4 Ecological Impacts of the Proposal

The known and potential impacts of the proposal were determined by both site-specific surveys (eg. areas of potential vegetation removal from project infrastructure were surveyed by GPS if necessary to quantify impacts) and by a review / interpretation of the existing scientific literature and data collated from the study area.

Given the size and scale of the proposal, the ecological impacts of the proposal are expected to be comparatively minimal. This is due to the following factors:

- Wind turbines are a non-polluting renewable energy source and prevent greenhouse gas emissions from being emitted by other sources of power generation by displacing high cost fossil fuels which have been identified as the major source of greenhouse gases responsible for human induced global warming.
- Most proposed turbine locations are predominantly cleared of native vegetation with the majority of properties used for cattle, sheep and horse grazing.
- Design phase ensured turbines and associated infrastructure were sited outside vegetated areas wherever possible.
- The area contains the EEC Ribbon Gum - Mountain Gum - Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion, however, impacts on this community will be minimal in comparison to the distribution of this community in the immediate surrounds and within the site perimeter.
- Implementation of a number of recommendations, as specified in this document.

Figure 4-1 shows the location of the important ecological characteristics within the study area. The important ecological characteristics shown on the map include potentially affected vegetation and threatened species.

Figures 4-2, 4-3 and 4-4 provide sectional zoom-ins of **Figure 4-1** to provide a higher level of detail in relation to impact analysis.

Impact has been assessed in relation to the following impact summary:

Impact buffers of 25 x 60m have been assessed around turbine locations and a 10m width has been assessed for access tracks. The easement for the 132 kV power line connecting the wind farm to the TransGrid line will be 40m wide and for the 33 kV overhead lines on the wind farm between the ridges will be up to 25m wide. Vegetation clearance is not required for the full easement width and will depend on the final line design. Vegetation clearance required from the conductors will vary from 2m at the poles to between 4m and 6m at mid-span. The design of the power lines can also be varied to reduce the impact on any specific areas of vegetation; for example by using taller poles or converting a section of the line to aerial bundled cable (ABC) which can be installed through trees with a minimum conductor clearance of 0.5m. The poles for the 33kV line are typically 15 to 25m high with spacing of 150 to 250m. Clearing estimates are based on the above as a worst case scenario; actual clearing may be substantially less than the estimate.

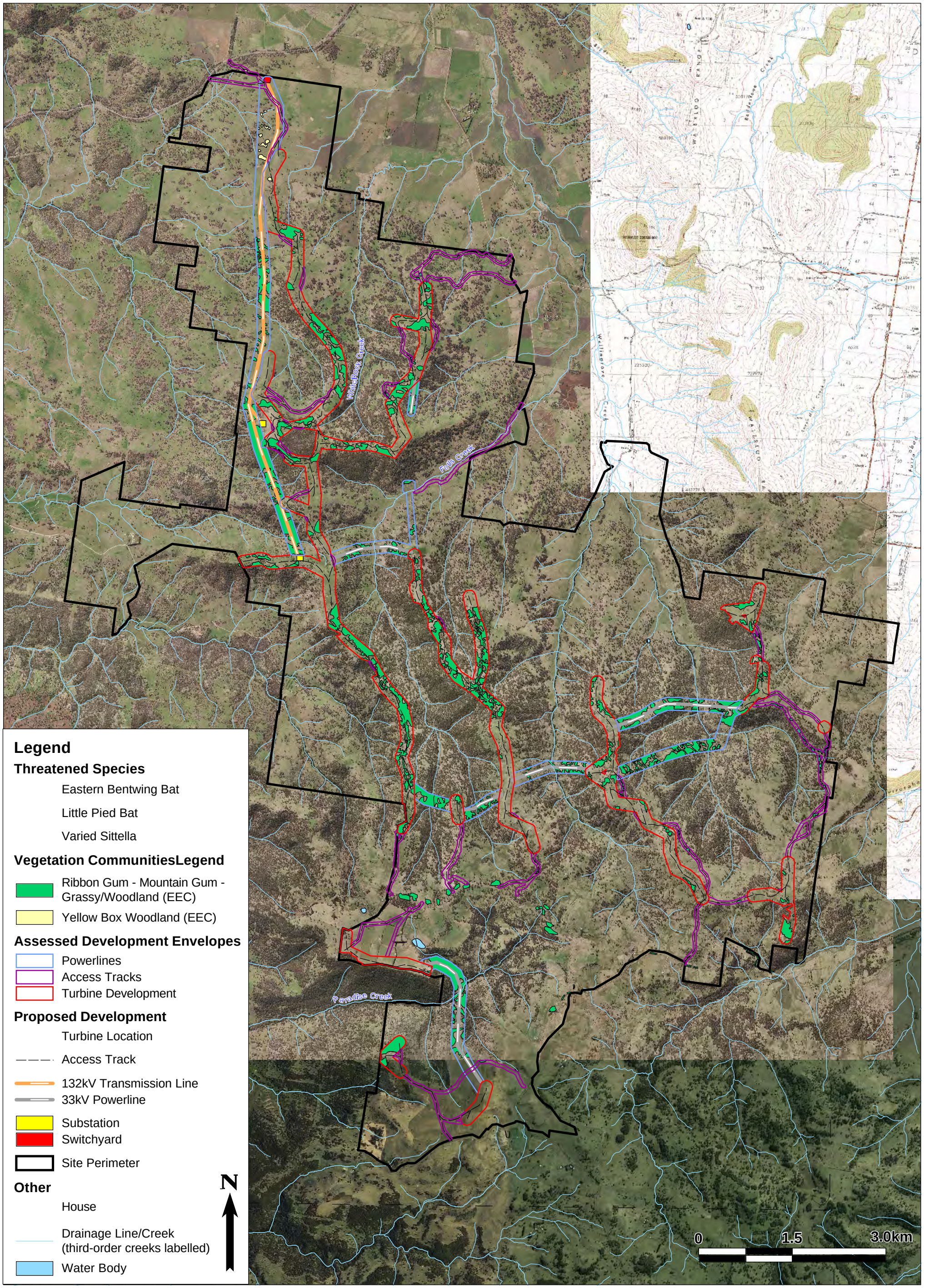


FIGURE 4-1 ECOLOGICAL CONSTRAINTS MAP

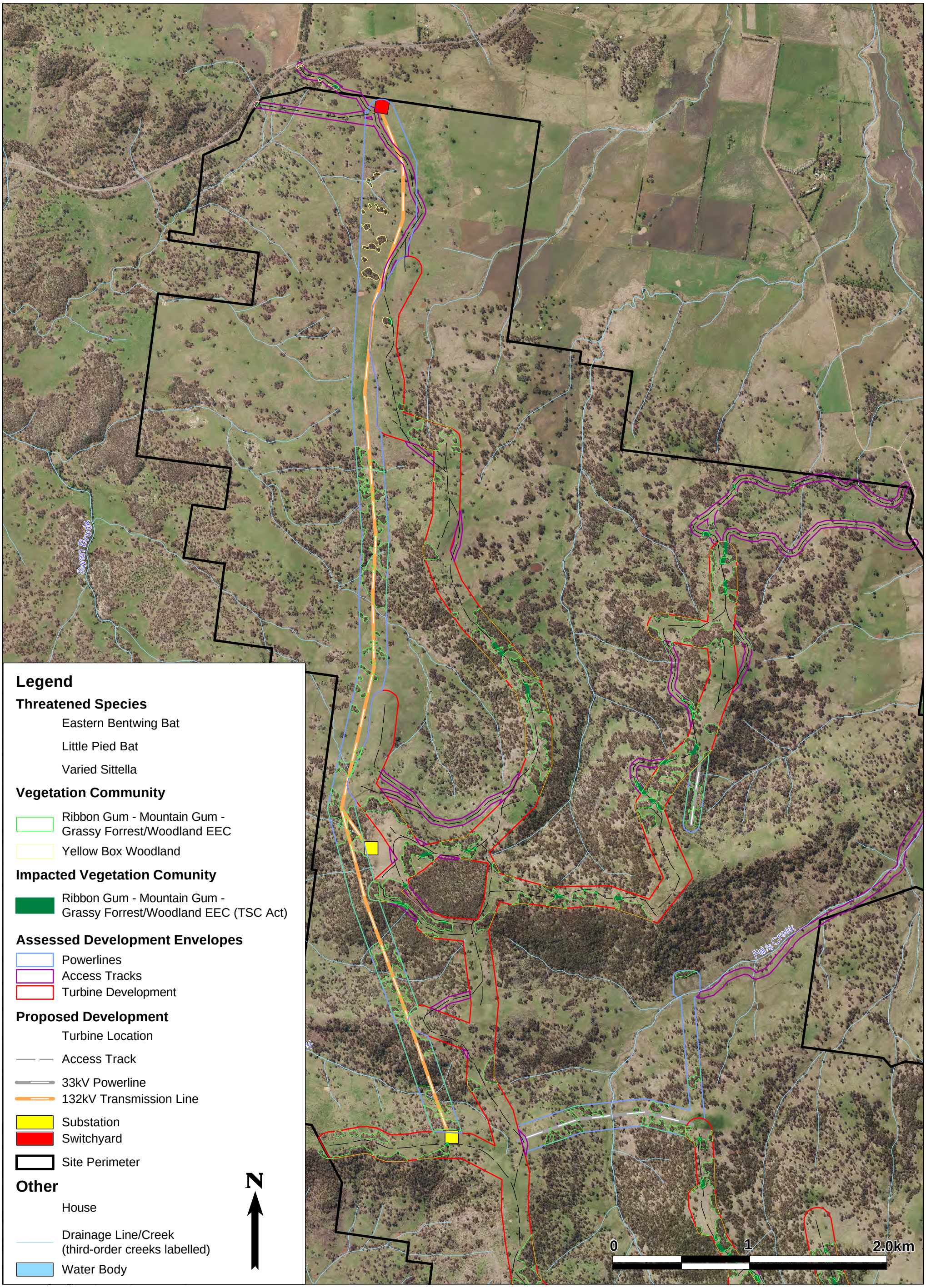


FIGURE 4-2 ECOLOGICAL CONSTRAINTS MAP (NORTH)

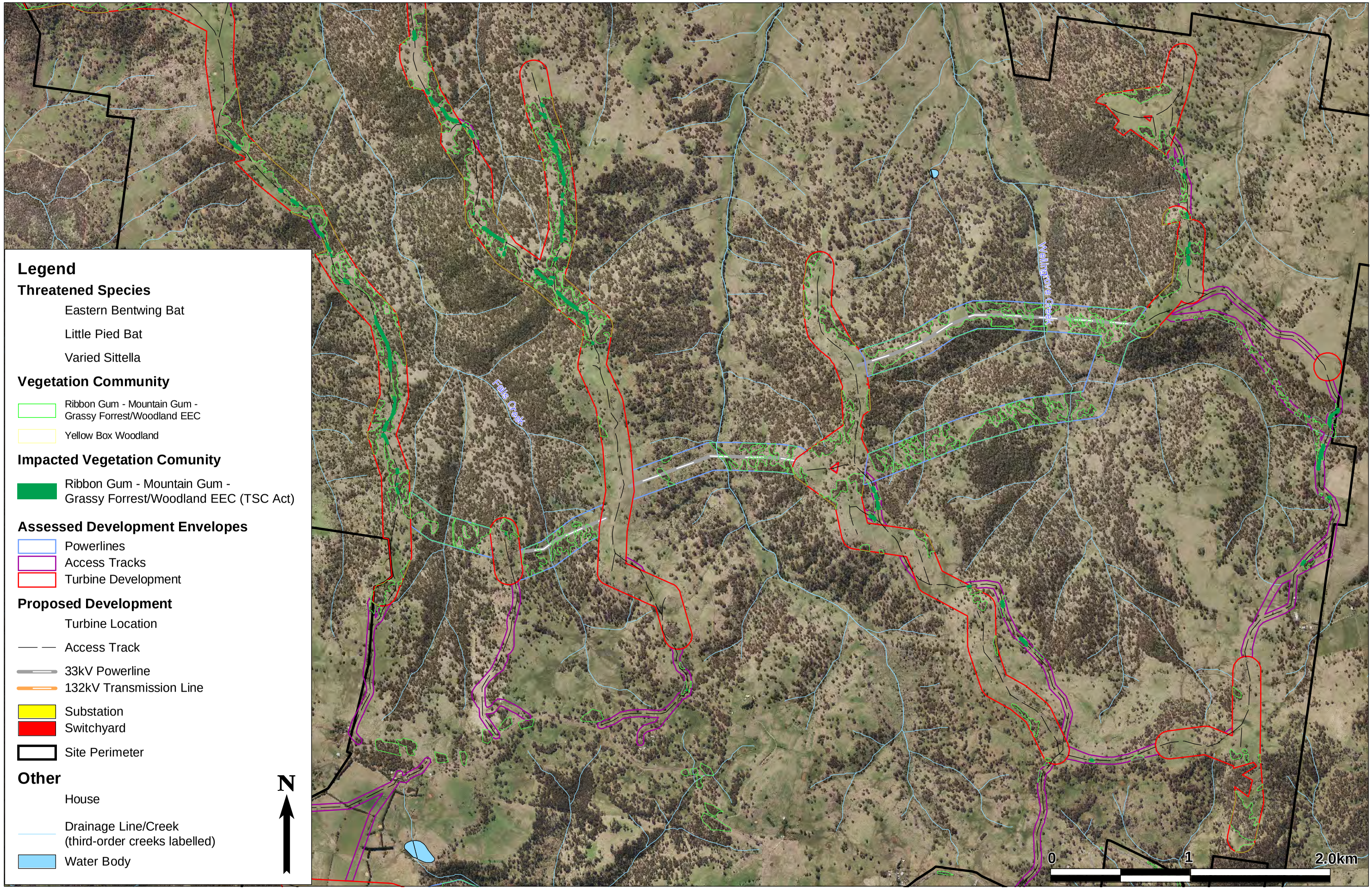


FIGURE 4-3 ECOLOGICAL CONSTRAINTS MAP (CENTRE)

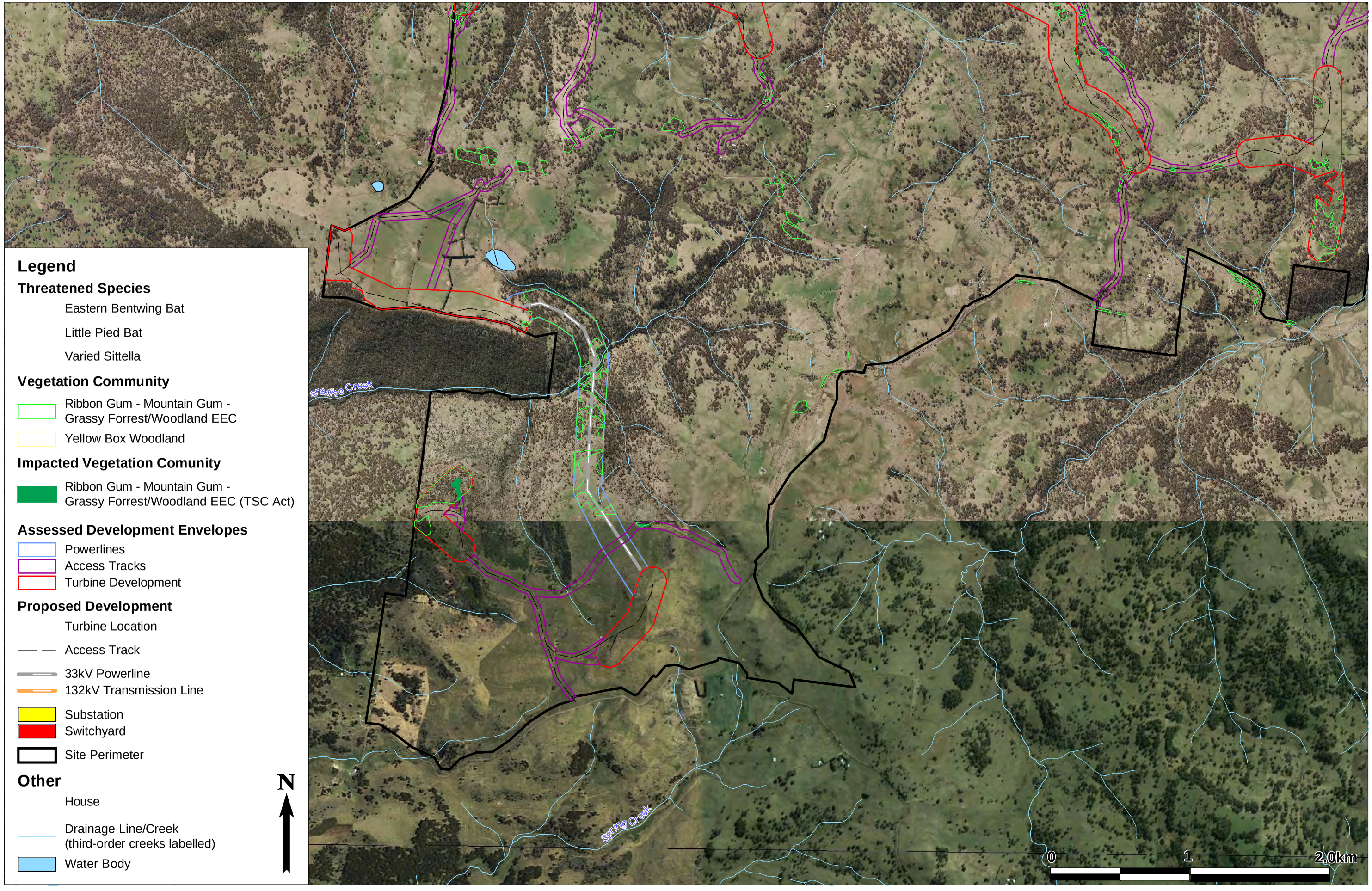


FIGURE 4-4 ECOLOGICAL CONSTRAINTS MAP (SOUTH)

4.1 Vegetation

4.1.1 Overview

The construction of the WRWF will cause some destruction or disturbance to native vegetation through construction of access tracks, cabling and construction of foundations and other associated infrastructure. Soil disturbance and the construction of access tracks may also facilitate the spread of weeds and cause localised erosion / sedimentation or waterway pollution. The Proponent will seek to minimise these impacts through effective weed-control and careful construction methods avoiding erosion and waterway pollution.

4.1.2 Known and Potential Impacts

Whilst careful sighting of the turbines and associated infrastructure in cleared areas and along existing access tracks has minimised the removal of native vegetation there will be some removal of native vegetation as a result of the proposal. Within the 1,361 ha study area there is approximately 330 ha of native vegetation. Of this, the Ribbon Gum EEC occupies approximately 327 ha and the Yellow Box EEC occupies 3.4 ha. The remaining 1031 ha is occupied by cleared pasture with scattered trees.

The proposal will modify the vegetation in two different ways. Direct and complete clearing will need to occur for the access roads, turbine footprints, cabling and other related infrastructure. This is estimated to result in the removal of 4.9 ha of the Ribbon Gum EEC.

For transmission lines it is unlikely that complete clearing will be necessary, although significant modification will still be required. The easement for the 132 kV power line connecting the wind farm to the TransGrid line will be 40m wide and for the 33 kV overhead lines on the wind farm between the ridges will be up to 25m wide. Vegetation clearance is not required for the full easement width and will depend on the final line design. Vegetation clearance required from the conductors will vary from 2m at the poles to between 4m and 6m at mid-span. The design of the power lines can also be varied to reduce the impact on any specific areas of vegetation. Considering a worst-case scenario of complete clearing and / or vegetation modification, it is estimated that none of the Yellow Box EEC and 17.6 ha of the Ribbon Gum EEC could be affected.

In total, this equates to a potential maximum impact of 22 ha (4.9 permanent vegetation loss for turbines and tracks + 17.6 modified vegetation for powerlines) of native vegetation classified as endangered. This equates to approximately 7% of the native vegetation within the study area and less than 2% of the overall study area. The relative impact in relation to the amount of native vegetation within the site perimeter and surrounding locality is predicted to be minimal as these communities and native vegetation in general are likely to be significantly more extensive based on aerial photo interpretation.

