodiversity impacts to the greatest extent practicable in light of Project requirements.

A high level review of the reduced impact associated with reducing the number of turbines from 97 to 78 was carried out prior to the development of the detailed engineering concepts. At this stage the area of impact was based on an indicative hardstand area for each turbine, with linking 6 metre wide access tracks only as earthworks modelling was not yet available to quantify the potential extent of cut and fill required for access roads. Based on this initial indicative assessment the 78 turbine layout impacted on 22% less native vegetation than the 97 turbine layout.

During the development of the wind farm layout as part of the preferred 78 turbine option, design workshop was held with the project ecologists, civil engineers and wind modellers to further optimise layout options to avoid impacts to significant biodiversity features, such as fauna habitat and microbat breeding areas. This review resulted in the wind farm layout being further reduced by an additional 8 turbines from a maximum of 78 turbines down to 70 turbines to further minimise biodiversity impacts and limit the clearing required to sensitive vegetation This further reduction on the number of turbines has contributed to a large reduction in the potential direct and indirect impacts, including potential impacts to habitat connectivity and turbine collision risk, associated with the project.

As part of the design workshop, preliminary ecological data from field surveys was overlaid with initial concept designs and opportunities to amend design elements were assessed. For this workshop, the following ecological data was provided:

- Areas of potential microbat roosts, as mapped using the LiDAR classification process, with a 100m buffer included.
- PCT mapping identifying areas of moderate and high condition vegetation communities to be avoided as much as possible.
- TEC mapping showing the location of the Ribbon Gum-Mountain Gum-Snow Gum community within the wind farm infrastructure corridor.

Key outcomes of this design review included:

- Removal of turbine locations in areas of steep terrain and located within 100m of identified microbat roosting habitat on rocky outcrops.
- Removal of turbine locations on very steep sections of the site within close proximity to microbat habitat roosts.
- Refinement of the access track along Morrisons Gap Road to avoid required vegetation trimming and clearing.

Accordingly, the exhibited project layout in the EIS avoided all identified microbat roosting habitat and have been optimised to minimise the extent of clearing. An analysis of the wind farm infrastructure layout between the 78 and 70 turbine configurations, shows that this resulted in an approximately 30% reduction in clearing extents (Table 44) to certain PCTs. Following the additional changes made to the Project to further reduce biodiversity impacts in response to the issues identified in submissions, impacts to native vegetation have been further materially reduced as shown below.

Table 44 Review of native vegetation impacts after design refinements to minimise biodiversity impacts

PCT	78 Turbine Layout	70 Turbine Layout	Amended design 70 turbines	65 Turbine Layout	Total Change (ha)	Total Change (%)
1194	100.17	75.65	50.80	39.29	-60.88	-61
507	0.35	0.19	0.09	0.09	-0.26	-73
927	3.64	0.00	0.00	0.00	-3.64	-100
931	5.13	6.30	6.20	3.21	-1.92	-38
934	22.46	17.96	11.87	22.82	0.36	2
954	2.15	2.73	1.37	1.23	-0.92	-43
Total	**133.90**	**102.82**	**70.33**	**66.64**	**-67.26**	-50

The additional amendments to the design undertaken in response to submisisons to further minimise impacts from internal roads, crane hardstands and laydowns/compounds were assisted by the results of the bushfire assessment which confirmed that sufficient fire protection is considered to be able to be achieved by the cleared areas themselves. Commitments for 10m APZ buffers from structures associated buildings, and infrastructure have been maintained.

It should be noted that the increase in impacts to PCT 934 have occurred as a result of detailed reviewed of plot data collected by Biosis, which showed an area mapped in the original BDAR as 'Exotic Grassland' was more representative of a Derived Native Grassland/Shrubland and was re-classified accordingly.

Further avoidance of direct impacts has been achieved through the changes made to the Project in response to the issues raised in submissions including the removal and relocation of turbines and hardstands, details of which are provided in Table 45 below.

Table 45 Design amendments and impact avoidance

Project Amendment	Description	Impact avoidance
Development footprint revision	Exhibited project footprint (EIS) comprised: • Permanent Development Footprint: approximately 242 ha • Temporary Development Footprint: approximately 271 ha • Total development footprint approximately 513 ha. Design revisions have resulted in the amended project footprint now comprising: • Permanent Development Footprint: approximately 103ha • Temporary Development Footprint: approximately 197 ha • Total development footprint approximately 300 ha	Substantial reduction in direct impacts to biodiversity values have been realised through further ongoing detailed design revision and footprint/infrastructure amendments. This is combines with the indirect benefits through the removal and relocation of turbines as well as a reduction in bulk earthworks and associated project infrastructure.
Removal of WP1	WP1 was the closest turbine to the Crawney Pass National Par and its removal reduces biodiversity impacts, native vegetation removal and the requirement for bulk earthworks. The road required to access the turbine has also been removed, further benefitting biodiversity values in that location.	WP1 was considered a Moderate Risk turbine and its removal benefits locally occurring threatened and non-threatened fauna species including microbats, Koala, Greater Glider, as well as to approximately 2ha of Ribbon Gum TEC vegetation. Removal from the project design has the direct benefit of reducing native vegetation removal, but also reduces potential connectivity impacts as the turbine was acting as an outlier on the south-western extent of the array, and the turbines now occur in a more linear arrangement in that location.
Removal of WP19	WP19 has been removed reducing impacts to biodiversity values in the centre of the wind farm. It will reduce the earthworks and vegetation clearance needed to install the turbine, supporting hardstand area and access road.	The removal of WP19 results in an increase separation gap from 1 – 1.5km between turbines in this location, to approximately 2.1km between turbine WP18 and turbines WP20-22 reducing habitat connectivity impacts in an areas of the wind farm where moderate condition habitats occur on either side of the ridgeline. The removal of WP19 also allows for an approximate 600 metre reduction of the intrusion into intact vegetation to the south of the development footprint.
Removal of WP23, 27	WP23, 27 and 31 have all been removed to	All three of these turbines were assessed a

Project Amendment	Description	Impact avoidance
and 31	reduce risk of direct and indirect impact biodiversity values including potential microbat breeding habitat, modelled owls breeding habitat, and intact vegetation. The removal of these turbines will reduce significant bulk earth works associated with hardstands and associated roads, and reduces the area of impact from the southern-most portion of the wind farm by 400 – 500m at each turbine location.	High Risk turbines (four assessed in total) relating to potential impacts to biodiversity values. WP23 was considered high risk due to its occurrence as southern outlier in high condition intact native vegetation considered likely to support habitat for numerous threatened species, WP27 was located in close proximity to confirmed potential microbat breeding habitat, and WP31 occurred in proximity to modelled large forest ole breeding habitat. The removal of these three turbines will substantially benefit biodiversity values utilising the habitats along this southern portion of the wind farm, both directly though a reduction in vegetation removal, and indirectly through a reduction in potential collision risk, breeding habitat disturbance, and connectivity impacts.
Reorientation of WP2 hardstand	The hardstand for WP2 has been reorientated such that it now occurs largely on exotic grassland.	This reorientation complements the reduction of impacts associated with the removal of WP1 and reduces impacts to Ribbon Gum TEC vegetation by another 0.3ha (on top of the 1ha reduction highlighted above from WP1).
Relocation of WP47	WP47 has been relocated 209 metres north east of the exhibited location. This is to reduce the extent of vegetation clearance in this location.	Increased buffer distance from retained native vegetation on the escarpment and reduction in clearing native vegetation benefits biodiversity values in that location.
Relocation of WP50	WP50 was been moved approximately 130m to the north-east to avoid indirect impacts to conformed microbat potential breeding habitat.	WP50 was the fourth (of four) turbines assessed as High Risk turbine, and has been substantially relocated to avoid indirect impacts to the conformed microbat potential breeding habitat that occurs to the south-west of the turbine and hardstand location. The turbine, turbine blade and additional zone of disturbance are now all located well outside the 100m BAM prescribed microbat breeding habitat buffer. The relocation of this turbine will benefit microbats potentially utilising the potential habitat through a reduction of potential collision risk, and potential vibration impacts during construction.

7.2 Microbat and bird habitat

The results of the field investigations identified substantial species diversity in threatened microbats using the site, including both cave and hollow-dependent species. Some of these bats are assessed as ecosystem credit species, and their impacts are quantified as part of the impacts to native vegetation. These include Little Pied Bat *Chalinolobus picatus*, Eastern False Pipistrelle *Falsistrellus tasmaniensis* and Eastern Coastal Free-tailed Bat *Micronomus norfolkensis*. The presence of these bats is predicted based on vegetation type and geographic location. The field surveys also confirmed the presence of several species credit bats, where presence cannot be reliably predicted by PCT mapping Large-eared Pied Bat *Chalinolobus dwyeri*, Little Bent-wing Bat *Miniopterus australis*, Large Bent-wing Bat *Miniopterus orianae oceanensis* and Eastern Cave Bat *Vespadelus troughtoni*.

Due to the high level of activity recorded for threatened cave-dwelling bats within, and surrounding the development footprint, additional mapping and assessment was completed to maximise the buffer from this area of breeding habitat. Using the LDAR data, areas of potential roost habitat was mapped using the method described in Section 5.4.2 of this BDAR. These areas were then subject to ground-truthing to confirm the presence of rocky outcrops where cave-dwelling bats may roost (Figure 15). However, the success of these ground-truthing surveys in February 2020 were significantly hampered by rain and foggy weather making access to these areas, representing the steepest parts of the site, unsafe. As such the potential microbat roost habitat polygons were required to remain highly conservative in nature, with little refinement from ground surveys possible (refer Section 5.4.2). These highly conservative potential bat roost areas were then used to further refine the wind farm layout, allowing for avoidance of direct impacts to all areas of potential habitat, to be considered as part of the design process.

The wind farm layout was initially amended to avoid any direct impacts to areas of roost habitat for cave-dwelling bats and no project related infrastructure is proposed within these important areas. To further avoid impacts a 100 metre buffer was applied around all identified areas of roosting habitat on steep cliffs, and as much as possible, the placement of turbines was designed to avoid this buffer.

Follow-up desktop assessment and ground-truthing surveys (as described in Section 5.4.2) were able to be completed in March 2021 to further refine the original microbat roost polygons. Direct impacts from all but one of the 70 turbines were found to be outside the 100 metre buffer on high potential microbat roost habitats. Following on from ground-truthing assessments of microbat habitat qualitative risk assessments were completed for potential turbine impacts to microbats and birds, and a risk assessment was also completed on a turbine by turbine basis. As outlined in Sections 8.3.1, 8.3.2 and 8.3.3 a number of microbat and bird species were assessed as being at a moderate risk of impact at both the local site scale and the local population scale, and four turbines were assessed as presenting a high risk of impact to aerial biodiversity values.

Following consultation between Biosis ecologists and project designers and engineers three of the four turbines assessed as 'High Risk' have subsequently been removed from the project layout, and the fourth turbine has been relocated over 100 meters further from the area of confirmed potential microbat habitat (Table 45). This removal or relocation of turbines has resulted in no turbines occurring within 300 metres of confirmed potential microbat habitat, with rotor-swept area and additional zones of disturbance (refer Section 8.5) occurring within >170 metres from the edge of the habitat. This has resulted in potential serious and unavoidable impacts to cave roosting bats being avoided be the project. Additionally, one of the high risk turbines was previously located within the 100 metre owl breeding habitat buffer from a gully modelled as potentially suitable habitat for all four large forest owl species, assumed present within the subject land. The removal of this turbine ensures there is an additional 450 metre buffer from this potential breeding habitat.

Detailed assessment of the impacts associated with the location of turbines and confirmed microbat roost habitat are contained in the following sections of this BDAR, and mitigation measures have been developed, to be implemented through a Bird and Bat Adaptive Management Plan to ensure impacts are further minimised through the construction and operational phase of the project.

The location and siting of turbines also considered including suitable buffers to areas of potential foraging habitat by microbats. The assessment has used the formula for required buffers to areas of vegetation developed in Natural England Technical Information Note TIN051 – Bats and onshore wind turbines interim guidance. This method takes into consideration the hub height and blade length of adjacent turbines and identifies the required horizontal distance a turbine should be placed to maintain a suitable buffer (Figure 22).

$$b = \sqrt{(50 + bl)^2 - (hh - fh)^2}$$

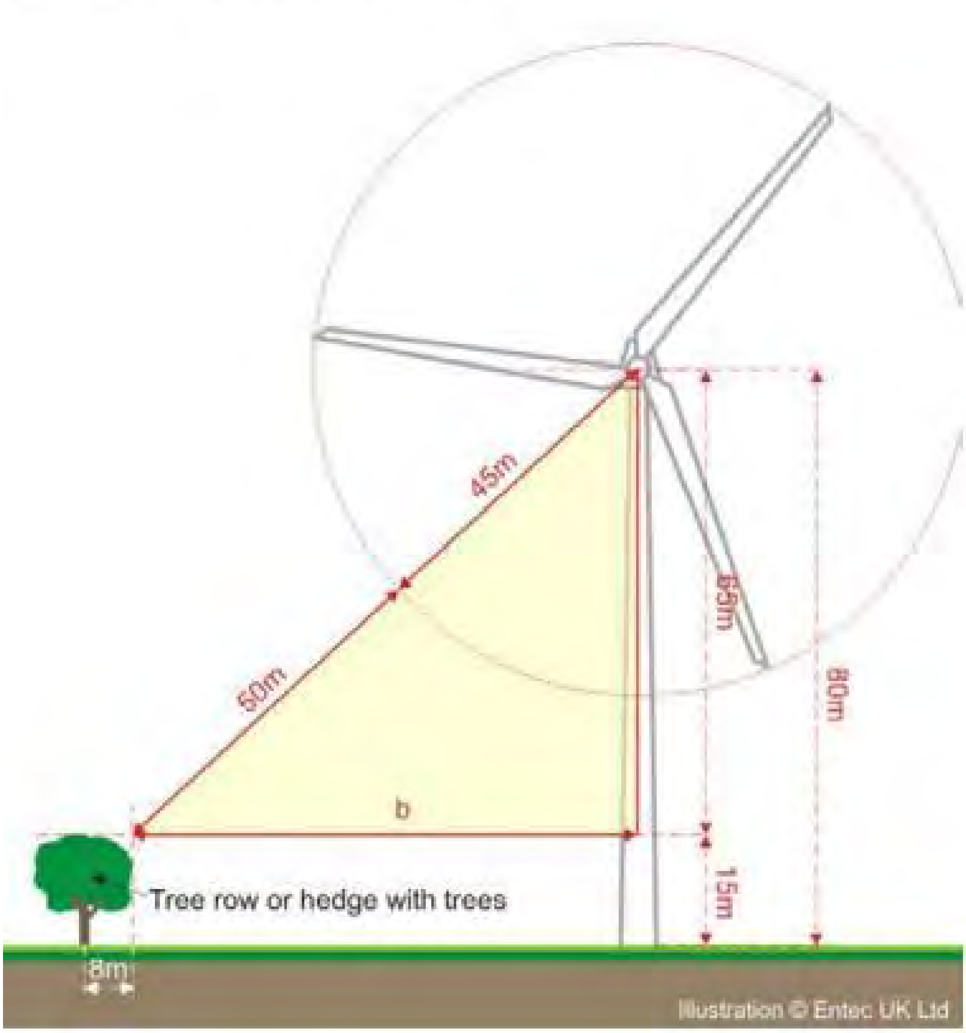


Figure 22 Extract from Technical Information Note TIN051 Bats and onshore wind turbines, showing how buffer distance is determined from top of canopy to blade tip

As field surveys identified a high diversity and relative abundance of threatened microbats across the subject land, further analysis was carried out on each of the turbines to assess the quantum of potential incursion into the required buffer (Table 45) and to determine the buffers for the Project.

In applying the buffer formula from TIN051, the following site specific parameters were input for the required variables to use for the formula to obtain the buffer:

- Turbine name is a unique identifier for each turbine and the spatial location of each turbine was mapped using GIS so it's position relative to the nearest foraging habitat feature was able to be measured.
- Distance to foraging habitat was determined using the measure tool in GIS to measure the distance from the wind turbine to the nearest patch of native vegetation, ground-truthed as part of the PCT mapping for the development footprint.
- Feature height is an estimate of the canopy height of the nearest patch of PCT assessed to be potential microbat foraging habitat. This tree height was taken to be a median height of the vegetation community type as defined by Walker and Hopkins, 1990.

This assessment was completed on a turbine that provides a ground clearance of 58m from the blade tip.

Regarding the buffer assessment using the formula in TIN051, the project wind turbine layout achieves a minimum of 36m clearance from top of canopy to blade tip. The assessment shows that:

- 34% of turbines provide a buffer of 30-40m.
- 43% of WTGs provide a buffer of 40-50m.
- 23% of WTGs provide a buffer of > 50m.

Accordingly, the Project provides an average buffer of 51m from the tip of blades and the closest area of tree canopy.

Table 46 Assessment of buffer from blade tip to top of canopy using TIN051

Turbine Name	Distance to foraging habitat (m)	PCTs and condition in 100m buffer	Feature height (m)	Buffer distance (m)
WP31	21.15	931; 1194-high	23.5	36.42
WP1	22.11	1194- high	23.5	36.60
WP27	22.47	1194-high	23.5	36.67
WP33	22.74	931-high; 1194-mod	23.5	36.72
WP23	23.00	1194-mod	23.5	36.77
WP43	23.00	1194-mod	23.5	36.77
WP61	23.10	1194-mod&high; 927-high	23.5	36.79
WP18	23.17	1194-mod; 934-mod&high	23.5	36.80
WP21	23.58	1194-high	23.5	36.88
WP24	24.78	1194-mod	23.5	37.13
WP11	25.73	931-mod; 934-high	23.5	37.33
WP49	26.72	1194-low&high	23.5	37.55
WP22	26.99	1194; 934-high	23.5	37.61
WP70	28.16	1194-low; 931-high	23.5	37.88
WP16	29.47	1194-mod	23.5	38.20
WP9	30.14	931-mod; 1194-low	23.5	38.37
WP63	30.64	1194-mod	23.5	38.50
WP20	30.97	1194-high; 934-low	23.5	38.58
WP6	31.64	1194-high	23.5	38.76
WP28	31.79	1194-high	23.5	38.80
WP36	33.07	1194-low&mod	23.5	39.14

Turbine Name	Distance to foraging habitat (m)	PCTs and condition in 100m buffer	Feature height (m)	Buffer distance (m)
WP58	33.26	1194-mod	23.5	39.19
WP46	34.70	1194-mod&high	23.5	39.60
WP59	35.13	1194-low&high;934-high	23.5	39.72
WP2	36.10	1194- high	23.5	40.01
WP54	36.15	1194-low, mod&high	23.5	40.02
WP51	36.85	1194-low&mod	23.5	40.24
WP4	23.89	507-mod	20	40.38
WP48	37.74	1194-low&high	23.5	40.51
WP8	38.13	931-mod; 934-low	23.5	40.63
WP30	50.89	931-mod; 934-DNG&mod	28.5	40.66
WP64	38.66	1194-high; 927-high	23.5	40.80
WP57	39.46	1194-mod	23.5	41.05
WP7	39.75	1194-high	23.5	41.15
WP12	42.53	934-mod; 1194-high; 954-high	23.5	42.08
WP34	25.18	1194-mod&high	18.5	42.10
WP5	43.07	1194-mod	23.5	42.27
WP38	43.11	1194-high	23.5	42.28
WP15	43.57	1194-DNG&Mod; 954-High	23.5	42.44
WP65	44.33	1194-high	23.5	42.71
WP66	44.98	931-high;1194-mod	23.5	42.95
WP50	46.07	1194-low, mod&high	23.5	43.35
WP53	38.23	1194-low&high	18.5	45.42

Turbine Name	Distance to foraging habitat (m)	PCTs and condition in 100m buffer	Feature height (m)	Buffer distance (m)
WP68	51.78	1194-low&mod	23.5	45.57
WP13	54.16	954-high	23.5	46.57
WP69	54.66	1194-low	23.5	46.78
WP29	43.46	931-mod; 934-DNG&mod	18.5	47.10
WP62	55.81	1194-low&mod	23.5	47.28
WP3	56.31	1194- high; 934- mod	23.5	47.50
WP19	30.80	934-high	13.5	48.22
WP39	59.15	1194-mod&high	23.5	48.77
WP17	33.47	1194-mod; 934-high	13.5	48.89
WP14	59.73	931-mod; 1194-DNG; 954-high	23.5	49.03
WP60	60.22	1194-low&mod;934-high	23.5	49.26
WP32	51.47	931-high; 1194-DNG&mod	18.5	50.03
WP42	38.57	1194-low&high	13.5	50.29
WP41	39.16	934-high	13.5	50.47
WP10	66.42	931; 1194; 934-mod	23.5	52.24
WP52	68.19	1194-low	23.5	53.13
WP40	35.35	931-low; 934-high	8.5	54.20
WP37	78.76	1194-low&high	18.5	62.96
WP25	93.27	934-low	23.5	67.46
WP56	93.90	1194-mod	23.5	67.85
WP67	113.66	1194-low	23.5	81.05
WP44	95.29	NA		87.53

Turbine Name	Distance to foraging habitat (m)	PCTs and condition in 100m buffer	Feature height (m)	Buffer distance (m)
WP47	169.27	1194-low&high	23.5	123.92
WP35	157.02	NA		128.70
WP55	161.17	NA		131.83
WP26	184.47	NA		149.97
WP45	184.62	NA		150.10

7.3 Transmission line route selection and design optimisation

During the design development phase, a wider landscape assessment area was reviewed for potential transmission line corridor. Seven potential transmission line routes were identified and to understand visual impact and willingness to reach land agreements. Desktop and field validated vegetation and habitat maps where reviewed and transmission line options assessed for likely impacts to significant biodiversity features, with a focus on minimising impacts to TECs. A desktop assessment was undertaken to identify the potential impacts to native vegetation communities for each of the seven options using the State Vegetation Type Mapping for the alignments (Table 47). The initial alignment options are illustrated on Figure 23 below.

Table 47 Transmission line route selection and estimate of native vegetation impacts.

Transmission line option	Estimated area of PCT impacts
Route 1	105.02
Route 2	127.98
Route 3	118.70
Route 4	126.47
Route 5	127.03
Route 6	178.24
Route 7	138.91

Following the review of each of these seven options, two preferred routes were selected and an optimisation consisting of a 200 metre corridor was undertaken to adjust the routes to minimise further impact around mapped PCTs and TECs. The transmission line corridor was then further refined to a single option a 60 metre wide impact areas was determined, resulting in impacts to 31.4 hectares of exotic grassland, and 53.5 hectares of native vegetation, of which 3.1 hectares comprises Box Gum Woodland CEEC. This level of impact includes those areas determined as impacted by AECOM (2021) where the vegetation occurs within valleys spanned by the overhead lines (refer section 7.3 for more detail).

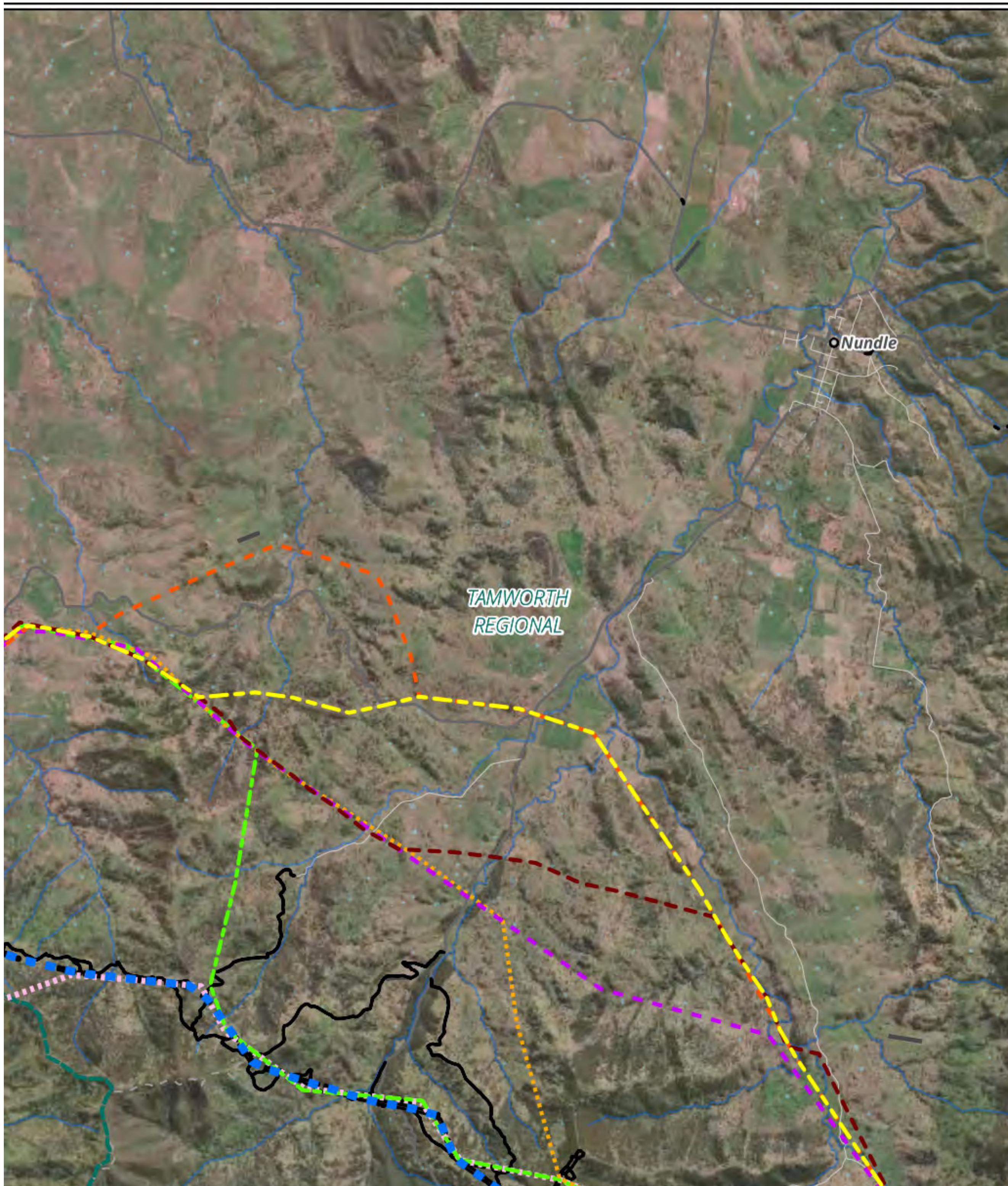
In March 2021, following exhibition of the EIS, another re-design of the transmission line alignment was completed, relocating approximately 3 kilometres of the transmission line corridor further reducing impacts to a number of patches of high condition native vegetation by locating the footprint now predominantly in areas of exotic grassland, further south and closer to the turbines. This design revision has resulted in materially reduced direct impacts to native vegetation and habits, including mapped habitat for Koala and Spotted-tailed Quoll.

As part of responding to concerns of impact along the transmission line route, AECOM was engaged to prepare a *330 kV Overhead Line vegetation Clearance Report* to further refine the impacts to biodiversity along the transmission line corridor. The scope of the assessment was to:

- Review the Lidar Survey to incorporate the vegetation data for upload into PLS-CADD.
- Prepare the PLS-CADD Maximum design temperature bottom conductor profile with a vegetation clearance line – 3.0 metres plus 1.0 metre regrowth (minimum 4.0 metre required).
- Prepare the structure clearance envelope of 60.0 metres around structure locations.
- Prepare the 50 degree C and 500 pa vegetation clearance envelopes for all spans on the Hills of Gold 330 kV transmission line.

The assessment report (provide as Appendix I) confirms that vegetation occurring within valleys will be sufficiently spanned by the overhead lines so that clearing can be avoided. It should be noted that the AECOM report provided highly refined polygons mapping impacted vegetation to the scale of individual tree canopies, which have been conservatively expanded to the full 60 metre wide transmission line corridor footprint assessed for impacts as part of this BDAR. This has ensured that whilst impacts along the transmission line corridor have been reduced, the impacts assessed remain conservative in nature.

Opportunities to carry out ecological restoration works across the remaining portions of the transmission line corridor which require clearing will be investigated during detailed design, and are committed to in Section 8.9 of this BDAR. At a minimum, this will include native grass seeding, but where appropriate due to operational and safety constraints, planting with native shrubs and trees will be considered.



Nundle
TAMWORTH REGIONAL

7.4 Access roads – construction and operation

Existing road infrastructure was prioritised to provide construction access and operational tracks for the Project. This included locating primary construction access routes along the existing public access roads Head of Peel Road and Morrisons Gap Road. The alignment of the new sections of access tracks within the wind farm corridor largely follows the existing cleared sections of the site, and the development footprint has considered a 5 metre buffer for the majority of the access tracks.

Recent design updates made following preparation of the original BDAR have resulted in the following revisions to the project access roads and ancillary facilities and result in materially reduced impacts to biodiversity values, compared to those asessed in the original BDAR.

Table 48 Design amendments and impact / benefit

Project Amendment	Description	Impact/benefit
Traffic Access to Project Area	All Project traffic will access the Project Area via Morrisons Gap Road only. The Head of Peel Road will not be used for Project related construction and operational traffic and will be for emergency use only. As a result, road upgrades previously proposed along the Crawney Road / Head of Peel access route ('Southern Route') will not be undertaken	Reduction in number of waterway crossings and impacts to native vegetation and fauna habitat through removing access along Head of the Peel Road.
Removal and realignment of internal road networks	Removal of the internal road from the Project Area near southern end of Head of Peel Road into western area of the Project Site. Sections of track between WP16 to WP17, WP17 to WP18, WP46 to WP47 and WP66 to WP67 and have been reassessed to avoid biodiversity impact and following contractor input on reducing earthworks and required width of footprint.	Removal of internal roads will directly and indirectly benefit previously impacted biodiversity values due to a reduction in vegetation clearing, bulk earthworks and fragmentation of vegetation and habitats.
Key Intersection, Devils Elbow and Morrison Gap Road design update	The proposed road upgrades at Devils Elbow and the Barry Road/Morrison Gap Road intersection have been modified. Proposed upgrades would require vegetation clearing with the Devils Elbow footprint approximately 2.5 ha and the Barry Road/Morrison Gap Road proposed footprint is approximately 2.4 ha.	Impacts associated with the exhibited project footprint (EIS) at Devils Elbow comprised approximately 17ha of native vegetation generally in high condition. Substantial design revisions have reduced the impact assessed in this location to 2.5 ha of native vegetation (refer Plate 1 above), leading to direct and indirect benefits to previously impacted vegetation and habitats in this area. This includes Box Gum Woodland Critically Endangered Ecological Community and habitat for threatened fauna species. Previously exhibited impacts considered a number of design options of which only one was intended

Project Amendment	Description	Impact/benefit
		to be constructed. The final route selected presented the lowest impact option and was further refined to avoid impacts.
Transport Route Updates	The transport route for OSOM from the Port of Newcastle to the Project Area has been amended by the following: • Removal of the tower route option via Tamworth; • Removal of the Head of Peel Road route ('Southern Route') (as stated above) and associated alternate routes through Nundle including Happy Valley Road, Jenkins St, Gill St, Innes St; • Inclusion of route optionality in Muswellbrook; • Two additional laybys for OSOM traffic on Lindsay Gap Road and Morrisons Gap Road to allow existing road users to pass slower moving Project traffic.	Refinement of designs ensure a more accurate assessment of impacts.
Ancillary Infrastructure Amendments	As a result of the removal of the Head of Peel Road access to the Project Area, the construction laydown area and batching plant at the top of the Head of Peel Road access route has been deleted. The laydown area / batch plant has been relocated to the footprint of the BESS / substation and O&M facility.	Overall design revisions to ancillary areas have resulted in a reduction to previously presented impacts biodiversity values.
	Substation, BESS and O&M configuration has been amended following further substation design works	
	Relocation of O&M to WP56 based on feedback in the Hazards and Risk Report	
	Laydown Area and Concrete Batching Plant optionality for all laydown areas with the exception of laydowns along Morrisons Gap Road to host concrete batching plants (total number of batching plants for the Project will not increase and will remain as two).	
	An additional temporary construction compounds are proposed adjacent to WTG 56 and at the eastern (downslope) extent of the Devils Elbow bypass in an existing cleared pullover bay. No impacts	

Project Amendment	Description	Impact/benefit
	to vegetation will occur at the evils Elbow compound.	

In addition to minimising clearing associated with access tracks, it is proposed that up to 200 hectares of this development footprint (considered temporary impacts related to construction) will be rehabilitated with native species mixes. This will compensate for some of the impacts associated with earthworks for road batters. However, in order to ensure an appropriate degree of conservatism, all impacts, including temporary impacts have been fully assessed in this BDAR.

7.5 Overall direct impact reduction resulting from project amendments following the Original BDAR

The following tables highlight the reduction of impacts to native vegetation, TECs and threatened BAM species credit species, based on the additional field investigations and recent design revision undertaken following the preparation of the original BDAR.

Table 49 Revised vegetation impacts

Vegetation condition class	2020 BDAR Area (ha)	Updated BDAR Area (ha)	Reduction	% of mapped vegetation
Planted or urban vegetation	7.39	0.24	97%	0.08%
Exotic grassland	272.36	164.48	40%	55.35%
Derived Native Grasslands	30.91	29.06	6%	9.78%
Native vegetation – Low condition	37.11	19.28	48%	6.49%
Native vegetation – Moderate condition	73.8	46.18	37%	15.54%
Native vegetation – High condition	64.88	37.92	42%	12.76%
TOTAL	**486.45**	**297.15**	**39%**	**100%**

Table 50 Reductions in project refinements

Relevant matter	Details	2020 BDAR Direct impacts	2021 Updated BDAR Direct impacts	Total change
Native vegetation communities and ecosystem credit species habitats.	Direct loss of native vegetation communities associated with site clearing	207.7 ha	132.43 ha	-75.27 ha
Threatened ecological communities	Direct loss of Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion	57.43 ha	23.36 ha	-34.07 ha

Relevant matter	Details	2020 BDAR Direct impacts	2021 Updated BDAR Direct impacts	Total change
	Direct loss of White Box Yellow Box Blakely's Red Gum Woodland and derived native grassland	13.33 ha	6.07 ha	-7.26 ha
Habitat for threatened fauna species – species credit species	Large-eared Pied Bat*	61.08 ha	19.68 ha foraging habitat 0 ha breeding habit	-41.4 ha
	Eastern Cave Bat*	62.49 ha	19.68 ha foraging habitat 0 ha breeding habitat	-42.81 ha
	Large Bent-winged Bat*	23.12 ha	0 ha (foraging and breeding habitat)	-23.12 ha
	Little Bent-winged Bat*	23.12 ha	0 ha (foraging and breeding habitat)	-23.12 ha
	Southern Myotis	2.21 ha	3.97 ha	1.76 ha
	Eastern Pygmy-possum	70.03 ha	18.14 ha	-51.89 ha
	Koala	50.76 ha	36.44 ha	-14.32 ha
	Squirrel Glider	26.20 ha	16.06 ha	-10.14 ha
	Booroolong Frog	1.59 ha	0.64 ha	0.95 ha
	Border Thick-tailed Gecko	0.17 ha	0.17 ha	0 ha
	Powerful Owl	Assessed as not present as none were observed during surveys	1.99 ha based on assumed presence	No change. However, based the conservative assumption that this species is present despite not being located during surveys, 1.99 ha of potential habitat will be impacted.
	Sooty Owl	As above	As above	As above
	Barking Owl	As above	As above	As above
	Masked Owl	As above	As above	As above
Habitat for threatened fauna species – ecosystem credit species	State and Commonwealth listed threatened fauna species known or predicted to occur	207.7 ha	132.43 ha	-75.27 ha

Relevant matter	Details	2020 BDAR Direct impacts	2021 Updated BDAR Direct impacts	Total change
Total Reduction				293.74 ha

These project amendments resulted in a total reduction in impacts to vegetation of 39 %, with a reduction of 42 % in areas of high condition native vegetation. A total of 72.41 hectares of low to high condition native vegetation has been assessed as avoided in this updated layout and BDAR.

As a result targeted field survey, significant refinement have been achieved for previously assumed potential roosting / breeding habitat locations for cave dwelling bats including the threatened Eastern Cave Bat, Large Bent-winged Bat, Little Bent-winged Bat and Large-eared Pied Bat within and surrounding the development footprint. The former conclusion of a potential significant impact to Large-eared Pied Bat has been updated to unlikely, and coupled with turbine removal and relocation, potential Serious and Irreversible Impacts to all four species have now been avoided. Further information is provided in Section 8.8.

7.6 Possible alternative site access footprint at Barry Road and Morrisons Gap Road

An alternative and less preferred option for site access exists at the corner of Barry Road and Morrisons Gap Road where road upgrades are required to allow for the delivery of turbine components to site. The current footprint and impact calculations included in this BDAR are based on the preferred access option, where the majority of the roadworks and associated impacts are mainly confined to the southern side of Barry Road, with some minor works required on the northern side of the road. The alternative design includes re-locating the majority of the roadwork to the northern side of Barry Road to create a large sweeping turning area.

The preferred and alternative options for site access at the corner of Barry Road and Morrisons Gap Road are illustrated on Plate 2 below.

Plate 2 Preferred and alternative options for site access (approx areas)

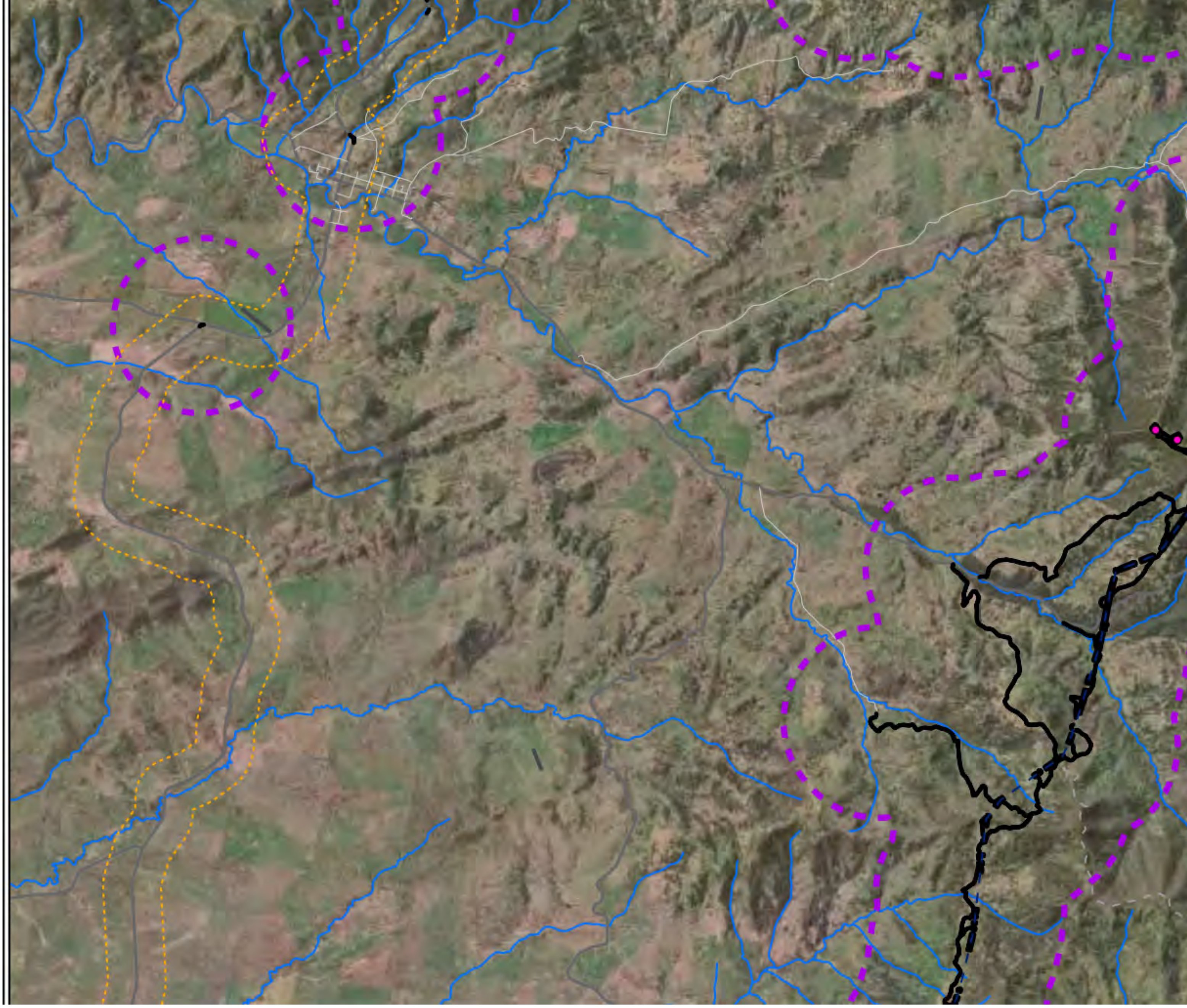
As landowner negotiations are ongoing at the time of finalisation of this BDAR, impacts included and assessed herein are based on the preferred southern option only. Table 51 below provides a comparison of the potential impacts to biodiversity values in this location if the preferred southern, or less preferred northern option, are selected.

Table 51 Impact comparison for preferred and alternative options for site access

Biodiversity value	Preferred – Southern option impacts (Ha	Less preferred – Northern option impacts (ha)	Impact comparison if Northern option progressed (Ha)
PCT 1194 – High	0.01	0.58	+ 0.57
PCT 1194 – Moderate	0.15	0.06	- 0.09
PCT 1194 – DNG	0.10	0.04	- 0.06
Ribbon Gum-Mountain Gum-Snow Gum TEC (total of PCT 1194 impacts)	0.26	0.68	+ 0.42
Eastern Pygmy-possum	0.01	0.58	+ 0.57
Greater Glider	0.01	0.54	+ 0.53
Koala	0.16	0.65	+ 0.49
Spotted-tailed Quoll	0.16	0.65	+ 0.49

Biodiversity value	Preferred – Southern option impacts (Ha	Less preferred – Northern option impacts (ha)	Impact comparison if Northern option progressed (Ha)
Squirrel Glider	0.16	0.65	+ 0.49

If the less preferred northern option is ultimately progressed, impacts will be formally recalculated as part of detailed design, however even with this eventuality, the Proponent is committed to ensuring total impacts are kept within the upper limits detailed in this BDAR, which will be made possible by expected savings made elsewhere within the current worst case scenario development footprint assessed herein.

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8 Assessment of Impacts

8.1 Impact summary

The approach to impact assessment has included assessment of a worst-case scenario covering direct impacts associated with habitat loss and indirect impacts associated with construction and operation of the project.

Table 52 details the impacts of the optimised Project to biodiversity following the implementation of the measures outlined above to avoid and minimise impacts. Where biodiversity impacts are relevant for each proposal phase this has been identified accordingly. These are discussed further in the following sections.