This represents the least possible impact to native habitats in the study area and native vegetation in general as a consequence of the proposal, which has already been substantially refined and altered. All wind turbines have been located away from remnant

stands of native vegetation as far as practicable and every effort will be made to divert tracks and cabling infrastructure away from existing native vegetation stands and paddock trees.

No threatened flora species were recorded in the immediate vicinity of the proposed works. A record for *Dichanthium setosum* is located to the south of the study area; however this record is located well away from any construction or cabling areas. Therefore it is unlikely that threatened flora will be significantly impacted upon.

Whilst there may be some increased levels of soil disturbance during construction and potential for the spread of weeds, weeds are already dominant within the landscape and these issues will be addressed by the implementation of an Environmental Management Plan (EMP) and / or a Construction Management Plan (CMP) for the proposal. Weeds will therefore be subject to a higher level of management than is currently the case.

4.2 Birds

4.2.1 Overview

Research undertaken both overseas and in Australia has demonstrated two types of impacts to birds: 1) direct mortality from collisions, and 2) indirect impacts from avoidance, habitat disruption and displacement (NWCC 2004; AusWEA 2005).

There are a number of important factors that influence avian mortality. The location of wind farms is seen as a major factor, with those sited near wetlands, critical habitat areas, or along migratory flight paths having greatest impacts. The rates of collisions can be influenced by adverse weather conditions and poor visibility, flight characteristics of birds (e.g. fast flying, flocking, and nocturnal flyers may be more prone to collisions) and an individual species' ecology (e.g. migratory species may be less familiar with the area).

Turbulence created by the rotors (as a specific consideration) is also likely to affect species and result in a low level of mortality. This aspect of wind turbine impacts has been subject to little available research. Such effects are particularly likely for smaller birds and bats, which would be less able to divert course away from the blades / strong turbulence, once caught in the turbulence zone.

Occasional deaths may be likely attributable to birds and bats being caught in such a turbulence zone generated by the proposed wind turbines, however numbers are unlikely to be significant, either due to this specific impact, or to blade-strike in general. This is particularly due to the locations of the turbines being in primarily existing cleared areas.

Baerwald et al (2008) indicates that barotrauma, the death of birds due to pressurised air at the blade tips, is less likely to impact birds due to the rigidity of their lungs, than it is likely to impact upon bats.

The probability of adverse bird interactions appears to be both site-specific and species specific. The most important step that can be taken to avoid adverse bird interactions is to locate facilities based on careful siting studies and away from critical habitat (Colson and Associates 1995).

International Examples

Impacts to birds have been shown to vary among sites and are considered likely to depend on several factors including the amount of bird use, vegetation, and biological characteristics of the specific wind plant and surrounding area (NWCC 2004).

The most quoted international examples of turbines killing large numbers of birds are from poorly situated wind farms at Altamont Pass (California, USA) and Tarifa (Spain). In both cases the wind farms were located along bird migration routes and in critical habitats for endangered species. The Altamont pass wind farm, containing 5,400 smaller turbines with high rotating speeds densely laid on a bird migration route and staging area has killed over 22,000 birds in 20 years of operation, although management practices such as rodent control are thought to have worsened the problem (Rae 2005). Studies conducted at a number of other wind farm sites in the USA and Scotland have recorded minimal to no fatalities, including sites frequented by raptors (Rae 2005).

Based on a review of 12 comprehensive bird-monitoring studies in the USA, fatality rates have averaged 2.3 individuals per turbine per year (NWCC 2004). The impact of wind turbine collisions has been estimated to be less than 0.02 percent of the staggering 200 – 500 million collision related deaths in the USA from other structures such as vehicles (60 – 80 million), buildings and windows (98 – 980 million), and communication towers (4 – 50 million) (AusWEA 2004).

Recent research in North America (Barclay et al 2007) undertaken over 33 wind farm sites indicates that the average annual mortality rate for birds was 0.61 per turbine. This included a range of tower heights and rotor swept areas. Heights ranged from 24 to 94m, while diameter of rotor swept areas ranged from 15 to 80m. The study also indicated that differences in rotor swept area were not a significant factor in relation to impacts, with no evidence that taller turbines are associated with increased bird fatalities. In fact, the per turbine mortality rate for birds was constant with tower height. Barclay et al. (2007) indicated that factors influencing fatality rates may include differences in the number of species present within the area, their population sizes, the use of migration corridors, variation from site to site at which birds fly, and variation in numbers of migrants from year to year.

Australian Examples

In Australia, collision rates are generally around one to two birds per turbine per year (AusWEA 2004). The most susceptible Australian birds are likely to include:

- birds of prey and owls, particularly soaring species such as eagles and kites;
- nocturnal migrating songbirds;
- locally-breeding high-flying songbirds such as Magpie-larks;

- waterbirds such as Straw-necked Ibis and Black Swans;
- ducks;
- shorebirds, including migratory waders; and
- *Neophema* Parrots (*source:* AusWEA 2002).

Within Australia most wind farm development has been along coastal areas in Western Australia, South Australia and Victoria. In Tasmania, the first two stages of the Woolnorth wind farm have been the subject of a bird and bat strike-monitoring program. There has been some evidence for a slightly decreased usage of the site by birds post-construction and several species have been reportedly hit by turbines including Wedge-tailed Eagles, seabirds such as Petrels, Common Skylark, Grey Fantail, Black Currawong and Banded Lapwing (Rae 2005).

Studies conducted at Stanwell's Toora wind farm in South Gippsland found no evidence of significant levels of bird mortality with any impacts confirmed to localised indirect effects on common farmland birds. Species such as Wedge-tailed Eagles were regularly observed before and after operations began, but avoided the turbines by flying around or between them (AusWEA 2004).

As the Australian industry develops, more information is coming to light that the mortality rates at Australian wind farms are lower than in the northern hemisphere, which appears to be due primarily to the lack of large numbers of night-migrating songbirds in Australia (AusWEA 2004).

4.2.2 Known and Potential Impacts

As the proposal will remove a relatively small area of remnant vegetation in comparison to the remaining remnant vegetation, the main potential impacts to birds are likely to be as a result of collisions with turbines and/or avoidance behaviour.

From the results obtained during field surveys, including flight activity and behaviour monitoring, and the collation of available literature, it was possible to assess the collision potential of birds seen or expected to occur within the study area, as shown in **Table 4-1:** Collision**.** Whilst risk potentials were classified into high / medium / low risks, it should be noted that the overall collision potentials of birds with the wind turbines is considered to remain relatively low, however it was necessary to determine which birds have a greater risk of collision.

Generally, the results indicated that the non-passerines, birds of the Orders Anseriformes (swans, ducks); Falconiformes (hawks, kites, eagles, falcons); and Psittaciformes (cockatoos, parrots, lorikeets) have greater risk potentials, than the passerines (wrens, warblers, fantails, honeyeaters, whistlers, finches, swallows). The non-passerines generally have flight characteristics that make them more prone to collisions with wind turbines. They are usually larger and less mobile than the passerines and many occur in flocks and in more open areas. Furthermore, most passerine species are small species,

which are potential prey for larger bird species and therefore tend to keep lower to the ground where they remain in close proximity to the shelter of vegetation.

With specific regard to the species noted within the study area, it is considered that raptors (e.g. Nankeen Kestrel and Wedge-tailed Eagle), wetland / waterbirds (e.g. Wood Duck), and other common local resident birds (eg. Yellow-faced Honeyeaters, Magpie, Crimson Rosella and Raven) would be most likely to be prone to turbine collisions. Some minor changes to the local distribution and abundance of these species may be expected as a consequence of the ongoing operation of the turbines, although these impacts are not expected to be significant.

The threatened Varied Sittella was observed within the study area. This species forages within the tree canopy and as such is unlikely to be impacted by rotor blades or turbulence. The Varied Sittella inhabits woodland vegetation and therefore, the minimal removal of woodland vegetation for construction activities is unlikely to significantly impact on this species.

This information suggests that impacts are likely to be mainly restricted to localised indirect effects on common farmland birds, as has been noted elsewhere within Australia (AusWEA 2004). In consideration of the above-mentioned factors, potential impacts to birds are expected to be relatively minimal and in line with stated AusWEA (2002) and Barclay et al. (2007) collision rates of around one to two birds per turbine per year.

Sufficient baseline data has been collected and presented herein, from which a post-construction monitoring program can be established to further assess the impacts of the proposal on bird species and populations.

Table 4-1: Collision Potential of Selected Birds Seen or Expected to Occur within the Study Area

Birds	Risk Potential	Reasons	Risk Period
Non - Passerines			
Order: Anseriformes Black Swan	Medium / High	Size, low manoeuvrability, occurs in flocks, night flyer, preferred habitat close by. *Waterfowl common collision victim in overseas studies (primarily transmission lines).*	All year
Ducks (Grey Teal, Pacific Black, Australian Wood Duck)	Medium / High	Occur in small flocks (flocks may lack spontaneous manoeuvrability), habitat close by.	All year
Order: Podicipediformes Grebes (Australasian Grebe, Hoary-headed Grebe)	Medium / High	Sedentary during breeding, but nocturnal nomadic movements occur outside of the breeding season. Direct flyer with low manoeuvrability.	Winter
Order: Pelecaniformes Cormorants (Little Pied, Little Black & Great)	Medium / High	Highly mobile due to movements between foraging sites. Lower manoeuvrability after feeding. Some species flock reducing the spontaneous manoeuvrability of individuals.	All year

Birds	Risk Potential	Reasons	Risk Period
Order: Ciconiiformes Egrets and Herons (Cattle, & Great Egrets, White-faced and White-necked Herons)	Medium / High	Order of mobile species due to movements between foraging sites. Slow flying and limited manoeuvrability.	All year
Ibises (White & Straw-necked)	Medium / High	Fly in 'V' flocks (although usually a great heights), highly gregarious, prefer grasslands.	All year
Order: Falconiformes Falcons (Australian Hobby, Black, Peregrine, & Brown Falcons & Australian Kestrel)	High	Flight height, aerial feeding. *Falcons are a common collision victim overseas (wind turbines & transmission lines).*	All year
Eagles (Wedge-tailed and Little)	High	Size, lower manoeuvrability in the case of the Wedge-tailed (may carry food on claw) and concentrated prey scanning of Little. There are a number of records of Wedge-tailed Eagle collisions with wind turbines.	All year
Kites, Goshawks and Baza (Whistling Black-shouldered & potentially Square-tailed Kites; Brown Goshawk &, Collared Sparrowhawk, Pacific Baza)	High	A group of raptors encompassing open habitat species and those that forage above and within the canopy of forests and woodlands. Most species relatively manoeuvrable in flight, though preoccupation with scanning for prey predisposes them to collision risks.	All year
Order Gruifomes*:* Crakes, Rails & Gullinules (Eurasian Coot, Dusky Moorhen, Purple Swamphen)	Low	Low frequency of nocturnal movements between wetlands.	All year
Order: Charadriiformes Migratory Waders (Painted and Latham's Snipe)	Medium / High	Migratory (Snipe Species) tendency to unfamiliarity with surroundings and often move during the night.	Oct – Mar
Resident Waders (Dotterels, Plovers & Lapwings)	Medium / High	Most resident species at least nomadic between foraging sites or dispersive in response to rainfall constraints on foraging habitat. Lapwings sedentary with frequent territorial flights.	All year
Order: Columbiformes Pigeons (Crested)	High	Forages in loose groups and exhibits explosive takeoff fights in response to predator threats	All year
Order: Psittaciformes Cockatoos (Galah, Yellow-tailed Black, Glossy, Sulphur-crested and Corellas)	Medium / High	Most occur in flocks and move daily between roosts and feeding areas. Medium manoeuvrability.	All year
Parrots (Crimson & Eastern Rosellas and King Parrots).	High	Flocking species exhibiting swift and direct flight.	All year
Grass Parrots (Turquoise & Red-rumped Parrot)	Medium	Swift flying but more reliant on cover than other parrot species.	All year
Lorikeets and Swift Parrot (Rainbow, Scaly-breasted, Musk & Little and Swift Parrot)	High	Highly nomadic swift flying species that tend to move in flocks and small groups in response to the distribution of blossom. Highly manoeuvrable, but speed limits their ability to change direction quickly	All year

Birds	Risk Potential	Reasons	Risk Period
Order Cuculiformes: Cuckoos (Pallid, Fan-tailed, Shining Bonze, Channel-billed & Koel).	Medium	Most latitudinal or altitudinal migrants. Locally nomadic during breeding season.	Aug – Feb
Order Strigiformes: Owls (Boobook, Barn & potentially Powerful, Barking & Masked).	High	Nocturnal and highly mobile in response to foraging and breeding habits.	All year
***Order Caprimulgiformes*:** Frogmouthes (Tawny Frogmouth)	Medium	Nocturnal movements between habitats.	All year
Order Apodiformes Swifts (White-throated Needletail)	Medium	Swift flying nomad usually at high altitudes. Swift flight direct flight with low manoeuvrability.	Summer
Order Coraciformes: Kingfishers (Sacred, Laughing Kookaburra)	Medium	Movements between foraging and breeding territories.	Spring / Summer
Passerines			
Order: Passeriformes Welcome Swallow & Tree Martin	Medium	Small & able to change direction rapidly. Aerial feeding and flight heights increase risks.	Aug – Apr
Richard's Pipit & Rufous Songlark	Medium	High flight heights during breeding cycle.	Spring / Summer
Dollarbird	Medium	Aerial forager for flying insects.	Sep – Feb
Treecreepers (White-throated & Red-browed)	Low	Forest associations.	All year
Sittellas	Medium	Nomadic canopy forager that moves in family groups.	All year
Fantails (Willy Wagtail, & Grey)	Low	Low flight heights & foraging behaviour.	All year
Fairy-wrens (Superb)	Low	Low flight heights & foraging behaviour.	All year
Pardalotes (Striated and Spotted) and Mistletoe Bird.	Medium	Nomadic canopy foragers.	All year
Thornbills (Brown, Striated, Buff-rumped, and Yellow-rumped,).	Medium	Generally low flying although movements between forest and woodland habitats can be at a reasonable height.	All year
Scrubwrens (White-browed).	Low	Understorey species.	All year
Honeyeaters (White-eared, White-naped, Brown-headed, Yellow-faced, Noisy Miner, Red Wattlebird, Noisy Friarbird & Eastern Spinebill)	Medium / High	Small species are agile flyers but all are locally and seasonally nomadic in response to blossom distribution. Species such as the eastern spinebill feed closer to ground than most honeyeaters. Night migration.	All year
Whistlers (Rufous & Grey Shrike-thrush).	Low	Forest and woodland inhabitants.	All year
Cuckoo-shrikes (Little, Black-faced & Cicadabird)	Medium / High	Locally nomadic.	All year
Australian Magpie, Butcherbirds (Pied & Grey and Pied Currawong)	Medium / High	Foraging and perching behaviour (in close proximity to blades), flight height. Sedentary nature reduces risk although Currawongs are seasonally nomadic.	All year
Raven (Australian, Forest & Little)	Medium / High	Perching behaviour, flight heights, nomadic.	All year

4.2.3 Cumulative Impacts

Cumulative risks of increasing numbers of wind farms has been identified as being of concern for particular species of birds and bats in Australia by SEWPAC. This aspect of concern in relation to wind farms has been investigated by Biosis for SEWPAC, with the results contained in a report entitled *Wind farm collision risk for birds – Cumulative risks for threatened and migratory species* (Department of Environment and Heritage 2006). The report is a collation of six individual reports, with those being:

- An overview of the modelling of cumulative risks posed by multiple wind farms;
- Modelled cumulative impacts on the Orange-bellied Parrot (*Neophema chrysogaster*);
- Modelled cumulative impacts on the Tasmanian Wedge-tailed Eagle (*Aquila audax fleayi*);
- Modelled cumulative impacts on the Swift Parrot (*Lathamus discolor*);
- Modelled cumulative impacts on the White-bellied Sea-eagle (*Haliaeetus leucogaster*); and
- Risk level to select species listed under the EPBC Act of collision at wind farms in Gippsland, Victoria.

Of most relevance to the WRWF is the overview of the modelling of cumulative risks posed by multiple wind farms and the risk level investigation of select species at Gippsland. The Swift Parrot report has also been considered, although there are no known records in the locality of this species.

The risk of collision with the rotor blades was identified as being the focus of the cumulative impact investigation for multiple wind farms.

The model requires a high level of data, including the following:

- The numbers of flights each bird species may make below rotor height, and for which just the lower portion of the turbine towers present a collision risk.
- The numbers of bird flights that may occur at heights within the zone swept by the turbine rotors, and for which the moving rotor blades present a collision risk.
- The numbers of movements-at-risk of collision.
- The mean area (m^2 per turbine) of the tower, nacelle and stationary rotor blades of a wind generator that present a risk to birds.
- The additional area (m^2 per turbine) presented by the movement of rotors during the potential flight of a bird through a turbine.
- A calculation, based on the layout and total number of turbines proposed for a wind farm, of the number of turbines likely to be encountered by a bird in any one flight. This differs according to whether turbines are aligned in a linear or a clustered array on the landscape.
- The known or estimated entire population of the species

This data is then used in the model to assess the likelihood of individual birds being hit (and dying) as a result of flights through the wind farm area. This can be done for either sedentary or migratory species. Each wind farm within the likely movement area of each species is assessed and the likelihood of a bird being hit increases with an increase in wind farms / turbine numbers.

Such data is available, or can be readily predicted for, species such as the Orange-bellied Parrot, Tasmanian Wedge-tailed Eagle, Swift Parrot and White-bellied Sea-eagle. These species have been subject to intensive surveys due to their conservation status. However, the studies indicate that the general availability of sufficient data for individual species is rare, even for threatened species.

At this stage even monitoring data in Australian conditions is rare. No comprehensive investigation of bird or bat avoidance behaviour having been undertaken within any wind farm in Australia, aside from a single short investigation at one wind farm. This is stated as being a significant constraint to predictive cumulative monitoring, which can only be overcome by the accumulation of data from well-designed investigations at operational wind farms.

The closest other known proposals are located at:

- Glen Innes Wind Farm, approximately 5km east, 22 turbines, approved;
- Sapphire Wind Farm, adjoining current study area to the north, approximately 160 turbines, proposed; and
- Ben Lomond Wind Farm, approximately 8km south-east, 98 turbines, proposed.

There are currently no operational windfarms within 50km of the study area. Cumulative impacts are expected to occur to a minor degree. However given the likely low fatality rates outlined in this report, such impacts are unlikely to impact significantly upon birds, particularly threatened birds.

In terms of barrier effects, the spacing of the turbines allows for expansive areas for birds to move through the site when moving throughout the locality. The general spacing of turbines is between 250m and 500m. Such spacing is considered to be sufficient for birds to navigate through the locality with generally minor disruptions to their existing movement patterns. Most likely movement directions and locations through the study area would be through Wellingrove Creek valley (north-south) and through the northern parts of Falls Creek valley (east-west). These areas contain a low number of turbines in general. In addition, a barrier is not likely to provided when considering the local birdlife would prefer to move through valleys and lower areas. Such areas occur particularly to the north of the study area and it is likely that birds moving through the locality would prefer such areas rather than the steep ridges of the study area.

No nationally listed threatened bird species were recorded within the study area, however, one nationally listed migratory species, Rainbow Bee-eater (*Merops ornatus*) was recorded during bird surveys. The Rainbow Bee-eater was observed foraging above and within woodland canopies.

4.3 Bats

4.3.1 Overview

There is little information on the impact of wind turbines on bats, although recent information from the US has suggested that bats suffer collision fatality at some level, particularly during migratory periods (NWCC 2004; Barclay et al. 2007; Kunz et al., 2007). Bats fly at night, and like other migrating bird species, there is also some evidence that bats may be in fact subject to higher collision rates than many other birds. There is also some evidence that higher-flying species such as *Tadarida australis* may be vulnerable to collisions (AusWEA 2002).

To address the growing concern among researchers and the potential for significant impacts to bat populations, the issue of bats and wind farms has been the subject of cooperative research efforts to understand and deter bat mortality.

The issue was the subject of a workshop / presentation at the Australasian Bat Society Conference in Melbourne in 2005 (Glenn Hoye *pers. comm.*). The outcomes of the conference included:

- potential threats to bats from wind farms include blade strike, disruption to populations from noise, and by clearance of vegetation removing roosts and foraging resources;
- the issue of resident and migrating or nomadic bat species was highlighted including the identification of significant maternity roosts (such as for Eastern Bentwing-bat) and the presence of important forest remnants within the locality during pre-development assessments;
- results achieved to date include: bats have been observed flying through rotor swept area with occasional collisions; bats appear to investigate both stationary and moving blades; and the ratio of avoidance behaviour to contact with blades is high; and
- discussion included potential mitigation efforts, post development monitoring programs and required future research.

4.3.2 Known and Potential Impacts

Despite the number of Anabat night surveys a generally low number of microchiropteran bat species were recorded within the study area. These included the Eastern Bent-wing Bat, Little Pied Bat, Gould's Wattled Bat, Chocolate Wattled Bat and White-striped Freetail Bat. A relatively low number of passes were recorded for each species, indicating a general low level of use of the area by these species. The most passes of the Anabat were recorded by the Eastern Bent-wing Bat, but the total numbers of this species were also generally low. These species occur in a variety of habitats including woodlands and open grasslands (Churchill 1998).

Both direct and indirect impacts on bats may occur as a result of the proposal. Potential direct impacts are associated with mortality resulting from collision with rotors and monopoles and barotrauma. Barotrauma can occur when a bat is suddenly passing

through a low air pressure region surrounding the turbine blade tips, resulting in death through lung or other tissue damage (Baerwald et al 2008). Potential indirect impacts on bats may include disruption of foraging behaviour and breeding activities resulting from alterations in landscapes. The key potential impacts to bats include the loss of a small number of hollow-bearing trees and mortality resulting from collisions with turbines and/or turbine avoidance behaviour.

The proposal may remove a small number of hollow-bearing trees that may be used by hollow-roosting species such as Gould's Wattled Bat and the Chocolate Wattled Bat. However, turbines and infrastructure have been located away from these key habitat features as far as practicable. Wind turbines have been located as far as practicable away from the remnant patches.

Species at highest risk from rotor strike are highflying species such as the White-striped Freetail Bat and potentially the Eastern Bent-wing Bat.

The White-striped Freetail Bat was recorded from two passes at two sites within the study area during current investigations. This species is a fast-flying, high altitude forager, taking prey 50m or more above the ground. They are not overly manoeuvrable and rely on speed to capture prey items. Based on these traits it is of particular concern in relation to wind farms. A study by Hoye (2005b) for a proposal at Crookwell identified that turbines situated in open pasture away from forest remnants are likely to suffer relatively low levels of bat strike although the bat species stated as being of most risk was the White-Striped Freetail Bat. Hoye (2005b) indicated that activity levels of this species were proportionately higher in pasture as against forest remnants when compared to other species and that Hall & Richards (1972) had identified this species as being known to suffer mortality from "Dunlite" wind generators.

The Eastern Bent-wing Bat was the most commonly recorded species within the study area during the survey period. It forages many times above the tree canopy, although whether this includes up to rotor height is uncertain. It will also fly close to the ground when in open areas. These traits suggest that this species is less likely to impacted by turbine operation. This species is a cave-dwelling species and as such does not rely on tree hollows for roosting.

Bat experts Ray Williams (pers. comm.) and Glenn Hoye (pers. comm.) indicate that the closest known roosts for Bent-wing Bats are located at:

- Riverton (approximately 80km N), being a maternity roost;
- Tingha (30km W), being a roost site; and
- Emmaville / Torrington (30km N), being roost sites.

They have also indicated that this species is likely to roost in the region in old mines and caves where available. It is not possible to ascertain more information than this without undertaking extensive on-ground studies. However, based on such information it appears that this species is likely to be roosting in a number of areas within the locality and region, with the nearest known maternity roost being 80km to the north.

It is considered that, while these species occurs in the study area, they would also be very common in the immediate vicinity of the study area, and are common throughout the locality and region.

Relevant studies of wind farms in Australia and their corresponding impacts on species such as the White-striped Freetail Bat are few. It is considered appropriate that ongoing monitoring of the turbines occurs to ensure that assumptions made during the assessment process are not flawed due to a lack of available scientific literature. Such monitoring would inform and provide rigorous scientific information that could assist in determining and implementing appropriate contingency plans for this proposal, while also assisting in assessing the impacts of future proposals in other areas.

Although the threatened Grey-headed Flying-fox (*Pteropus poliocephalus*) is likely to occasionally occur during the flowering of eucalypts in the region, no NPWS Atlas of NSW Wildlife records exist within the area, suggesting the locality is not significant to the species, and accordingly few or no impacts are expected. No camps are known to be located in close proximity to the study area. It is expected that, were fatalities do occur as a result of impacts with the turbines, these would be minor in relation to deaths occurring via other permitted activities such as culling near fruit farms. Regular monitoring would ensure that this is the case and where required, contingency plans are in place (as likely to be identified in the recommended EMP).

Whilst it is acknowledged that there may be a potential loss of a very low number of individuals due to turbine strikes or barotrauma, it is considered unlikely that this will place any local population(s) of these species at risk of extinction given that the key habitat features including forested remnants and caves will remain relatively unaffected. The loss of hollow-bearing trees will be minimised by micro-siting turbines and infrastructure. It is considered that numbers likely to be affected by the proposal are not significant.

A post-construction monitoring program has been recommended to further assess the known and potential impacts to bat populations.

4.3.3 Cumulative Impacts

The State-listed Eastern Bentwing-bat and Little Pied Bat are known to occur in the locality. It is considered that bat death attributable to the proposal in addition to the surrounding operating and approved wind farms is unlikely to be significant on populations of any of these species (refer to **Section 4.3.2** for explanation).

In terms of barrier effects, the spacing of the turbines allows for expansive areas for bats to move through the site when moving throughout the locality. The general spacing of turbines is between 250m and 500m. Such spacing is considered to be sufficient for bats to navigate through the locality with generally minor disruptions to their existing movement patterns. Most likely movement directions and locations through the study area would be through Wellingrove Creek valley (north-south) and through the northern parts of Falls Creek valley (east-west). These areas contain a low number of turbines in general. In

addition, a barrier is not likely to provided when considering the local bats would prefer to move through valleys and lower areas. Such areas occur particularly to the north of the study area and it is likely that bats moving through the locality would prefer such areas rather than the steep ridges of the study area.

Adaptive management including ongoing monitoring will ensure that this is the case and mitigative measures will be implemented where necessary.

4.4 Other Fauna

4.4.1 Overview

There is little or no published data on the impacts of wind turbines on ground based fauna, although some minor localised changes in the distribution and abundance of species may occur. There is no evidence that domesticated animals or grazing stock are negatively influenced and it is typical for stock to graze up to the base of wind turbines on farmland (AusWEA 2002). The main impacts on terrestrial fauna are considered likely to be limited to the removal of vegetation for the construction of turbines and associated infrastructure.

4.4.2 Known and Potential Impacts

Only minor impacts would be expected to terrestrial and arboreal fauna. The removal of a relatively small area of woodland, principally for powerline easements and access tracks would be unlikely to result in the reduction / alteration of fauna populations within the locality. A small number of hollow-bearing trees may be removed; however, the impacts to hollow dependent bird, mammal, and reptile species are considered unlikely to be significant.

Some minor alterations may occur to species movement patterns on a local basis especially during construction and as a result of turbine operation. There may be some increased potential for collisions with vehicles to terrestrial fauna such as kangaroos. Removal of exposed rocks for the construction purposes may also have some minor impacts to terrestrial fauna such as reptiles and small mammals.

4.5 Key Habitats and Corridors

Loss and fragmentation of habitat across the landscape are primary threats to the conservation of biodiversity, ecological processes and natural systems.

While the proposal would result in the removal of some areas of remnant vegetation, principally for powerline easements and access roads, the areas removed are unlikely to significantly impact on any key habitat areas or mapped corridors within the study area, particularly given the narrow, linear form of the required infrastructure.

4.6 Aquatic Habitats and Groundwater Dependant Ecosystems

Inappropriately located wind turbine infrastructure works may potentially cause erosion, sedimentation, pollution, and alteration of flow regimes to creeks and other aquatic habitats (such as dams and wetlands), leading to further impacts to native flora and fauna species.

No major impacts are expected, as the majority of the proposal infrastructure (turbines, cables, & access roads) are to be located on ridge-tops. It is considered that provided appropriate measures are implemented, there should be no decrease in water quality or quantity as a result of the proposal. Specific water crossings of the development will use existing structures to minimise crossing impacts and power line crossings will avoid impacts as poles are planned to be located over 50 m from any creeks.

Whilst there may be some potential for oil spills and other accidents during construction, an Environmental Management Plan (EMP) and a Construction Management Plan (CMP) will be established to minimise the impacts of any such potential occurrences or of potential erosion issues.

No impacts are expected to significant wetland areas. The study area is not located within the immediate catchment area of any such sites, nor is it located between or close to any significant conservation areas within the region and potential habitat corridors between such areas.

Groundwater Dependant Ecosystems (GDE's) are unlikely to be affected by the proposal. The proposal sits upon the top of the watershed to the east and west of the east coast of Australia. None of the natural ecosystems observed to occur within the study area are likely to be reliant on groundwater to any significant extent.

4.7 Rationale to Support Conclusions

The information detailed in the above Section 4 for this document outlines the rationale to support conclusions made in relation to the likely impacts of the project. It has been concluded that the likely impacts of the refined layout of the project are unlikely to significantly impact upon local flora and fauna, in particular EEC's, birds and bats.

Reasons for this are summarised below:

- In terms of habitat, the project refinement has lead to minimal relative impacts when considered in terms of the habitat availability in the study area. Habitat protection was a focus of the project design refinement process. The final design will require modification of only 7% of the native vegetation within the study area and less than 2% of the overall study area. Much of this habitat to be affected is in an agricultural-affected landscape.
- The Ribbon Gum EEC will be affected by the project as impacts upon some forested vegetation cannot be avoided for the project to remain viable. Of 327 ha within the study area, 22ha will be modified to some extent. Epuron is investing appropriate offsets to compensate for this impact;

- The Yellow Box EEC and its habitat has been entirely protected through the redesign of the project. No impact is predicted to occur upon this EEC;
- No threatened flora were recorded within the study area or are likely to be affected by the proposal;
- The threatened Varied Sittella was the only threatened bird observed within the study area. This bird species forages within the tree canopy and as such is unlikely to be impacted by rotor blades or turbulence. The Varied Sittella inhabits woodland vegetation and therefore, the minimal removal of woodland vegetation for construction activities is unlikely to significantly impact on this species;
- All other birds recorded are common species and technically do not require consideration under the TSC Act. Nevertheless, the project has been refined to minimise impacts to native vegetation that provides habitat for a majority of these native bird species. Research outlined in Section 4 indicates that recorded mortality rates to date are relatively low for birds per turbine;
- The Eastern Bent-wing Bat was the most commonly recorded species within the study area during the survey period. This species is a threatened species under the TSC Act. It forages many times above the tree canopy, although whether this includes up to rotor height is uncertain. It will also fly close to the ground when in open areas. These traits suggest that this species is less likely to impacted by turbine operation. This species is a cave-dwelling species and as such does not rely on tree hollows for roosting. The Little Pied Bat, also a threatened species and occurs in a diverse range of native habitats. It roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Whilst it is acknowledged that there may be a potential loss of a very low number of individuals of these species due to turbine strikes or barotrauma, it is considered unlikely that this will place any local population(s) of these species at risk of extinction given that the key habitat features including forested remnants and caves will remain relatively unaffected. With the current level of available scientific literature there appears to be limited knowledge on how barotrauma could be minimised at wind farms;
- No other threatened fauna was recorded during the surveys;
- Topographical features have been considered as part of the design process and there are no areas of particular note that require modification of the design in terms of likely fauna movement through the study area; and
- Weather may form an influencing factor on visibility for fauna species in the air, such as on foggy days or night visibility would be lower than on clear days. Such factors are likely to have been included in previous recorded observations of bird and bat fatalities in the past and are part of natural variability. While the mortality rate could theoretically increase during inclement weather it is likely that the overall mortality rates would still remain low.

5 Adaptive Management Program

5.1 Proposed Management Measures

Adaptive management is a principle that encourages an exploratory, experimental approach to management problems, and emphasises the value of continuous monitoring and periodic adjustment of management regimes.

Within Australia, there is a recognised lack of research on the behaviour of bird and bat species and resultant impacts in relation to wind farms. This can only be overcome by monitoring the behaviour of species at operating wind farms and by monitoring mortality of individual species.

An adaptive management program will be used at White Rock Wind Farm. This will ensure that the low-level impacts predicted in this assessment eventuate. It will provide a mechanism whereby issues will be identified, monitored, assessed and addressed as necessary. In regards to flora and fauna this will occur via two reporting avenues:

- An Environmental Management Plan (EMP) and Construction Management Plan (CMP); and
- A Bird and Bat Monitoring Program incorporating a BACI design (Before, After, Control, Impact) and dedicated bird and bat strike searches.

These are described in more detail below.

5.1.1 Management Planning

Constructional and operational phases of the development should be in line with the Best Practice Guidelines for Wind Energy Projects (AusWEA 2002), including the implementation of an Environmental Management Plan (EMP) and / or a Construction Management Plan (CMP).

In accordance with the guidelines the EMP and / or CMP will involve:

- Identification of risks;
- Identification of mitigation processes; and
- Identification of monitoring processes.

This would include management of issues such as erosion, dust and sediment control, storage of hazardous materials, weed control, rehabilitation and waste management. Regular reporting of monitoring results (at such frequencies as required by consenting authorities) would be undertaken. While not specifically for flora and fauna, such a management plan would provide for the protection of the environment in general (including habitats) and by default flora and fauna. The monitoring phase will ensure that where any issues are identified the EMP / CMP can be updated to reflect the need for

appropriate management. These issues would be reported to the consent authorities, including demonstration of how each specific issue was dealt with.

5.1.2 Bird and Bat Monitoring

A post-construction bird and bat monitoring program will be established to determine the impacts of the proposal on bird / bat populations. This will be undertaken for a period of up to five years from the date of initial operation. Such data will prove invaluable for assessing the impacts of future wind farms within the northern tablelands of NSW and elsewhere within Australia. The bird and bat monitoring program would be designed and undertaken in accordance with guidelines prepared by NWCC (1999) and AusWEA (2005).

The Before – After – Control – Impact (BACI) experimental design process should be used during ongoing monitoring of wind farm operation (AusWEA 2005). This involves monitoring the existing situation, monitoring any changes in bird behaviour or injuries / deaths and devising methods (or implementing previously proposed ameliorative measures) to ensure any impacts above a certain acceptable level are controlled.

AusWEA (2005) identifies that during the operational phase, direct impacts should be assessed via bird utilisation and roaming surveys, population assessment, population viability analysis and dead bird searches. Indirect impacts should be assessed via bird utilisation and roaming surveys, gradient studies, population assessment, population viability analysis, avoidance studies and indirect disturbance impact assessments.

The proposed bird and bat monitoring will include:

- Dead bird and bat searches;
- Indirect disturbance impact assessments; and
- Avoidance studies.

The monitoring of the above factors will generally occur in accordance with the methods outlined in AusWEA (2005) at regular intervals. Reports will be provided to consent authorities at required frequencies and mitigation measures will be implemented and reported as necessary.

5.1.3 Weed Management

Weed management will be a top priority during both construction and operation of the proposal. It is recognised that the accidental transport of weeds (including plant material and seeds) between areas containing high density of weeds to those containing low density should not be exacerbated as a result of development of the proposal. The EMP / CMP will contain weed management measures including:

- wash down of all vehicles using a high pressure hose / wash down bay will occur on a daily basis and / or between properties as determined;
- spraying road ways upon once constructed with weed inhibitors;
- installing wash down facilities at each of the construction compounds to ensure no

weeds are transported from the study area following the days construction;

- checking tyres for weeds when moving between properties;
- identification of major problematic / noxious weeds to inform construction personnel;
- inductions for all construction / operation personnel on weed control and procedures.

6 Environmental Legislation Assessment

6.1 Identification of Subject Species and Communities

Threatened flora and fauna species (listed under the TSC Act and the EPBC Act) that have been gazetted / recorded from within the vicinity of the study area have been considered within this assessment. EEC's and Endangered Populations known from the broader area have also been addressed. Each species / community / population is considered for its potential to occur within the study area and the likely level of impact as a result of the overall proposal (**Table 6-1**). This assessment deals with each species / community / population separately and identifies the ecological parameters of significance associated with the overall proposal.

The list of species in the following table has been created from a search of the DECCW Atlas of NSW Wildlife (undertaken in November 2010) and EPBC Act Protected Matters Database (undertaken in November 2010) for threatened flora and fauna species within a 30 kilometre radius of the study area**.** Those species / communities that have been identified as having either a moderate level of impact (or greater) as a result of the proposed development estate or that have been recorded within the study area during field investigations have been subject to further assessment within **Section 6.2** of this report.

'Species' or **'EEC / Population'** – Lists each threatened species / EEC / population known from the vicinity of the study area. The status of each threatened species under the TSC Act and EPBC Act is also provided.

'Habitat Description and Known Populations' or **'Habitat Description and Known Stands / Populations'** – Provides a brief account of the species / community / population and the preferred habitat attributes required for the existence / survival of each species / community / population.

'Chance of Occurrence within Study area'– Assesses the likelihood of each species / community / population to occur within the study area in terms of the aforementioned habitat description and taking into account local habitat preferences, results of recent field investigations, data gained from various sources and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Likely Level of Impact'– Assesses the likely level / significance of impacts to each species / community / population that would result from the proposed windfarm, taking into account both short and long-term impacts. This assessment is largely based on the chance of occurrence of each species / community with due recognition to other parameters such as home range, habitat use, connectivity etc. It also considers the scope of the proposal, including the likely 'ecological footprint', duration of construction works, proposed remediation works etc.