Table 52 Potential impacts to biodiversity

Biodiversity value	Potential impact	Infrastructure type	Proposal phase	
			Construction	Operation
Direct impacts				
Native vegetation and ecosystem credit species habitats	Clearing of 132.43 ha of native vegetation, comprised of:	All	✓	
Threatened Ecological Communities	Clearing of 23.36 ha of Ribbon Gum-Mountain Gum-Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion	Wind turbine infrastructure Temporary construction footprint Transmission line Transport route upgrades Internal roads Ancillary	✓	
	Clearing of 6.07 ha of White Box Yellow Box Blakely's Red Gum Woodland	Transmission line Transmission line access tracks Transport route upgrades	✓	
Threatened fauna habitat – Species credit species and MNES	Clearing of 19.68 ha of foraging habitat for Large-eared Pied Bat	Wind farm infrastructure Transmission line Transmission line access tracks Internal roads Ancillary	✓	
	Clearing of 19.68 ha of foraging habitat for Eastern Cave Bat	Wind farm infrastructure Transmission line	✓	

Biodiversity value	Potential impact	Infrastructure type	Proposal phase	
			Construction	Operation
		Transmission line access tracks Internal roads Ancillary		
	Clearing of 18.14 ha of habitat for Eastern Pygmy-possum	Wind farm infrastructure Transmission line Transmission line access tracks Internal roads Ancillary	✓	
	Clearing of 36.44 ha of habitat for Koala	Wind farm infrastructure Transmission line Transmission line access tracks Internal roads Ancillary Haul route upgrades	✓	
	Clearing of 0.17 ha of habitat for Border Thick-tailed Gecko	Transmission line Transport line access tracks Transport route upgrades	✓	
	Clearing of 3.97 ha of breeding habitat for Southern Myotis	Wind turbine infrastructure Transport route upgrades Internal roads	✓	
	Clearing of 32.30 ha of habitat for Greater Glider	Wind farm infrastructure Transmission line Transmission line access tracks Internal roads Ancillary Transport route upgrades	✓	
	Clearing of 40.67 ha of habitat for Spotted-tailed Quoll	Wind farm infrastructure	✓	

Biodiversity value	Potential impact	Infrastructure type	Proposal phase	
			Construction	Operation
		Transmission line Transmission line access tracks Internal roads Ancillary Transport route upgrades		
	Clearing of 16.06 ha of habitat for Squirrel Glider	Wind farm infrastructure Transmission line Transmission line access tracks Internal roads Ancillary Transport route upgrades	✓	
	Clearing of 1.99 ha of habitat for Barking Owl	Internal roads	✓	
	Clearing of 0.99 ha of habitat for Masked Owl	Internal roads	✓	
	Clearing of 1.99 ha of habitat for Powerful Owl	Internal roads	✓	
	Clearing of 1.99 ha of habitat for Sooty Owl	Internal roads	✓	
	Clearing of 0.64 ha of impact for Booroolong Frog	Transmission line and access tracks	✓	
Indirect impacts				
Threatened fauna	Collision risk for birds and bats	Wind farm infrastructure		✓
Native vegetation, threatened ecological communities and habitat for threatened species	Edge effects and impacts to habitat viability	All lands in proximity of cleared areas	✓	✓
	Disturbance of habitats from noise and light	All land in proximity to operational infrastructure which generates noise or requires night lighting	✓	✓
	Disturbance from weeds, pests and pathogens	Wind farm and transmission line	✓	✓

Biodiversity value	Potential impact	Infrastructure type	Proposal phase	
			Construction	Operation
		corridor		
	Fauna injury/ mortality	All lands	✓	✓
Prescribed impacts				
Native vegetation, threatened ecological communities and habitat for threatened species	Loss of habitat connectivity	Wind farm and transmission line corridor	✓	✓
	Impacts to hydrology and water quality	Wind farm and transmission line corridor	✓	
	Impacts to karst, caves, crevices, cliffs and other geological feature of significance	Low potential for wind farm corridor	✓	
Threatened fauna and migratory species	Impacts of wind turbine strikes on protected animals	Wind farm corridor		✓
	Impacts to flight paths for raptors and resident aerial species	Wind farm corridor		✓
Other impacts				
Aquatic habitats	Impacts to hydrology and downstream water quality	Access/ transport routes	✓	
	Impacts to fish passage	Access/ transport routes	✓	

8.2 Direct impacts

Direct impacts associated with the development are primarily related to the proposed site clearing works. Site clearing will be carried out for the development footprint. As identified in Table 49, the amended Project has resulted in a total reduction in direct impacts to vegetation of 39%, with a reduction of 42% occurring in areas of high condition native vegetation. A total of 74.26 hectares of native vegetation previously proposed to be impacted has now been avoided as a result of the amended layout.

8.2.1 Clearing of native vegetation

The majority of the impacts to vegetation within the development footprint will be to exotic grassland and planted vegetation, with a total of 164.72 hectares of clearing of this vegetation type required.

A total of 132.43 hectares of native vegetation will be cleared from within the development footprint. This includes:

- 29.43 ha for temporary construction footprint.
- 15.05 ha for wind turbine infrastructure.
- 20.29 ha for internal roads.
- 46.90 ha for the transmission line.

- 6.55 ha for the transmission line access tracks.
- 5.58 ha for the transport route upgrades.
- 8.62 ha for ancillary areas.

As described in Section 3 of this BDAR in detail, the condition of the native vegetation is highly variable and patchy, with the majority being derived native grassland, low or moderate condition.

The 132.43 hectares of native vegetation which is contained in the development footprint represents 0.6% of the approximately 21,540 hectares of native vegetation contained within the landscape assessment buffer area of 1,500m and is an even smaller fraction of the native vegetation which surrounds the assessment area

To mitigate impacts to native vegetation as a result of temporary impacts, site rehabilitation and ecological restoration works will be completed in areas such as batters for access tracks, temporary construction laydown areas and trenching for underground cabling. A Biodiversity Management Plan for the site will also look at opportunities for revegetation and restoration plans to buffer areas of important habitat, such as the adjacent Ben Halls Gap Nature Reserve and to provide for biodiversity corridors through the development footprint.

Estimates of areas to be subject to rehabilitation works (temporary impacts) through seeding or planting with native species, includes a total of 200 hectares and includes:

- 6.52 hectares within the wind farm infrastructure development footprint.
- 92.11 for bulk earthworks associated with the wind farm development footprint.
- 29.27 hectares for internal access roads development footprint.
- 63.82 hectares for the transmission line development footprint.
- 6.61 hectares for ancillary infrastructure development footprint.
- 1.47 hectares for the transport haul route development footprint.

These rehabilitation works will materially contribute towards minimising the impacts to native vegetation and fauna habitats within the development footprint. During detailed design, opportunities to include trees and shrubs in the rehabilitation species mix will be considered where site constraints regarding safety and operation permit. Based on these current estimates for areas to be subject to rehabilitation, the loss of 132.43 hectares of native vegetation can be compensated by the 200 hectares of restoration, including seeding areas currently mapped as exotic grasslands with native seeding or planting.

8.2.2 Threatened Ecological Communities

A total of 29.43 hectares of the vegetation which will be impacted by the updated development footprint is associated with two threatened ecological communities being White Box Yellow Box Blakely's Red Gum Woodland and Ribbon Gum-Mountain Gum-Snow Gum open forest or woodland (Table 53).

To provide some context on the significance of impacts to these TECs, an assessment of the potential extent of these communities in the assessment area has been carried out. The White Box-Yellow Box-Blakely's Red Gum Woodland TEC occurs within the transmission line corridor, so the assessment of area impacted considered the investigation area for corridor options. This provides a more focused assessment of the impacts for the local landscape which is considered more representative than looking at a bioregional or sub-bioregional scale where percent impacts would be further diluted.

Table 53 Proposal impacts to threatened ecological communities

TEC	Area impacted (ha)	Area in investigation (ha)	% of investigation area impacted
White Box Yellow Box Blakely's Red Gum Woodland	6.07	1,693.6	0.4%
Ribbon Gum-Mountain Gum-Snow Gum open forest or woodland	23.36	1,059	2.2%

Based on an estimate of the likely extent of these TECs within the assessment area, the project is unlikely to result in a significant impact to these TECs, as there are substantial areas retained in the area for investigation associated with the wind farm and transmission line easement. The estimate of area of TECs for White-Box-Yellow-Box-Blakely's Red Gum extent was derived from the State Vegetation Map for Border Rivers Gwydir / Namoi Region Version 2.0. VIS_ID 4467 (OEH, 2020a), with associated PCTs that comprise the TEC calculated within the transmission line investigation area.

For the area of Ribbon Gum-Mountain Gum-Snow Gum TEC estimated within the wind farm corridor investigation area, a combination of the State Vegetation Map State Vegetation Type Map: Upper Hunter Version 1.0. VIS_ID 4894 (OEH, 2020 and field survey data was used.

Mitigation measures during detailed design to further reduce impacts to these TECs will be investigated. In particular, the current development footprint considers a 'worst case' clearing footprint for the transmission line easement, assessing complete clearing within the easement. Depending on the height of the towers and the topography of the easement, there will be locations where the existing eucalypt forest can be retained, while still maintaining the required safety and operational clearance to the transmission lines.

- State Vegetation Type Map: Border Rivers Gwydir / Namoi Region Version 2.0. VIS_ID 4467 (OEH, 2020a).
- State Vegetation Type Map: Upper Hunter Version 1.0. VIS_ID 4894 (OEH, 2020b).
- Greater Hunter Native Vegetation Mapping Version 4.0. VIS_ID 3855 (DPIE, 2015).

8.2.3 Clearing of habitat for threatened fauna species

Direct impacts to threatened fauna habitat within the development footprint has been calculated using the species polygons developed using the methodology described in Section 5.5 of this BDAR. Table 54 presents a summary of estimated impacts to habitat for threatened fauna within the development footprint. In addition to the habitat mapped for species credit species, a number of threatened fauna were directly observed on site. These species, and others considered likely to occur are ecosystem credit species (in accordance with the BAM) and their habitat comprise part or all of the native vegetation to be impacted by the Project. This generally includes forage and potential breeding habitat for species with less specific habitat requirements, that can utilise large amount of the undisturbed habitat present within and surrounding the subject land.

Table 54 Direct impacts to habitat (or potential habitat based on assumed presence) for species credit species

Species	Habitat polygons impacted (ha)							
	Temporary construction footprint	Wind turbine infrastructure	Internal roads	Transmission line	Transmission line access tracks	Transport route upgrades	Ancillary	Total
Large-eared Pied Bat (foraging)	9.94	6.45	1.75	0.24	0.09	0	1.21	**19.68**
Eastern Cave Bat (foraging)	9.94	6.45	1.75	0.24	0.09	0	1.21	**19.68**
Large Bent-winged Bat (breeding)	0	0	0	0	0	0	0	**0**
Little Bent-winged Bat (breeding)	0	0	0	0	0	0	0	**0**
Southern Myotis	2.42	1.30	0.22	0	0	0.04		**3.97**
Koala	14.93	7.77	3.70	6.85	0.17	2.26	0.76	**36.44**
Eastern Pygmy-possum	7.15	4.18	1.95	3.61	0.02	1.22	0.01	**18.14**
Squirrel Glider	6.01	4.03	1.16	2.32	0.06	1.76	0.72	**16.06**
Border Thick-tailed Gecko	0	0	0	0.06	0.04	0.07	0	**0.17**
Sooty Owl	0	0	1.99	0	0	0	0	**1.99**
Powerful Owl	0	0	1.99	0	0	0	0	**1.99**
Masked Owl	0	0	0.99	0	0	0	0	**0.99**

8.3 Indirect impacts

This section details potential indirect impacts associated with the construction and operation of the proposal following the implementation of proposed avoidance and minimisation measures. The likely extent and nature of these impacts is discussed in further detail below in relation to each element of the proposal.

Overall, the indirect impacts of the amended Project are materially reduced as compared to the Project as assessed in the original BDAR.

8.3.1 Indirect/uncertain impacts to microbats

By its nature as a wind farm, the project has the potential to cause indirect impacts to identified threatened and non-threatened species microbats recorded within the development footprint. Direct impacts to loss of breeding and foraging habitat are addressed above, and indirect impacts associated with construction are detailed below, however there are also potential operational phase impacts that are also required to be addressed. Indirect impacts, many of which are considered uncertain in relation to microbats, have the potential to occur during the operational phase of the project include:

- Loss of habitat connectivity.
- Avoidance of areas of habitat due to air disturbance surrounding operational turbines.
- Turbine strike and possibly barotrauma.

Potential impacts to local populations of microbats that could occur as a result of loss of habitat connectivity and as a result of air disturbance around operational turbines are assessed in the prescribed impacts section of this BDAR. The potential for and likely consequences of turbine strike and possibly barotrauma are included herein.

It has been confirmed as part of this assessment that a range of microbat species recorded within the project area occur at varying frequencies at elevations that put them at risk of collision with the turbine rotor blades. Based on the specifications of the turbine options being considered for the operation phase of the project, the 'worst case scenario' turbine will result in a rotor swept area of 162 metres occurring between 58 and 220 metres above ground level. As outlined in Section 5.4.2 of this BDAR, 19 out of the total 28 species of microbats recorded during the field surveys were recorded by acoustic detectors mounted at approximately 60 meters elevation on met masts, representing air space within rotor swept area. Of the 19 species recorded at 60 metres elevation, eight are listed as threatened under either or both the NSW BC Act and Commonwealth EPBC Act. These include:

- Eastern Coastal Free-tailed Bat.
- Eastern False Pipistrelle.
- Greater Broad-nosed Bat.
- Large Bent-winged Bat.
- Large-eared Pied Bat.
- Little Bent-winged Bat.
- Little Pied Bat.
- Yellow-bellied Sheath-tailed Bat.

Activity levels for threatened microbats at elevations within rotor swept area range from a mean of 1.8 calls per night for Greater Broad-nosed Bat, 1.5 calls per night for Little Bent-winged Bat and 1.1 calls per night for

Eastern False Pipistrelle, down to 0.2 calls per night for Little Pied Bat and 0.1 calls per night for Large-eared Pied Bat (averaged over the three detectors installed). These activity levels are considered low when compared to the White-striped Free-tail Bat, the most commonly recorded bat during the field survey, with an average of 39 calls per night recorded at 60 metres elevation, but activity levels quickly reduce for the remainder of the species in the bat population with only three other species more active than Greater Broad-nosed Bat within the range of rotor swept area.

As outlined in Section 5.4.2 of the BDAR, rates of impact cannot be quantified for microbats to the same degree they can for birds as to do so requires the number of individuals present within the project area to be determined, and microbats cannot realistically be counted. As such, assessment of potential impacts to microbats as a result of turbine strike has been undertaken by way of a qualitative risk assessment used to determine the likelihood of impact and the potential consequences of any impact that may occur.

The criteria used to establish likelihood of impact and potential consequences of turbine strike are provided in Table 55 below.

Table 55 Qualitative risk assessment criteria for likelihood and consequences of the impacts of turbine strike for microbats

Likelihood	Criteria	Consequence	Criteria
Rare	An event may occur only in unusual circumstances (<5%).	Negligible	Occasional individuals lost but no impact to the viability of the local or broader population.
Unlikely	An event could occur during some circumstances (>5 - <50%).	Minimal	Repeated loss of small number but no impact to the viability of the local or broader population.
Possible	An event could occur during most circumstances (>50% - <95%).	Moderate	Repeated loss of individuals that may cause changes to the local abundance of a species for up to 5 years.
Probable	An event is expected to occur in most circumstances (>95%).	Significant	Major loss of individuals that may cause changes to the regional or state population of a species for up to 10 years.

The matrix used to qualify the risk associated with of the potential impacts established in accordance with the criteria outlined in Table 55 is provided in below in Table 56.

Table 56 Qualitative risk assessment matrix for significance of impacts of potential turbine collisions for microbats

Likelihood	Consequence			
	Negligible	**Minimal**	**Moderate**	**Significant**
Rare	Low	Low	Moderate	High
Unlikely	Low	Low	Moderate	High
Possible	Low	Moderate	High	High
Probable	Moderate	High	High	High

The project specific risk assessment for the potential for turbine strike impacts for microbats is provided below in Table 57. The risk to nine species of bat is confirmed to be moderate, indicating that during the operational phase individual bats are likely to be injured. However, the risk to populations of each species is low as they occur in high densities throughout the Project Area and beyond.

Table 57 Qualitative risk assessment for potential blade strike impacts to microbats

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
White-striped Free-tailed bat	*Austronomus australis*	-	Recorded via ultrasonic detection in RSH	A very common widespread species recorded in high numbers during site surveys. Recognised as an at risk bat species in relation to wind farm developments due to their foraging and flight behaviour. Due to its poor ability to detect and avoid obstacles, particularly mobile ones, such as turbine blades, White-striped Free-tail Bats are one of the most commonly recorded species in carcass monitoring at Australian windfarms. Highly susceptible to collision mortality regularly, however, populations generally secure and dense to withstand moderate instances of mortality should it occur.	Possible	Minimal	**Moderate**
Large-eared Pied Bat	*Chalinolobus dwyeri*	V - BC Act and V - EPBC Act	Recorded via ultrasonic detection in RSH	Declining species that roosts in caves and recorded onsite. May forage within RSH and therefore susceptible to collision risk. Only two identified areas onsite that could potentially consist of breeding/roosting habitat. In the unlikely event that collisions occur, short term impacts to a local population may eventuate.	Unlikely	Moderate	**Moderate**
Gould's Wattled Bat	*Chalinolobus gouldii*	-	Recorded via ultrasonic detection in RSH	A common and widespread large microbat that is fast, high flier with restricted manoeuvrability. Like the White-striped Freetail Bat, this species has a poor ability to detect and avoid obstacles while	Unlikely	Minimal	**Low**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
				pursuing prey, particularly mobile ones such as turbine blades. Highly susceptible to collision mortality regularly, however populations generally secure and dense to withstand moderate instances of mortality should it occur.			
Chocolate Wattled Bat	*Chalinolobus morio*	-	Recorded via ultrasonic detection in RSH	A relatively common and widespread microbat that is fast with increased manoeuvrability than the Gould's Wattled Bat. Generally restricted to canopies and fringing vegetation, may be susceptible to collision mortality on occasion, however populations generally secure and dense to withstand low instances of mortality should it occur.	Unlikely	Minimal	**Low**
Little Pied Bat	*Chalinolobus picatus*	V - BC Act	Recorded via ultrasonic detection in RSH	A declining species that occurs in dry open forest and woodlands. The subject land is within its most easterly distribution limit. Roosts in cave and occasionally within trees hollows and other structures. Relatively confined to canopies and timbered areas but may fly within RSH on occasion. Should a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Rare	Minimal	**Low**
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V - BC Act	Recorded via ultrasonic detection in RSH	A declining species generally confined to tall forests and woodlands. Generally known to fly below canopies and within RSH, recorded on site in low numbers, but	Rare	Moderate	**Moderate**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
				one of the more common threatened species present within RSH. In the unlikely event that collisions occur, short term impacts to a local population may eventuate.			
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	V - BC Act	Recorded via ultrasonic detection in RSH	A declining species found within wide ranging habitats. recorded regularly during site surveys. Known to fly within or above canopies and within RSH, was recorded on site within RSH and therefore at risk of collision. In the unlikely event that collisions occur, short term impacts to a local population may eventuate.	Rare	Moderate	**Moderate**
Little Bent-winged Bat	*Miniopterus australis*	V - BC Act	Recorded via ultrasonic detection in RSH	Little Bent-wing Bats is a small microbat that roosts in caves and disperse widely through a range of habitats. This species is migratory and are a fast-flying species that often forage beneath canopy height however may fly with RSH. May co-habitat with other cave dwelling microbats. In the unlikely event that collisions occur, short term impacts to a local population may eventuate.	Rare	Moderate	**Moderate**
Eastern Bent-winged Bat	*Miniopterus orianae oceanensis*	V - BC Act	Recorded via ultrasonic detection in RSH	Eastern Bent-wing Bats roost in caves and disperse widely through a range of habitats. Recorded regularly during site surveys. This species is migratory and are a fast-flying species that often forage above canopy height and may fly with RSH.	Unlikely	Moderate	**Moderate**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
				Nearest maternity site likely to be used by individuals present within the project area is over 250 km to the south of the subject land. In the unlikely event that collisions occur, short term impacts to a local population may eventuate.			
Southern Myotis	*Myotis macropus*	V - BC Act	Recorded onsite	Generally found around riparian areas. Not known to fly within RSH and not considered to be at risk of collision due to their favoured foraging and roosting preferences in gullies and surrounding waterways	Rare	Minimal	**Low**
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	-	Recorded onsite	A relatively common and widespread microbat that is fast with high manoeuvrability. Generally restricted to foraging within or beneath the canopy however may forage within open areas, especially where lights have attracted large insect numbers. Should a collision occur, it is likely only to occur to a very small number of individuals that would be impacted.	Rare	Minimal	**Low**
Northern Free-Tailed Bat	*Ozimops lumsdenae*	-	Recorded via ultrasonic detection in RSH	Widespread and relatively common species of varying habitats. Generally restricted to foraging within or beneath the canopy, however two species were recorded in low numbers within RSH at the site. Should a collision occur, its likely only to occur to a very small number of individuals that would be impacted.	Rare	Minimal	**Low**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
Inland Free-tailed Bat	*Ozimops petersi*	-	Recorded via ultrasonic detection at canopy height		Unlikely	Minimal	**Low**
South-eastern Free-tailed Bat	*Ozimops planiceps*	-	Recorded via ultrasonic detection at canopy height		Rare	Minimal	**Low**
Ride's Free-Tailed Bat	*Ozimops ridei*	-	Recorded via ultrasonic detection in RSH		Rare	Minimal	**Low**
Golden-tipped Bat	*Phoniscus papuensis*	V - BC Act	Recorded onsite	Generally found within wet sclerophyll and rainforest areas and not generally at high altitudes, which makes these observations somewhat unique. However, not known to fly within RSH and not considered to be at risk of collision due to their favoured foraging and roosting preferences.	Rare	Negligible	**Low**
Grey-headed Flying Fox	*Pteropus poliocephalus*	V - BC Act and V-EPBC Act	Sub-optimal habitat onsite and potential to move throughout the broader locality	A declining species that inhabits wide ranging habitats and moves large distances foraging, however generally roosts/breeds close to or near riparian areas. May occur on an intermittent bases transiting through the landscape, however the occurrence of known camps and forage resources mean regular flights through the development footprint are considered unlikely. Recent instances in Victoria have seen an increased rate of collision mortality. Should a collision occur, it is likely only to occur to a very small number of individuals that	Rare	Minimal	**Low**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
				would be impacted.			
Smaller Horseshoe Bat	*Rhinolophus megaphyllus*	-	Recorded via ultrasonic detection in RSH	Widespread and common cave dependent species. Often roost together in large numbers. Generally, fly close to the ground and beneath canopies, but on occasion fly with RSH and susceptible to collisions. Should a collision occur, it is likely only to occur to a very small number of individuals that would be impacted.	Rare	Negligible	**Low**
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*	V - BC Act	Recorded via ultrasonic detection in RSH	Widespread species within a range of habitats including rainforest, woodland and grassland. High and fast flier over the forest canopy, but lower in more open areas and fringing vegetation. Roosts within tree hollows. Has potential to fly within RSH. In the unlikely event that collisions occur, short term impacts to a local population may eventuate.	Unlikely	Moderate	**Moderate**
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V - BC Act	Recorded via ultrasonic detection in RSH	A declining species generally confined to timbered gullies and near riparian areas. Not commonly known to fly above canopies or within RSH but was recorded on site within RSH. In the unlikely event that collisions occur, short term impacts to a local population may eventuate.	Unlikely	Moderate	**Moderate**
Inland Broad-nosed Bat	*Scotorepens balstoni*	-	Recorded via ultrasonic detection at canopy height	A widespread species that generally fly within riparian areas but may also fly above canopies and RSH on occasion. Highly mobile, however, not recorded within RSH	Rare	Minimal	**Low**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
				and not considered to be at risk of collision due to their favoured foraging and roosting preferences. In the unlikely event a collision occurs, populations generally secure and dense to withstand low instances of mortality should it occur.			
Little Broad-nosed Bat	*Scotorepens greyii*	-	Recorded via ultrasonic detection in RSH	A common widespread species recorded regularly during site surveys. Generally, fly within riparian areas but may also fly above canopies and RSH on occasion. Highly mobile and susceptible to collision mortality, however populations generally secure and dense to withstand moderate instances of mortality should it occur.	Possible	Minimal	**Moderate**
Eastern Broad-nosed Bat	*Scotorepens orion*	-	Recorded via ultrasonic detection at canopy height	A common coastal species, however on its most westerly distribution limit. Generally found within moist forests and woodlands. Generally fly within gullies and riparian areas but may also fly above canopies and RSH on occasion. Highly mobile, however, should a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Rare	Negligible	**Low**
Large Forest Bat	*Vespadelus darlingtoni*	-	Recorded via ultrasonic detection at canopy height	A large widespread bat with restricted manoeuvrability due to its size. Not known to fly within RSH and not considered to be at risk of collision due to their favoured foraging and roosting preferences. In the unlikely event a collision occurs,	Unlikely	Minimal	**Low**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
				populations generally secure and dense to withstand low instances of mortality should it occur.			
Southern Forest Bat	*Vespadelus regulus*	-	Recorded via ultrasonic detection at canopy height	A moderate sized widespread bat. Not known to fly within RSH and not considered to be at risk of collision due to their favoured foraging and roosting preferences. In the unlikely event a collision occurs, populations generally secure and dense to withstand low instances of mortality should it occur.	Rare	Minimal	**Low**
Eastern Cave Bat	*Vespadelus troughtoni*	V - BC Act	Recorded onsite	A cave dependent and uncommon species. Generally confined to forage beneath canopies and fringing vegetation but may make rapid skirmishes across open areas. Not recorded within RSH, however should a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Rare	Minimal	**Low**
Little Forest Bat	*Vespadelus vulturnus*	-	Recorded via ultrasonic detection in RSH	A small sized, very common and widespread bat. They are highly agile fast fliers with high manoeuvrability. May fly beneath and above canopy height and on occasion within RSH. Should a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Unlikely	Minimal	**Low**

Based on the table above, a total of nine species have been assessed as being subject to a Moderate risk of impact resulting from blade strike. Moderate risks relate to either an expectation for more frequent collisions with turbines due to a species proclivity for flights within rotor swept height, or more substantial impacts to local populations due to individuals comprising a more significant and/or substantial portion of the local population.

The nine species considered to be subject to a moderate risk of impact from turbine strike, include:

- White-striped Free-tailed bat (not listed).
- Large-eared Pied Bat – Vulnerable, BC Act and Vulnerable, EPBC Act.
- Eastern False Pipistrelle – Vulnerable, BC Act.
- Eastern Coastal Free-tailed Bat – Vulnerable, BC Act.
- Little Bent-winged Bat – Vulnerable, BC Act.
- Eastern Bent-winged Bat – Vulnerable, BC Act.
- Yellow-bellied Sheath-tailed Bat – Vulnerable, BC Act – Vulnerable, BC Act.
- Greater Broad-nosed Bat – Vulnerable, BC Act.
- Little Broad-nosed Bat (not listed).

As impacts associated with blade strike to the above species cannot be quantified and are considered somewhat uncertain, adaptive management is required through the preparation and implementation of an operational Bird and Bat Adaptive Management Plan (BBAMP) that will be prepared prior to operation of the wind farm. The BBAMP will allow for ongoing monitoring of any bat mortality, continually test the assumptions of this impact assessment and enable adaptive management measures to be implemented, if required, to reduce measured impacts. The plan will include methods for monitoring of bat mortality, provide any acceptable thresholds for mortality and adaptive management regimes if thresholds are exceeded.

Further detail on adaptive management and the likely contents of the BBAMP are provided in Section 8.9.1 below.

Whilst impacts to microbat species may occur as a result of turbine strike, it is considered unlikely that additional impacts will occur as a result of barotrauma. A paper published in December 2020 in the journal PLOS One, by Lawson et al, describes how mortality as a result of barotrauma is unlikely to occur due to the areas where exposure to the level of pressure variation required to cause mortality are present only in the immediately vicinity of the turbine blades, and that flight paths required for bats to be exposed to these areas are highly improbable. As such, even a small change in flight path would result in the bat being hit by the blade or experiencing a much smaller pressure change. Furthermore, the magnitude of the low-pressures bats could experience when flying near wind turbines is approximately 8 times smaller than the pressure that causes mortality in rats, the smallest mammal for which data are available. The magnitude of the high-pressures that bats may experience are approximately 80 times smaller than the exposure level that causes 50% mortality in mice, which have a body mass similar to several bat species that are killed by wind turbines in the United States (Lawson et al 2020).

The study concludes that, if bats have a physiological response to rapid low- and high-pressure exposure similar to that of other mammals, that it is unlikely that barotrauma is responsible for a significant number of turbine-related bat fatalities, and that impact trauma is the likely cause of the majority of wind-turbine-related bat fatalities. (Lawson et al 2020)

The above information is not considered to lessen the overall likelihood or risk of mortality for microbats interacting with turbine blades, it is simply presented to address the potential for barotrauma specifically, to cause potential mortality.

8.3.2 Collision risk (birds)

The SEARs and the BAM require an impact assessment to migratory species and any resident raptors that may be subject to indirect impacts associated with blade strike during the operational phase of the project. The results of the bird utilisation survey and the Collision Risk Model (Appendix D) indicate that there are no migratory bird species at risk of collision with turbines during the operation of the wind farm. Three resident raptors were identified, including Wedge-tailed Eagle, Nankeen Kestrel and Brown Goshawk. It should be noted that this assessment was based on the Project's previous 70 turbine layout, and as such potential impacts are likely to have been reduced.

Using additional site based information from field surveys, as well as literature reviews, population estimates were able to be obtained for Wedge-tailed Eagle and Nankeen Kestrel to inform a more detailed assessment of the significance of impacts to these species. Based on this assessment it is considered unlikely that the project will have a significant impact on the population of resident raptors.

Cherriman (2007) provided an overview of studies that have investigated the size of Wedge-tailed Eagle territories in temperate regions. Territory sizes in studies near Perth (Cherriman 2007); at two other sites in the south-east of Western Australia (Ridpath and Brooker 1987); near Canberra in south- eastern Australia (Leopold and Wolfe 1970); and, in South Australia (Rowe et al. 2017) were all between 31 km^2 and 42 km^2. Foster and Wallis (2010) studied the species west of Melbourne and recorded nearest- neighbour distances averaged 4.7 kilometres. In a study in western NSW, Sharp et al. (2001) found the mean distance to nearest neighbour between Wedge-tailed Eagle nests was in the order of 1 pair per 3–9 km2. They noted this was considerably higher than that noted in other semi-arid zone studies (~1 pair per 40–48 km2).

Using a conservative mean Wedge-tailed Eagle territory size of 30 km^2, the average diameter of a territory would be slightly greater than 12 kilometres. As a consequence, we have based the modelling exercise for Wedge-tailed Eagles on the assumption that the 26 kilometre linear array of the proposed wind farm may intersect with three territories, occupied by six adult birds.

Cherriman (2013) reported that breeding productivity (number of chicks fledged) was 0.73 young per pair, across 15 occupied territory-years. Debus et al. (2007) recorded very similar results with 10 young produced in 12 pair-years, equating to 0.8 young fledged per pair per year. On the basis of those studies, we have conservatively assumed that, on average, three pairs will be accompanied by a total of three flying juveniles, bringing the average site-population of Wedge-tailed Eagles to a total of 9.

During field investigations of the site, field staff documented one instance each in which three, four and five Wedge-tailed Eagles were observed simultaneously.

Informed assumptions were able to be developed and employed for the potential site-population sizes of Nankeen Kestrels and Wedge-tailed Eagles and this permitted the model to provide projections expressed as average numbers of potential collisions per annum for those two species. Depending upon avoidance capacity and all other assumptions used for Nankeen Kestrels the model returned a likely range of between 0.07 and 0.36 collisions for that species per annum. Under the same caveats for Wedge-tailed Eagles, the likely range was between 0.98 and 5.86 collisions per annum.

Further to the quantitative Collision Risk Model undertaken to the project, an additional qualitative risk assessment for the impacts of turbine strike has been prepared for avian species known or considered to have the potential to occur within the project area, as provided above for microbats.

Forest owl species assumed present within, and/or immediately surrounding, the development footprint (refer Section 5.4.2) are included as part of this risk assessment and have all been assessed as Low risk of impact through blade strike. This is due largely to their behaviour of flying within or just above the canopy, and therefore below rotor swept height.

The criteria used to establish likelihood of impact and potential consequences of turbine strike are provided in Table 58 below.

Table 58 Qualitative risk assessment criteria for likelihood and consequences of the impacts of turbine strike for birds

Likelihood	Criteria	Consequence	Criteria
Rare	An event may occur only in unusual circumstances (<5%).	Negligible	Occasional individuals lost but no impact to the viability of the local or broader population.
Unlikely	An event could occur during some circumstances (>5 - <50%).	Minimal	Repeated loss of small number but no impact to the viability of the local or broader population.
Possible	An event could occur during most circumstances (>50% - <95%).	Moderate	Repeated loss of individuals that may cause changes to the local abundance of a species for up to 5 years.
Probable	An event is expected to occur in most circumstances (>95%).	Significant	Major loss of individuals that may cause changes to the regional or state population of a species for up to 10 years.

The matrix used to qualify the risk associated with of the potential impacts established in accordance with the criteria outlined above is provided in below in Table 59.

Table 59 Qualitative risk assessment matrix for significance of impacts of potential turbine collisions for birds

Likelihood	Consequence			
	Negligible	**Minimal**	**Moderate**	**Significant**
Rare	Low	Low	Moderate	High
Unlikely	Low	Low	Moderate	High
Possible	Low	Moderate	High	High
Probable	Moderate	High	High	High

The project specific risk assessment for the potential for turbine strike impacts for birds is provided below in Table 60.

Table 60 Qualitative risk assessment for potential blade strike impacts to birds

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
Australian Magpie	*Cracticus tibicen*	-	Observed in subject land	Common widespread species within varying habitats. Generally prefer more open space and woodlands and not generally found within dense forests. May suffer collision mortality, however populations generally secure and robust to withstand low instances of mortality should it occur.	Rare	Negligible	**Low**
Australian Raven	*Corvus coronoides*	-	Observed in subject land	Common widespread species found within all habitats. Highly disturbance tolerant species. May suffer collision mortality due to unmitigated or opportunistic carcass predation, however populations generally secure and robust to withstand low instances of mortality should it occur.	Rare	Negligible	**Low**
Barking Owl	*Ninox connivens*	V - BC Act	Habitat onsite and potential to occur within the broader locality	Distributed widely but declining and uncommon species within woodlands, fringing forests and rural areas. Roosts often occur near or adjacent to riparian areas. Generally moves throughout or just above canopy, and unlikely to move within the RSH. Should a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Rare	Minimal	**Low**
Black Kite	*Milvus migrans*	-	Habitat onsite and potential to occur within the broader locality	Common widespread species within varying habitats. Highly disturbance tolerant species and may occur in large numbers at times due to other environmental factors i.e. foraging opportunities. Soars on thermals and often undertakes aerobatic displays increasing collision risk. Populations generally secure and robust to withstand low instances of mortality should it occur.	Rare	Negligible	**Low**
Brown Falcon	*Falco berigora*	-	Habitat onsite and	Common widespread species within varying habitats.	Rare	Negligible	**Low**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
			potential to occur within the broader locality	May suffer collision mortality regularly due to unmitigated or opportunistic carcass predation. Not known to be deterred by wind turbines, Brown Falcons are been found regularly in carcass searches at Victorian wind farms. Populations generally secure and robust to withstand low instances of mortality should it occur.			
Brown Goshawk	*Accipiter fasciatus*	-	Observed in subject land	Widespread but uncommon species found within woodland and forest habitats, often nesting near riparian areas. Populations generally secure and robust to withstand low instances of mortality in the unlikely event it should occur.	Unlikely	Negligible	**Low**
Crimson Rosella	*Platycercus elegans*	-	Observed in subject land	Widespread and common species of woodland and forest habitats within the tablelands. Generally occur in small flocks or pairs and move generally within or just above canopy height. Populations generally secure and robust to withstand low instances of mortality in the unlikely event it should occur.	Rare	Negligible	**Low**
Dusky Woodswallow	*Artamus cyanopterus*	V - BC Act	Habitat onsite and potential to occur within the broader locality	Widespread but declining species of open woodlands that can be resident, nomadic or seasonally migratory. Often seen at foraging at varying heights in small to moderate sized flocks, often with other aerial foragers. At risk of collision as may fly within RSH, however, should a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Rare	Minimal	**Low**
Fork-tailed Swift	*Apus pacificus*	M	Habitat onsite and potential to occur	Widespread however sparsely distributed often following weather events. Soars within and above RSH	Unlikely	Minimal	**Low**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
			within the broader locality	so at risk of collision. Should a collision occur, its likely only to occur to a very small number of individuals that would be impacted			
Galah	*Eolophus roseicapilla*	-	Observed in subject land	Common widespread species within varying habitats. Generally prefer more open space and woodlands and not generally found within dense forests. May occur in large flocks. May suffer collision mortality on occasion, however populations generally secure and robust to withstand low instances of mortality should it occur.	Rare	Negligible	**Low**
Glossy Black Cockatoo	*Calyptorhynchus lathami*	V - BC Act	Habitat onsite and potential to occur within the broader locality	Widespread but rare species highly dependent on woodland and open forests with substantial distribution of Allocasuarina within the midstorey. Hollow dependent. Moving throughout the landscape more readily due to bushfire impacts, but generally move just above canopy height, and unlikely to fly within RSH regularly. Should a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Rare	Minimal	**Low**
Laughing Kookaburra	*Dacelo novaeguineae*	-	Observed in subject land	Widespread disturbance tolerant species that inhabits most vegetation types. Mostly confined to skirmishes from perched positions but may move throughout the landscape above canopy height. Unlikely to suffer collision mortality regularly, however populations generally secure and robust to withstand low instances of mortality should it occur.	Rare	Negligible	**Low**
Little Eagle	*Hieraaetus morphnoides*	-	Habitat onsite and potential to occur	Widespread but rare and declining species of woodlands, open forests and rural areas. When seen,	Unlikely	Moderate	**Moderate**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
			within the broader locality	often soaring within thermals above or within RSH. Not recorded during site surveys however may occur in future in low densities and at risk of collision. In the unlikely event that collisions occur, short term impacts to a local population may eventuate.			
Little Lorikeet	*Glossopsitta pusilla*	V - BC Act	Observed in subject land	Uncommon but widespread species within woodland and forest habitats on tablelands and coastal regions. Generally sparse on the tablelands however may suffer collision mortality on occasion. Should a collision occur, it's likely only to occur to a very small number of individuals that would be impacted.	Rare	Minimal	**Low**
Little Wattlebird	*Anthochaera chrysoptera*	-	Observed in subject land	Inhabits varying coastal habitats and on the edge of it is westerly distribution. Prefers dry heathy habitats and woodlands. May suffer collision mortality on occasion, however populations generally secure and robust to withstand low instances of mortality should it occur	Rare	Negligible	**Low**
Masked Owl	*Tyto novaehollandiae*	V - BC Act	Habitat onsite and potential to occur within the broader locality	Distributed widely but declining and uncommon species within woodlands, fringing forests and rural areas. Generally moves throughout or just above canopy, and unlikely to move within the RSH. Should a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Rare	Minimal	**Low**
Nankeen Kestrel	*Falco cenchroides*	-	Observed in subject land	Widespread species often in high densities across varying habitats, but commonly encountered in open woodland and farmland areas. One of the most commonly encountered species in mortality surveys at established wind farms in Australia. May suffer	Possible	Minimal	**Moderate**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
				collision mortality regularly, however populations generally secure and robust to withstand low instances of mortality should it occur.			
Pied Currawong	*Strepera graculina*	-	Observed in subject land	Common altitudinal nomadic species but now more common and widespread within varying habitats. Aggressive and disturbance tolerant species. May suffer collision mortality on occasion, however populations generally secure and robust to withstand low instances of mortality should it occur.	Rare	Negligible	**Low**
Powerful Owl	*Ninox*	V - BC Act	Habitat onsite and potential to occur within the broader locality	Largest of Australia's owls and generally distributed in tall forests east of the Great Dividing Range, and rarely seen in recent times on the western slopes, however this is likely dependent on abundance of suitable hollows and preferred large prey abundance. Generally moves throughout or just above canopy in forested areas, and unlikely to move within the RSH, however some juveniles may disperse further and higher than normal. In the rare event that a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Rare	Minimal	**Low**
Rainbow Lorikeet	*Trichoglossus moluccanus*	-	Observed in subject land	Disturbance tolerant and widespread species within woodland and forest habitats on tablelands and coastal regions. Generally sparse on the tablelands however may suffer collision mortality on occasion. Populations generally secure and robust to withstand low instances of mortality should it occur.	Rare	Negligible	**Low**
Red Wattlebird	*Anthochaera carunculata*	-	Observed in subject land	Aggressive honeyeater that inhabits varying coastal habitats and on the edge of it is westerly distribution.	Rare	Negligible	**Low**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
				Prefers dry forest and woodland habitats. Sparsely distributed throughout the tablelands and unlikely to suffer from collision mortality, however populations generally secure and robust to withstand low instances of mortality should it occur			
Regent Honeyeater	*Anthochaera phrygia*	CE - BC Act and CE - EPBC Act	Habitat onsite and potential to occur within the broader locality	A highly mobile critically endangered species that is cryptic and nomadic and generally follows blossoming eucalypts and mistletoes through eucalypt forest and woodlands. Associated with the inland/eastern slopes of the Great Dividing Range, particularly Capertee Valley, Bingara/Barraba regions and the Hunter Valley and Central Coast of NSW (Bird Life Australia 2016). Generally sticks to canopies and number of individuals and flights over the turbine locations is likely to be low.	Rare	Minimal	**Low**
Sooty Owl	*Tyto tenebricosa*	V - BC Act	Habitat onsite and potential to occur within the broader locality	Distributed widely but declining and uncommon species within woodlands, fringing forests and rural areas. Generally moves throughout or just above canopy, and unlikely to move within the RSH. Should a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Rare	Minimal	**LOW**
Square-tailed Kite	*Lophoictinia isura*	V - BC Act	Habitat onsite and potential to occur within the broader locality	Uncommon species that inhabits open eucalypt forests and woodlands, often where there is a broken canopy, but it also ranges into nearby open habitats to forage. Generally nests along or near riparian areas. The NSW Scientific Committee (2009) considers that "windfarms may cause occasional collision mortalities of Square-tailed Kites, although this species is a very manoeuvrable, slow flyer and is probably capable of generally avoiding collisions with turbines blades." Not	Rare	Moderate	**Moderate**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
				recorded during site surveys however may occur in future in low densities and at risk of collision. In the unlikely event that collisions occur, short term impacts to a local population may eventuate.			
Spotted Pardalote	*Pardalotus punctatus*	-	Observed in subject land	Common widespread species within forest canopies and woodlands habitats, that nest within hollows in tunnels on the ground. Unlikely to suffer collision mortality as tends to stick within canopies for foraging and movement, however populations generally secure and robust to withstand low instances of mortality should it occur.	Rare	Negligible	**Low**
Sulphur-crested Cockatoo	*Cacatua galerita*	-	Habitat onsite and potential to occur within the broader locality	Common resident and widespread species within varying timbered habitats. Generally prefer more open space and woodlands and not generally found within dense forests. May occur in large flocks. May suffer collision mortality on occasion, however populations generally secure and robust to withstand low instances of mortality should it occur.	Rare	Negligible	**Low**
Swift Parrot	*Lathamus discolor*	E - BC Act and CE - EPBC Act	Foraging and transient habitat onsite and potential to occur within the broader locality	Highly mobile winter non-breeding migrants to NSW and Vic, Swift Parrots move nomadically through the landscape, using a diversity of foraging habitats within coastal and tableland regions. Generally move along lower slopes and gullies. Likelihood of collision risk is considered very low.	Rare	Minimal	**Low**
Turquoise Parrot	*Neophema pulchella*	V- BC Act	Habitat onsite and potential to occur within the broader locality	Declining species that favours open, grassy woodland with dead trees that fringe large patches of remnant vegetation and near permanent water. A fast flier at a range of heights, this species may be susceptible to	Rare	Minimal	**Low**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
				collision risk if moving throughout the site. Should a collision occur, its likely only to occur to a very small number of individuals that would be impacted			
Wedge-tailed Eagle	*Aquila audax*	-	Observed in subject land	Widespread and disturbance tolerant species but most exposed risk of collision due to soaring of thermals whilst foraging. Have been known to be struck at other wind farms in NSW and Vic. Populations generally secure and robust but may suffer collision mortality regularly and therefore, short term impacts to a local population may eventuate.	Unlikely	Moderate	**Moderate**
Whistling Kite	*Haliastur sphenurus*	-	Habitat onsite and potential to occur within the broader locality	Widespread species often seen in pairs and commonly encountered in open woodland, farmland areas and wetlands. Generally nests near riparian areas and waterways. May suffer collision mortality on occasion, however populations generally secure and robust to withstand low instances of mortality should it occur.	Unlikely	Minimal	**Low**
White-breasted Woodswallow	*Artamus leucorynchus*	-	Observed in subject land	Widespread species of open woodlands generally close to water. Often seen at foraging at varying heights in small to moderate sized flocks, often with other aerial foragers. At risk of collision as may fly within RSH, however, should a collision occur, its likely only to occur to a very small number of individuals that would be impacted and populations generally secure and robust to withstand low instances of mortality should it occur.	Rare	Negligible	**Low**
White-throated Treecreeper	*Cormobates leucophaea*	-	Observed in subject land	Resident species of forest, woodlands and occasionally rainforest habitats. Generally occurs	Rare	Negligible	**Low**

Common name	Scientific name	Status	Reasoning	Habitat values and behavioural considerations	Indirect impact - Collision risk		
					Likelihood	Consequence	Risk
				within low canopy and not at risk of collision.			
White-throated Needletail	*Hirundapus caudacutus*	V - EPBC Act	Habitat onsite and potential to occur within the broader locality	Widespread non-breeding migratory species within Australia that is an aerial forager, infrequently coming to timbered areas for respite, and therefore often fly within or above RSH. Mortality has been known to occur at other wind farms however is uncommon. Should a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Unlikely	Minimal	**Low**
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	-	Observed in subject land	Common widespread species within a range of eucalyptus and pine dominated woodland and forest habitats. May occur in large flocks and move above around the landscape through RSH. May suffer collision mortality on occasion, however populations generally secure and robust to withstand low instances of mortality should it occur.	Unlikely	Negligible	**Low**

Based on the table above, a total of four species have been assessed as being subject to a Moderate risk of impact resulting from blade strike. Moderate risks relate to either an expectation for more frequent collisions with turbines due to a species proclivity for flights within rotor swept height, or more substantial impacts to local populations due to individuals comprising a more significant and/or substantial portion of the local population.