Table 6-1: Threatened Species Considered for the Study Area and Assessment of Potential Impacts

Species / Community	Habitat Description	Chance of Occurrence In The Study Area	Likely Level of Impact
Plants			
Acacia macnuttiana MacNutt's Wattle (V, V*)	Occurs only on the New England Tablelands and just extending onto the North West Slopes. Found in widely scattered locations in the Tenterfield area and west to around Torrington. Grows in dry forest or woodland and heath vegetation, usually on granite or metasediments and often near streams (DECCW 2010)	**Low – Moderate** This species was not detected within the study are during the survey; however, there is suboptimal habitat present within the wooded areas of the study area.	**Low** Whilst some habitat is present within the study the removal of a small amount of native vegetation being removed for the proposal is unlikely to represent any threat to this species.
Acacia petraea Lancewood (E)	Recorded in NSW from the Hungerford and Bourke-Louth districts. Also occurs in several localities in south-western Queensland, confined to the Grey Range and its outliers in the Gregory South and Warrego districts. Lancewood grows in heath to woodland vegetation on rocky ridge tops, jump-ups and scarps with shallow to skeletal, gravely sandy soils. Associated species near Hungerford include *Eremophila scoparia, E. latrobei* and *Dodonaea petiolaris*. Near Hungerford, the species has been found only on ridge tops along rocky outcrops, growing as a common tree with *Eremophila scoparia, Eremophila latrobe*i and *Dodonaea petiolaris*. Flowers in winter and spring. Plant abundance in populations has been recorded as common and as a very sparse roadside scrub. In Queensland, *Acacia petraea* grows as a tall shrubland (DECCW 2010).	**Low – Moderate** This species was not detected within the study area during the survey; however, there is potential habitat present in the form of ridge tops, jump-ups and scarps.	**Low** Whilst some habitat is present within the study the removal of a small amount of native vegetation being removed for the proposal is unlikely to represent any threat to this species.
Acacia pubifolia Velvet Wattle (E, E*)	Velvet Wattle occurs in NSW and Qld. In NSW it is known from two main populations, one north of Emmaville and the other near Warrabah National Park. Velvet Wattle generally grows in dry shrubby woodland on granite and metasediment soils (DECCW 2010).	**Low – Moderate** This species was not detected within the study area during the survey; however, there is suboptimal woodland habitat.	**Low** Whilst some habitat is present within the study the removal of a small amount of native vegetation being removed for the proposal is unlikely to represent any threat to this species.
Almaleea cambagei Torrington Pea (E, V*)	Usually grows in wet heath and acid swamp areas and along watercourses on granite, above 900 m altitude. Associated species include *Baeckea omissa, Epacris microphylla, Callistemon sieberi, Leptospermum* and *Restio* species. The species flowers from September to November.	**Low** No potential habitat for this species was found to occur within the study area.	**Low** The proposal is unlikely to represent any threat to this species.
Astrotricha roddii Rod's Star Hair (E, E*)	Occurs in NSW in the Ashford area north of Inverell, including Kwiambal and Kings Plains National Parks, Severn River Nature Reserve and Severn River State Forest, and has also been recorded at one site in southern Queensland. Rod's Star Hair usually grows in low dry woodland and shrublands on granite and acid volcanic outcrops, often in rock crevices (DECCW 2010).	**Low – Moderate** This species was not detected within the study area during the survey; however, there is potential habitat present in the form woodland and shrub land.	**Low** Whilst some habitat is present within the study the removal of a small amount of native vegetation being removed for the proposal is unlikely to represent any threat to this species.
Boronia granitica Granite Boronia (V, E*)	Occurs in scattered localities on the New England Tablelands and North West Slopes north from the Armidale area. Grows on granitic soils amongst rock outcrops, often in rock crevices, and in forests and woodlands on granite scree and shallow soils. However, at Severn River it grows on deep red soils.	**Low – Moderate** This species was not detected within the study area during the survey; however, there is potential habitat present in the form rock outcrops and woodlands.	**Low** Whilst some habitat is present within the study the removal of a small amount of native vegetation being removed for the proposal is unlikely to represent any threat to this species.
Bothriochloa biloba Lobed Bluegrass (V*)	Occurs in woodland vegetation and grasslands, usually on brown clay and black Baltic soils. It can also occur on cleared roadsides. Widespread on the New England Tablelands and North West Slopes and Plains, particularly in western areas.	**Low – Moderate** This species was not detected within the study during the current survey; however, there is suboptimal habitat present within the wooded and unimproved areas of the study area.	**Low - Moderate** Whilst some habitat is present within the study the removal of a small amount of native vegetation for the proposal is unlikely to represent any threat to this species.

Species / Community	Habitat Description	Chance of Occurrence In The Study Area	Likely Level of Impact
Cadellia pentastylis *Ooline* (V, V*)	Occurs along the western edge of the North West Slopes from north of Gunnedah to west of Tenterfield. There appears to be a strong correlation between the presence of Ooline and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sandy loam surface layer, grading from a light clay to a medium clay with depth (DECCW 2010)	**Low** No potential habitat for this species was found to occur within the study area.	**Low** The proposal is unlikely to represent any threat to this species.
Callistemon pungens (V*)	Grows in or near rocky watercourses, usually in sandy creek beds on granite or sometimes on basalt; from near Inverell to the eastern escarpment at New England National Park.	**Low – Moderate** This species was not detected during the current survey and potential habitat for this species does occur within the creek beds that criss cross the study area.	**Low** The proposal is unlikely to represent any threat to this species.
Cryptostylis hunteriana Leafless-tongue Orchid (V, V*)	Saprophytic orchid. Grows in swamp heath on sandy soils. Distribution is from the Gibraltar Range in the north to south of Eden.	**Low** No potential habitat for this species was found to occur within the study area.	**Low** The proposal is unlikely to represent any threat to this species.
Dichanthium setosum Bluegrass (V)	Grows in woodland and native grassland on stony, red-brown, hard setting soils over basalt, or on black soil. Occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, as well as in Qld and WA.	**Moderate** Not recorded within the current survey, although potential habitat does exist within the less improved pasture and woodland areas of the study area. Local records do exist nearby and one record is within 1km from turbine 9.	**Low – Moderate** Whilst some habitat is present within the study the removal of a small amount of native vegetation for the proposal is unlikely to represent any threat to this species.
Digitaria porrecta Finger Panic Grass (E, E*)	In NSW Finger Panic Grass is found on the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran on native grassland, woodlands or open forest with a grassy understorey, on richer soils. Often found along roadsides and travelling stock routes where there is light grazing and occasional fire. (DECCW 2010).	**Moderate** Not recorded within the current survey, although potential habitat does exist within the woodland and unimproved pasture areas of the study area.	**Low – Moderate** Whilst some habitat is present within the study the removal of a small amount of native vegetation for the proposal is unlikely to represent any threat to this species.
Diuris pedunculata Small Snake Orchid (E, E*)	A small yellow donkey orchid with a stem less than 10cm high and flowers about 13mm in length, this species has two thin leaves that can be up to 16cm long. It flowers from August to October and has a tendency toward moist habitats on grassy slopes and flats, but has also been found on rocky or gravely substrates. Originally described as occurring from Tenterfield to the Hawkesbury River, most current records occur on the New England Tablelands in the Armidale, Uralla, Guyra and Ebor districts.	**Low** The current survey was undertaken during this species flowering period and no plants were recorded within the study area. Due to the modified nature of the study area and grazing over the entire study area, this species is unlikely to occur.	**Low** It is unlikely that this species will occur within the areas of the study area where the majority of the turbines and infrastructure will be placed.
Eucalyptus camphora subsp. *relicta* Warra Broad-leaved Sally (E)	A small tree or mallee confined to Warra National Park near Backwater, east of Guyra. Found scattered on open swampy flats. Requires swampy and waterlogged habitats, located on relatively infertile granite soils. Flowering is from February to April.	**Low** No potential habitat for this species was found to occur within the study area.	**Low** The proposal is unlikely to represent any threat to this species.
Eucalyptus mckieana McKie's Stringybark (V, V*)	Found in grassy open forest or woodland on poor sandy loams, most commonly on gently sloping or flat sites. Associated species at Northern Tablelands sites include *Angophora floribunda*, *Eucalyptus amplifolia*, *E. andrewsii*, *E. bridgesiana*, *E. youmanii*, *E. nicholii*, *E. blakelyi* and *E. conica.* At North Western Slopes *E. andrewsii*, *E. stannicola*, *E. prava*, *A. floribunda*. Locally common to abundant forming moderately dense forest in association with other local trees. Flowering during March - May.	**Low – Moderate** This species was not detected during the current survey and potential habitat for this species may occur within the lower stretches study area.	**Low** Whilst some habitat is present within the study the removal of a small amount of native vegetation for the proposal is unlikely to represent any threat to this species.
Eucalyptus nicholii Narrow-leaved Black Peppermint (V, V*)	Grows in dry grassy woodland, on shallow infertile soils, mainly on granite. However, the species is widely planted as an urban street tree and in gardens. Occurs from Nundle to north of Tenterfield in the New England Tablelands.	**Low – Moderate** This species is more common further west of the study area near Tingha with populations reserved within Single NP. No individuals of this species were detected during the current survey.	**Low** Whilst some habitat is present within the study the removal of a small amount of native vegetation for the proposal is unlikely to represent any threat to this species.

Species / Community	Habitat Description	Chance of Occurrence In The Study Area	Likely Level of Impact
Eucalyptus rubida subsp. barbigerorum Blackbutt Candlebark (V,V*)	Known from scattered populations on the New England Tablelands from Guyra to the Tenterfield area. Occurs within woodland on medium to high fertility soils, often on cold flats.	**Low** No potential habitat for this species was found to occur within the study area.	**Low** The proposal is unlikely to represent any threat to this species.
Micromyrtus grandis Severn River Heath-myrtle (E)	Restricted to Severn River Nature Reserve and an adjacent property, about 60km north-west of Glen Innes on the New England Tablelands. Severn River Heath-myrtle grows in heath and low woodland in crevices of acid volcanic rocky outcrops and in the shallow soil of surrounding areas, at altitudes of 600 to 750 m. It occurs in open and exposed sites. Associated species within low woodland include *Eucalyptus crebra, Allocasuarina inophloia, Acacia* sp. aff. *pubifolia, Xanthorrhoea johnsonii*; in heath the association comprises *Leptospermum novae-angliae, Micromyrtus sessilis* and *Leucopogon neo-anglicus*.	**Low** No potential habitat for this species was found to occur within the study area.	**Low** The proposal is unlikely to represent any threat to this species.
Lepidium peregrinum Wandering Pepper-cress (E, V*)	Little is known about the habitat requirements for this species, however the largest population occurs in an open riparian forest dominated by *Eucalyptus camaldulensis* and *Casuarina cunninghamiana*, with a variably dense shrubby understorey.	**Low** No potential habitat for this species was found to occur within the study area.	**Low** The proposal is unlikely to represent any threat to this species.
Picris evae Hawkweed (V, V*)	Habitat consists of open Eucalyptus forest and *Dichanthium* grassland, roadsides and cultivated areas (paddocks). Soils are black, dark grey or red-brown and reddish clay-loam or medium clay soils. All recent collections appear to come from modified habitats such as weedy roadside vegetation. The flowering/fruiting period is October-January; however some plants have been collected until May.	**Low** Very little potential habitat, in the form of black, dark grey or red-brown and reddish clay-loam or medium clay soils, exists for this within the study area. Potential habitat would be restricted to lower areas where grazing pressures and pasture improvement are likely to further reduce opportunities for this species to be limited to roadside vegetation and similar ungrazed situations.	**Low** The proposal is unlikely to represent any threat to this species.
Rutidosis heterogama (V, V*)	Small asteraceous herb recently growing in open forest on moist or sandy soils and often occurring in disturbed areas. Occurring coastally from Wyong to Evans Head and from Ashford and Torrington to Wandsworth on the New England Tableland.	**Low** No potential habitat for this species was found to occur within the study area.	**Low** The proposal is unlikely to represent any threat to this species.
Thesium australe Austral Toadflax (V, V*)	Occurs in grassland or grassy woodland, often in damp sites with *Themeda australis* (Kangaroo Grass).	**Moderate** This species has been recorded widely within the local area. Targeted surveys for this species within the study area failed to detect any further populations, however this species may be present.	**Low – Moderate** Whilst some habitat is present within the study the removal of a small amount of native vegetation for the proposal is unlikely to represent any threat to this species.
Tylophora linearis (V, E*)	Found in the Barraba, Mendooran, Temora and West Wyalong districts in the northern and central western slopes of NSW Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla* and *Allocasuarina luehmannii.* Also grows in association with *Acacia hakeoides, Acacia lineata, Melaleuca uncinata*, *Myoporum* species and *Casuarina* species. (DECCW 2010).	**Low** No potential habitat for this species was found to occur within the study area.	**Low** The proposal is unlikely to represent any threat to this species.
Tylophora woollsii (E*)	The Cryptic Forest Twiner is found from the NSW north coast and New England Tablelands to southern Queensland, but is very rare within that range. Known on the Tablelands from the Bald Rock and Boonoo Boonoo areas north of Tenterfield. This species grows in moist eucalypt forest, moist sites in dry eucalypt forest and rainforest margins. Plants appear to persist as a network of stems under leaf litter when aerial stems are absent (DECCW 2010).	**Low** No potential habitat for this species was found to occur within the study area.	**Low** The proposal is unlikely to represent any threat to this species.

Species / Community	Habitat Description	Chance of Occurrence In The Study Area	Likely Level of Impact
Zieria ingramii Keith's Zieria (E)	Known only from Goonoo Goonoo State Forest, about 40 km north-east of Dubbo. An old record exists from a locality east of Mogriguy on the Mendooran Road, however searches of the area have not relocated the species. Grows in dry sclerophyll forest on light sandy soils. All known populations have been recorded in Eucalyptus-Callitris woodland or open forest with a shrubby to heathy understorey. Mostly from gentle slopes in red-brown and yellow-brown sandy loams, often with a rocky surface (DECCW 2010).	**Low** No potential habitat for this species was found to occur within the study area.	**Low** The proposal is unlikely to represent any threat to this species.
Herpetofauna			
Delma torquata Collared Delma (V*)	Inhabits eucalypt or acacia dominated woodland and open forest where it is associated with suitable microhabitats (exposed rocky outcrops, or a sparse understorey of tussock grass, shrubs or semi-evergreen vine thickets)	**Low** Potential habitat for this species may occur within more continuous open woodland occurring down-slope of proposed turbine sites within the study area.	**Low** The proposal is unlikely to significantly impact this species.
Underwoodisaurus sphyrurus Border Thick-tailed Gecko (V, V*)	Found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree. Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter.	**Low** Potential habitat for this species may occur within more continuous open woodland occurring down-slope of proposed turbine sites within the study area.	**Low** The proposal is unlikely to significantly impact this species.
Litoria booroolongensis Booroolong Frog (E)	Occurring in vegetation and cobbled shorelines along permanent streams flowing west of the Great Dividing Range. Once widespread from the northern NSW tablelands to Victoria, but recent records are limited to the south-western slopes.	**Low** No suitable habitat occurs within the study area for this species.	**Low** The proposal is unlikely to significantly impact this species.
Litoria castanea Yellow-spotted Bell Frog (E, E*)	Inhabits swamps, lagoons, ponds and slow-flowing streams. Not recorded in the wild since the 1970's, but its previously known range included the New England table-lands and the southern table-lands from Bombala to Lake George.	**Low** Potential habitat for this species may occur within farm dams within the study area, but these habitats are not within the immediate vicinity of turbine sites.	**Low** As this species is unlikely to occur, the proposal is unlikely to represent any threat to this species.
Mixophyes iterates Southern Barred Frog (E, E*)	Coast and ranges from south-eastern Queensland to the Hawkesbury River in NSW. North-eastern NSW, particularly the Coffs Harbour-Dorrigo area, is now a stronghold. Giant Barred Frogs forage and live amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m. They breed around shallow, flowing rocky streams from late spring to summer. Females lay eggs onto moist creek banks or rocks above water level, from where tadpoles drop into the water when hatched. Tadpoles grow to a length of 80 mm and take up to 14 months before changing into frogs. When not breeding the frogs disperse hundreds of metres away from streams. They feed primarily on large insects and spiders (DECCW 2010).	**Low** No suitable habitat occurs within the study area for this species.	**Low** The proposal is unlikely to significantly impact this species.
Avifauna			
Black-necked Stork (*Ephippiorhynchus asiaticus*) (E)	In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, south to central-eastern NSW and with vagrants recorded at scattered sites well away from the coast (for example, near Moree, north-east of Hay and in Victoria). In NSW, the species becomes increasingly uncommon south of the Northern Rivers region, and rarely occurs south of Sydney. Breeding has been recorded as far south as Buladelah in recent years (since 1995), though most breeding in NSW occurs in the north-east. The species *Ephippiorhynchus asiaticus* comprises two	**Low** Farm dams within the study area provide potential foraging habitat for this species. Due to the relatively small area of farm dams within the study area and the larger availability of farm dams and other wetlands within the region, this species is unlikely to occur in the study area any more frequently than on an rare basis. This species may fly through the study area while moving within the local landscape.	**Low** The proposal is unlikely to significantly impact this species.

Species / Community	Habitat Description	Chance of Occurrence In The Study Area	Likely Level of Impact
	subspecies, *E.a. asiaticus* in India and south-eastern Asia, and *E. a. australis* in Australia and New Guinea. These are eventually likely to be treated as two separate species, with the Australian and New Guinea birds known as the Satin Stork *Ephippiorhynchus australis*. Black-necked Storks are mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as salt marshes, mudflats and sand flats, and mangrove vegetation. They mainly forage in shallow, still water, preferring open wetlands, and taking a variety of prey, including eels and other fish, frogs, turtles, snakes, and small invertebrates, such as crabs and small insects. (DECCW 2010).		
Oxyura australis Blue-billed Duck (V)	A frequenter of deep freshwater swamps with thick vegetation. In NSW mostly occurring within 300km of the Murray-Darling basin, but may occur in more coastal areas during dry inland conditions.	**Low** Although it cannot be discounted that Blue-billed Ducks may fly through the proposal area during east / west dispersals, the lack of suitable habitat in the immediate vicinity of the study area, suggests that dispersal movements would follow routes including other areas containing preferred habitat. As such the likelihood that this species might occur within the study area is considered low.	**Low** Due to the lack of suitable habitat and the low likelihood that this species would occur within the study area it is unlikely that the proposal will represent a threat to Blue-billed Duck populations.
Lophoictinia isura Square-tailed Kite (V)	Inhabits open forests and woodlands, particularly those on fertile soils with abundant passerines. They may also range in nearby open habitats but not into extensive treeless regions. This species is notably absent from alpine regions and small isolated remnant woodlands in large open areas.	**Low** Woodland habitats are fragmented within the study area and this species is generally absent from high altitude areas. Unlikely to exist, although due to the wide ranging habits of this species accidental records within the study cannot be discounted.	**Low** This species may fly within the height range of the turbine blades. Due to the low chance of occurrence within the study area, this species is unlikely to be significantly impacted.
Circus assimilis Spotted Harrier (V)	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months. Preys on terrestrial mammals (e.g bandicoots, bettongs, and rodents), birds and reptile, occasionally insects and rarely carrion (DECCW 2010).	**Low - moderate** Areas of pasture and grassland provide potential foraging habitat for this species particularly during periods of long grass growth.	**Low** The species is unlikely to fly within the height range of the turbine blades and is therefore unlikely to be signicantly impacted by the proposed turbines. The relatively small area of woodland/forest vegetation that would be removed is unlikely to significantly impact on this species.
Rostratula australis Australian Painted Snipe (E)	A small freshwater and estuarine wader, which prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Sparsely occurring over a wide distribution it is known to occur in high altitude, and coastal swamps, but most records are from the Murray-Darling Basin.	**Low** Farm dams within the study area, and farm dams and other wetlands within the local area provide potential habitat for this species. This species has not been recorded on the Atlas of NSW Wildlife Database within a 30km radius of the study area. This species may occur in the study area on a rare basis during rare movements within the local area.	**Low** Due to the low chance of occurrence within the study area, this species is unlikely to be significantly impacted by the proposal.
Calyptorhynchus lathami Glossy Black-Cockatoo (V)	Occurs in forests and woodlands where it forages predominantly on *Allocasuarina* cones. Requires large Eucalypt tree hollows for nesting.	**Low** No preferred food trees were identified during field surveys, however they may occur in the local area and birds may move through the proposal study area. This species is unlikely to occur on any more than a rare basis.	**Low** Due to the low chance of occurrence this species is unlikely to be significantly impacted by the proposal.

Species / Community	Habitat Description	Chance of Occurrence In The Study Area	Likely Level of Impact
Lathamus discolor Swift Parrot (E, E*)	On the mainland this species frequents Eucalypt forests and woodlands with large trees having high nectar production during winter. Mainland winter foraging sites often vary from year to year. Nests only in Tasmania.	**Low** This species has not been recorded on the Atlas of NSW Wildlife Database within a 30km radius of the study area. This species may occur on a rare basis during periods of significantly eucalypt flowering.	**Low** Due to the low chance of occurrence this species is unlikely to be significantly impacted by the proposal.
Neophema pulchella Turquoise Parrot (V)	Inhabits forests and woodlands with suitable nest hollows and grassy foraging areas. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Nests in tree hollows, logs or posts, from August to December.	**Moderate** Suitable habitat for this species occurs within the study area and there are several records of this mobile species within a 30km of the study area. This species may occur.	**Low – Moderate** *Neophema* parrots are listed by AusWEA (2002) as potential turbine strike victims however it is unknown if this species commonly flies within the height range of the turbine blades for this proposal. Individuals of this species may collide with turbine blades however, if such collisions occur it is highly likely that only a very small number of birds would be affected. This species is unlikely to be significantly impacted by the proposal.
Glossopsitta pusilla Little Lorikeet (V)	Habitat is mainly dry, open sclerophyll forests and woodlands, usually dominated by Eucalyptus.	**High – Moderate** Suitable habitat for this species occurs within the study area and there are several records of this mobile species within a 30km of the study area. This species may occur.	**Low** It is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur however, if such strikes occur it is highly likely that only a very small number of birds would be affected. This species is unlikely to be significantly impacted by the proposal.
Ninox connivens Barking Owl (V)	Occurs mainly in dry sclerophyll woodland. Nests in large Eucalypt hollows, and roosts in hollows or thick vegetation. Hunts a range of prey species including birds and both terrestrial and arboreal mammals.	**Moderate** Suitable habitat for this species occurs within the study area and there are several records of this species within a 30km of the study area. This species may occur.	**Low** It is unlikely that this species commonly flies within the height range of the turbine blades for this proposal however, should turbine strike occur to individuals flying within the turbine blade height, it is highly likely that only a very small number of birds would be affected. This species is unlikely to be significantly impacted by the proposal.
Ninox strenua Powerful Owl (V)	Occurs in sclerophyll forests and woodlands where suitable prey species occur (being predominantly arboreal mammals). Requires large hollows, usually in Eucalypt trees, for nesting. Roosts in dense vegetation within such areas.	**Low** This species has been recorded twice within a 30 km radius of the study area however, the species is unlikely to occur within the study area due to the lack of large remnants of woodland vegetation.	**Low** It is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur however, given the lack of large remnant woodlands within the study area, should turbine strikes occur it is highly likely that only a very small number of birds would be affected. This species is unlikely to be significantly impacted by the proposal.
Chthonicola sagittata Speckled Warbler (V)	Occupies Eucalypt and Cypress woodlands in drier coastal areas and on the western slopes of the Great Dividing Range. Appears unable to persist in districts where no forested fragments larger than 100ha remain. Occurs in the central and southern Hunter Region where suitable habitat exists.	**High** This species has been recorded four times within a 30 km radius of the study area. This species is likely to occur in parts of the study area that contain shrub cover, particularly where it is associated with areas of remnant woodland.	**Low** This species is a species of the lower canopy, shrub layer and ground covers. This species is unlikely to fly within the height range of the turbine blades. The relatively small areas of habitat removal for this proposal are unlikely to significantly impact this species. This species is unlikely to be significantly impacted by the proposal.
Climacteris picumnus Brown Treecreeper (V)	Frequents drier forests and woodlands, particularly open woodland lacking a dense understorey. Also found in grasslands in proximity to wooded areas where there are sufficient logs, stumps and dead trees nearby. Feeds on invertebrate larvae and small insects, particularly ants. Utilises hollows for roosting/nesting. Appears not to persist in remnants less than 200ha.	**Low – Moderate** This species has been recorded four times within a 30 km radius of the study area. While this resident and relatively conspicuous species was not recorded during field surveys, it may occur in areas not sampled. Proposed turbine locations (predominantly cleared pasture) are unlikely to provide suitable habitat for this species however some areas of proposed powerlines and access tracks (through remnant woodland areas) may possibly provide suitable habitat for the species. This species occurs in dry sclerophyll forest exhibiting significant understorey woodland debris.	**Low** This species is a ground cover, shrub layer and lower canopy species that is highly unlikely to ever fly within the height range of the turbine blades for this proposal. Given the relatively small areas of woodland proposed to be removed for this proposal, this species is unlikely to be significantly impacted if it does occur.
Daphoenositta chrysoptera Varied Sittella (V)	A small 'treecreeper' like bird that covers the majority of Australia. They can be found in a wide range of habitats. Open eucalypt forests and woodlands are the preferred habitat, but this species may also be found in mallee, coastal tea-tree scrubs, inland acacia communities, golf courses orchards and scrubby gardens.	**High** This species was recorded in the study area during field surveys.	**Low** While this species generally flies within the canopy or slightly above it, it is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur. However, if such strikes occur it is highly likely that only a very small number of birds would be affected. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species. This species is unlikely to be significantly impacted by the proposal.

Species / Community	Habitat Description	Chance of Occurrence In The Study Area	Likely Level of Impact
Xanthomyza phrygia Regent Honeyeater (E, E*)	Nomadic Honeyeater that disperses to non-breeding areas, including the coast, in winter, where flowering trees are sought. This species was once widespread within the western slopes and tablelands of NSW, but they are now unpredictable in this area. They can potentially exist anywhere where suitable foraging habitat occurs within the tablelands. Nests mainly west of the divide, although breeding has been recorded in the Armidale area.	**Low** Two records of this highly nomadic seasonal species occur within 30km of the study area. The species may occur on a rare basis during periods of heavy eucalypt flowering within remnant woodland areas.	**Low** It is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur however, if such strikes occur it is highly likely that only a very small number of birds would be affected. Due to the low chance of occurrence and the high likelihood that turbine strikes would be rare if they occur, this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species.
Petroica boodang Scarlet Robin (V)	Ranges from SE Qld to the Victoria coast into South Australia. In summer, forages in stringybark, other eucalypt woodland, from stumps, low branches. . Is part migratory in which in autumn/winter moves to more open habitats. Habitat are foothill forests, woodlands, watercourses, in autumn/winter more open habitats, river red gum woodlands, golf courses, parks, orchards and gardens.	**Moderate** Seven records of this species occur within a 30km radius of the study area. Suitable habitat occurs for this species within the study area.	**Low** It is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur however, if such strikes occur it is highly likely that only a very small number of birds would be affected. Due to the low chance of occurrence and the high likelihood that turbine strikes would be rare if they occur, this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species.
Poephila cincta subsp. *cinta* Black-throated Finch (southern subspecies) (E, E*)	The species is found in eucalypt woodland and riverside vegetation, including paperbark and wattle shrubland. Areas close to water with a dense understorey of seeding grass and shrubs are favoured.	**Low** A single record of this species occurs within a 30km radius of the study area. No suitable habitat occurs within the individual proposed turbine locations however some areas of suitable habitat may occur within areas of proposed powerlines and access tracks.	**Low** As there is no suitable habitat within the proposed turbine locations, this species is unlikely to encounter turbines and furthermore is unlikely to fly within the turbine blade height. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species.
Stagonopleura guttata Diamond Firetail (V)	Small Finch occupying open woodlands / forests and associated habitats with grassy understorey. Generally found west of the Divide or in drier semi-coastal areas such as the upper Hunter Valley. Appears unable to persist in remnants less than 200ha.	**Low** Five records of this species occur within a 30km radius of the study area. Suitable habitat occurs for this species within the study area.	**Low** It is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur however, if such strikes occur it is highly likely that only a very small number of birds would be affected. Due to the low chance of occurrence and the high likelihood that turbine strikes would be rare (if they occur), this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species.
Mammals			
Dasyurus maculatus Spotted-tailed Quoll (V, V*)	Found in a variety of forested habitats. This species creates a den in fallen hollow logs or among rocky outcrops. Generally does not occur in otherwise suitable habitats that are in close proximity to urban development. Most records west of the divide associated with significant areas of rugged country.	**Low** This species requires extensive old-growth habitat, which does not occur within the study area. Therefore it is unlikely that this species occurs within the study area.	**Low** Due to the lack of records and suitable habitat within the locality it is unlikely that this species will be affected by the proposal.
Petrogale penicillata Brush-tailed Rock Wallaby (E, V*)	Occurs in forests and woodlands along the Great Divide and on the western slopes in escarpment country with suitable caves and rocky overhangs for shelter.	**Low** Tableland populations of this species occur in the gorge country to the east, but the extensive rocky habitats required by this species do not occur within the study area.	**Low** Due to the lack of records and suitable habitat within the locality it is unlikely that this species will be affected by the proposal.
Petaurus norfolcensis Squirrel Glider (V)	Occurs in Eucalypt Forests and Woodlands where it feeds on sap exudates and blossoms. In these areas tree hollows are utilised for nesting sites. Also requires winter foraging resources when the availability of normal food resources may be limited, such as winter-flowering shrub and small tree species.	**Moderate** Records for this species occur within 30km of the study area and suitable habitat exists within the study area.	**Low** Due to the small amount of vegetation to be removed by the proposal in relation to the amount available in the vicinity, it is unlikely that this species will be affected by the proposal.
Petaurus australis Yellow-bellied Glider (V)	Usually associated with tall, mature wet Eucalypt forest. Also known from tall dry open forest and mature woodland. The diverse diet of this species is primarily made up of Eucalypt nectar, sap, honey dew, manna and invertebrates found under decorticating bark and	**Low – Moderate** One record for this species occurs within 30km of the study area and whilst suitable habitat exists within the locality, habitat within the study area is considered marginal.	**Low** Due to the marginal habitat and small amount of vegetation to be removed by the proposal in relation to the amount available in the vicinity, it is unlikely that this species will be affected by the proposal.

Species / Community	Habitat Description	Chance of Occurrence In The Study Area	Likely Level of Impact
	pollen. Tree hollows for nest sites are essential, as are suitable food trees in close proximity.		
Phascolarctos cinereus Koala (V)	Occurs in forests and woodlands where it requires suitable feed trees (particular *Eucalyptus* spp.) and habitat linkages. Will occasionally cross open areas, although it becomes more vulnerable to predator attack and road mortality during these excursions.	**Moderate – High** Several records for this species occur within the locality. Habitat for this species exists throughout the study area.	**Low** Due to the small amount of vegetation to be removed by the proposal in relation to the amount available in the vicinity, it is unlikely that this species will be affected by the proposal.
Potorous tridactylus Long-nosed Potoroo (V, V*)	Prefers cool rainforest, wet sclerophyll forest and heathland. Sleeps by day in a nest on the ground, and digs for succulent roots, tubers, fungi and subterranean insects. Some diggings seemingly attributable to this species may belong to *Isoodon macrourus* (Northern Brown Bandicoot).	**Low** Largely a coastal species in NSW, no records for this species occur within the wider locality of the study area and woodland habitat within the study area does not contain dense understorey vegetation frequented by this species.	**Low** Due to the lack of records and suitable habitat within the locality it is unlikely that this species will be affected by the proposal.
Pteropus poliocephalus Grey-headed Flying-fox (V, V*)	Forages over a large area for nectar / fruits etc. Seasonally roosts in communal base camps situated within wet sclerophyll forests or rainforest. Frequently observed to forage in flowering Eucalypts. May occur anywhere within the Hunter Region where food or roosting resources are available.	**Low – Moderate** Unlikely to frequent the study area continuously throughout the year, but may occur during periods of heavy eucalypt flowering.	**Low – Moderate** This species is considered to be a potential turbine strike victim. This species commonly flies commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur however, if such strikes occur it is highly likely that only a very small number of bats would be affected. Due to the low chance of occurrence within the height of the turbine blades and the high likelihood that turbine strikes would be rare (if they occur), this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species
Chalinolobus dwyeri Large-eared Pied Bat (V, V*)	This species forages in tall open forests and the edges of rainforest. It roosts in caves, mine shafts and similar structures.	**Low – Moderate** Whilst suitable roosting and foraging habitat exists within the study area, no records exist from the Glen Innes 1:100,000 map sheets (Atlas of NSW Wildlife data) and the species was not recorded during investigations.	**Low** Due to the lack of records within the locality it is unlikely that this species occurs and as such is unlikely to be affected by the proposal.
Chalinolobus picatus Little Pied Bat (V)	This species forages in a range of habitats including dry open forest, open woodland and mulga. It roosts in caves, mine shafts and similar structures.	**Moderate** Recorded during field surveys and twice within a 30km radius of the study area. Caves occur within the locality and potential foraging habitat occurs throughout the study area.	**Low - Moderate** This species is considered to be a potential turbine strike victim. It is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur however, if such strikes occur it is highly likely that only a very small number of bats would be affected. Due to the low chance of occurrence within the height of the turbine blades and the high likelihood that turbine strikes would be rare (if they occur), this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species. As this species roosts and breeds within caves and similar structures, the proposal is unlikely to have any impact on this species roosting and breeding habitat.
Miniopterus schreibersii Eastern Bentwing-Bat (V)	This species utilises a range of habitats for foraging, including rainforest, wet and dry sclerophyll forests, woodlands and open grasslands. Requires caves or similar structures for roosting habitat.	**High** Recorded within the study area. Caves occur within locality and potential foraging habitat occurs throughout the study area.	**Low - Moderate** This species is considered to be a potential turbine strike victim. It is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur however, if such strikes occur it is highly likely that only a very small number of bats would be affected. Due to the low chance of occurrence within the height of the turbine blades and the high likelihood that turbine strikes would be rare (if they occur), this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species. As this species roosts and breeds within caves and similar structures, the proposal is unlikely to have any impact on this species roosting and breeding habitat.

Species / Community	Habitat Description	Chance of Occurrence In The Study Area	Likely Level of Impact
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat (V)	Range of habitats from rainforest to arid shrubland, roosts in tree-hollows. There are scattered records of this species across the New England Tablelands and North West Slopes. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country.	**Moderate** Recorded twice within 30km of the study area. Hollow-bearing trees that may be used as roost study areas and potential foraging habitat occur throughout the study area.	**Low - Moderate** This species is considered to be a potential turbine strike victim. While this species is known to fly above the canopy (Churchill 2008) it is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur. However, if such strikes occur it is highly likely that only a very small number of bats would be affected. Due to the high likelihood that turbine strikes would be rare (if they occur), this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species.
Scoteanax rueppellii Greater Broad-nosed Bat (V)	Forages in moister gullies and wet sclerophyll forests as well as in lightly wooded areas and open spaces / ecotones. This species roosts in tree hollows.	**Moderate** Recorded four times within 30km of the study area. Hollow-bearing trees that may be used as roost study areas and potential foraging habitat occur throughout the study area.	**Low - Moderate** This species is considered to be a potential turbine strike victim. While this species is known to within and adjacent to forest canopies (Churchill 2008) it is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur. However, if such strikes occur it is highly likely that only a very small number of bats would be affected. Due to the high likelihood that turbine strikes would be rare (if they occur), this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species.
Nyctophilus timoriensis Greater Long-eared Bat (V)	This species is thought to prefer semi-arid areas, though has been recorded from the high rainfall areas in southwest WA. Known to roost in tree hollows, fissures in branches and under dried sheets of bark still attached to trees.	**Moderate** Records known for the wider locality. Hollow-bearing trees that may be used as roost study areas and potential foraging habitat occur throughout the study area.	**Low - Moderate** This species is considered to be a potential turbine strike victim. It is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur. However, if such strikes occur it is highly likely that only a very small number of bats would be affected. Due to the high likelihood that turbine strikes would be rare (if they occur), this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species.
Endangered Ecological Communities			
Howell shrublands in the Northern Tablelands and Nandewar bioregions (E)	This community has been recorded primarily around Copeton Dam and Goonoowigal near Inverell with a small occurrence at Warrabah. It is dominated by low shrubs, particularly *Homoranthus prolixus* and *Babingtonia densifolia*. Occasionally all shrubs may be absent giving a grassland structure or *Callitris endlicheri* and various eucalypts such as *Eucalyptus dealbata* and *E. prava* may be present giving the appearance of open woodland.	**Low** The species composition and geomorphological characteristics of this EEC do not occur within the study area.	**Low** This EEC does not occur within the study area therefore the proposal is unlikely to represent any threat to this EEC.
McKies stringybark/ blackbutt open forest in the Nandewar and New England Tableland bioregions (E)	Characteristic tree species include *Eucalyptus andrewsii*, *E. mckieana* and *Callitris endlicheri*. This community is found on lateritic soils in low lying areas on hill slopes and open depressions. It has a restricted distribution between Clayton Chase in the north and areas south of Gilgai. It is currently known from Inverell LGA, but may occur in Guyra and Uralla and possibly other LGAs.	**Low** The species composition and geomorphological characteristics of this EEC do not occur within the study area.	**Low** This EEC does not occur within the study area therefore the proposal is unlikely to represent any threat to this EEC.
Montane peatlands and swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and	It occurs on undulating tablelands and plateaus above 400-500m elevation, generally in catchments with basic volcanic or fine-grained sedimentary substrates or occasionally, granite. The community consists of a dense, open or sparse layer of shrubs with soft-leaved sedges, grasses and forbs. It is the only type of wetland that may contain more than trace amounts of *Sphagnum* sp., the hummock forming mosses. Small trees may be present as scattered emergents or absent from the	**Low** The species composition and geomorphological characteristics of this EEC do not occur within the study area.	**Low** This EEC does not occur within the study area therefore the proposal is unlikely to represent any threat to this EEC.

Species / Community	Habitat Description	Chance of Occurrence In The Study Area	Likely Level of Impact
Australian Alps bioregions. (E)	community.		
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (CE*)	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland are typically dominated by tussock grasses in the genera *Austrodanthonia, Austrostipa, Bothriochloa, Chloris, Enteropogon,* or *Themeda.*	**Low** The species composition and geomorphological characteristics of this EEC do not occur within the study area.	**Low** This EEC does not occur within the study area therefore the proposal is unlikely to represent any threat to this EEC.
New England Peppermint (*Eucalyptus nova-anglica*) Woodland on Basalts and Sediments in the New England Tableland Bioregion (E)	A woodland community dominated by *E. nova-anglica* and occasionally *E. dalrympleana* subsp. *heptantha* (Mountain Gum). This community is characterised by few shrubs within a grassy understorey and grows on valley flats characterised by basaltic soils, fine-grained sedimentary and acid volcanic substrates and poorly drained loam-clay soils. It is known to occur in the greater Armidale locality at Boorolong and Mt Duval NR's to the north, Yina NR to the east and Imbota NR to the southeast.	**Low** The species composition and geomorphological characteristics of this EEC do not occur within the study area.	**Low** Areas where this community occurs are well away from any proposed development areas. It is highly unlikely that the proposal will have an impact upon this community
Ribbon Gum, Mountain Gum, Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion (E)	An EEC occurring across a wide range of LGA's within the Bioregion with the canopy stratum containing *Eucalyptus viminalis* (Ribbon Gum), *E. dalrympleana subsp. Heptantha* (Mountain Gum), *E. pauciflora* (Snow Gum or White Sallee) and less often *E. stellulata* (Black Sallee). In the understorey the shrubs, *Acacia dealbata, Pultenaea microphylla* and *Pimelea linifolia*, are often present. The ground cover layer is usually densely to very densely covered with grass species, such as, *Poa sieberiana var. sieberiana, P.labillardieri var. labillardieri, Themeda australis* and *Elymus scaber*, and there is often a diverse compliment of herbaceous plant species present. This EEC provides important habitat for the nationally and State threatened plant species *Thesium australe* (Austral Toadflax).	**High** This vegetation community was recorded as the dominant community throughout the study area. The majority of this vegetation is currently being grazed by livestock with the shrub layer being mostly absent and high pasture weed incursions throughout its extent within the study area.	**Low - Moderate** This vegetation community occurred as the dominant vegetation community within the study area. Small areas of this community will be required to be removed for the construction of roads and cabling. The majority of the vegetation to be removed has been highly altered from agriculture practices which has occurred over the past century.
Upland Wetlands of the Drainage Divide of the New England Tablelands (E, CE*)	An EEC, which is represented by a number of high altitude wetlands on the New England Tableland. They range in size from shallow and temporary ponds to near-permanent wetland habitats and are usually vegetated by sedges, rushes, spike-rushes, grasses or other aquatic plants. Vegetation distribution may vary between wetlands depending upon water depth and in some wetlands vegetation may die back during dry times.	**Low** The species composition and geomorphological characteristics of this EEC do not occur within the study area.	**Low** This EEC does not occur within the study area therefore the proposal is unlikely to represent any threat to this EEC.
Weeping Myall Woodlands (E*)			
White Box Yellow Box Blakely's Red Gum Woodland (E)	White Box Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*). Intact study areas contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. The community also includes a range of mammal, bird, reptile, frog and invertebrate fauna species. Intact stands that contain diverse upper and mid-storeys and groundlayers are rare. Modified study areas include the following: 1. areas where the	**High** This vegetation community was recorded within the north of the study area. The whole of this vegetation is currently being grazed by livestock with the shrub layer being completely absent and the ground layer improved. This community therefore qualifies as an Endangered Ecological Community under the TSC Act but not under the EPBC Act, which requires a native understorey to be present in order to be considered as the listed community.	**Low** Efforts have been made to avoid impacts to this EEC and therefore the proposal is unlikely to represent any threat to the EEC.