The four species considered to be subject to a moderate risk of impact from turbine strike, include:

- Little Eagle – Vulnerable, BC Act
- Nankeen Kestrel
- Square-tailed Kite – Vulnerable, BC Act
- Wedge-tailed Eagle

As impacts associated with blade strike are considered somewhat uncertain in accordance with the BAM, and as previously mentioned, adaptive management is required through the preparation and implementation of an operational BBAMP that will be prepared prior to operation of the wind farm.

8.3.3 Turbine risk assessment

To further assess potential risk of impact to threatened species associated with turbine placement, barriers to movement and potential collision with turbine blades, a qualitative risk assessment has been prepared on a per turbine basis. Factors considered when assessing the risk associated with the turbines include:

- Proximity to potential microbat roosts.
- Connectivity.
- Presence of raptor nests.
- Fauna sightings within the development footprint and surrounds.
- Presence of hollow-bearing trees.
- Proximity to National Park's estate.
- Canopy buffer to rotor swept height.
- Turbine proximity and predicted zone of disturbance.

Table 61 provides guidance on how the above consideration have been applied with regards to potential turbine risk. Table 57 provides the results of the risk assessment for the 70 turbines proposed for the project. The risk assessment table is based on that contained in Section 7.2 of this BDAR.

Table 61 Qualitative risk consideration for turbines

Risk	Reasoning
Low	Potential unacceptable triggers considered unlikely. Adaptive management and monitoring of impact triggers required within BBAMP
Moderate	Potential unacceptable triggers considered possible. Stringent mitigation may be required pending adaptive management to be identified within the BBAMP
High	Potential unacceptable triggers considered probable. Stringent mitigation measures required prior to construction and detailed within BBAMP

Table 62 Qualitative risk assessment for turbines for full 70 turbine layout

Turbine No.	Dist. to foraging habitat (m)	PCTs and condition in 100m buffer	Feature height (m)	Buffer distance (m)	Risk	Comments
WP1	22.11	1194- high	23.5	36.6	Moderate	**Removed from project layout**
WP2	36.1	1194- high	23.5	40.01	Moderate	Relocated within project layout
WP3	56.31	1194- high; 934- mod	23.5	47.5	Low	
WP4	23.89	507-mod	20	40.38	Low	
WP5	43.07	1194-mod	23.5	42.27	Low	
WP6	31.64	1194-high	23.5	38.76	Moderate	
WP7	39.75	1194-high	23.5	41.15	Moderate	
WP8	38.13	931-mod; 934-low	23.5	40.63	Low	
WP9	30.14	931-mod; 1194-low	23.5	38.37	Moderate	
WP10	66.42	931; 1194; 934-mod	23.5	52.24	Low	
WP11	25.73	931-mod; 934-high	23.5	37.33	Low	
WP12	42.53	934-mod; 1194-high; 954-high	23.5	42.08	Moderate	
WP13	54.16	954-high	23.5	46.57	Low	
WP14	59.73	931-mod; 1194-DNG; 954-high	23.5	49.03	Low	
WP15	43.57	1194-DNG&Mod; 954-High	23.5	42.44	Low	
WP16	29.47	1194-mod	23.5	38.2	Moderate	
WP17	33.47	1194-mod; 934-high	13.5	48.89	Low	
WP18	23.17	1194-mod; 934-mod&high	23.5	36.8	Low	
WP19	30.8	934-high	13.5	48.22	Low	**Removed from project layout**
WP20	30.97	1194-high; 934-low	23.5	38.58	Low	
WP21	23.58	1194-high	23.5	36.88	Moderate	
WP22	26.99	1194; 934-high	23.5	37.61	Moderate	
WP23	23	1194-mod	23.5	36.77	High	**Removed from project layout**
WP24	24.78	1194-mod	23.5	37.13	Moderate	

Turbine No.	Dist. to foraging habitat (m)	PCTs and condition in 100m buffer	Feature height (m)	Buffer distance (m)	Risk	Comments
WP25	93.27	934-low	23.5	67.46	Low	
WP26	184.47	NA		149.97	Low	
WP27	22.47	1194-high	23.5	36.67	High	**Removed from project layout**
WP28	31.79	1194-high	23.5	38.8	Moderate	
WP29	43.46	931-mod; 934-DNG&mod	18.5	47.1	Low	
WP30	50.89	931-mod; 934-DNG&mod	28.5	40.66	Low	
WP31	21.15	931; 1194-high	23.5	36.42	High	**Removed from project layout**
WP32	51.47	931-high; 1194-DNG&mod	18.5	50.03	Moderate	
WP33	22.74	931-high; 1194-mod	23.5	36.72	Moderate	
WP34	25.18	1194-mod&high	18.5	42.1	Low	
WP35	157.02	NA		128.7	Low	
WP36	33.07	1194-low&mod	23.5	39.14	Low	
WP37	78.76	1194-low&high	18.5	62.96	Low	
WP38	43.11	1194-high	23.5	42.28	Low	
WP39	59.15	1194-mod&high	23.5	48.77	Low	
WP40	35.35	931-low; 934-high	8.5	54.2	Moderate	
WP41	39.16	934-high	13.5	50.47	Moderate	
WP42	38.57	1194-low&high	13.5	50.29	Moderate	
WP43	23	1194-mod	23.5	36.77	Moderate	
WP44	95.29	NA		87.53	Low	
WP45	184.62	NA		150.1	Low	
WP46	34.7	1194-mod&high	23.5	39.6	Moderate	
WP47	169.27	1194-low&high	23.5	123.92	Low	Relocated within project layout
WP48	37.74	1194-low&high	23.5	40.51	Low	
WP49	26.72	1194-low&high	23.5	37.55	Moderate	
WP50	46.07	1194-low, mod&high	23.5	43.35	High	Relocated within project layout

Turbine No.	Dist. to foraging habitat (m)	PCTs and condition in 100m buffer	Feature height (m)	Buffer distance (m)	Risk	Comments
WP51	36.85	1194-low&mod	23.5	40.24	Moderate	
WP52	68.19	1194-low	23.5	53.13	Moderate	
WP53	38.23	1194-low&high	18.5	45.42	Moderate	
WP54	36.15	1194-low, mod&high	23.5	40.02	Moderate	
WP55	161.17	NA		131.83	Low	
WP56	93.9	1194-mod	23.5	67.85	Low	
WP57	39.46	1194-mod	23.5	41.05	Moderate	
WP58	33.26	1194-mod	23.5	39.19	Moderate	
WP59	35.13	1194-low&high;934-high	23.5	39.72	Moderate	
WP60	60.22	1194-low&mod;934-high	23.5	49.26	Low	
WP61	23.1	1194-mod&high; 927-high	23.5	36.79	Moderate	
WP62	55.81	1194-low&mod	23.5	47.28	Low	
WP63	30.64	1194-mod	23.5	38.5	Low	
WP64	38.66	1194-high; 927-high	23.5	40.8	Moderate	
WP65	44.33	1194-high	23.5	42.71	Low	
WP66	44.98	931-high;1194-mod	23.5	42.95	Low	
WP67	113.66	1194-low	23.5	81.05	Low	
WP68	51.78	1194-low&mod	23.5	45.57	Low	
WP69	54.66	1194-low	23.5	46.78	Low	
WP70	28.16	1194-low; 931-high	23.5	37.88	Moderate	

Based on the table above, a total of four turbines were assessed as representing a High risk of impact to threatened species, based largely on proximity to threatened microbat and potential owl breeding habitat, and also relating to their location, canopy buffer and surrounding intact vegetation. Three of these turbines (WP23, WP27, WP31) have all subsequently been removed from the project due in a large part to the high level of risk to biodiversity values assessed as part of the above analysis. WP50 has also been substantially relocated to ensure no direct or indirect impacts will occur within the 100 metre BAM prescribed microbat breeding habitat buffer on adjacent habitat. The removal of these turbine from the Project means that serious and irreversible impacts to microbats are unlikely to occur as a result of development in proximity to confirmed potential breeding habitat. The High risk rating for WP50 has been conservatively retained to ensure a high level of monitoring will occur from the outset given it is the closest turbine to potential microbat breeding habitat (refer Section 8.9.1 for further detail).

Two additional turbines (WP1 and WP19) have also been removed from the Project which has resulted in decreased direct and indirect impacts to biodiversity values, and turbines WP2 and WP47 have also been relocated or re-orientated resulting in reduced impacts to biodiversity values. Removing WP19 creates a gap of over 2 kilometres between turbine WP18 and turbines WP20-22, and the removal of WP19 allows for an approximate 600 metre reduction of the intrusion into intact vegetation to the south of the development footprint, allowing more available airspace for aerial fauna around the southern extent of the wind farm corridor. The removal of turbines WP19, WP23, WP27 and WP31 have resulted in reduced impacts to habitat connectivity in the southern portion of the development footprint. More information is provided in Section 8.5.

A further 28 have been assessed as representing a Moderate risk. Additional mitigation strategies have been developed for High and Moderate risk turbines and are outlined in Section 8.9 of this BDAR. The remaining 36 turbines have been assessed as Low risk and are not considered to require additional mitigation strategies to reduce potential impacts to threated species.

8.3.4 Summary of collision risks and indirect impacts

The following provides a summary and conclusions for impacts relating to possible bird and bat collision with wind turbines.

- The vast majority of bird and bat species recorded or have the potential to utilise the vegetation within or surrounding the subject land are considered to have a low or negligible risk of collision mortality, with no significant broader impacts to regional populations anticipated.
- Nine species of microbats are considered to be subject to a moderate risk of impact from turbine strike, and include:
  - White-striped Free-tailed bat (not listed).
  - Large-eared Pied Bat – Vulnerable, BC Act and Vulnerable, EPBC Act.
  - Eastern False Pipistrelle – Vulnerable, BC Act.
  - Eastern Coastal Free-tailed Bat – Vulnerable, BC Act.
  - Little Bent-winged Bat – Vulnerable, BC Act.
  - Eastern Bent-winged Bat – Vulnerable, BC Act.
  - Yellow-bellied Sheath-tailed Bat – Vulnerable, BC Act – Vulnerable, BC Act.
  - Greater Broad-nosed Bat – Vulnerable, BC Act.
  - Little Broad-nosed Bat (not listed).

- Four species of birds are considered to be subject to a moderate risk of impact from turbine strike, and include:
  - Little Eagle – Vulnerable, BC Act.
  - Nankeen Kestrel.
  - Square-tailed Kite – Vulnerable, BC Act.
  - Wedge-tailed Eagle.
- There are no bird or bat species that are considered to be subject to be a high risk of collision mortality.
- Risk of impact to threatened and non-threatened species is considered highest for turbine WP50.
- Potential low level impacts to habitat connectivity for migratory bird and bat species, and/or long-range foragers, for species recorded within the development footprint, or considered highly likely to occur.
- Potential additional indirect loss of habitat resulting from avoidance behaviour resulting from aerial fauna flying near/within the zone of disturbance surrounding the operational wind turbines.
- The protection, management and enhancement of vegetation and fauna habitat outside the approved disturbance areas within or surrounding the subject land toward a benchmark state will contribute to effectively minimising indirect impacts.

The magnitude of known and expected impacts to threatened species resulting from prescribed and indirect impacts is not considered to be significant enough to warrant additional offsetting. Further offsetting may be considered as part of ongoing adaptive management if trigger levels are realised which are determined to be of a level significant enough to warrant additional offsets. These trigger levels will be developed in the preparation of the BBAMP.

As outlined in Section 5.4.2 a combination of acoustic call data analysis, desktop/on-ground assessment of potential habitat locations, and geomorphological analysis and advice has been undertaken to determine the likelihood of microbat species roosting and/or potentially breeding within the development footprint or immediate surrounds.

Call data was analysed based on the time each call was recorded relative to sunset/sunrise to assess potential correlations that suggest bats may be roosting within, or in the vicinity of, the development footprint. It could be expected that if bats were roosting within the development footprint, calls would be clustered around sunset when the bats are exiting the roost for nightly forage activity, especially so give the proximity of the majority of the detectors to areas of possible microbat habitat. Furthermore, if bats were roosting elsewhere in the landscape and travelling to the site as part of foraging activity, calls would be expected to be less clustered towards sunset and be spread more throughout the remainder of the night. It could also be expected that if bats were roosting in the immediately vicinity of the development footprint there would be another spike in activity before dawn.

Based on the analysis of the time ranges which species' calls were recorded (refer Section 5.4.2), it is concluded that whilst some species, including Large Bent-winged Bat, Little Bent-winged Bat and White-striped Free-tailed Bat, are arriving on site during the early parts of the night, there is no clear evidence to suggest that regularly utilised roosts are present within the development footprint or immediate surrounds. There are no strong correlations around sunset, and many of the calls are occurring after twilight and later into the night.

Desktop and on-ground assessment of areas of potential microbat cave roosts found two areas to support high potential for roosting and potentially breeding bats within the subject land. These areas comprised a steep cliffline on the southern portion of the development footprint and pillar like outcrop with many deep and vertical fissures in the central/eastern portion of the development footprint, both outside the development footprint. No direct evidence of bats, such as guano or odours, were recorded at either habitat feature, suggesting the features were not currently utilised by microbats, but the potential for their use into the future exists. The Geomorphological assessment found that whilst the development footprint and broader landscape are likely to support a diverse range of rocky terrain forming many opportunities for potential microbat habitat, there were unlikely to be any large caves present proximal to the development footprint, and that the development footprint in no way stood out as supporting particularly higher quality habitat than the surrounding landscape (Environmental Geosurveys 2021).

It is concluded that whilst roosting opportunities may exist for both cave dependent and non-cave dependent microbat species within and immediately surrounding the development footprint, the potential for large roost sites is low, and that roosting opportunities (both rocky and within tree hollows) are unlikely to be limited in the wider landscape. As such, the potential for the development to result in significant or substantial impacts to microbat roosts is considered low.

Limitations of the field investigation relating to microbat trapping surveys to attempt to determine the presence of breeding bats within the development footprint are provided in Section 5.4.2. However, to address the potential for impacts to breeding bats, call data and temporal abundance/activity within the development footprint was analysed for the four BAM species credit bats, which are considered at highest risk from potential impacts to breeding habitat/activity. Each of these four species of microbat; Large-eared Pied Bat, Large Bent-winged Bat, Little Bent-winged Bat and Eastern Cave Bat are known to seasonally migrate to colonial maternity sites, with Large Bent-winged Bat and Little Bent-winged Bat known to travel large distances and congregate in large numbers. Due to this behaviour of communal breeding, activity data can be used to infer whether bats are present or absent from the development footprint during known breeding season, and to determine relative level of activity before during and after these seasons.

Relative abundance of Large-eared Pied Bat indicates that breeding roosts are unlikely to be present within or immediately surrounding the development footprint as higher levels of activity would be expected in November, with activity levels dropping in late March. Neither of these trends were observed for the species. Eastern Cave Bat can be seen to be most active within the project area in April, with low levels of activity recorded in February and March. Little is known about the breeding biology of this species; however, it could be expected that some activity would have been recorded in November if maternity roosts were present. Large Bent-winged Bat activity suggests that individuals occurring within the project area are unlikely to be breeding females, who are known to leave maternity roosts in February, which would lead to a reduction in activity through March and into April. Little Bent-winged Bat activity shows little evidence to suggest breeding behaviour in the immediately vicinity of the development footprint, and that overall activity for the species is comparatively low. Furthermore, Little Bent-winged Bat is known to co-occur in maternity roosts with Large Bent-winged Bat, especially in colder environment, and based on activity data for Large Bent-winged Bat, there is again little evidence to suggest either species is breeding in the area.

Whilst it is acknowledged that without trapping surveys, microbat breeding activity cannot be conclusively ruled out from occurring within and surrounding the project area, however analysis temporal activity patterns do not suggest that this is occurring. It is concluded that based on the low potential for large numbers of bats roosting in the immediate vicinity of the development footprint, combined with the lack of evidence to suggest microbats are congregating within the development footprint during known breeding seasons, that the potential for impacts to breeding microbats as a result of the development are low.

These conclusions are based on the evidence outlined in this BDAR and the trends observed which do not show strong signs of breeding and/or large scale roosting behaviour. Furthermore, the development and implementation of the BBAMP will allow for these conclusions to be tested with stringent adaptive management criteria through the operational phases of the project.

8.3.5 Disturbance of habitats from noise and light

Habitats within and adjacent to the development footprint are likely to be subject to some increased disturbance from noise and light, primarily during the construction phase of the project. Noise and light impacts during operation will be negligible, with limited impacts to native fauna from the operation of the wind turbines. There may be some minor impacts associated with lighting of access tracks, site offices and other ancillary sites during operation, however these can be mitigated through lighting design measures.

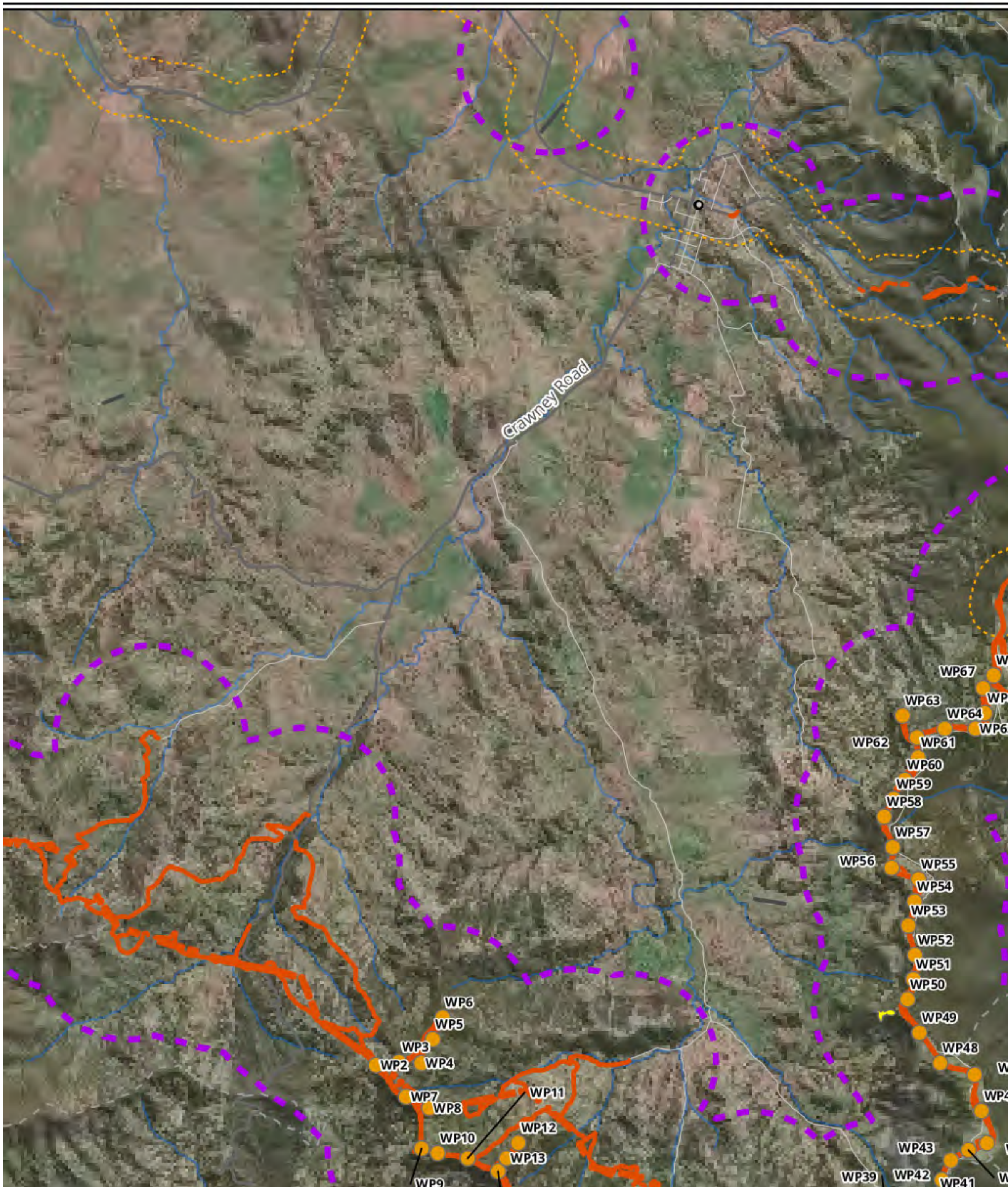
The majority of the threatened fauna that have been identified to be potentially impacted by the project are nocturnal, so measures to manage noise and light from construction at night will be implemented. Aviation hazard lighting is not expected to have an impact on nocturnal fauna using the habitats within and adjacent to the development footprint. Considering the high elevation of the turbines and implementation of shields, any light spill is unlikely to occur below the tree canopy impacting on the behaviour of any terrestrial or arboreal fauna.

8.3.6 Disturbance from weeds, pests and pathogens

There is the potential for weeds and pathogens to be introduced and spread during construction as a result of machinery movements and increased foot traffic.

Works associated with the proposed road upgrades on the haul route are considered low risk as these will be limited to the road corridor where lands are already subject to disturbance from adjacent transport activities.

Pathogens, including Root Rot *Phytophthora cinnamomi*, Myrtle Rust *Austropuccinia psidii* and Chytrid Fungus *Batrachochytrium dendrobatidis*, have the potential to be introduced to the site during construction and, if so, terrestrial and aquatic habitats within the development footprint could be impacted. Mitigation measures to control the spread of weeds, pests and pathogens will be detailed in a Biodiversity Management Plan.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WP41

8.4 Waterway crossings

A desktop assessment was carried out to identify and map aquatic habitat values and potentially occurring threatened aquatic species for the development footprint. The assessment incorporated the review of relevant spatial datasets and documentation as outlined in Section 1.8 of this document and was supported by general observations of aquatic values during fieldwork.

There is no suitable habitat for any threatened aquatic species within the development footprint and any indirect impacts are not considered likely to results in any impacts to potential habitat downstream.

Streams identified for the assessment area were classified according to the Strahler (1952) stream ordering system. Riparian buffers were identified and mapped for each stream in accordance with Appendix E of the BAM. The majority of the streams within the development footprint for the turbines, internal roads, transmission line and access tracks are first order streams being located high in the catchment. There is limited value for any aquatic threatened species within these environments and no targeted surveys for aquatic species were required under the BAM.

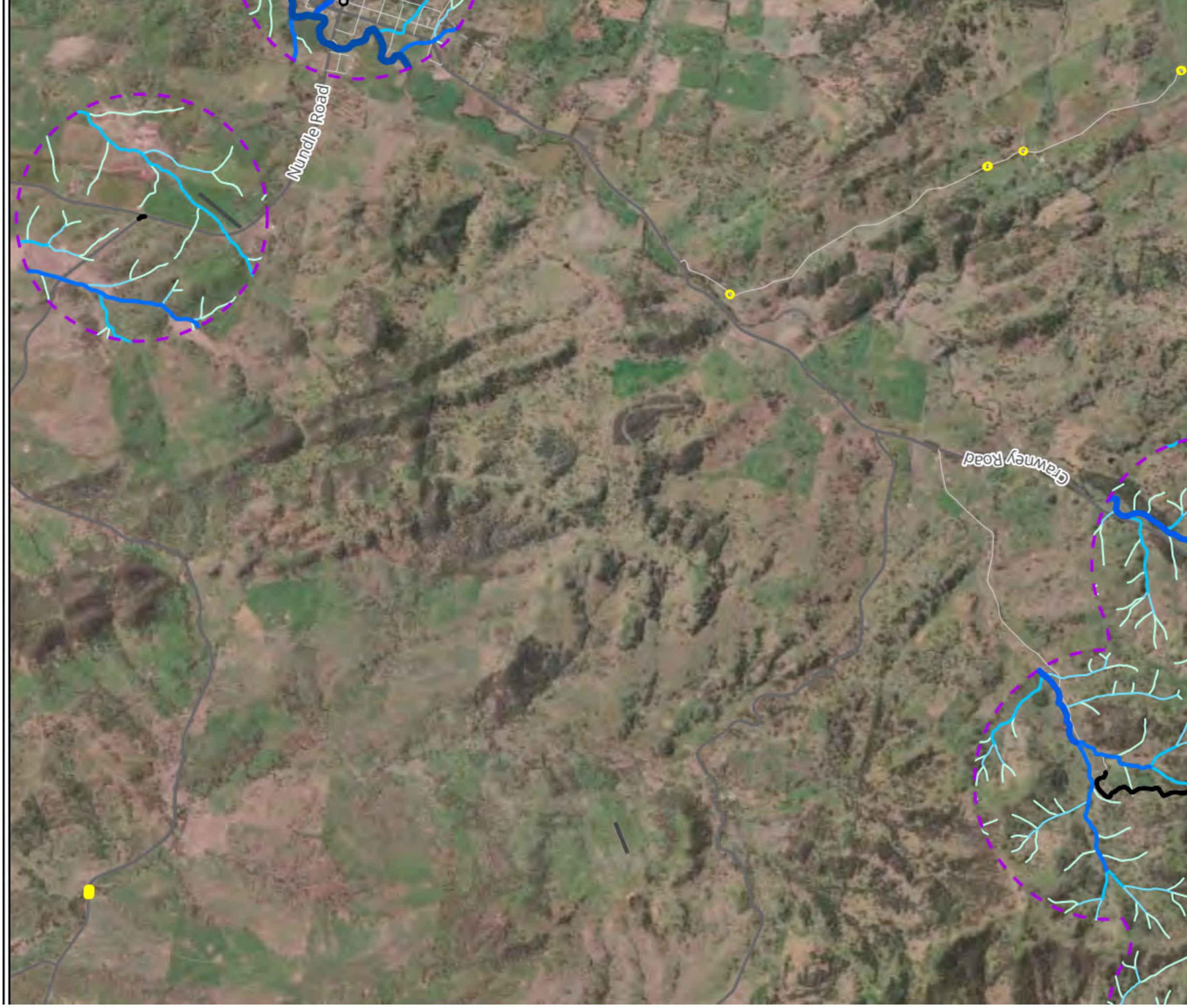
There are 15 locations that require upgrades of creek crossings along the transport haul route. In these locations there is an existing crossing structure that is likely to require upgrading to allow for the safe transport of turbine infrastructure, raising the vertical clearance of the crossing to allow clearance of long elements such as turbine blades.

Where there is an existing bridge that has been identified for upgrades, the works will generally include additional strengthening to accommodate additional weight or widening. This may involve new foundations, piers and carriageway with these works resulting in minimal impacts to the existing waterway channel. A similar approach will be adopted for any existing culverts that are required to be strengthened.

Where there is an existing causeway, additional assessment will be required during detailed design to determine if any upgrade works are required. If the causeway crossing is suitable for the transport requirements no works will be completed. If added vertical clearance is required a culvert will be the likely crossing structure. A summary of the existing crossing locations which may potentially require upgrades subject to further assessment, and the type of fish habitat for each crossing is provided in Table 63.

Table 63 Assessment of fish habitat class at waterway crossings

Site number	Crossing location and existing structure type	Stream order	Fish habitat class
3	Goonoo Goonoo Creek crossing, Lindsay's Gap Road, Garoo Bridge	3	Class 2
5	Middlebrook Creek crossing, Lindsay's Gap Road, Garoo Bridge	3	Class 2
6	Wardens Brook, Head of Peel Road, Nundle Causeway	3	Class 2



Nundle Road
Crawney Road

8.5 Prescribed impacts

The following section provides an assessment of prescribed impacts as required by Section 8.3 of the BAM (DPIE 2020), information is provide in Table 64.

Table 64 Assessment of BAM prescribed biodiversity impacts

Karst, caves, crevices, cliffs, rocks and other geological features of significance
Assessment of the impacts of the proposal on threatened entities associated with karst, caves, crevices, cliffs, rocks and other geological features of significance must:
Predict the nature, extent and duration of short-term and long-term impacts to karst, caves, crevices, cliffs, and other geological features of significance
The project will not directly impact upon any karst, caves, crevices, cliffs, and other geological features of significance. Such features may be utilised as habitat for roosting and possibly breeding for locally occurring cave-dependent microbat species. Potential habitat within and immediately surrounding the development footprint was assessed via desktop and follow-up ground confirmation surveys in February 2020 and again in March 2021. Detailed methods and results of these assessments are provided in Section 5.4.2 of this BDAR, however in summary, two areas supporting geological features suitable for microbat roosting were found to the north-west and south of the development footprint, with other areas targeted during surveys confirmed not to support suitable habitat features. In order to provide additional scientific advice on the likelihood of the project area and surrounding landscape to provide roosting and potential breeding habitat opportunities for microbats, a desktop geomorphological assessment was undertaken by Environmental Geosurveys Pty Ltd (Environmental Geosurveys 2021) (Appendix F). The assessment found that whilst the basalt lithology present at the project area may support opportunities for microbat roosts, no substantial caves were likely to be present, and that no data was found to suggest that the development footprint and immediate surrounds geomorphologically standout from the surrounding landscape in one way or another. Furthermore, it was concluded that the diverse terrain and lithology, and dynamic geomorphology result in high potential for microbat roosting sites to occur across the landscape as a whole, at all elevations within the expected flight range of microbats (estimated to be 50-75 kilometres) that may be present within the project area (Environmental Geosurveys 2021). The assessment notes that the project area lies in the southern margin of the New England Orogen, which comprises a complex geological history resulting in a wide range of rock types and structures in northeast NSW and southeast Queensland. The basement rocks developed from the Cambrian to the Carboniferous, and over time have been altered by multiple episodes of deformation and igneous intrusions, and further sedimentation during the Permian prior to the break-up of Gondwana. The exposed basement geology includes stratified silicic and calcareous sedimentary beds, granitoids and interbedded volcanics previously subjected to and altered by metamorphism, large-scale folding and faulting. Widespread volcanism in the Cenozoic covered much of the surface of the New England Orogen, but the areal extent of volcanics has been reduced by denudation (Environmental Geosurveys 2021). Thus, the diverse geology present in the landscape surrounding the project area continues to the north through the NSW North Coast, Nandewar and New England Tablelands bioregions (which together comprise much of the New England Orogen). Habitats present in the locality of the project area are therefore also likely to occur elsewhere within broader geological landscape and are therefore unlikely to form a substantial portion of the potential habitat available to microbats, or be significant at a bioregional scale. As the project will not result in direct impacts to karst, caves, crevices, cliffs and other features of geological significance, the habitat feature present will remain available to be utilised by microbats into the future, and the project has avoided all impacts in close proximity (<150 metres) the confirmed potential microbat habitat features.

Indirect impacts with the potential to occur during the construction phase of the project are expected to be able to be suitably mitigated such that no substantial consequences would occur to cave bats potentially utilising the areas of high potential bat roosting in the vicinity of the development footprint. Further information on the proposed construction and operational mitigations measures and commitments are provided in Section 8.9 of this BDAR.
Predict the consequences of impacts on the threatened entities potentially present within the subject land associated with karst, caves, crevices, cliffs and other geological features of significance
The project will not result in direct impacts to karst, caves, crevices, cliffs and other features of geological significance suitable to provide roost or breeding habitat for cave dependent bat species. Threatened species known to occur within the project area most likely to use potential habitat provided by geological features of significance include: • Eastern Cave Bat • Eastern False Pipistrelle • Large Bent-winged Bat • Large-eared Pied Bat • Little Bent-winged Bat Indirect impacts to these species have the potential to occur during the construction phase of the project. Impacts may occur via noise and vibration impacts, and vegetation removal within the vicinity of two high potential roost locations, although substantial redesign works have been undertaken to reduce the potential for such impacts, with construction works now occurring no closer than 100 metres and 430 metres from the habitat features. It is difficult to predict how microbats potentially using these habitat features may be impacted by construction impacts as there is limited literature available on vibration impacts to microbats. As such the project has committed to monitoring for the presence of microbats and implementing mitigation measures if bats are found to be present during breeding or winter torpor seasons (refer Section 8.9.1). Further indirect impacts may occur as a result of avoidance and blade strike, with these impacts addressed in Section 8.3 of this BDAR.
Justify predictions with appropriate modelling, relevant literature and other published sources (if available), or advice from experts for impact to species associated with karst, caves, crevices, cliffs and other geological features of significance
The Preliminary Geotechnical and Geophysical Interpretative Report (Tetra Tech Coffey 2021) prepared for the development states that at this stage it is expected that the design preference will be to support each turbine on a single reinforced, or mass concrete block gravity footing. Whilst indicative footing or sizing information have not been supplied, it is expected that such a footing would be square, or hexagonally shaped in plan, at least 20 to 25 metres wide, and 3 to 5 metres deep. With reference to the preliminary project geotechnical models for the Windfarm Ridgelines, it is expected that founding conditions for the majority of Wind Turbine Generator footings would then comprise residual soils and/or extremely weathered basalt. (Tetra Tech Coffey 2021). The report goes on the state that it is understood that earthworks and excavations are proposed to both construct the turbine footings, form laydown areas, and for service roads. Excavation of this material is expected to require a hydraulic rock breaker, blasting, or mechanical splitting to fracture and loosen the in-situ rock. As block sizes in this type of material may be large, there is also a significant potential for overbreak (Tetra Tech Coffey 2021). Based on this advice, and as outlined above it is recommended that disturbance to roosting microbats as a result of ground vibration during breeding season (November to February) or winter torpor season (May to September) will be avoided and minimised as far as practicable, and mitigation measures and project commitments have been made to implement this recommendation (refer Section 8.9.1). It is not expected that direct impacts will occur to the habitat features due to the excavations being no closer than 100 meters from potential habitat.

Predict the nature, extent and duration of short-term and long-term impacts to rocks
As outlined above, additional assessment of the geomorphological characteristics of the project area was undertaken by Geosurveys Pty Ltd (Environmental Geosurveys 2021) (Appendix F), who concluded that there was no data found to suggest that the development footprint and immediate surrounds geomorphologically standout from the surrounding landscape in one way or another, and that similar geomorphological characteristic were likely to occur in the medium distance (50-75 kilometres) and far broader bioregional landscape. Whilst the subject land contains rocky areas, no areas could be said to be significant at the local or bioregional scale, with regards to providing high quality habitat for threatened species, not provided in similar or higher condition elsewhere, such as within the adjacent National Parks estate. As such it is not expected that the project will result in significant of substantial impacts to rocks, or the threatened species associated with rocks, in the short or long term.
Predict the consequences of impacts on the threatened entities potentially present within the subject land associated with rocks
Threatened species considered as part of this assessment, associated with rock, and most likely to use rock as a habitat component include: • Booroolong Frog • Border Thick-tailed Gecko • Brush-tailed Rock-wallaby • Spotted-tailed Quoll Rocks are provide a range of generalist and specific habitat components for these species based on the following information provided in the BioNet Threatened Biodiversity Data Collection: Booroolong Frog • Adults occur on or near cobble banks and other rock structures within stream margins. • Shelter under rocks or amongst vegetation near the ground on the stream edge. • Sometimes bask in the sun on exposed rocks near flowing water during summer. • Eggs are laid in submerged rock crevices and tadpoles grow in slow-flowing connected or isolated pools. Border Thick-tailed Gecko • Species often occurs on steep rocky or scree slopes, especially granite, however, also recorded from areas of basalt and metasediment slopes and flats. • Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. • Shelter by day under rock slabs, in or under logs, and under the bark of standing trees. Brush-tailed Rock-wallaby • Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. • Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night when foraging. • Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Spotted-tailed Quoll • Quolls use hollow-bearing trees, fallen logs, other animal burrows, small caves and rock outcrops as den sites. • Use communal 'latrine sites', often on flat rocks among boulder fields, rocky cliff-faces or along rocky stream beds or banks. Such sites may be visited by multiple individuals. Targeted surveys were undertaken for all species outlined above as part of the field campaign for this biodiversity assessment. Border Thick-tailed Gecko and Brush-tailed Rock Wallaby were not recorded. Spotted-tailed Quoll was recorded on a remote camera trap and a deceased individual was found. Booroolong Frog was assumed present along Wombramurra Creek, where a known population of the species occurs to the north of the project area, and surveys were undertaken outside the recommended season.

Border Thick-tailed Gecko habitat has also been assumed to be present where suitable habitat was recorded in locations where targeted nocturnal survey was not able to be undertaken, however direct impacts to the species comprise a total of just 0.17 hectares. As such potential impacts to rocks as a result of the project are not considered likely to result in substantial additional impacts to the species. The project is unlikely to impact upon rocky habitat supporting the population of Booroolong Frog as direct impacts will not occur to the creek or creek banks, and indirect impacts will be avoided through mitigation measures outlined in Section 8.9 of this report. Impacts to rocky habitat that has the potential to support Brush-tailed Rock Wallaby are not expected, as the species' presence has been discounted from the subject land. The project will permanently remove rocky habitat likely to be utilsed by Spotted-tailed Quoll, however, no den or latrine sites were recorded within the subject land during field surveys. Furthermore, rocky habitat present forms only a small portion of the similar habitat available to individuals present within the development footprint and project area. Areas of higher quality habitat, not impacted by the project, occur in the large areas of intact vegetation to the south and east of the development footprint and these areas are expected to be of higher importance to the local population of the species. The consequences of removal of rocks associated with the project are considered negligible to Booroolong Frog, Border Thick-tailed Gecko and Brush-tailed Rock-wallaby. Consequences of the impacts to rocky habitat for Spotted-tailed Quoll are considered likely to be minor in nature. Whilst habitat likely to be used in some capacity by the species will be impacted, no important den or latrine sites were recorded, and areas of higher quality habitat adjacent other development footprint, much more likely to support dens and latrines, will not be impacted.
Justify predictions with appropriate modelling, relevant literature and other published sources (if available), or advice from experts for impact to species associated with rocks
• As outlined above
Human-made structures or non-native vegetation
No human made structure considered likely to support threatened species will be impacted by the project. Assessment of the impacts of development on the habitat of threatened species or ecological communities associated with human made structures is therefore not required. Non-native vegetation impacted by the project largely comprises areas of exotic grassland, with only minor occurrences of non-native trees and shrubs. No threatened species potentially impacted by the project are associated with exotic grassland. Assessment of the impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation is therefore not required.
Habitat connectivity
Assessment of the impacts of the proposal on connectivity of habitat of threatened entities must
Describe the nature, extent and duration of short-term and long-term impacts
Areas of highest quality habitats occur to the south, east and north-east of the project area supported by large tracts of intact native vegetation. Areas to the north and west of the project area generally comprise cleared farming land with more densely vegetated areas present along steep ridgelines and gullies, less suitable for agriculture / farming practices. The central portion of the transmission line traverses a north-south running ridgeline, forming part of the Liverpool Range, which supports what appears from aerial imagery to be intact to moderately intact vegetation to the north and south of the project area. The eastern portion of the transmission line and the western extent of the wind farm corridor run along a north-west to south-east running ridgeline supporting patchy native (partially intact) vegetation to the north and larger tracts of intact vegetation to the south, including Crawney Pass National Park. The central and eastern portions of the windfarm corridor occur along a ridgeline that forms the western extent of very large tracks of intact vegetation to the south and east, with areas of intact vegetation present surrounding the upper catchment of the Peel River adjacent to the development footprint to the north.