Species / Community	Habitat Description	Chance of Occurrence In The Study Area	Likely Level of Impact
	main tree species are present ranging from an open woodland formation to a forest structure, and the groundlayer is predominantly composed of exotic species; and 2. study areas where the trees have been removed and only the grassy groundlayer and some herbs remain.		
White Gum Moist Forest in the NSW North Coast Bioregion – Preliminary determination (E)	White Gum Moist Forest is a Tall Open Forest which has a canopy of eucalypts and an understorey of rainforest trees, shrubs, vines, palms and ferns. The dominant overstorey species include *Eucalyptus salinga* (Sydney Blue Gum), *Eucalyptus microcorys* (Tallowwood) and or *Lophostemon confertus* (Brush Box). The dominant understorey species include *Acmena smithii* (Lilly Pilly), *Acronychia oblongifolia* (Common Acronychia), *Cordyline petiolaris* (Coast Banksia), *Cryptocary microneura* (Murrogun), *Diploglottis australis* (Native Thorn), *Polyscias elegans* (Celery Wood), *Rubus rosifolius* (Rose-leaf Bramble) a wide variety of rainforest vines and graminiods also occur within the understorey of this EEC. This community occurs on the escarpment slopes and foothills of North-east NSW, most commonly between 400 and 650 m elevation. Soils are usually derived from basalt or fine-grained sediments, or alluvial substrates. It is typically found in gullies and on lower slopes but it has been previously recorded on upper slopes and basalt ridges.	**Low** The species composition and geomorphological characteristics of this EEC do not occur within the study area.	**Low** This EEC does not occur within the study area therefore the proposal is unlikely to represent any threat to this EEC.
Endangered Populations			
Tusked Frog population in the Nandewar and New England Tablelands Bioregions	The Tusked Frog is a small frog growing to 50mm long. The dorsal ground colour is a sandy brown to dark grey-brown with raised lumpy tubercles topped with chocolate brown. The species has a black and white pattern on the ventral side and red colouration in the groin and the back of the thighs. Males are separated from females by a disproportionately large head size. The species is common in coastal habitats, but has become increasingly rare in high altitudinal areas. Habitat favoured by this species encompasses a wide range of habitat types and they are usually well hidden in vegetation associated with standing water, such as ponds, dams, wetlands and flooded grasslands.	**Low – Moderate** Potential habitat for this species occurs within farm dams containing vegetation and within the lower drainage lines of the study area. This species was not recorded during fauna surveys despite suitable breeding conditions evidenced by the calling of several other species.	**Low** This species is unlikely to be adversely affected by the proposal.

Notes:
(V) = Vulnerable Species listed under the TSC Act.
(E) = Endangered Species listed under the TSC Act.
(V*) = Vulnerable Species listed under the EPBC Act.
(CE*) = Critically Endangered Species listed under the EPBC Act.
(E*) = Endangered Species listed under the EPBC Act.
(M*) = Migratory Species listed under the EPBC Act.

6.2 Assessment of Significant Species / Communities

Following the assessment carried out within **Table 6-1**, it has been deemed appropriate to apply further detailed assessment to the following species / communities, due to projected potential levels of impacts likely to result from the proposal.

Flora

- *Bothriochloa biloba* Lobed Bluegrass (V*)
- *Dichanthium setosum* Bluegrass (V)
- *Digitaria porrecta* Finger Panic Grass (E, E*)
- *Thesium australe* Austral Toadflax (V, V*)

Endangered Ecological Communities

- Ribbon Gum – Mountain Gum – Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion;

Fauna

- *Neophema pulchella* Turquoise Parrot (V)
- *Pteropus poliocephalus* Grey-headed Flying-fox (V, V*)
- *Miniopterus schreibersii* Eastern Bentwing-bat (V)
- *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat (V)
- *Scoteanax rueppellii* Greater Broad-nosed Bat (V)
- *Nyctophilus timoriensis* Greater Long-eared Bat (V)
- *Chalinolobus picatus* Little Pied Bat (V)

6.2.1 Threatened Flora

Bothriochloa biloba

This species was not detected within the study during the current survey, however there is suboptimal habitat present within the wooded areas of the study area.

The construction of the proposal is unlikely to have a significant impact upon the species as the study area has already been significantly impacted upon by a long history of agricultural practices which has reduced the likelihood of occurrence of this species. Additionally, the proposal will impact on a relatively small area of any potential habitat. Therefore, it is considered that the development proposal will not have a significant impact upon the population.

Dichanthium setosum

This species was not detected within the study during the survey, however there is a record within the south-east of the study area perimeter and additional records within the locality.

The construction of the proposal is unlikely to have a significant impact upon the species as the study area has already been significantly impacted upon by a long history of agricultural practices which has reduced the likelihood of occurrence of this species. Additionally, the proposal will impact on a relatively small area of any potential habitat. Therefore, it is considered that the development proposal will not have a significant impact upon the population.

Digitaria porrecta

This species was not detected within the study during the current survey, however there is some habitat present within the less "improved" parts of the study area.

Notwithstanding, the construction of the proposal is unlikely to have a significant impact upon the species as the study area has already been significantly impacted upon by a long history of agricultural practices which has reduced the likelihood of occurrence of this species. Additionally, the proposal will impact on a relatively small area of any potential habitat. Therefore, it is considered that the development proposal will not have a significant impact upon the population.

Thesium australe

Targeted surveys for this species within the study area failed to detect this species, however several records exist within the local area and the Ribbon Gum – Mountain Gum – Snow Gum Tall Open Forest vegetation communities within the study area provide potential habitat for this species. The majority of this community is degraded by grazing with incursions of pasture weeds and a simplified structure. However there are some adjacent areas of intact moderately good condition vegetation on the steeper slopes which would provide ideal habitat for this species. These more suitable areas are located away from any turbine locations or associated infrastructure and will not be impacted upon by the proposal. Therefore, it is considered that the development proposal will not have a significant impact upon the population.

6.2.2 Endangered Ecological Communities

Ribbon Gum – Mountain Gum – Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion;

This EEC is the dominant vegetation community throughout the study area. Approximately 22 ha (7%) of the mapped EEC within the study area will be required to be removed as part of the proposal. The majority of this community is degraded by grazing with incursions of pasture weeds and a simplified structure.

Given that the majority of this EEC (93%) will be not be impacted upon by the proposal and larger intact stands occur immediately adjacent along the steeper slopes, it is considered highly unlikely this EEC will be significantly impacted upon by the proposal. Therefore it is unlikely that the development proposal will have a significant impact upon this EEC.

6.2.3 Threatened Fauna

Turquoise Parrot

This species was not observed during bird surveys and most pastured areas of the study area were characterised by dense ground coverings of pasture grasses, which are not highly suitable to this species' foraging requirements. This species is common to the west in the Inverell area, but there may be some movements to the tablelands when dry foraging conditions drive them from those areas. It is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur. However, if such strikes occur it is highly likely that only a very small number of birds would be affected. Due to the low chance of occurrence and the high likelihood that turbine strikes would be rare (if they occur), this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species.

Grey-headed Flying Fox

No roosting camps for this bat where found in the vicinity of the study area. This species was not observed during surveys within the study area, but may occur on an intermittent basis during periods of heavy eucalypt flowering. Given that the study area does not represent a substantial resource for this species and visiting animals will be rare, the proposal is unlikely to have a significant impact upon this species.

This species is considered to be a potential turbine strike victim. This species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur. However, if such strikes occur it is highly likely that only a very small number of bats would be affected. Due to the high likelihood that turbine strikes would be rare (if they occur), this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species.

Eastern Bentwing-Bat

This species utilises a diverse range of woodland habitats for foraging, and it is likely that the study area would be used as part of its foraging range. Within the study area, the Eastern Bentwing Bat was recorded at 12 study areas. Cave roosting habitat exists within steep rocky gullies within the vicinity.

This species is considered to be a potential turbine strike victim. It is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur. However, if such strikes occur it is highly likely that only a very small number of bats would be affected. Due to a low chance of occurrence within the height of the turbine blades and the high likelihood that turbine strikes would be rare (if they occur), this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species. As this species roosts and breeds within caves and similar structures, the proposal is unlikely to have any impact on this species roosting and breeding habitat.

Yellow-bellied Sheathtail-Bat
This species was not recorded during surveys, however records exist in the locality. This species is considered at risk since it flies at height within relatively open areas preferred for turbine placement. However, if present, the low activity of this species within the study area suggests that the species occurs at relatively low density.

Roosting habitat within hollow-bearing trees occurs within forested remnants and as paddock trees within the grassland with scattered trees vegetation community. Careful micro-siting of turbines and infrastructure has been undertaken to minimise the number of hollow-bearing trees that would be required to be removed within the study area.

Due to the low activity levels and frequency of occurrence of the species within the study area the species is not considered likely to be placed at risk of extinction as a result of the proposal. In addition, the minimisation of hollow-bearing tree removal will limit the potential impacts on roosting habitat as a result of the proposal.

Greater Broad-nosed bat
This species was not recorded during surveys, however records exist in the locality. This species is generally associated with forested riparian habitats such as in gullies along creeks and rivers. As such, the proposed turbines that are situated on ridge tops and more than 100m away from vegetation are not considered likely to be a threat to this species.

Roosting habitat within hollow-bearing trees occurs within forested remnants and as paddock trees within the grassland with scattered trees vegetation community. Careful micro-siting of turbines and infrastructure will be undertaken to minimise the number of hollow-bearing trees that would be required to be removed within the study area.

Greater Long-eared Bat
This species was not recorded during surveys, however records exist in the locality. This species is generally associated with semi-arid areas and as such would only occur on study area intermittently or in very low numbers.

Roosting habitat within hollow-bearing trees and behind bark occurs within forested remnants and as paddock trees within the grassland with scattered trees vegetation community. Careful micro-siting of turbines and infrastructure will be undertaken to minimise the number of hollow-bearing trees that would be required to be removed within the study area.

Little Pied Bat
This species utilises a diverse range of woodland habitats for foraging, and it is likely that the study area would be used as part of its foraging range. Cave roosting habitat exists within steep rocky gullies within the vicinity. This species is considered to be a potential turbine strike victim. It is unknown if this species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur however, if such strikes occur it is highly likely that only a very small number of bats would be affected. Due

to the low chance of occurrence within the height of the turbine blades and the high likelihood that turbine strikes would be rare (if they occur), this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species. As this species roosts and breeds within caves and similar structures, the proposal is unlikely to have any impact on this species roosting and breeding habitat.

6.3 Key Threatening Processes (KTP)

A Key Threatening Process (KTP) is defined in the TSC Act as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities. Something can be a threat if it:

- adversely affects two or more threatened species, populations or ecological communities; or
- could cause species, populations or ecological communities that are not currently threatened to become threatened.

Key Threatening Processes are listed in Schedule 3 of the TSC Act. Those potentially applicable to the proposal, are as follows:

1. Loss of Hollow-bearing trees

The proposal will likely require the removal of some hollow-bearing trees (mainly along proposed powerlines and access tracks) and as such is considered as likely to contribute to the Key Threatening Process "Loss of Hollow-bearing Trees".

2. Clearing of Native Vegetation

The proposed development will require the removal of a relatively small area of native vegetation (mainly along proposed powerlines and access tracks) and as such is considered to contribute to the Key Threatening Process "Clearing of Native Vegetation".

3. Human Caused Climate Change

The proposal is likely to contribute slightly to the Key Threatening Process "Human Caused Climate Change" as a result of clearing vegetation. It is considered that clearing and modification of the landscape would constitute only a minor incremental increase in the effects of this KTP. Additionally, the provision of renewable energy sources such as wind power would reduce emissions when compared to existing energy sources such as coal. Thus the extent to which the proposal could contribute to this process is considered unlikely to be significant.

4. Infection of Native Plants by Phytophthora cinnamomi

Phytophthora cinnamomi is a water mould (like a fungus) that attacks the roots of susceptible plants, in many cases killing the plants. In some native plant communities, epidemic disease can develop causing death of large numbers of plants. *P. cinnamomi* may spread with the movement of infected soil or plant material by people, animals and may be transported by percolating through the soil, in creeks or storm runoff. People can

also transport the fungus to new areas on dirt adhering to vehicles, items they are carrying or footwear.

The transportation of *Phytophthora cinnamomi* from other areas may occur by the movement of soils attached to earth moving machinery. Precautionary measures such as cleaning of machinery prior to transportation can help to limit the potential for this KTP to occur, and should be addressed in Environmental Management Plans for study area construction activities.

5. Invasion of Native Plant Communities by Exotic Perennial Grasses

There is opportunity for the KTP "Invasion of native plant communities by exotic perennial grasses" to occur within the study area due to the removal of vegetation and the exposing of underlying soils. For the most part, this KTP already occurs along tracks throughout all the cleared areas within the study area. Precautionary measures such as clearing of machinery prior to clearing can help to limit the potential for this KTP to occur, and should be addressed in Environmental Management Plans generated for study area construction activities.

6. Removal of Dead Wood and Dead Trees

During the clearing of vegetation within the study area a number of dead trees are likely to be removed and this may represent opportunity for the KTP "Removal of dead trees and dead wood". It is unlikely that this KTP will represent a significant threat to threatened species occurring within the study area, provided an ecologist is present during clearing works. Consideration should be given to selective relocation of dead trees and logs into conservation lands.

7. Alteration to the Natural Flow Regimes of Rivers And Streams and Their Floodplains and Wetlands

Construction of the access tracks and wind turbines will likely result in very minor changes to the runoff characteristics of land within the study area. Such changes may result in a insignificant alteration to the natural flow regimes of ephemeral streams within the local area.

No other KTP's are believed to be relevant to the current proposal.

6.4 Assessment under the EPBC Act

An EPBC Act Protected Matters Database Search was undertaken using the DEWHA on-line database (accessed October 2010) to generate a list of relevant matters of National Environmental Significance (NES) within the Study Area.

The matters of NES relevant to this flora and fauna assessment are:

- Wetlands of International Significance (RAMSAR study areas);
- TECs;
- Threatened species;

- Migratory species; and
- Critical Habitats

Table 6-1 includes the EPBC Act listed threatened species and TECs identified during the database search. Following is an assessment of whether the Proposal is likely to impact on any of the above matters of NES.

6.4.1 Wetlands Protected by International Treaty (the RAMSAR Convention)

The site does not contain any wetland areas of international significance. However, it is located within the same catchment as the Gwydir Wetlands Ramsar Site. The site is located approximately 240km upstream of the Gwydir Wetlands Ramsar Site, and will not have a direct impact on this wetland of international significance.

6.4.2 Nationally Listed Threatened Species and Ecological Communities

The EPBC Protected Matters Database Search identified a number of TEC and threatened species as potentially occurring within the Study Area. Following the removal of marine species and the addition of other EPBC Act-listed ecological communities and threatened species identified during the literature review process, the following EPBC Act listed species and communities were identified as potentially occurring within the study area (in **Table 6-1**):

- *Bothriochloa biloba* Lobed Bluegrass (V*)
- *Digitaria porrecta* Finger Panic Grass (E, E*)
- *Thesium australe* Austral Toadflax (V, V*)
- *Pteropus poliocephalus* Grey-headed Flying-fox (V, V*)
- White box - yellow box - Blakely's red gum grassy woodlands and derived native grasslands EEC

Bothriochloa biloba was not detected within the study during the current survey, however there is suboptimal habitat present within the wooded areas of the study area. The construction of the proposal is unlikely to have a significant impact upon the species as the study area has already been significantly impacted upon by a long history of agricultural practices which has reduced the likelihood of occurrence of this species. Additionally, the proposal will impact on a relatively small area of any potential habitat. Therefore, it is considered that the development proposal will not have a significant impact upon the population.

Targeted surveys for *Thesium australe* within the study area failed to detect this species, however several records exist within the local area and the Ribbon Gum – Mountain Gum – Snow Gum Tall Open Forest vegetation communities within the study area provide potential habitat for this species. The majority of this community is degraded by grazing with incursions of pasture weeds and a simplified structure. However there are some adjacent areas of intact moderately good condition vegetation on the steeper slopes which would provide ideal habitat for this species. These more suitable areas are located away from any turbine locations or associated infrastructure and will not be impacted upon by

the proposal. Therefore, it is considered that the development proposal will not have a significant impact upon the population.

Digitaria porrecta was not detected within the study during the current survey, however there is some habitat present within the less improved areas of the study area. Notwithstanding, the construction of the proposal is unlikely to have a significant impact upon the species as the study area has already been significantly impacted upon by a long history of agricultural practices which has reduced the likelihood of occurrence of this species. Additionally, the proposal will impact on a relatively small area of any potential habitat. Therefore, it is considered that the development proposal will not have a significant impact upon the population.

The Grey-headed Flying-fox was not observed during surveys within the study area, but may occur on an intermittent basis during periods of heavy eucalypt flowering. This species is considered to be a potential turbine strike victim. This species commonly flies within the height range of the turbine blades for this proposal and as such turbine strike may occur. However, if such strikes occur it is highly likely that only a very small number of bats would be affected. Due to the high likelihood that turbine strikes would be rare (if they occur), this species is unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on this species.

White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands does not occur within the study area. Although the NSW equivalent of this community is considered to occur in the form of the Yellow Box Woodland community, the EPBC definition requires a native understorey to be present in order to be considered as the listed community. No native understorey exists and therefore this community does not occur. In any case this community will not be impacted upon.

6.4.3 Nationally Listed Migratory Species

A total of 11 migratory species listed under the EPBC Act have been recorded or have suitable habitat within the Study Area. Of the 11 migratory species, the following six species potentially fly within the turbine blade height;

- White-bellied Sea Eagle *Haliaeetus leucogaster*
- White-throated Needletail *Hirundapus caudacutus*
- Rainbow Bee-eater *Merops ornatus*
- Great Egret *Ardea alba*
- Cattle Egret *Ardea ibis*
- Fork-tailed Swift *Apus pacificus*

Each of these species is potential turbine strike victims. Each species may fly within the height range of the turbine blades for this proposal and as such turbine strike may occur. However, if such strikes occur it is highly likely that only a very small number of birds would be affected (due to nature avoidance behaviour). Due to the high likelihood that

turbine strikes would be rare (if they occur), these species are unlikely to be significantly impacted by the proposal. The removal of relatively small areas of woodland for this proposal (in relation to the amount remaining) is unlikely to significantly impact on any of the migratory species.

The proposal is unlikely to substantially modify, destroy or isolate an area of important habitat, result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat or seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species.

6.4.4 EPBC Act Summary Statement

Due to the relatively small area of woodland habitat to be removed relative to that remaining and the low chance of turbine strike for all high flying species, the proposed Proposal is unlikely to impact on any national listed threatened species, ecological communities or migratory species. A Referral may be made to SEWPAC where a precautionary approach is desired.

6.5 Assessment under SEPP 44 – 'Koala Habitat Protection'

First Consideration – Is the Land 'Potential Koala Habitat'?
Guyra and Severn Local Government Area (LGA) are listed in Schedule 1 of SEPP 44, therefore this policy is applicable to the study area. *Eucalyptus viminalis* (Ribbon Gum) was the only Schedule 2 Koala feed tree recorded within the study area.