Access road upgrades will occur along the northern end of Morrisons Gap Road where large areas of intact vegetation occur to the north and south. The development and operation of the wind farm will result in up to 65 turbines operating over an approximate liner distance of 30 kilometres along the ridgelines as described above. This linear alignment has the potential to create an obstacle to movement through the wind farm, impacting upon habitat connectivity in an east to west, and north to south direction within different portions of the development footprint. Habitat connectivity has the potential to be most substantially impacted for those species known to fly within the range of rotor-swept height, rather than those that move under, or potentially over, the turbine blades. It should be noted that impacts to habitat connectivity have been reduced through the removal of turbines WP1, WP19, WP23, WP27 and WP31 following turbine risk assessments undertaken following agency and public submissions. Removal of these turbines has resulted in a reduced impact to habitat connectivity in the southern and western portions of the development footprint. Removing WP19 creates a gap of over 2 kilometres between turbine WP18 and turbines WP20-22, and the removal of WP19 allows for an approximate 600 metre reduction of the intrusion into intact vegetation to the south of the development footprint, allowing more available airspace for aerial fauna around the southern extent of the wind farm corridor. Removal of WP1 from the project design reduces potential connectivity impacts as the turbine was acting as an outlier on the south-western extent of the array, and the turbines now occur in a more linear arrangement in that location. Removal of WP19, WP23, WP27 and WP31 reduce impacts to connectivity around the southern-most part of the development footprint by reducing the incursion into intact vegetation in that location by between 400 and 500 metres at each turbine location (refer Figure 1). Potential impacts to habitat connectivity will occur for the operational life of the wind farm, expected to be approximately 30 years, which is considered only to be in the short to medium term, following which impacts may be removed if the wind farm is decommissioned. For species that move within the height range where turbine strike is possible, and are likely to move through the operational wind farm corridor for foraging or potentially migratory movements, an associated impact of collision mortality could occur, albeit in rare circumstances. Impact risk assessment for all aerial species has been provided in Section 8.3 of this BDAR. Landscape scale habitat connectivity is mapped on Figure 27.
Predict the consequences of impacts for the persistence of the threatened entities potentially present within the subject land, taking into consideration mobility, abundance, range and other relevant life history factors
All threatened species and ecological communities rely of habitat connectivity to some degree to maintain genetic diversity and to allow for adaption to threatening processes. Threatened species reliant on the habitat connectivity across and surrounding the development footprint have been grouped into categories based on how they utilise habitat connectivity. These include: • Nomadic, migratory or long-range foraging birds and bats. • Sedentary birds and bats. • Small mammals. • Frogs and reptiles. • Flora and TECs. Species with the highest potential to be impacted by changes to habitat connectivity as a result of the project include species considered nomadic, migratory and/or long-range foragers and were recorded during completed surveys. Such species include: • Flame Robin • Grey-headed Flying-fox • Little Bent-winged Bat • Little Lorikeet • Large Bent-winged Bat • Yellow-bellied Sheathtail-bat These species are addressed further below in relation to how the project may impact upon habitat

connectivity at a population scale.

Flame Robin

- Species known to breed in upland areas and in winter move to the inland slopes and plains, therefore potentially moving through the development footprint.
- However, species is likely to occur beneath or within the canopy and therefore under the turbine's rotor swept height, thus being relatively unaffected by the project.

Grey-headed Flying-fox

- Species is known to fly at higher altitudes and likely within the range of rotor swept height and be capable of travelling up to 50 kilometres from a roost to forage.
- The DAWE National Flying-fox monitoring viewer has a number of camps mapped within 50 kilometres of the development footprint including large camps at Murrurindi and Tamworth, each having recorded >50,000 individuals present in the past (2017).
- It is considered unlikely that individual flying-foxes would regularly be flying through the wind farm as these two camps are between approximately 25 kilometres (Murrunrindi) and 50 kilometres (Tamworth) from the project area, and would represent long forage efforts over commensurate landscapes providing ample forage opportunities closer to the known roosts.
- Therefore the wind farm is not expected to represent a significant barrier to movement for this species, or substantially impact upon habitat connectivity at a bioregional scale.

Little Bent-winged Bat and Large Bent-winged Bat

- Species are known to occasionally fly at higher altitudes and likely within the range of rotor swept height, and to travel large distances (100s of kilometres) for breeding migrations. Species also known to fly higher during migratory flight, potentially putting them at risk of turbine strike.
- A known non-breeding roost for both species occurs approximately 5 kilometres south of the development footprint at Timor Caves. It is expected that bats would move between this roost and the known breeding roost in Karanga-Boyd NP (approximately 250 kilometres to the south) due to its occurrence in similar topographical and climatic zones, rather than the geographically closer breeding roost at Willi Willi NP, in sub-tropical climate to the east of the dividing range in the Kempsey LGA.
- Whilst these species have been recorded foraging within the development footprint, their expected southerly breeding migration means the development is not expected to result in a substantial impact to connectivity, such that the bioregional persistence of the species is under threat.

Little Lorikeet

- Species is known to be nomadic in response to flowering eucalypts and other feed tree species.
- The species is most likely to occur in areas of intact forest, woodland or riparian vegetation, however, can also occur in paddock trees.
- The species has the potential to fly within the range of rotor swept height meaning the operational wind farm may impact upon habitat connectivity, however when observed within the development footprint the species was present at approximately 15 metres elevation. The species was not recorded flying in the range of rotor swept area during any bird surveys undertaken for the current assessment.
- As agile flyers moving as part of larger flocks, Little Lorikeets can be expected to have some capacity for avoidance of rotor blades, potentially lessening the project's impacts to habitat connectivity.
- Commensurate habitat occurs within the 50 kilometres surrounding the wind farm (where recent BioNet records of the species occur) that provides the species with habitat connectivity. As such when considered at the scale of bioregional persistence, the project is unlikely to result is significant impact to habitat connectivity for the species.

Yellow-bellied Sheathtail-bat

- Species is considered to migrate from northern parts of Australia and south in summer, which could potentially include through the operational wind farm.
- The species is considered generally to forage above the canopy and has been recorded by detectors mounted at canopy height and 60 metres on met masts during the current study. However, the species is known to fly lower over open spaces and at the forest edge (Chruchill 2008).
- Based on the above the operational wind farm may impact upon habitat connectivity for individuals flying within the range of rotor-swept height.

- As the species is hollow-dependent for roosting and breeding, and known to generally forage over the canopy, it is considered more likely that movements may occur over vegetated areas surrounding the development footprint rather than the through the cleared areas of the wind farm potentially lessening the impacts to habitat connectivity for the species.

Potential risks to the species are further assessed in Section 8.3 of this BDAR. Bent-winged-Bat roosts and Grey-headed Flying-fox camps are is mapped on Figure 27.

The project area occurs on the boundary of three IBRA Bioregions, Nandewar, New England Tablelands, and NSW North Coast.

The project area occurs at the southern extent of the Nandewar bioregion, which extents approximately 440 kilometres north into Queensland to the west of the Great Dividing Range. The project area also occur at the southern extent of the New England Tablelands bioregion, which extents approximately 350 kilometres north to the Queensland border, along the Great Dividing Range. The project area occurs near the southern extent of the western edge of the NSW North Coast bioregion. The bioregion extents south-east approximately 150 kilometres to Newcastle, then follows the east coast approximately 420 kilometres north to Yamba, with a portion of the bioregion extending in a north-westerly direction to the Queensland border near Urbenville.

Within the NSW North Coast bioregion, habitat connectivity occurs along the coastal escarpments on the eastern side of the Great Dividing Range and the area of connectivity relevant to the project is of negligible importance to the remainder of the bioregion.

The majority of habitat connectivity within the New England Tablelands bioregion occurs along the western and eastern boundaries of the bioregion, with patchy connectivity throughout the central portions. The ridgeline and adjacent vegetated slopes comprising the project area partially supports connectivity from the south into the New England Tablelands bioregion, however substantial areas of habitat connectivity (approximately 50 kilometres wide) will remain following the development.

Connectivity through the Nandewar bioregion occurs along the eastern boundary (with New England Tablelands) of the bioregion, with lower levels of connectivity along the west, from Liverpool Range through hilly country forming the boundary of the Liverpool Plains and Tamworth LGAs, north towards Mount Kaputar NP. As with the New England Tablelands bioregion, the ridgeline supporting the project area forms part of the connectivity into the Nandewar bioregion, however connectivity will remain present post development to the east and west of the wind farm (approximately 15 to 20 kilometres wide either side of the project area).

Whilst the project may have a minor effect on connectivity into the New England Tablelands and Nandewar bioregions, its linear nature and location on the edge of larger areas of intact vegetation mean connectivity will remain present around the operational wind farm through commensurate high ridgetops and vegetated upper and lower slopes.

The project will result in low level or negligible consequences relating to impacts to habitat connectivity for the suite of threatened flora species, TECs, threatened frogs, reptiles, small mammals and other aerial species not addressed above, present or potentially present within the project area, with regards to bioregional persistence of the species. The development and operation of the wind farm and transmission line corridor will not result in a barrier to connectivity for the majority of these species which are likely to preferentially utilise the adjacent areas of higher quality habitat for movement corridors, or will be capable of moving through the operational development. Furthermore, the wind farm and transmission line have largely been located in areas of existing clearing, on vegetated edges, and in more highly disturbed areas, all of which are less suitable for providing habitat connectivity to terrestrial and arboreal species.

Sedentary birds and bats are less likely to fly through the project area, between forage/roosting habitats, due to the areas of highest quality habitat generally located to the south and east. As such, these species are not expected to be substantially impacted by reduced levels of habitat connectivity.

Justify predictions of impacts with relevant literature and other published sources of information

As outlined above.

Water bodies, water quality and hydrological processes
Assessment of the impacts of the proposal on water quality, water bodies and hydrological processes that sustain threatened entities must:
Describe the nature, extent and duration of short-term and long-term impacts

Numerous first order watercourses occur within the project area, characteristic of its ridgeline nature, with the majority flowing north and west off the ridgeline into the Namoi catchment, with the southern portion of the project area flowing to the Hunter catchment. A small portion of the eastern portion of the project area flows into the Manning catchment. There are 12 named tributaries within the development footprint, however, there are no third-order or higher watercourses impacted (ERM 2021). There are numerous farm dams within and surrounding the development footprint, some of which will be removed as a result of the project, others may be utilised for water requirements during construction.
Overland flow and run-off directed by the steep topography of the project area into gullies forming higher order streams and tributaries are the major hydrological process acting upon any potential threatened species habitat present within the development footprint. Man-made dams located along the overland-flow paths have created permanent or semi-permanent dams (pools) also providing habitat for some threatened species. Species most likely to utilise these habitat features within and proximal to the development footprint are Southern Myotis and Booroolong Frog.
As outlined in the project's Soils and Water Assessment (ERM 2021) overall potential risks to water and soils are relatively minor to moderate, with the primary constraints being steep slopes adjacent to the project footprint. This assessment is based on:
• For the most part, pad sites and access road construction occur on relatively low-moderate gradient lands high up in the respective drainage catchments.
• There is generally a very low risk of run-on or run-off of concentrated stormwater flows.
• Construction sites within the development footprint generally present a low to moderate erosion hazard considering factors such as climate, soils and landform.
• Impacts on water flows is not anticipated for the construction of the project, given the localised impacts are located upstream on the top of the ridgeline.
• Potential impacts downstream are able to be effectively managed at the source of works (i.e. velocity controls in areas with steep slopes) through the implementation of a progressive Erosion and Sediment Control Plan (ESCP).
• Additional measures are able to be effectively implemented to appropriately mitigate impacts associated with the identified sensitive locations in the adjacent National Park and waterways supporting populations of Booroolong Frog. Measures are to be included in the progressive ESCP to either:
  – Direct disturbed runoff away from the catchment area identified to contain the sensitive location.
  – Process runoff through additional sediment controls (e.g. sumps and/or sediment basins) and discharge at a low, non-erosive velocities. (ERM 2021).

Predict the consequences to the threatened entities likely to occur within the subject land
Watercourses and dams within, and adjacent to the development footprint were surveyed during the course of this assessment with results detailed in Sections 5.3 and 5.4 of this BDAR. No threatened frog species were recorded during surveys, however, Booroolong Frog has been assumed present along Wombramura Creek and is known to occur along first order tributaries of Peel River north of the development footprint. Southern Myotis has also been recorded during microbat acoustic detection surveys and is likely to utilise areas of open water, including farm dams, for foraging. Wombramurra Creek and first order tributaries of Peel River comprise a priority management site, forming a portion of the Peel River catchment Saving Our Species Site for Booroolong Frog, with the transmission line crossing the watercourse approximately 400 meters upstream of the nearest record, and the wind farm corridor occurs approximately 2.4 kilometres upstream of the nearest record of Booroolong Frog along a tributary of the Peel River. The habitats present at the point where the transmission line crosses Wombramurra Creek, and the habitats within the wind farm corridor are all considered degraded. Only minor

direct impacts may occur to Wombramurra Creek riparian vegetation which would be unlikely to substantially impact the population of the species, with potential minor impacts also occurring along the edges of Crawney Road (albeit outside the main riparian zone of the creek) if upgrades are required. Indirect impacts however, if not properly managed, could cause more substantial harm to the species and population. If potential impacts to soil and water movement as a result of land clearing and excavation are not adequately managed throughout the project, there is a possibility that Booroolong Frog habitat occurring further downstream within the Peel River or Wombramurra Creek could be adversely affected as a result of increased run off and sedimentation, changes in water flows, and increased pollution of the waterway. In particular, if sediment was to fill rock crevices within the river, the species would no longer be able to use this habitat for oviposition. If poorly managed, this could lead to a long-term decrease in the Peel River Booroolong Frog population, through reduction in breeding habitat. Boorloong Frog records along Wombramurra Creek are is mapped on Figure 27.

In order to minimise such impacts, a Soil and Water Management Plan (SWMP) will be prepared, outlining measures for the management and monitoring of surface water quality and hydrology during construction. The plan would also address any requirements for the management of pollutants or contaminated lands during construction so as to minimise impacts to terrestrial and aquatic habitats. The plan would include the implementation of a construction surface water quality monitoring to minimise impacts to surface water quality. An Erosion and Sediment Control Plan (ESCP) will also be prepared, outlining measures for the prevention of erosion and sedimentation during construction. If adequate soil and water management measures are employed, the indirect impact to Booroolong Frog habitat can be substantially reduced. Implementation and monitoring of the success of this plan would be a key requirement of the Biodiversity Management Plan.

Booroolong Frog is also known to occur within the Barnard River in Ben Halls Gap NP and a tributary to the Isis River in Crawney Pass NP, based on information provided by NSW NPWS during the project's submission process. The presence of the species within these waterways will also need to be considered in any Soil and Water Management Plan to be development for the project if potential run-off to these waterways is likely.

If constructing soil and water are management properly and in accordance with best practice construction environmental management then the project is not expected to result in significant of substantial impacts to Booroolong Frog.

As outline above Southern Myotis was recorded with the subject land and may utilise the existing farm dams for forage opportunities. However the presence of this type of forage habitat is not limited in the landscape and individuals present within the subject land will continue to utilize other forage opportunities following the decommissioning of dams as a result of the project. As such, significant or substantial impacts to Southern Myotis are not expected to occur as a result of impacts to waterbodies.

It is also expected that drainage design and engineering for the project will ensure overland flow patterns are maintained to a practicable level and the project will not result in substantial changes to hydrological patterns or increase erosion downstream potentially impacting downstream habitats.

Additional measures are able to be effectively implemented as part of the SWMP, ESCP and BMP to appropriately mitigate potential impacts associated with the identified sensitive location in the adjacent National Park (Sphagnum Moss Cool Temperate Rainforest). Measures are to be included in the progressive Erosion Sediment Control Plan (ESCP) to either:

- Direct disturbed runoff away from the catchment area identified to contain the sensitive location.
- Process runoff through additional sediment controls (e.g. sumps and/or sediment basins) and discharge at a low, non-erosive velocity (ERM 2021).

An updated assessment of site gradients and risk to this TEC is provided in the updated Soil and Water report including project commitments to avoid impact in the EIS (Someva 2021).

Based on the above information the project will not result in substantial or significant consequences to the bioregional persistence of threatened species or ecological communities potentially relying on hydrological processes or waterbodies present within the development footprint. Potential risk to soil and water are

considered low and able to be successfully managed to prevent downstream impacts.
Justify predictions of impacts with appropriate modelling (if available), relevant literature and other published sources of information, or consultation with species experts.
As outlined above.
Wind turbine strikes
Assessment of the impacts of wind turbine strikes on protected animals identified as likely to be present within the subject land must:
Predict the impact on species living in, or likely to fly over, the proposed development site, including bat or bird strike and barotrauma
The likelihood of impact of birds and bats resident in or likely to fly over the project area are presented in Sections 8.3.1, 8.3.2 and Appendix D of this BDAR.
Predict the rate and timing of impact per turbine per year for species likely to be affected
The predicted rates of impact for birds resident in or likely to fly over the project area are presented in Section 8.3.2 and Appendix D of this BDAR. It is not possible to make such a prediction for bats as individual bats cannot be counted, which is the data required to make such a prediction. A qualitative risk assessment has been undertaken to predict the potential impacts to microbat species and is presented in Section 8.3.1.
Predict the consequences of impacts for the persistence of populations
The consequence of impacts to local populations form a consideration as part of the qualitative risk assessment presented in Section 8.3.1. As outlined above, the project area occurs within, and on the boundary of, three separate bioregions; NSW North Coast, New England Tablelands and Nandewar, which comprise a combined are of approximately 100,000 square kilometres. Each of these bioregions supports substantial areas of habitat of lower, higher and of commensurate quality and value to that which occurs within, and immediately adjacent to, the project area, likely to be directly and indirectly impacted by the project. Whilst it is expected that impacts via blade strike and possibly barotrauma may occur, and further indirect impacts such as loss of habitat opportunities through avoidance of areas surrounding the turbine blades may occur, the scale at which these impacts may be realised is not expected to be such that the bioregional persistence of any species or populations will be subject to substantial or significant consequences. Indirect impacts associated with potential blade strike to individuals utilising the confirmed potential microbat root habitat features have been minimised through the removal of WP27 from the project design, creating a gap of over 400 metres between the habitat feature and the base of the nearest turbine, which is increased further if habitat height and rotor swept height are considered. Furthermore WP50 has been relocated approximately 130 metres to the north-east, ensuring a separation of over 300 meters from the base of the turbine and the top of the habitat feature. As outlined in Section 5.4.2 of this BDAR, there is potential for blade strike impacts for a number of cave-dwelling threatened microbat species including Eastern False Pipistrelle, Large Bent-winged Bat, Large-eared Pied Bat and Little Bent-winged Bat, which were all recorded by acoustic detectors mounted on met masts at approximately 60 metres above the ground. However, it is not expected that impacts associated with potential blade strike impacts would result in impacts substantial or significant enough to threaten the persistence of any of the these species within the bioregion, given the low level of relative activity recorded for all species at higher elevations (i.e. within the range of rotor blades), the wide ranging nature of the species, and the expected volume of commensurate habitat available in the landscape. It should be noted however that locally, repeated loss could alter populations in the short term, and the potential for this will be monitored through implementation of the BBAMP and mitigated accordingly.
Predict the cumulative impacts of the proposed development alongside existing wind farms, on species mortality, movement patterns and use of adjacent habitat
As wind farm developments increase in NSW, and Australia, bird and bat species with the potential to move over far ranging distances can be subject to impacts at multiple wind farms (Biosis, 2006). Five existing wind farms (considered to be those currently operating and/or having been approved for development) occur within approximately 200 kilometres of the project area, these include:

- Sapphire Wind Farm and White Rock Wind Farm both between Glen Innes and Inverell, approximately 200 kilometres to the north.
- Bodangora Wind Farm south-east of Dubbo approximately 200 kilometres to the south-west.
- Liverpool Range Wind Farm (yet to be constructed) approximately 120 kilometres to the south west.
- Kyoto Wind Farm (yet to be constructed) approximately 50 kilometres to the south-west.
- Additionally, Winterbourne and Doughboy Wind Farms, located on the Northern Tablelands near Armidale, as well Bowmans Wind Farm near Muswellbrook, are currently under assessment or EIS stage.

These wind farms range in size from 33 turbines at Bodangora, 42 turbines for Kyoto, 70 and 75 turbines at White Rock and Sapphire respectively, and up to 267 turbines at Liverpool Range.

Each of these wind farms are considered to potentially result in some level of mortality to wide ranging aerial species, however there would be limited overlap in species populations between four of these five wind farm due to their distal locations. Potential interactions of populations of long-range foragers and/or migrating species may occur between the Hills of Gold wind farm and the Kyoto wind farm, however large expanses of intact native vegetation and open air space occur between the two sites, meaning the likelihood of inividuals and/or populations occurring at both sites is considered minimal. Based on the number of turbines operating at the five wind farms within 200 kilometres of the project area, the Hills of Gold wind farm could be expected to contribute to 13 % of potential mortality to aerial species. Detailed and adaptive management plans, such as an Operational Bird and Bat Adaptive Management Plan, will be developed for the project and provide an effective monitoring program and strategy to manage and mitigate operational issues relating to operational and cumulative issues.

As only five existing wind farms (include two yet to be built) occur within approximately 200 kilometres of the current project area cumulative impacts to movement patterns and use of adjacent habitat are expected to be minimal.

Additional assessment cumulative impacts in provided in Section 8.7 and existing wind farms proximal to the subject land are is mapped on Figure 27.

Predict the likelihood and nature of impacts on aerial species living in, or likely to fly over, the proposed development site, including barriers to migratory pathways, and breeding, feeding and resting resources

The likelihood of impact of birds and bats resident in or likely to fly over the project area are presented in Sections 8.3.1, 8.3.2 and Appendix D of this BDAR, as well in the relevant prescribed impacts section above. Bent-winged Bat roosts and Grey-headed Flying-fox camps are is mapped on Figure 27.

Predict the impact of avoidance behaviour for migratory species relative to migration distances, and the availability of suitable habitat for breeding, feeding and resting over the migration route

The likelihood of impact of birds and bats, including known or potential migratory species, over the project area are presented in Sections 8.3.1, 8.3.2 and Appendix D of this BDAR. No species listed as migratory under the EPBC Act were recorded during the field campaign undertaken for the current assessment that extensively targeted the avian fauna present within the subject land during repeat surveys over multiple seasons. Impacts associated with barriers to habitat connectivity are provided above, including an assessment of species recorded that could be considered somewhat migratory, such as bent-winged bats.

Justify predictions with reference to data, collision risk modelling (if available), relevant literature or other published sources including any publications by the Department

Justifications for the likelihood of impacts for birds and bats resident in or likely to fly over the project area are presented in Sections 8.3.1, 8.3.2 and Appendix D of this BDAR.

Map the disturbance zone around wind turbines, and the significant landscape and habitat features within that zone, for species likely to be affected, e.g. hollow bearing trees and important habitat for migratory species

The predicted zone of disturbance around wind turbines is considered to equate to the area outside (and additional to) the rotor swept area where indirect effects of rotating turbine blades are likely to cause changes in air pressure, and/or other characteristics, that may impact upon aerial fauna which fly into this space. In the case of the current assessment, the rotor swept area is expected to extend up to 85 meters either side of the turbine hub, with an additional 50 meters beyond the blade tip considered as a nominal zone of disturbance. These 50 metres, where effects would dissipate away from the rotor swept area, is estimated as the maximum extent an aerial fauna species would likely be disturbed by fluctuations in the air space around rotating turbines. It is expected that smaller species would be more likely to experience disturbance from smaller changes in air pressure (etc), and therefore experience disturbance further from the blade tips, when compared to larger species likely to be more tolerant of smaller changes, and thus experiencing disturbance closer to the tips of the blades. The zone of disturbance therefore is considered to extend to a maximum of 135 metres from the turbine hub. The predicted zone of disturbance around each turbine is mapped on Figure 27.

The zone of disturbance can be considered to comprise two separate parts, those being the rotor swept area, and the area of air disturbance extending past the blade tip. Potential impacts to aerial species within the rotors swept area are largely associated with blade strike and possibly barotrauma, the risk and likelihood of which has been assessed for bird and bat species in Sections 8.3.1, 8.3.2 and Appendix D of this BDAR. Impacts associated with the area of air disturbance, past the end of the blade tips, are less clear but are likely associated with increased avoidance behaviour and barrier effect due to alteration of forces acting on aerial species, potentially leading additional indirect habitat loss due to expected avoidance behaviour.

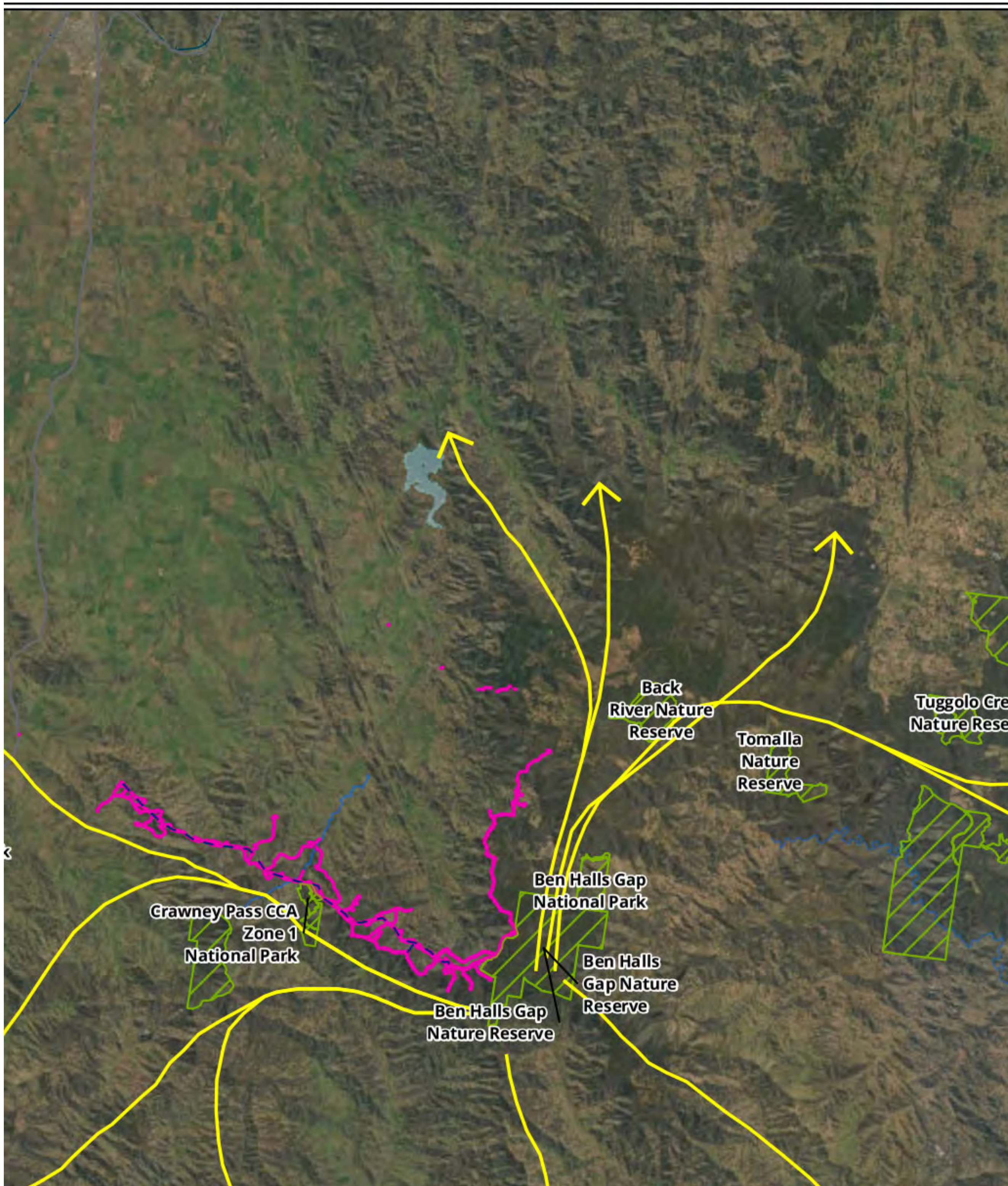
Within the combined zone of disturbance, equating to the rotor swept area and the additional area of air disturbance, habitat features likely to be utilised by aerial fauna include open grassy areas, paddock trees and intact vegetation supporting numerous hollows, small dams and minor watercourses. All of these features are potentially utilised for foraging, roosting and breeding habitat (for some species). Potential microbat roosting/breeding habitat near (former) WP27 and (relocated) WP50 no longer occur within the zone of disturbance from any turbines. Based on a 135 metre radius buffer around the 70 wind turbines the total area within the zone of disturbance is approximately 365 hectares, comprised of open airspace above 198 hectares of disturbed open areas of exotic grassland, and approximately 167 hectares of forest and woodland vegetation. This 365 hectares of potential airspace habitat could be considered to be a maximum area of possible forage habitat indirectly impacted for smaller aerial species such as microbats at times when the turbines are operational. Furthermore the amended design has reduced this potential impact by approximately 7% (or 26 hectares) as a result of the removal of 5 turbines from the Projects layout. Whilst this potential indirect impact to movement and potential forage habitat due to fauna avoiding areas surrounding operation wind turbines could be considered substantial when considered in isolation, it should be noted that none of the habitats present within the estimated zone of disturbance are limited in the landscape. The areas subject to disturbance comprise only a small fraction of commensurate habitats available to individuals of any local populations of species. Furthermore, as outlined above the removal and relocation of turbines has ensured that there is over 100 metres (and likely much more) between the extent of the zone of disturbance and any potential microbat cave breeding habitat, ensuring substantial areas of undisturbed airspace will occur and allow for entry/exit of these habitat features into the future.

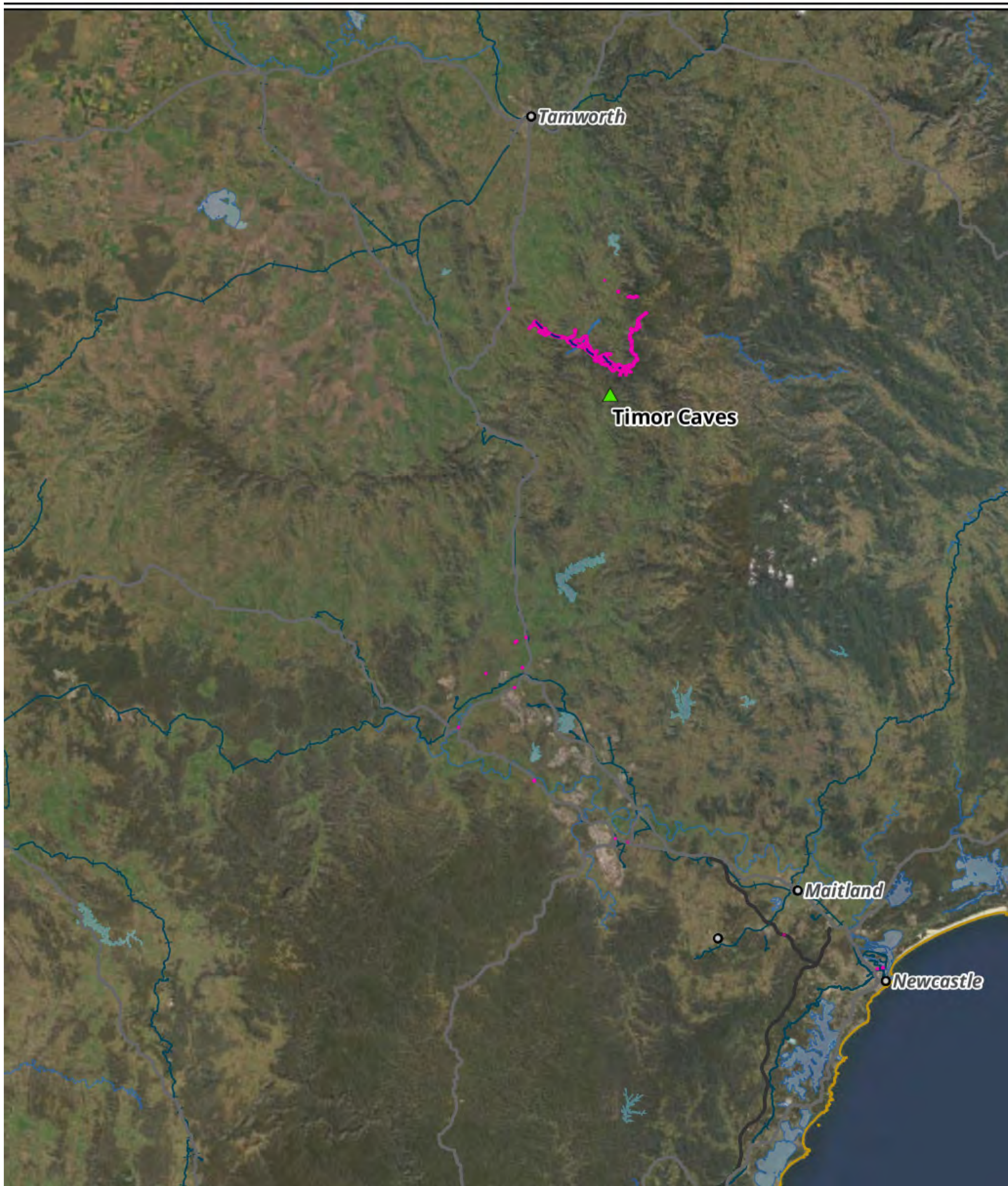
As outlined above, the project has the potential to result in impacts to habitat connectivity for some species potentially flying through the wind farm to access habitats as part of nomadic/migratory movements or long-range foraging. However as noted, habitat connectivity is maintained surrounding the development footprint and the likelihood of regular migratory movements through the wind farm is considered unlikely.

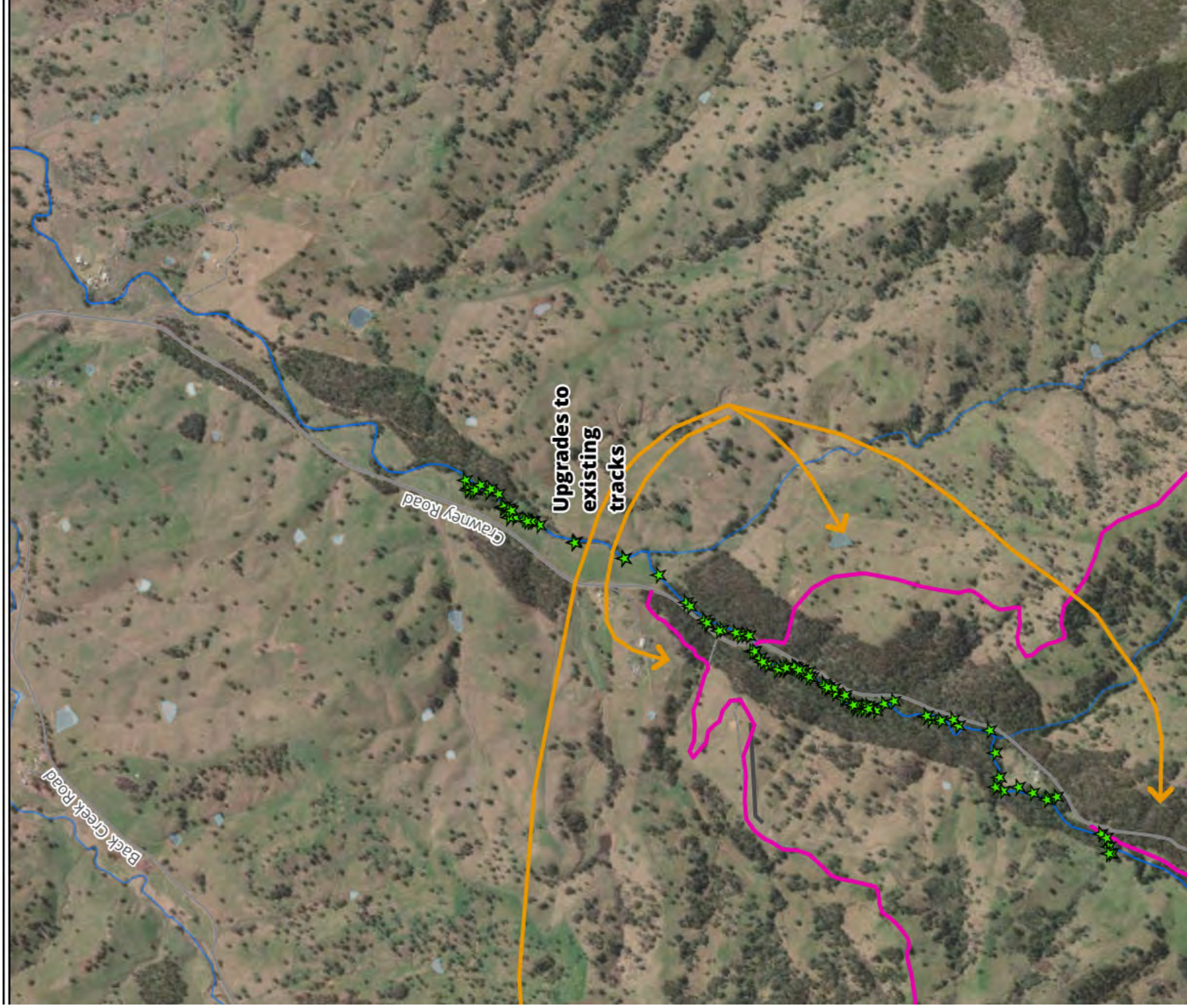
Furthermore, the proposed configuration of the wind farm is a linear row of turbines. In the more usual scattered or 'clustered' array, an aerial fauna species has a high probability of encountering multiple turbines in a given flight. The configuration of turbines for the current project is such that an individual is likely to encounter multiple turbines only in the rare event that it flies directly along the row of turbines, thus somewhat reducing the impacts to habitat connectivity.

The predicted zone of disturbance is illustrated on Figure 15.

Vehicle strikes
Assessment of the impacts of vehicle strikes on threatened fauna or fauna that are part of a TEC identified as potentially occurring within the subject land must:
Predict the likelihood of vehicle strike to each relevant species, considering mobility, abundance, range and other relevant life cycle factors
Terrestrial (and terrestrial/arboreal) mammals are at highest risk of being stuck by vehicles, which for the current assessment includes Koala and Spotted-tailed Quoll. Vehicle strikes are most likely to occur when increased vehicle movements occur across the development footprint, which will be during the construction phase of the project, with mobile plant and machinery moving across the site, and turbine components are being delivered and assembled. However, as both species considered at risk of vehicle strikes are nocturnal, the potential for vehicle strikes during construction is very low to negligible. Potential for vehicle strikes is also considered very low during the operational phase of the project and would only occur when vehicles are moving across the site at night. The frequency of this is expected to be low.
Estimate vehicle strike rates with supporting data or literature, where available
Not applicable
Predict the consequences of the impacts for the persistence of the relevant species
Due to the low potential for increased vehicle strikes during the construction and operational phases of the project, as well recommended mitigation measures, there are not expected to be any significance consequences to the local of bioregional populations of Koala or Spotted-tailed Quoll as a result of the project.
Justify predictions of impacts with relevant literature and other published sources of information
Not applicable


Back
River Nature
Reserve
Tomalla
Nature
Reserve
Ben Halls Gap
National Park
Ben Halls
Gap Nature
Reserve
Ben Halls Gap
Nature Reserve
Crawney Pass CCA
Zone 1
National Park


Tamworth
Timor Caves
Maitland
Newcastle


Upgrades to existing tracks
Crawney Road
Back Creek Road

Sapphire WF
White Rock WF
Armidale
Tamworth
Kyoto WF

8.6 Serious and irreversible impacts

Threatened species and ecological communities, listed in Appendix 3 of the 'Guidance to assist a decision-maker to determine a serious and irreversible impact and/or the NSW BioNet Threatened Biodiversity Profile Database, as entities potentially subject to SAIIs will be impacted, either directly or indirectly by the project.

Those entities relevant to the Project include:

- Box Gum Woodland TEC
- Large-eared Pied Bat
- Large Bent-winged Bat
- Little Bent-winged Bat
- Eastern Cave Bat

As outlined in the above section, turbine removal and relocation have resulted in all direct and indirect impacts previously located within the BAM prescribed 100 metre breeding habitat buffers for the above listed microbat species being removed. However SAII assessments were prepared in accordance with the former BAM (OEH 2017) on the basis of this impact occurring and have been retained and updated to provide additional impact assessment information for these species, as all were recorded within the project area, and the assessments provide valuable insights into the local populations and potential impacts.

In accordance with Clause 6.7 Of the BC Regulation 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.

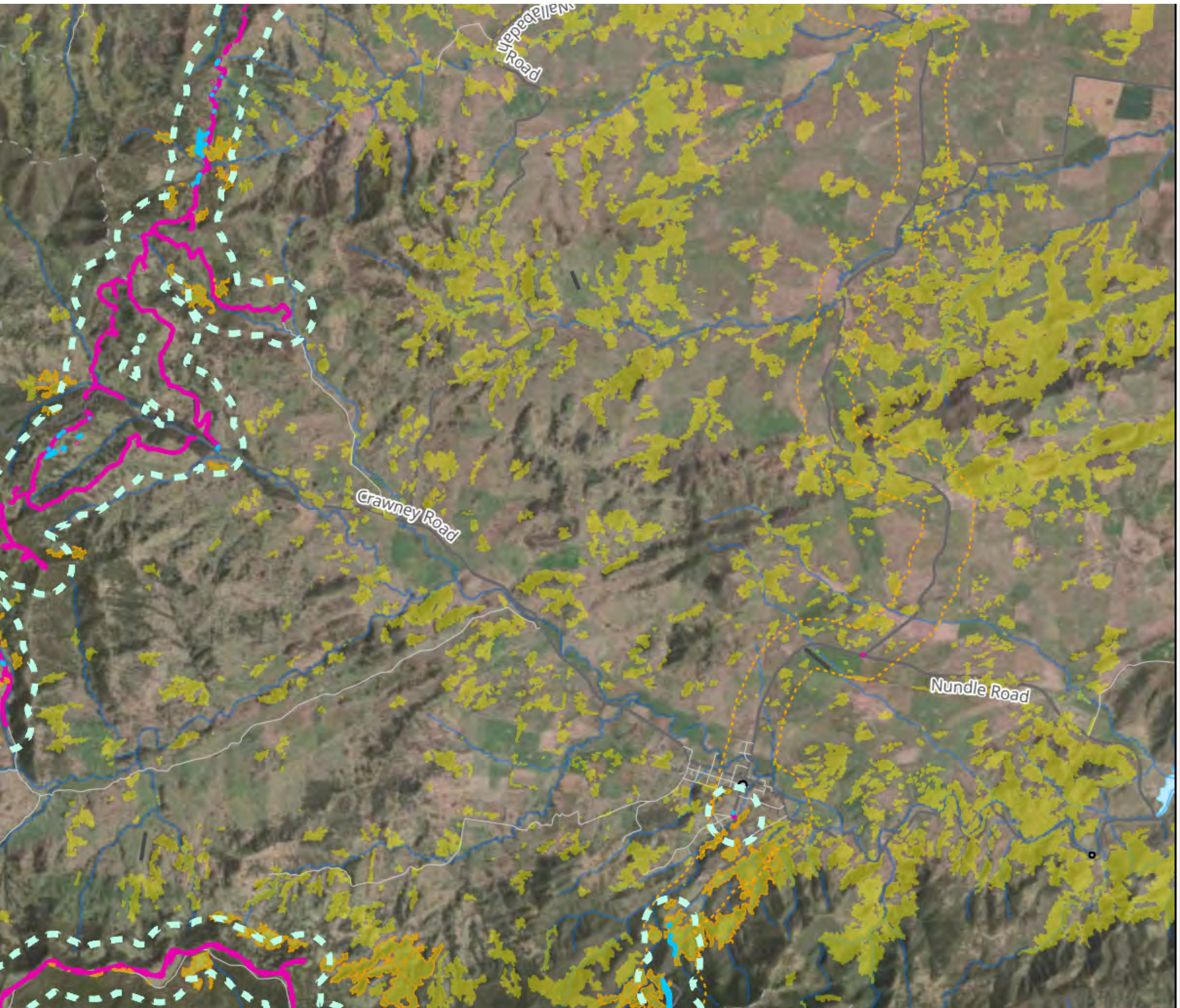
Assessments undertaken in accordance with Section 9.1 of the BAM for the above listed potential SAII entities are included in Appendix E, with a summary provided in Table 65. Impacts to Box Gum Woodland in the context of the SAII assessment are mapped on Figure 28.

Table 65 Summary of SAII assessments

SAII entity	Summary of assessment
Box Gum Woodland	Throughout the development of the project layout, design decisions have been implemented to avoid impacts to Box Gum Woodland. This has included early biodiversity surveys, prior to development of the preferred corridor. Preliminary assessment highlighted areas of key ecological concern and allowed for avoidance of these areas during the wind farm concept design. During the wind farm layout design, workshops were held between project ecologists, civil engineers and wind modellers to further optimise layout options and ensure impacts to the areas of mapped Box Gum Woodland. Overall design refinements undertaken since the exhibited BDAR have resulted in a

SAII entity	Summary of assessment
	reduction of impact to Box Gum Woodland CEEC from 13.3 hectares to 6.07 hectares. Approximately 41 % of the impacts to Box Gum Woodland (2.47 hectares) as a result of the project will occur on areas of DNG or that have been assessed as occurring in Low condition. The Project is not considered likely to reduce the extent of the CEEC at the national, bioregional or local scales, and as such the scale of the impact will not lead to a reduction in the geographic distribution of Box Gum Woodland across its known distribution. Furthermore indirect impacts associated with disruption or abiotic process, the loss of functionally important species, and/or exacerbation of fragmentation and isolation are considered unlikely to be substantial as a result of the Project. Further details are provided in Appendix E, and Figure 28.
Large Bent-winged Bat	Actions to avoid impacts to Large Bent-winged Bat include reduction in the numbers of turbines and changes to project layouts to avoid impacts to roosting/breeding habitat buffers, increased separation distances between turbines, and increase separation distances between blade tip and roost/forage habitats. Ongoing construction and operational phase commitments have also been made to reduce indirect impacts to bats potentially present in roost habitat, and potential blade strike impacts. Turbine removal and relocation have resulted in all direct and indirect impacts previously located within the BAM prescribed 100 metre breeding habitat buffers being removed. The local population of the species is considered to be quite large due to the presence of a known non-maternity roost at Timor Caves, approximately 5 kilometres south of the development footprint. Impacts associated with the project are considered relatively minor in the context of the species' potential forage distance, and also relatively minor to potential breeding habitat. Impacts associated with blade strike may occur, with Large Bent-winged Bat being one of the more frequently recorded bats within rotor swept height. Due to the uncertainty of these potential impacts ongoing monitoring, adaptive management, and mitigation strategies have been committed to, to minimise the likelihood and consequences of this impact. Local movement patterns may be somewhat disrupted by the operational wind farm, however bats forming the local population will generally be roosting south of the wind farm at Timor Caves, with breeding migrations are expected to be heading further south still. Further details are provided in Appendix E.
Little Bent-winged Bat	Actions to avoid impacts to Little Bent-winged Bat and associated residual impacts are generally aligned with Large Bent-winged Bat, as detailed above. This is due to the similarities in the species foraging, roosting and breeding habitats, and life-cycles. Turbine removal and relocation have resulted in all direct and indirect impacts previously located within the BAM prescribed 100 metre breeding habitat buffers being removed. Little Bent-winged Bat was recorded less frequently within rotor swept height than Large Bent-winged Bat, however the potential consequences of blade strike are considered similar, and commitments made to ensure ongoing reduction impacts to the species apply. Further details are provided in Appendix E.
Large-eared Pied Bat	Actions and commitments to avoid impacts to Large-eared Paid Bat are commensurate with those summarised above. Turbine removal and relocation have resulted in all direct

SAII entity	Summary of assessment
	and indirect impacts previously located within the BAM prescribed 100 metre breeding habitat buffers being removed. The size of the local population of Large-eared Pied Bat is considered to be smaller than the bent-winged bat species, and the species is known to generally fly closer to the canopy, hence lower activity levels recorded at all elevations during acoustic surveys are as expected. Impacts to forage habitat are considered relatively minor based on the presence of native vegetation within an estimated 2.5 km forage distance from the development footprint. Impacts to roosting and potential breeding habitat (and 100 m buffers) have been minimised through project design, and commitments have been made to further reduce potential impacts during micro-siting of turbines. Dispersal and movement patterns are not expected to be substantially interrupted due to the linear layout of the turbines and the species' habit of flying closer to the canopy.
Eastern Cave Bat	Actions and commitments to avoid impacts to Eastern Cave Bat are commensurate with those summarised above. Turbine removal and relocation have resulted in all direct and indirect impacts previously located within the BAM prescribed 100 metre breeding habitat buffers being removed. Little is known about the biology and ecology of the species, however, the local population of Eastern Cave Bat is considered to be similar to that of Large-eared Pied Bat. Impacts to the species are also expected to be of a similar magnitude and consequence to Large-eared Pied Bat, with further details provided in Appendix E. In summary, impacts to forage habitat are considered relatively minor based on the presence of native vegetation and impacts to roosting and potential breeding habitat have been minimised through project design, and commitments have been made to further reduce potential impacts during micro-siting of turbines.


Nundle Road
Crawney Road
Wallabadah Road

8.7 Cumulative impacts

An assessment of proposed and current wind farm projects within a 200km buffer of the project site has been carried out to provide a summary of potential cumulative impacts to biodiversity (Table 66). The summary chapters for biodiversity from each of these projects EIS or the scoping report was reviewed to gain an understanding of the main biodiversity impact and how these may contribute to cumulative impacts when considering the development of the Hills of Gold Project. The proximity of these wind farms to the subject land is mapped on Figure 27.

Table 66 Cumulative impacts from wind farms in the region

Project, description and location	Potential biodiversity impacts	Relevance to Hills of Gold
Kyoto Energy Park **47km away** **42 wind turbines, solar photovoltaic array and mini hydro plant** **EIS chapter reviewed.**	• No threatened flora. • 5.9 ha of impact to White Box-Yellow Box-Blakely's Red Gum TEC. • Seven threatened fauna species comprised of birds and microbats with lower terrestrial fauna diversity than the Hills of Gold project. • Potential Koala habitat, but no records or sign of activity during field surveys. • Wedge-tailed Eagle and Nankeen Kestrel identified in collision risk.	A test of significance under the now repealed *Threatened Species Conservation Act 1997* found that the project is unlikely to have a significant impact on threatened species and communities. An additional 5.9ha of impact to the TEC is not considered to substantially contribute to the impact assessment for impacts to this TEC for the Hills of Gold Project.
Bowmans Creek Wind Farm **59 km away** **Desktop assessment from request for SEARs**	• Nine PCTs mapped as being potentially impacted, with five of these being TECs.	The Bowmans Creek windfarm is in a different soil landscape than the Hills of Gold Project and there is no PCTs that are common to both.
Winterbourne Wind Farm **75km away** **Field assessment from request for SEARs**	• Two threatened fauna species, Scarlet Robin and Spotted-tailed Quoll. • Two TECs, New England Peppermint woodland and Box Gum woodland. • Five non-threatened raptors at risk of blade strike.	The Winterbourne windfarm is in a different soil landscape than the Hills of Gold Project and there are few PCTs that are common to both. Potential impacts to Wedge-tailed Eagle as a results of collision risk, however unlikely to be significant with a similar outcome as assessed for this Hills of Gold project
Liverpool Range Wind Farm **116km away**	• Key impacts are to Box Gum Woodland, woodland birds, forest owls and microchiropteran bats.	Assessment of collision risk for microbats determined that species unlikely to be significantly impacted by blade strike due to foraging heights within or below canopy.

8.8 MNES Significant impact assessment

A detailed assessment against the EPBC Act *Significant Impact Guideline 1.1 – MNES* is included in this section of the BDAR. The outcomes of this assessment indicate that the project has the potential to result in a significant impact to one TEC and three threatened fauna species, summarised in Table 67.

The following sections describe the significant impact assessment for all MNES species known or considered likely to occur in the development footprint.

Table 67 Summary of MNES assessed to have a significant impact under the EPBC Act guidelines

TEC and EPBC Status	Extent and nature of significant impact
White Box Yellow Box Blakely's Red Gum Woodland Critically Endangered	The project has been assessed as resulting in the direct impact and loss of up to 6.07 ha of this TEC within the transmission line, transmission line access tracks, and transport route upgrades infrastructure areas. It should be noted that actual impacts are considered likely to be almost half of that currently assessed at Devils Elbow (2.5 ha) following detailed design of project components. The current impact footprint assesses impact over a width of between 30 to 60 metres at that location, with the expected final design only requiring a 14.5 m average total width. Measures to avoid and minimise impacts to this TEC have been considered as part of the design, particularly in the selection of the preferred transmission line route. Additional mitigation measures to avoid impacts to the TEC will be considered and implemented where practicable during future design phases and any residual impacts will be offset. The current development footprint considers a 'worst case' clearing footprint for the transmission line easement, assessing complete clearing within the easement. Depending on the height of the towers and the topography of the easement, there will be locations where the existing eucalypt forest can be retained, while still maintaining the required safety and operational clearance to the transmission lines. This presents opportunities to further minimise the extent of clearing of this TEC during detailed design. As well as minimising impacts through design, site restoration and rehabilitation will utilise a species planting list drawn from this TEC where appropriate. Any **impacts to this TEC are considered unlikely to be significant**, as it is listed as critically endangered.
Koala Vulnerable	Given the scale of native vegetation removal required for the proposed works (> 20 hectares), the presence of Koala within the development footprint, and the contiguous nature of the development footprint with surrounding National Parks and State Forests, the EPBC Act referral guidelines classifies the vegetation within the development footprint as critical to the survival of the species. The referral guidelines, which are applicable to all project types, states that the proposed works has the **potential for a significant impact** on the species, due to the removal of greater than 20 hectares of habitat. The removal of 36.44 hectares of native vegetation known to support Koala (which has been reduced by 14.32 hectares due to design revisions undertaken for the amended project) has the potential to impact the species due to the removal of habitat available to the local population. It should be noted however that, based on a conservative home range buffer of 20 kilometres (Kavanagh, Stanton, & Brassil 2007, Davies et al. 2013) (further detailed below), up to approximately 116,500 hectares of native vegetation is available to those Koala individuals most likely to utilise the habitat within and directly adjacent to the development footprint. Of this 116,500 hectares of habitat approximately 32,000 hectares (27.5 %) was

TEC and EPBC Status	Extent and nature of significant impact
	burnt in the 2019-2020 bushfires (GEEBAM DPIE 2020), which leads to the remaining unburnt habitat becoming a more important resource to the local population. In consideration of the impacts of the 2019-2020 bushfires, the project will only impact upon approximately 0.4% of the habitat available to the local population, which includes the large areas of intact bushland to the south and east of the project footprint. The federal conservation aim for the Koala includes increased vegetation recovery in regions containing fragmented Koala populations, with the project's Biodiversity Offset Strategy aiming to contribute towards this in the local area through increased habitat connectivity, and in the overall achievement of the 'No Net Loss' standard. The current population in the area is not considered to be fragmented, and the areas of habitat impacted as part of the Project are generally small, isolated patches or areas of edge habitat adjacent to larger contiguous areas of Koala habitat. These impacts are not considered likely to result in a reduction in the size of the Koala population in the region. Measures to avoid and minimise impacts to critical Koala habitat have been considered during the design, especially as part of the design refinements for the wind farm resulting in a reduction of the proposed turbines from 97 to 65 and workshops to site infrastructure within cleared areas where practicable. Impacts to Koala habitat have been reduced by a further 27% from the 50.76 ha identified in the original BDAR, to 36.44 ha in the updated BDAR as a result of the project design changes and avoidance initiatives targeted specifically towards Koala habitat. Additional measures will be explored during detailed design phases to reinstate Koala habitat in suitable areas as part of revegetation and landscaping works for rehabilitation of areas subject to temporary impacts. Potential impacts through the construction phase of the Project will be minimised through implementation of the Biodiversity Management Plan that will target management actions specifically towards Koala with details provided in Section 8.9 below.
Large-eared Pied Bat Vulnerable	The proposed works would require the removal of 19.68 hectares of Large-eared Pied Bat habitat that likely forms foraging habitat for the species, based on a 2 km buffer on potential breeding habitat. Previously, potential breeding habitat for this species had been identified within the impact areas, associated with eucalypt forest that is within 100m of the mapped steep cliffs providing potential roosting/breeding habitat (refer to Section 5.4.2 above). However, following targeted field investigations this potential habitat was greatly refined, and project modifications undertaken to avoid this habitat with the result that no potential breeding and roosting habitat for Large-eared Pied Bat will be impacted by the Project. Based on the above, and further detailed in the significant impact criteria assessment below, this level of impact is **not considered likely to be a significant impact** to the species. This is largely due to the large areas of commensurate habitat available in the locality to this highly mobile species.
Spotted-tailed Quoll Endangered	In consideration of the significant impact criteria, the Project has been precautionarily assessed as leading to a **potentially significantly impact** on habitat of the Spotted-tailed Quoll within the development footprint and wider locality. The Spotted-tailed Quoll habitat within the development footprint is considered to be important habitat, given the Endangered EPBC Act threat status of the Spotted-tailed Quoll and the direct evidence of occupancy by the species (DAWE 2016). A total of 40.67 hectares of this habitat is proposed to be removed as part of the project, which is likely to adversely impact Spotted-tailed Quoll habitat within the locality. However, there is still approximately

TEC and EPBC Status	Extent and nature of significant impact
	84,000ha of unburnt native vegetation present within the expected habitat range for the local population of the species that is considered to be adequate for the population to persist. Measures to avoid and minimise impacts to important Spotted-tailed Quoll habitat have been implemented where practicable during the design of the Project, especially as part of the re-design work since EIS exhibition. Impacts to high and moderate condition PCTs have been reduced by a total of 54.58 ha as a result of project amendments, and the majority of this avoided native vegetation is considered potential habitat for the species. The removal of Spotted-tailed Quoll habitat from the development footprint may contribute to the threats currently impacting the species (i.e. habitat loss). However, the project's Biodiversity Offset Strategy aiming to contribute towards improvement in the species' habitat in the local area through increased habitat connectivity, and in the overall achievement of the 'No Net Loss' standard. Potential impacts through the construction phase of the Project will be minimised through implementation of the Biodiversity Management Plan that will target management actions specifically towards Spotted-tailed Quoll with details provided in Section 8.9 below.

8.8.1 White Box-Yellow Box-Blakely's Red Gum Woodland

Box Gum Woodland CEEC is strongly associated with more fertile soils on lower elevations across the known range in Queensland, New South Wales and Victoria. Over much of its range, this TEC has been subject to extensive clearing and modification for agriculture and grazing, so it often occurs as derived native grasslands with no overstorey.

To be considered the listed CEEC under the EPBC Act, areas of this community must have a predominantly native understorey (i.e. more than 50% of the perennial vegetative ground layer must comprise native species), and be 0.1 hectare (ha) or greater in size and contain 12 or more native understorey species, (excluding grasses), including one or more identified important species. Or patches can be over 2ha or greater in size and have either natural regeneration of the overstorey species or an average of 20 or more mature trees per ha (DECC, 2010).

Based on an analysis of the plot data collected within PCTs comprising this CEEC, all sampled patched meet these criteria and therefore all patches of the following PCTs, in all condition states are conservatively considered to represent the EPBC Act listed CEEC:

- PCT 433 - White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region, Brigalow Belt South Bioregion.
- PCT434 - White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion
- PCT 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.
- PCT 599- Blakely's Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion.

It is acknowledged that some areas mapped as the above listed PCTs in Low or DNG condition states may not in fact meet the EPBC Act listing requirements, however based on a lack of plot data in these lower condition patches, this updated BDAR has conservatively assumed that the mapped areas all consistute the CEEC to ensure a worst case assessment of impacts within the development footprint.

Based on this conservative assumption, the project will impact on 6.07 hectares of Box Gum Woodland CEEC, of which approximately 40% occurs in Low or DNG condition states, with impacts to higher condition patches largely associated with transport route upgrades at Devils Elbow. It should be noted however, that actual impacts are considered likely to be lower following detailed design of project components including Devils Elbow, where the current impact footprint assesses impact over a width of between 30 to 60 metres, with the expected final design only requiring a 14.5 metre average total width.

An assessment of the potential significant of this impact is presented in Table 68 below, with a significant impact to Box Gum Woodland determined to be unlikely.

Table 68 EPBC Act significant impact assessment for Box Gum Woodland

Criteria	Assessment response
Is there a real chance or possibility that the action will reduce the extent of an ecological community	As outlined in the EPBC Act Listing Advice for the CEEC the national extent of Box Gum Woodland occurs in an arc along the western slopes and tablelands of the Great Dividing Range from Southern Queensland through NSW to central Victoria (Beadle 1981). It occurs in the Brigalow Belt South, Nandewar, New England Tableland, South Eastern Queensland, Sydney Basin, NSW North Coast, South Eastern Highlands, South East Corner, NSW South Western Slopes, Victorian Midlands and Riverina Bioregions (Environment Australia 2000). The current extent of the CEEC in NSW is estimated as approximately 250,000 hectares, comprising just 7% of its pre-1750 extent of an estimated 3,700,000 hectares. Of this current estimated extant of 250,000 hectares, approximately 9,000 hectares is estimated to occur within the Nandewar IBRA bioregion, and approximately 39,000 hectares within the NSW North Coast IBRA bioregion (Commonwealth of Australia 2006). The project will impact upon a total of 6.07 hectares of Box Gum Woodland CEEC, the majority of which occurs within the Nandewar IBRA bioregion, with approximately 0.5 hectares of impact occurring in the NSW North Coast IBRA bioregion. These impacts represent a tiny fraction of the extant of Box Gum Woodland CEEC at the National scale, and at the bioregional scale. To assess potential impacts to the CEEC at a more local scale aerial vegetation mapping (DPIE 2019, DPIE 2015) was interrogated to ascertain the extant of PCTs known to represent Box Gum Woodland (NSW BioNet) within a 5 kilometre and 10 kilometres buffer of the development footprint. A total of approximately 10,800 hectares of PCTs known to partially or entirely represent Box Gum Woodland are mapped within the 5 kilometres buffer, and approximately 29,000 hectares are mapped within the 10 kilometre buffer. If only 10% of these mapped vegetation polygons were found to actually represent the EPBC Act listed CEEC, impacts associated with the project would again only represent a small fraction (0.5% and 0.2%) of the CEEC likely to be present in the locality. Based on the above, the project is not considered likely to reduce the extent of the CEEC at the national, bioregional or local scales.
Is there a real chance or possibility that the action will fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	Box Gum Woodland occurs within the development footprint in association with the transmission line corridor, transmission line access tracks and road upgraded along Barry Road outside Nundle and at Devils elbow. Along the transmission line and its access tracks the CEEC occurs in an already highly fragmented landscape, with the impacted patches of the CEEC, and the patches mapped in the surrounding landscape largely occurring as isolated patches of vegetation in an over-cleared landscape. Some larger patches of

Criteria	Assessment response
	potential CEEC also occur on steeper slopes in more intact vegetation where the CEEC is associated with PCT 488 Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills, however thee areas are mainly south of the development footprint and on the southern side of the ridgeline. Impacts associated with the construction and operation of the project's transmission line (and associated access tracks) will not result in fragmentation of any substantial patches of the CEEC, nor will it increase fragmentation in the landscape. Near Nundle a small isolated patch of Box Gum Woodland will be impacted by the required transport route upgrade works to allow for wind turbine components to be transported to the site. This impact will occur to a single Blakelys Red Gum tree present on the road side in low condition, and within a landscape of scattered paddock trees, and retained vegetation near creeks. This impact will not fragment or increase fragmentation of the CEEC in this location. More significant road upgrades works are required further east along Barry Road, at Devils Elbow, where the double hairpin turns must be bypassed to allow for turbine components to reach the site. Box Gum Woodland in this location exists not in its more typical grassy woodland form but on thinner rockier soils with a shrubbier understorey, as PCT 492 Silvertop Stringybark - Yellow Box - Apple Box - Rough-barked Apple shrub grass open forest. It does however, align well with the floristic and condition requirements for listing as the CEEC. Minor clearing of the CEEC is required at the eastern extent of the works area on road edges to widen the corners, and as such no fragmentation impacts will occur in this area. However to bypass the Devils Elbow corners clearing will occur over approximately 700 metres up the ridgeline through a patch of intact vegetation. This will result in the fragmentation of an approximately 5.5 hectare patch of vegetation to the north, that will no longer be part of the large contiguous patch of vegetation, and will be surrounded on all side by roads (approximately 10 to 15 m wide). This vegetation was mapped as PCT 541 Silvertop Stringybark - Rough-barked Apple grassy open forest during assessment of haul route impacts and is noted as having the upper stratum dominated by Silvertop Stringybark and Rough-barked Apple. It is considered likely that this vegetation supports occasional Yellow Box, moving downslope from the adjacent PCT 492 (Box Gum Woodland CEEC), but the vegetation to the north is considered unlikely to represent the CEEC. Indirect impacts to this fragmented patch of retained vegetation (PCT 541) will be managed through best practice road drainage designs, ensuring current hydrological patterns are maintained a close as possible to the system. Impacts to PCT 492 in this location occur along a ridgeline on the northern edge of a large mapped patch of the PCT, and as such fragmentation impacts are not expected to occur. It is therefore considered that the project will not fragment or increase fragmentation of Box Gum Woodland CEEC.
Is there a real chance or possibility that the action will adversely affect habitat critical to the survival of an ecological community	Habitat critical to the survival of Box Gum Woodland is on the moderate to highly fertile soils of the western slopes of NSW, which includes the sections of the transmission line corridor, albeit in generally poor condition (refer Table 24). Critical habitat for the survival of the CEEC also includes areas that contain the floristic structure and patch size requirements listed in the recovery plan for Box Gum Woodlands.

Criteria	Assessment response
	The proposed development will impact on 6.07 hectares of this habitat, either a part of an already disturbed landscape or on the edge of a larger patch of the CEEC within intact vegetation. Based on the scale of the impact, and the tiny proportions of existing Box Gum Woodland and its habitat this equates to in the locality, the projects is not considered likely to adversely affect habitat critical to the survival of the CEEC.
Is there a real chance or possibility that the action will modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	The construction and operation of the 330kV transmission line or section of open road built to the required Australian Standards is unlikely to result in changes to any abiotic factors that are critical to the long term survival of Box Gum Woodland in areas adjacent to the development footprint. The construction of the transmission line will not require substantial earthworks that could impact on surface water or groundwater flow patterns. The current design has also allowed for several access tracks into the transmission line corridor to limit the need for substantial earthworks along the length of the alignment to enable construction. Earthworks and design of the roadway constructed to bypass Devils Elbow will ensure that existing environmental processes are not substantially altered or negatively impacted by the construction.
Is there a real chance or possibility that the action will cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	The impacts to Box Gum Woodland associated with the project are confirmed to generally low condition vegetation within a fragmented landscape associated with the transmission line and its access racks, and to high condition vegetation within larger patches of intact vegetation associated with road upgrades. Neither will result in clearing of vegetation unique to the locality, or to species locally common when compared to elsewhere in the development footprint or broader locality. As such the project is not considered likely to cause a substantial change in the species composition of an occurrence of Box Gum Woodland such that it would continue to decline.
Is there a real chance or possibility that the action will cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: • **assisting invasive species, that are harmful to the listed ecological community, to become established, or** • **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community**	As outlined above impacts to Box Gum Woodland associated with the project are confirmed to generally low condition vegetation within a fragmented landscape associated with the transmission line and its access racks, and to high condition vegetation within larger patches of intact vegetation associated with road upgrades. Box Gum Woodland present along the transmission line and in the surrounding landscape largely occurs as fragmented and isolated patches in an over-cleared landscape. The construction and operation of the transmission line will not result in negative ongoing impacts to the CEEC in the landscape, nor will it increase existing pressures associated with fragmentation, isolation and edge effects. Box Gum Woodland along Barry Road mainly occurs on the edges of the extent of the CEEC, and within larger patches of intact grassy and shrub/grass woodland. The construction and operation of the new roadways may result in an increase in edge effects where the new road will occur through an existing patch of intact vegetation, however it is not expected that sources of negative impacts such as weed encroachment will increase above the levels that already existing in the landscape. The vegetation currently exists in in high condition away from the immediate roadside edges and there is no reason to expect this would change into the future.

Criteria	Assessment response
	It cannot be said that the project is likely to cause a substantial reduction in the quality or integrity of an occurrence of an ecological community through vectors such as invasion of weeds, or the increase of chemicals or other pollutants.
Is there a real chance or possibility that the action will interfere with the recovery of an ecological community	Where the CCEC occurs along the transmission line, ongoing negative pressures are impacting upon existing patches associated with fragmentation, isolation and edge effects. Landuse in these locations is unlikely to change and as such it can be expected that the condition and overall extant of the CEEC in the locality will continue to decline. Along Barry Road the CEEC occurs within, and on the edges of, large patches of intact grassy and shrub/grass woodland, surrounding by a broader landscape similar to that along the transmission line, and other areas supporting pine forestry practices. There is limited opportunity for recovery of Box Gum Woodland in this landscape with rural pressures likely to continue preventing opportunities for regeneration or rehabilitation of Box Gum Woodland across the majority of the landscape, and steeper/hillier areas less suitable for farming also limited in their capacity to allow for an increase is extent or condition of the CEEC. The project will not result in direct or future ongoing impacts that are likely to interfere with the recovery of Box Gum Woodland, and the seeking of local offset opportunities may actually provide some scope for the CEEC to be rehabilitated in the vicinity of the project area.

8.8.2 Koala

Koala is listed as Vulnerable under the Commonwealth EPBC Act. It occurs from north-east Queensland to South Australia, including parts of NSW. A rapid decline in the number of individuals has been seen since European settlement, primarily due to a reduction in available good quality vegetation with appropriate canopy species suitable for supporting the species (DECC 2008).

The development footprint is located within the Northern Tablelands Koala Management Area (KMA), and the project will require the removal of a total of 132.43 hectares of native vegetation within the development footprint. Of this, 36.44 hectares is considered to be Koala habitat.

Potential impacts of the proposed works include removal of documented Koala feed trees within the Northern Tablelands KMA located within the development footprint, including Snow Gum, Mountain Gum, Mountain Ribbon Gum, Yellow Box and Messmate (OEH 2018).

Within 10 kilometres of the development footprint, the species has been recorded seven times (EES 2020), with an additional two individuals recorded within the development footprint during the current field assessment (consisting of a mother and joey, Biosis 2019). The closest previous records of Koala occur within Ben Halls Gap Nature Reserve, which is east of, and contiguous with, the development footprint. Hanging Rock State Forest, Nundle State Forest, and Tomalla State Forest and Nature Reserve all lie within 20 kilometres of the assessment area, and contain scattered Koala records throughout (EES 2020). For the purposes of this assessment the definition of “the population” encapsulates all contiguous areas of Koala habitat into a singular spatial unit.

Koala populations throughout Australia are currently under increased pressure due to the 2019-2020 summer bushfires that occurred across the southern and eastern states of Australia. An extent of 5.3 million ha of land representing 6.7% of NSW has been impacted by bushfires affecting over 60 threatened fauna species. DAWE have provided several resources in response to these fires including analyses of listed species habitat within fire affected areas (DAWE 2020a), as well as provisional lists of fauna that require urgent management intervention (DAWE 2020b). Approximately 13% of the likely and known distribution of the combined Koala population has been identified as occurring within fire affected areas, and Koala has been identified as one of the species requiring urgent management intervention. Given this context, remaining areas of high quality Koala habitat are of key importance in the conservation of the species.

A detailed assessment of impacts to Koala against the significant impact guidelines is provided in Table 69. Impacts to Koala's are considered to be potentially significant due to the loss of habitat critical to the survival of Koala.

Table 69 EPBC Act significant impact assessment for Koala

Criteria	Assessment response
Is there a real chance or a possibility that the action will lead to a long-term decrease in the size of an important population?	The Commonwealth Species Profile and Threats Database (SPRAT) currently states that there is a data deficiency in regard to the delineation of sub-populations throughout the listed Koala's range (DAWE 2020a). Therefore, it is currently difficult to specify important populations and such a proposition must be assessed on a case by case basis, using the information available for a particular location. The extent of a sub-population is likely to be defined by significant natural or anthropogenic barriers. The development footprint lies approximately 100 kilometres south east of Gunnedah, a known Koala hot-spot. In Gunnedah, local records of Koala were particularly high from the 1970s to the 1990s but began declining rapidly after multiple heat waves hit the area around 2009 (Gunnedah Shire Council 2015). Since then, further impacts to Koalas such as clearing of land and vehicle strikes have further contributed to the decline of the Koala population. It is likely that the Gunnedah population would be considered an 'important population' of the species. Conversely, Koala records nearby the current assessment area are much less concentrated, and little is known about the abundance, distribution or movement patterns of Koalas in the broader area. It is unlikely that Koalas inhabiting the development footprint would be considered part of an 'important population' of Koalas. Regardless, Koalas are known to breed in the locality of the development footprint (recent record of mum and joey, Biosis 2019), and the locality is likely to be used by the species. The proposed works require impacts to 36.44 hectares of native vegetation identified as potential Koala habitat, which has been reduced by 14.32 hectares due to design revisions undertaken for the amended project, these impacts will however reduce the availability of resources within the locality. Given the proposed impacts occur on the edge of an extensive reserve system (greater than 3000 hectares), it is unlikely that the overall size of the existing population will diminish as a result of the works. Impacts to Koala habitats impacted within the development footprint are also to largely fragmented patches located within a matrix of agricultural land. There are no large, intact areas of Koala habitat proposed to be impacted and the project will not cause any permanent barriers to Koala movement within or through the development footprint. Overall, it is unlikely that the proposed works will lead to a long-term decrease in the size of an important population.
Is there a real chance or a possibility that the action will reduce the area of occupancy of	Koalas occurring in and nearby the development footprint are not considered to form part of an 'important population' of Koalas. The proposed works require impacts to 36.44 hectares of native vegetation

Criteria	Assessment response
an important population?	identified as potential Koala habitat, which has been reduced by 14.32 hectares due to design revisions undertaken for the amended project, these impacts will however reduce the availability of resources within the locality. Whilst impacts to these areas may restrict the expansion of the existing Koala population, given the proposed impacts occur on the edge of an extensive reserve system (greater than 3,000 hectares), it is unlikely that the overall size of the existing population will diminish as a result of the works. Overall, it is unlikely that the proposed works will significantly reduce the area of occupancy of an important population.
Is there a real chance or a possibility that the action will fragment an existing important population into two or more populations?	Koalas occurring in and nearby the development footprint are not considered to form part of an 'important population' of Koalas. Within the locality of the development footprint, Koala records are scattered throughout the landscape, mostly to the north and east. Koala have been recorded within the wider area surrounding the development footprint, with previous records also occurring within Ben Halls Gap Nature Reserve, Hanging Rock State Forest, Nundle State Forest, and Tomalla State Forest and Nature Reserve, all laying within 20 kilometres of the development footprint (EES 2020). To the west of the development footprint however, land is largely cleared for farming, and large gaps occur between areas of native vegetation. It is likely that the development footprint falls at the western edge of the local Koala population, with Koalas mostly inhabiting the nearby nature reserves to the east. The proposed works require removal of 36.44 hectares of potential Koala habitat (reduced by 14.32 hectares due to design revisions undertaken for the amended project), however, this habitat occurs at the western fringes of Ben Halls Gap Nature Reserve. While removal of this vegetation will reduce resources for Koala in the area, it is unlikely to fragment the local population, which most likely occurs largely east of the development footprint. Overall, it is unlikely that the proposed works will result in the fragmentation of the current existing population into two or more populations.
Is there a real chance or a possibility that the action will adversely affect habitat critical to the survival of a species?	Table 4 of the EPBC Act referral guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) (DoE 2014) includes a habitat assessment tool for assessing habitat critical to the survival of the Koala. Impact areas that score five or more are considered to include critical habitat for the species. The area of the proposed works returned a score of 8, and therefore constitutes habitat critical to the survival of Koala. This score was based on the following criteria: • Evidence of one or more Koalas within 2 kilometres of the edge of the impact area within the last 5 years (2 points). • Has forest, woodland or shrubland with emerging trees with two or more known koala food tree species (2 points). • Area is part of a contiguous landscape ≥ 1000 hectares (2 points). • Evidence of infrequent or irregular Koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for Koala occurrence (1 point). • Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context (1 point). The EPBC Act referral guidelines for Koala include assessment criteria under Section 7 for determining whether a proposed action including impacts to critical

Criteria	Assessment response
	koala habitat requires an EPBC referral (see Figure 2: assessing adverse effects on habitat critical to the survival of the Koala). As the development footprint contains habitat classed as critical, and the impact to vegetation is more than 20 hectares, the guidelines state that the impact to Koala is most likely to be significant for the purposed of the EPBC Act. Given the patchy spatial arrangement of majority of the native vegetation removal, the presence of Koala within and surrounding the development footprint, the limited barriers to movement and corridors from the project, and the contiguous nature of the development footprint with surrounding National Parks and State Forests, this assessment considers the Project is unlikely to result in impacts that will actually adversely affect habitat critical to the survival of the species in the locality. Regardless, based on the guidance provided in the EPBC Act referral guidelines, the removal of Koala habitat as a result of the project is considered to have the potential result in a significant impact to the species. In addition, large-scale bushfires during the summer of 2019-2020 have reduced the availability of Koala habitat across its distribution by approximately 13 % (DAWE 2020a). Studies have shown that the home ranges of Koalas vary based on foraging resources. One study in north-western NSW found that the home ranges for male Koala's was around 12 hectares, and for female's it was around 9 hectares (Kavanagh, Stanton, & Brassil 2007). A second study in semi-arid landscape of southwest Queensland found that home range size varied significantly with the availability of water, with average home range being around 18 hectares where annual rainfall was in excess of 580 mm per annum, increasing to around 80 hectares where annual rainfall was around 450 mm per annum (Davies et al. 2013). Given the typically high annual rainfall around Hanging Rock (BOM Station 055200) which has ranged from 424.6 mm to 1452.90 mm since 2014 (BOM 2020), a conservative 20 kilometre buffer around the wind farm development footprint is likely to include the home ranges of those individuals most likely to utilise the habitat within and directly adjacent to the development footprint. Within this 20 kilometre buffer area approximately 32,000 hectares (27.5 %) of native vegetation has been burnt, with the area estimated to support a total of approximately 116,500 hectares of native vegetation. Most (approximately 26,200 hectares or 82 %) of this vegetation has been burnt to a medium or high degree of intensity, in accordance with the burnt area classes outlined in the GEEBAM (NSW Department of Planning, Industry and Environment 2020), meaning both the canopy and understorey have either been partially of completely burnt. As such, the native vegetation being removed by the Project is of potentially greater importance than prior to the 2019-2020 bushfires for the species, given it mainly represents unburnt habitat within an areas where a substantial portion of the vegetation as burnt.
Is there a real chance or a possibility that the action will disrupt the breeding cycle of an important population?	Koalas occurring in and nearby the development footprint are not considered to form part of an 'important population' of Koalas. The 36.44 hectares of vegetation being removed (reduced by 14.32 hectares due to design revisions undertaken for the amended project) occurs on the fringes of native vegetation along the western side of Ben Halls Gap Nature Reserve. While Koalas are known to breed in the locality (project record of mother and joey, Biosis 2019), it is also likely that such behaviour occurs throughout the reserve system to

Criteria	Assessment response
	the north and east of the development footprint. While the removal of vegetation as part of the proposed works will reduce habitat (including breeding habitat) for Koala in the local area, the local Koalas are not considered an important population and the abundance of habitat available within the nearby reserve system would likely continue to support the breeding and population growth of the species in this area. Overall, it is unlikely that the proposed works will disrupt the population or breeding cycle of an important population of Koala.
Is there a real chance or a possibility that the action will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The proposed works will remove 36.44 hectares of potential Koala habitat from the development footprint, reduced by 14.32 hectares due to design revisions undertaken for the amended project. This includes removal of native trees identified as feed trees for Koala within the Northern Tablelands KMA (OEH 2018). As Koala are known to utilise the development footprint, the removal of this habitat will decrease the availability of habitat for the species within the locality. In addition, large-scale bushfires during the summer of 2019-2020 have reduced the availability of Koala habitat across its distribution by approximately 13 % (DAWE 2020a). Approximately 32,000 hectares of native vegetation within a 20 kilometre buffer of the development footprint has been lost due to bushfire. This represents 27.5 % of the 116,500 hectares of native vegetation estimated to occur within this buffer. As such the native vegetation being removed by the Project is of potentially greater importance than usual for the species. However the habitat within the development footprint is located on the edges of vegetation patches, with significant tracts of more in-tact vegetation still available to Koala within the nearby reserve system to the north and east, where the main portion of the koala population is expected to exist. Additionally, protecting and enhancing native vegetation outside of approved disturbance areas and managing the remaining remnant vegetation and habitat within or surrounding the development site toward a benchmark state, would aid in the recovery of Koala habitat locally. Overall, it is unlikely that the proposed works would cause the local population of the species to decline.
Is there a real chance or a possibility that the action will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Invasive species such as the European Fox *Vulpes vulpes* that may predate Koala are considered established within the region. Invasive weeds species are not known to directly harm populations of Koala but do have potential to reduce quality of habitat in the adjoining bushland and therefore increase potential to harm the population of Koala. Management measures would be prepared, implemented and audited to avoid and minimise the environmental risks associated with weeds, pests and pathogens. As a minimum, these would include: • Completion of a site weed assessment and development of a Weed Management Plan. The Weed Management Plan would sit as a sub-plan to the Environmental Management Strategy (EMS) • Implementation of appropriate weed control and weed disposal in accordance with Biosecurity protocols. • Any soil or other materials imported to the site for use in restoration or rehabilitation would be certified free from weeds and pathogens or obtained from sources that demonstrate best practice management to minimise weed and pathogen risks. • Appropriate disposal of any weed material.
Is there a real chance or a	The proposed action will result in removal of potential habitat for Koalas within the

Criteria	Assessment response
possibility that the action will introduce disease that may cause the species to decline?	development footprint. This impact is not likely to results in the introduction of diseases that may cause the species to decline.
Is there a real chance or a possibility that the action will interfere substantially with the recovery of the species?	There is no accepted or adopted national recovery plan for Koala. However, the approved conservation advice (Commonwealth of Australia 2012) gives priority to the following conservation actions: • Develop and implement a development planning protocol to be used in areas of koala populations to prevent loss of important habitat, Koala populations or connectivity options. • Development plans should explicitly address ways to mitigate risk of vehicle strike when development occurs adjacent to, or within, Koala habitat. • Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary. • Identify populations of high conservation priority. • Investigate formal conservation arrangements, management agreements and covenants on private land, and for Crown and private land investigate and/or secure inclusion in reserve tenure if possible. • Manage any other known, potential or emerging threats such a Bell Miner Associated Dieback or Myrtle rust. • Develop and implement options of vegetation recovery and re-connection in regions containing fragmented Koala populations, including inland regions in which Koala populations were diminished by drought and coastal regions where development pressures have isolated Koala populations. • Develop and implement a management plan to control the adverse impacts of predation on Koalas by dogs in urban, peri-urban and rural environments. • Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions. The project cannot be said to be adverse to any of the above conservation actions, and if proposed local biodiversity offsets are secured as planned habitat in the locality surrounding the wind farm will be improved and conserved in perpetuity.

8.8.3 Large-eared Pied Bat

The Large-eared Pied Bat is a medium-sized insectivorous bat measuring a total length of approximately 100 millimetres and weighing 7–12 grams (Hoye and Dwyer 1995). The species is listed as Vulnerable under the BC Act and the EPBC Act. The species' current distribution is poorly known. Records exist from Shoalwater Bay, north of Rockhampton, Queensland, through to the vicinity of Ulladulla, NSW in the south (Hoye 2005). Despite the large range, it has been suggested that the species is far more restricted within the species' range than previously thought (DECC 2007). Much of the known distribution is within NSW. Available records suggest that the largest concentrations of populations appear to be in the sandstone escarpments of the Sydney basin and the north-west slopes (Coolah Tops, Mt Kaputar, Warrumbungle National Park and Pilliga Nature Reserve. Although the species is widely distributed, it is uncommon and patchy within this area (DERM 2011).

The species requires a combination of sandstone cliff/escarpment to provide roosting habitat that is adjacent to higher fertility sites, particularly box gum woodlands or river/rainforest corridors which are used for foraging (TSSC 2012). Almost all records have been found within several kilometres of cliff lines or rocky terrain (Hoye 2005). Roosting has also been observed in disused mine shafts, caves, overhangs and disused Fairy Martin Hirundo ariel nests (Hoye and Dwyer 1995).

Known breeding locations are extremely limited within NSW. Five locations are known to have been used for breeding within NSW, including:

- A mine tunnel at Copeton which was used for breeding until flooded by dam waters in 1976 (Dwyer 1966).
- A sandstone cave near Coonabarabran, NSW (Pennay 2008).
- Capture of lactating females adjacent to sandstone cliffs in Ulan, NSW (Fly by Night 2005).
- Observations of small groups of females in a disused gold mine near Barraba, NSW (DERM 2011).
- Anecdotal observations of small groups of females and young bats in the sandstone Pilliga region, NSW (DERM 2011).