Eucalyptus viminalis occurred as a dominant species within Ribbon Gum – Mountain Gum – Snow Gum – Tall Open Forest in addition to occurring commonly as scattered trees within the Cleared Pasture with Scattered Trees vegetation community. Due to the widespread occurrence of *Eucalyptus viminalis,* it comprised greater than 15% of the canopy tree species within much of the study area. As such, areas mapped as Ribbon Gum – Mountain Gum – Snow Gum – Tall Open Forest, New England Blackbutt – Silver Top Stringybark – Ribbon Gum Open Forest and Cleared Pasture with Scattered Trees vegetation communities within the study area were found to be potential Koala habitat as defined by SEPP 44 Koala Habitat Protection.

Second Consideration – Is the Land 'Core Koala Habitat'?
Core Koala habitat is defined by SEPP 44 Koala Habitat Protection as "an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population". No animals were noted on study area and no secondary evidence of the presence of Koalas was identified. Notwithstanding, several records exist within the locality and in close proximity to the study area. It is unlikely that 'Core Koala Habitat' occurs within the study area.

Should the koala occur within the study area the proposal is unlikely to have a significant impact on the koala. A relatively small area of woodland vegetation, relative to the remaining woodland vegetation, would be cleared for powerlines and access tracks as

part of the proposal. The removal of such vegetation is unlikely to significantly impact on the koala.

6.6 Key Thresholds Assessment (Part 3A)

As required by the Draft *Guidelines for Threatened Species Assessment* for Part 3A applications (DEC / DPI 2005), the following assessment of Key Thresholds (four in total) is provided for the proposal.

1. ***Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.***

The proposal has the potential to impact on threatened fauna species primarily through mortality resulting from occasional turbine strikes. The fauna species most at risk from the proposal include highflying bird and bat species such as raptors, wetland/waterbirds, and the Eastern Bentwing-bat. Turbines and infrastructure have been positioned away from remnant vegetation as far as possible to minimise potential impacts on threatened flora species and endangered ecological communities. Providing the recommended mitigation measures are adopted, the proposal is considered likely to maintain biodiversity values within the region.

2. ***Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.***

Given the small amount of vegetation to be removed and providing the recommended mitigation measures are adopted, the proposal is considered unlikely to reduce the long-term viability of a local population of species or endangered ecological community.

3. ***Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.***

Given the small amount of vegetation to be removed and providing the recommended mitigation measures are adopted, the proposal is considered unlikely to accelerate the extinction of threatened species or endangered ecological communities recorded within the study area.

4. ***Whether or not the proposal will adversely affect critical habitat.***

There is no declared “Critical Habitat” within the study area or local area, and as such the proposal will not adversely affect any such habitat.

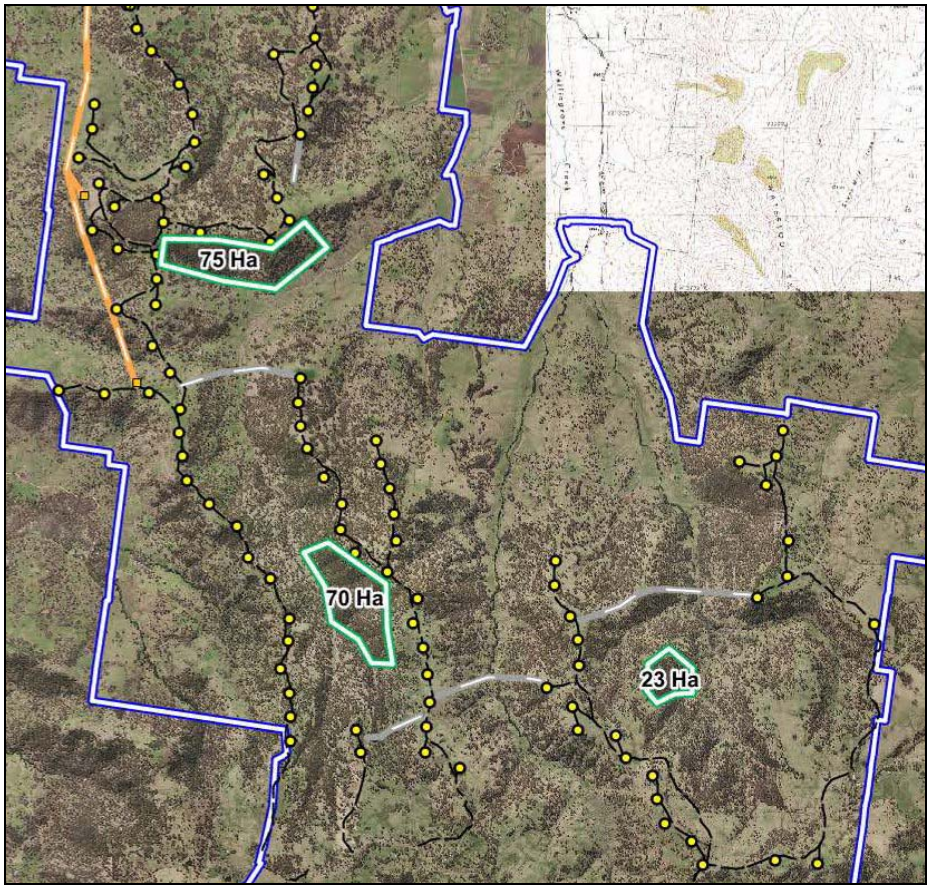
6.7 Green Offsets

Measures to avoid, mitigate or compensate impacts on flora and fauna are required to be considered. Such measures are required to ensure that the proposal can aim to result in an improved or maintained outcome in accordance with DECCW’s vegetation offset principles.

The advantage of the proposal in this regard is that the development design process has focused on ensuring that the turbines and associated infrastructure avoid and absolutely minimise direct impacts upon existing native vegetation and corresponding habitats. This has been the major consideration provided to flora and fauna in terms of avoidance of impacts as the proposal has resulted in negligible impacts upon the existing natural habitat on the study area.

Approximately 5ha of native vegetation would need to be cleared for turbine and access track construction and approximately 17ha modified for transmission and power line easements. It is proposed to offset these impacts by considering permanently conserving part of three areas within the overall project areas. It is proposed to conserve at least 44ha in total. Such conservation is most likely to occur via a Conservation Agreement with DECCW.

The three potential areas for conservation are identified in the plate below.



Potential offset locations for the project

No field surveys have been carried out in the proposed offset areas yet, but based on the surveys of the adjoining study area, the ecology assessment of the site and a review of the aerial photography it has been assessed that the proposed offset areas are likely to contain the Ribbon Gum EEC that would need to be offset. If ground-truthing reveals that this EEC does not occur, equivalent offset areas would be identified and agreed with DECCW. They are also considered likely to contain similar habitats to those impacted by

the project. They are however considered to be likely to be in better condition than those impacted areas. These offsets are not considered to be too close to the wind farm, they will permanently protect habitat for species that already exists and that have been predicted to be subject to only minor impacts as a result of the project. Whereby condition improvements are also made, this will support such species in persisting in the locality.

In addition to offsetting, mitigation / compensation is to be provided in other forms. These include those measures outlined in **Section 8** of this report.

7 Conclusion

From the information presented herein, it is asserted that the flora and fauna issues identified within the Draft NSW Wind Energy EIA Guidelines (Planning NSW 2002) and the Best Practice Guidelines for Implementation of Wind Energy Projects in Australia (AusWEA 2002) have been adequately addressed. Other guidelines (DEH 2004; AusWEA 2005; DEH 2006) referred to in this assessment have also been adequately considered.

Given the size and scale of the proposal, the ecological impacts of the proposal are expected to be comparatively minimal. This is due to the following factors:

- Wind turbines are a non-polluting renewable energy source and prevent greenhouse gas emissions from being emitted by other sources of power generation by displacing high cost fossil fuels which have been identified as the major source of greenhouse gases responsible for human induced global warming.
- The area is predominantly cleared of native vegetation with the majority of properties used for cattle, sheep and horse grazing.
- The design phase ensured turbines and associated infrastructure were located away from vegetated areas.
- There will be minimal removal of trees and few impacts to remnant native vegetation.
- The area does not occur as part of any significant habitat resource for threatened fauna species. Where significant flora species or vegetation was identified, turbines have been sympathetically located.
- Implementation of a number of recommendations, as specified in **Section 8**.

The Key Thresholds Assessment (**Section 6.6**) indicated that no significant impacts to threatened species or endangered ecological communities are likely as a consequence of the proposal.

No significant impacts are expected to any matters of National Environmental Significance (NES), as listed under the EPBC Act. It is considered that no further assessment / approval is required under the EPBC Act, although it may be advisable for the proposal to be referred to DEWHA for confirmation of this as a precaution.

As a positive environmental consequence, the proposal addresses (in-part) the key threatening processes of “human-caused climate change” (as listed under the TSC Act), and “loss of climatic habitat caused by anthropogenic emissions of greenhouse gases” (as listed under the EPBC Act).

Some minor impacts to birds and bats may occur due to turbine collisions. Some minor changes to the local distribution and abundance of locally occurring common species may also be expected as a consequence of the ongoing operation of the turbines. However, these impacts are not expected to be significant with few or no impacts on population(s) sizes or surrounding habitats.

From the data presented herein, there appears to be no significant ecological constraints to the development of proposals within this locality of the northern tablelands region. This is based on the premise that appropriate baseline studies are undertaken, potential ecological impacts are minimised through appropriate siting of turbines and associated infrastructure, and further mitigation measures are dealt with in the Environmental / Construction Management Plans, as demonstrated herein. Offsets will also be provided to compensate for the loss of impact vegetation and habitat.

8 Recommendations and Mitigation

The following recommendations should be adhered to / implemented to minimise and monitor any likely and potential ecological impacts of the proposal:

- An Adaptive Management Program be implemented (see **Section 5**), including a bird and bat monitoring program.
- All vegetation removal should be restricted to a minimal development footprint. Careful micro-siting of roads and cabling should be undertaken to minimise potential impacts.
- Turbine locations should be microsited within a 100 metre radius to further protect native vegetation and habitats.
- Access roads and cabling should be aligned along existing tracks wherever possible to minimise vegetation removal and loss of hollow-bearing trees, number of easements, and the spread of weeds.
- Powerlines between turbines should be constructed underground and along road infrastructure where possible to minimise number of easements through properties and further incidents of potential avian collisions (including the creation of perching locations in the vicinity of turbines).
- A post-construction bird and bat monitoring program, such as that described by NWCC (1999) and AusWEA (2005) should be established to determine the impacts of the proposal on bird / bat populations. Such data may prove invaluable for assessing the impacts of future wind farms within New South Wales.
- Constructional and operational phases of the development should be in line with the Best Practice Guidelines for Wind Energy Projects (AusWEA 2002), including the implementation of an Environmental Management Plan (EMP) and a Construction Management Plan (CMP).
- The CMP should include appropriate weed control measures such as washing machinery after entering affected areas and spraying road ways to ensure the spread of weeds is restricted during construction and throughout the ongoing operation of the proposal.
- Pre-clearing surveys should be undertaken by an experienced ecologist at turbine and infrastructure locations to identify hollow-bearing trees and threatened flora species prior to the commencement of any construction and should include:
  - Marking of hollow bearing trees and threatened flora species (where appropriate);
  - Areas of vegetation to be retained should be clearly marked (especially for endangered ecological communities); and
  - Careful micro-siting of infrastructure and turbines to minimise the removal of hollow-bearing trees and/or threatened flora should be undertaken. Where removal of hollow-bearing trees cannot be avoided, an ecologist should be present during felling to minimise harm to fauna species.

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Appendix 1

Flora & Fauna Species Lists

Flora Species List

Class/Subclass	Family	Scientific Name	Common Name
Magnoliidae	Apiaceae	*Cyclospermum leptophyllum**	Slender Celery
Magnoliidae	Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort
Filicopsida	Aspleniaceae	*Asplenium flabellifolium*	Necklace Fern
Magnoliidae	Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Magnoliidae	Asteraceae	*Brachyscome nova-anglica*	-
Magnoliidae	Asteraceae	*Calotis cuneifolia*	Purple Burr Daisy
Magnoliidae	Asteraceae	*Carduus nutans* subsp. *nutans*	Nodding Thistle
Magnoliidae	Asteraceae	*Carthamus lanatus**	Saffron Thistle
Magnoliidae	Asteraceae	*Conyza albida = C. sumatrensis**	Tall Fleabane
Magnoliidae	Asteraceae	*Cymbonotus lawsonianus*	Bears-ear
Magnoliidae	Asteraceae	*Euchiton gymnocephalus*	Cudweed
Magnoliidae	Asteraceae	*Euchiton involucratus*	Star Cudweed
Magnoliidae	Asteraceae	*Hypochaeris radicata**	Flatweed
Magnoliidae	Asteraceae	*Senecio madagascariensis**	Fireweed
Magnoliidae	Asteraceae	*Silybum marianum**	Variegated Thistle
Magnoliidae	Asteraceae	*Sonchus asper**	Prickly Sow-thistle
Magnoliidae	Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Magnoliidae	Asteraceae	*Taraxacum officinale**	Dandelion
Magnoliidae	Boraginaceae	*Echium plantagineum**	Paterson's Curse
Magnoliidae	Brassicaceae	*Capsella bursa-pastoris**	Shepherds purse
Magnoliidae	Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell
Magnoliidae	Campanulaceae	*Wahlenbergia gracilis*	Australian Bluebell
Magnoliidae	Carophyllaceae	*Cerastium vulgare**	Mouse-ear Chickweed
Liliidae	Caryophyllaceae	*Petrorhagia nanteuilii*	Proliferous Pink
Magnoliidae	Caryophyllaceae	*Stellaria media**	Common Chickweed
Magnoliidae	Convolvulaceae	*Dichondra repens*	Kidney Weed
Liliidae	Cyperaceae	*Carex inversa*	Knob Sedge
Filicopsida	Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Magnoliidae	Epacridaceae	*Brachyloma daphnoides*	Daphne Heath
Magnoliidae	Fabaceae/faboideae	*Desmodium varians*	Slender Tick-trefoil
Magnoliidae	Fabaceae/faboideae	*Glycine clandestina*	Twining Glycine
Magnoliidae	Fabaceae/faboideae	*Trifolium arvense**	Haresfoot Clover
Magnoliidae	Fabaceae/faboideae	*Trifolium campestre**	Hop Clover
Magnoliidae	Fabaceae/faboideae	*Trifolium dubium**	Yellow Suckling Clover
Magnoliidae	Fabaceae/faboideae	*Trifolium pratense**	Red Clover
Magnoliidae	Fabaceae/faboideae	*Trifolium repens**	White Clover
Magnoliidae	Fabaceae/faboideae	*Vicia sativa* subsp. *sativa**	Common Vetch
Magnoliidae	Fabaceae/faboideae/ Mimosoideae	*Acacia binervata*	Two-veined Hickory
Magnoliidae	Fabaceae/faboideae/ Mimosoideae	*Acacia dealbata*	Silver Wattle

Class/Subclass	Family	Scientific Name	Common Name
Magnoliidae	Fabaceae/faboideae/ Mimosoideae	*Acacia implexa*	Hickory Wattle
Magnoliidae	Fabaceae/faboideae/ Mimosoideae	*Acacia melanoxylon*	Blackwood
Magnoliidae	Geraniaceae	*Geranium molle**	Geranium
Magnoliidae	Lamiaceae	*Marrubium vulgare**	White Horehound
Liliidae	Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Liliidae	Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush
Magnoliidae	Loranthaceae	*Amyema pendulum*	Mistletoe
Magnoliidae	Myrtaceae	*Angophora floribunda*	Rough-barked Apple
Magnoliidae	Myrtaceae	*Eucalyptus blakeleyi*	Blakeleys Red Gum
Magnoliidae	Myrtaceae	*Eucalyptus dalrympleana* subsp. *heptantha*	Mountain Gum
Magnoliidae	Myrtaceae	*Eucalyptus laevopinea*	Silvertop Stringybark
Magnoliidae	Myrtaceae	*Eucalyptus melliodora*	Yellow Box
Magnoliidae	Myrtaceae	*Eucalyptus stelluata*	Black Sallee
Magnoliidae	Myrtaceae	*Eucalyptus viminalis*	Ribbon Gum
Magnoliidae	Oxalidaceae	*Oxalis perrenans*	Yellow-flowered Wood Sorrel
Liliidae	Phormiaceae	*Dianella caerulea* var. *assera*	Flax Lily
Magnoliidae	Pittosporaceae	*Bursaria spinosa* var. *spinosa*	Blackthorn
Magnoliidae	Plantaginaceae	*Plantago debilis*	Slender Plantain
Magnoliidae	Plantaginaceae	*Plantago lanceolata**	Ribwort
Liliidae	Poaceae	*Aristida ramosa*	Purple Wiregrass
Liliidae	Poaceae	*Aristida vagans*	Three-awn Speargrass
Liliidae	Poaceae	*Austrodanthonia racemosa var. racemosa*	Wallaby Grass
Liliidae	Poaceae	*Austrodanthonia tenuior*	Wallaby Grass
Liliidae	Poaceae	*Avena sp.*	Oats
Liliidae	Poaceae	*Cynosurus echinatus**	Rough Dog's Grass
Liliidae	Poaceae	*Elymus scaber*	Wheat Grass
Liliidae	Poaceae	*Festuca sp.*	
Liliidae	Poaceae	*Imperata cylindrica*	Blady Grass
Liliidae	Poaceae	*Pennisetum clandestinum**	Kikuyu
Liliidae	Poaceae	*Phalaris aquatica**	Phalaris
Liliidae	Poaceae	*Phalaris sp.*	Phalaris
Liliidae	Poaceae	*Poa seiberiana*	Tussock Grass
Liliidae	Poaceae	*Themeda australis*	Kangaroo Grass
Magnoliidae	Polygonaceae	*Rumex brownii*	Swamp Dock
Magnoliidae	Polygonaceae	*Rumex crispus**	Curled Dock
Magnoliidae	Primulaceae	*Anagallis arvensis var. caerulea**	Blue Pimpernel
Magnoliidae	Primulaceae	*Anagallis arvensis**	Scarlet Pimpernel
Magnoliidae	Ranunculaceae	*Clematis glycinoides* var. *glycinoides*	Headache Vine
Magnoliidae	Ranunculaceae	*Ranunculus lappaceus*	Glossy Buttercup
Magnoliidae	Rosaceae	*Acaena ovina*	-
Magnoliidae	Rosaceae	*Rubus ulmifolius**	Blackberry

Class/Subclass	Family	Scientific Name	Common Name
Magnoliidae	Rubiaceae	*Asperula conferta*	Common Woodruff
Magnoliidae	Santalaceae	*Exocarpos cupressiformis*	Native Cherry
Filicopsioda	Sinopteridaceae	*Cheilanthes sieberi* subsp. *sieberi*	Poison Rock Fern
Magnoliidae	Solanaceae	*Solanum nigrum**	Black Nightshade
Magnoliidae	Sterculiaceae	*Brachychiton populneus*	Kurrajong
Magnoliidae	Urticaceae	*Urtica incisa*	Stinging Nettle
Magnoliidae	Urticaceae	*Urtica urens**	Small Nettle
Magnoliidae	Verbenaceae	*Verbena bonariensis**	Purpletop
Magnoliidae	Violaceae	*Melicytus dentatus*	Tree Violet

Fauna Species List

Family sequencing and taxonomy follow for each fauna class:

Birds – Christidis and Boles (2009).

Herpetofauna - Cogger (1996).

Mammals - Van Dyck and Strahan (ed) (2008).

Appendix Key

Symbol	Meaning
✓	= Species Detected
#	= number of individuals recorded
*	= Introduced species
T	= Identified from tracks, scats, remains, etc
H	= Heard
(CE)	= Species listed under *TSC Act* as Critically Endangered
(E)	= Species listed under *TSC Act* as Endangered
(V)	= Species listed under *TSC Act* as Vulnerable
(CE*)	= Species listed under the *EPBC Act* as Critically Endangered
(E*)	= Species listed under the *EPBC Act* as Endangered
(V*)	= Species listed under the *EPBC Act* as Vulnerable
(M*)	= Species listed under the *EPBC Act* as Migratory
(C)	= Species listed under China-Australia Migratory Bird Agreement (CAMBA).