The maternity site at Barraba lies approximately 150 kilometres north of the current development footprint, while the maternity site at Coonabarabran lies approximately 185 kilometres west. Post-lactating females have also been recorded approximately 16 kilometres south west of the development footprint near Murrurundi.

The structure of maternity roosts appears to be very specific (arch caves with dome roofs). Caves need to be high and deep enough to allow juvenile bats to learn to fly safely inside and have indentations in the roof. Roosting bats cluster in these indentations, presumably to allow the capture of heat. These physical characteristics are very uncommon in the landscape and their scarcity presumably poses an important limiting factor in the distribution of the Large-eared pied bat (Pennay 2008). No maternity roosts were identified within or adjacent to the development footprint or the 1,500m landscape buffer development footprint, as part of the desktop and field investigations completed for this project.

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area (EPBC Act). In relation to vulnerable threatened species, occurrences include but are not limited to:

- A geographically distinct regional population, or collection of local populations.
- A population, or collection of local populations, that occurs within a particular bioregion.

To date, there have been no genetic studies undertaken on the Large-eared Pied Bat. Movement of this species between areas has not been recorded and its dispersal ability and habits are not known (DERM 2011). Thus, it is difficult to define 'populations' of the species.

The closest previous records of Large-eared Pied Bat occur approximately 16 kilometres south west of the development footprint, nearby Murrurundi (EES 2020). These sightings recorded post-lactating females, indicating that breeding of the species likely occurs within the locality. The species was also recorded in 10 different locations on an ultrasonic acoustic device within the development footprint during the current assessment, likely using vegetation within the development footprint for foraging. Further previous records of the species lie 30 kilometres north west of the development footprint, near Quirindi. As the morphology of the species suggests that individuals do not disperse over large distances like similar species (DERM 2011), for the purposes of this assessment individuals occurring within the development footprint and nearby in Murrurundi and Quirindi are considered to make up the local population.

The proposed works will likely result in the loss of 19.68 hectares of potential Large-eared Pied Bat habitat calculated in accordance with the BAM, and comprising vegetation communities that are known to be associated with the foraging requirements for this species, as well as nearby to roosting/breeding habitat features such as caves, cliffs and rocky areas. This area of potential habitat represents the total foraging habitat available to the species.

Previously two high potential roosting/breeding habitats were identified within the development footprint, adjacent to wind turbines WP27 and WP50. Approximately 2,000 square metres (1.8 %) of native vegetation would have been removed from the 100 metre radius buffer area (totalling 108,465 square metres) surrounding the identified habitat adjacent to the WP27 turbine. Removal of vegetation was also to occur approximately 5 metres outside of the 100 metre radius buffer area (totalling 168,036 square metres) surrounding the identified habitat adjacent to WP50. However, following further changes made to the project as part of the ongoing project design, these habitats will no longer be impacted and as such there will be no direct impacts to the roosting/breeding habitats as a result of the proposed works.

It should be noted that although impacts to microbats via blunt force trauma or possibly barotrauma from wind turbines is one of the environmental risks associated with wind farms, Large-eared Pied Bat forage for small flying insects below the forest canopy (OEH 2017), and are considered unlikely to be at high risk of turbine strike due to the lower likelihood of the species foraging nearby the turbines. That being said, this species was recorded within RSH (approximately 60m above canopy height) on the rare occasion. It was previously predicted that in the vicinity of WP27, due to the size of the turbine blades, that there would be some incursion into the air space above the 100 metre radius buffer applied to the high potential roosting/breeding habitat in this area. A distance of approximately 22 metres was been calculated between foraging habitat and the tips of the WP27 turbine blades. Although considered unlikely that a collision event would occur, this turbine has since been removed and as such these risks have been successfully avoided.

A detailed assessment of impacts to Large-eared Pied Bat against the significant impact guidelines is provided in Table 70. Impacts to Large-eared Pied Bats are considered unlikely to be significant.

Table 70 EPBC Act significant impact assessment for Large-eared Pied Bat

Criteria	Assessment response
Is there a real chance or a possibility that the action will lead to a long-term decrease in the size of an important population?	Information about the size, distribution and interactions of Large-eared Pied Bat populations is largely unknown. No populations have been defined as 'important populations' for the species. The largest concentration of records for this species appears to be in the sandstone escarpments of the Sydney basin, and northwest slopes of NSW. Important populations are likely to occur at the edge of the species range, for example in the sandstone escarpments of Morton National Park at the southern end of its range (DERM 2011). The local population, defined from nearby records, does not occur at the edge of the species' range in NSW, however it does occur at the eastern edge of the species range in the regional area. While the species has been recorded abundantly within the Pilliga to the west of the development footprint, no records of the species occur from the development footprint east to the coast. Due to the very few known breeding locations of the species, the record of nearby post-lactating females, and the occurrence of the development footprint at the edge of the regional occurrence of individuals, it is likely that the local population of Large-eared Pied Bat is an important population. The species is known to roost in sandstone caves, and travel down to nearby fertile wooded valleys to forage. A geomorphological assessment of the development footprint and surrounding landscape found that the diverse terrain and lithology and dynamic geomorphology within the locality creates a high potential for microbat roosting sites across landscapes at all elevations, within the expected flight range of microbats that may be present within the development footprint (Environmental Geosurveys Pty Ltd 2021). However, whilst the basalt lithology present at the development footprint may support opportunities for microbat

Criteria	Assessment response
	roosts, no substantial caves were likely to be present, and that no data was found to suggest that the development footprint and immediate surrounds geomorphologically standout from the surrounding landscape in one way or another (Environmental Geosurveys Pty Ltd 2021). The proposed works are likely to result in direct impact (via removal) of approximately 19.68 hectares of Large-eared Pied Bat habitat in the form of vegetation associated with the species that occurs nearby caves, cliffs and rocky areas, representing the total foraging habitat available to the species. Two high potential roosting/breeding habitats were previously identified within the development footprint, adjacent to wind turbines WP27 and WP50. Approximately 2,000 square metres (1.8 %) of native vegetation would have been removed from the 100 metre radius buffer area (totalling 108,465 square metres) surrounding the identified habitat adjacent to the WP27 turbine. Removal of vegetation would also have occurred approximately 5 metres outside of the 100 metre radius buffer area (totalling 168,036 square metres) surrounding the identified habitat adjacent to WP50. However, due to project modifications which have resulted in the removal of these two turbines, these impacts have been successfully avoided. As such there are no direct impacts to roosting/breeding habitat (or associated buffer areas) for this species as a result of the proposed project. The likelihood of a collisions with the installed turbine infrastructure is considered unlikely due to the species' foraging and movement behaviour. However, if repeated collisions were to occur the consequences are considered to be moderate as this could lead to a reduction in the local abundance of the species in the shorter-term (up to 5 years). Due to the expected low likelihood of occurrence and the level of high quality forage habitat, and commensurate habitat present in the locality, it is considered unlikely that the Project will lead to a long-term decrease in the size of the current important population of the species.
Is there a real chance or a possibility that the action will reduce the area of occupancy of an important population?	Given the abundance of rocky escarpments and caves in the broader locality, it is likely that Large-eared Pied Bat are breeding within the area. This is supported by nearby records of post-lactating females. Whilst there are no direct impacts to the two high potential breeding/roosting habitats within the development footprint, the Project will remove 19.68 hectares of foraging habitat for the species. This removal of native vegetation will lead to a reduction in the area of occupancy of the current important population. However, vegetation within the development footprint is well connected to surrounding vegetation, with approximately 28,000 hectares of native vegetation within the 2.5 kilometre area surrounding the development footprint, which is likely to represent the maximum dispersal distance of the local population (Williams & Thomson 2018). This area includes large tracts of intact native vegetation within the Ben Halls Gap National Park, Crawney Pass National Park, Wallabadah Nature Reserve and the Nundle and Hanging Rock State Forests. These areas represent prime foraging habitat for the species and are all within 2.5 kilometres of various locations along the development footprint. Given the plentiful natural roosts that are also likely to be available to individuals within 2.5 kilometres of the development footprint, due to the underlying geomorphology (Environmental Geosurveys Pty Ltd 2021), these foraging habitats would be easily

Criteria	Assessment response
	accessible to individuals within the local population. The removal of 19.68 hectares of native vegetation as part of the proposed works represents a tiny portion of the native vegetation within the foraging distance of the species and is therefore not considered to have a significant impact on the species.
Is there a real chance or a possibility that the action will fragment an existing important population into two or more populations?	The native vegetation to be removed and land proposed to be removed as part of the proposed project lies on the western edge of Ben Halls Gap Nature Reserve. Land to the west of the development footprint contains large, cleared areas with scattered remnant vegetation. The removal of 19.68 hectares of potential Large-eared Pied Bat foraging habitat from the development footprint will reduce the availability of resources in the immediate vicinity of the development footprint, it is unlikely to fragment the existing local population of Large-eared Pied Bat, as the species is mobile and would still be able to use habitat located in the Nature Reserve to the east, and on nearby farmland.
Is there a real chance or a possibility that the action will adversely affect habitat critical to the survival of a species?	Habitat critical to the survival of the species is defined as (DERM 2011): • Maternity roosts. • Sandstone cliffs and fertile wooded valley habitat within close proximity of each other. The current project proposes the removal of 19.68 hectares of Large-eared Pied Bat habitat, consisting of foraging habitat. No direct impacts will occur to the identified high potential roosting/breeding habitat. As such the removal of this habitat is not considered to adversely affect habitat critical to the survival of Large-eared Pied Bat.
Is there a real chance or a possibility that the action will disrupt the breeding cycle of an important population?	As above, it is likely that Large-eared Pied Bat are breeding within the broader locality surrounding the development footprint, due to the abundance of rocky escarpment and caves, and nearby records of post-lactating females. However, the impacts associated with the project are restricted to 19.68 hectares of habitat. There are no direct impacts to high potential roosting/breeding habitats for the species. As such the removal of vegetation associated with the project is unlikely to interrupt the species' breeding cycle.
Is there a real chance or a possibility that the action will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The proposed works will likely result in the removal of 19.68 hectares of potential Large-eared Pied Bat habitat in the form of wooded areas nearby sandstone cliffs. There are no direct impacts to the two high potential roosting/breeding habitats. As such it is considered unlikely that the Project would decrease the availability of habitat for the species such that the species would likely decline.
Is there a real chance or a possibility that the action will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	There is potential for the introduction of weeds, pests or pathogens as a result of the proposed works, via movement of vehicles and plant, and increase in foot traffic. However, management measures would be prepared, implemented and audited to avoid and minimise the environmental risks associated with weeds, pests and pathogens. As a minimum, these would include: • Completion of a site weed assessment and development of a Weed Management Plan. The Weed Management Plan would sit as a sub-plan to the EMS.

Criteria	Assessment response
	• Implementation of appropriate weed control and weed disposal in accordance with Biosecurity protocols. • Any soil or other materials imported to the site for use in restoration or rehabilitation would be certified free from weeds and pathogens or obtained from sources that demonstrate best practice management to minimise weed and pathogen risks. • Appropriate disposal of any weed material. • Implementation of appropriate hygiene protocols where there are potential or known pathogen risks.
Is there a real chance or a possibility that the action will introduce disease that may cause the species to decline?	The IUCN Species Survival Commission released a statement on 19 June 2020 stating that there is a credible risk of human-to-bat transmission of SARS-Cov-2, a virus currently circulating the globe and causing a pandemic of the illness Covid-19 (IUCN SSC 2020). However, introduction of this disease to Large-eared Pied Bats within the development footprint as a result of the proposed works is unlikely for the following reasons: • The project will implement measures to minimise the risk of Covid-19 spread among the workforce as required. • No contact or sharing of closed areas between humans and bats is expected as a result of the proposed works. • If further microbat trapping or survey is undertaken by an ecologist as part of the proposed project, the recommendations provided by the IUCN will be followed, including the wearing of a face mask by the ecologist, and avoidance of handling of any microbats. • The transmission of SARS-Cov-2 is considered unlikely as a result of the proposed works. One of the main disease threats threatening insectivorous microbats globally is the exotic pathogen White-nose fungus. There have been no cases of White-nose fungus recorded in Australia (DAWE 2019). As such it is unlikely that the proposed development would result in the fungus being spread to the microbats that make up the local population.
Is there a real chance or a possibility that the action will interfere substantially with the recovery of the species?	The following recovery objectives have been specified within the National recovery plan for the Large-eared Pied Bat: • Identify priority roost and maternity sites for protection. • Implement conservation and management strategies for priority sites. • Educate the community and industry to understand and participate in the conservation of the Large-eared Pied Bat. • Research the Large-eared Pied Bat to augment biological and ecological data to enable conservation management. • Determine the meta-population dynamics throughout the distribution of the Large-eared Pied Bat. One of the recovery actions stated under these objectives is the protection of known roosts and associated foraging habitats and management of threats. Approximately 19.68 hectares of potential Large-eared Pied Bat foraging habitat is proposed to be removed as part of the project. As no direct impacts will occur to potential roosting/breeding sites, the proposed works are unlikely to interfere with this recovery action, and the recovery of the species generally.

8.8.4 Spotted-tailed Quoll

The Spotted-tailed Quoll is listed as Endangered under the EPBC Act. The Spotted-tailed Quoll is a nocturnal, cat-sized, carnivorous marsupial with reddish-brown fur and distinctive white spots over its back and tail (OEH 2019).

The species was previously widely distributed from south-east Queensland, eastern NSW, Victoria, south-east South Australia and Tasmania (Jones 2001). The subspecies' mainland range is now considered to have reduced by 50–90% (Jones 2001). However, detailed distribution records and abundance estimates are generally lacking due to the scale and intensity of surveying that is required to detect the species across its entire range (DAWE 2016).

The Spotted-tailed Quoll has a preference for mature wet forest habitat, especially in areas with rainfall 600 mm/year (McKay 2008). Unlogged forest or forest that has been less disturbed by timber harvesting is also preferable. The Spot-tailed Quoll is predominantly nocturnal and rests during the day in dens (Jones 2001). Habitat requirements include suitable den sites such as hollow logs, tree hollows, rock outcrops or caves (OEH 2019). Individuals also require an abundance of food, such as birds and small mammals, and large areas of relatively intact vegetation through which to forage (DAWE 2020c). This subspecies is moderately arboreal and approximately 11% of travelling is done in trees (Jones 2001). The Spotted-tailed Quoll occupy large home ranges, with females occupying 200 – 500 hectares, while males can occupy from 500 to over 4000 hectares (OEH 2019).

The Spotted-tailed Quoll has previously been recorded within and adjacent to the development footprint, including during the current assessment. In 2019 a roadkill individual was located within the Ben Halls Gap State Forest adjacent the development footprint, and another individual was recorded on a camera trap within the development footprint. Hanging Rock State Forest, Nundle State Forest, and Tomalla State Forest and Nature Reserve all lie within 20 kilometres of the development footprint and contain scattered previous Spotted-tailed Quoll records throughout (EES 2020). For the purposes of this assessment the definition of "the local population" encapsulates all contiguous areas of this Spotted-tailed Quoll habitat into a singular spatial unit.

The local population of Spotted-tailed Quolls occurring within and nearby the development footprint is not considered to be an 'important population' of the species. There are currently 10 populations within NSW that are defined as 'important populations' of the species, with the closest populations to the development footprint occurring approximately 40 kilometres south east in Barrington Tops, and 80 kilometres north east in Walcha (DAWE 2016).

Potential Spotted-Quoll habitat occurs throughout the development footprint in the form of eucalypt woodland, rocky outcrops, caves, logs and tree hollows. Approximately 40.67 hectares of Spotted-tailed Quoll habitat will be removed as part of the proposed works. This habitat is comprised of the PCTs identified in Bionet, assessed as having high and moderate condition levels.

Spotted-tailed Quoll populations throughout Australia are currently under increased pressure due to the 2019-2020 summer bushfires that occurred across the southern and eastern states of Australia. An extent of 5.3 million ha of land representing 6.7% of NSW has been impacted by bushfires affecting over 60 threatened fauna species. DAWE have provided several resources in response to these fires including analyses of listed species habitat within fire affected areas (DAWE 2020a), as well as provisional lists of fauna that require urgent management intervention (DAWE 2020b). Approximately 29 % of the known distribution for Spotted-tailed Quoll has been identified as occurring within fire affected areas, and the species was identified as requiring urgent management intervention following those fires (DAWE 2020d). Given this context, remaining areas of unburnt Spotted-tailed Quoll habitat are now of higher importance in the conservation of the species.

A detailed assessment of impacts to Spotted-tailed Quoll against the significant impact guidelines is provided in Table 71. Impacts to Quoll's are conservatively considered likely to be significant due to the loss of habitat for the local population, classified as important habitat (DAWE 2016), and considered to be of greater importance as refuge following the loss of habitat in the local area from the 2019-2020 bushfires.

Table 71 EPBC Act significant impact assessment for Spotted-tailed Quoll

Criteria	Assessment response
Is there a real chance or a possibility that the action will lead to a long-term decrease in the size of a population?	The local population of Spotted-tailed Quolls occurring within and nearby the development footprint is not considered to be an 'important population' of the species. Habitat within the development footprint is known to be used by Spotted-tailed Quoll. The removal of 40.67 hectares of potential Spotted-tailed Quoll habitat from the development footprint (reduced by approximately 40-50 hectares as a result of project design revisions), is unlikely to limit the habitat available to the local population. The species requires large home ranges, with females occupying non-overlapping ranges of approximately 200-500 hectares, and males occupying very large, overlapping home ranges from 500 to over 4,000 hectares, depending on foraging resources (EES 2020). As the impacts associated with the project generally occur on the edges of larger areas of higher quality habitats (with the adjacent reserve system comprising greater than 30,000 hectares), it is considered unlikely that the project will result in long-term decrease in the size of the local population, which will remain supported by the higher quality habitats not impacted by the project..
Is there a real chance or a possibility that the action will reduce the area of occupancy of the species?	As above, habitat within the development footprint is known to be used by Spotted-tailed Quoll. The removal of 40.67 hectares of potential Spotted-tailed Quoll habitat from the development footprint (reduced by approximately 40-50 hectares as a result of project design revisions), is unlikely to reduce the area of occupancy of the species, which is estimated to be 2,512 km^2 (Commonwealth of Australia 2020), as they will still be able to move through and around the relatively narrow linear development footprint.
Is there a real chance or a possibility that the action will fragment an existing population into two or more populations?	As the development footprint occurs on the western edge of Ben Halls Gap Nature Reserve, habitat in the form of eucalypt woodland and rocky outcrops is proposed to be removed mostly along the edges of remnant vegetation. Clearing in this spatial arrangement it will not cause novel fragmentation that would split the local population into two or more populations.
Is there a real chance or a possibility that the action will adversely affect habitat critical to the survival of a species?	Habitat that is critical to the survival of the Spotted-tailed Quoll includes large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey (DAWE 2016). However, the threshold densities of these critical components required to support quoll populations are unknown. Consequently, it is currently not possible to define (or map) habitat critical to the survival of the Spotted-tailed Quoll. The Recovery Plan states that given the Endangered threat status of the Spotted-tailed Quoll, all habitats within its current distribution that are known to be occupied are considered important (DAWE 2016). Furthermore, due to the large bushfires that occurred across southern and eastern Australia in the summer of 2019-2020, approximately 29 % of the available habitat across Spotted-tailed Quoll's known range was lost, and the species was

Criteria	Assessment response
	identified as requiring urgent management intervention following those fires (DAWE 2020d). Given this context, any remaining areas of Spotted-tailed Quoll habitat are now of increased importance in the conservation of the species. The species requires large home ranges, with females occupying non-overlapping ranges of approximately 200-500 hectares, and males occupying very large, overlapping home ranges from 500 to over 4,000 hectares, depending on foraging resources (EES 2020). In the Marengo State Forest in north-eastern NSW, females were reported to have non-overlapping range of up to 175 hectares, and males have an overlapping range of up to 757 hectares (Glen & Dickman 2006). A 20 kilometre buffer around the wind farm development footprint is likely to include the home ranges of all those individuals most likely to utilise the habitat within and directly adjacent to the development footprint. Within this 20 kilometre buffer area approximately 32,000 hectares (27.5 %) of native vegetation has been burnt, with the area estimated to support a total of approximately 116,500 hectares of native vegetation. Most (82 %) of this vegetation has been burnt to a medium or high degree, in accordance with the burnt area classes outlined in the GEEBAM (NSW Department of Planning, Industry and Environment 2020), meaning both the canopy and understorey have either been partially of completely burnt. In spite of the influence of the 2019-2020 bushfires, the removal of approximately 40.67 hectares of Spotted-tailed Quoll habitat as part of the Project, is not expected to be of a magnitude substantial enough to adversely affect habitat critical to the survival of a species as a whole. However, impacts to the local population are conservatively considered to be more substantial, due to the due to the higher value of unburnt habitat in the locality. Due to the large home ranges required by the species, with female home ranges generally not overlapping, and the loss of approximately 27.55% of estimated native vegetation from the 20 kilometre area surrounding the development footprint in the 2019-2020 bushfires (NSW Department of Planning, Industry and Environment 2020), the removal of 40.67 hectares of habitat is considered a moderate loss. This conclusion is conservatively made despite the reduction in impacts the project has been able to achieve, and the largely sub-optimal and edge effected nature of the habitat impacted.
Is there a real chance or a possibility that the action will disrupt the breeding cycle of a population?	Potential Spotted-tailed Quoll breeding habitat may be removed from the development footprint as part of the proposed works, including rocky outcrops, tree hollows and logs. Due to the reserve system directly adjacent the development footprint, encompassing Ben Halls Gap Nature Reserve, Hanging Rock State Forest, Nundle State Forest, and Tomalla State Forest and Nature Reserve, it is likely that adequate den sites are located within the locality such that the breeding cycle of the local population will not be interrupted by the proposed works.
Is there a real chance or a possibility that the action will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is	Approximately 40.67 hectares of Spotted-tailed Quoll habitat is proposed to be removed from the development footprint as part of the proposed works, which as been reduced by approximately 40-50 hectares as a result of project design revisions. However, records of the species are scattered throughout the locality, and encompass the nearby reserve system, including the adjacent Ben Halls Gap Nature Reserve. The proposed works would result in a reduction of habitat

Criteria	Assessment response
likely to decline?	available to the local population, and the available habitat within 20 kilometres of the development footprint has been further reduced by approximately 25% as a result of the 2019-2020 bushfires, which is considered substantial. However there is still approximately 84,000 hectares of native vegetation present and unaffected by bushfire. It is therefore considered that there is adequate habitat available in surrounding farmland and nature reserves that the species as a whole is not likely to decline. The local population will however be placed under increased pressure as a result of the removal of areas of unburnt habitat in the locality. Protecting and enhancing native vegetation outside of approved disturbance areas and managing the remaining remnant vegetation and habitat within or surrounding the development site toward a benchmark state, may somewhat mitigate the potential impacts of the Project and aid in the recovery of Spotted-tailed Quoll habitat locally, and will be undertaken as part of the projects Biodiversity Offset Strategy (refer Section 9.1).
Is there a real chance or a possibility that the action will result in invasive species that are harmful to an endangered species becoming established in the species' habitat?	There is potential for the introduction of weeds, pests or pathogens as a result of the proposed works, via movement of vehicles and plant, and increase in foot traffic. However, management measures would be prepared, implemented and audited to avoid and minimise the environmental risks associated with weeds, pests and pathogens. As a minimum, these would include: • Completion of a site weed assessment and development of a Weed Management Plan. The Weed Management Plan would sit as a sub-plan to the EMS. • Implementation of appropriate weed control and weed disposal in accordance with Biosecurity protocols. • Any soil or other materials imported to the site for use in restoration or rehabilitation would be certified free from weeds and pathogens or obtained from sources that demonstrate best practice management to minimise weed and pathogen risks. • Implementation of appropriate hygiene protocols where there are potential or known pathogen risks. • Appropriate disposal of any weed material.
Is there a real chance or a possibility that the action will introduce disease that may cause the species to decline?	The proposed action will result in removal of potential habitat for Spotted-tailed Quoll within the development footprint. This impact is not likely to results in the introduction of diseases that may cause the species to decline.
Is there a real chance or a possibility that the action will interfere substantially with the recovery of the species?	The main threats to Spotted-tailed Quoll include habitat loss and fragmentation, poison baiting, predation by invasive species, deliberate killing, road mortality, poor burning regimes and climate change, among others. The National Recovery Plan for the Spotted-tailed Quoll lists the following management objectives: • Determine the distribution and status of Spotted-tailed Quoll populations throughout the range and identify key threats and implement threat abatement management practices. • Investigate key aspects of the biology and ecology of the Spotted-tailed Quoll to acquire targeted information to aid recovery. • Reduce the rate of habitat loss and fragmentation on private land. • Evaluate and manage the risk posed by silvicultural practices.

Criteria	Assessment response
	• Determine and manage the threat posed by introduced predators (foxes, cats, wild dogs) and of predator control practices on Spotted-tailed Quoll populations. • Determine and manage the impact of fire regimes on Spotted-tailed Quoll populations. • Reduce the frequency of Spotted-tailed Quoll road mortality. • Assess the threat Cane Toads pose to Spotted-tailed Quolls and develop threat abatement actions if necessary. • Determine the likely impact of climate change on Spotted-tailed Quoll populations. • Increase community awareness of the Spotted-tailed Quoll and involvement in the Recovery Program. The proposed works would involve the removal of 40.67 hectares of potential Spotted-tailed Quoll habitat, which would contribute to the above listed threat of habitat loss for the species and is somewhat averse to the management objective 'reduce the rate of habitat loss and fragmentation on private land'. However the condition of the majority of habitat impacted is sub-optimal due to its occurrence along vegetated edges between intact vegetation and cleared farmland. Furthermore no important den or latrine sites were recorded during the field instigations, and well vegetation riparian zones, used commonly for movement through an individual's range are not well represented in the development footprint. As impacted habitats are largely considered sub-optimal, and the protection and enhancement of native vegetation outside of approved disturbance areas and management of the remaining remnant vegetation and habitat within or surrounding the development site toward a benchmark state, may aid in the recovery of Spotted-tailed Quoll habitat locally, the project cannot be said to be likely to interfere substantially with the recovery of the species.

8.8.5 Greater Glider

The Greater Glider is listed as Vulnerable under the EPBC Act. It is the largest gliding possum in Australia, with a head and body length of 35 – 46 centimetres, and a tail measuring 45 – 60 centimetres (Menkhorst & Knight 2011). The species is arboreal and nocturnal and is mostly restricted to eucalypt forests and woodlands. It is typically found in highest abundance in tall, montane and moist eucalypt forests with old trees and abundant hollows. The species favours forests with a diversity of eucalypt species, due to the seasonal variation in its preferred tree species. During the day Greater Glider shelters in tree hollows, particularly those that are in large, old trees (McKay 2008).

The Greater Glider is found throughout eastern Australia, from the Windsor Tableland in north Queensland through to central Victoria. The broad extent of occurrence is unlikely to have changed substantially since European settlement, however the area of occupancy has decreased substantially, mostly due to land clearing (Threatened Species Scientific Committee 2016). This decline is most likely continuing due to further land clearing, fragmentation, fire and forestry activities. The species is considered to be particularly sensitive to forest clearance, logging and fire, and is slow to recover following major disturbance. The species is also considered to be sensitive to fragmentation due to a low dispersal ability, previously showing low persistence in small forest fragments (Threatened Species Scientific Committee 2016).

A total of 25 Greater Gliders were recorded within the development footprint during targeted surveys in the current assessment. Previous records of the species are also scattered throughout the adjacent Ben Halls Gap Nature Reserve (EES 2020). As Greater Glider tend to have relatively small home ranges (1 – 4 ha), for the purposes of this assessment, those records throughout the development footprint and adjacent reserves make up the 'local population'. Nationally, there are no officially recognised 'important populations' of Greater Glider. However in NSW, there are three specific populations listed as Endangered under the BC Act (EES 2020). These are the populations of the Eurobodalla LGA, Mount Gibraltar Reserve, and Seven Mile Beach National Park which are remote from the project. It is not considered that the local population addressed in this assessment makes up an important population of the species.

Approximately 37.45 hectares of known Greater Glider habitat is proposed to be removed from the development footprint as a part of the current project. This encompasses high condition eucalypt woodland, on the wind farm and internal roads development footprint.

Greater Glider populations throughout Australia are currently under increased pressure due to the 2019-2020 summer bushfires that occurred across the southern and eastern states of Australia. DAWE have provided several resources in response to these fires including analyses of listed species habitat within fire affected areas (DAWE 2020a), as well as provisional lists of fauna that require urgent management intervention (DAWE 2020b). Approximately 29 % of the known distribution for Greater Glider has been identified as occurring within fire affected areas, and the species has been identified as requiring urgent management intervention. Given this context, any remaining areas of high quality Greater Glider habitat are now of key importance in the conservation of the species. Greater Glider is sensitive to wildfire, and it is slow to recover following major bushfire disturbances. (Lunney 1987, Threatened Species Scientific Committee 2016). Home ranges for the species are typically small, ranging from 1-4 hectares (Pope, Lindenmayer, & Cunningham 2004), and thus reoccupation of burnt sites in subsequent years is likely to be slow as a result of the species' limited dispersal capabilities (Threatened Species Scientific Committee 2016).

A detailed assessment of impacts to Greater Glider against the significant impact guidelines is provided in Table 72, with impacts considered unlikely to be significant.

Table 72 EPBC Act significant impact assessment for Greater Glider

Criteria	Assessment response
Is there a real chance or a possibility that the action will lead to a long-term decrease in the size of an important population?	The *Matter of NES Significant impact guidelines 1.1* (Commonwealth of Australia 2013) defines an important population as: *A population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:* • Key source populations either for breeding or dispersal • Populations that are necessary for maintaining genetic diversity, and/or • Population that are near the limit of the species range. There is currently no national recovery plan prepared for Greater Glider(DAWE 2021). Due to the lack of a national recovery plan there are no important populations that have been formally identified for the species at the Commonwealth level. Within NSW there are three endangered populations that have been identified, the Eurobodalla LGA population, the Mount Gibraltar Reserve area population, and the Seven Mile Beach National Park population. All of these populations occur south of Sydney and are thus geographically distant from the Project. No significant populations north of Sydney are identified in the national Conservation Advice for the species (Threatened Species Scientific Committee 2016). According to the *Ben Halls Gap National Park Plan of Management* (NPWS 2002), the park contains one of the highest recorded densities of Greater Glider, due to the high nutrient levels within the eucalypt foliage, as well as the number of suitably sized hollows. The Project will not impact on any of the habitats within the Ben

Criteria	Assessment response
	Halls Gap National Park, and most of the development in the vicinity of the park occurs on pre-disturbed, cleared areas that are currently utilised for cattle grazing along its western border. Due to the predominantly linear nature of the development, it is also unlikely to represent a significant dispersal barrier for any individuals moving into or out of the western boundary of the Ben Halls Gap Nature Reserve, beyond that which already exists in the area. Connectivity to the contiguous native vegetation to the north, east and south of the national park will not be impacted by the Project. The species is considered as "widespread and common…particularly in north-eastern NSW" (Kavanagh 2004, Threatened Species Scientific Committee 2016), with multiple records also occurring within the nearby Hanging Rock, Nundle and Tomalla State forests (EES 2020). Given the high level of connectivity between these areas it is highly like that breeding is occurring between individuals in these reserves, and that there is free movement of genes across the landscape. The population within the Ben Halls Gap National Park also does not occur at the limit of the species range. As such the local population of Greater Glider, which is considered to be those individuals that occur within the development footprint and adjacent reserves, is not considered to be an important population key to the long-term survival and recovery of the species. As such the Project is unlikely to result in a long term decrease of an important population of the species.
Is there a real chance or a possibility that the action will reduce the area of occupancy of an important population?	The Project will result in the removal of native vegetation that is likely to be utilised by individuals that comprise the local population of Greater Glider. The local population is likely to include individuals within the development footprint as well as individuals within the large population known to reside in the Ben Halls Gap National Park (NPWS 2002). The development primarily occurs on pre-disturbed, cleared areas that are currently utilised for cattle grazing, including areas along the western border of the Ben Halls Gap National Park. The clearing of native vegetation is primarily occurred on the edges of vegetation patches, and scattered trees within these pre-disturbed areas. The development is also a predominantly linear design, which is unlikely to represent a significant dispersal barrier for any individuals moving into or out of the western boundary of the Ben Halls Gap Nature Reserve, beyond that which already exists in the area. Whilst the removal of native vegetation within the development footprint will result in localised reductions in species habitat, it is unlikely to result in a significant decrease in the area of occupancy over which the species ranges within the locality. Furthermore, given the local population does not occur at the edge of the species range, with a high occurrence of the species across the locality as represented by records in the Hanging Rock, Nundle and Tomalla State forests (EES 2020), it is not considered that the local population meets the criteria of an important population.
Is there a real chance or a possibility that the action will fragment an existing important population into two or more populations?	The local population is likely to include individuals within the development footprint as well as individuals within the large population known to reside in the Ben Halls Gap National Park (NPWS 2002). The development primarily occurs on pre-disturbed, cleared areas that are currently utilised for cattle grazing, including areas along the western border of the Ben Halls Gap National Park. The clearing of native vegetation is primarily occurred on the edges of vegetation patches, and scattered trees within these pre-disturbed areas. The development is also a

Criteria	Assessment response
	predominantly linear design, which is unlikely to represent a significant dispersal barrier for any individuals moving into or out of the western boundary of the Ben Halls Gap Nature Reserve, beyond that which already exists in the area. Connectivity to the contiguous native vegetation to the north, east and south of the national park will not be impacted by the Project. As such it is unlikely that the Project would result in significant modification to dispersal of individuals throughout the area, such that the population would become split into two or more populations. As the local population does not occur at the edge of the species range, with a high occurrence of the species across the locality as represented by records in the Hanging Rock, Nundle and Tomalla State forests (EES 2020), it is not considered that the local population meets the criteria of an important population.
Is there a real chance or a possibility that the action will adversely affect habitat critical to the survival of a species?	Habitat critical to the survival of Greater Glider includes large, mature trees with hollows (for sheltering and breeding), and large remnant vegetation patches. Greater Glider are highly sensitive to fragmentation and are generally unable to persist in small vegetation patches. In addition, large-scale bushfires during the summer of 2019-2020 have reduced the availability of Greater Glider habitat across its distribution by approximately 29 % (DAWE 2020a). As the species' is known to have a small home range, ranging from 1-4 hectares (Pope, Lindenmayer, & Cunningham 2004), a conservative 20 kilometre buffer around the wind farm development footprint is likely to include the home ranges of all of the individuals that utilise the habitat within to the development footprint, as well as those individuals adjacent to the development footprint that may infrequently disperse through the site. Within this 20 kilometres buffer area approximately 32,000 hectares (27.5 %) of native vegetation has been burnt, with the area estimated to support a total of approximately 116,500 hectares of native vegetation. Most (82 %) of this vegetation has been burnt to a medium or high degree, in accordance with the burnt area classes outlined in the GEEBAM (NSW Department of Planning, Industry and Environment 2020), meaning both the canopy and understorey have either been partially of completely burnt. As such the 35.48 hectares of native vegetation being removed by the Project is of potentially greater importance than usual for the species. The current project proposes the removal of approximately 25.54 hectares of Greater Glider habitat, encompassing eucalypt woodland known to support the species, and the associated hollow-bearing trees throughout. Due to the large number of Greater Glider recorded during the current assessment, this habitat appears to be highly suitable for the species. It is not considered likely that the removal of 37.45 hectares of known habitat for the species would adversely affect habitat critical to the survival of this species. The project footprint avoids areas of higher quality, intact and large patch size vegetation with abundant hollows, which is important habitat for this species.
Is there a real chance or a possibility that the action will disrupt the breeding cycle of an important population?	The local population of Greater Glider addressed in this assessment is not considered to be an important population of the species.
Is there a real chance or a	The current project proposes the removal of approximately XXX hectares of known

Criteria	Assessment response
possibility that the action will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Greater Glider habitat, encompassing eucalypt woodland known to support the species, and the associated hollow-bearing trees throughout. Due to the large number of Greater Glider recorded during the current assessment, this habitat appears to be highly suitable for the species. In some areas this vegetation occurs in small remnant patches within cleared areas. Removal of this vegetation would make the land unusable to Greater Glider, as they are not able to persist in cleared areas and have limited dispersal ability. In addition, large-scale bushfires during the summer of 2019-2020 have reduced the availability of Greater Glider habitat across its distribution by approximately 29 % (DAWE 2020a). Approximately 32,000 hectares of native vegetation within a 20 kilometre buffer of the development footprint has been lost due to bushfire. This represents 27.5 % of the 116,500 hectares of native vegetation estimated to occur within this buffer. As such the 37.45 hectares of native vegetation known to support the species, being removed by the Project is of potentially greater importance than usual for the species. However, protecting and enhancing native vegetation outside of approved disturbance areas and managing the remaining remnant vegetation and habitat within or surrounding the development site toward a benchmark state, would aid in the recovery of Greater Glider habitat locally. Additionally, Ben Halls Gap Nature Reserve occurs directly east of the development footprint, and likely provides large areas of suitable habitat to the species. As Greater Glider require relatively small home ranges (1-4 hectares), it is considered that there is adequate habitat within the nearby reserve and retained within the development footprint to support the local population of Greater Gliders, and that the proposed works would not cause the species to decline.
Is there a real chance or a possibility that the action will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Invasive weeds species are not known to directly harm populations of Greater Glider but do have potential to reduce quality of habitat in the adjoining bushland and therefore increase potential to harm the population of the species. Management measures would be prepared, implemented and audited to avoid and minimise the environmental risks associated with weeds, pests and pathogens. As a minimum, these would include: • Completion of a site weed assessment and development of a Weed Management Plan. The Weed Management Plan would sit as a sub-plan to the EMS. • Implementation of appropriate weed control and weed disposal in accordance with Biosecurity protocols. • Any soil or other materials imported to the site for use in restoration or rehabilitation would be certified free from weeds and pathogens or obtained from sources that demonstrate best practice management to minimise weed and pathogen risks. • Appropriate disposal of any weed material at an appropriately licensed facility.
Is there a real chance or a possibility that the action will introduce disease that may cause the species to decline?	The proposed action is not likely to results in the introduction of diseases that may cause the species to decline.
Is there a real chance or a possibility that the action will interfere substantially with the	The national conservation advice for Greater Glider lists the primary conservation objectives for the species as: • Manage threats to secure or increase overall population size.

Criteria	Assessment response
recovery of the species?	• Maintain viable populations at all known localities. While the proposed removal of 37.45 hectares of Greater Glider habitat will not contribute to the recovery of the species, it is not considered likely to substantially interfere with the recovery of the species for the following reasons: • Ben Halls Gap Nature Reserve occurs directly east of the development footprint, and likely contains large areas of high quality habitat for the species. This habitat is considered adequate such that the loss of 37.45 hectares of habitat within the development footprint would not reduce the local population size or decrease the viability of the local population. There is also large areas of suitable Greater Glider habitat retained within the development footprint. • As part of the project, preclearance assessments would be undertaken and clearing of hollow-bearing trees would be supervised by an ecologist, and any Greater Gliders utilising the habitat being removed from the development footprint would be captured and relocated. Due to the large areas of suitable habitat nearby (i.e. within the reserve system), it is likely that displaced individuals would be successfully relocated, assuring that the local population would not decrease in numbers as a result of the proposed works.

8.8.6 Booroolong Frog

The Booroolong Frog is listed as Endangered under the EPBC Act. The species is an obligate river-breeding frog that was historically found along streams on the western fall of the Great Dividing Range in New South Wales between 200 and 1300 metres above sea level (DAWE 2020d). Several populations were also found along eastern flowing streams in the northern half of the species former range. This species underwent a dramatic decline during the mid-1980s, and the results of recent surveys suggest that declines have occurred throughout its former known range, particularly on the New England Tablelands (OEH 2012). The factors identified as contributing to the historic and continued decline of the Booroolong Frog include disease (Chytridiomycosis) caused by infection with the Amphibian Chytrid Fungus (*Batrachochytrium dendrobatidis*), habitat degradation, altered stream flows, and stream drying associated with recent severe droughts. The introduction of exotic predatory fish is also likely to have impacted on the Booroolong Frog in the wild, and this impact may be continuing.

The Booroolong Frog lives along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. The species shelter under rocks or amongst vegetation near the ground on the stream edge. Eggs are laid in submerged rock crevices and tadpoles grow in slow-flowing connected or isolated pools (Hunter 2007).

Based on habitat connectivity, 28 local populations are currently known across the range of the Booroolong Frog (OEH 2012). For this assessment, the closest population occurs along the Peel River within the Namoi Catchment, with the river occurring less than 500 metres from the development footprint. First order streams connected to the Peel River occur within the development footprint in parts. The closest record of Booroolong Frog to the development footprint occurs approximately 400 metres to the north of the transmission line along Wombramurra Creek, and 2.4 kilometres north west, along the Peel River, with abundant records along the both watercourses heading further north west (EES 2020). The Peel River is currently considered a Key Management Site for conservation of the Booroolong Frog as part of the Saving Our Species program run by the NSW Government (OEH 2020). The Peel River population is considered to be the local population for the purposes of this assessment.

As part of the proposed works, approximately 0.64 hectares of Booroolong Frog habitat will be directly removed in the form of riparian vegetation alongside creeklines, this has been reduced by 0.95 hectares as a result of the project's design revisions. However, due to the location of the development footprint upstream and in close to proximity to the Peel River, the proposed works have some potential to have further indirect impacts to Booroolong Frog habitat as a result of changes in water flows, and increased run off and sedimentation as a result of land clearing and excavation.

In order to minimise such impacts, a Soil and Water Management Plan will be prepared, outlining measures for the management and monitoring of surface water quality and hydrology during construction. The plan would also address any requirements for the management of potential acid sulphate soils or contaminated lands during construction so as to minimise impacts to terrestrial and aquatic habitats. The plan would include the implementation of a construction surface water quality monitoring to minimise impacts to surface water quality. An Erosion and Sediment Control Plan will also be prepared, outlining measures for the prevention of erosion and sedimentation during construction. If adequate soil and water management measures are employed, any indirect impacts to Booroolong Frog habitat will be substantially reduced.

A detailed assessment of impacts to Booroolong Frog against the significant impact guidelines is provided in Table 73, with impacts considered unlikely to be significant providing best practice construction environmental management measures are employed to prevent pollution of adjacent / downstream habitats.

Table 73 EPBC Act significant impact assessment for Booroolong Frog

Criteria	Assessment response
Is there a real chance or a possibility that the action will lead to a long-term decrease in the size of a population?	The direct removal of 0.64 hectares of Booroolong Frog habitat at the upper reaches of first order streams connected to the Peel River is not considered likely to cause a decrease in the size of the Peel River population. The closest record of Booroolong Frog to the development footprint occurs between 400 metres and 2.4 kilometres downstream, and Booroolong Frog were not recorded within the development footprint during the current assessment, suggesting that habitat within the development footprint is marginal. However, targeted surveys for Booroolong Frog were not able to discount the presence of the species from the along the transmission line, as surveys were undertaken outside of the recommended survey period. However, if potential impacts to soil and water movement as a result of land clearing and excavation are not adequately managed throughout the project, there is a possibility that Booroolong Frog habitat occurring further downstream within the Peel River could be adversely affected as a result of increased run off and sedimentation, changes in water flows, and increased pollution of the waterway. In particular, if sediment was to fill rock crevices within the river, the species would no longer be able to use this habitat for oviposition. If poorly managed, this could lead to a long-term decrease in the Peel River Booroolong Frog population, through reduction in breeding habitat.
Is there a real chance or a possibility that the action will reduce the area of occupancy of the species?	As above, the direct removal of 0.64 hectares of Booroolong Frog habitat at the upper reaches of first order streams connected to the Peel River is not considered likely to cause a reduction in occupancy of the Peel River population, as the closest record of Booroolong Frog to the development footprint occurs between 400 meters and 2.4 kilometres downstream, and Booroolong Frog were not recorded within the development footprint during the current assessment. This suggests that habitat within the development footprint is marginal. It should be noted that targeted surveys for Booroolong Frog were not able to discount the presence of the species from the transmission line, as surveys were undertaken outside of the recommended survey period.

Criteria	Assessment response
	However, if potential impacts to soil and water movement as a result of land clearing and excavation are not adequately managed throughout the project (in line with legal requirements to avoid water pollution), there is a possibility that Booroolong Frog habitat occurring further downstream within the Peel River could be adversely affected as a result of increased run off and sedimentation, changes in water flows, and increased pollution of the waterway which could lead to a reduction in the area of occupancy of the Peel River Booroolong Frog population, through reduction in available habitat.
Is there a real chance or a possibility that the action will fragment an existing population into two or more populations?	The development footprint is located between 400 meters and 2.4 kilometres south east of the nearest previous record of Booroolong Frog, with all previous records in the locality occurring downstream to the north west. As the development footprint occurs at the outer edge of the local population's range, it is unlikely that loss of habitat in this area would lead to the fragmentation of the Peel River Booroolong Frog population.
Is there a real chance or a possibility that the action will adversely affect habitat critical to the survival of a species?	Habitat critical to the survival of the Booroolong Frog is defined as rocky sections of permanent streams occupied by the species. Any action that reduces stream permanency (e.g. pumping water) or results in loss of rock crevices (e.g. smothering by weeds or sedimentation), is likely to threaten the persistence of local populations of this species. As above, the direct removal of 0.64 hectares of Booroolong Frog habitat at the upper reaches of first order streams connected to the Peel River is not considered likely to adversely affect habitat critical to the survival of the species, as the closest record of Booroolong Frog to the development footprint occurs between 400 meters and 2.4 kilometres downstream, and Booroolong Frog were not recorded within the development footprint during the current assessment. This suggests that habitat within the development footprint is marginal. It should be noted that targeted surveys for Booroolong Frog were not able to discount the presence of the species from the transmission line, as surveys were undertaken outside of the recommended survey period. However, if potential impacts to soil and water movement as a result of land clearing and excavation are not adequately managed throughout the project, there is a possibility that Booroolong Frog habitat occurring further downstream within the Peel River could be adversely affected as a result of increased run off and sedimentation, changes in water flows, and increased pollution of the waterway. If water flow was to be affected within the Peel River such that previous areas of habitat no longer contained permanent water, or sedimentation occurred to the extent that rock crevices were filled and unable to be used for oviposition, this would be considered an adverse effect on habitat critical to the survival of the species.
Is there a real chance or a possibility that the action will disrupt the breeding cycle of a population?	As above, the direct removal of 0.64 hectares of Booroolong Frog habitat at the upper reaches of first order streams connected to the Peel River is not considered likely to disrupt the breeding cycle of the species, as the closest record of Booroolong Frog to the development footprint occurs between 400 meters and 2.4 kilometres downstream, and Booroolong Frog were not recorded within the development footprint during the current assessment. This suggests that habitat within the development footprint is marginal. It should be noted that targeted

Criteria	Assessment response
	surveys for Booroolong Frog were not able to discount the presence of the species from the transmission line, as surveys were undertaken outside of the recommended survey period. Booroolong Frogs require rock crevices in shallow slow-medium flowing permanent streams to breed (OEH 2012). If potential impacts to soil and water movement as a result of land clearing and excavation are not adequately managed throughout the project however, there is a possibility that Booroolong Frog habitat occurring further downstream within the Peel River could be adversely affected as a result of increased run off and sedimentation, changes in water flows, and increased pollution of the waterway. If water flow was to be affected within the Peel River such that previous areas of habitat no longer contained permanent water, or sedimentation occurred to the extent that rock crevices were filled and unable to be used for oviposition, this could likely disrupt the breeding cycle of the Peel River population.
Is there a real chance or a possibility that the action will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Booroolong Frog has been previously recorded along 18 kilometres of the Peel River. The direct removal of 0.64 hectares of Booroolong Frog habitat at the upper reaches of first order streams connected to the Peel River, 400 metres to 2.4 kilometres from the closest record, is not considered likely to decrease the availability of habitat for the species such that the species is likely to decline. However, if potential impacts to soil and water movement as a result of land clearing and excavation are not adequately managed throughout the project, there is a possibility that Booroolong Frog habitat occurring further downstream within the Peel River could be adversely affected as a result of increased run off and sedimentation, changes in water flows, and increased pollution of the waterway. The Peel River Booroolong Frog population is one of only 28 known populations. If water flow was to be affected within the Peel River such that previous areas of habitat no longer contained permanent water, or sedimentation occurred to the extent that rock crevices were filled and unable to be used for oviposition, this could likely decrease the extent of the species habitat such that the species could decline.
Is there a real chance or a possibility that the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat?	There is potential for the introduction of weeds, pests or pathogens as a result of the proposed works, via movement of vehicles and plant, and increase in foot traffic. However, management measures would be prepared, implemented and audited to avoid and minimise the environmental risks associated with weeds, pests and pathogens. As a minimum, these would include: Completion of a site weed assessment and development of a Weed Management Plan. The Weed Management Plan would sit as a sub-plan to the CEMP. Implementation of appropriate weed control and weed disposal in accordance with Biosecurity protocols. Any soil or other materials imported to the site for use in restoration or rehabilitation would be certified free from weeds and pathogens or obtained from sources that demonstrate best practice management to minimise weed and pathogen risks. Disposal of any weed material at an appropriately licensed facility. Implementation of appropriate hygiene protocols where there are potential or known pathogen risks.

Criteria	Assessment response
Is there a real chance or a possibility that the action will introduce disease that may cause the species to decline?	Pathogens, including the amphibian Chytrid Fungus *Batrachochytrium dendrobatidis*, have the potential to be introduced to the site during construction. The timing and rapid nature of the Booroolong Frogs' decline from the New England Tablelands, which coincided with the disappearance of several other frog species in this region, was likely due to an outbreak of Chytrid Fungus (Mahony 1999). Declines have been recorded from higher altitude sites, where habitat remains intact, compared to persistence at lower altitudes, which is consistent with other Chytrid Fungus induced declines. Sick and dead infected Booroolong Frogs have been observed in the wild on several occasions, and healthy frogs have tested positive for infection. It is currently unclear as to whether Chytrid Fungus is present within the Peel River. However, extensive preventative measures should be undertaken during the construction phase to ensure that the disease is not introduced into the development footprint or the river system. This will be addressed in a project Biodiversity Management Plan.
Is there a real chance or a possibility that the action will interfere substantially with the recovery of the species?	The National Recovery Plan for Booroolong Frog *Litoria booroolongensis* (NSW OEH 2011b) identifies the following recovery actions: • Complete systematic surveys. • Determine the taxonomic status of northern and southern populations. • Identify genetic sub-division across the species range. • Continue and expand riparian protection and restoration. • Regulate the establishment of softwood plantations. • Enforce legislation protecting streams and water flow. • Reduce the transmission of potentially harmful pathogens. • Determine current impacts and prevent impacts from introduced predatory fish. • Implement an effective monitoring program. • Model the influence of predicted climate change. • Develop efficient reintroduction techniques. • Assess the capacity to use assisted colonisation. • Determine impact of herbicides. • Determine the current impact of Chytridiomycosis. • Determine the influence of reduced water quality. • Increase public awareness and provide specific education and training. • Establish a recovery team. As 0.64 hectares of Booroolong Frog habitat in the form of riparian vegetation is to be removed as a part of the proposed works, the only recovery action that may be interfered with as a result of the project is the continued expansion of riparian protection and restoration. However, removal of 0.64 hectares of habitat at the southern edge of the local species population is not considered to be a substantial interference to the recovery of the species.

8.9 Mitigating and managing impacts

Table 74 identifies proposed measures to further mitigate and manage unavoidable impacts to biodiversity, following all efforts to avoid and minimise undertaken to date.

Table 74 Proposed mitigation measures

ID	Impact	Project component	Mitigation measures	Timing	Responsibility
B1	General	Entire development footprint	An Environmental Management Strategy (EMS) will be prepared and implemented, including industry standard measures for the management of soil, surface water and pollutants, weeds, pests and pathogens, as well as site-specific measures and relevant sub-management plans. Relevant sub-plans specific to the management of biodiversity are a Biodiversity Management Plan, Weed Management Plan and Bird and Bat Adaptive Management Plan.	Pre-construction/ construction	Contractor
B2		Entire development footprint	All site workers would be trained to ensure awareness of requirements of the EMS (**B1**), relevant sub-plans and statutory responsibilities. Site-specific training would be provided when specific work activities were taking place near areas of identified biodiversity value that are to be protected.	Construction	Contractor
B3	Clearing of native vegetation, threatened ecological communities and habitat for threatened flora and fauna	Entire development footprint	Prepare and implement a biodiversity offset strategy, in accordance with the requirements of the BC Act and the EPBC Act Offsets Policy.	Pre-construction	Proponent
B4	Direct impacts to native vegetation	Entire development footprint	Opportunities to further minimise impacts to native vegetation will continue to be explored during the detailed design. This would include measures to minimise the construction footprint and clearing requirements with a particular focus on the protection of hollow bearing trees and fauna movement corridors.	Pre-construction	Proponent

ID	Impact	Project component	Mitigation measures	Timing	Responsibility
B5	Impacts to native vegetation, threatened ecological communities and habitat for threatened species	Entire development footprint	Opportunities to further minimise impacts to native vegetation will continue to be explored during the detailed design. This would include measures to minimise the construction footprint and clearing requirements with a particular focus on the protection of hollow bearing trees and fauna movement corridors. Upon final design and an understanding of detailed impact, a Biodiversity Management Plan would be prepared and implemented. The Biodiversity Management Plan will address terrestrial and aquatic matters by including: • Plans for the development footprint and adjoining area showing updated and current extents of native vegetation, flora and fauna habitat, threatened species and threatened ecological communities and measures to minimise impacts to these features. • Plans showing areas to be cleared and areas to be protected, including exclusion zones and protected habitat features, and areas for native vegetation rehabilitation or re-establishment. This will be key to minimising impacts to Koala and Spotted-tailed Quoll. • Mapping and identification of individual tree hollows and termite mounds and measures to minimise impacts to these features. • Protocols for communicating biodiversity features to the design team during any turbine micrositing and design refinements to minimise and avoid impacts. • Pre-clearing protocols, including pre-clearing inspections, establishment of exclusion zones and on-ground identification of specific habitat features to be retained and/ or relocated. • Vegetation clearing protocols, including staged habitat removal (including of wombats, Koala, and other fauna) and any specified seasonal limits on clearing activities. • Maintaining areas of habitat connectivity for as long as is practicable through or around the construction area. • Maintaining isolated paddock trees within the development footprint where possible to provide refuge to locally occurring fauna species (incl. Koala).	Pre-construction/ construction / post-construction	Contractor

ID	Impact	Project component	Mitigation measures	Timing	Responsibility
			• Protocols for the salvage and relocation of woody debris, tree hollows and bush rock. • Requirements for temporary deterrent fencing, signage and/or requirements to modify driver behaviour and regular visual inspections to minimise the risk of fauna injury / mortality (particularly Koala and Spotted Tailed Quoll) due to vehicle strike or entrapment in deep excavations, with details to be developed during the preparation of the BMP. • Opportunity for egress to any species that may become trapped in any open excavation in the form of graded exits or tools to support climbing out. • Fauna handling and unexpected threatened species finds procedures. • Procedures detailing the management of pathogens such as chytrid fungus. • Rehabilitation, revegetation, reuse of soils and other habitat management actions. • Limit construction and operational traffic speed limits to minimise the potential for vehicle strike, and include sufficient signage on potential presence of threatened fauna species. • Ensure construction and operation personnel are educated on the presence of fauna such as Koala and Spotted-tailed Quoll in the locality, how to manage potential interactions, and to be aware of the potential for vehicle strikes when driving through the sites (particularly after dark). • Weed, pest and pathogen management requirements. • Monitoring during construction and post-construction. • Adaptive management measures to be applied if monitoring indicates unexpected adverse impacts. Operational measures to minimise the ongoing impact of the project to threatened fauna will be implemented as part of an operational component of the Biodiversity Management Plan, and will include: • Revegetation with Koala feed tree species where appropriate. • Design of operational fencing layout to ensure fauna (incl Koala and Spotted-tailed Quoll) can continue to move through the		

ID	Impact	Project component	Mitigation measures	Timing	Responsibility
			landscape, and if they enter the wind farm are able to self-relocate back into surrounding landscape by providing egress opportunities. Ensure fauna are prevented from accessing higher traffic areas or other potentially hazardous area, and are funnelled towards areas of potential habitat rather than towards the operational wind farm, or into dead-ends and bottle-necks. • Installation of glider poles for glider species in areas where the width of the transmission line easement exceeds minimum requirements for species movement. • Establishment of Biodiversity Stewardship sites on neighbouring properties.		
B6	Impacts to threatened flora	Entire development footprint	A pre-clearing survey is to be carried out to confirm the presence/absence of threatened flora within lands that have not been surveyed within and adjacent to the development footprint. As a part of the survey, the size and extent of confirmed threatened flora populations must be determined. The results of the survey are to provide the updated baseline mapping of the vegetation communities and key fauna habitat on site for inclusion in the Biodiversity Management Plan (B5) and inform specific measures for the protection and management of threatened flora. This is to include at a minimum, specific requirements for the clearing process, any proposed translocation opportunities (for native fauna such as wombats) and associated contingency measures.	Pre-construction	Proponent
B7	Impacts to threatened fauna and karst, caves, crevices, cliffs and other geological feature of significance	Entire development footprint	As a part of the Biodiversity Management Plan, opportunities for the salvage and re-use of important habitat features, including tree-hollows and bush rock, are to be identified. The plan is to include detailed procedures for the implementation of these activities.	Pre-construction and construction	Contractor
B8		Entire development footprint	Opportunities to further minimise any impacts to fauna habitat are to be fully explored through detailed design phase including any strategies for habitat restoration augmentation post-work. Habitat avoidance should prioritise the retention of karst and caves offering potential habitat for threatened fauna.	Pre-construction	Proponent

ID	Impact	Project component	Mitigation measures	Timing	Responsibility
B9	Impacts to National Park estate	Wind farm corridor	An appropriate buffer will be maintained to National Park estate where practicable. Implementing vegetated buffers between the access tracks and wind turbine pads and the National Park estate is to be considered during detailed design. The selection of areas of buffer plantings and species to be planted will be carried out in consultation with the Area Manager, Barrington Tops National Parks and Wildlife Service. The Erosion and Sediment Control Plan will include specific actions to identify sensitive receptors associated with the National Park estate, including waterways and the adjacent Sphagnum Moss TEC	Pre-construction	Proponent
B10	Edge effects and impacts to habitat viability	Entire development footprint	Restore and rehabilitate all areas within the temporary development footprint. Priority should be given to movement corridors for fauna, significant habitats and threatened ecological communities.	Post-construction	Contractor
B11	Disturbance from weeds, pests and pathogens	Entire development footprint	Management measures would be prepared and implemented to avoid and minimise the environmental risks associated with weeds, pests and pathogens. As a minimum, these would include: • Completion of a site weed assessment and development of a Weed Management Plan, as a sub-plan to the EMS. • Implementation of appropriate weed control and weed disposal in accordance with Biosecurity protocols. • Any soil or other materials imported to the site for use in restoration or rehabilitation would be certified free from weeds and pathogens or obtained from sources that demonstrate best practice management to minimise weed and pathogen risks. • Appropriate disposal of any weed material. • Implementation of appropriate hygiene protocols where there are potential or known pathogen risks including procedures detailing the management of pathogens such as chytrid fungus.	Construction	Contractor
B12	Habitat disturbance from light	Entire development footprint	Proposal design and construction to minimise light impacts as much as possible through the use of sensor lighting and/ or directional lighting for more heavily utilised parts of the site.	Pre-construction and construction	Contractor/ Proponent

ID	Impact	Project component	Mitigation measures	Timing	Responsibility
B13	Impacts of wind turbine strikes on protected animals	Wind farm corridor	Operational management measures specific to the wind turbines will be implemented. These are described in Section 8.9.1 of this BDAR. Bird and bat activity within the site is generally concentrated around areas of vegetation. A minimum safe distance of 30m will be maintained from the turbine blade tip to the adjacent tree canopy to minimise any risk of bird or bat strike.	Pre-construction, post-construction	Proponent
B14		Wind farm corridor	Prepare and implement, an operational Biodiversity Management Plan, as part of the project EMS, detailing ongoing measures for the protection and management of flora and fauna during the operational phase of the proposal. The plan is to identify at a minimum: • Target species, important habitats and ecological features to be monitored and managed within the site. • Specific management measures to be implemented during operations including a proposed schedule for implementation, including carrying out revegetation works with native species within the development footprint, including up to 90% of the transmission line corridor, and up to 50% of the transport route upgrades. • Requirements for the monitoring of target species, important habitats and ecological features within the site and processes to be implemented to ensure an adaptive management approach. • Specific requirements for the monitoring and management of bird and bat mortality from blade strike including any considerations for the timing of species seasonal movements and/ or breeding periods. • Performance objectives and proposed contingency measures. • Roles, responsibilities and reporting requirements.	Post-construction	Proponent
B15		Wind farm	Prepare and implement a Bird and Bat Adaptive Management Plan (BBAMP), as a sub-plan to the EMS. The BBMP will include: • A description of measures to be implemented on the wind farm site for minimising bird and bat strike. • Suitable measures must be identified for the minimisation and management bird and bat strike risks during operation.	Pre-operation	Proponent

ID	Impact	Project component	Mitigation measures	Timing	Responsibility
			• Trigger levels for further investigation and mitigation measures to be implemented. • An adaptive management plan to be implemented if the monitoring determines threatened or at risk species are subject to adverse impacts. • A detailed monitoring and reporting plan to assess the potential impacts and effectiveness of design and operational measures to mitigate bird and bat strike. For example, the plan may contain the following suggested structure: **1 Introduction** 1.1 Background 1.2 Statutory requirements of BBMP 1.3 BBMP Objectives 1.4 Consultation 1.5 Site description **2 Baseline bird and bat information** 2.1 Bird survey methodology 2.2 Bat survey methodology 2.3 Results **3 Risk assessment** 3.1 Species and groups of concern 3.2 Risk assessment methodology 3.3 Risk assessment results 3.4 Conclusions of risk assessment **4 Operational phase surveys** 4.1 Monitoring 'at risk' groups 4.2 Bird utilisation surveys 4.3 Bat surveys 4.4 Carcass searches 4.4.1 Turbine selection 4.4.2 Search protocol 4.4.3 Scavenger rates and trials 4.4.4 Detectability (Observer) trials		

ID	Impact	Project component	Mitigation measures	Timing	Responsibility
			4.4.5 Incidental carcass protocol 4.4.6 Analysis of results and mortality estimation 4.5 Personnel involved 4.6 Injured bird and bat protocol 4.7 Reporting and review **5 Mitigation measures to reduce risk** **6 Trigger – Action – Response Plan**		
B16	Impacts to water quality and hydrology and threatened species associated with waterbodies	Entire development footprint	The Biodiversity Management Plan will include measures for the management and monitoring of surface water quality and hydrology during construction, as applicable to the protection of biodiversity values. The plan would also address any requirements for the management of potential acid sulphate soils or contaminated lands during construction so as to minimise impacts to terrestrial and aquatic habitats. A Soil and Water Management Plan will be prepared, outlining measures for the management and monitoring of surface water quality and hydrology during construction. The plan would also address any requirements for the management of pollutants or contaminated lands during construction so as to minimise impacts to terrestrial and aquatic habitats. The plan would include the implementation of a construction surface water quality monitoring to minimise impacts to surface water quality. An Erosion and Sediment Control Plan will also be prepared, outlining measures for the prevention of erosion and sedimentation during construction. A targeted focus of this sub-plan will be to prevent indirect impacts to waterways potentially supporting Booroolong Frog surrounding the development footprint, waterways that traverse the National Park estate and the location of the Sphagnum Moss TEC in Ben Halls Gap Nature Reserve. The Soil and Water Management Plan will include procedures detailing the management of pathogens such as chytrid fungus.	Construction and operation	Contractor/ Proponent
B17		Entire development	Prepare and implement an Erosion and Sediment Control Plan, as a		

ID	Impact	Project component	Mitigation measures	Timing	Responsibility
		footprint	sub-plan within the EMS, outlining measures for the prevention of erosion and sedimentation during construction.		
B18	Impacts to aquatic habitats and fish passage	Access/ transport routes	Proposed waterway crossings associated with access / transport routes are to minimise impacts to aquatic habitat and address Fisheries requirements for maintaining fish passage.	Pre-construction and construction	Contractor/ Proponent
B19	Fauna injury / mortality	Entire development footprint	The Biodiversity Management Plan will include the following to minimise and manage any risk of fauna injury mortality during construction: • Strategies for fauna management during construction including any identification roles, responsibilities and contingency measures such as temporary stop works and engagement of fauna specialist. • Requirements for temporary deterrent fencing, signage and/or requirements to modify driver behaviour and regular visual inspections to minimise the risk of fauna injury / mortality (particularly Koala and Spotted Tailed Quoll) due to vehicle strike or entrapment in deep excavations, with details to be developed during the preparation of the BMP. • Opportunity for egress to any species that may become trapped in any open excavation in the form of graded exits or tools to support climbing out. • Pre-clearing protocols, including pre-clearing inspections, establishment of exclusion zones and on-ground identification of specific habitat features to be retained and/ or relocated. – For example, occupation surveys for wombat burrows, application of exclusion measures / deterrents prior to vegetation clearing / earthworks, works undertaken in presence of spotter / catcher. • Protocols for fauna handling and management of adverse incidents. • Fauna monitoring and management protocol including identification and reporting of fauna mortalities to the relevant Biodiversity Conservation Division office.	Construction	Contractor

ID	Impact	Project component	Mitigation measures	Timing	Responsibility
B20	Impacts to habitat connectivity	Entire development footprint	The following opportunities will be fully explored as a part of the detailed design: • Opportunities to further minimise the disturbance footprint and clearing within important movement corridors for fauna. • Opportunities for post-works restoration of habitat connectivity within important movement corridors for fauna. • Areas subject to temporary disturbance will be rehabilitated using a native species planting schedule as much as practical considering any operational and safety constraints. • The total area exposed and cleared at any one time will be minimised and planned to allow for fauna movement during construction and periods of temporary disturbance	Pre-construction	Proponent
B21	Impacts to habitat connectivity	Transmission line	The following measures will be implemented post-construction to minimise impacts to flora and fauna within the transmission line easement: • Promotion of the growth of vegetation under the transmission line to the maximum allowable height to maintain habitat connectivity for fauna. • Management of understorey vegetation in easements should be managed to maintain composition and quality and to prevent weed invasion. • Installation of glider poles for glider species in areas where the width of the transmission line easement exceeds minimum requirements for species movement. • Establishment of Biodiversity Stewardship sites on neighbouring properties.	Post-construction	Proponent
B22	Effectiveness of mitigation and management measures	Entire development footprint	Consistent with any specific requirements of the approved Biodiversity Management Plan (**B1**), a monitoring program would be implemented during construction to assess the effectiveness of mitigation and management measures implemented, to identify any unexpected impacts and appropriate contingency measures necessary for the protection of biodiversity. A register of inspections will be established.	Construction and post-construction	Contractor/ Proponent

8.9.1 Operational turbine specific mitigation measures

Mitigation measures for all turbines to ensure impacts associated with bird and bat blade strike are minimised

1. Development of a Bird and Bat Adaptive Management Plan (BBAMP) in consultation with BCD and to the satisfaction of the Secretary of the DPIE to be implemented throughout life of project.
2. Intensive monitoring period for the first six months of operation will be included in the BBAMP, followed by regular bird and bat monitoring/mortality surveys for the life of the wind farm at frequencies based on the findings of each survey period and the adaptive management measures detailed in the BBAMP. The use of detection dogs during carcass surveys will be investigated and employed if found to be suitable and appropriate.
3. Investigation into the need for, and effectiveness of, appropriate low wind speed operational curtailment strategies if required based on the results of ongoing bird and bat monitoring/mortality surveys (further detailed below). This may include measures such as prevention of blade rotation prior to electricity generation cut-in speeds, and/or increased night time cut-in speeds.
4. Research into the ongoing development in bat and bird deterrent systems and the associated reduction of impacts, to establish whether implementation at the Project would be effective and practicable with the goal of integrating into the BBAMP if proven effective and justified based on the results of ongoing bird and bat monitoring/mortality surveys.
5. Regular ongoing maintenance of rotor blades to improve ultrasonic bounce-back enabling microbat avoidance.
6. Installation of lighting schemes that minimise insect attraction to turbines within rotor swept height.
7. Commitment to provision of data from ongoing bird and bat monitoring surveys and effectiveness of BBAMP to specialist research entities who are prepared to enter into appropriate agreements with the Project.

Frequency of bird and bat monitoring/mortality surveys will be developed in consultation with BCD, as part of the preparation and development of the BBAMP. Ongoing and potential timing amendments to monitoring will include inspections and reporting continued for the life of the wind farm, at intervals determined by the results of previous monitoring and in accordance with the BBAMP.

Additional mitigation measures for high risk turbines

Turbines proximal to microbat roosting/breeding habitat - WP50

1. Disturbance to roosting microbats as a result of ground vibration during breeding season (November to February) or winter torpor season (May to September) will be avoided and minimised as far as practicable.
   a. If construction works likely to result in ground vibration cannot practicably be avoided during these periods then monitoring of the presence of microbats within the habitat feature(s) near WP50 will be undertaken prior to any vibration-causing construction activities where required works coincide with breeding/torpor periods. If microbats are confirmed present prior to construction works commencing (during these periods), monitoring will continue during and post-construction, and suitable impact mitigation measures will be investigated such as:

i) investigation into a suitable maximum vibration level to prevent disturbance to roosting microbats

ii) assessment of what activities or plant may cause this maximum vibration level to be triggered; and

iii) at what distance (setbacks) unacceptable levels of vibration may be experience at the habitat location.

Further details will be provided in the BMP.

2. Additional low wind speed seasonal curtailment strategy with increased night-time cut-in speeds will be implemented.
    a. The strategy will be determined through measures such as analysis/comparison of microbat activity data with wind data collected during the EIS, or through undertaking a controlled experiment using (for example) a Before-After-Control-Impact (BACI) design, and implemented as part of the BBAMP.
3. Increased frequencies of bird and bat monitoring/mortality surveys for at least months 7-30 of operation in relation to this turbine location. Following which, the results will determine the frequency with which surveys will be ongoing and detailed in the BBAMP.

Additional mitigation measures for moderate risk turbines

1. Increased frequencies of bird and bat monitoring/mortality surveys for at least months 7-18 of operation. Following which the results will determine the frequency with which surveys will be ongoing, and the requirement of any adaptive management strategies.
2. Potential implementation of seasonal low wind speed curtailment strategies dependent on the results of ongoing monitoring.

8.10 Adaptive management strategy

Construction and operational management plans will all contain an adaptive management component. Adaptive management strategies will be receptive to any new and relevant data that may arise through ongoing assessment and monitoring and is key to the successful implementation of crucial objectives yet also allow flexibility to changing dynamics and ongoing feedback and results. This includes measures to monitor predicted and uncertain impacts which will trigger adaptive management actions and allow for effective and quick responses.

An overall Environmental Management Strategy (EMS) would be developed with site specific sub management plans that will entail an adaptive management strategy component. Those sub management plans in relation to biodiversity include but are not limited to a Biodiversity Management Plan (BMP) and a Bird and Bat Adaptive Management Plan (BBAMP)

8.10.1 Biodiversity Management Plan (BMP)

A BMP would be implemented demonstrating adaptive management strategies to ensure key milestones are achieved including project commitments:

- Protecting vegetation and fauna habitat outside the approved disturbance areas and managing the remaining remnant vegetation and fauna habitat within or surrounding the development site toward a benchmark state, minimising indirect impacts, especially to Koala and Spotted-tailed Quoll.

- Fauna monitoring and management protocol including identification and reporting of fauna mortalities to the relevant Biodiversity Conservation Division office.
- Collection of detailed baseline weed data and ensuring no increase of key emerging weeds or invasive pests.
- Mapping and identification of individual tree hollows and termite mounds and measures to minimise impacts to these features.
- Pre-clearing protocols, including pre-clearing inspections, establishment of exclusion zones and on-ground identification of specific habitat features to be retained and/ or relocated.
  - For example, occupation surveys for wombat burrows, application of exclusion measures / deterrents prior to vegetation clearing / earthworks, works undertaken in presence of spotter / catcher.
- Monitoring of soil and water controls to prevent indirect impacts associated with water pollution to all waterways potentially supporting populations of Booroolong Frog.
- Clear performance targets and monitoring criteria.
- Corrective actions.
- Timing and responsibilities.

A recommended outline of the BMP is provided below with further details demonstrated within the mitigation measures listed in Table 74.

- Introduction
  - Background
  - Management scope and objectives
- Planning requirements
- Construction and operational activities
- Habitat management
  - Flora and fauna values
  - Soils
  - Weeds and pests (i.e. key emerging weeds and priority weeds)
  - Baseline data
- Environmental mitigation measure
- Site specifics
  - Inductions
  - Erosion /sediment control
  - Retained vegetation and rehabilitation works
- Adaptive management
  - Performance criteria, triggers, and responses
- Compliance management

- Review and Improvement

8.10.2 Bird and Bat Adaptive Management Plan (BBAMP)

The overall objectives of the BBAMP is to provide an effective monitoring program and strategy to manage and mitigate operational issues relating to bird and bat impacts for the wind farm. Guided by the collision risk assessment and turbine risk assessment, and importantly, additional baseline data, a detailed BBAMP would be developed prior to operation of the wind farm, in conjunction with relevant stakeholders, to inform adaptive management measures around the potential for collision mortality, barrier effects and behavioural displacement of resident, nomadic and migratory bird and bat species.

The BBAMP would include baseline data on threatened bird and bat species as well as those considered at moderate risk surrounding the development that could potentially be affected. One of the key objectives for the collection of detailed baseline data is to gather adequate information that can be replicated on the existing bird and bat species abundance prior to commencement of construction of the wind farm. This would include the setup of impact zones and control zones that would be monitored pre construction and upon operation for an agreed amount of time. The data collected will be utilised to detect changes in the species use (including changes in activity patterns such as avoidance) of the site post-construction and during operation of the wind farm and allow for stringent mitigation measures to be implemented as and when they are required to be.

A recommended outline of the BBAMP is provided below with some known specifics detailed within the mitigation measures listed in Section 8.9.1. All requirements of the BBAMP would be developed in consultation with DPIE and BCS:

- Introduction.
  - Purpose and objectives.
  - Description of the proposal.
- Baseline line information.
  - BACI principle (Before, After, Control, Impact).
  - Impact monitoring points.
  - Control monitoring points.
- Significant impact and trigger impact levels for further investigations.
  - Guiding principles.
    - To operate without any significant impact on the viability of the population of any species of birds or bats.
  - Trigger levels for responses, (for example and subject to change).
    - Triggers for responsive management actions will apply where the number of collisions per annum represents a low, but uncertain potential to result in a negative effect on the local population. This is a precautionary objective, as it will be implemented at levels substantially below numbers of collision mortality events that are considered likely to represent a significant impact on the viability of the overall population of any species.
    - For threatened species, a trigger-level impact will occur where any carcass; feather spot; or injured individual of a single threatened species is found under or close to a wind turbine during any mortality search or incidentally by wind farm personnel.

- Where population numbers are not well understood, an unacceptable impact will be considered to have occurred where more than three carcasses of any one species are detected during formal searches and/or incidentally in the period of any two consecutive months.

- Monitor and report on the effectiveness of impacts and trigger levels.
  - Broad categories of potential causes of heighten collision risk.
  - Carcass search method.
  - Fall zone and estimation for unsearchable zones.
  - Search duration and timing as per turbine risk assessment responses (high, moderate, low).
  - Data collection.
- Mitigation measures.
  - Detailed description of the measures that would be implemented on site for minimising bird and bat strike during the project, including but not limited to;
    - Standard practice for carcass removal.
    - Further assessment and potential for curtailing of specific turbines during seasonal periods, short term curtailing of high and moderate risk turbines pending trigger levels results or reduction in overall cut in speeds of high risk turbines.
    - Responses to low and moderate risk turbines.
    - Deterrence measures such as ultrasonic deterrents on moderate and high risk turbines, lighting options to reduce attracting insects as far as practicable.
  - Pest animal control.
- Compliance management.
  - Responsibilities.
  - Adaptive management - Review and improvement to reduce collisions.
  - Reporting.
    - A report will provide results of all investigations and studies related to effects of the wind farm on bird and bat species of concern within 3 months of completion of all annual activities. Reporting will be annually for the first five years of operation and every two years thereafter for the life of the project.
    - DPIE and EES will be promptly notified following determination by the wind farm operator or the contracted qualified ecologist that a trigger level for any species of concern is detected.

9 Impact summary and biodiversity credit report

For residual impacts that cannot be avoided or fully mitigated, offsets will be required by the BOS to ensure no net loss to biodiversity. In accordance with Section 6.3 of the BC Act, the following values are subject to assessment and offset under the BOS:

- Impacts of the clearing of native vegetation and the loss of habitat.
- Impacts that are prescribed by the regulations.

A summary of relevant impacts associated with the proposal which trigger an offsets requirement is presented in Table 75.

Table 75 Summary of proposal impacts subject to assessment and offset under the BOS

Relevant matter	Details	Direct impacts (area/ count)
Native vegetation communities and ecosystem credit species habitats.	Direct loss of native vegetation communities associated with site clearing	132.43 ha
Threatened ecological communities	Direct loss of Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion	23.36 ha
	Direct loss of White Box Yellow Box Blakely's Red Gum Woodland and derived native grassland	6.07 ha
Habitat for threatened fauna species – species credit species	Large-eared Pied Bat*	19.68 ha foraging habitat
	Eastern Cave Bat*	19.68 ha foraging habitat
	Southern Myotis	3.97 ha
	Eastern Pygmy-possum	18.14 ha
	Koala	36.44 ha
	Squirrel Glider	16.06 ha
	Booroolong Frog	0.64 ha
	Border Thick-tailed Gecko	0.17 ha
	Powerful Owl	1.99 ha
	Sooty Owl	1.99 ha
	Barking Owl	1.99 ha
	Masked Owl	0.99 ha
Habitat for threatened fauna species – ecosystem credit species	State and Commonwealth listed threatened fauna species known or predicted to occur	132.43 ha

* Dual credit species

The BAM Calculator offset credit summary reports are included in Appendix G and summarised below in Table 76.

These offset credits have been calculated using the amended design footprint developed following the original BDAR. The assessment presented in this updated BDAR is appropriately conservative and precautionary and is based on worst-case footprint that will be refined and reduced during future detailed design phases. The calculation of credits has also assumed benchmark vegetation integrity scores when the required number of field-verified BAM plots were not achieved. This method, while being highly conservative, has likely over-estimated several of the credit calculations which are influenced by vegetation integrity score data.

During the detailed design phase of the Project, further refinements to the development footprint will be undertaken that will determine the Project's final impacts. Once the development footprint has been finalised, the BAM-Calculator will be updated at assess this final impact footprint, as well as to include any additional BAM plots collected to more accurately determine the range of vegetation integrity scores within the subject land, and the Project's offset liability will be re-calculated. Undertaking this final update and re-assessing the Project's offset liability will ensure there is a strong incentive for continued impact avoidance and minimisation post project approval.

A Biodiversity Offset Strategy has been prepared and includes commencement of investigations on a number of properties adjacent to the project area where Biodiversity Stewardship Sites can be established. These properties are on similar elevated ridgelines, with similar PCTs and fauna habitats, also being subject to historical impacts associated with farming. More information is provided in Section 9.1 below.