(J)	= Species listed under Japan-Australia Migratory Bird Agreement (JAMBA)
D	= 'Definite' level of identification during Anabat echolocation analysis
P	= 'Probable' level of identification during Anabat echolocation analysis
Po	= 'Possible' level of identification during Anabat echolocation analysis
Data Source	
5 to 110	= Proposed wind turbine locations (amphibians, reptiles and birds)
1 to 19	= Anabat detector number (mammals, see Figure 2-2)
Opp.	= Species recorded opportunistically across the study area

Amphibians

Family Name	Scientific Name	Common Name	Turbine Number																Opp
			5	6	31	34	37	43	45	52	53	56	67	78	80	81	91	99	110	
Myobatrachidae (Ground Frogs)	*Crinia signifera*	Common Froglet								H										✓
	Limnodynastes tasmaniensis	Spotted Grass Frog						H												✓
	Uperoleia laevigata	Smooth Toadlet																		✓
Hylidae (Tree Frogs)	*Litoria fallax*	Eastern Dwarf Tree Frog																		✓
	Litoria tyleri	Tyler's Tree Frog																		✓
	Litoria verreauxii	Verreaux's Frog																		✓

Reptiles

Family Name	Scientific Name	Common Name	Turbine Number																Opp.
			5	6	31	34	37	43	45	52	53	56	67	78	80	81	91	99	110	
Scincidae (Skinks)	*Lampropholis delicata*	Grass Skink										1								

Birds

Family Name	Scientific Name	Common Name	Turbine Number																Opp.
			5	6	31	34	37	43	45	52	53	56	67	78	80	81	91	99	110	
Phasianidae (True Quails, Pheasants & Fowls)	*Coturnix pectoralis*	Stubble Quail																		1
Anatidae (Swans, Geese & Ducks)	*Chenonetta jubata*	Australian Wood Duck							2											
Accipitridae (Hawks, Kites & Eagles)	*Aquila audax*	Wedge-tailed Eagle	0								1		2			2				
Falconidae (Falcons)	*Falco cenchroides*	Nankeen Kestrel		O					H	2			1			1				
Cacatuidae (Cockatoos)	*Eulophus roseicapillus*	Galah						1	H			H		1			1			
	Cacatua galerita	Sulphur-crested Cockatoo													1	H				
Psittacidae (Parrots)	*Trichoglossus haematodus*	Rainbow Lorikeet					1			6	21							2	14	
	Glossopsitta concina	Musk Lorikeet							1			1		1	7					

Family Name	Scientific Name	Common Name	Turbine Number																	Opp.
			5	6	31	34	37	43	45	52	53	56	67	78	80	81	91	99	110	
	Nymphicus hollandicus	Cockatiel																		3
	Platycercus elegans	Crimson Rosella			4	6		2	5	2		6	6	2	6	3		4	9	
	Platycercus eximius	Eastern Rosella		O				H					7		1	4	3			
Cuculidae (Old World Cuckoos)	*Cacomantis flabelliformis*	Fan-tailed Cuckoo											H			H				
	Chalcites lucidus	Shining Bronze-Cuckoo														H				
Halcyonidae (Kingfishers & Kookaburras)	*Dacelo novaeguineae*	Laughing Kookaburra	H					1					H	H		H	1			
	Todiramphus sanctus	Sacred Kingfisher											H							
Meropidae (Bee-eaters)	*Merops ornatus*	Rainbow Bee-eater (M*)							10			H		H				H		
Climacteridae (Australo-Papuan Treecreepers)	*Cormobates leucophaea*	White-throated Treecreeper					H		H			H								
Maluridae (Fairy-Wrens & Emu-Wrens)	*Malurus cyaneus*	Superb Fairy-wren	H				H			2		H			H		H			
Pardalotidae (Pardalotes, Scrubwrens & Thornbills)	*Pardalotus punctatus*	Spotted Pardalote												1		H				
	Paradalotus striatus	Striated Pardalote	H	O	H	1	H		H	H	H	H	3	7	4		H	H	1	
	Acanthiza pusilla	Brown Thornbill	O				H			H				1						
	Acanthiza reguloides	Buff-rumped Thornbill							3	1	1	1		7						

Family Name	Scientific Name	Common Name	Turbine Number																	Opp.
			5	6	31	34	37	43	45	52	53	56	67	78	80	81	91	99	110	
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill						H						7			H			
	Acanthiza lineata	Striated Thornbill												6						
Meliphagidae (Honeyeaters)	*Anthochaera carunculata*	Red Wattlebird	O	H	5	3	9	2	1	8	1	11	5	6	6	1	2	8	3	
	Philemon corniculatus	Noisy Friarbird				1	2		1		1		H			H	1		1	
	Manorina melanocephala	Noisy Miner		H	H	4	H					H	8	H	H	H	1		H	
	Meliphaga lewinii	Lewin's Honeyeater																		
	Lichenostomus chrysops	Yellow-faced Honeyeater	H	O	H		H	H	H	10	2	H	2	3	3	H	H		H	
	Lichenostomus leucotis	White-eared Honeyeater							H	1										
	Melithreptus brevirostris	Brown-headed Honeyeater												8						
	Melithreptus lunatus	White-naped Honeyeater								1	1			5						
	Lichmera indistincta	Brown Honeyeater																		
	Acanthorhynchus tenuirostris	Eastern Spinebill					H			1	3				2	1				
Neosittidae (Sittellas)	***Daphoenositta chrysoptera***	**Varied Sittella (V)**									2									
Pachycephalidae (Whistlers, Shrike-tit & Shrike-thrushes)	*Pachycephala rufiventris*	Rufous Whistler					H							1	H	H	1			
	Colluricincla harmonica	Grey Shrike-thrush					H								H					

Family Name	Scientific Name	Common Name	Turbine Number																	Opp.
			5	6	31	34	37	43	45	52	53	56	67	78	80	81	91	99	110	
Dicruridae (Monarchs, Fantails & Drongo)	*Myiagra rubecula*	Leaden Flycatcher												1						
	Grallina cyanoleuca	Magpie-lark												H						
	Rhipidura albiscarpa	Grey Fantail					1	H	H	H					H		H			
Campephagidae (Cuckoo-shrikes & Trillers)	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike						2				1								
Artamidae (Woodswallows, Butcherbirds & Currawongs)	*Artamus spp.*	Unidentified Woodswallow			2															
	Cracticus torquatus	Grey Butcherbird														H		H	1	
	Cracticus nigrogularis	Pied Butcherbird		H													1			
	Cracticus tibicen	Australian Magpie			H	1	1	1		H	H		H	H	1	H	1	H	3	
	Strepera graculina	Pied Currawong	H					H		H		H	H	1		1	H	2		
Corvidae (Crows & allies)	*Corvus coronoides*	Australian Raven	H			H	H	H	H	2						H				
Dicaeidae (Flowerpeckers)	*Dicaeum hirundinaceum*	Mistletoebird							H											
Hirundinidae (Swallows & Martins)	*Hirundo neoxena*	Welcome Swallow						1												
Zosteropidae (White-eyes)	*Zosterops lateralis*	Silvereye			H			H			6									
Sturnidae (Starlings & allies)	*Sturnus vulgaris*	*Common Starling						1									H			

Mammals

Family Name	Scientific Name	Common Name	Anabat Locations (see Table 3-1)																Opp.
			1	2	3	4	5	6	7	8	9	10	11	13	14	15	16	18	19	
Macropodidae (Wallabies & Kangaroos)	*Macropus giganteus*	Eastern Grey Kangaroo																		✓
	Macropus robustus	Common Wallaroo																		✓
	Macropus rufogriseus	Red-necked Wallaby																		✓
	Wallabia bicolor	Swamp Wallaby																		✓
Molossidae (Freetail-bats)	*Tadarida australis*	White-striped Freetail-bat							D		D									
Vespertilionidae (Vespertilionid Bats)	***Miniopterus schreibersii***	**Common Bentwing-bat (V)**			D	P		D	D	D	D	P	D	P		Po	P		Po	
	Chalinolobus gouldii	Gould's Wattled Bat			P		D	D	D		D	P			Po					
	Chalinolobus morio	Chocolate Wattled Bat	D	D					D					P						
	Chalinolobus picatus	**Little Pied Bat (V)**					Po											Po		
Suidae (Pigs)	**Sus scrofa*	Pig																		T
Bovidae (Horned Ruminants)	**Capra hircus*	Goat																		✓
Cervidae (Deer)	**Dama dama*	Fallow Deer																		✓

Appendix 2

Qualifications of Personnel

Curriculum Vitae

TOBY LAMBERT

Senior Ecologist / Senior Project Manager

Newcastle, NSW

Bachelor of Environmental Science, University of Newcastle, 1993 - 1996

Accredited BioBanking Assessor, Tafe NSW – Ryde, 2009

NSW Driver's Licence (Class C)

OH&S Induction Training (Green Card)

NPWS Scientific Investigation Licence and NSW Animal Ethics Research Authority

AREAS OF EXPERTISE:

Toby has over fourteen years experience in undertaking and managing a diverse array of ecological and environmental surveys and assessments. As a Senior Ecologist – Senior Project Manager, he supervises all facets of flora and fauna assessment and related reports: planning, supervision of field and reporting staff, project scheduling, budget management, liaising with clients and Government departments and providing advice of all kinds. He has also been called upon to prepare expert evidence for matters at the NSW Land and Environment Court. Toby has produced ecological and environmental documentation for private and public projects ranging in complexity. These include a number of wind farms throughout Australia and New Zealand, coal mines and a range of infrastructure projects within the Hunter region. Toby has also managed ecological master planning for residential projects in Sydney, the Central Coast and the Hunter. Toby's fields of expertise are Environmental Impact Assessment and mediation, flora, fauna and habitat survey method, design and identification, detailed understanding of legislation and threatened species issues, terrestrial fauna surveys and project management. He has experience in conducting comprehensive fauna surveys and preparing related documentation in a broad array of environments throughout New South Wales, with most projects located in the greater Sydney area, Blue Mountains, Central Coast, Hunter and Forster / Great Lakes regions. Toby has also undertaken ecological projects in Western Australia, Queensland, the ACT and New Zealand.

SELECTED PROJECT EXPERIENCE:

Ecology

- **Hunter Economic Zone Industrial Estate -** Project Manager for the environmental component of the development of the Hunter Economic Zone industrial estate at Kurri Kurri, to be the largest industrial estate in NSW.
- **Centennial Coal -** Environmental Project Manager for consultancy works to Centennial Coal covering a broad range of disciplines, but primarily focussed on ecological impact assessments, monitoring and management at six coal mines in the western Blue Mountains and Lake Macquarie NSW.
- **Peabody Energy Australia -** Senior Project Manager for project specific and ongoing monitoring requirements for Wambo Coal Mine at Warkworth in the Upper Hunter Valley. Toby liases directly with the Environmental Manager of the mine in relation to requirements to fulfil consent conditions for the ongoing development and operation of the project.
- **Allco Wind Energy -** This involved undertaking fauna surveys for a 100 turbine wind farm on the North Island of New Zealand and coordinating other ecological specialists to prepare an ecological impact assessment for submission to Taranaki Council. Aspects included regular liason with the Department of Conservation regarding issues of significance, survey methodology, and mitigation and management measures to protect significant ecological features. Local bird groups were also involved and Toby was involved in the public consultation sessions.

- **Stockland Wallarah Peninsula -** This Lake Macquarie, NSW project required a multi-disciplinary approach to an innovative residential proposal on environmentally sensitive land. Project management of, and participation in, a large and diverse planning team were major features of this work. Toby was a pivotal member of the project management team that provided the detailed ecological input and advice that was required from the early stages of the planning process to the point of submission to determining authorities. The proposal required sophisticated and creative impact assessment and reporting. Toby made a major contribution to the production of a series of comprehensive ecological reports that ensured the ecological integrity of the site was maintained in the post-development landscape.

PREVIOUS EXPERIENCE:

Senior Project Manager - Cumberland Ecology, Epping **2005**
Duties included flora and fauna surveying and survey design; overseeing and contribution to the preparation of complex ecological and environmental reports for both small and large projects; flora and fauna surveying and survey design; liaison with both the private sector and federal, state and local government departments.

Principal Consultant / Co-Founder - Keystone Ecological, Kariong **2004 - 2005**
Preparation and development of Keystone Ecological Flora and Fauna Impact Assessment report format; development of client database, including organisation of promotional material, logo design and customer relations; administration including preparation of quotes and invoices and organising accounts and BAS statements; Flora and fauna surveying and survey design; along with Anabat II Data Analysis.

Project Manager - Ecology - Conacher Travers Environmental, Somersby **1998 - 2004**
Supervision of flora and fauna survey design; report quality control; production of technical reports such as Review of Environmental Factors, Flora & Fauna Assessments, Statement of Environmental Effects, Species Impact Statements and Plans of Management, Land and Environment Court Evidence preparation, EPBC Act Referrals and Preliminary Information preparation; Flora & fauna surveying; liaison with Department of Environment and Conservation, Department of Environment and Heritage, Department of Infrastructure, Planning and Natural Resources, Department of Agriculture, Local Governments and private clients; Anabat II Data Analysis; Water Testing; Data Recording and Statistical Analysis.

Volunteer for Green and Golden Bell Frog Survey - Australian Museum, North Avoca **1999 - 2001**
Survey and searches for the endangered species Green & Golden Bell Frog; assisting in weighing, measuring and micro-chipping frogs for on-going research purposes.

Environmental Scientist - Australian Defence Industries (ADI), St Marys **1998**
Bore Water Sampling; statistical analysis of test results; and report production.

Environmental Scientist - Anne Clements & Associates, North Sydney **1997**
Field Assistant to Botanist and data recording.

Research Assistant - University of Newcastle **1996**
Initiation of design of final year project for Biology Dept; research into fire regimes on species composition & regeneration in open woodland; use of advanced scientific equipment including infra red gas analyser in the field, and replication of experiments using computer database; theoretical knowledge on soils, nutrient cycles & vegetation types.

MEMBERSHIPS & ACHIEVEMENTS:

- Ecological Consultants Association of NSW (ECA) – Council Member
- Newcastle Green Drinks for Environmental Professionals organising committee

Curriculum Vitae

STEVEN COX

Senior Ecologist – Project Manager

Newcastle, NSW

Bachelor of Applied Science (Environmental Science) (Honours)

NSW Driver's Licence (Class C)

OH&S Induction Training (Green Card)

NPWS Scientific Investigation Licence

Senior First Aid

AREAS OF EXPERTISE:

Steven has 12 years experience in the environmental industry with key experience in ecological project management, survey design, field survey, report writing, report review and client relations. In his position as Senior Ecologist, Steven is responsible for the management of ecological projects at all levels, ranging from proposal preparation to report delivery and client liaison. His areas of expertise are design & management of ecological impact assessment projects; flora, fauna and habitat survey methodology design and management; detailed understanding of threatened species legislation and issues; terrestrial fauna and fauna habitat surveys; ecological project management and report writing; along with tree felling supervision and ecological report review.

Steven has project managed and / or participated in numerous mining, energy, local government and private projects, including impact assessments for new coal and gold mines, extensions to existing mines, power substations, power lines, pipelines, access roads and private infrastructure. Steven has designed and / or undertaken the ecological component of structure plans for local government; prepared an affidavit for court proceedings (in an alleged illegal clearing case); and undertaken ecological report reviews for a local council. He has participated in Koala and Platypus field survey and impact assessment; together with nest box installation and monitoring.

SELECTED PROJECT EXPERIENCE:

Ecology

- **Rocglen Coal Mine Extension Project** – Gunnedah NSW (2010).
- **Ecosystem Function Analysis** – Wambo Coal, Singleton NSW (2010).
- **Annual Flora and Fauna Monitoring** – Karuah, NSW (2010).
- **Narrabri Coal Mine Stage 2 Extension Project** – Narrabri, NSW (2009).
- **Muswellbrook Transmission Line Upgrade** – Muswellbrook, NSW (2009).
- **Anvil Hill Flora and Fauna Impact Assessment** – Muswellbrook NSW (2006).
- **Preparation of Expert Witness Affidavit (illegal clearing)** – Forster NSW (2006)
- **Project Management** – Management of numerous land development and mining ecological projects across NSW (2005-2010).

PREVIOUS EXPERIENCE:

Senior Ecologist – Ecotone Ecological Consultants **2008 - 2009**
Duties included flora and fauna surveying and survey design; overseeing and contribution to the preparation of complex ecological and environmental reports for both small and large projects; liaison with both the private sector and federal, state and local government department**.**

PhD Candidate – Koala Ecology, University of Sydney **2007 – 2008**
Steven investigated selected aspects of the ecology of the koala in the Bathurst area of NSW. The project involved the capture and subsequent radio-tracking of up to 50 koalas across a fragmented agricultural landscape. At this stage of the project (2007-2008) activities were limited to data entry, data analysis and report/chapter writing.

Senior Ecologist – Umwelt Australia Pty Ltd **2005 – 2006**
Duties included: preparation of fee proposals; desktop studies and literature searches; flora and fauna surveying and survey design; contribution to the preparation of complex ecological and environmental reports for both small and large projects.

Casual Lecturer / Demonstrator - University of Newcastle **2002 – 2005**
Duties included the delivery of first and second year biology and ecology lectures; demonstration of first and second year biology and ecology laboratory sessions; field trip organisation and management; lecture and laboratory session design; report and exam marking.

Casual Ecologist – Cenwest Environmental Consultants Pty Ltd **1997-2005**
Duties principally comprised all aspects of preparation and completion of fauna surveys across mine sites and development sites within NSW, and the writing of fauna impact assessment reports.

PhD Candidate – Koala Ecology, Charles Sturt University **1997 – 2008**
Steven investigated selected aspects of the ecology of the koala in the Bathurst area of NSW. The project involved the capture and subsequent radio-tracking of up to 50 koalas across a fragmented agricultural landscape. Duties included: project design, site selection, landholder liaison, licensing, koala capture, koala tracking, habitat assessment, data entry, data analysis and report/chapter writing

Platypus Researcher **1996 – 2001**
Steven ran the field component of a long-term platypus research project from 1996 to 2001. Duties included: landholder liaison, volunteer liaison, field preparation, platypus capture and handling, data entry, database creation and management, scientific paper production.

MEMBERSHIPS & ACHIEVEMENTS:

- NSW Animal Ethics Research Authority
- Landscape Function Analysis (LFA)
- Hunter Bird Observer Club (HBOC)
- Birds Australia (BA)
- Ecological Society of Australia (ESA)
- Royal Zoological Society of Australia (RZS)
- Australian Mammal Society (AMS)
- Australian Society of Herpetologists (ASH)

Curriculum Vitae

Name: Paul Hillier

Office: RPS Newcastle

Position in Company: Ecologist

Qualifications / Awards

B.Env.Sc. (Environmental Management)
OH&S Induction Training (Green Card)
NSW Driver's Licence (Class C)
St John Ambulance Senior First Aid Certificate
Dive Master (PADI Scuba Diver)

Areas of Expertise:

- Targeted and general Terrestrial flora and fauna surveys
- Threatened Flora & Fauna Assessment, Reporting and Legislation
- GPS Survey and GIS Mapping Projects

Recent Experience Includes:

Paul Hillier has broad range of Ecological Assessment reporting experience from 5 years of professional ecological work both in Australia and abroad. Project experience has primarily included a range of flora and fauna assessment disciplines as required by a wide range of corporate and domestic client requirements. Paul has been employed both within the private and public sector, providing a strong knowledge and understanding of the role of both developers and government in legislation and planning.

Paul has the majority of his experience within the consultancy industry, primarily focussing on the preparation of Flora and Fauna Assessments, Environmental Assessments, Environmental Impact Statements, Review of Environmental Factors and Statement of Environmental Effects. Paul has experience with targeted threatened flora and fauna surveys, including a strong knowledge of Geographic Information Systems mapping and analyses.