Table 76 Biodiversity offsets required to address residual impacts

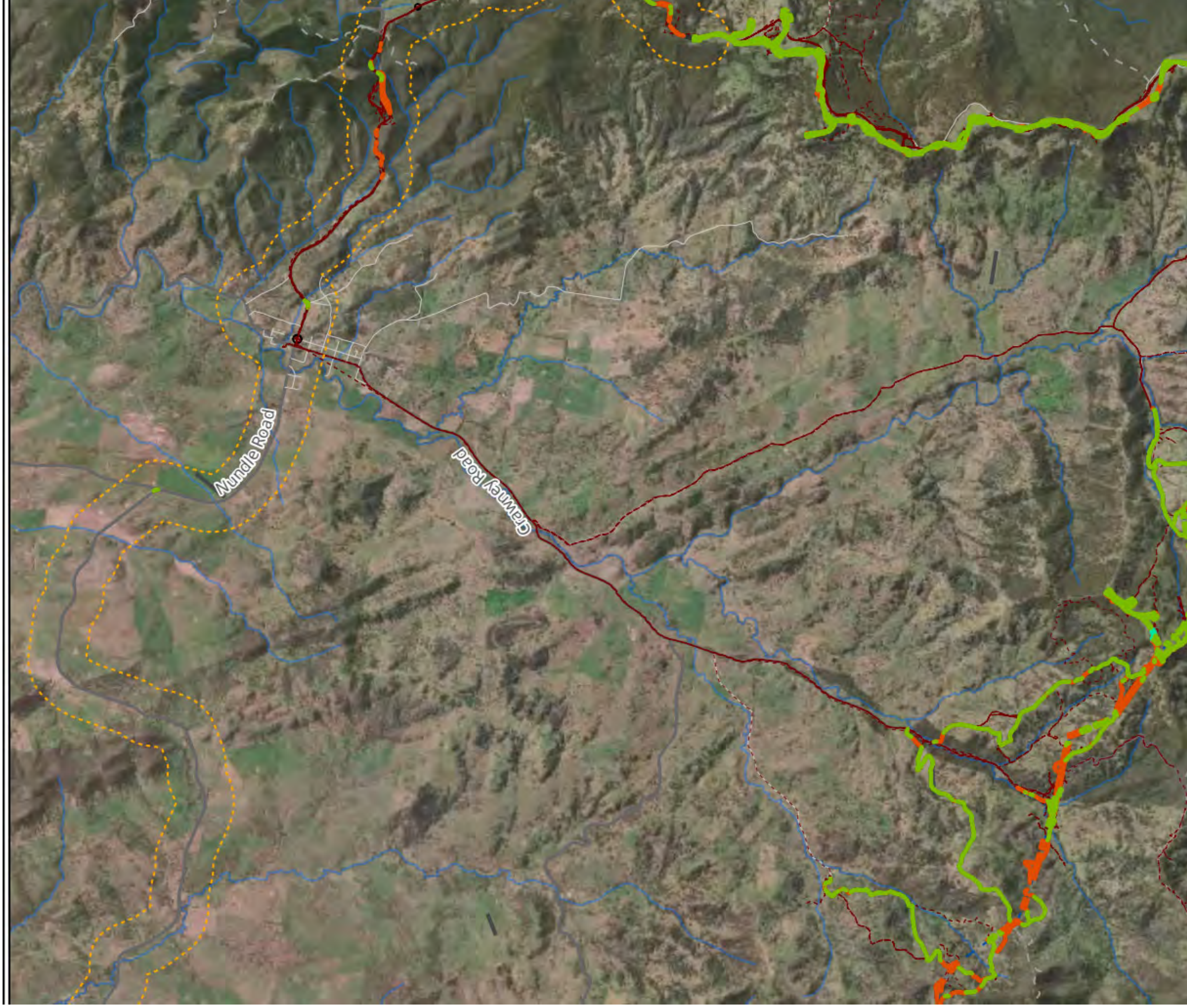
Relevant matter	Associated TEC	Direct impacts (ha)	Credits required
Ecosystem credits			
PCT 433: White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region, BBS Bioregion	White Box Yellow Box Blakely's Red Gum Woodland and derived native grassland	0.01	1
PCT 434: White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion	White Box Yellow Box Blakely's Red Gum Woodland and derived native grassland	0.01	1
PCT 486 - River Oak moist riparian tall open forest of the upper Hunter Valley, including Liverpool Range	-	2.12	78
PCT 490- Silvertop Stringybark - Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range, Brigalow Belt South Bioregion	-	1.84	68
PCT 492: Silvertop Stringybark - Yellow Box - Apple Box - Rough-barked Apple shrub grass open forest mainly on	White Box Yellow Box Blakely's Red Gum Woodland and derived native grassland	4.62	238

Relevant matter	Associated TEC	Direct impacts (ha)	Credits required
southern slopes of the Liverpool Range, Brigalow Belt South Bioregion			
PCT 507: Black Sallee - Snow Gum grassy woodland of the New England Tableland Bioregion	-	0.09	3
PCT 526 - Mountain Ribbon Gum - Messmate - Broad-leaved Stringybark open forest on granitic soils of the New England Tableland Bioregion	-	1.12	49
PCT 540 - Silvertop Stringybark - Ribbon Gum - Rough-barked Apple open forest on basalt hills of southern Nandewar Bioregion, southern New England Tableland Bioregion and NSW North Coast Bioregion	Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion	1.44	53
PCT 540 - Silvertop Stringybark - Ribbon Gum - Rough-barked Apple open forest on basalt hills of southern Nandewar Bioregion, southern New England Tableland Bioregion and NSW North Coast Bioregion	-	39.20	1,402
PCT 541 - Silvertop Stringybark - Rough-barked Apple grassy open forest of southern Nandewar Bioregion, southern New England Tableland Bioregion and NSW North Coast Bioregion	-	11.37	382
PCT 586 - Snow Grass - Swamp Foxtail tussock grassland sedgeland of cold air drainage valleys of the New England Tableland Bioregion	-	2.56	76
PCT 599 - Blakely's Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion	White Box Yellow Box Blakely's Red Gum Woodland and derived native grassland	1.43	89
PCT 931 - Messmate - Mountain Gum tall moist forest of the far southern New England Tableland Bioregion	-	3.21	78
PCT 934 - Messmate open forest of the tableland edge of the NSW North Coast Bioregion and New England Tableland Bioregion	-	22.82	482

Relevant matter	Associated TEC	Direct impacts (ha)	Credits required
PCT 954 - Mountain Ribbon Gum - Messmate open forest of escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion	-	1.23	54
PCT 1194 - Snow Gum - Mountain Gum - Mountain Ribbon Gum open forest on ranges of the NSW North Coast Bioregion and eastern New England Tableland Bioregion	Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion	22.00	700
PCT 1194 - Snow Gum - Mountain Gum - Mountain Ribbon Gum open forest on ranges of the NSW North Coast Bioregion and eastern New England Tableland Bioregion	-	17.29	495
PCT 1604 - Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	-	0.02	1
PCT 1691 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	-	0.04	2
Total			**4,252**
Species credits			
Large-eared Pied Bat	-	19.68	690
Eastern Cave Bat	-	19.68	690
Southern Myotis	-	3.97	101
Koala	-	36.44	1,360
Eastern Pygmy-possum	-	18.14	726
Squirrel Glider	-	16.06	622
Booroolong Frog	-	0.64	33
Border Thick-tailed Gecko	-	0.17	8
Powerful Owl	-	1.99	85
Sooty Owl	-	1.99	127
Barking Owl	-	1.99	85
Masked Owl	-	1.99	43

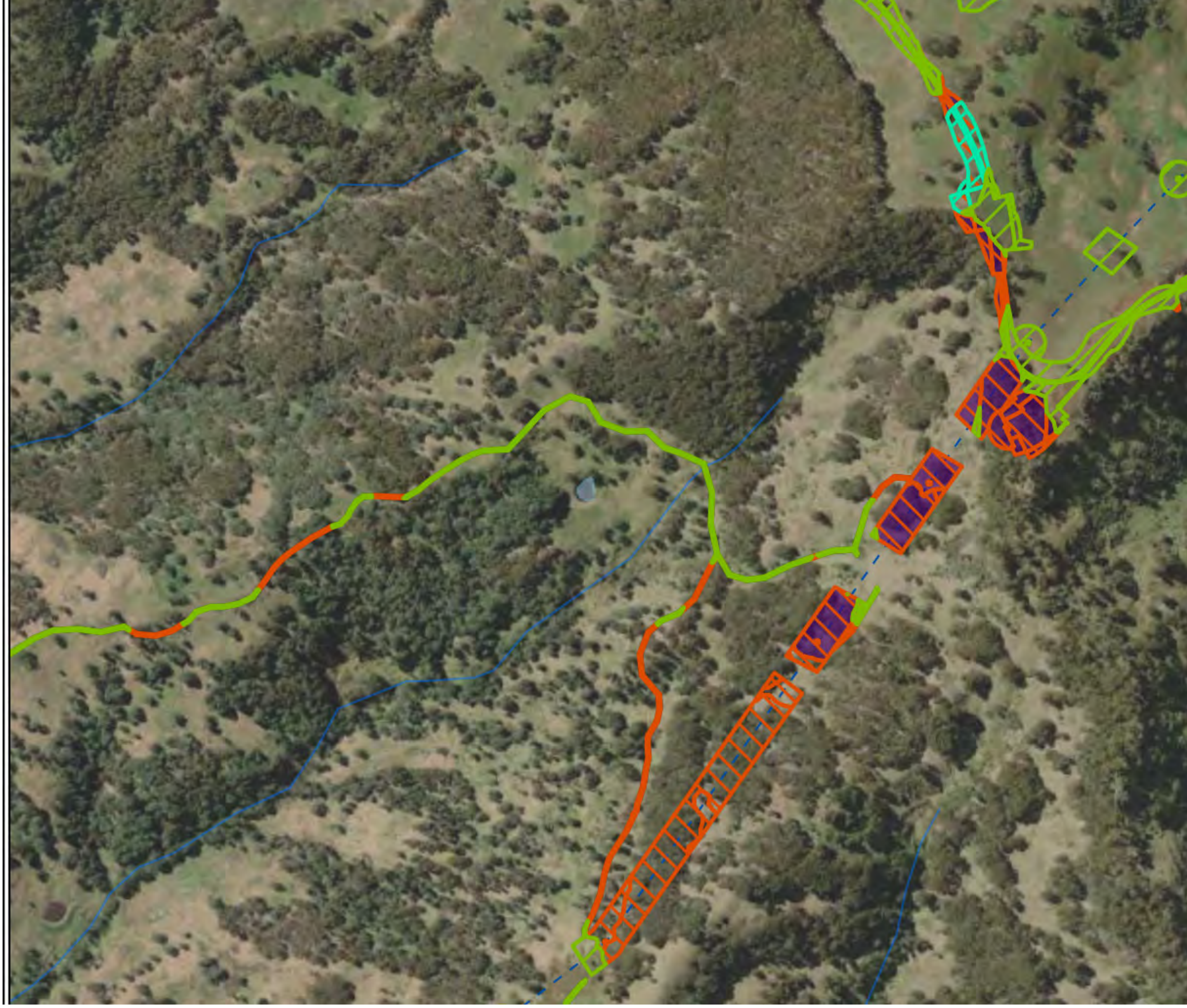
BAM-C notes

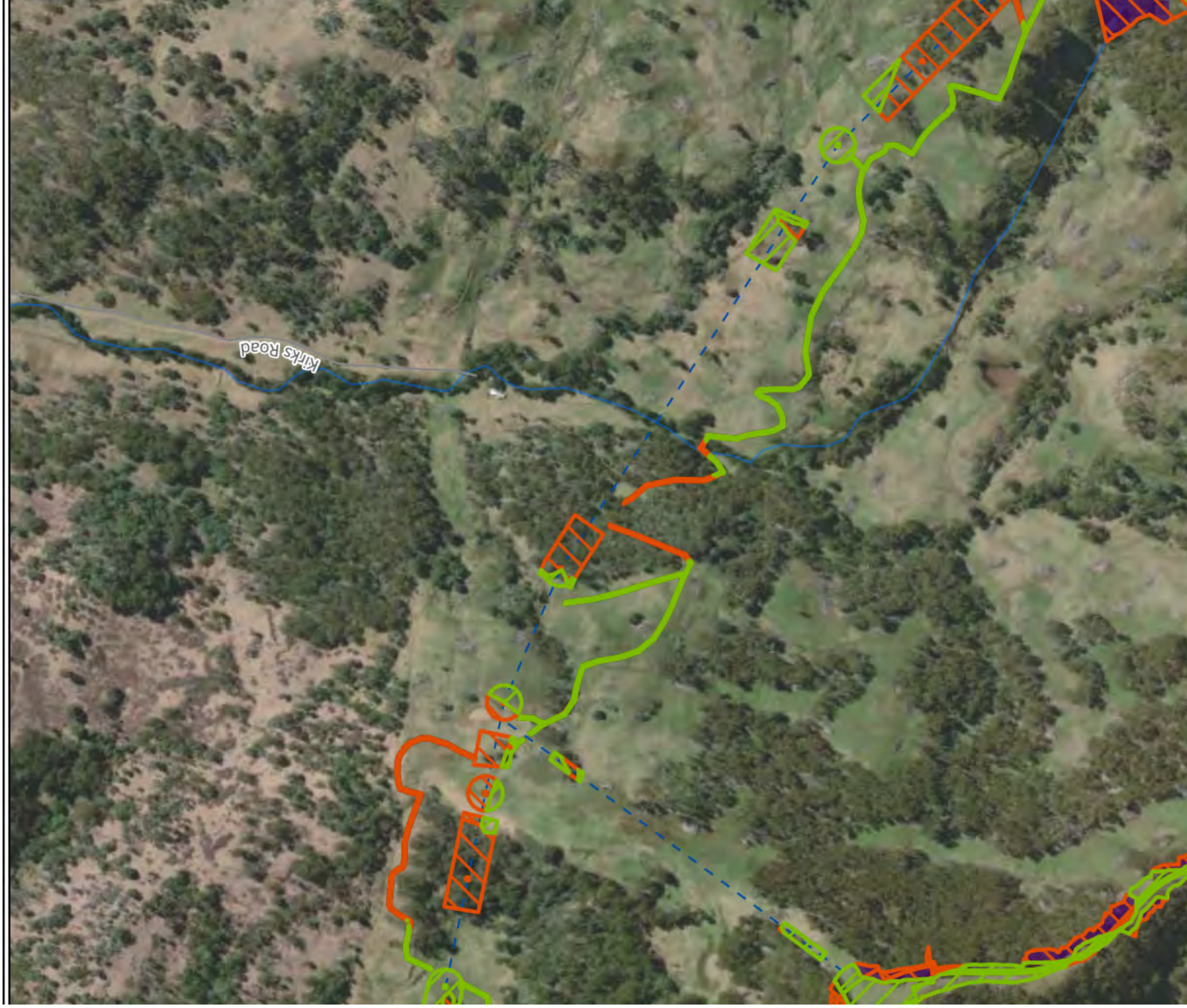
- BAM-C was originally established under the Nandewar IBRA Bioregion and Peel IBRA subregion and as such Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion was not available to be selected.
- To account for some areas of PCT 1194 and PCT 540 not representing the above TEC (based on the occurrence of the vegetation outside the New England Tableland IBRA Bioregion) vegetation zones were split by location and entered into the BAM-C as (for example) 540_High_TEC and 540_High, and 1994_Moderate_TEC and 1194_Moderate. Areas noted as "TEC" in the BAM-C represent those impacted occurrences of PCT 540 and PCT 1194 that represent Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland EEC.
- As areas of TEC and non-TEC PCT 1194 and PCT 540 are not actually considered separate vegetation zones in accordance with the BAM (just entered into the BAM-C as such), the same plot data was entered for all TEC and non-TEC examples of each vegetation zone, to ensure the correct VI scores were carried across all vegetation zones.


Nundle Road
Crawney Road


Basin Creek Road

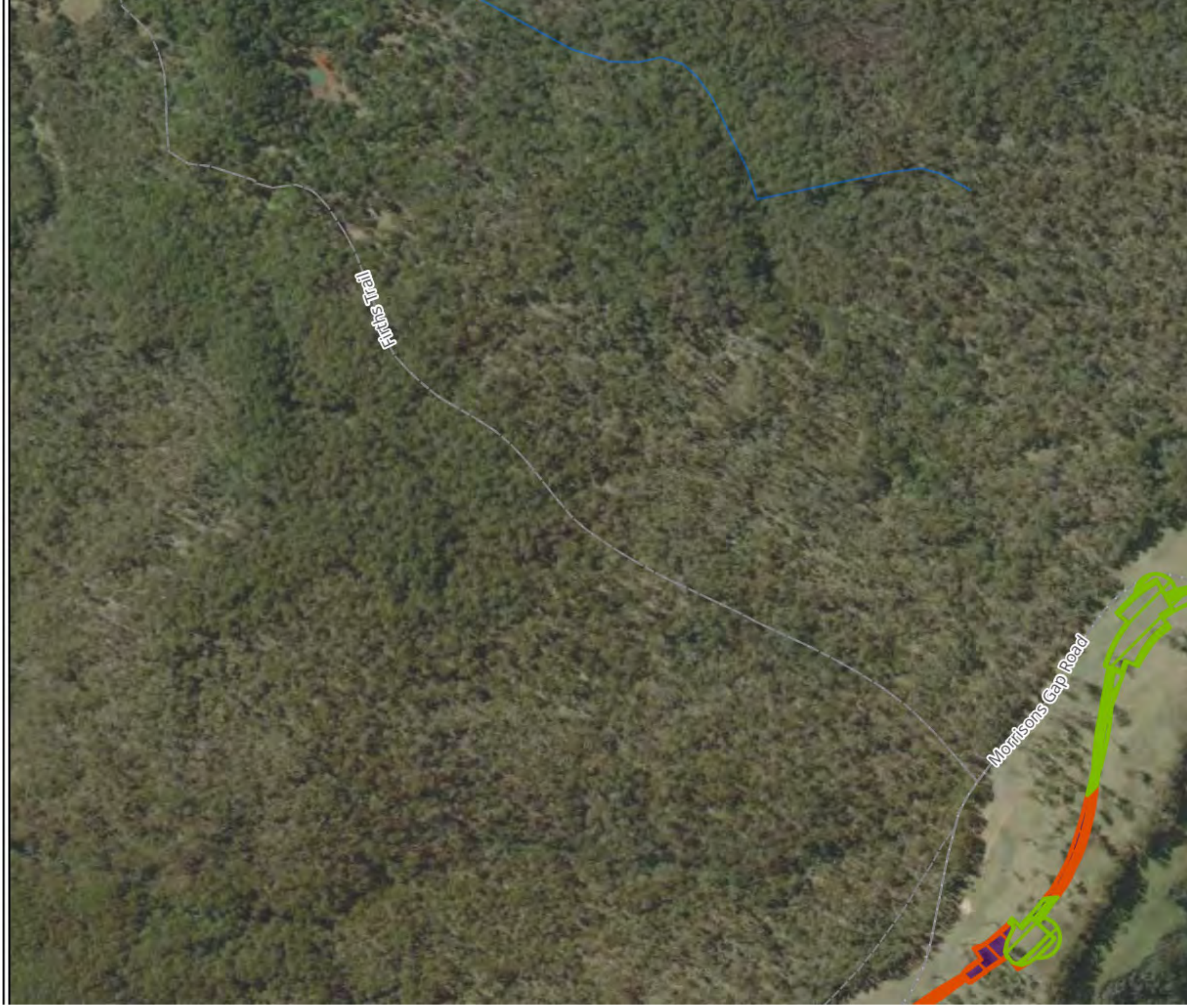

Back Creek Road




Kirks Road

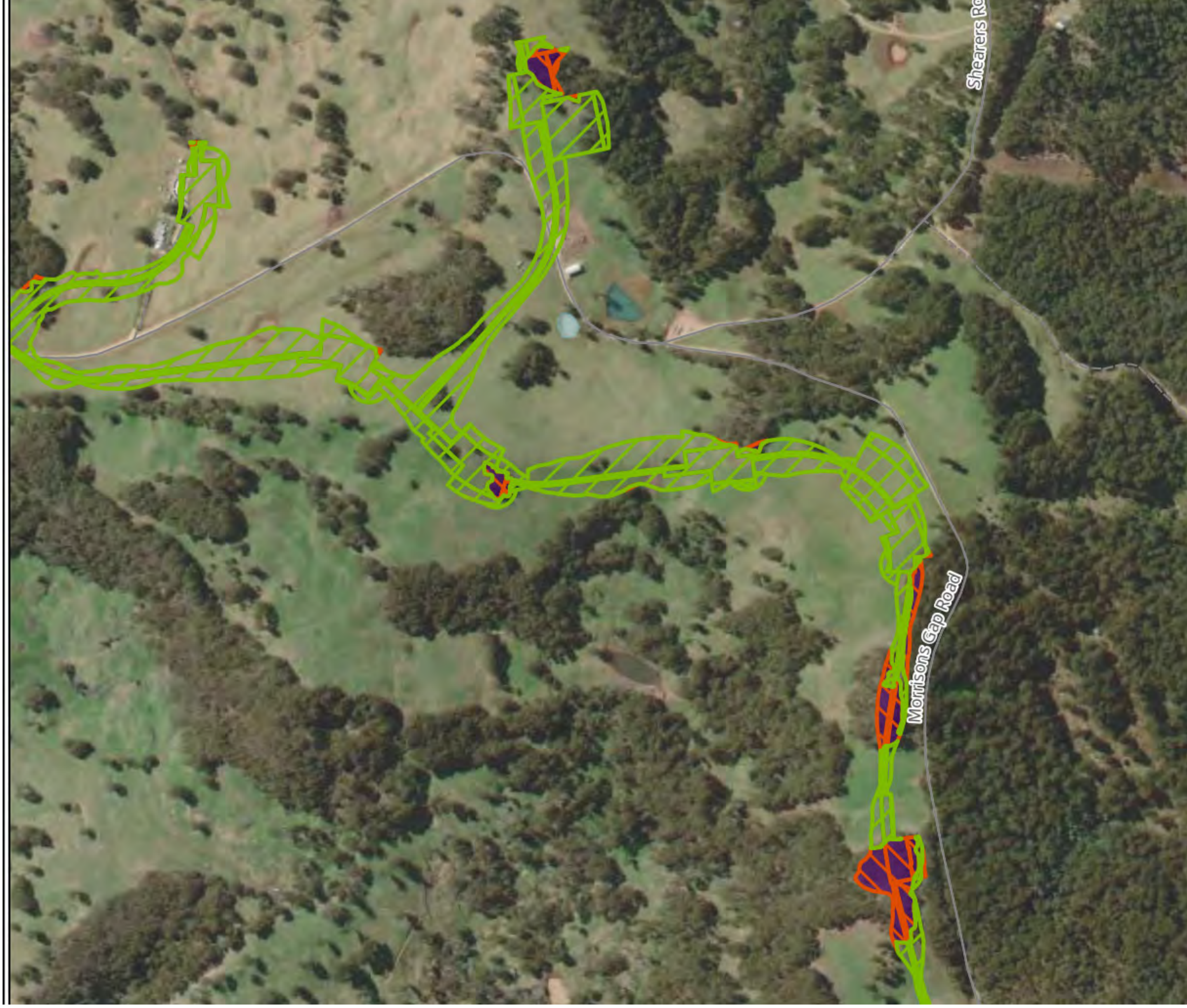
Head Of Peel Road
Morrisons Gap Road
Farrel Trail


Treefern Trail
Paddock Trail



Firths Trail
Morrisons Gap Road


Morrisons Gap Road


Shearers Ro
Morrisons Gap Road

Barry Road


Forest Way
Barry Road
emetery Road


Barry Road


Barry Road


Old Hanging Rock Road


Nundle Road
Lindsays Gap Road


Lindsays Gap Road
New England Highway


Main Northern Railway
New England Highway

Stair Sreet


Kayuga Road


Bengalla Road


Wybong Road


Denman Road
Jerrys

Pringle Street
Lonsdale Street
Jerrys Plains
Pagan Street


Putty Road
Mitchell Line


Hunter Expressway


Industrial Drive
George Street
Selwyn Street
Roll Shop Road
Administration Drive

9.1 Biodiversity Offset Strategy

Biosis completed a Biodiversity Offset Strategy following public exhibition of the BDAR that confirms the potential for biodiversity stewardship sites for identifying, creating and retiring the required biodiversity credits. The project Porponent has commenced investigations on a number of properties adjacent to the project area where Biodiversity Stewardship Sites can be established. These properties are on similar elevated ridgelines, with similar PCTs and fauna habitats, also being subject to historical impacts associated with farming.

Due to the large size of the combined offset investigation area (almost 8500 hectares) opportunities to ground-truth vegetation types, to determine suitability, and assess management requirements to determine potential costs, were somewhat limited. To overcome this, existing vegetation mapping, including that developed this BDAR, was reviewed in combination with high definition aerial imagery, to define high potential areas for ground-truthing surveys, undertaken over four days in January 2021. Broad assumptions have been made when determining the potential suitability of vegetation and associated costs of management for areas both ground-truthed, as well as those not visited on ground. The aim of this work was to determine feasibility of potential Biodiversity Stewardship Sites on identified land in order to progress landowner discussions and preparation of Biodiversity Stewardship Agreements with the NSW Minister for the Environment.

In particular, the potential to create Biodiversity Stewardship Sites on land surrounding the Project to provide a wildlife corridor between Ben Halls Gap Nature Reserve and Crawney Pass / Wallabadah Nature Reserve has been investigated. There have been seven (7) neighbouring landowners identified who could potentially host a biodiversity stewardship site to deliver the wildlife corridor. The Proponent is seeking to enter into agreements with these neighbouring landowners to secure the potential wildlife corridor. Subject to these agreements being successfully concluded and Biodiversity Stewardship Sites established in accordance with legislative requirements, the Proponent commits to delivering a wildlife corridor between Ben Halls Gap Nature Reserve and Crawney Pass / Wallabadah Nature Reserve as part of the biodiversity offsets required for the Project. This wildlife corridor would improve local habitat connectivity between exiting conservation areas that would particularly benefit local Koala and Spotted-tailed Quoll populations impacted by the project.

9.1.1 Offsetting obligations and options

The amended BDAR records 4,252 ecosystem credits related to 17 Plant Community Types (PCT) in 10 Offset Trading Groups (OTG), as being required to compensate for residual impacts of the development. Grouping of the PCTs by OTG provides insight into the volume of credits needed for each type in relation to the price of individual credits.

It should be noted that the level of impact calculated and assessed in the BDAR is considered to be a conservative overestimate of impacts, with future avoidance and minimisation opportunities available through project staging and design optimisations.

There are three broad options available for securing the offsets required for the project, each with their own benefits and drawbacks, these options are:

- Payment to the Biodiversity Conservation Fund (the Fund) managed by the BCT.
- Purchase of credits from the open market, with consideration of applying the 'Like for Like' Variation Rules.
- Establish a Biodiversity Stewardship Site(s) to generate credits to use for offsetting.

Option 1: Payment to the Fund managed by the BCT

Satisfying an offset obligation by paying to the Fund has the major benefit of being an expedited and transparent way for proponents to meet their offset obligations. However, it does include increased costs associated with the 'Risk premium' included by the BCT, and an administrative cost per credit type required.

Meeting an offset obligation by paying to the Fund can therefore be completed within 2-3 weeks of receiving project approval, and the price provided by the BOP-C (honoured by the BCT as of the day of receipt of a completed application) includes all administrative costs associated with the process.

This process avoids delays to future project stages as a result of outstanding biodiversity offset requirements.

It should be noted that following the Commonwealth's formal endorsement of the BOS in March 2020, payment to the Fund to satisfy an offset obligation for EPBC Act listed species resulting from a significant impact due to a Controlled Action is now allowable.

Option 2: Purchase credits from the open market

Potential benefits from procuring credits from the open market include a potential increase in offsetting options when applying the like-for-like rules included in the BAM, and then further again when applying the 'Like for Like Variation Rules'. There is also the ability to negotiate with sellers on price, potentially with multiple credit holders. Drawbacks include a potential paucity of credits on the market, sellers setting a high price and not being willing to negotiate, timeframes associated with negotiations, timeframes associated with procurement of a range of credit types (if required), timeframes to process sales, and additional credit 'transfer' and 'retirement' fees.

It is difficult to accurately estimate potential costs of credits on the open market as the price is wholly determined by the credit holder (sellers) and is based on their requirements for funding the required management actions at their BioBank or Stewardship Site. However, recent investigations into the current credit market undertaken for other State Significant Development projects have shown that market prices are selling below that determined by the BOP-C in order for individual credit owners to secure credit sales over the BCT.

Initial analysis into the current market availability of the credits required for the project has been undertaken, the results of which are provided in Table 77 below. It should be noted that the credits presented below were available as of February 2021, however due to the nature of the open market their future availability cannot be guaranteed.

Table 77 Credit register searches for like-for-like credits

Credit type	Number required	Number available (BAM) Feb 2021
Northern Tableland Wet Sclerophyll Forests >=70% and <90%	495	-
Northern Escarpment Wet Sclerophyll Forests >=70% and <90%	560	-
White Box Yellow Box Blakely's Red Gum Woodland	329	1941
Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland	753	
New England Dry Sclerophyll Forests >=50% and <70%	1833	1395 (pending review)
Eastern Riverine Forests <50%	78	3 (pending review)

Credit type	Number required	Number available (BAM) Feb 2021
Tableland Clay Grassy Woodlands >=70% and <90%	3	-
New England Grassy Woodlands <50%	68	-
Temperate Montane Grasslands >=70% and <90%	76	-
Northern Tableland Wet Sclerophyll Forests >=50% and <70%	54	-

Biodiversity credits may be available for purchase, but not listed on public registers for a number of reasons. Additionally, credits created under the previous BioBanking scheme (BBAM) are not easily cross-referenced related to changes in PCT naming conventions. An alternative market engagement tool is to lodge a Credits Wanted request via the online BAM Calculator tool (BAM-C), which lists the PCT and number of credits sought on the Credit Demand Register. Interested parties may then come forward with credits for sale and/or Biodiversity Stewardship Site opportunities.

Option 3: Establish a Biodiversity Stewardship Site

Establishment of a Biodiversity Stewardship Site (or multiple sites) with the intention of generating credits to satisfy the project's offset obligation appears to be a feasible option for the current BOS. This is due to the presence of land adjacent to the development site that supports similar biodiversity values.

The major benefit of establishing a Biodiversity Stewardship Site to offset the project's impacts is the reduction in the cost of the offset credits.

9.1.2 Local offset feasibility

Desktop review

Prior to commencing the field investigation, information including the BDAR's vegetation assessment, and aerial vegetation mapping projects were reviewed to identify which of the proposed properties were worth targeting for field investigations.

Of the initial 12 suggested offset investigation properties, seven were assessed as highest priority for field investigation based on the results of the desktop assessment suggesting a higher likelihood of the presence of like-for-like PCTs and offsetting options. Details of the prioritised properties are provided in Table 78 below.

Table 78 Highest priority offset investigation properties

Property	Approx. area (ha)	Comments
Property 01	1090 ha – mixed areas of vegetation and grazed land	Large property to the west of the wind farm assessment area with high ridgelines likely to support target PCTs / OTGs. Provides landscape connectivity over Crawney Mountain to Wallabadah Nature Reserve.
Property 02	830 ha – intact vegetation present of the slopes and gullies away from the norther edge of the property	Potential offset areas are immediately adjacent to the wind farm assessment area and already known to support areas of the target PCTs / OTGs. Provides a portion of the landscape connectivity to the south of the development footprint from Ben Halls Gap Nature Reserve to Crawney Pass National Park.
Property 03	780 ha – mixed areas of intact vegetation, razed and pasture	Potential offset areas are immediately adjacent to the wind farm and transmission line assessment areas and considered

Property	Approx. area (ha)	Comments
	improved land	likely to support areas of the target PCTs / OTGs.
Property 04	1400 ha – areas on intact vegetation in the south and west, more cleared and grazed land to the north and east	Large property to the west of the wind farm assessment area with high ridgelines likely to support target PCTs / OTGs. Provides landscape connectivity over Crawney Mountain to Wallabadah Nature Reserve.
Property 05	830 ha – largely intact / patchy vegetation immediately below the ridgeline. South-eastern corner large ae of intact vegetation	Desktop assessment of offset potential partly combined with BDAR mapping. Ridgeline forming the northern boundary of the property targeted for rehabilitation and enhancement of local habitat connectivity.
Property 06	104 ha – largely intact vegetation	Potential offset areas are immediately adjacent to the wind farm assessment area and already known to support areas of the target PCTs / OTGs.
Property 07	1735 ha – large areas of intact vegetation in the south, remainder of the property is patchy with well vegetated and cleared areas	Desktop assessment only. Large property to the south-west of the wind farm assessment area with high ridgelines likely to support target PCTs / OTGs.
Property 08	207 ha – largely intact vegetation	Potential offset areas are immediately adjacent to the wind farm assessment area and already known to support areas of the target PCTs / OTGs.
Property 09	990 ha – intact to patchy vegetation on middle to upper slopes	Desktop assessment only. Potential offset areas to the north of the wind farm on middle and upper slopes. Large areas of intact to patchy vegetation, drainage lines expected to be weedy.

Due to the large size of a number of the above properties not all areas within each property were able to be assessed, and furthermore not all areas assessed were considered suitable for potential offsets. Access to the Property 07, Property 09 and Property 05 properties were not possible during the field investigation, however they remain important opportunities to establish a potential Biodiversity Stewardship Sites. The Property 06 property was excluded following completion of the field investigation and neither are discussed further.

Field investigation

A field investigation of the assessment area was undertaken on 19 to 22 February 2020 by Callan Wharfe (Senior Ecologist and Offset Lead) and Brooke Corrigan (Consulting Restoration Ecologist) of Biosis, prior to the updates to the BDAR. Vegetation within the assessment area was surveyed using the random meander technique (Cropper 1993) over 80 person hours.

General classification of native vegetation in NSW used in this BOS is based on the classification system in Keith (2004) which uses three groupings of vegetation: vegetation formation, vegetation class and vegetation type, with vegetation type the finest grouping. The target grouping referred to in this report is PCT as defined by the BAM (DPIE 2020)), and has been the standard used across NSW since 2016. However due to the rapid nature of the field investigations PCTs were not always able to be determined. Where PCTs could not be determine this was due to either the complex nature of PCTs present the assessment area, the disturbed nature of the vegetation in some areas due to bushfire and/or other disturbance factors, and the lack of floristic data due to the collection of floristic (BAM) plots being outside the scope of this assessment.

Where PCT could not be determined the vegetation class (Keith 2006) was able to be established, which forms the basis of the OTG for biodiversity credits, and as such is still a useable and useful guide to the suitability of proposed offset sites for matching the credit requirement at the wind farm.

Vegetation condition was assessed across all areas investigated to determine the required management actions and to facilitate the development of the TFDs. This data was again collected via rapid assessment and as such broad assumptions were made around required management actions based on the ecologists' knowledge and experience and assessment of the on-ground condition of the vegetation.

A habitat-based assessment was completed to determine the presence of suitable habitat for species credit species habitat species requiring offset (Arup 2020). This list was filtered according to species descriptions, life history, habitat preference and soil preference to determine those species most likely to be present within the assessment area.

Desktop assessment of credit yield (Part A)

Following completion of the field investigation, data analysis was undertaken to determine the expected credit yield for each of the potential offset properties. PCT benchmark data was assessed and appropriate vegetation integrity scores were determined for each condition class mapped for each PCT, and these values were input into the BAM Calculator.

TFDs were calculated based on data gathered during the field investigation and extrapolated across the areas considered as highest potential for inclusion in a Biodiversity Stewardship Site to calculate an estimated TFD for each property, and thus the minimum credit price.

Table 79 below provides a guide to the areas assessed for inclusion with potential Biodiversity Stewardship Sites across each of the five ground-truthed and three desktop properties, the potential credit yield, and provides an estimate of the potential surplus vs deficit in biodiversity credits based on total areas assessed across all offset investigation properties and the credits required at the development site as provided in this BDAR.

Table 79 Estimate of credit generation potential of potential offset lands

Offset Trading Group	Total estimated area (ha)	Total credits generated	Credits required	Surplus / deficit
Northern Tableland Wet Sclerophyll Forests / Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland	827	4689	1302	3387
Northern Escarpment Wet Sclerophyll Forests	353	1940	560	1380
New England Dry Sclerophyll Forests	847	4884	1833	3051
New England Grassy Woodlands	91	466	68	398
Totals	2117	11,979	3763	8216

It can be seen from the above table that there are opportunities for generation of the majority of the required offsets, based on OTGs, if Biodiversity Stewardship Sites can be established and matching like-for-like offsets can be confirmed.

An assessment of the potential for each of the of the offset investigation properties to generate species credit was also undertaken, and advice is provided in Table 80 below.

Table 80 Assessment of habitat for threatened fauna species credit species

Species credit species	Credits required	Potential habitat present	Likelihood of credit generation	Expected cost to generate credits	Notes
Eastern Cave Bat	690	Property 01 Property 02 Property 03 Property 04 Property 05 Property 07 Property 09	High	Low	Costs associated with deployment and collection of bat detection units, and associated data analysis. Surveys required to be undertaken in warmer months when bats are more active.
Large-eared Pied Bat	690				
Koala	1360	Property 01 Property 02 Property 03 Property 04 Property 05 Property 07 Property 08 Property 09	Moderate – High	Low – Moderate	Costs are associated with deployment and collection of remote cameras and analysis of data. However, remote cameras have a lower likelihood of capture of the species, when compared to active searched for signs of activity (scats, scratches), or nocturnal searches for individuals. These survey types have a higher associated cost.
Eastern Pygmy-possum	726	Property 02 Property 05 Property 04 Property 08	Low – Moderate	Moderate	Costs are associated with deployment and collection of remote cameras and analysis of data. However, camera trapping of Eastern Pygmy Possum requires a high level of habitat assessment to find the highest quality habitats due to the species' small home ranges.
Squirrel Glider	622	Property 01 Property 02 Property 03 Property 04 Property 05 Property 07 Property 08 Property 09	Moderate	Low - Moderate	Costs are associated with deployment and collection of remote cameras and analysis of data. However, camera trapping of Squirrel Gliders is less intensive than Eastern Pygmy Possum as the species is known to move over large distance. Spot-lighting and call-playback options are, also available to confirm presence, however these survey methods are more intensive and thus more expensive.

Species credit species	Credits required	Potential habitat present	Likelihood of credit generation	Expected cost to generate credits	Notes
Southern Myotis	101	Property 02 Property 03 Property 08 Property 09	High	Low	Costs are associated with deployment and collection of bat detection units, and associated data analysis. Surveys required to be undertaken in warmer months when bats are more active
Booroolong Frog	33	Property 04 (possible) Property 08 (possible)	Low	Moderate	Cost are associated with nocturnal searches for the species within high quality habitat. However habitat for the species was not found to be present in any of the properties assessed on-ground as potential Biodiversity Stewardship Sites.
Border Thick-tailed Gecko	8	Property 01 Property 02 Property 03 Property 04 Property 05 Property 07 Property 08 Property 09	Low	High	Costs are associated with nocturnal searches for the species within high quality habitat. It is expected that a high level of repeat surveys would be required to confirm species presence.
Barking Owl **Powerful Owl** **Masked Owl** **Sooty Owl**	• 85 • 85 • 43 • 127	Property 02 Property 03 Property 04 Property 06 Property 07	Moderate	Moderate	Costs are associated with the requirement to locate the breeding tree for any of the target owl species. It is likely that these owls may be breeding on one or more of these properties, but locating the nest may become resource heavy.

9.1.3 Enhancement of local habitat connectivity

The project's proposed offset strategy of targeting local properties for the establishment of Biodiversity Stewardship Sites provides potential opportunities for strategic enhancement of local habitat connectivity. Such enhancements could occur along the southern side of the ridgeline between Ben Halls Gap Nature Reserve and Crawney Pass National Park, and over Crawney Mountain to Wallabadah Nature Reserve, linking the three conservation areas. This enhancement of local connectivity can be achieved through the in-perpetuity conservation agreements being pursued over the Property 02, Property 05, Property 04 and Property 01 properties, which will improve the biodiversity values on the land and increase habitat connectivity. Connectivity enhancements realised in this strategic location will not only offset direct impacts resulting from the project, but also allow for potential indirect impacts associated with disruption of habitat connectivity to be mitigated against and offset through the establishment of a managed corridor linking local conservation reserves and high-quality habitats.

9.1.4 Conclusion and recommendations

The analysis of potential offsets options set out above is preliminary in nature and would be subject to further assessment to confirm the appropriateness of individual properties to be used as Biodiversity Stewardship Sites as well as agreements being reached with each landholder. The estimated number of credits potentially generated from individual properties may change when field data is captured and utilised in the future.

To be considered a matching offset credit the vegetation at the development site and the proposed offset site need to be a match for OTG (commensurate with 'vegetation class (Keith 2004) and the estimate of percentage cleared for the PCT. PCT 1194 has a high percentage cleared value (>=70% and <90%), compared to the other PCT options in the same OTG (those being PCT 1551, 1555 and 1559). Alternative PCTs have been assessed as lower having percentage cleared (<50%), and thus would not be a suitable offset for impacts to PCT 1194. Due to this disparity, additional floristic data collection is required to determine the presence of PCTs at the potential offset sites that would be considered matching for PCT 1194.

The remaining PCTs and OTGs have a substantially higher level of confidence than the Wet Sclerophyll Forests / PCT 1194 complex.

It is recommended further work be undertaken to determine the presence of PCT 1194 matching vegetation at the offset properties due to the significant opportunity for cost saving that could be realised if matching credits can be generated at a Biodiversity Stewardship Site.

As outlined in this BDAR, the project has been assessed as having the potential to result in significant impacts to one ecological community and two fauna species listed under the Commonwealth, namely White Box-Yellow Box-Blakely's Red Gum Grassy Woodland, Koala and Spotted-tailed Quoll. Locally established Biodiversity Stewardship Sites are not expected to result in offset opportunities for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland, due to the landscape positions of the proposed sites. Opportunities for offsetting impacts to Koala and Spotted-tailed Quoll are expected to be available within the proposed sites, and these would be expected to meet the requirements for offsetting under the EPBC Act.

Timeframes to complete the on-ground assessments and prepare the reports and BSA application are likely to be 2 to 3 months, and review by the BCT is likely to take a further 6 months. It can be expected that the whole process may take up to 12 months to reach a signed BSA and have the credits available for offsetting purposes. There are also specific survey timeframes that may need to be adhered to for threatened species credits looking to be generated. These are not entirely relevant for the project's impacts, however surveys over the warmer months would be much more likely to detect the targeted microbat species at any proposed offset site.

Commencing of the detailed investigations required to establish the Biodiversity Stewardship Sites should also occur as soon as possible to reduce any lead time referred to above. The generation of species credit should be pursued for those species noted as having a high likelihood of generation and a low to moderate associated cost.

9.1.5 Offset staging plan

As outlined in Section 1.6, the project proposes to stage the construction to ensure ongoing avoidance and minimisation of impact can be achieved as the detailed design of the project progresses, as well as staged retirement of biodiversity credit liabilities. A detailed staging plan will be based on final turbine and balance of plant contractor selected and associated construction plan preferences.

Prior to works commencing for each of the construction stages listed below, the biodiversity offset required associated with each stage will be secured and retired.

The following set of example construction stages (or components) provided in Table 81 has been considered possible to be discrete packages of work for which staging of offset obligations is feasible. The resultant offset credit liabilities for each of these stages is provided in Table 82 below.

Table 81 Construction Staging Concept Scope of Works

Scope of Work	Description
Haulage and External Route Upgrades	Required public road upgrades associated with bringing in materials and commencing construction on site.
Construction Compound and Internal Roads, Turbine Hardstands and Foundations	Establishment of construction facility and temporary laydown areas and commencement of internal road upgrades. This may be further broken up in stages by area of the project.
Ancillary Infrastructure	Substation, batching plant, O&M Facility and temporary laydown areas.
Transmission Line	External Transmission line construction.
Switching Station	This is located 20km from the wind farm Project Site and may be staged separately.

The Proponent will provide a final project staging plan to DPIE with final detailed layout plan, updated surveys (if required and outside of the current subject land) and BAM calculations during detailed design and prior to the commencement of construction.

Table 82 Potential staged credit requirement

Project total impacts and credits				Stage impacts (Ha)					Stage credits				
Relevant matter	**TEC**	**Direct impacts (ha)**	**Credits req.**	**Ancillary Infra.**	**Cmpnds, Intr. Rds, Trbne Hs & Fndtns**	**Haulage Route Upgrades**	**Switching Station**	**TxL**	**Ancillary Infra.**	**Cmpnds, Intr. Rds, Trbne Hs & Fndtns**	**Haulage Route Upgrades**	**Switching Station**	**TxL**
Ecosystem credits													
PCT 433	Box Gum Woodland TEC	0.01	1			0.01			0	0	1	0	0
PCT 434	Box Gum Woodland TEC	0.01	1					0.01	0	0	0	0	1
PCT 486	-	2.12	78		0.11			2.01	0	4	0	0	74
PCT 490	-	1.84	68					1.84	0	0	0	0	68
PCT 492	Box Gum Woodland TEC	4.62	238			2.68		1.94	0	0	138	0	100
PCT 507	-	0.09	3		0.09				0	3	0	0	0
PCT 526	-	1.12	49		0.01	1.11			0	1	48	0	0
PCT 540	Ribbon Gum - Mountain Gum - Snow Gum TEC	1.44	53		1.44				0	53	0	0	0
PCT 540	-	39.2	1402		9.83			29.37	0	352	0	0	1050
PCT 541	-	11.37	382		0.44	0.10	0.69	10.14	0	15	3	23	341
PCT 586		2.56	76		2.56				0	76	0	0	0
PCT 599	Box Gum Woodland TEC	1.43	89			0.33		1.10	0	0	20	0	69
PCT 931	-	3.21	78	0.03	2.74	0.42		0.01	1	66	10	0	1
PCT 934	-	22.82	482	7.18	13.68			1.96	152	289	0	0	41
PCT 954	-	1.23	54		1.23				0	54	0	0	0
PCT 1194	Ribbon Gum - Mountain Gum - Snow Gum TEC	22	700	0.72	18.73	0.86		1.61	23	596	29	0	52
PCT 1194	-	17.37	495		13.92			3.45	0	397	0	0	98
PCT 1604	-	0.02	1			0.02			0	0	1	0	0

Project total impacts and credits				Stage impacts (Ha)					Stage credits				
Relevant matter	**TEC**	**Direct impacts (ha)**	**Credits req.**	**Ancillary Infra.**	**Cmpnds, Intr. Rds, Trbne Hs & Fndtns**	**Haulage Route Upgrades**	**Switching Station**	**TxL**	**Ancillary Infra.**	**Cmpnds, Intr. Rds, Trbne Hs & Fndtns**	**Haulage Route Upgrades**	**Switching Station**	**TxL**
PCT 1691	-	0.04	2			0.04			0	0	2	0	0
Total ECS		**132.5**	**4252**	**7.94**	**64.77**	**5.57**	**0.69**	**53.44**	**176**	**1906**	**252**	**23**	**1895**
Species credits													
Large-eared Pied Bat	-	19.68	690	1.21	18.14			0.33	42	636	0	0	12
Eastern Cave Bat	-	19.68	690	1.21	18.14			0.33	42	636	0	0	12
Southern Myotis	-	3.97	101		3.93	0.04			0	100	1	0	0
Koala	-	36.44	1,360	0.76	26.40	2.26		7.02	28	985	84	0	263
Eastern Pygmy-possum	-	18.14	726	0.01	13.28	1.22		3.63	1	531	49	0	145
Squirrel Glider	-	16.06	622	0.72	11.20	1.76		2.38	28	434	68	0	92
Booroolong Frog	-	0.64	33					0.64	0	0	0	0	33
Border Thick-tailed Gecko	-	0.17	8			0.07		0.11	0	0	3	0	5
Powerful Owl	-	1.99	85		1.99				0	85	0	0	0
Sooty Owl	-	1.99	127		1.99				0	127	0	0	0
Barking Owl	-	1.99	85		1.99				0	85	0	0	0
Masked Owl	-	0.99	43		0.99				0	43	0	0	0
Total SCS		**121.74**	**4570**	**3.90**	**98.06**	**5.34**	**0.00**	**14.43**	**141**	**3662**	**205**	**0**	**562**
Grand totals		**254.24**	**8822**	**11.84**	**162.83**	**10.92**	**0.69**	**67.87**	**317**	**5568**	**457**	**23**	**2457**

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